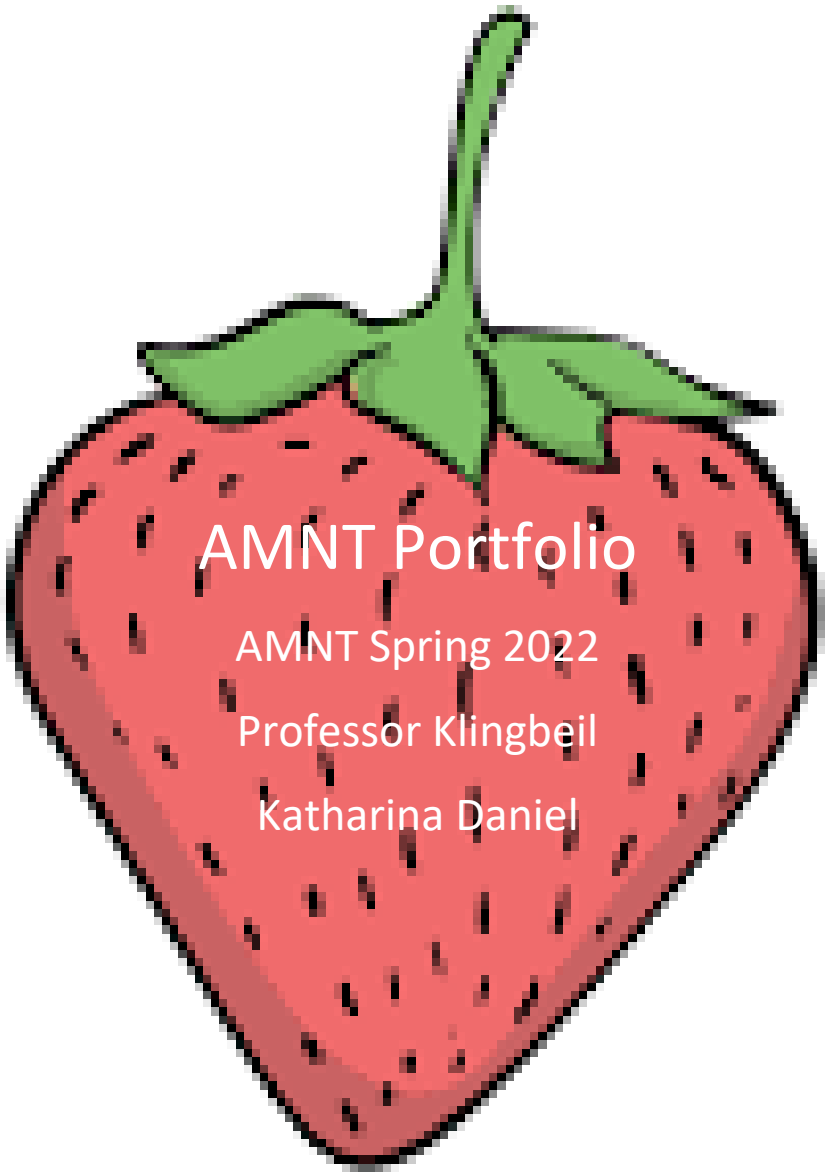

AMNT Portfolio

AMNT Spring 2022

Professor Klingbeil

Katharina Daniel

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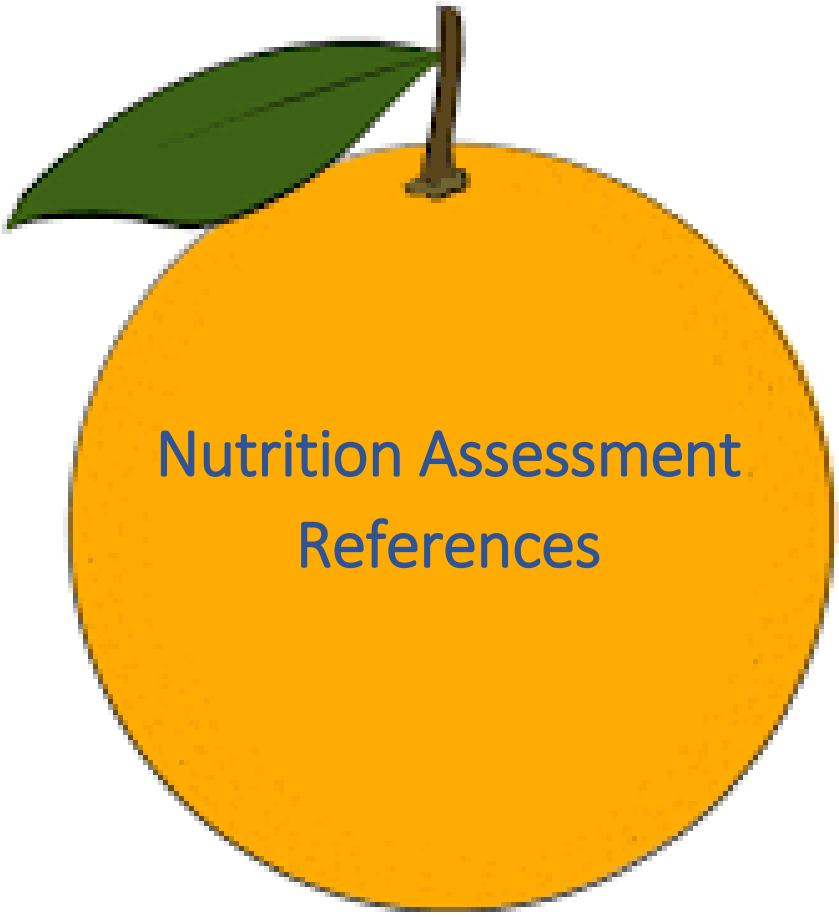

Nutrition Assessment
References

Assessment Tools and Equations

Supplementary Materials Packet pg. 3-17

Assessment of Body Weight

IDEAL BODY WEIGHT

For use with adult patients >18yo

Hamwi Method for Ideal Body Weight (IBW)[1]

- Female equation: 5 feet (60") 100#, every inch over add 5#
- Male equation: 5 feet (60") 106#, every inch over add 6#

Ideal Body Weight Range (IBW range)[2] → Add/subtract 10% of IBW

Percent Ideal Body Weight (% IBW) → $\%IBW = \frac{\text{Actual Weight}}{\text{IBW}} \times 100$

Adjustments to IBW for Spinal Cord Injury[3]

Quadriplegia	Reduction of 10-15%
Paraplegia	Reduction of 5-10%

Analysis of IBW:

Greater than 120% of IBW:	Obese
110%-120% of IBW:	Overweight
90%-109% of IBW:	Adequate
80%-89% of IBW:	Underweight
70%-79% of IBW:	Moderately underweight
Less than 70% of IBW:	Severely underweight

ADJUSTED IDEAL BODY WEIGHT (AIBW)

Using the AIBW for estimation of energy, protein, and fluid needs for obese individuals has been used in the past. This practice is considered controversial since there is insufficient evidence to support use of adjusted weights in the clinical setting[4].

[1] (Hamwi, 1964)
[2] (Charney & Malone, 2016) (Lefton, 2016)
[3] (Lefton, 2016)
[4] (Lefton, 2016)

USUAL BODY WEIGHT

Usual Body Weight (UBW) → $UBW = \frac{\text{Actual Weight}}{\text{UBW}} \times 100$

Assessment of Weight Change→ $\%\ \text{Weight Change} = \frac{\text{UBW - CBW}}{\text{UBW}} \times 100$

Analysis of UBW:

- Changes of 10% or less of no major concern unless bring person above or below IBW
- Changes of 10% or more need to be addressed→ is weight gain or loss desired or planned
- See Malnutrition section for guidelines/assessment criteria

BODY MASS INDEX

Body Mass Index (BMI)

English	Wt in lbs/(Ht in in^2) x 703
Metric	Wt in kg/(Ht in m^2)

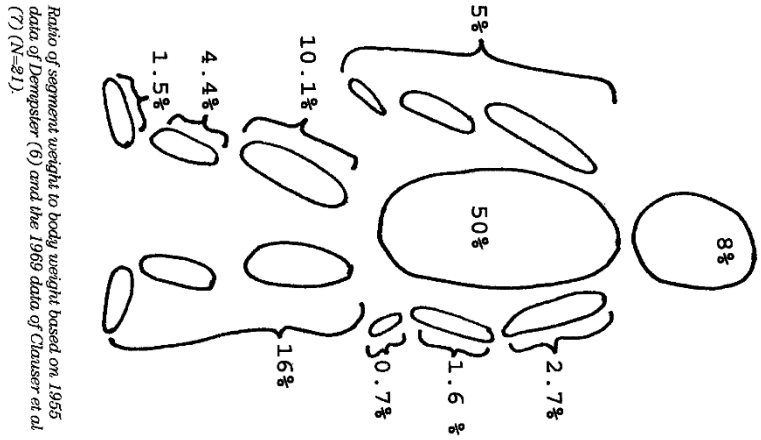
BMI Classification for Adults (>20yo)[5]

<18.5kg/m^2	Underweight
18.5 -24.9kg/m^2	Normal
25-29.9kg/m^2	Overweight (Pre-Obesity)
30- 34.9kg/m^2	Class 1 Obesity
35- 39.9kg/m^2	Class 2 Obesity
≥ 40kg/m^2	Class 3 Extreme Obesity

[5] (World Health Organization, 2017) (Obesity Health Initiative Task Force, 1998)

Amputations

If an amputation has occurred, adjustments should be made to the IBW, BMI, and other measures to account for the missing body part(s). The image and table below provide a summary of reference measures to use in these calculations[6]:



Body Part	% Weight Contribution
Trunk without limbs	50%
Hand	0.7%
Forearm with hand	2.3%
Forearm without hand	1.6%
Upper arm	2.7%
Entire arm	5%
Foot	1.5%
Lower leg with foot	5.9%
Lower leg without foot	4.4%
Thigh	10.1%
Entire leg	16%

Estimating Nutrient Needs for Adults

BASAL METABOLIC RATE (BMR)

- **Resting Metabolic Rate (RMR)**
- **Basal Energy Expenditure (BEE)**
- **Resting Energy Expenditure (REE)**

HARRIS BENEDICT EQUATION[7]:

Male: RMR = 66.47 + (13.75 × wt in kg) + (5 × ht in cm) – (6.76 × age in years)

Female: RMR = 655.1 + (9.56 × wt in kg) + (1.7 x ht in cm) – (4.7 × age in years)

THE MIFFLIN ST JEOR EQUATION[8]

Male: RMR = (9.99 × wt in kg) +(6.25 × ht in cm) – (4.92 × age in years) + 5

Female: RMR = (9.99 × wt in kg) + (6.25 × ht in cm) – (4.92 × age in years) – 161

TOTAL ENERGY EXPENDITURE

QUICK CALCULATION FOR TEE

TEE = Weight in kg x Activity/Stress factor

ACTIVITY LEVEL	FACTOR
Minimal Activity (bedridden)	25 kcal/kg
Normal Activity (ambulatory)	30 kcal/kg
Moderate Activity	35 kcal/kg

[6] (Osterkamp, 1995)
[7] (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017)
[8] (Mifflin, et al., 1990) (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017)

Increased Activity	40 kcal/kg
Intense Activity	45 kcal/kg

Spinal Cord Injuries[9]:

Quadriplegia	22.7kcal/kg
Paraplegia	27.9kcal/kg

TOTAL ENERGY EXPENDITURE *(continued)*

TEE= BMR or BEE X Activity *AND/OR* Injury Factor ± 500kcals for desired wt gain/loss + fever factor

SAMPLE ACTIVITY FACTORS [10]:

ACTIVITY LEVEL	FACTOR
Confined to bed	1.2
Out of bed, low activity	1.25-1.3
Average activity	1.5
Moderate activity	1.6-1.75
Highly active	2.0

SAMPLE INJURY FACTORS:

INJURY TYPE	FACTOR
Burns: <0-20%BSA	1.2-1.5
Burns: 20-40%BSA	1.5-1.8
Burns: >40%BSA	1.8-2.0
Cancer	1.1-1.7
Major Surgery	1.1-1.3
Moderate Infection	1.2-1.4
Multiple trauma with patient on ventilator	1.5-1.7
Severe Infection	1.4-1.8

[9] (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017)
[10] (Texas Children's Hospital Nutrition Committee, 2013)

Skeletal Trauma	1.2-1.4
Skeletal or head trauma (steroid treated)	1.6-1.8
Wound healing	1.2-1.6

FEVER FACTOR[11]

Fahrenheit scale: add 7% of REE for every 1º over normal

Centigrade scale[12]: add 12% of REE for every 1º over normal

[11] (Kinney & Roe, 1962)

[12] (Texas Children's Hospital Nutrition Committee, 2013)

ADDITIONAL EQUATIONS FOR ESTIMATION OF ENERGY NEEDS *(CRITICAL ILLNESS)*

THE IRETON JONES EQUATION FOR CRITICALLY ILL PATIENTS [13]

Spontaneously Breathing (1992):

TEE = 629 – 11(age in years) + 25(wt in kg) – 609(1 for obesity, 0 if normal wt)

Vent Dependent (revised 2002):

TEE= 1784 – 11(age in years) + 5(wt in kg) + 244(1 M, 0 F) + 239(1 T, 0 for none)+ 804(1 for B, 0 for none)

T= trauma; B= burns; M= male, F= females

PENN STATE EQUATIONS [14]:

Modified (2010)

- **Vent Dependent (BMI ≥30kg/m^2 and >60yo):**
  RMR= MSJ (0.71) + Tmax(85) + VE(64) - 3085

2003b

- **Vent Dependent (BMI <30kg/m^2 or <60yo with a BMI ≥30kg/m^2):**
  RMR= MSJ(0.96) + VE (31) + Tmax(167) – 6212

  MSJ= Mifflin St. Jeor; VE = minute ventilation (L/min); T_{max} = max temp (in C)

OBESE CRITICALLY ILL PATIENTS[15]:

When IC is available	65-70% measured energy expenditure
BMI 30-50kg/m^2	11-14 kcal/kg actual wt
BMI >50kg/m^2	22-25kcal/kg ideal wt with adequate protein

[13] (Wooley & Frankenfield, 2012)
[14] (Academy of Nutrition and Dietetics. Evidence Analysis Library, 2012) (Academy of Nutrition and Dietetics. Evidence Analysis Library, 2010) (Frankenfield, Coleman, Alam, & Cooney, 2009) (Frankenfield, Validation of an equation for resting metabolic rate in older obese critically ill patients, 2011) (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017)
[15] (McClave, et al., 2016)

Protein Needs

Protein Needs = weight in kg X protein factor

** There is some clinical evidence that suggests special situations may require even more protein than listed in the tables below.*

Classification Description	**Protein Factor** *(in g/kg/d unless otherwise noted)*
DRI Reference	0.8g/kg
Adult Maintenance	0.8-1g/kg
Older Adults	≥1g/kg
BMI >27kg/m^2 *(with normal renal/liver function)*	1.5-2g/kg IBW
Obesity class I or II, trauma (ICU) *(with hypocaloric feedings)*	1.9g/kg IBW
Obesity class III, trauma (ICU) *(with hypocaloric feedings)*[16]	2-2.5g/kg IBW
Pregnancy	+25g/d
Mild Depletion/Stress	1-1.2g/kg
Moderate Depletion/Stress	1.2-2g/kg
Severe Depletion/Stress	1.5-2.5g/kg

[16] (Charney & Malone, 2016) (Malone & Krystofiak Russell, Nutrient Requirements, 2016) (McClave, et al., 2016)

Condition Specific Requirements [17]:

Renal Failure	**Non-dialyzed** **GFR >55mL/min** **GFR <55mL/min**	 0.8g/kg 0.6g/kg
	Acute Renal Failure/Acute Kidney Injury[18] Noncatabolic, without dialysis Catabolic or with initiation of dialysis	 0.8-1.2g/kg 1.2-1.5g/kg
	Dialysis[19] **Hemodialysis** **Peritoneal Dialysis**	 ≥1.2g/kg, ≥50% HBV ≥1.2-1.3g/kg, ≥50% HBV
	CRRT	≥1.5-2.5g/kg
Cancer	**Bone Marrow Transplant**	1.5g/kg
	Cancer	1-1.5g/kg
	Cancer Cachexia	1.5-2.5g/kg
GI Conditions	**Inflammatory Bowel Disease**	1-1.5g/kg
	Short Bowel Syndrome	1.5-2g/kg
Solid-Organ Transplant	**Acute/post-transplant**	1.5-2g/kg
	Long-term	1g/kg
Pulmonary Disease		1.2-1.5g/kg
Critical Illness	**Sepsis, burns, traumatic brain injury**	1.5-2g/kg+
Stroke		1-1.25g/kg

[17] (Charney & Malone, 2016) (Malone & Krystofiak Russell, Nutrient Requirements, 2016)
[18] (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017)
[19] (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017)

Fluid Needs

Fluid needs may be restricted or increased as a result of a person's disease, condition, activity level, or existence in extremes of temperature

Chronological Age Method

> 75 yo	25ml/kg
55-75 yo	30ml/kg
20-55 yo	35ml/kg
16-30 yo	40ml/kg

Holliday Segar Method

For Infants <10kg	100ml/kg for the first 10 kg
For Infants and Children 10-20kg	50ml/kg for each kg >10 + 1000mL
Children and Adults <50yo, >20kg	20ml/kg for each kg >20 + 1500mL
Adults >50yo, >20kg	15ml/kg for each kg >20 + 1500mL

Other Methods of Estimation of Fluid Needs

RDA	1-1.5ml/kcal est needs
Fluid Balance Method	UOP + 500ml/d
Body Surface Area (BSA)*	1500mL/m^2 BSA

*** To Calculate BSA [20]:**

Weight in kg	Body Surface Area (m^2)
<5kg	kg x 0.05 + 0.05
5-10kg	kg x 0.04 + 0.1
10-20kg	kg x 0.03 + 0.2
20-40kg	kg x 0.02 + 0.4
>40kg	kg x 0.01 + 0.8

[20] (Texas Children's Hospital Nutrition Committee, 2013)

Determining Body Mass: Fat vs. Lean

Fat Mass (FM) = Body Weight X Body Fat%

Lean Body Mass (LBM) = Body Weight - (Body weight X Body fat%)

ASSESSMENT OF BODY FAT PERCENTAGE

Age	Up to 30	30-50	50+
Females	14-21%	15-23%	16-25%
Males	9-15%	11-17%	12-19%

Average Body Fat Percentage of Athletes

Sport	Male	Female	Sport	Male	Female
Baseball	12-15%	12-18%	**Rowing**	6-14%	12-18%
Basketball	6-12%	20-27%	**Shot Putters**	16-20%	20-28%
Body building	5-8%	10-15%	**Skiing (X country)**	7-12%	16-22%
Cycling	5-15%	15-20%	**Sprinters**	8-10%	12-20%
Football (Backs)	9-12%	No data	**Swimming**	9-12%	14-24%

Estimating Energy Needs for Athletic Performance

Equations for determining Resting Metabolic Rate (RMR), Basal Metabolic Rate (BMR), Resting Energy Expenditure REE

Nelson Equation

Resting Metabolic Rate (RMR) = ((108 X LBM kg) + (16.9 X FM kg)) X 0.239

Cunningham Equation

RMR = 500 kcal + (22 X LBM kg)

Owen Equation

Male: RMR = 879 + (10.2 X kg)

Female: RMR = 795 + (7.18 X kg)

Lorenzo Equation

RMR = (9 X kg) + (11.7 X ht cm) – 857

Schofield Equation

Male 15-18	BMR = (17.6 X kg) + 656
Female 15-18	BMR = (13.3 X kg) + 690
Male 19-30	BMR = (15 X kg) + 690
Female 19-30	BMR = (14.8 X kg) + 485
Male 31-60	BMR = (11.4 X kg) + 870
Female 31-60	BMR = (8.1 X kg) + 842
Male >60	BMR = (11.7 X kg) + 585
Female >60	BMR = (9 X kg) + 656

Katch-McArdle

RMR = 370 + (21.6 X LBM kg)

Determining Total Energy Needs (TEE) for Athletes

TEE = RMR or BMR or REE X Activity Factor

Activity Factors	Male	Female
Resting (sleeping/reclining)	1	1
Sedentary (minimal walking, sitting, TV, reading)	1.3	1.3
Light (office work, walking 2.5-3 mph)	1.6	1.5
Moderate (walking 3.5-4mph, tennis)	1.7	1.6
Very active (full time athletes, active military duty, team sports)	2.1	1.9
Extremely active (FT athletes, 2 day practices for college/professional)	2.4	2.2

Specific Energy Needs for Daily Activities and Sports Activities:

Metabolic Equivalent of Task, or Metabolic Equivalent Units (METS)

1 Met = 3.5ml/kg/min of oxygen consumption

To calculate caloric needs using METS use the following equation:

(BMR/24) X (MET Value of event) X (Duration of event, expressed in Hours)

Sample list of MET Values of Events

MET Value	Major Heading	Specific Activities
3.5	Bicycling	Bicycling, leisure, 5.5 mph
5.0	Conditioning exercise	Elliptical trainer, moderate
9.8	Running	Running, 6mph, (10min mile)
7.3	Dancing	Aerobic, high impact
1.3	Inactivity, light	Sitting quietly, watching TV
3.5	Home	Cooking or food prep, moderate effort

For further MET Values go to Compendium of Physical Activities: https://sites.google.com/site/compendiumofphysicalactivities/

Pediatric Energy, Protein, and Fluid Needs

ENERGY NEEDS

World Health Organization Equation (WHO) [21] *W=weight in kg*

Age	MALE (REE)	FEMALE (REE)
0-3 years	60.9W – 54	61W - 51
3-10 years	22.7W + 495	22.5W + 499
10-18 years	17.5W +651	12.2W +746
>18 years	15.3W + 679	14.7W + 496

Schofield Equation [22] *W=weight in kg; H=height in cm.*

Age	Schofield Equation for Boys: BMR	Schofield Equation for Girls: BMR
< 3 years	0.167W + 15.174H - 617.6	16.252W + 10.232H - 413.5
3-10 years	19.59W + 1.303H + 414.9	16.969W + 1.618H + 371.2
10-18 years	16.25W + 1.372H + 515.5	8.365W + 4.65H + 200
>18 years	15.057W – 1.004H + 705.8	13.623W + 2.83H + 98.2

TOTAL ENERGY NEEDS → REE X Activity Factor (and/or stress factor if ill)

Sample Factors [23]

Activity Factors		Illness/Injury Factors	
Bed Rest	1.2	Cardiac Failure	1.15-1.25
Ambulatory	1.3	Minor Surgery	1.05-1.2
Starvation	0.7-0.85	Major Surgery	1.3-1.5
Activity + Stress Factors		Sepsis	1.6
Nourished child + bedrest + mild/mod stress	1.3	Burns	1.5-2.5
Normal activity + mild/mod stress OR inactive + severe stress OR minimal activity + malnutrition requiring catch-up	1.5	Catch-up Growth	1.5-3
Active child + catch-up needs or severe stress	1.7	Closed Head Injury	1.32
		Trauma	1.1-1.8

[21] (Texas Children's Hospital Nutrition Committee, 2013)
[22] (Texas Children's Hospital Nutrition Committee, 2013)
[23] (Texas Children's Hospital Nutrition Committee, 2013)

ENERGY NEEDS (TOTAL) [24]

Age (yr)	Kilocalories/kg/day	Age (yr)	Kilocalories/kg/day
Pre-term	105–130	4–8	60-70
0–1	80–107	9–13	47-60
1-3	80-85	12–18	34-40

PROTEIN NEEDS [25]

Age	Recommendations	Critically Ill
0-6 months	1.52g/kg	2-3g/kg
7 months – 1 year	1.2g/kg	
1-3 years	1.05g/kg	
4-13 years	0.95g/kg	1.5-2g/kg
14-18 years	0.85g/kg	1.5g/kg
>18 years	0.8g/kg	

* Hospitalized infants and those with special conditions may require more protein than shown above.

FLUID NEEDS

See previous section on fluid requirements.

PEDIATRIC GROWTH GOALS[26]:

Age	Weight (grams)	Height (cm/wk)	Head Circumference (cm/wk)
Preemie <2kg	15-20g/kg/d	0.8-1.1	0.8-1
Preemie >2kg	20-30g/d	0.8-1.1	0.8-1
0-4 months	23-34g/d	0.8-0.93	0.38-0.48
4-8 months	10-16g/d	0.37-0.47	0.16-0.2
8-12 months	6-11g/d	0.28-0.37	0.08-0.11
12-16 months	5-9g/d	0.24-0.33	0.04-0.08
16-20 months	4-9g/d	0.21-0.29	0.03-0.06
20-24 months	4-9g/d	0.19-0.26	0.02-0.04
2-6 years	While growth patterns vary among children, from ages 2 to puberty, children gain an average of 2-3kg and grow 5-8cm per year		
6-10 years			

[24] (Texas Children's Hospital Nutrition Committee, 2013)
[25] (Texas Children's Hospital Nutrition Committee, 2013)
[26] (Texas Children's Hospital Nutrition Committee, 2013)

Rounding Rules and Conversions Table

Conversions

2.2 lbs	1 kg
12 in	1 ft
2. 54 cm	1 in
10 mm	1 cm
100 cm	1 m
1000 mL	1 L
4.93 mL	1 tsp
3 tsp	1 tbsp
29.57 mL	1 Fl oz
8 Fl ozs	1 cup

Calories & Protein

1 g of CHO	4 kcals
1 g of pro	4 kcals
1 g of fat	9 kcals
1 oz meat/chicken/fish	7 g pro

Rounding

Whole Numbers ONLY	*Volume*: ml/hr or ml/d (fluid, formula, IL)
	Calories
1 Decimal Place	g of CHO, protein, fat
	PN Solutions: %D, %AA
	Macronutrient Distribution: % kcals (from fat, CHO, pro)
	Weight in kg or lbs
	Ht in cm or inches
	BMI, %UBW, %IBW, %wt lost or gained, % needs met (energy/pro/fluid)
2 Decimal Places	Ht in meters

A Few Examples:

- 0.45 rounds to 0.5; 0.44 rounds to 0.4
- 0.95 rounds to the nearest whole number; 0.94 rounds to 0.9
- For whole numbers, the rules above still apply and then 1.5 rounds to 2; 1.4 rounds to 1

The Nutrition Care Process

Nutrition Diagnostic Terminology (2020)

Nutrition Diagnostic Terminology

Each term is designated with an alpha-numeric NCPT hierarchical code, followed by a five-digit (eg, 99999) Academy SNOMED CT/LOINC unique identifier (ANDUID). Neither should be used in nutrition documentation. The ANDUID is for data tracking purposes in electronic health records.

	NCPT Code	ANDUID
INTAKE (NI)		
Actual problems related to intake of energy, nutrients, fluids, bioactive substances through oral diet or nutrition support		
Energy Balance (1)		
Actual or estimated changes in energy (calorie/kcal/kJ) balance		
❑ Increased energy expenditure	NI-1.1	10633
❑ Inadequate energy intake	NI-1.2	10634
❑ Excessive energy intake	NI-1.3	10635
❑ Predicted inadequate energy intake	NI-1.4	10636
❑ Predicted excessive energy intake	NI-1.5	10637
Oral or Nutrition Support Intake (2)		
Actual or estimated food and beverage intake from oral diet or nutrition support compared with client goal		
❑ Inadequate oral intake	NI-2.1	10639
❑ Excessive oral intake	NI-2.2	10640
❑ Inadequate enteral nutrition infusion	NI-2.3	10641
❑ Excessive enteral nutrition infusion	NI-2.4	10642
❑ Enteral nutrition composition inconsistent with needs	NI-2.5	11142
❑ Enteral nutrition administration inconsistent with needs	NI-2.6	11143
❑ Inadequate parenteral nutrition infusion	NI-2.7	10644
❑ Excessive parenteral nutrition infusion	NI-2.8	10645
❑ Parenteral nutrition composition inconsistent with needs	NI-2.9	11144
❑ Parenteral nutrition administration inconsistent with needs	NI-2.10	11145
❑ Limited food acceptance	NI-2.11	10647
Fluid Intake (3)		
Actual or estimated fluid intake compared with client goal		
❑ Inadequate fluid intake	NI-3.1	10649
❑ Excessive fluid intake	NI-3.2	10650
Bioactive Substances (4)		
Actual or estimated intake of bioactive substances, including single or multiple functional food components, ingredients, dietary supplements, alcohol		
❑ Inadequate bioactive substance intake	NI-4.1	10859
❑ Inadequate plant stanol ester intake	NI-4.1.1	11077
❑ Inadequate plant sterol ester intake	NI-4.1.2	11078
❑ Inadequate soy protein intake	NI-4.1.3	11080
❑ Inadequate psyllium intake	NI-4.1.4	11079
❑ Inadequate beta glucan intake	NI-4.1.5	11076
❑ Excessive bioactive substance intake	NI-4.2	10653
❑ Excessive plant stanol ester intake	NI-4.2.1	11084
❑ Excessive plant sterol ester intake	NI-4.2.2	11085
❑ Excessive soy protein intake	NI-4.2.3	11087
❑ Excessive psyllium intake	NI-4.2.4	11086
❑ Excessive beta glucan intake	NI-4.2.5	11081
❑ Excessive food additive intake	NI-4.2.6	11083
❑ Excessive caffeine intake	NI-4.2.7	11082
❑ Excessive alcohol intake	NI-4.3	10654
Nutrient (5)		
Actual or estimated intake of specific nutrient groups or single nutrients as compared with desired levels		
❑ Increased nutrient needs (specify) _____	NI-5.1	10656
❑ Inadequate protein energy intake	NI-5.2	10658
❑ Decreased nutrient needs (specify) _____	NI-5.3	10659
❑ Imbalance of nutrients	NI-5.4	10660
Fat and Cholesterol (5.5)		
❑ Inadequate fat intake	NI-5.5.1	10662
❑ Excessive fat intake	NI-5.5.2	10663
❑ Intake of types of fats inconsistent with needs (specify) _____	NI-5.5.3	10854
Protein (5.6)		
❑ Inadequate protein intake	NI-5.6.1	10666
❑ Excessive protein intake	NI-5.6.2	10667
❑ Intake of types of proteins inconsistent with needs (specify) _____	NI-5.6.3	10855
Amino Acid (5.7)		
❑ Intake of types of amino acids inconsistent with needs (specify) _____	NI-5.7.1	12007
Carbohydrate and Fiber (5.8)		
❑ Inadequate carbohydrate intake	NI-5.8.1	10670
❑ Excessive carbohydrate intake	NI-5.8.2	10671
❑ Intake of types of carbohydrate inconsistent with needs (specify) _____	NI-5.8.3	10856
❑ Inconsistent carbohydrate intake	NI-5.8.4	10673
❑ Inadequate fiber intake	NI-5.8.5	10675
❑ Excessive fiber intake	NI-5.8.6	10676
Vitamin (5.9)		
❑ Inadequate vitamin intake (specify)	NI-5.9.1	10678
❑ A (1)		10679
❑ C (2)		10680
❑ D (3)		10681
❑ E (4)		10682
❑ K (5)		10683
❑ Thiamin (6)		10684
❑ Riboflavin (7)		10685
❑ Niacin (8)		10686
❑ Folate (9)		10687
❑ B6 (10)		10688
❑ B12 (11)		10689
❑ Pantothenic acid (12)		10690
❑ Biotin (13)		10691
❑ Excessive vitamin intake (specify)	NI-5.9.2	10693
❑ A (1)		10694
❑ C (2)		10695
❑ D (3)		10696
❑ E (4)		10697
❑ K (5)		10698
❑ Thiamin (6)		10699
❑ Riboflavin (7)		10700
❑ Niacin (8)		10701
❑ Folate (9)		10702
❑ B6 (10)		10703
❑ B12 (11)		10704
❑ Pantothenic acid (12)		10705
❑ Biotin (13)		10706
Mineral (5.10)		
❑ Inadequate mineral intake (specify)	NI-5.10.1	10709
❑ Calcium (1)		10710
❑ Chloride (2)		10711
❑ Iron (3)		10712
❑ Magnesium (4)		10713
❑ Potassium (5)		10714
❑ Phosphorus (6)		10715
❑ Sodium (7)		10716
❑ Zinc (8)		10717
❑ Sulfate (9)		10718
❑ Fluoride (10)		10719

Nutrition Diagnostic Terminology

Each term is designated with an alpha-numeric NCPT hierarchical code, followed by a five-digit (eg, 99999) Academy SNOMED CT/LOINC unique identifier (ANDUID). Neither should be used in nutrition documentation. The ANDUID is for data tracking purposes in electronic health records.

	NCPT Code	ANDUID
INTAKE (NI)		
Actual problems related to intake of energy, nutrients, fluids, bioactive substances through oral diet or nutrition support		
Energy Balance (1)		
Actual or estimated changes in energy (calorie/kcal/kJ) balance		
❑ Increased energy expenditure	NI-1.1	10633
❑ Inadequate energy intake	NI-1.2	10634
❑ Excessive energy intake	NI-1.3	10635
❑ Predicted inadequate energy intake	NI-1.4	10636
❑ Predicted excessive energy intake	NI-1.5	10637
Oral or Nutrition Support Intake (2)		
Actual or estimated food and beverage intake from oral diet or nutrition support compared with client goal		
❑ Inadequate oral intake	NI-2.1	10639
❑ Excessive oral intake	NI-2.2	10640
❑ Inadequate enteral nutrition infusion	NI-2.3	10641
❑ Excessive enteral nutrition infusion	NI-2.4	10642
❑ Enteral nutrition composition inconsistent with needs	NI-2.5	11142
❑ Enteral nutrition administration inconsistent with needs	NI-2.6	11143
❑ Inadequate parenteral nutrition infusion	NI-2.7	10644
❑ Excessive parenteral nutrition infusion	NI-2.8	10645
❑ Parenteral nutrition composition inconsistent with needs	NI-2.9	11144
❑ Parenteral nutrition administration inconsistent with needs	NI-2.10	11145
❑ Limited food acceptance	NI-2.11	10647
Fluid Intake (3)		
Actual or estimated fluid intake compared with client goal		
❑ Inadequate fluid intake	NI-3.1	10649
❑ Excessive fluid intake	NI-3.2	10650
Bioactive Substances (4)		
Actual or estimated intake of bioactive substances, including single or multiple functional food components, ingredients, dietary supplements, alcohol		
❑ Inadequate bioactive substance intake	NI-4.1	10859
❑ Inadequate plant stanol ester intake	NI-4.1.1	11077
❑ Inadequate plant sterol ester intake	NI-4.1.2	11078
❑ Inadequate soy protein intake	NI-4.1.3	11080
❑ Inadequate psyllium intake	NI-4.1.4	11079
❑ Inadequate beta glucan intake	NI-4.1.5	11076
❑ Excessive bioactive substance intake	NI-4.2	10653
❑ Excessive plant stanol ester intake	NI-4.2.1	11084
❑ Excessive plant sterol ester intake	NI-4.2.2	11085
❑ Excessive soy protein intake	NI-4.2.3	11087
❑ Excessive psyllium intake	NI-4.2.4	11086
❑ Excessive beta glucan intake	NI-4.2.5	11081
❑ Excessive food additive intake	NI-4.2.6	11083
❑ Excessive caffeine intake	NI-4.2.7	11082
❑ Excessive alcohol intake	NI-4.3	10654
Nutrient (5)		
Actual or estimated intake of specific nutrient groups or single nutrients as compared with desired levels		
❑ Increased nutrient needs (specify) _____	NI-5.1	10656
❑ Inadequate protein energy intake	NI-5.2	10658
❑ Decreased nutrient needs (specify) _____	NI-5.3	10659
❑ Imbalance of nutrients	NI-5.4	10660
Fat and Cholesterol (5.5)		
❑ Inadequate fat intake	NI-5.5.1	10662
❑ Excessive fat intake	NI-5.5.2	10663
❑ Intake of types of fats inconsistent with needs (specify) _____	NI-5.5.3	10854
Protein (5.6)		
❑ Inadequate protein intake	NI-5.6.1	10666
❑ Excessive protein intake	NI-5.6.2	10667
❑ Intake of types of proteins inconsistent with needs (specify) _____	NI-5.6.3	10855
Amino Acid (5.7)		
❑ Intake of types of amino acids inconsistent with needs (specify) _____	NI-5.7.1	12007
Carbohydrate and Fiber (5.8)		
❑ Inadequate carbohydrate intake	NI-5.8.1	10670
❑ Excessive carbohydrate intake	NI-5.8.2	10671
❑ Intake of types of carbohydrate inconsistent with needs (specify) _____	NI-5.8.3	10856
❑ Inconsistent carbohydrate intake	NI-5.8.4	10673
❑ Inadequate fiber intake	NI-5.8.5	10675
❑ Excessive fiber intake	NI-5.8.6	10676
Vitamin (5.9)		
❑ Inadequate vitamin intake (specify)	NI-5.9.1	10678
❑ A (1)		10679
❑ C (2)		10680
❑ D (3)		10681
❑ E (4)		10682
❑ K (5)		10683
❑ Thiamin (6)		10684
❑ Riboflavin (7)		10685
❑ Niacin (8)		10686
❑ Folate (9)		10687
❑ B6 (10)		10688
❑ B12 (11)		10689
❑ Pantothenic acid (12)		10690
❑ Biotin (13)		10691
❑ Excessive vitamin intake (specify)	NI-5.9.2	10693
❑ A (1)		10694
❑ C (2)		10695
❑ D (3)		10696
❑ E (4)		10697
❑ K (5)		10698
❑ Thiamin (6)		10699
❑ Riboflavin (7)		10700
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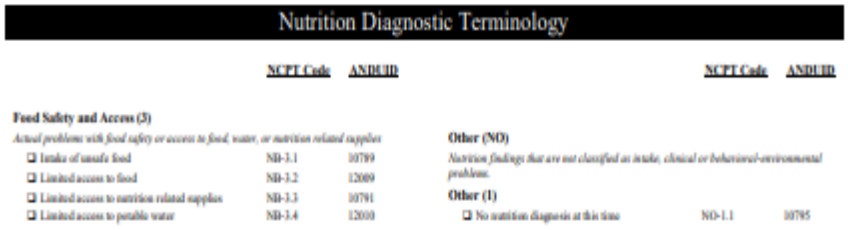
❑ Sodium (7)		10716
❑ Zinc (8)		10717
❑ Sulfate (9)		10718
❑ Fluoride (10)		10719



Nutrition Diagnostic Terminology

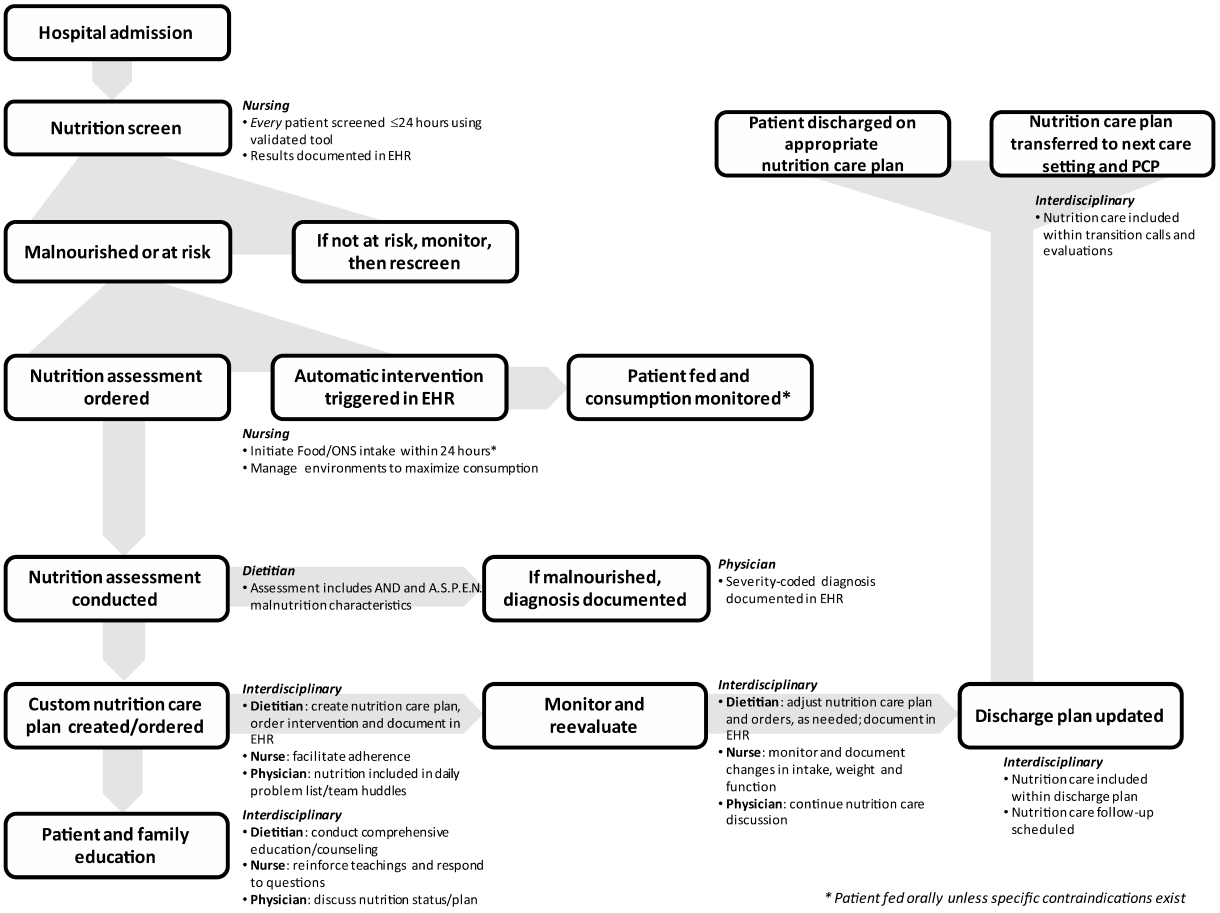
	NCPT Code	ANDUID
Food Safety and Access (3)		
Actual problems with food safety or access to food, water, or nutrition related supplies		
❑ Intake of unsafe food	NB-3.1	10789
❑ Limited access to food	NB-3.2	12089
❑ Limited access to nutrition related supplies	NB-3.3	10791
❑ Limited access to potable water	NB-3.4	12010

	NCPT Code	ANDUID
Other (NO)		
Nutrition findings that are not classified as intake, clinical or behavioral-environmental problems.		
Other (1)		
❑ No nutrition diagnosis at this time	NO-1.1	10795

Malnutrition Screening and Diagnosis Packet

Supplementary Materials Packet pg. 42-49

Hospital Malnutrition (Undernutrition) Screening and Care Plan Development

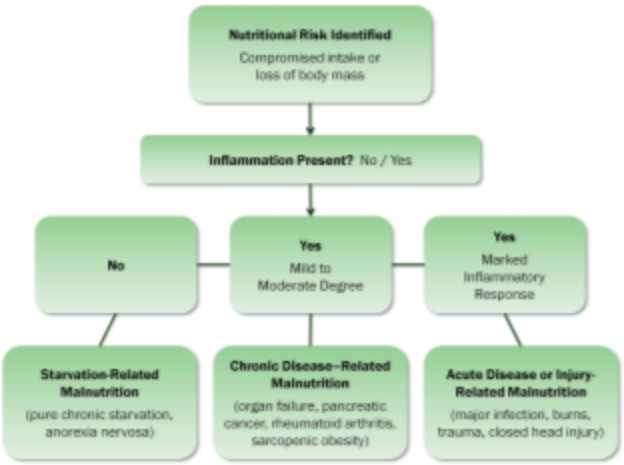


Malnutrition (Undernutrition) Screening and Diagnostic Criteria[34]

General Characteristic for the Diagnosis of Malnutrition

1. Weight loss
2. Inadequate energy intake
3. Loss of muscle mass
4. Loss of subcutaneous fat
5. Fluid accumulation (edema)
6. Reduced hand grip strength

Etiology Based Malnutrition



LaRose, 2015; REV 6.17

[34] (White, Guenter, & Jensen, 2012) (Malone & Hamilton, The Academy of Nutrition and Dietetics/The American Society for Parenteral and Enteral Nutrition Consensus Malnutrition Characteristics: Applications in Practice, 2013)

Academy/ASPEN Clinical Characteristics That the Registered Dietitian (RD) Can Obtain and Document to Support the Diagnosis of Malnutrition in Adults[35]

A minimum of two characteristics is recommended for diagnosis of either severe or nonsevere malnutrition.

	Malnutrition in the Context of Acute Illness or Injury		Malnutrition in the Context of Chronic* Illness		Malnutrition in the Context of Social or Environmental Circumstances	
Intake	Nonsevere (Moderate) Malnutrition	Severe Malnutrition	Nonsevere (Moderate) Malnutrition	Severe Malnutrition	Nonsevere (Moderate) Malnutrition	Severe Malnutrition
	< 75% of estimated energy requirement for > 7 days	≤ 50% of estimated energy requirement for ≥ 5 days	< 75% of estimated energy requirement for ≥ 1 month	≤ 75% of estimated energy requirement for ≥ 1 month	< 75% of estimated energy requirement for ≥ 3 months	≤ 50% of estimated energy requirement for 1 ≥ month
Weight Change (Wt Loss)	% Time	% Time	% Time	% Time	% Time	% Time
	1-2%: 1 week 5%: 1 month 7.5%: 3 months	> 2%: 1 week > 5%: 1 month > 7.5%: 3 months	5%: 1 month 7.5%: 3 months 10%: 6 months 20%: 1 year	> 5%: 1 month > 7.5%: 3 months > 10%: 6 months > 20%: 1 year	5%: 1 month 7.5%: 3 months 10%: 6 months 20%: 1 year	> 5%: 1 month > 7.5%: 3 months > 10%: 6 months > 20%: 1 year
Loss of SubQ Fat	Mild	Moderate	Mild	Severe	Mild	Severe
Loss of Muscle Mass	Mild	Moderate	Mild	Severe	Mild	Severe
Fluid Status Edema	Mild	Moderate to Severe	Mild	Severe	Mild	Severe
Hand Grip Strength	N/A	Not recommended in the ICU	N/A	Measurably reduced for Age/Gender	N/A	Measurably reduced for Age/Gender

LaRose, 2015; REV 6.17

[35] (Malone & Hamilton, The Academy of Nutrition and Dietetics/The American Society for Parenteral and Enteral Nutrition Consensus Malnutrition Characteristics: Applications in Practice, 2013) (White, Guenter, & Jensen, 2012)

TERMS:[36]

Food and Nutrient Intake→Malnutrition is the result of inadequate food and nutrient intake or assimilation; thus recent intake compared with estimated requirements is a primary criterion defining malnutrition. The RD obtains or reviews the food and nutrition history, estimates optimum energy needs, compares energy needs with estimates of energy consumed, and reports inadequate intake as a percentage of estimated energy requirements over time.

Interpretation of Weight Loss→The RD evaluates weight in light of other clinical findings, including the presence of under hydration or overhydration. The RD assesses weight change over time reported as a percentage of weight lost from baseline.

Physical Findings→Malnutrition typically results in changes to the physical exam. The RD may perform a physical exam and document any one of the physical exam findings below as an indicator of malnutrition.

Body Fat→Loss of subcutaneous fat (eg orbital, triceps, fat overlying the ribs).

Muscle Mass. Muscle loss→ for example, wasting of the temples (temporalis muscle); clavicles (pectoralis and deltoids); shoulders (deltoids); interosseous muscles; scapula (latissimus dorsi, trapezius, deltoids); thigh (quadriceps); and calf (gastrocnemius).

Fluid Accumulation→ The RD evaluates generalized or localized fluid accumulation evident on exam (extremities, vulvar/scrotal edema or ascites). Weight loss is often masked by generalized fluid retention (edema), and weight gain may be observed.

Reduced Grip Strength→ Consult standards supplied by the manufacturer of the measurement device.

NOTES:

1. The National Center for Health Statistics defines "chronic" as a disease/condition lasting 3 months or longer.
2. Height and weight should be measured rather than estimated to determine body mass index.
3. Usual weight should be obtained to determine the percentage and to interpret the significance of weight loss.
4. Basic indicators of nutritional status such as body weight, weight change, and appetite may substantively improve with refeeding in the absence of inflammation. Refeeding and/or nutrition support may stabilize but not significantly improve nutrition parameters in the presence of inflammation.
5. Serum proteins such as albumin and prealbumin are not included as *defining* characteristics of malnutrition because recent evidence analysis shows that serum levels of these proteins do not change in response to changes in nutrient intake.

LaRose, 2015; REV 6.17

[36] (Academy of Nutrition and Dietetics, 2018) (Malone & Hamilton, The Academy of Nutrition and Dietetics/The American Society for Parenteral and Enteral Nutrition Consensus Malnutrition Characteristics: Applications in Practice, 2013) (Tappenden KA, et al., 2013) (White, Guenter, & Jensen, 2012)

Parameters Useful in the Assessment of Physical Status[37]

	Exam Areas	Tips	Well Nourished	Mild-Moderate Malnutrition	Severe Malnutrition
Subcutaneous Fat	Orbital region—surrounding the eye	View patient when standing directly in front of them, touch above cheekbone.	Slightly bulged fat pads, fluid retention may mask loss	Slightly dark circles, somewhat hollow look	Hollow look, depressions, dark circles, loose skin
	Upper arm region—triceps/biceps	Arm bent, roll skin between fingers; do not include muscle in pinch.	Ample fat tissue obvious between folds of skin	Some depth pinch, but not ample	Very little space between folds, fingers touch
	Thoracic and lumbar region—ribs, lower back, midaxillary line	Have patient press hands hard against a solid object.	Chest is full, ribs do not show; slight to no protrusion of the iliac crest	Ribs apparent, depressions between them less pronounced; iliac crest somewhat prominent	Depression between the ribs very apparent; iliac crest very prominent
Muscle Loss	Temple region—temporalis muscle	View patient when standing directly in front of them, ask patient to turn head side to side.	Can see/feel well-defined muscle	Slight depression	Hollowing, scooping, depression
	Clavicle bone region—pectoralis major, deltoid, trapezius muscles	Look for prominent bone. Make sure patient is not hunched forward.	Not visible in male, visible but not prominent in female	Visible in male, some protrusion in female	Protruding, prominent bone
	Clavicle and acromion bone region—deltoid muscle	Patient arms at side, observe shape.	Rounded, curves at arm/shoulder/neck	Acromion process may slightly protrude	Shoulder to arm joint looks square, bones prominent, acromion protrusion very prominent
	Scapular bone region—trapezius, supraspinous, infraspinous muscles	Ask patient to extend hands straight out, push against solid object.	Bones not prominent, no significant depressions	Mild depression or bone may show slightly	Prominent, visible bones, depressions between ribs/scapula or shoulder/spine
	Dorsal hand—interosseous muscle	Look at thumb side of hand; look at pads of thumb when tip of forefinger touching tip of thumb.	Muscle bulges, could be flat in some well-nourished people	Slightly depressed	Depressed area between thumb-forefinger
Lower Body (Less Sensitive to Change)	Patellar region—quadricep muscle	Ask patient to sit with leg propped up, bent at knee.	Muscles protrude, bones not prominent	Knee cap less prominent, more rounded	Bones prominent, little sign of muscle around knee
	Anterior thigh region—quadriceps muscles	Ask patient to sit, prop leg up on low furniture. Grasp quads to differentiate amount of muscle tissue from fat tissue.	Well rounded, well developed	Mild depression on inner thigh	Depression/line on thigh, obviously thin
	Posterior calf region—gastrocnemius muscle	Grasp the calf muscle to determine amount of tissue.	Well-developed bulb of muscle	Not well developed	Thin, minimal to no muscle definition
Edema	Rule out other causes of edema, patient at dry weight	View scrotum/vulva in activity-restricted patient; ankles in mobile patient.	No sign of fluid accumulation	Mild to moderate pitting, slight swelling of the extremity, indentation subsides quickly (0-30 s)	Deep to very deep pitting, depression lasts a short to moderate time (31-60 s), extremity looks swollen (3-4+)

Assessment of Edema: 1+ → 2 mm deep, barely detectable, immediate rebound; 2+ → 4mm deep, a few sec to rebound; 3+ → 6 mm deep, 10-12 sec to rebound; 4+ → 8 mm: very deep, >20 sec to rebound

LaRose, 2015; REV 6.17

[37] (Academy of Nutrition and Dietetics. Nutrition Care Manual, 2017) (Malone & Hamilton, The Academy of Nutrition and Dietetics/The American Society for Parenteral and Enteral Nutrition Consensus Malnutrition Characteristics: Applications in Practice, 2013)

Pediatric Malnutrition Classification[38]

Primary Indicators When a Single Data Point Is Available			
	Mild Malnutrition	**Moderate Malnutrition**	**Severe Malnutrition**
Weight-for-height Z-score	−1 to −1.9 Z-score	−2 to −2.9 Z-score	≤ −3 Z-score
BMI-for-age Z-score	−1 to −1.9 Z-score	−2 to −2.9 Z-score	≤ −3 Z-score
Length/height-for-age Z-score	No data	No data	−3 Z-score
Mid–upper arm circumference	≤ −1 to −1.9 Z-score	≤ −2 to −2.9 Z-score	≤ −3 Z-score
Primary Indicators When Two or More Data Points Are Available			
	Mild Malnutrition	**Moderate Malnutrition**	**Severe Malnutrition**
Weight gain velocity (<2 years of age)	Less than 75% of the norm for expected weight gain	Less than 50% of the norm for expected weight gain	Less than 25% of the norm for expected weight gain
Weight loss (2–20 years of age)	5% loss from usual body weight	7.5% loss from usual body weight	10% loss from usual body weight
Deceleration in weight for length/height or BMI/age Z-score	Decline of 1 Z-score	Decline of 2 Z-scores	Decline of 3 Z-scores
Inadequate nutrient intake	51%–75% estimated energy/protein needs	26%–50% estimated energy/protein needs	≤25% estimated energy/ protein needs

** The National Center for Health Statistics defines "chronic" as a disease/condition lasting 3 months or longer.*

**** Though the above criteria were specifically developed for malnutrition (undernutrition) assessment in children, a comprehensive physical exam is also necessary to identify symptoms of specific nutrient deficiencies with or without a malnutrition diagnosis.*

LaRose, 2015; REV 6.17

[38] (Becker P, et al., 2014)

Defining Pediatric Malnutrition (Undernutrition) Classifications[39]

Assessment of Z-score measures

Weight/Length, Weight/Height, BMI/Age, and Length/Age *Z*-score measures are based on standard growth criteria. To calculate a child's exact Z-score, computer programs must be used since extrapolating a Z-score form a growth chart would be inaccurate. There are multiple tools online including those found at www.peditools.org.

Assessment and Monitoring of Growth

For growth monitoring and evaluation, the World Health Organization (WHO) Growth Charts/Tables should be used for children <2 years of age and CDC Growth Charts should be used for children ages 2-20. These growth grids can be used to assess wt/lt and BMI/age to evaluate for the malnutrition criteria outlined in the tables provided. Head Circumference measures should be monitored until a child's third birthday.

NOTE: The current malnutrition definitions are not suitable for standard application with premature infants at this time.

Average Growth Velocity by Age Group

Age	Weight (grams)	Height (cm/wk)	Head Circumference (cm/wk)
Preemie <2kg	15-20g/kg/day	0.8-1.1	0.8-1
Preemie >2kg	20-30g/day	0.8-1.1	0.8-1
0-4 months	23-34g/d	0.8-0.93	0.38-0.48
4-8 months	10-16g/d	0.37-0.47	0.16-0.2
8-12 months	6-11g/d	0.28-0.37	0.08-0.11
12-16 months	5-9g/d	0.24-0.33	0.04-0.08
16-20 months	4-9g/d	0.21-0.29	0.03-0.06
20-24 months	4-9g/d	0.19-0.26	0.02-0.04
2-6 years	While growth patterns vary among children, from ages 2 to puberty, children gain an average of 2-3kg and grow 5-8cm per year		
6-10 years			

Weight Loss

Though pediatric weight loss is listed as part of the malnutrition criteria for children 2-20 years of age, the duration of weight loss is not defined. As with adults, some weight loss may be desired though some would argue that weight loss in the pediatric population is never really desired.

Weight loss should be evaluated on a case-by-case basis. To state that "mild malnutrition" occurs with a 5% weight loss from a child's usual weight is a good starting point, but it is important to think about how long it took for this weight loss to occur. Was it rapid in the setting of a GI illness? Was it long term weight loss 2/2 poor/inaccurate caregiver knowledge about proper feeding? We cannot say that a weight loss of 5% (or more) is indicative of malnutrition unless we know more.

Deceleration in Weight/Length (Height) or BMI/age Z-score

To determine if a patient's wt/lt or BMI/age Z-scores are decelerating, multiple data plots are needed on the growth chart over a period of time. Current guidelines do not specify how often these measures should be plotted and variability in measurement frequency may be dictated in part by diagnosis and/or patient age.

Inadequate Nutrient Intake

Since the same malnutrition criteria are being used to evaluate children from 2-20 years of age, it is important to think about oral intake in the context of age. For example, it may be reasonable to think that a 16 year old could be at very low risk for malnutrition consuming only 51-75% of his or her estimated energy/protein needs for 1 week though the same would not be true for an infant or younger child. Again, this is why we don't have more specific guidelines to work from here. Identifying children with malnutrition requires a practitioner to use some clinical judgment.

NOTE: Some centers may choose to standardize intake and weight loss criteria based on specific age ranges. Young children or those with other malnutrition risk factors may meet screening and follow up criteria more rapidly than older or better-nourished children.

LaRose, 2015; REV 6.17

[39] (Texas Children's Hospital Nutrition Committee, 2013)

A Guide to Writing PES Statements for Patients with Malnutrition (Undernutrition)

1. **First, you must define the type of malnutrition and the severity of the malnutrition. To form the beginning of your statement, answer these 4 questions:**
   - Is it disease/injury related or starvation related? (Though in some cases it seems like it could be both, for our purposes, it's really not. "Disease related" or "injury related" implies inflammation; 'starvation related' does not).
   - For disease/injury related malnutrition, is the malnutrition chronic or acute? **The National Center for Health Statistics defines "chronic" as a disease/condition lasting 3 months or longer.* (Also, acute = disease/injury; chronic = disease/condition per the NDT wording).
   - How would you classify the patient's level of malnutrition based on the provided criteria? (Mild, Moderate, Severe)
   - Is it hospital acquired/induced? This may be used by some institutions for outcomes tracking- though it is not always required.
2. **Once you have answered the questions above, you can form your PES statement to communicate the patient's level of malnutrition.**
3. **Don't forget that you are using standard language to formulate your statement and it's always a good idea to be as specific and descriptive as possible. Though the full words are written out here, using 'r/t' for 'related to' and 'AEB' for 'as evidenced by' is generally accepted.**

_____ related to _____ as evidenced by _____.

EXAMPLES: Chronic moderate disease or condition related malnutrition r/t HIV+ status as evidenced by pt meeting <75% est energy needs x 1 month and wt loss of 11% over the past 6 months.

Severe starvation related malnutrition r/t AN as evidenced by wt loss of 15% of UBW over the past 5 weeks, significant loss of subcutaneous fat, and oral intake of ~25% energy needs over the past 5 weeks.

Mild starvation related hospital induced malnutrition r/t prolonged NPO status and suboptimal enteral intake as evidenced by pt with admit wt/lt z-score of -0.5 now decreased to -1.1 and wt loss of 10g/d over the past 12 days

LaRose, 2015; Cucinotta REV 8.19

Laboratory Assessment

Annotated Laboratory Values

Common Laboratory Values for Adults

NOTE: Reference ranges vary depending upon the lab; always rely on individual laboratory reference ranges.

Test	Abbreviation	Reference Range	Indicates
Alanine Amino Transferase	ALT	0-35 U/L	↑ w/ Hepatitis, jaundice, cirrhosis, hepatic cancer, Mi, severe burns, trauma, mononucleosis, pancreatitis
Albumin	Alb	3.5-5.5 g/dl	^ with dehydration V with surgery, edema, burns, over hydration, cancer, hepatic disease
Alkaline Phosphatase	Alk Phos, ALP	36-92 U/L	^with hepatic disease
Ammonia	NH_3	<50 mcg/dl	^ with hepatic disease, heart failure, pulmonary emphysema, high protein diet, vigorous

			exercise
Amylase		0-130 U/L	^with acute pancreatitis, perforated peptic ulcer, renal unstuffiness V with hepatitis, cirrhosis, pancreatic insufficiency
Aspartate Amino Transferase	AST	0-35 U/L	^ with cell injury/ death V with uncontrolled DM, beriberi
Blood Urea Nitrogen	BUN	8-20 mg/dl	↑ w/ renal failure, shock, dehydration, infection ↓ w/ hepatic failure, malnutrition, over hydration
C-Reactive Protein	CRP	<0.5 mg/dL	↑ w/ acute and chronic inflammation V with hypoalbuminemia, elevated phosphorus, alkalosis, diarrhea, starvation
Calcium	Ca++	9-10.5 mg/dl	^with dehydration, anemia, hyperventilation V with diabetic acidosis, fever, acute infection
Chloride	Cl	98-106 mEq/L	^ with acute and chronic inflammation
Cholesterol (total) HDL LDL	Chol	120-199 mg/dl ≥40 mg/dl ≤130 mg/dl	^ with coronary artery disease
Copper	Cu	70-155 ug/L	^ with acute and chronic renal disease, muscle damage, hyperthyroidism
Creatinine	Cr	0.4-1.2 mg/dl	^with MI, acute CVA, hypothyroidism, vigorous excerise
Creatinine Phosphokinase	CPK, CK	30-170 U/L	^ with metabolic acidosis V metabolic alkalosis
Ferritin		15-200 ng/ml	^ with inflammation diseases, chronic renal diseases, iron overload V with iron deficiency
Fibrinogen		150-350 mg/dL	^ with inflammation, tissue damage
Folic Acid	Folate, Fol	2.5-20 ng/ml (serum) 160-855 ng/mL (blood)	^ with megalbo0lastic and hemolytic anemias, malnutrition, malabsorption, hyperthyroidism, vit C def

Glucose	Gluc, FBS	70-105 mg/dl (fasting) <140 mg/dL (2h PP)	^ with DM, hyperthyroidism V with insulin overdose, hypothyroidism
Glycated Hemoglobin	HbA1c	<5.7% (non-diabetic)	^ with poorly controlled DM V with sickle-cell anemia, malnutrition
Hematocrit	HCT	41-51% Males 36-47% Females	^ with dehydration V with anemia, blood loss, over hydration
Hemoglobin	Hgb	14-17 g/dl Males 12-16 g/dl Females	^ with serve burns, CHF, COPD, dehydration V with anemia, cirrhosis, HIV
Homocysteine		0.4-1.89 ng/L Females 0.54-2.16 mg/L Males	^ with vit b12/ folate def
International Normalized Ratio	INR	2-3 (std therapy)	
Iron	Fe	60-160 mcg/dL	^ with T2DM, hyperthyroidism, leukemia V with RBC shortage
Lactic Dehydrogenase	LDH, LD	60-160 U/L	^ with MI, leukemia, megaloblastic anemia, pulmonary infraction, cancer, renal failure
Lactic Acid		6-16 mg/dL (venous)	^ with intense exercise, serious infection, shock
Lipase		<95 U/L	^ with acute pancreatitis, renal insufficiency V with viral hepatitis, protein, malnutrition
Magnesium	Mg	1.5-2.4 mEq/L	^ with renal failure, diabetes acidosis, hypothyroidism, dehydration V with chronic diarrhea, alcoholism, pancreatitis, renal disease, hyperthyroidism
Mean Corpuscular Hemoglobin	MCH	28-32 pg	^ with macrocytic anemia V with iron deficiency anemia
Mean Corpuscular Hemoglobin Concentration	MCHC	32-36 g/dL	
Mean Corpuscular Volume	MCV	80-100 fL	^ with bog RBC V with small RBC
Osmolality (Plasma)		275-295 mOsm/kg H_2O	^ with dehydration V with over hydration

Parathyroid Hormone	PTH	10-65 pg/mL	^ with hyperparathyroidism
Phosphorus	P	3-4.5 mg/dl (serum)	^ with ESRD, hypocalcemia V with hyperparathyroidism, alcoholism, rickets, gout
Platelet Count		150-350 x 10^3/uL (blood)	^ with thrombocytosis cancer, anemia V wit low immune system, leukemia
Potassium	K+	3.5-5 mEq/L	^ with renal failure, tissue damage, uncollared DM V with GI loss, alcoholism, malnutrition, diarrhea, vomiting
Prealbumin (Transthyretin)	Pre-alb / PAB	18-45 mg/dl	^ with renal failure V with acute catabolic state hepatic disease, infection, surgery
Prothrombin Time	PT	11-13 sec	^ with longer clotting time
Red Blood Cell Count	RBC	4.2-5.9 x 10^6 calls/uL	^ with deration, serve diarrhea V with anemia, hemorrhage, iron def
Retinol-Binding Protein	RBP	2.1-6.4 mg/dl	v with liver disease
Sodium	Na++	136-145 mEq/L	6 with dehydration V with edema, serve burns, water intoxication
Tissue Transglutaminase	tTG	<4.0 U/mL	^ with celiac disease
Total Iron Binding Capacity	TIBC	250-460 ug/dL	^ low iron levels V high iron levels
Total Protein	TP	6-7.8 g/dL	V hepatic, malabsorption, diarrhea
Transferrin % Saturation	% Sat	20-50%	
Triglycerides	TG	<150 mg/dl – desirable	^ hyperlipidemia, pancreatitis V COPD
Uric Acid		3.7-7.8mg/dl Male 2.5-6.1mg/dl Female	^ with renal failure, gout, anorexia, leukemia, acute infectious disease
Vitamin A		20-100 ug/dl	V with liver disease, gastric, pernicious anemia, excessive folate intake

Vitamin B12		200-800 pg/ml	V terminal ileal disease
Vitamin D (25OH)		<20 ng/dL: Deficient 20-30 ng/dL: Insufficient 30-100 ng/dl: normal	V liver disease, small bowel disease
Vitamin E		5.5-18 ug/dl	V with liver disease, pancreatic insufficiency
White Blood Cells	WBC	3.9-10.7 x 10^3 cells/uL	^ with leukemia, bacterial infection, hemorrhage cancer V with viral infection, chemo Tx, radiation, HIV
Zinc	Zn	66-110 ug/dL	^ with CHD, arteriosclerosis, IBD V with malnutrition, diarrhea, nephritic syndrome.

Laboratory Worksheets

Acid-Base Table

Anion Gap: A measurement of the interval between the sum of the cations ($Na^{++} + K^{+}$) minus the sum of the anions ($Cl^{-} + HCO_3^{-}$) in the blood.

	ABG Values			Electrolyte Profile Values		Possible Causes	Compensation
Acid-Base Imbalance	**pH**	**Acid; PCO_2**	**Nothing to do with acid; basic HCO_3-**	**CO_2**	**Cl^-**		
Normal Ranges	7.35 - 7.45	35-45 mm Hg	22-26 mEq/L	23-29 mEq/L	97-107 mEq/L		
Respiratory Acidosis	Low; blood is more acidic	High; CO2 is acidic	Normal or high	↓	↑	Emphysema, COPD, impaired respiratory function, excessive CO2 retention	Increase renal acid excretion
Respiratory Alkalosis	high	low	Normal or low	↑	↓	Post-intense exercise, anxiety, early sepsis, excessive expiration of CO2 and H20	Decrease in renal acid excretion
Metabolic Acidosis	low	Normal or high	Low	↓	↑	Diarrhea, uremia, DKA, starvation, a high-fat and low CHO diet, drugs	hyperventilation
Metabolic Alkalosis	high	Normal or low	high	↑	↓	Diuretics, increased akali ingestion, loss of Cl, vomiting	Hypoventilation

Correction of acid-base disorders is always based on treating the primary disturbance.

Medication Lists

	MEDICATION	USE	INTERACTIONS/GUIDELINES	EXAMPLES
ARTHRITIS/PAIN	Non-Steroidal Anti-Inflammatory Drugs (NSAIDS)	To reduce pain, fever, and inflammation	**Food:** Take with food, water, or milk to decrease stomach upset. With high doses, patients may require additional vitamin C, K, and folate. **Supplements:** Limit/avoid supplemental garlic, ginger, ginseng, gingko, and horse chestnut→ possible impact on blood clotting. **Avoid alcohol.**	Ibuprofen, Naproxen
	Corticosteroids	To relieve inflamed areas of the body, reduce swelling and itching allergies, rheumatoid arthritis, other conditions	**Food:** Take with food or milk to decrease stomach upset. Avoid simple sugars and large quantities of CHO d/t risk for impaired glucose tolerance. Limit grapefruit and citrus fruit. May require decrease in Na+; may need to supplement with calcium, vitamin D, or protein. **Monitoring:** Increased appetite. Possible hyperglycemia, hyperlipidemia, and wt gain with long-term use. **Avoid alcohol.**	Prednisone, Solumedrol, Decadron

SEIZURES	Anticonvulsant/Antiepileptic Therapy	Control certain seizures in people with epilepsy, also used to treat trigeminal neuralgia (a condition that causes facial nerve pain)	**Food:** take with food or milk to decrease stomach upset. Avoid grapefruit, itrus fruit, star fruit, and pomegranate juice. Give supplemental vitamin D and calcium **Avoid alcohol.**	Tegretol, Keppra, Phenobarbitol, Depakote, Topamax
	MEDICATION	**USE**	**INTERACTIONS/GUIDELINES**	**EXAMPLES**
CARDIOVASCULAR	Diuretics	To help eliminate water, sodium, and chloride from the body	**Food:** Take on an empty stomach since food decreases drug availability. Take with food or milk is stomach upset occurs. **Monitoring:** Some diuretics cause a loss of calcium, potassium, and magnesium; supplementation may be required on an individual basis.	Furosemide (Lasix), Hydro-chlorothiazide (HCTZ)
	Cholesterol Lowering HMG-CoA Reductase	Used with diet, wt loss, exercise to reduce the risk of heart attack and stroke and to decrease the chance that heart surgery will be needed in people who have heart disease or who are at risk of developing heart disease.	**Food:** Take with food. Do not take with grapefruit or citrus fruits. Follow a low fat/sat fat diet. **Supplements:** St. John's Wort. **Avoid alcohol.**	Zocor (Simvastatin) "Statins": Lipitor, Crestor

	Beta Blockers	To decrease the nerve impulses to blood vessels	**Food:** Take with food to increase bioavailability. Take separately from orange juice. Possible need to decrease dietary calcium and sodium (d/t decreased absorption). **Supplements:** Avoid natural licorice. Take 2 hours before or 6 hours after calcium supplements or antacids. **Avoid alcohol.**	Atenolol, Propranolol
	Anticoagulants	To prevent the formation of blood cells	**Food:** Limit/monitor vitamin K consumption. **Supplements:** Do not exceed the upper limited for vitamins A and E. Limit/avoid supplemental garlic, ginger, ginseng, saw palmetto, gingko, and horse chestnut→ possible impact on blood clotting.	Warfarin (Coumadin)
	MEDICATION	**USE**	**INTERACTIONS/GUIDELINES**	**EXAMPLES**
INFECTIONS	Antibacterials (Penicillin)	Used to treat infections caused by bacteria, such as pneumonia/ bronchitis (infection of the airway tubes leading to the lungs) and infections of the ears, nose, throat, urinary tract, and skin. Also helps eliminate a bacteria that causes ulcers.	**Food:** Take on an empty stomach, or 1 hour before of 2 hours after food. If upset stomach occurs, take with food. Avoid guar gum. **Supplements:** Use caution when taking vitamin K.	Penicillin, Amoxicillin

	Antibacterials (Tetracyclines)	Treat infections caused by bacteria (pneumonia and other respiratory tract infections). Also can help treat acne.	**Food:** Take on an empty stomach with 8 oz of water. Avoid taking medication with dairy products, antacids, and vitamin supplements containing iron because they can interfere with medication effectiveness.	Tetracycline, Doxycycline
	Antifungals	Treat & prevent fungal infections (yeast infections in vagina, mouth, throat, esophagus, abdomen, lungs, blood). Treat meningitis	**Food:** Take with food to increase absorption. Grapefruit/citrus must be avoided with certain medications. **Avoid alcohol.**	Fluconazole
	Sulfamethoxazole	Treat bacterial infections (UTI)	Unless your doctor tells you otherwise, continue your normal diet. Drink plenty of fluids during your treatment.	Sulfa, Bactrim
	Antivirals	Helps treat shingles and genital herpes (decrease pain/ itching, helps sores heal & prevents new ones from forming)		Valacyclovir, Valgancyclovir
	MEDICATION	**USE**	**INTERACTIONS/GUIDELINES**	**EXAMPLES**

MOOD DISORDERS	Monoamine Oxidase Inhibitors (MAOIs) *Note: not commonly prescribed any more*	To treat depression; increases the amounts of certain natural substances that are needed to maintain balance.	**Food:** MANY dietary restrictions (foods that contain tyramine and other pressor amines). Possibly fatal drop in BP if foods high in tyramine are consumed (aged cheeses, chocolates, ages meats, soy sauce, miso, avocados, sauerkraut, caffeine, bananas, and more—should be avoided). **Avoid alcohol.**	Phenelzine, Rasagiline
	Anti-Anxiety Drugs	To relieve anxiety disorders; slowing brain activity to allow for relaxation.	**Food:** Take with food if upset stomach occurs. Avoid grapefruit/citrus, and caffeine. **Supplements:** Use caution with sedative herbal supplements like chamomile, and kava. Avoid stimulants like caffeine, maté, and guarana. **Avoid alcohol.**	Lorazepam, Diazepam
	Depressant	To treat insomnia; slowing brain activity to allow sleep.	**Food:** Do not take with food or within 1-2 hours after a meal **Avoid alcohol.**	Zolpidem (Ambien) Sedative-hypnotics

	Amphetamine Adrenergic agents	Part of a treatment program to control symptoms of ADHD.	Unless your doctor tells you otherwise, continue your normal diet.	Adderall
	MEDICATION	**USE**	**INTERACTIONS/GUIDELINES**	**EXAMPLES**
GASTROINTESTINAL	H_2 Receptor Antagonists	Treat ulcers, GERD & conditions where the stomach produced too much acid.	**Food:** Take with or without food with a full 8 oz of water. A bland diet is recommended. Take 2 hours before an iron or antacid supplement. May decrease B12 absorption. **Caffeine:** May irritate the stomach **Monitoring:** Long-term use may result in B_{12} deficiency. **Avoid alcohol.**	Cimetidine (Tagamet), Ranitidine (Zantac), Famotidine (Pepcid)
	Proton Pump Inhibitors			Omeprazole (Prilosec), Pantoprazole (Protonix)
	Antidiarrheals	Control acute diarrhea and ongoing diarrhea w inflammatory bowel disease (IBD)	Drink plenty of water/ clear fluids to replace lost while having diarrhea	Loperamide

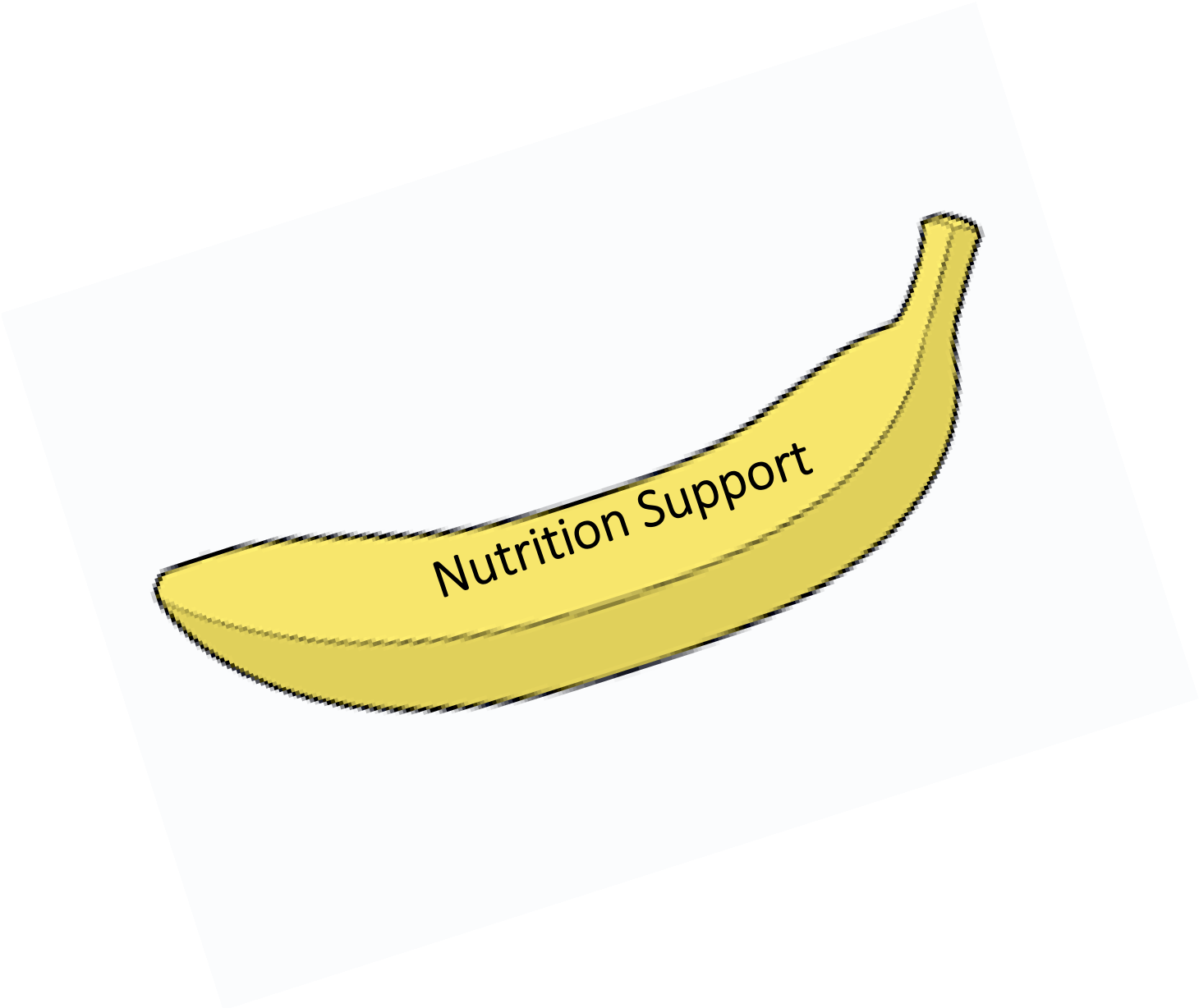
	Anti-anxiety Agents	To prevent nausea and vomiting caused by cancer chemotherapy, radiation therapy, and surgery.	Unless your doctor tells you otherwise, continue your usual diet.	Ondansatron (Zofran)
	Cholagogues and Choleretics	To dissolve & prevent gallstones in people who do not want surgery or cannot have surgery to remove gallstones.	Best to take with meals, unless otherwise directed by your doctor	Ursodiol
	MEDICATION	**USE**	**INTERACTIONS/GUIDELINES**	**EXAMPLES**
GASTROINTESTINAL	Surface- Active Agents/ Stool Softeners	On a short-term basis to relieve constipation by people who should avoid straining during bowel movements	Take with water	Peri-colace, Colace, Senna
	Antiflatulent/ anti foaming	Treat the symptoms of gas (uncomfortable/ painful pressure, fullness & bloating)		Simethicone

	Antiemetic	To relieve heartburn and speed of healing of ulcers and sores in the esophagus in people who have gastroesophageal reflux disease that did not get better with other treatments.	Unless your doctor tells you otherwise, continue your regular diet	Meto-clopramide (Reglan)
	Corticosteroids	Relieve sneezing, runny/ stuffy/ itchy nose caused by hay fever or other allergies.		Budesonide
	MEDICATION	**USE**	**INTERACTIONS/GUIDELINES**	**EXAMPLES**
IMMUNOSUPPRESSANTS		To prevent transplant rejections in people who have received kidney, liver, and heart transplants.	Oral solution may be mixed with milk/ chocolate milk or orange juice. Avoid drinking/ eating grapefruit. Limit potassium in your diet (bannas, prunes, raisins and orange juice)	Cyclosporine, Tacrolimus
				Cellcept (MMF)

MISC. MEDICATIONS	Hematinic	Treat anemia in people with chronic kidney failure & people with certain type of cancer chemotherapy.	Control blood pressure and increase iron levels.	Epogen
		Allergies, antiemetic (in cancer pts)	Unless your doctor tells you otherwise, continue your normal diet.	Diphenyl-hydramine

NOTE:

Some medications listed on the tables above may have many uses/indications. You do not need to include every possible thing that the medication could be used for—the most common uses are fine. I have filled in some of the boxes to get you started. You should use reliable resources to complete the table; many of the public resources found online will not give you enough information about the nutritional implications


Nutrition Support

Nutrition Support Standards

ASPEN Adult Nutrition Support Standards 2018 Article

Standards of Practice

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Standards for Nutrition Support: Adult Hospitalized Patients

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Abstract

The American Society for Parenteral and Enteral Nutrition defines standards as benchmarks representing a range of performance of competent care that should be provided to assure safe and efficacious nutrition care in most circumstances. Standards are documents that define the structure needed to provide competent care. These Standards for Nutrition Support for Adult Hospitalized Patients are an update of the 2010 Standards. These practice-based standards are intended for use by healthcare professionals charged with the care of adult hospitalized patients receiving nutrition support therapy in any hospital with or without a formal nutrition support service or team. These Standards address professional responsibilities as they relate to patient assessment, diagnosis, education, care plan development, implementation, clinical monitoring, evaluation, and professional issues around nutrition support. (*Nutr Clin Pract*. 2018;33:906–920)

Keywords

enteral nutrition; hospitalization; nutrition assessment; nutrition support; parenteral nutrition; standard of care

Introduction

The American Society for Parenteral and Enteral Nutrition (ASPEN) is dedicated to improving patient care by advancing the science and practice of clinical nutrition and metabolism. Founded in 1976, ASPEN is an interdisciplinary organization whose members are involved in the provision of clinical nutrition therapies, including parenteral and enteral nutrition. With more than 6,500 members from around the world, ASPEN is a community of dietitians, nurses, pharmacists, physicians, scientists, students, and other health professionals from every facet of nutrition support clinical practice, research, and education. ASPEN envisions an environment in which every patient receives safe, efficacious, and high-quality nutrition care. ASPEN's mission is to improve patient care by advancing the science and practice of clinical nutrition and metabolism. These Standards for Nutrition Support for Adult Hospitalized Patients are an update of the 2010 standards.[1] They are intended for use by any hospital with or without a formal nutrition support service (or team).

ASPEN defines standards as benchmarks representing a range of performance of competent care that should be provided to assure safe and efficacious nutrition care in most circumstances.[2] Standards are documents that define the structure needed to provide competent care. Standards usually address professional responsibilities as they relate to patient assessment, diagnosis, education, care plan development, implementation, clinical monitoring, evaluation, and professional issues. ASPEN publishes discipline-based (eg, dietitian, nurse, pharmacist, or physician) and practice-based (eg, adult hospitalized patients, pediatric hospitalized patients, home and alternate site care) standards. Standards are presented in the most generic terms possible. The details of specific tests, therapies, and protocols are left to the

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discretion of individual healthcare facilities. Each healthcare facility shall strive to provide the best nutrition support care that is possible given the resources of the organization. The standards aim to ensure sound and efficient nutrition care for those in need of nutrition support therapy.

Important Note

These standards do not constitute medical or other professional advice and should not be taken as such. To the extent that the information published herein may be used to assist in the care of patients, this is the result of the sole professional judgment of the attending healthcare professional whose judgment is the primary component of quality medical care. The information presented in these standards is not a substitute for the exercise of such judgment by the healthcare professional. Circumstances in clinical settings and patient indications may require actions different from those recommended in this document and in those cases, the judgment of the treating professional should prevail.

Audience for Standards

These practice-based standards are intended for use by healthcare professionals charged with the care of adult hospitalized patients receiving nutrition support therapy.

Level of Care

As limited by the *Important Note* above, these Standards of Practice present a range of performance of competent care that should be provided by healthcare professionals caring for adult hospitalized patients receiving nutrition support therapy. Terminologies included in each standard are specified as:

(a) "*Shall*": Indicates standards to be followed strictly.
(b) "*Should*": Indicates that among several possibilities one is particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.
(c) "*May*": Indicates a course of action that is permissible within the limits of recommended practice.

These standards have been developed by the ASPEN Task Force on Standards for Nutrition Support: Adult Hospitalized Patients, reviewed by the ASPEN Clinical Practice Committee, and approved by the ASPEN Board of Directors on July 25, 2018. These Standards of Practice should be used in conjunction with the previously published ASPEN Clinical Guidelines, Standards, Position Papers, and other Board Approved documents, which can be accessed at the ASPEN Documents Library, http://www.nutritioncare.org/Clinical_Practice_Library/.

Chapter I: Organization

Standard 1. Nutrition Support Service (or Team)

A nutrition support service (or team) should assess and in collaboration with patients' primary teams, manage the nutrition support therapy of patients who require or may require nutrition support therapy. These patients are often, but not always, determined to be nutritionally-at-risk at admission or upon subsequent evaluation.[3] Organized nutrition support services (or teams) are associated with improved patient outcomes, decreased length of hospitalization, and improved cost effectiveness.[4-19] If a hospital does not have a designated nutrition support service (or team), the care used to provide nutrition support therapy should be interprofessional. The scope and design of the nutrition support service (or team) and their respective activities vary according to the unique attributes of each hospital. Among various organizations, management of nutrition support may comprise a spectrum of activities including no formal structure, an administrative nutrition committee only, a consultative nutrition support service (or team), or a nutrition support service (or team) that assumes responsibility for the nutrition care of patients who receive nutrition support therapy.

1.1 When an organized nutrition support service (or team) exists, it shall be directed by a clinician who has appropriate education, specialized training, patient care experience, or experience in managing nutrition support services (teams).
1.2 An organized nutrition support service (or team) should include a physician, nurse, dietitian, and pharmacist, each following the standards of practice for their discipline, as available.[20-23]
1.3 If a nutrition support service (or team) is not established, nutrition support therapy should be managed with an interprofessional approach that includes the patient's physician, nurse, dietitian, and pharmacist.

Standard 2. Policies and Procedures

Written policies and procedures for providing nutrition support therapy shall be current.

2.1 The policies and procedures shall be developed with the input of and review by all members of the nutrition support service (or team) and/or nutrition support committee.
2.2 The policies and procedures shall be reviewed periodically and revised as appropriate to define optimal patient care and therapeutic outcomes. (See 3.2.)

Standard 3. Performance Improvement

The nutrition support service (or team) and/or nutrition support committee shall regularly review and report on service performance, quality indicators, patient outcome data, and adverse events related to nutrition support therapies.[24] These reports shall be shared with all internal stakeholders and reported to external agencies as required.

- 3.1 The nutrition support service (or team) and/or nutrition support committee shall recommend policy, procedure, or protocol changes that improve and/or enhance the safety and efficacy of nutrition support therapy.
- 3.2 The review of service performance should assess the appropriateness and effectiveness of nutrition support therapy.

Chapter II: Nutrition Care

Nutrition care and the administration of nutrition support therapy shall proceed according to a series of steps with feedback loops. These steps include nutrition screening, formal nutrition assessment, creation of a nutrition care plan, implementation of the plan, patient monitoring, evaluation of the plan, evaluation of the care setting, and reformulation of the plan or termination of therapy. (See Figure 1: ASPEN Adult Nutrition Care Pathway.)

Standard 4. Nutrition Screening

Nutrition screening is defined as "a process to identify an individual who is malnourished or who is at risk for malnutrition to determine if a detailed nutrition assessment is indicated."[1] Patients who are nutritionally-at-risk shall be identified by a validated screening process and by periodic rescreening per institutional policy or standard.[3,25-33] This process should be created, approved, and regularly reviewed by a group with organizational authority, preferably a designated nutrition committee.

- 4.1 Results of the nutrition screening shall be documented and communicated and appropriate intervention shall be initiated within the time frame specified by the hospital or as clinically indicated.
- 4.2 A procedure for rescreening of patients not immediately identified as nutritionally-at-risk should be implemented and regularly reviewed.

Standard 5. Nutrition Assessment

All patients identified as nutritionally-at-risk based on the nutrition screening shall undergo a nutrition assessment.[3,27-33] This nutrition assessment shall be documented and made available to all patient care providers. The intent of the nutrition assessment is to document baseline nutrition parameters, identify nutrition risk factors and specific nutrition deficits, determine individual nutrition needs, and identify medical, psychosocial, and socioeconomic factors that may influence the prescription and administration of nutrition support therapy.[34,35]

- 5.1 The nutrition assessment shall be performed within the time frame specified by the hospital and by a dietitian or a clinician with documented specialized expertise in nutrition.
- 5.2 The nutrition assessment shall include evaluation of the patient's current nutrition status and nutrition requirements.
  - 5.2.1 A malnutrition diagnosis, if present, and degree of malnutrition shall be clearly documented to facilitate appropriate diagnosis coding.
  - 5.2.2 Degree of obesity (ie, class I, class II, or class III), if applicable, shall also be documented.
- 5.3 The patient's nutrition requirements shall be summarized based on the findings of the nutrition assessment and should include energy, macronutrient (protein, and as appropriate, carbohydrate and fat), as well as fluid, electrolyte, and micronutrient requirements, as appropriate.
- 5.4 Nutrition assessment shall include a review and documentation of factors relevant to delivery of nutrition support therapy. Relevant factors may include, but are not limited to, the following: ability to eat safely and adequately, patient's goals, assessment of aspiration risk, functional status of the gastrointestinal tract, cognitive function/abilities, enteral and vascular access, and results of tests and invasive procedures.

Chapter III: The Nutrition Care Plan

Standard 6. Goals

The process of nutrition care is multifactorial and shall include multiple levels of intervention including screening for nutrition risk factors. The nutrition care plan shall be created from a comprehensive review and analysis of information gathered from many aspects of the patient's care. The nutrition care plan should include "statements of nutrition goals and monitoring/evaluation parameters, the most appropriate route of administration of nutrition therapy, method of nutrition access, anticipated duration of therapy, and training and counseling goals and methods."[32]

A formal nutrition assessment provides the basis for the nutrition care plan. The nutrition care plan guides comprehensive nutrition therapy by defining its rationale, describing appropriate intervention and monitoring, and delineating recommended reassessment and reevaluation parameters. This process facilitates changes in care

support therapy.

(if applicable), the nutrition support service (or team), the

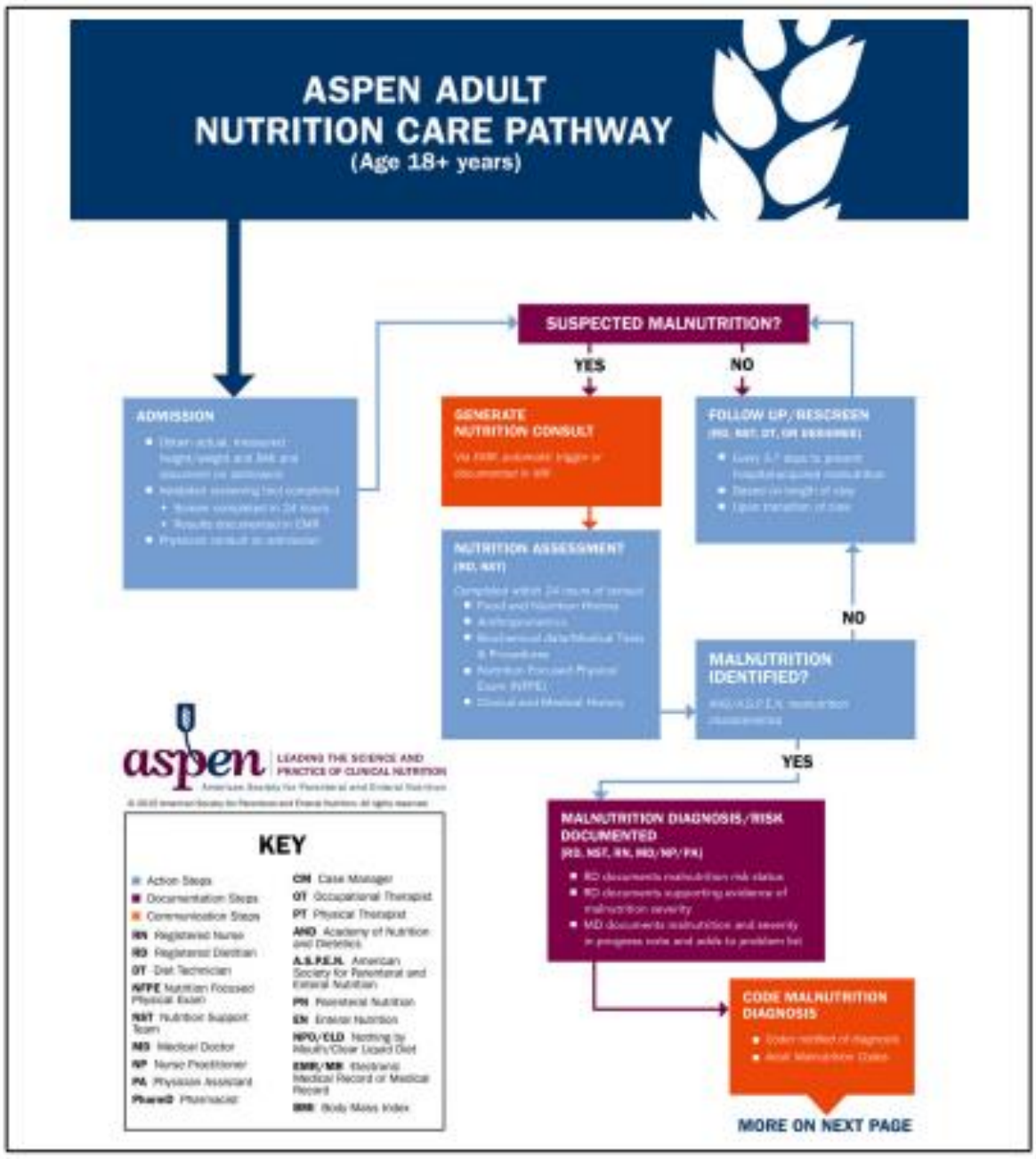


Figure 1. The American Society for Parenteral and Enteral Nutrition adult nutrition care pathway.

appropriate to the clinical setting while considering the continuum of care. Revision of the nutrition care plan based on changes in clinical status and achievement of goals of therapy should occur before discontinuation of nutrition support therapy.

Standard 7. Interprofessional Approach

The nutrition care plan should be developed using an interprofessional team approach involving the patient, caregiver (if applicable), the nutrition support service (or team), the

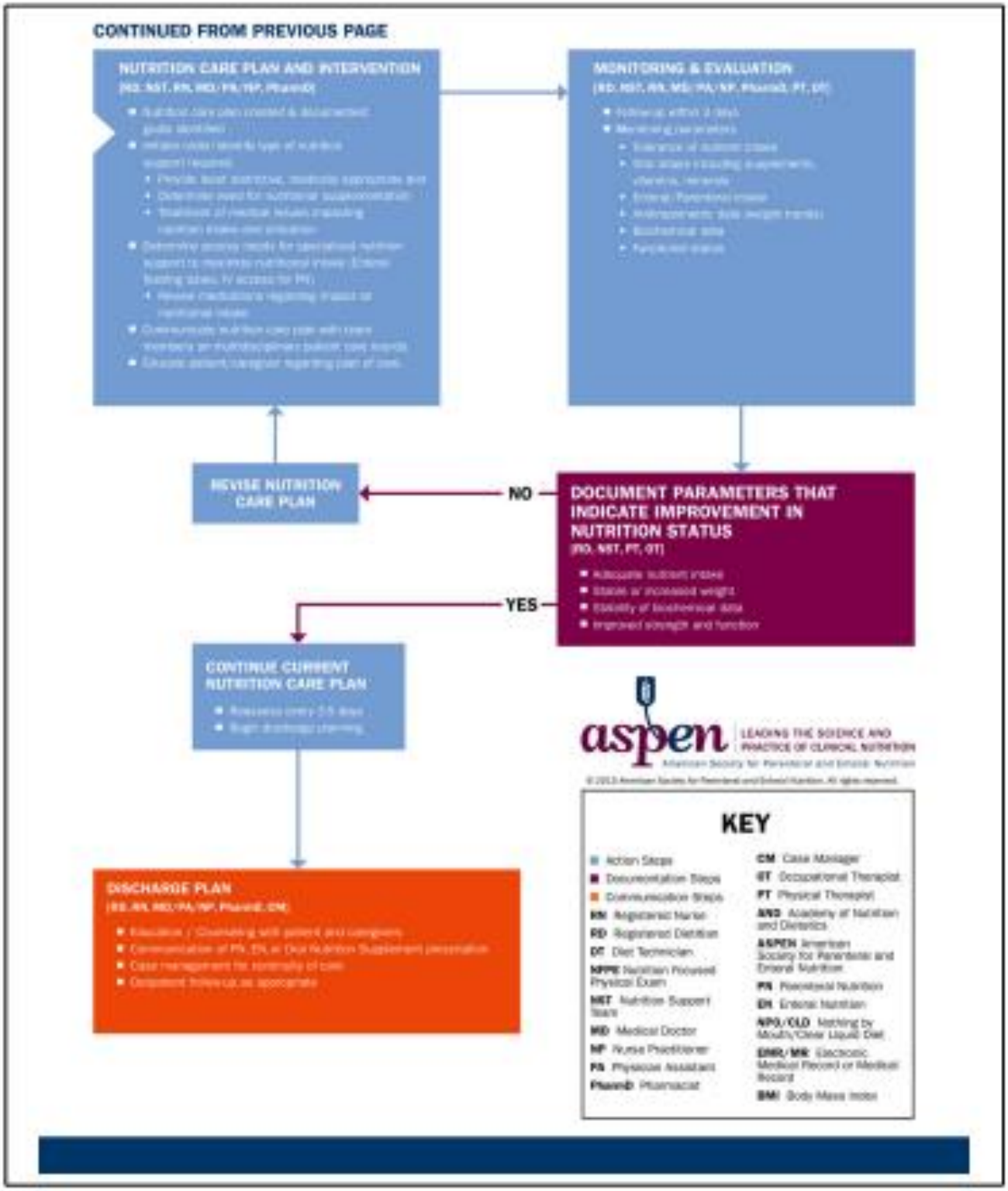


Figure 1. *Continued*

patient's physician(s), dietitian(s), nurse(s), pharmacist(s), and other appropriate healthcare professionals.

Standard 8. Patient and Caregiver Communication

The nutrition care plan should include patient and/or caregiver(s) education about nutrition support therapy, goals, and expectations and should incorporate the wishes of the patients and/or caregiver(s). Appropriate routes of administration shall be defined, identification of intake goals shall be included, and estimated duration of therapy as well as criteria for discontinuation of therapy should be addressed.

Standard 9. Selection of Route

The route selected to provide nutrition support therapy shall be appropriate to the patient's clinical status or condition and shall periodically be assessed for continued appropriateness as well as for its adequacy in meeting goals of the nutrition care plan.[36] (See Figure 2: Route of administration algorithm.)

Standard 10. Selection of Formulation

The enteral nutrition (EN) or parenteral nutrition (PN) formulation shall be appropriate for the patient's disease process and compatible with the route of access.[37,38]

10.1 The EN or PN formulation shall be adjusted as appropriate based on the patient's clinical response.

10.2 The EN or PN formulation shall be adjusted accordingly when significant amounts of nutrients are provided (eg, parenteral infusions, medications) through means other than the EN formula or PN admixture or lost/eliminated through mechanical procedures or anatomical defects (eg, renal replacement therapy, enterocutaneous fistula) .

Chapter IV: Implementation

Standard 11. Ordering Process

Implementation of the nutrition care plan shall follow nutrition assessment and development of a formal nutrition care plan.

11.1 Authority to prescribe nutrition support therapy shall be determined by hospital policy and applicable professional licensure laws.

11.1.1 Hospital policy should clearly articulate the appropriate credentials, training, and/or certifications and competencies required for clinicians who prescribe nutrition support therapy.

11.1.2 As delineated by clinical privileges and applicable professional licensure laws, a nutrition support clinician may enter/write orders for feeding formulations, laboratory tests, and adjunctive therapy (eg, intravenous [IV] fluids, insulin, IV/oral electrolytes) and adjust regimens based on response to therapy, changing clinical condition(s), altered laboratory values, and nutrition assessment parameters.

11.1.3 Hospital policy should include a competency for nutrition support therapy prescribing.[39]

11.2 Orders for nutrition support therapy shall be documented in the patient's medical record before administration.

11.2.1 A standardized order format and review process for nutrition support therapies orders shall be used to minimize the risk of adverse events and error. This process shall include standardized electronic orders (eg, computerized provider order entry [CPOE] system) for prescribing PN and EN. Handwritten order to prescribe PN and EN should be avoided due to potential for error. Verbal and telephone orders and text messaging of orders should be avoided.[40,41] See ASPEN Parenteral Nutrition Safety Consensus Recommendations[38] and ASPEN Safe Practices for Enteral Nutrition Therapy[40] for details of the prescribing process for PN and EN.

11.3 Nutrition care plans shall be implemented to promote safe, accurate, and effective nutrition support therapy based on the patient's needs and clinical condition and will provide resource-efficient and fiscally responsible care.

Standard 12. Nutrition Support Access

Access for nutrition support therapy shall be achieved and maintained in a manner that minimizes risk to the patient and optimizes therapeutic outcome(s).[36,40-43]

12.1 Standard techniques and policies should be established and followed for access device insertion and routine care. (See section 16.5.)

12.1.1 The selection of a venous access site (central vs peripheral vein) should depend on expected duration of therapy, nutrition requirements, and patient's vascular condition and preferences.[40,43,44] When PN is

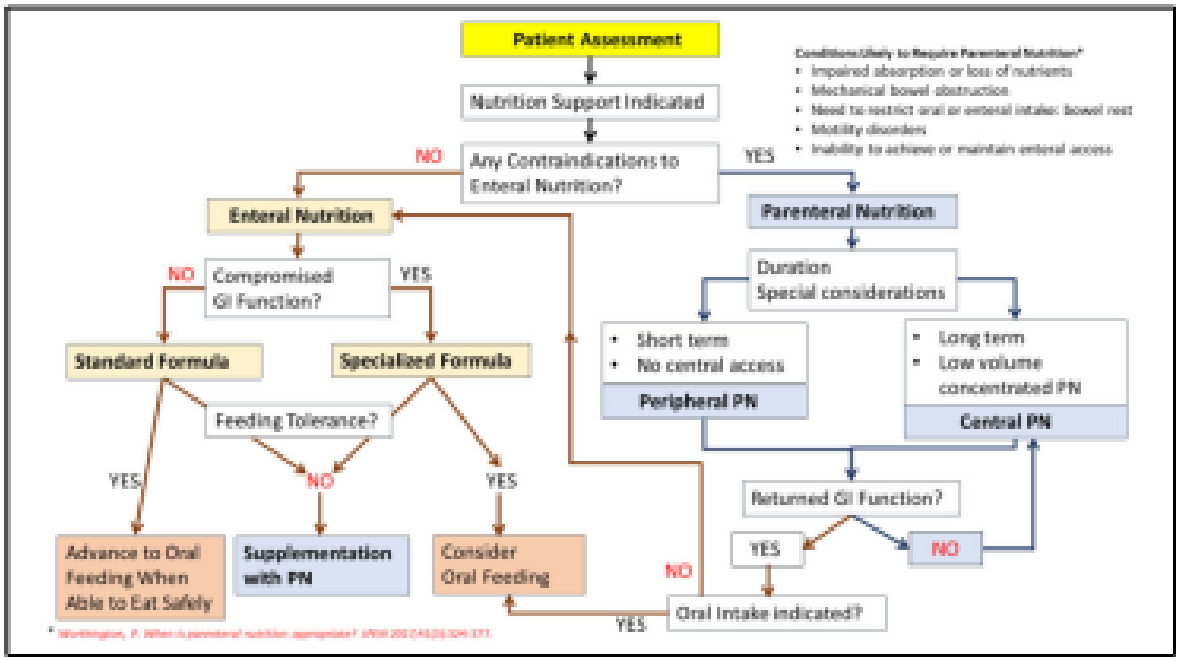


Figure 2. Route of administration algorithm. GI, gastrointestinal; PN, parenteral nutrition.

administered via a central access device, the femoral vein site should be avoided, especially in the obese, to minimize infection risks associated with nontunneled central venous catheters (CVCs).[43,45-48] Peripherally inserted central catheters (PICC) should not be used as a strategy to reduce central line-associated bloodstream infection (CLABSI).[46] A CVC with the fewest number of lumens or ports required for that patient should be used for PN administration.[46]

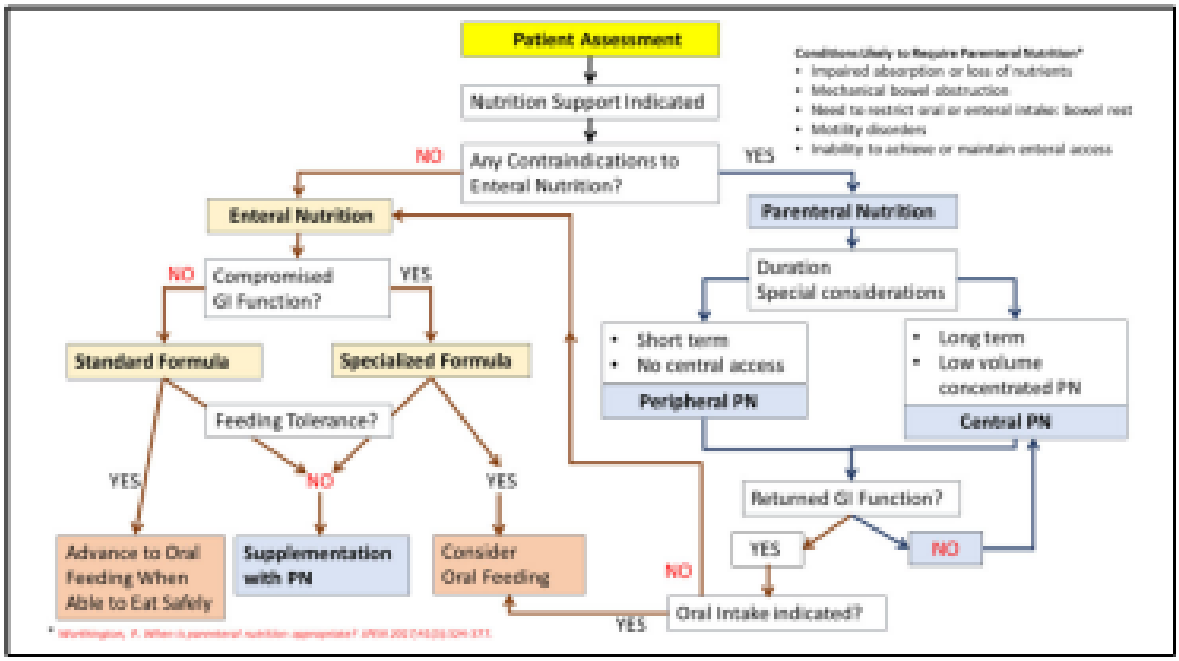
12.1.2 The selection of an enteral access device (nasoenteric vs enterostomy [ie, gastrostomy, jejunostomy]) should depend on the patient's disease state, needs and goals, ethical situation, gastrointestinal anatomy and function, expected duration of EN therapy, and the ability to safely access the gastrointestinal tract via radiologic, surgical, endoscopic techniques, or other guided technology.[41,42,48-51] (See Table 1: Selection of Enteral Access Based on Gastric Tolerance and Anticipated Feeding Duration.)

12.1.3 Appropriate access devices shall be placed by a physician, nurse, or trained healthcare professional who is competent to place the specific access device. Guidance technology for placement of central venous access and enteral access devices should be used only by clinicians who have completed prerequisite training and credentialing required by the respective institution.[50,52,53] Professionals with knowledge in preventing, recognizing, and managing complications associated with the placement and maintenance of the access devices should monitor the use of the access devices.[41,43,44,46-48]

12.1.4 Proper placement of central venous access devices shall be confirmed using appropriate technology and documented in

Table 1. Selection of Enteral Access Based on Gastric Tolerance and Anticipated Feeding Duration[41].

Normal Gastric Motility	Duration	
	Short Term (4–6 Weeks)	Long Term (Longer Than 6 Weeks)
Yes	Nasogastric	Gastrostomy
No	Nasoduodenal Nasojejunal	Jejunostomy



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the medical record before initial use.[45,64] For enteral access devices, the auscultatory method shall not be relied upon to differentiate between pulmonary, gastric, and small bowel placement of a nasoenteric tube.[50] When using enteral access system or guidance technology to place enteral access devices, if any difficulty occurs during insertion, confirmation of the final tube position should be done per institution protocol.[53] Radiographic confirmation is the gold standard for determining the exact tube position after insertion and should be used.[41,49-52]

12.1.5 Central venous access should be used for the delivery of PN admixtures with an osmolarity greater than 900 mOsm/L.[54] The catheter tip should be positioned in the lower segment of the superior vena cava adjacent to the cavo-atrial junction.[43] Peripheral PN may be administered, if indicated, through a peripheral access device provided the osmolarity of the admixture is less than or equal to 900 mOsm/L. Lipid injectable emulsion (ILE) may be concurrently infused.[43,44,54]

12.1.6 Monitoring procedures for nutrition support therapy administration shall include visual inspection of the patient's enteral or parenteral access devices and insertion site.

12.2 Complications related to an access device and outcome(s) of the interventions to manage the complication(s) shall be clearly documented in the medical record.

Standard 13. PN Admixture Preparation

PN shall be prepared accurately as prescribed and stored safely according to United States Pharmacopeia (USP) General Chapter-<797>: Pharmaceutical Compounding-Sterile Products.[55]

13.1 PN formulations shall be prepared using current policies and procedures regarding manufacturing, compatibility, and stability. These procedures shall be supervised by a licensed pharmacist with appropriate credentials and experience.[40,44]

13.1.1 A hospital-specific standardized process for PN preparation shall be used. This may include the use of standardized PN formulations when appropriate.[40,56]

13.1.2 A pharmacist shall review the contents of a PN order for appropriateness and compare it with previous orders when applicable.[40,56]

13.2 In hospitals that use automated compounding devices (ACDs) for preparation of PN formulations, policies and procedures shall be developed to address responsibilities for operation and maintenance, staff training, and monitoring ACD performance (ie, quality assurance).[40,57]

13.2.1 Adequate training of personnel shall include use of computer software to assist in daily use and trouble shooting of ACDs.[40]

13.2.2 PN substrate dosing limit alerts shall be activated in the computer software and used in the assessment of the PN formulation prior to compounding.[40]

13.2.3 Documents generated by the ACD or other electronic devices shall be compared with the ordered PN formulation.[40]

13.2.4 The pharmacist and/or pharmacy technician shall monitor the equipment during the preparation process to assure proper operation.[40]

13.2.5 End-product and validation testing of PN admixtures should be completed.

13.3 In hospitals that outsource preparation of PN admixtures, policies and procedures shall be developed for appropriate ordering, storage, preparation, labeling, and dispensing of PN admixtures. Hospitals should ensure that the outsource agency prepares PN formulations in accordance with USP General Chapter <797>: Pharmaceutical Compounding-Sterile Products.[55]

13.4 In hospitals that use standardized, commercially available PN products, policies and procedures shall be developed for appropriate ordering, storage, preparation, labeling, and dispensing of PN admixtures.[40,56]

13.5 PN admixtures shall be sterile and free from physical contaminants (foreign materials and physical matter) and minimize patient exposure to aluminum.[40,59]

13.6 A pharmacist should refer to ASPEN, American Society of Health-system Pharmacists (ASHP), FDA Drug Shortages, or other appropriate resource(s) on managing shortages and outages of PN components and develop hospital-specific strategies to provide optimal PN therapy during shortages.

13.7 Nonnutrient medication (eg, insulin) should be added to PN only when supported by physiochemical compatibility and stability data.[54]

13.8 A pharmacist shall conduct a visual inspection of the final PN admixture prior to dispensing.[39]

13.10 Additions to PN admixture shall not be made outside of the pharmacy sterile compounding environment.

Standard 14. EN Formula Preparation

EN formulas and products shall be prepared accurately and safely as prescribed and stored according to the manufacturers' directions and published safety consensus recommendations.[41]

14.1 EN formulas shall be prepared by trained personnel under professional supervision in a clean environment. Aseptic technique shall be used in the preparation of EN formulas.[41]
- 14.1.1 Preparation equipment shall be sanitized regularly.
- 14.1.2 Open-system containers shall be filled with EN formula using aseptic technique.

14.2 Any addition of modular products or water to the formula shall be ordered by the prescribing clinician or designee.
- 14.2.1 Additions to EN formulas shall not be done at the bedside.
- 14.2.2 Additions to closed-system EN containers shall not be made.

Standard 15. Packaging and Labeling

PN admixtures and EN formula containers shall be appropriately packaged and labeled in a standardized fashion according to hospital policy and procedure.

15.1 PN admixtures shall be packaged in administration containers that can assure maintenance of sterility and allow visual inspection during preparation, storage, and infusion.
- 15.1.1 The PN admixtures and ILE administered as a separate infusion shall be labeled with the following as described in the ASPEN Parenteral Nutrition Safety Consensus Recommendations:[40]
  - Two patient identifiers (eg, name, medical record number, date of birth)
  - Patient location or address
  - Administration date and time
  - Beyond-use date and time
  - Route of administration (central vein vs peripheral vein)
  - Prescribed volume
  - Method of administration (continuous vs cyclic)
  - Complete name of all ingredients expressed in the same units of measure as the PN order
  - All PN ingredients shall be ordered as amount per day (ie, grams per day, mEq per day)
  - Name of compounding institution or pharmacy
- 15.1.2 Auxiliary labels should be affixed to PN admixture packaging to reduce risk of error (eg, for central line only).
- 15.1.3 The PN admixture shall be stored in a refrigerator (per established guidelines), unless the admixture will be administered immediately to the patient.[40,45,53]

15.2 EN formulas shall be packaged in administration containers, which assure accuracy of volume, cleanliness, and minimize the risk for contamination.[41]
- 15.2.1 Open-system administration containers should be used if the EN formula will be modified with modular products. However, the addition of modular products to an open-system container may result in an unacceptable risk of contamination in hyperthermal environments.[41]
- 15.2.2 Hospital-prepared EN formulas shall be stored in a refrigerator (per established guidelines), unless the formula will be administered immediately to the patient.

15.3 EN labels shall be standardized.
- 15.3.1 EN formula containers shall be labeled accurately with the contents and 2 patient identifiers (eg, name, medical record number, date of birth), product name and strength, additives, volume, and appropriate hang time.[41]
- 15.3.2 EN formula container labels shall also contain delivery site/access, route (enteral), and method of administration (eg, continuous, cyclic, bolus).[41]
- 15.3.3 EN formula container labels shall contain a statement indicating that the product is for enteral administration only.[41]
- 15.3.4 EN formula container labels shall contain a statement indicating that the product is not for IV administration.[41]

Standard 16. Administration of Nutrition Support Therapy

EN formulas and PN admixtures shall be administered safely and accurately in accordance with the prescribed order and consistent with the patient's tolerance.[40,41]

16.1 Nutrition support therapy shall be administered by or under the supervision of trained personnel.

16.2 Hospital-specific procedures shall exist regarding techniques used to administer nutrition support therapy. Organizations should use infusion pumps with the ability to reduce errors.[40]

16.3 Acute care facilities should establish a policy that prohibits the use of a PN admixture prepared for administration at home or in subacute or long-term care facilities. PN should be discontinued prior to discharge or transport to another facility.[40]

16.4 Each PN admixture should be inspected prior to and during administration. If visual changes are present, the admixture shall not be administered, and the pharmacy shall be notified.[40,60]

16.5 Before nutrition support therapy is administered to the patient, the label on the container shall be checked against the order and the patient's identity shall be verified per hospital policy to assure the prescribed formulation is delivered to the appropriate patient and administered by the correct route at the designated/intended time.[40,41,61,62] Administration tubing should be attached to PN containers immediately prior to use.[40]

16.6 The administration rate of the prescribed nutrition support therapy shall be checked each time a new volume is ordered or initiated and periodically during its administration.[40,41] Use of an independent double-check verification should be performed by a second clinician prior to beginning a PN infusion.[40,41,62]

16.7 Procedures shall be written to prevent and manage vascular or enteral access device occlusion and IV extravasation.[41,42,44,63]

16.8 EN and PN processes shall be documented in the patient's medical record including tolerance, administration volumes, and hourly rates. The amount of nutrition therapy ordered vs amount administered should be noted and reasons for discrepancies evaluated.[41]

16.9 Policies and procedures shall exist to prevent, diagnose, manage, and monitor patient infections caused by contamination of the PN admixture or the equipment/devices used in its administration, as PN is an independent risk factor for CLABSI.[46–48,64]

16.9.1 Infection prevention strategies shall be used to minimize CLABSI including a bundle of targeted, evidence-based catheter insertion and maintenance practices.[46–48]

16.9.2 Access ports shall be disinfected with an appropriate antiseptic prior to catheter manipulation and manipulation should be minimized; vascular access devices used for PN should not be used for blood sampling.[46,47,64] Coinfusion of fluids or medications into the PN system should be avoided, if possible. If no alternatives are available, a pharmacist shall review the compatibility and stability data for coinfusion prior to administration.[40,64]

16.9.3 Unit-specific data regarding CLABSI shall be shared with all internal stakeholders and reported to external agencies as required.[47]

16.9.4 PN admixtures shall be labeled with the beyond-use date and time and discarded as indicated. Once the delivery system is accessed, the administration of a PN admixture shall be completed within 24 hours.[40,44–46,53]

16.9.5 Administration sets for PN shall be changed every 24 hours or with each new PN container. A 1.2-micron filter shall be used for all total nutrient admixtures and a 0.22-micron filter for dextrose/amino acids (2-in-1) admixtures.[40,44,65]

16.9.6 ILE administered separately from PN admixtures (dextrose/amino acids) shall be infused through a 1.2-micron filter and be completed within 12 hours of initiating the infusion.[40,44,65]

16.10 A policy shall exist regarding the maximal rate of administration for ILE. Manufacturers' recommendations should be considered in formulating this statement.

16.11 Cycling of PN admixtures should be considered for patients with or at risk for liver dysfunction, on long-term PN, or those who are stable, active, and may benefit from infusion-free time.[66,67]

16.12 Prevention strategies shall be used to minimize the risk of microbial contamination of EN formulations. (Refer to the Enteral Nutrition Practice Recommendations[41] and Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient[31] for details.)

16.13 Procedures and protocols to minimize the risk of regurgitation and aspiration of EN formulations should be implemented.[41]

16.13.1 All patients receiving EN shall be assessed for risk of aspiration and steps employed to reduce aspiration risk and pneumonia.[31,41,68–70]

16.13.2 The head of the bed should be elevated 30–45° during EN administration unless contraindicated.[31,41,69–71]

16.14 An enteral feeding protocol should be designed to assure that optimal nutrients are delivered and unnecessary interruption of feeding minimized. Gastric residual volumes may be used to assess EN tolerance as part of a multifaceted approach.[31,41,68]

16.15 Policies and procedures shall exist to minimize the risk of enteral misconnections.[41,72-74]

16.15.1 Hospitals should conform to International Organization of Standardization (ISO) standard 80369-3 that is driving the production of products with incompatible connectors by designing features that make incorrect connections impossible (eg, ENFit).[41,74-77] Enteral delivery devices (administration sets, feeding tubes, and enteral syringes) with connectors that can physically connect with other nonenteral connectors shall not be purchased.

16.15.2 Standard Luer syringes shall not be used to administer oral or enteral medications or EN formula.[41,74]

16.15.3 Tubes or catheters shall be traced from the patient to the point of origin before connecting any new device or infusion.[41,74,78]

16.15.4 Tubes and catheters having different purposes should be routed in different, standardized directions (eg, IV lines routed toward the head; enteric lines toward the feet) and labeled at proximal and distal tubing ends.[73]

16.16 Protocols shall be established for administering medications and modular products through an enteral access device.[41]

16.16.1 Medications should not be mixed directly with EN formulas due to potential drug-drug and drug-nutrient interactions.[41,78-81]

16.16.2 Medication orders should specify the route of delivery (eg, PO, NG tube, G tube, J tube) and be administered according to current guidelines. Special considerations include use of proper dosage form, administration of the drug separate from the EN formula and other drugs, and the location of drug delivery in the gastrointestinal tract.[41,78-81]

16.16.3 Enteral access device(s) should be flushed appropriately before and after each medication administration and restarting EN administration to help prevent occlusion.[41,80,82]

Standard 17. Adverse Events Management

An adverse event, including sentinel events related to the administration of nutrition support therapy and the equipment/access devices, shall be documented and reported according to hospital protocol to promote a culture of patient safety. Protocols should be developed and followed to decrease the risk of adverse events.

Chapter V: Monitoring and Reevaluating the Nutrition Care Plan

Standard 18. Parameters and Frequency

A plan for monitoring the effect of nutrition support therapy interventions should be stated in the nutrition care plan.[36,40,41]

Monitoring parameters are chosen relative to the therapy goals of the nutrition care plan. The nutrition care plan shall be revised to optimize nutrition support therapy and achieve predetermined goals, as indicated.

18.1 The frequency of monitoring should depend on severity of illness, level of metabolic stress, nutrition status, as well as the patient's clinical condition.[31,36,40,41]

18.1.1 Daily or more frequent monitoring should be required in patients who are critically ill, have debilitating diseases (eg, diabetes mellitus) or infection, are at risk for refeeding syndrome complications, are transitioning between PN or EN and oral diet, or have experienced complications associated with nutrition support therapy.

18.1.2 Weekly or as clinically indicated monitoring may be needed in patients who are clinically and metabolically stable with documented stable laboratory parameters.

18.2 Monitoring parameters should include the following:

- Physical assessment, including clinical signs of fluid and nutrient excess or deficiency
- Functional status
- Vital signs
- Actual nutrient intake (oral, enteral, and parenteral)
- Weight
- Laboratory data
- Diagnostic tests
- Review of all medications
- Changes in gastrointestinal function
- Input and output/fluid balance

18.3 Appropriate changes in nutrition support therapy shall be made based on results of monitored parameters. Recommended changes in nutrition

support therapy including EN formula/PN admixture or administration route and resulting outcomes shall be documented in the nutrition care plan.[84]

18.4 Protocols should be established to maintain blood glucose control in patients receiving EN or PN.[85-87]

Standard 19. Reevaluation of Nutrition Care Plan

The patient shall be monitored for progress toward short- and long-term goals as defined in the nutrition care plan.[36,41]

19.1 Appropriate parameters should be measured serially during nutrition support therapy and documented.[36,40,41] Parameters may include weight change, changes in laboratory data, adequacy of intake, ability to transition to oral diet, functional status performance, and quality of life.

19.2 The monitoring parameters should be compared with the goals of the nutrition care plan. If goals are not being met, a new clinical issue or complication develops, and/or an adverse event occurs, the nutrition care plan should be modified.

Chapter VI: Transition of Therapy

Standard 20. Adequacy of Intake

The transition of nutrition therapies shall be monitored. Recommendations for improving oral and EN intake shall be documented. Adequacy of energy and nutrient intake is based on clinical judgment and shall be assessed and documented before discontinuation of nutrition support therapy.[31,35,40] (See Figure 2: Route of administration algorithm.)

Standard 21. Continuity of Care

Continuity of the nutrition support therapy shall occur through active communication with all members of the patient care team, the patient, and caregiver(s). (See Figure 1: Adult nutrition care pathway.)

21.1 A plan shall be developed for transition of nutrition support therapy to an alternate healthcare facility or to home care and should include identification of the primary clinician responsible for coordinating, monitoring, providing education, and ordering home nutrition support therapy.[31,36,40,41,87,88]

21.2 Indications for home nutrition support therapy shall be documented.

21.3 Appropriate education should be provided to patient and/or caregiver(s) and documented before discharge. Communication with home infusion and healthcare agencies and with the patient's home nutrition support management team should be established prior to hospital discharge.

21.4 The nutrition support therapy prescription and administration schedule should be documented and communicated with home infusion and home health agencies before discharge.[36,40,41,45,88] Specifically, with PN, there should be pharmacist-to-pharmacist communication to the alternate healthcare facilities or home agencies.

21.5 Periodic monitoring should be recommended depending on patient's condition.[35,39,40,86]

Standard 22. Nutrition Therapy at End-of-Life Care

The decision on nutrition support therapy in an end-of-life setting should be determined by patient autonomy and the patient's family member(s) or surrogate decision maker. The patient or the patient's family member(s) or surrogate decision maker shall decide on acceptance or refusal of medical therapy.[36,41,86,88-90]

22.1 The clinician has no obligation to provide nutrition support therapy and hydration to a patient in the end-of life situation.[89-90]

22.2 Decisions at end-of-life are often made based on healthcare and spiritual literacy of the patient and his/her family; they shall be involved in the healthcare process of end-of-life.

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Enteral Nutrition

Adult EN Formulary

Tube Feeding Formulas													
USAGE	**Product**	**Nutrient Values per**	**Kcal**	**Pro (g)**	**CHO (g)**	**Fat (g)**	**Fiber (g)**	**Osmolality (mOsm/kg)**	**Na/K (mg)**	**Ca/Phos (mg)**	**Water (mL/L)**	**mL to meet 100% DRIs**	**Features** (all formulas are gluten-free and suitable for lactose intolerance)
General use	Compleat	1L	1060	48	136	40	8	450	1000/ 1560	880/ 840	828	1400	Food-based TF formula
	Fibersource HN	1L	1200	54	164	40	15.2	480	1120/ 1920	960/ 960	808	1250	MCT:LCT = 20:80; Kosher
	Jevity 1.2	1L	1200	55.5	169.4	39.3	18	450	1350/ 1850	1200/ 1200	807	1000	MCT:LCT = 19:81; Kosher; Halal
	Jevity 1.5	1L	1500	63.8	215.7	49.8	22	525	1400/ 2150	1200/ 1200	760	1000	MCT:LCT = 19:81; Kosher; Halal
	TwoCal HN	1L	2000	83.5	218.5	90.5	5	725	1450/ 2440	1050/ 1050	700	948	MCT:LCT = 19:81; Low-residue; Kosher; Halal
No fiber/ chrons	Nutren 1.0	1L	1000	40	136	34	0	330	880/ 1600	800/ 800	844	1500	MCT:LCT = 20:80; Low-residue; Kosher
	Nutren 1.5	1L	1500	68	176	60	0	430	1300/ 2400	1200/ 1200	764	1000	MCT:LCT = 20:80; Low-residue; Kosher
	Osmolite 1.2	1L	1200	55.5	157.5	39.3	0	360	1340/ 1810	1200/ 1200	820	1000	MCT:LCT = 20:80; Kosher; Halal
Kidneys/diabets	Nepro w/ CARBSTEADY	1L	1800	81	161	96	12.6	745	1060/ 1060	1060/ 720	727	944	Kosher; dialysis
	Suplena w/ CARBSTEADY	1L	1795	45	196	96	12.7	780	802/ 1139	1055/ 717	738	944	Low-residue; Kosher; Halal

Critcare	Pivot 1.5	1L	1500	93.8	172.4	50.8	7.5	595	1400/ 2000	1000/ 1000	759	1000	MCT:LCT = 20:80; Hydrolyzed protein; Low-residue; contains Arginine and Glutamine; Halal
GI intol. Inflam	Vital AF 1.2 Cal	1L	1200	75	110.6	53.9	5.1	425	1266/ 1688	844/ 844	811	1185	MCT:LCT = 45:55; Hydrolyzed protein; Low-residue (low fiber, no gas)
GI intol/ allergies	Peptamen w/ Prebio	1L	1000	40	128	40	4	300	480/ 1600	800/ 700	844	1500	MCT:LCT = 70:30; Hydrolyzed protein; Low-residue
	Peptamen 1.5	1L	1500	68	188	56	0	585	880/ 2080	1000/ 1000	772	1000	MCT:LCT = 70:30; Hydrolyzed protein; Low-residue
	Vivonex RTF	1L	1000	50	176	11.6	0	630	700/ 1200	668/ 668	848	1500	MCT:LCT = 40:60; Elemental; Low-residue; Kosher, expensive

Oral Supplements

Product	**Nutrient Values per**	**Kcal**	**Pro (g)**	**CHO (g)**	**Fat (g)**	**Fiber (g)**	**Osmolality (mOsm/kg)**	**Na/K (mg)**	**Ca/Phos (mg)**	**% Water**	**mL to meet 100% DRIs**	**Features / Usage** (all are gluten-free and suitable for lactose intolerance EXCEPT*)
Boost Breeze	237mL	250	9	54	0	0	750	80/ 0	0/ 150	81	N/A	Clear liquid; Low-residue; Kosher; Halal
Boost	237mL	240	10	41	4	3	625	150/ 460	300/ 300	88.6	1185	Kosher
Boost Plus	237mL	360	14	45	14	3	670	200/ 360	350/ 300	78.1	1185	Kosher
Glucerna Shake	237mL	180	10	16	9	4	670	210/ 380	260/ 140	88.6	N/A	Kosher; Halal
Nepro with CARBSTEADY	237mL	425	19.1	37.9	22.7	3	745	250/ 250	250/ 170	72.6	944	PO/TF; Kosher
Suplena with CARBSTEADY	237mL	425	10.6	46.4	22.7	3	780	190/ 270	250/ 170	73.8	944	PO/TF; Low-residue; Kosher; Halal
Magic Cup (No Sugar Added)	129g	280	9	32	13	5	N/A	130/ 190	200/ 190	N/A	N/A	Frozen dessert; *NOT suitable for lactose intolerance

Modular Supplements									
Product	**Nutrient Values per**	**Kcal**	**Pro (g)**	**CHO (g)**	**Fat (g)**	**Fiber (g)**	**Na/K (mg)**	**Ca/Phos (mg)**	**Features / Usage** (all are gluten-free and suitable for lactose intolerance)
Benecalorie	1.5 fl oz (1 pkt)	330	7	0	33	0	0	100/0	PO—not for TF; Low-residue; Kosher
Beneprotein	7g (1 scoop)	25	6	0	0	0	15/30	20/0	Low-residue
Pro-Stat (Sugar Free)	30mL	100	15	10	0	0	50/20	0/50	Hydrolyzed protein; soy-free; Kosher
Microlipid	15mL (1 TBSP)	67.5	0	0	7.5	0	0	0	Emulsified lipid supplement; sourced from safflower oil; Kosher
MCT Oil	15mL (1 TBSP)	115	0	0	14	0	0	0	Sourced from coconut oil; Kosher
Juven	24g (1 pkt)	90	2.5	8.4	0	0	0	200/0	Amino Acid supplement (Arginine and Glutamine); Vitamins C, E, B12 and Zinc; Low-residue; Kosher; Halal
Nutrisource Fiber	4g (1 TBSP)	15	0	4	0	3	15/10	0	Kosher

Pediatric EN Formulary

Pediatric (≥1yr) Tube Feeding Formulas *(Nutrient values per 1L / 1000mL)*												
USAGE	**Product**	**Kcal**	**Pro (g)**	**CHO (g)**	**Fat (g)**	**Fiber (g)**	**Osmolality (mOsm/kg)**	**Na/K (mg)**	**Ca/Phos (mg)**	**Water (mL/L)**	**mL to meet 100% DRIs**	**Features** (all formulas are GF and LF; all can be consumed PO**)
general	Compleat Pediatric	1060	38	132	39	6.8	380	760/ 1640	1440/ 1000	820	1-8yo: 1000mL 9-13yo: 1500mL	**Food-based TF formula only
	Compleat Pediatric Reduced Calorie	600	30	75	20	10	380	770/ 1760	1440/ 1050	820	1-8yo: 1000mL 9-13yo: 1500mL	**Food-based TF formula only
	Nutren Junior w/ Fiber	1000	30	110	49.6	6	350	460/ 1320	1200/ 800	852	1-8yo: 1000mL 9-13yo: 1500mL	50% whey protein; Kosher
Fiber based/lacto	Nutren Junior	1000	30	110	49.6	0	350	460/ 1320	1200/ 840	852	1-8yo: 1000mL 9-13yo: 1500mL	50% whey protein; Low-residue; Kosher
	Bright Beginnings Soy	1000	29.6	108	50	12.5	<500	375/ 1542	958/ 892	833	n/a	Milk protein-free; Kosher; dairy sensitive
Renal/ DM	Nepro w/ CARBSTEADY	1800	81	161	96	12.6	745	1060/ 1060	1060/ 720	727	n/a	Kosher
	Suplena w/ CARBSTEADY	1795	45	196	96	12.7	780	802/ 1139	1055/ 717	738	n/a	Low-residue; Kosher; Halal
GI issues/ malasporsion	Pediasure Peptide	1000	30	134	41	3	250	717/ 1980	1390/ 1055	845	1-8yo: 1000mL 9-13yo: 1500mL	60% MCT; Hydrolyzed protein; contains DHA; Kosher; Halal
	Pediasure Peptide 1.5	1500	45	201	61	5	450	1075/ 2975	2090/ 1580	768	1-8yo: 667mL 9-13yo: 1000mL	60% MCT; Hydrolyzed protein; contains DHA; Kosher; Halal
	Peptamen Junior w/ PREBIO*	1000	30	136	38.4	4	365	480/ 1500	1200/ 900	844	1-8yo: 1000mL 9-13yo: 1500mL	60% MCT; Hydrolyzed protein, 100% whey protein; *soluble fiber blend
	Peptamen Junior w/ Fiber	1000	30	136	38.4	7.4	390	480/ 1500	1200/ 900	844	1-8yo: 1000mL 9-13yo: 1500mL	60% MCT; Hydrolyzed protein, 100% whey
	Peptamen Junior 1.5	1500	46	180	68	5.6	450	720/ 2300	1800/ 1360	772	1-8yo: 750mL 9-13yo: 1000mL	60% MCT; Hydrolyzed protein, 100% whey

Severe malabsorption **+ vitiami	EleCare Jr	1000	31	106.7	49.1	0	590	459/ 1526	1174/ 854	839	n/a	33% MCT; Elemental formula; Halal	
	Neocate Junior (unflavored with prebiotics	1000	31	109	49	4	620	506/ 1380	1200/ 809	843	1-3yo: 930kcal 4-8yo: 1370kcal	9-13yo: 1565kcal 14-18y: 2550kcal	35% MCT; Elemental formula; Kosher
	Vivonex Pediatric	800	24	126	23.2	0	360	400/ 1200	1120/ 840	880	1-8yo: 1000mL 9-13yo: 1500mL	70% MCT; Elemental formula	

Pediatric (≥1yr) Oral Supplements

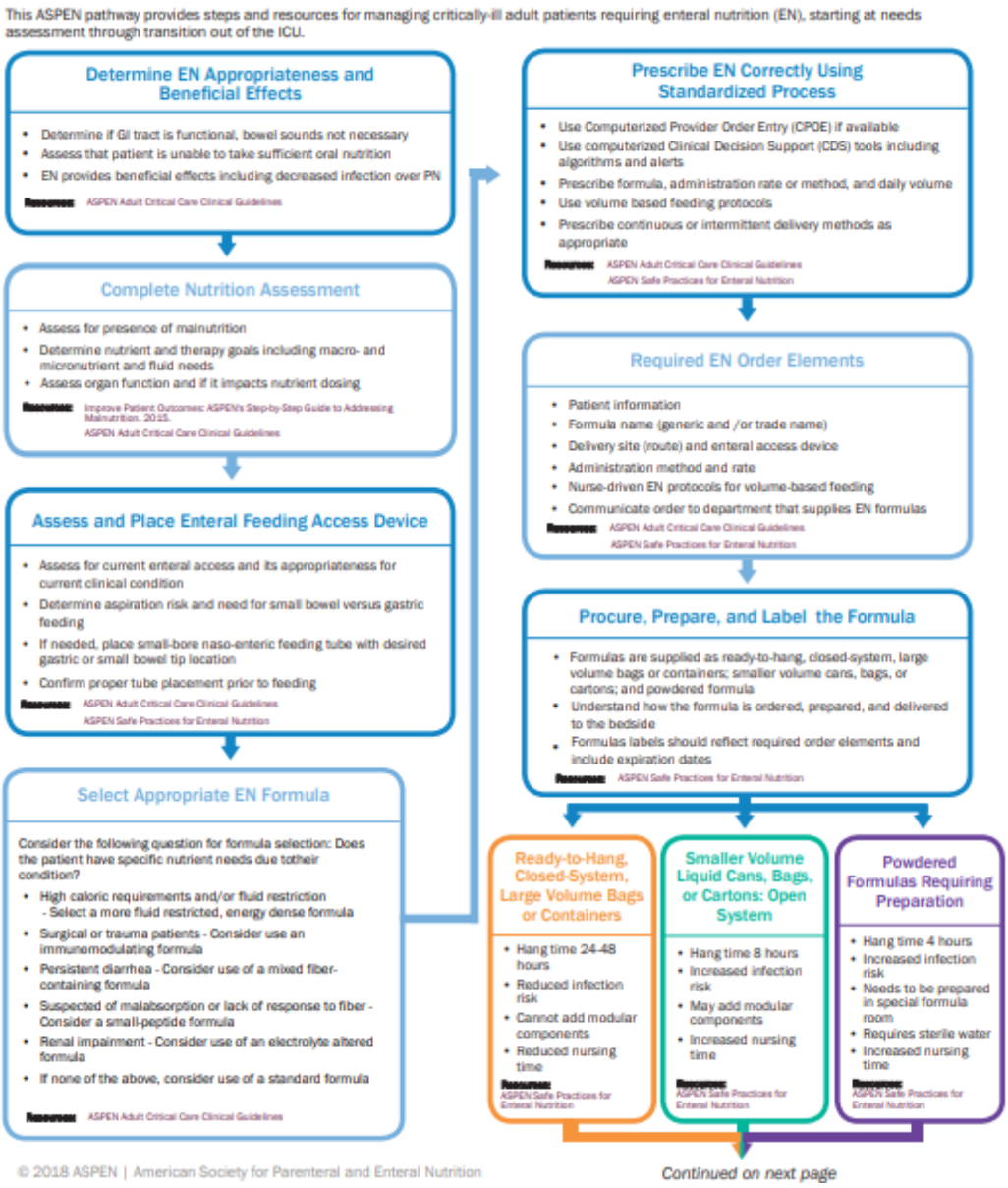
Product	Nutrient Values per	Kcal	Pro (g)	CHO (g)	Fat (g)	Fiber (g)	Osmolality (mOsm/kg)	Na/K (mg)	Ca/Phos (mg)	% Water	mL to meet 100% DRIs	Features / Usage (all are GF and LF)
Boost Kid Essentials	237mL	240	7	32	9	0	550	130/ 270	300/ 210	84%	1-8yo: 1000mL 9-13yo: 1500mL	Low-residue; Kosher
Boost Kid Essential 1.5	237mL	360	10	39	18	0	390	165/ 310	350/ 300	72%	1-8yo: 750mL 9-13yo: 1000mL	Low-residue; Kosher
Pediasure w/ Fiber	237mL	240	7	33	9	3	480	90/ 350	250/ 200	84%	n/a	Kosher; Halal
Pediaure 1.5	237mL	350	14	38	16	0	370	90/ 390	350/ 250	78%	1-8yo: 1000mL 9-13yo: 1500mL	Low-residue; Kosher; Halal

Infant Breastmilk / Formulas *(Nutrient values per 100kcal)*

USAG E	Product	Pro (g)	CHO (g)	Fat (g)	Na (mg)	K (mg)	Ca (mg)	Phos (mg)	Fe (mg)	Vit A (IU)	Vit D (IU)	Osmolality (mOsm/kg)	Features / Usage / Comments
general	Term Human Milk	1.5	10.3	6.1 - 6.6	24	75	41	21	0.05	284 - 310	3	286	Preferred feeding; AAP recs all infants get ≥400IU vit D w/in a few days of birth
	Enfamil Infant	2	11.2	5.3	27	108	78	43	1.8	300	60	300	Milk-based; 60:40 whey-casein
	*Similac Advance (19 or 20kcal/oz)	2.07	10.7	5.6	25	110	82	44	1.9	300	75	310	Contains DHA; Kosher; Halal *Scoop size differs*
Dairy	Similac PM 60/40	2.2	10.2	5.6	24	80	56	28	0.7	300	60	280	60:40 whey-casein; Low mineral content; Kosher; Halal

sen													
GI intolerance	Gerber Good Start GentlePro	2.2	11.6	5.1	27	108	67	38	1.5	300	60	250	Partially hydrolyzed formula
	Enfamil Gentlease	2.3	10.8	5.3	36	108	82	46	1.8	300	60	230	Partially hydrolyzed formula; 60:40 whey-casein; Contains DHA and choline
	*Similac Soy Isomil (19 or 20kcal/oz)	2.45	10.4	5.46	46	110	110	79	1.9	300	60	200	Soy protein isolate; Contains DHA; Kosher; Halal; **Scoop size differs*
allergies	Nutramigen Enflora w/ LGG	2.8	10.3	5.3	47	110	94	52	1.8	300	50	260	Extensively hydrolyzed casein; hypoallergenic; Contains DHA
	Pregestimil	2.8	10.2	5.6	47	110	94	52	1.8	350	50	290	55% MCT; Extensively hydrolyzed casein; Hypoallergenic; Contains DHA
Severe malnutrition	Neocate Infant DHA/ARA	2.8	10.8	5.1	39.1	109	116	82.2	1.5	280	72.9	375	Elemental formula; Dairy-free; Contains DHA; Kosher; Halal

Enteral Nutrition Care Pathway for Critically Ill Adult Patients



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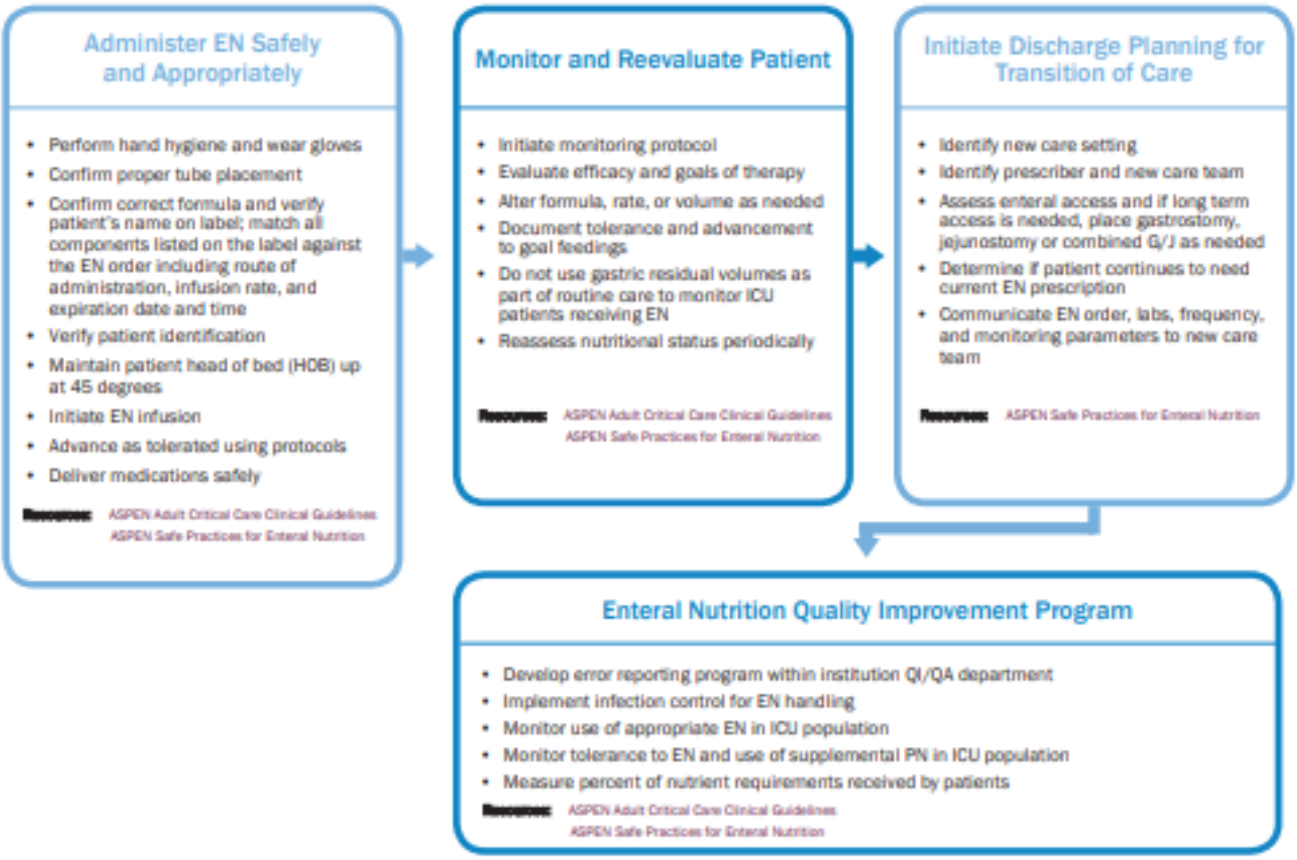

To view an interactive, online version of the pathway, visit nutritioncare.org/ENPathway.

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Pathway development supported by: Abbott

TF Calculation Worksheet

Tube Feed Calculation Worksheet

Continuous EN Regimen

To complete the worksheet below, you will first need to know or calculate your **patient's fluid needs** (expressed as ml/d) as well as the **kcals needed from TFs**.

1. Determine how many ml formula will be provided. First, divide the tube feeding kcal goal by the kcal/ml of the formula.

   _____ kcals from EN ÷ _____ kcal/mL in formula = _____ mL/d of formula

2. For a *continuous* regimen, determine the mL/hr you will give by dividing the mL/d of formula by the number of hrs you will give the feeds.

   _____ mL/d of formula ÷ _____ hrs = _____ mL/hr of formula

3. To determine the *exact provision* for your formula, round the ml/hr calculated above to the nearest whole number then recalculate the total volume.

   _____ mL/hr (rounded) x _____ hrs = _____ mL/d of formula

4. Determine the *actual* nutrients the tube feeding will provide:

   Kcal: _____ mL/d of formula x _____ calories/ml of formula = _____ kcals

   Pro: _____ mL/d of formula ÷ 1000 = _____ L x ____ g pro/L of formula = _____ g pro

   Fluid: _____mL/d of formula ÷ 1000 = ____L x _____mL H2O/L of formula = _____mL

5. Determine *additional* fluid required:

   _____ mL/d fluid needs – _____ mL of water in formula =

   _____ mL/d of additional free water needed

6. When finished, write out the complete regimen as follows:

   Rec TF regimen of _____ at _____ mL/hr which provides _____ kcal/d, _____ g pro/d, and _____ mL/d free water/d.

   Regimen meets _____ % est kcal needs and _____ % est pro needs.

   In addition, rec give an additional _____ mL/d of water to meet fluid needs.

   Total fluids (TFs + water) gives _____ mL/d which meets _____ % est fluid needs.

Bolus EN Regimen

To complete the worksheet below, you will first need to know or calculate your **patient's fluid needs** (expressed as ml/d) as well as the **kcals needed from TFs**.

1. Determine how many ml formula will be provided. First, divide the tube feeding kcal goal by the kcal/ml of the formula.

   _____ kcals from EN ÷ _____ kcal/mL in formula = _____ mL/d of formula

2. For a *bolus* regimen, determine the mL per feed you will give by dividing the mL/d of formula by the number of feedings you will provide (usually 3-5).

   _____ mL/d of formula ÷ _____ # of feeds = _____ mL per feed of formula

3. To determine the *exact provision* for your formula, round the ml per feed calculated above to the nearest whole number then recalculate the total volume.

   _____ mL per feed (rounded) x _____ # of feeds = _____ mL/d of formula

4. Determine the *actual* nutrients the tube feeding will provide:

   Kcal: _____ mL/d of formula x _____ calories/ml of formula = _____ kcals

   Pro: _____ mL/d of formula ÷ 1000 = _____ L x _____ g pro/L of formula = _____ g pro

Fluid: _____mL/d of formula ÷ 1000 = ____L x _____mL H2O/L of formula = _____mL

5. Determine *additional* fluid required:

   _____ mL/d fluid needs – _____ mL of water in formula =

   _____ mL/d of additional free water needed

6. When finished, write out the complete regimen as follows:

   Rec TF regimen of _____ at _____ mL _____ x per day which provides _____ kcal/d, _____ g pro/d, and _____ mL/d free water/d.

   Regimen meets _____ % est kcal needs and _____ % est pro needs.

   In addition, rec give an additional _____ mL/d of water to meet fluid needs.

   Total fluids (TFs + water) gives _____ mL/d which meets _____ % est fluid needs.

Tube Feed Calculation Practice

Example #1

Directions: Calculate a continuous regimen for the following patient using the provided formula.

Formula: 2 kcal/mL, 80g pro/L, 700mL water/L

Female patient:

Anthros: Ht: 165cm Wt: 52kg

Est'd Needs:

- Energy goal: 1630 kcal/d
- Pro goal: 62g/d
- Fluid goal: 1560mL/d

Calculate rate:

___1630_____ kcals from EN ÷ __2_____ kcal/mL in formula = ____815_____ mL/d of formula

___815_____ mL/d of formula ÷ _____24___ hrs = 33.95=34_____ mL/hr of formula

_____34____ mL/hr (rounded) x _____24___ hrs = _____816_____ mL/d of formula

Kcal, pro & fluid tube feeding provides:

Kcal: ___816_____ mL/d of formula x ___2_____ calories/ml of formula = _____1632_____ kcals

Pro: ___816____ mL/d of formula ÷ 1000 = ___.816_____ L x ___80___ g pro/L of formula = ____65__ g pro

Fluid: __816_____mL/d of formula ÷ 1000 = _____.816____L x __700____mL H2O/L of formula = ___571___mL

To get the required amount of water, add the rest to flush the tube feed.

____1560_____ mL/d fluid needs – _____571_____ mL of water in formula =

_____989_____ mL/d of additional free water needed

Rec TF regimen of _____formula 2.0 kcal/mL_____ at

___34_____ ml/hr x ___24____ hrs which provides _____1632_____ kcal/d,

____65_____ g pro/d, and _____571_____ ml/d free water/d.

Regimen meets ____100_____ % est kcal needs and ___105_____ % est pro needs.

In addition, rec give an additional _____989_____ ml/d of water flushes to meet fluid needs. Total fluids (TFs + water) gives ____1560_____ ml/d which meets

_____100_____ % est fluid needs.

1. Name the formula
2. Rate- how much for how long
3. Kcals, pro and free water
4. Put into %
5. Free water flush tube

Case #1

Directions: Determine the appropriate amount of TF for the following patient.

Formula: Nutren 1.0

Female patient: Ht: 66" Wt: 110lbs Age: 45

Determine the following:

1. Total energy needs (BEE = 1162 kcal/d) using a stress factor of 1.5:
    a. 1162*1.5= 1743 kcal
2. Protein needs using a factor of 1.3g pro/kg wt
    a. 110#/2.2= 50 kg * 1.3g pro= 65 g pro
3. Fluid needs using Holliday-Segar method:
    a. 1500-20kg, 30kg * 20mL= 2100mL

4. Calculate a continuous TF regimen (use the space below):

    a. Nutren 1.0= 1000 kcal/L, 40g pro/L, 844 mL/L

    b. 1743 kcal/ 1 kcal= 1743 mL nutren 1.0

    c. 1743 mL/ 24 hr= 72.6 mL/hr= 73mL/hr

    d. 73mL/ hr *24 hr= 1752 mL /1000= 1.752 L

    e. 1752 mL * 1 kcal/mL = 1752 kcal

    f. 1.752 L * 40g/L= 70g pro

    g. 1.752 L * 844 mL/L= 1479 mL H2O (HAVE)

    h. 2100-1479= 621 mL H2O (NEED)

5. Write out the complete regimen as follows:

Rec TF regimen of Nutren 1.0 at ___73_____ ml/hr which provides _____1752_____ kcal/d, _____70_____ g pro/d, and _____1479_____ ml/d free water/d.

Regimen meets _____100____ % est kcal needs and ____108_____ % est pro needs.

In addition, rec give an additional _____621_____ ml/d of water to meet fluid needs.

Total fluids (TFs + water) gives _____2100_____ ml/d which meets ____100_____ % est fluid needs.

Case #2

Directions: Determine the appropriate amount of TF for the following patient.

Formula: TwoCal HN

Male patient: Ht: 69” Wt: 145lbs Age: 32

Determine the following:

1. Total energy needs (BEE = 1600 kcal/d) using a stress factor of 1.4:

    a. 2240

2. Protein needs using a factor of 1.3:
    a. 145#/2.2=66 * 1.3= 85.68= 86
3. Fluid needs using Holliday-Segar method:
    a. 1500+ 700= 2200
    b. 2414
4. Calculate a TF regimen over 18 hrs (cycled) (use the space below):
    a. TwoCal HN 2000 kcal, 83.5 g pro, 700 mL H2O
    b. 2240/ 2= 1120
    c. 1120/18= 62.2 mL/ hr
    d. 62 * 18=1116 /1000= 1.116 L
    e. KCALS: 1116*2=2232
    f. PRO: 1.116 * 83.5= 93
    g. H2O: 1.116* 700= 781
    h. 2200-781= 1419
5. Write out the complete regimen as follows:

Rec TF regimen of TwoCal HN at _____62_____ mL/hr x 18hrs which provides ____2232_____ kcal/d, _____93_____ g pro/d, and _____781_____ mL/d free water/d.

Regimen meets ___112_____ % est kcal needs and ____111_____ % est pro needs.

In addition, rec give an additional _____1419_____ mL/d of water to meet fluid needs.

Total fluids (TFs + water) gives ____2200_____ mL/d which meets _____100_____ % est fluid needs.

Additional Calculations

Directions: Use the label provided to determine the amount of calories, protein and fluid provided from the following regimens.

Peptamen 1.5 @ 94mL/hr
94ml.hr * 24hr= 2256ml/1000=2.26
Kcal: 2.26 *1.5=3384
Pro: 2.26*68=153.7
Fluid 2.26* 772=1745

Nutrition Information (Vanilla)		250 mL (1 Carton)	1000 mL
Calories	kcal	375	1500
Total Fat*	g	14	56
Sodium	mg (mEq)	260 (11.3)	1040 (45.2)
Potassium	mg (mEq)	470 (12)	1880 (48)
Total Carbohydrate	g	47	188
Protein	g	17	68
Vitamin A			
Retinol	mcg	300	1200
ß-Carotene	mcg	360	1440
Vitamin C	mg	130	520
Calcium	mg	250	1000
Iron	mg	6.7	26.8
Vitamin D	mcg	5	20
Vitamin E	mg	7.6	30.4
Vitamin K	mcg	30	120
Thiamin	mg	0.75	3
Riboflavin	mg	0.9	3.6
Niacin	mg	10.5	42
Vitamin B_6	mg	1.5	6
Folic Acid	mcg	200	800
Vitamin B_{12}	mcg	3	12
Biotin	mcg	150	600
Pantothenic Acid	mg	5.3	21.2
Phosphorus	mg	250	1000
Iodine	mcg	56	224
Magnesium	mg	100	400
Zinc	mg	9	36
Selenium	mcg	19	76
Copper	mg	0.75	3
Manganese	mg	1	4
Chromium	mcg	15	60
Molybdenum	mcg	45	180
Chloride	mg (mEq)	435 (12.3)	1740 (49)
L-Carnitine	mg	37.5	150
Taurine	mg	37.5	150
Choline	mg	170	680
Water	mL	192	768

*MCT provides 10 g/250 mL and 40 g/1000 mL

Peptamen 1.5	1L	1500	68	188	56	0	585	880/ 2080	1000/ 1000	772	1000

Parenteral Nutrition

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Parenteral Nutrition Basics for the Clinician Caring for the Adult Patient

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Abstract

Parenteral nutrition (PN) is a life-sustaining therapy providing nutrients to individuals with impaired intestinal tract function and enteral access challenges. It is one of the most complex prescriptions written routinely in the hospital and home care settings. This article is to aid the nutrition support clinician in the safe provision of PN, including selecting appropriate patients for PN, vascular access, development of a PN admixture, appropriate therapy monitoring, recognition of preparation options, and awareness of preparation and stability concerns. (*Nutr Clin Pract*.XXXX;xx:xx-xx)

Keywords

nutritional support; parenteral nutrition solutions; central venous catheters; vascular access devices

Nutrition support of the adult patient with parenteral nutrition (PN) has advanced dramatically since its development and clinical introduction over 50 years ago.[1] A complex therapy with nearly 40 different components, PN requires careful patient selection, timing of initiation, individualized therapeutic dosing, and appropriate monitoring to maximize therapy benefits and minimize risks.[2] Furthermore, ordering practices vary between institutions and patient types (eg, neonate, pediatric, adult). Recent PN guidelines highlight education as an opportunity to improve safety and efficacy of PN.[3] Individuals involved in prescribing and monitoring PN should be confident in their knowledge of PN, including indications, vascular access, admixture design and delivery, and PN-associated complications.[2,3] This article is intended to provide an overview of PN admixtures, including implementation and management strategies to assist the nutrition support clinician with safe and effective use of PN in the adult patient. While key to safe PN utilization, neither PN order entry nor PN review and verification processes will be covered in this article. The reader is directed to the American Society for Parenteral and Enteral Nutrition (ASPEN) PN resources page available at www.nutritioncare.org for additional information.

Indications

PN is traditionally indicated when an individual cannot be fed enterally. However, there are circumstances when infusion of nutrition intravenously may be more appropriate or required to provide adequate nutrients. The decision to initiate PN and the timing of initiation is often multifactorial and requires incorporation of elements such as the patient's desires, attitude toward the therapy, overall prognosis, nutrition status, and subjective quality of life. Incorporation of this information should provide clarity as to the purpose and goals of therapy. Patient desires, prognosis, and subjective quality of life often change with treatment duration and course of disease. Therefore, the indication for PN should be periodically reassessed.

Vascular Access

PN as well as other intravenous (IV) medications influence vascular access-type selection. Other factors to consider include expected duration of therapy, frequency of therapy (daily vs intermittent), patient activity level and lifestyle, surgical history of the head and neck, psychosocial issues, and ability to care for the device.[4] Prior to initiation of PN, it is important to evaluate a patient's vascular access type, tip location, and insertion site to ensure safe delivery of the preparation. Table 1 describes common IV access used for infusions of PN admixtures and briefly discusses advantages and disadvantages as well as limitations to each device.[4]

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Table 1. Vascular Access Devices.[4]

Catheter Type	Placement	Advantages	Disadvantages
Central access	Jugular, femoral, subclavian		
Percutaneous nontunneled central catheter		Economical, easily removable, can be replaced over guidewire, useful in acute care and shortduration therapies	Catheter breakage not repairable, patient self-care difficult, requires sutures to prevent dislodgment, high risk for catheter-related infection, not recommended for home care
Tunneled cuffed catheters	Percutaneous placement via subclavian or jugular vessel; cephalic, jugular vein cutdown	Long-term usage, home care, dressings and sutures can be removed after 1 month, self-care easy, repair kit available	Operating room or specialized room for placement, requires small procedure for removal
Peripherally inserted central catheter (PICC) nontunneled	Percutaneous placement via a peripheral vein	Used in acute and home care for therapies ranging from several weeks to months, low risk of placement complications, placement occurs anywhere from radiology suite to patient bedside	Self-care may be difficult with antecubital placement because dressing changes require both hands, repair kits may not be available
Implanted ports	Percutaneous venous placement via subclavian, jugular, or peripheral vessels	Used for long-term therapies, site care only when accessed, monthly heparin flush, body image intact, no external segment for breakage	Needle access required, needle dislodgement can result in infiltration, placement in operating room or specialized room, surgical procedure for removal
Peripheral access Peripheral catheters	Percutaneous peripheral insertion	Least expensive, least risk for catheter-related infections, no special placement room, clinicians are easily trained in placement	Requires site rotation every 48–72 hours, not appropriate to infuse preparations >400–600 mOsm/L, concentrated antibiotics, and vesicants
Midline catheters	Percutaneous peripheral insertion	Used for therapies lasting 2–4 weeks	Not appropriate for infusions requiring central access, including PN with >900 mOsm/L
Midclavicular catheters	Percutaneous peripheral insertion	Used for therapies 2–3 months	Not appropriate for infusions requiring central access, including PN with >900 mOsm/L

PN, parenteral nutrition. Reprinted with permission from Krzywda EA, Andris DA, Edmiston CE. Parenteral access devices. In Mueller C, ed. *The A.S.P.E.N. Nutrition Support Core Curriculum: A Case-Based Approach: The Adult Patient*. Silver Spring, MD: ASPEN; 2012:269.

Formula Design

Assessing Energy and Protein Requirements

Components used in PN typically include protein as amino acids (AAs) and energy substrates as carbohydrates and fat, as well as electrolytes, vitamins, trace elements, minerals, and water. Careful consideration of patient-specific needs, including age, body habitus, nutrient requirements to support physical activity and maintain a healthy body mass index (BMI), and conditionspecific concerns (wounds, infection, critical illness, and kidney or liver dysfunction), needs to be incorporated into determining energy and protein requirements.[5–7] The most accurate way to predict metabolic needs is through indirect calorimetry, but use is limited by availability and cost. Many published predictive equations estimate energy and protein requirements based on different factors listed above and range from 40%–75% in accuracy compared with indirect calorimetry. A weight-based approach provides simplicity over predictive equations with calories ranging from 20–35 kcal/kg/d and protein from 0.8–2.5 g/kg/d (see Table 2).[5,7–12]

Recently new approaches to macronutrient dosing have emerged and include strategies such as permissive underfeeding, hypocaloric high-protein feeding, and supplemental PN. Permissive underfeeding, used primarily in critically ill patients, provides less energy than estimated to prevent complications such as hyperglycemia and electrolyte derangements. This strategy has been associated with fewer infectious complications and reduced hospital mortality.[7,9] Hypocaloric high-protein feeding, studied in critically ill obese patients, provides a caloric deficit with adequate protein supplementation and has been shown to be as efficacious as eucaloric feeding. This strategy may decrease hospital length of stay, multiple-organ failure, and number of hyperglycemic episodes per day.[10–11,13] Supplemental PN, whether early (1–7 days after intensive care unit [ICU] admission) or late (>7 days of ICU admission), is used when full enteral feeding is not possible or inadequate to meet caloric target. A morbidity and mortality benefit as well as timing of supplemental PN remains a controversy.[14–18]

Table 2. Approximate Adult Daily Energy and Protein Requirements.[5,7–12]

Patient Type	Energy, kcal/kg[a,b]	Protein, g/kg
Well nourished, healthy, maintenance	20–25	0.8–1
Critically ill, metabolic stress, trauma, undernourished	25–30 (up to 35 in certain cases)	1.2–2 (up to 2.5 in certain cases)
Critically ill obese (BMI t30)[c]	11–14 of ABW or 22–25 of IBW	BMI 30–40, t2 of IBW BMI >40, t2.5 of IBW
Acute renal failure, chronic kidney disease	25–30 (up to 35 in certain cases)	ND, 0.8–1.2 HD, 1.2–1.5 (may need to adjust based on frequency of dialysis) CRRT, 1.5–2.5 PD, 1.2–1.4

ABW, actual body weight; BMI, body mass index; CRRT, continuous renal replacement therapy; HD, hemodialysis; IBW, ideal body weight; ND, nondialysis; PD, peritoneal dialysis.
[a]Predictive equations may also be used to estimate needs. [b]If available goals may be directed by indirect calorimetry. [c]Hypocaloric feeding is not appropriate for patients with impaired renal or hepatic function. Published data are limited on use of hypocaloric feeds as a long-term dosing strategy or use in the non–critically ill patient.

Macronutrients

Protein

Aiding in formation and repair of body structures such as skin, tendons, membranes, muscles, organs and bones, proteins are an important component of the human body's mass and structure.

In PN, a mixture of crystalline AAs is used to provide protein and, if oxidized for energy, yields 4 kcal/g. Standard AAs are a mixture of essential and nonessential amino acids that are commercially available from a variety of manufacturers.[19] Specialized or modified AA preparations also available are specifically formulated to meet the needs of disease or specific AA requirements in adults.[20,21] These products can be more costly with controversial clinical benefit over protein dose modification using standard AA preparations. Table 3 details a comparison of the various AA preparations available.[19–24] While preparations are therapeutic equivalents, they are not generic equivalents due to different buffering electrolytes and pHs, which can affect compatibility.

Carbohydrates

Carbohydrates, the primary energy source in the human body, provide approximately 45%–65% of daily energy requirements. Stored as glycogen in the liver

and muscle, it is a vital energy source for the brain and other cells in the body to function properly.

In PN, the carbohydrate substrate used is dextrose monohydrate. It often makes up about 60% of total kcal/d or approximately 70%–85% of nonprotein calories in the preparation.[5,25] An acidic solution with a pH of 4.0 (3.2–6.5), dextrose provides 3.4 kcal/g and is commercially available from a variety of pharmaceutical manufacturers.[19,20] Available only in one commercially prepared premixed peripheral PN preparation, glycerin (also called glycerol), a sugar alcohol, can alternatively be used as a carbohydrate source providing 4.3 kcal/g. This preparation has been reported to induce less hyperglycemia than dextrose-containing preparations.[19,20]

IV Fat Emulsion

Fatty acids aid structural integrity and fluidity of cell membranes and affect cell signaling pathways such as apoptosis, inflammation, and cell-mediated immune responses.[26] Classified by hydrocarbon chain length (short, medium, long), number of double bonds (saturation), and location of those double bonds, fatty acids are a calorie-dense form of energy for the body. Providing about 15%–30% of nonprotein calories in a PN admixture, it serves as a source to prevent essential fatty acid deficiency (EFAD).[5] Using this calorie-dense macronutrient as part of a "mixed-fuel" system can reduce infusion rates and total dextrose needed in PN, improve metabolic tolerance, and prevent complications compared with fat-free PN admixtures (see Metabolic Complications of PN section).

In the United States, long-chain triglycerides (LCTs) are commercially available in the form of soybean oil (Intralipid [Fresenius Kabi, Mississauga, Canada], Nutralipid [B. Braun

Medical, Bethlehem, PA], Liposyn III [Hospira, Lake Forest, IL]) and not yet to the market a combination of olive oil/soybean oil (Clinolipid; Baxter International, Deerfield, IL), which are summarized in Table 4.[27–30] Ranging in concentrations from 10%–30%, these oil-in-water emulsions also contain egg phospholipids as an emulsifier and glycerin to adjust osmolality.[19,20] Glycerin also adds caloric content to the IV fat emulsion (IVFE) and varies depending on concentration of the fat emulsion. A 10% emulsion provides 1.1 kcal/mL in

Table 3. Common Commercially Available Crystalline Amino Acids.[19–24]

Type	Manufacturer	Name	pH	Strengths, %	Intrinsic Additives, per g AA
Standard	Hospira	Aminosyn	5.2 (4.5–6.0)	8.5[a]	0.41 mEq Chloride 1.06 mEq Acetate
				10	1.47 mEq Acetate
		Aminosyn II	5.8 (5.0–6.5)	10	0.38 mEq Na^{2+} 0.72 mEq Acetate
				15	0.34 mEq Na^{2+} 0.72 mEq Acetate
	Baxter	Travasol	6.0 (5.0–7.0)	10	0.4 mEq Chloride 0.88 mEq Acetate
		Clinisol	6.0 (5.0–7.0)	15	0.85 mEq Acetate
		Prosol	6.0 (5.5–6.5)	20	0.7 mEq Acetate
	B. Braun	FreAmine III	6.5 (6.0–7.0)	10	0.1 mMol PO_4 <0.03 mEq Chloride 0.1 mEq Na^{2+} 0.89 mEq Acetate
		PlenAmine	5.6 (5.2–6.0)	15	1.01 mEq Acetate
Stress	Hospira	Aminosyn HBC[b]	5.2 (4.5–6.0)	7	1.01 mEq Acetate
	B. Braun	FreAmine HBC[b]	6.5 (6.0–7.0)	6.9	<0.04 mEq Chloride 0.14 mEq Na^{2+} 0.86 mEq Acetate
Liver failure	B. Braun	HepatAmine[c]	6.5 (6.0–6.8)	8	0.1 mMol PO_4 <0.04 mEq Chloride 0.13 mEq Na^{2+} 0.78 mEq Acetate
Renal failure	Hospira	Aminosyn RF[d]	5.2 (4.5–6.0)	5.2	2.17 mEq Acetate
	B. Braun	NephrAmine[e]	6.5 (6.0–7.0)	5.4	<0.06 mEq Chloride 0.09 mEq Na^{2+} 0.81 mEq Acetate

AA, amino acid; Na^{2+}, sodium; PO_4, phosphate. [a]Manufactured with and without electrolytes.[4] [b]Contains high concentrations of the branched-chain AAs isoleucine, leucine, and valine relative to standard preparations. [c]Contains high concentrations of the branched-chain AAs isoleucine, leucine, and valine, as well as low concentrations of methionine and the aromatic AAs phenylalanine and tryptophan relative to standard preparations. [d]Contains essential AAs plus arginine. [e]Contains essential AAs only.

comparison to a 20% emulsion, which provides 2 kcal/mL, and a 30% emulsion providing 2.9–3 kcal/mL.[28–30] Europe has additional products, including a fish oil–based IVFE (Omegaven; Fresenius Kabi, Bad Homburg, Germany) containing only ω-3 fatty acid as well as IVFE blends containing medium-chain triglycerides (MCTs) (Lipoplus [B. Braun, Melsungen, Germany], SMOFLipid [Fresenius Kabi, Bad Homburg, Germany], Structolipid [Fresenius Kabi, Bad Homburg, Germany], Lipofundin-MCT [B. Braun, Melsungen, Germany]), which are oxidized faster than LCT.[20,26,31]

Soybean oil, a mixture of ω-6 and ω-3 polyunsaturated fatty acids, contains a larger number of double bonds, the target for lipid peroxidation, leading to an increase in oxidative stress. In addition, ω-6 is metabolized to arachidonic acid, leading to proinflammatory eicosanoids such as prostaglandins, thromboxanes, and leukotrienes. Due to these mechanisms, soybean oil–based IVFE has been

Table 4. Food and Drug Administration Approved Intravenous Fat Emulsion Products.[27–30]

Name	Manufacturer	Populations Approved for Use	Strength(s) Available, %	pH	Fat Source	Major Fatty Acid Components, % Range	Osmolality, mOsm/kg Water
Clinolipid[a]	Baxter	Adults only	20	6.0–9.0	4:1 (olive/soy)[b]	Linoleic[c] (13.8–22) Oleic[d] (44.3–79.5) Palmitic (7.6–19.3) Linolenic[e] (0.5–4.2) Stearic (0.7–5)	340
Intralipid	Fresenius Kabi	Preterm infant Pediatrics Adults	10 20 30[f]	8.0 (6.0–8.9)	Soybean oil	Linoleic[c] (44–62) Oleic[d] (19–30) Palmitic (7–14) Linolenic[e] (4–11) Stearic (1.4–5.5)	300–350
Nutrilipid	B. Braun	Preterm infant Pediatrics Adults	20	6.8 (6.0–8.9)	Soybean oil	Linoleic[c] (48–58) Oleic[d] (17–30) Palmitic (9–13) Linolenic[e] (4–11) Stearic (2.5–5)	390
Liposyn III	Hospira	Preterm infant Pediatrics Adults	10 20 30[f]	8.3 (6.0–9.0) 8.3 (6.0–9.0)	Soybean oil	Linoleic[c] (54.5) Oleic[d] (22.4) Palmitic (10.5) Linolenic[e] (8.3) Stearic (4.2)	284

[a]Not on the market at the time of this publication.

[b]Olive oil contains significant amounts of α-tocopherol that contributes to vitamin E status.

[c]ω-6. [d]ω-9. [e]ω-3. [f]Thirty percent preparation is only approved for compounding purposes.

associated with adverse immunological effects and proinflammatory properties.[31–33]

The 2016 joint guidelines by ASPEN and the Society of Critical Care Medicine (SCCM) suggest no soybean oil– based IVFE be administered during the first week following the initiation of PN in critically ill patients and to a maximum of 100 g/wk if there is concern for EFAD due to the possibility of immunosuppression (quality of evidence: very low).[7] This recommendation is based primarily from a study by Battistella et al[34] conducted nearly 20 years ago in a small study population of 60 trauma patients. Well-designed clinical trials are needed to determine the impact on immune response and overall risk of IVFE in the critically ill patient.[7,34,35]

Olive oil, a monounsaturated fatty acid containing ω-9 fatty acids, has one double bond and is less susceptible to lipid peroxidation than soybean oil.[26,36] The Food and Drug Administration (FDA)–approved product in the United States is an olive oil/soybean oil–based IVFE in a 4:1 ratio (Clinolipid) but, at the time of this publication, is not yet available on the market. When studied against soybean oil–based products, it has shown less impact on neutrophil function, lymphocyte proliferation, and interleukin-2 production in vitro and in vivo as well as shorter mechanical ventilation time and ICU length of stay.[37–40] In contrast, 2 studies found no difference in length of stay, mortality, nosocomial infection, or inflammatory and oxidative stress markers between patients. These studies did find an increase in systolic blood pressure and impaired endothelial function in

patients receiving soybean oil compared with olive oil.[41,42] Aforementioned studies are limited by the heterogeneity of study design, population, and specific IVFE. Mixed olive oil/soybean oil–based IVFE may be beneficial in populations where immunological and inflammatory effects may be detrimental to outcomes such as critically ill, severely burned, or immunocompromised patients.

Electrolytes

Electrolyte requirements for an adult receiving PN vary depending on anticipated patient requirements, nutrition status, presence of organ dysfunction, and underlying disease states. In addition, ongoing losses, medications, and fluid or electrolyte shifts can also necessitate electrolyte dose changes to the PN admixture. As an example, potassium, phosphate, and magnesium may need to be dosed more conservatively in renal dysfunction because of impaired excretion.[5] See Table 5 for suggested daily maintenance and maximum electrolyte PN additions for adults.

Table 5. Suggested Intravenous Electrolyte Doses for Adults.[5,25]

Electrolyte	Maintenance Range[a]	Intake Maximums[b,c]
Sodium	1–2 mEq/kg/d	150 mEq/L
Potassium	1–2 mEq/kg/d	240 mEq/d
Calcium	10–15 mEq/d	25 mEq/d
Magnesium	8–20 mEq/d	48 mEq/d
Phosphate	20–40 mmol/d	60 mmol/d
Chloride/acetate	Change to maintain acid base balance	

[a]These requirements are based on healthy people with normal losses.
[b]Suggested maximums may vary depending a facility policies. Compounding limitations may not allow for additions at maximum threshold.
[c]Intake maximums are to be used as a guide to help the practitioner with safe electrolyte dosing and avoid potential error but should not supersede clinical judgment.

Typically to maintain acid base balance, the chloride and acetate are used in equal amounts, but adjustments can be made depending on acid base status. Often by maximizing the

Table 6. Salt Forms of Electrolytes.[43]

Electrolyte	Salt Form
Sodium	Chloride, acetate, phosphate
Potassium	Chloride, acetate, phosphate
Chloride	Sodium, potassium
Acetate	Sodium, potassium
Phosphate	Sodium, potassium
Magnesium	Sulfate,[a] chloride
Calcium	Gluconate,[a] gluceptate, chloride

[a]Preferred salt form for use in parenteral nutrition admixtures.

amount of acetate in PN, one can avoid exacerbating metabolic acidosis; conversely, maximizing chloride and limiting acetate will reduce the risk of exacerbating a metabolic alkalosis.[5,20] Commercially available AA preparations contain certain electrolytes that need consideration such as acetate, which can affect the patient's acid base status, and phosphate, which can disrupt admixture chemical stability with calcium.[20]

Electrolytes are available in various salt forms (see Table 6) and are manufactured as single salts or as combination products. They can also come included in certain stock AA preparations as well as commercially available PN admixtures. Certain salts are preferred for use in PN admixture because they are less likely to cause incompatibilities compared with alternative salts such as calcium chloride, calcium gluceptate, and magnesium chloride.

While there is no "one size fits all" approach to dosing electrolytes in PN, guidelines recommend that electrolytes shall be ordered as the complete salt form vs the individual ion and as amount per day or amount per kilogram per day.[44] We suggest that practitioners new to ordering electrolytes in PN develop a systematic approach to dosing like the example in Figure 1.

Vitamins

Essential to maintain fundamental functions of the body, including growth, metabolism, and cellular integrity, vitamins are organic substances that are unable to be synthesized by the human body and necessary additions to PN. Commercially available products for use in adult PN preparations include single-vitamin products and multivitamin products with both fatsoluble and water-soluble vitamins. Parenteral fat-soluble vitamin daily dose in multivitamin products is approximately the same as the oral recommended daily allowance (RDA). Watersoluble vitamins in parenteral doses are 2.5–5 times greater than oral RDA.[45–48] Rationale for the increased requirements over oral RDA includes increased needs secondary to malnutrition, presence of baseline vitamin deficiencies, and metabolic changes secondary to acute and chronic illness. Additional rationale specific to water-soluble parenteral vitamins is the increased urinary vitamin losses compared with oral administration.[48] Table 7 provides the composition of commercially available parenteral multivitamin products in the United States for adults. Experts have raised concern as to whether the daily dose of 200 International Units per day of vitamin D is adequate to avoid deficiency in a PN-dependent patient. Furthermore, there is currently no separate parenteral ergocalciferol or cholecalciferol product commercially available to supplement a patient who is vitamin D deficient and either is unable to take or fails to respond to oral vitamin D supplements.[48]

Trace Elements

Trace elements are required for normal metabolism and growth. Commonly used trace elements include copper, manganese, chromium, zinc, selenium, and iron. Trace element (TE) products are available as single-entity products and in various multiple TE combinations and concentrations. Table 8 provides the daily requirement for TEs in adults based on healthy individuals with normal losses and details the doses provided in multi-TE products.

Adult daily copper requirements for the PN patient are 0.3– 0.5 mg. This is 50% less than the dose provided in standard multi-TE products. Since

copper is mainly excreted in the bile, the amount provided in PN should be reduced by 0.15 mg in patients with cholestasis.[48,49] Manganese, also mainly excreted in bile, is provided in multi-TE products in a standard daily dose of 400–800 mcg. This is 4 times the recommended parenteral requirement of 55 mcg daily.[49] Manganese has also been found as a contaminant in PN.[50] Omit copper or manganese in a patient with symptoms of toxicity or with elevated whole-blood concentrations.[49]

Standard multi-TE dose of chromium ranges from 10–12 mcg, which is similar to the recommended daily dose of 10 mcg. Consider an omission or reduction of PN chromium dose in patients with renal failure or elevated serum creatinine due to risk of accumulation.[49] The typical dose of zinc provided in PN of 3–5 mg/d is adequate to meet estimated adult parenteral requirements.[48,49] Zinc has also been found as a contaminant in PN at approximately 1.1 mg/2L.[50] Selenium in a dose of 60 mcg is provided in multi-TE products and meets minimal adult recommended requirements. Higher doses may be required to maintain ideal serum concentrations as selenium needs are increased in patients with malnutrition, critical illness, and burn injuries.[48,49]

Other TEs that can be supplemented in PN are molybdenum, iodine, and iron. The most common of these is iron. There are several injectable iron product available on the market, but only iron dextran is approved for addition to PN and should be reserved for addition in IVFE free admixtures secondary to the potential to destabilize an admixture containing IVFE.[31,51] (See Parenteral Nutrient Systems for Delivery section.)

PN Drug Shortage Considerations

In recent years, a multitude of drug shortages in the United States have affected PN compounding. Nearly all components

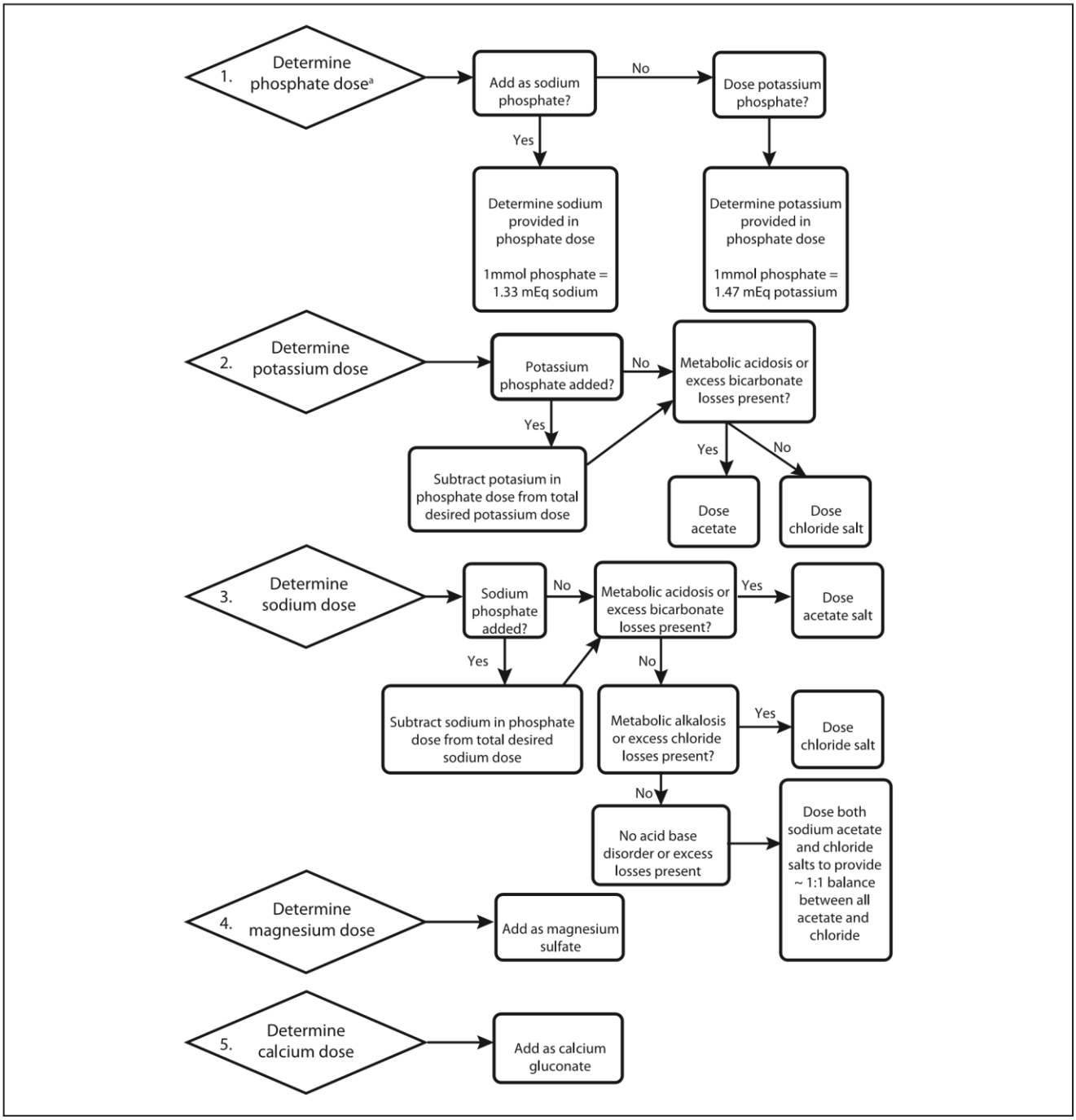

Figure 1. Algorithm for electrolyte dosing in parenteral nutrition.
[a]Compatibility dependent on amino acid preparation used in compounding.

of PN have been in short supply at times over the past 5 years due to a variety of factors, including acquisition of raw materials, manufacturing interruptions, and consolidation of the market. ASPEN has assembled a panel of experts to establish management strategies for shortage situations. Please visit ASPEN Latest News and ASPEN Product Shortage Latest News (http://www.nutritioncare.org) for additional information on product shortages and considerations to assist in management of specific shortage issues. These recommendations are not to be used during routine clinical practice when ample supply is available. Traditional recommended dosing

of PN components should resume after resolution of product shortage.[52]

Table 7. Contents of Parenteral Multivitamin Preparation.[45–48]

Vitamin	Daily Dose (10 mL)
Thiamin (B_1)	6 mg
Riboflavin (B_2)	3.6 mg
Niacinamide (B_3)	40 mg
Folic acid	600 mcg
Dexpanthenol	15 mg
Pyridoxine (B_6)	6 mg
Cyanocobalamin (B_{12})	5 mcg
Biotin	60 mcg
Ascorbic acid (C)	200 mg
Retinol (A)[a]	1 mg (3300 USP units)
Ergocalciferol (D)[a]	5 mcg (200 USP units)
dl-α Tocopheryl acetate (E)[a]	10 mg (10 USP units)
Phylloquinone (K)[a,b]	150 mcg

USP, *United States Pharmacopeia.*

[a]Fat-soluble vitamins.

[b]Available products can be made with or without phylloquinone; if using formulation without phylloquinone, patients may need supplementation.

Table 8. Daily Requirements and Dosage Guideline for Trace Elements in Adults.[5,49]

Trace Element	Recommended Daily Dose	Daily Dose Provided by U.S. Multitrace Products
Copper, mg	0.3–0.5	1–1.2
Manganese, mcg	55–100	300–800
Chromium, mcg	10–12	10–12
Zinc, mg	2.5–5	3–5
Selenium, mcg	60; 100 if deficiency exists	0–60
Iron, mg	1	None

Initiation, Monitoring, and Discontinuation

Rate of PN initiation is determined by multiple factors, including nutrition and clinical status, history of glucose tolerance, and ability to tolerate volume. Protein, having minimal metabolic side effects, generally can be started at or near goal dose.[5,53,54] In general, initial carbohydrate amount should not exceed 150–200 g/d. For patients with diabetes mellitus or at risk for hyperglycemia, limiting initial dextrose to 100–150 g/d has been recommended.[53,55] For patients in whom partial goal feeds are desired on day 1, strategies are outlined in Table 9 for safe initiation, which include limiting initial maximum carbohydrate dose. In most adult patients, goals can be achieved in 2–3 days, and advancement is often based on glycemic control, electrolyte management, and IVFE tolerance.[5,25,53]

Monitoring of PN should include routine evaluation and assessment of clinical condition with the focus on nutrition and metabolic effects of the PN therapy. Serial documentation is helpful to guide adjustments to fluids, electrolytes, and nutrient therapy.[54] See Table 10 for suggested monitoring parameters and frequency.[25,53,54,56,57]

The goal of PN therapy is to return to using the gastrointestinal (GI) tract with oral diet or enteral feeds when possible. Transitional feeding is considered the period between oral diet or enteral nutrition initiation and PN discontinuation. This transition should be planned to avoid potential decline in nutrition status when PN is discontinued. Figure 2 details a suggested approach for transition and discontinuation of PN. For many patients PN may be discontinued as soon as they are able to tolerate a diet that has been advanced past clear liquids. Others may require a more detailed transitional feeding plan. Individuals with significant nutrition compromise such as those with malabsorption syndromes, those with active malignancy, the elderly, and those who are debilitated or require special monitoring are candidates for this more detailed plan.[54]

Metabolic Complications of PN

Hyperglycemia

Hyperglycemia is a common complication of PN therapy. Often multifactorial, risk increases with age, obesity, severity of illness, rate of dextrose infusion, and diabetes mellitus diagnosis. Studies have shown development of PN-associated hyperglycemia independently increases odds of complications during hospitalization and

mortality.[58,59] A multicenter study of 605 non–critically ill patients receiving PN demonstrated patients with mean blood glucose levels >180 mg/dL were 5.6 times more likely to die while hospitalized compared with those with mean blood glucose levels <140 mg/ dL.[60] These observations indicate that prevention and correction of hyperglycemia via modification of nutrient composition, use of insulin therapy, or a combination of both should be strongly considered during PN therapy. Strategies to prevent and manage hyperglycemic excursions include limiting dextrose infusions at rates d4 mg/kg/min or 6 g/kg/d. It is also recommended in diabetes mellitus and critically ill patients to limit, at least initially, dextrose infusions to 2 mg/kg/min or 150 g/d until control of serum glucose is attained. After serum glucose control is achieved (140–180 mg/dL), rates of dextrose infusion can be increased to provide nutrition needs.[55,58] Insulin is the treatment of choice to control hyperglycemia during PN with subcutaneous and IV insulin being effective in management. Treatment with IV continuous insulin infusion is preferred in patients with conditions such as critical illness, hemodynamic compromise, or multifactorial hyperglycemia as it allows for frequent dose adjustments. Another option is directly adding insulin to the PN preparation. It is important to note that regular insulin is the only insulin compatible with PN preparations. Studies have generally used insulin-to-carbohydrate ratios to determine the initial dose. Ratios range from 1 unit per 4 g to 1 unit per 15 g in patients

Table 9. Macronutrient Initiation and Advancement.[5,7,25,53,54]

Macronutrient	Initiation	Approximate Daily Requirements	Recommended Maximum Doses[a]
Dextrose	**General population** 150–200 g/d 15%–20%, g % of admixture **Critically ill/DM/hyperglycemia** 100–150 g/d or 10%–15%, g% of admixture Increase to goal when blood glucose <180 mg/dL	50%–60% of TDC or 70%–85% of NPC **General population** 4.3–7 g/kg/d (3–4.8 mg/kg/min) **Critically ill/DM/hyperglycemia** 2.9–5.8 g/kg/d (2–4 mg/kg/min)	7 g/kg/d
Amino acids	Start near or at goal Caution with serum urea nitrogen >100 mg/dL	10%–20% of TDC Up to 2.5 g/kg/d based on clinical condition	2.5 g/kg/d
Intravenous fat emulsion	Start near or at goal Caution with serum triglycerides t400 mg/dL In critically ill, hold soybean oil–based IVFE during first week following PN initiation, or if there is a concern for EFAD, provide only 100 g/wk, divided into 2 doses	20–40% TDC or 15–30% NPC or 0.5–1 g/kg/d	2.5 g/kg/d in healthy adults or 1.5 g/kg/d in critically ill or 0.11 g/kg/h

DM, diabetes mellitus; EFAD, essential fatty acid deficiency; IVFE, intravenous fat emulsion; NPC, nonprotein calories; total daily calories. [a]Routine use of maximum doses is not recommended. Careful evaluation and close monitoring are

Table 10. Suggested Monitoring for Adults Receiving Parenteral Nutrition.[25,53,54,56,57]

Parameter	Baseline	Initiation	Critically Ill	Stable Inpatient	Stable Home

Serum chemistries (Na, K, Cl, CO_2, serum urea nitrogen, creatinine, ionized calcium,[a] magnesium, phosphorus, serum glucose)	Yes	Daily for 3 consecutive days	Daily	1–2 times per week	Every other week for 1–3 months, then every month and as needed
ALT, AST, ALP, total bilirubin	Yes	Day 1	Weekly	Monthly	Same schedule as serum chemistries
Serum triglycerides	Yes	Day 1	Weekly	Weekly	Every other week for 1–3 months, then monthly, therapy >6 months every 6–12 months
CBC with differential	Yes		Weekly	Weekly	As needed
Weight	Yes	Daily	Daily	2–3 times per week	Daily, same time and same scale until fluid status stable, then weekly to monthly
Intake and output	Yes	Daily	Daily	Daily unless fluid status assessed via physical examination	
INR, PT	Yes	Day 1	Weekly	As needed	As needed
Capillary glucose[b,c]		As needed	Every 1–6 hours	As needed	When ill or at risk of glucose intolerance
Nitrogen balance	As needed		As needed	As needed	As needed

ALP, alkaline phosphatase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; CBC, complete blood count; Cl, chloride; CO_2, bicarbonate or total carbon dioxide; INR, international normalized ratio; K, potassium; Na, sodium; PT, prothrombin time.

[a]When ionized calcium not available, it may be reasonable in non–critically ill patients to calculate a corrected calcium using the Orrell equation: Corrected serum [Ca] (mg/dL) = measured serum [Ca] (mg/dL) + [0.8 × (4 –measured serum albumin (g/dL))].

[b]Monitoring frequency may be adjusted or discontinued based on antidiabetic medication use and glycemic target achievement. [c]140–180 mg/dL is the recommended glycemic target range for patients receiving nutrition support.

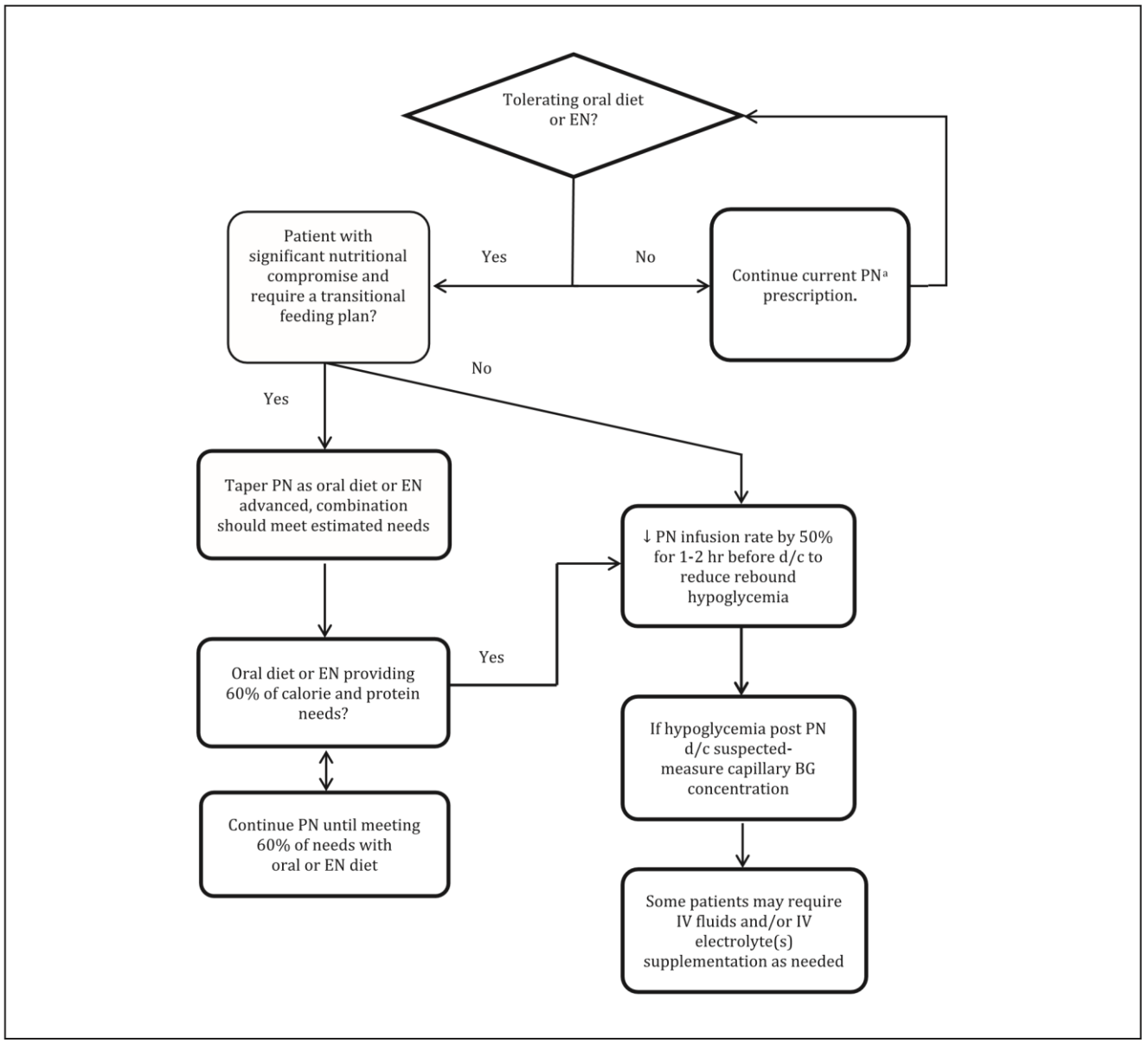

Figure 2. Transitional feeding and parenteral nutrition discontinuation. BG, blood glucose; d/c, discontinuation; EN, enteral nutrition;

IV, intravenous; PN, parenteral nutrition. [a]PN may have a negative effect on appetite.

with diabetes mellitus and up to 1 unit per 20 g in patients with no diagnosis of diabetes mellitus, with titration as needed.[61–63]

Hypoglycemia

Hypoglycemia with PN is typically seen in the following situations: endogenous insulin levels not adjusting to abrupt withdrawal of dextrose, recovery from acute illness, decreased dose of corticosteroids or vasopressors, progressive organ dysfunction, or insulin overdose in the PN preparation. It has been associated with increased risk of complications, length of hospitalization, and mortality.[53,59] Treatment includes initiation of dextrose infusion at a similar rate as the PN admixture (keeping in mind typical PN solution contains 10%–20% dextrose), administration of 12.5–25 g of a 50% dextrose, and stopping any source of insulin administration.[59] Patients at higher risk for rebound hypoglycemia are those with diabetes mellitus, treatment with IV insulin, and lower BMI.[64] Strategies for reducing this rebound hypoglycemia include gradual taper of PN infusion rate over 1–2 hours before discontinuation and establishing oral diet or enteral nutrition (EN) tolerance prior to

PN discontinuation.[65,66]

EFAD

Essential fatty acids, or those that cannot be synthesized by the body, include linoleic acid (an ω-6 fatty acid) and α-linolenic acid (an ω-3 fatty acid). These are further converted in the body to arachidonic acid and eicosapentaenoic acid, both essential for second-messenger formation in the body.[67] Clinical signs and symptoms of deficiency include scaly dermatitis, hair loss, anemia, thrombocytopenia, hepatomegaly, and fatty liver.[68–70] Biochemical evidence of EFAD can be determined by a triene/tetraene ratio of >0.4 representing decreased linoleic acid levels, which can occur within 1–3 weeks in adults receiving IVFE-free PN.[67] To prevent EFAD, it is recommended to provide at least 2%–4% of linoleic acid and 0.25%–0.5% of α-linolenic acid of total daily calories. In practice, providing approximately 5% of total weekly calories or about 100 g/wk as soybean-based IVFE usually is sufficient for most adult patients.[5]

Hypertriglyceridemia

Hypertriglyceridemia occurs if the infusion rate of IVFE exceeds the capacity of plasma fat clearance. Reported complication occur 6%–38% of the time in patients receiving PN. Dose used as well as population factors are known to increase risk of intolerance during PN therapy. These risk factors include renal failure, sepsis, pancreatitis, dextrose overfeeding or hyperglycemia, diabetes mellitus, obesity, alcoholism, and multiple-organ failure. Drugs such as corticosteroids, cyclosporine, tacrolimus, clevidipine, propofol, and rapid infusion of IVFE (>0.11 g/ kg/h) may also

put patient at risk for intolerances.[71,72] Hypertriglyceridemia secondary to PN therapy can impair immune response, increase the risk of pancreatitis, and alter pulmonary hemodynamics.[71,73] Serum triglyceride concentration should be monitored in a patient receiving PN or IVFE with acceptable levels <400 mg/dL.[5]

Other factors affecting plasma clearance of IVFE include free phospholipid content and particle size. Amount of phospholipid, as described in percentage, is similar between all concentrations of IVFE. Clearance of the 20% concentration is faster than that of the 10% concentration due to its lower concentration of free phospholipids (those not participating as an emulsifying agent) and its larger particle size.[71] Strategies to reduce hypertriglyceridemia during PN therapy include temporary discontinuation, reducing the infusion rate, and limiting provision to provide only essential fatty acids.

Refeeding Syndrome

Refeeding syndrome is generally described as the metabolic and physiologic shift in fluid and electrolytes after introduction of nutrition in malnourished patients and can occur with oral nutrition, EN, or PN.[74] Carbohydrate introduction stimulates insulin secretion, causing minerals and electrolytes to shift intracellularly. This shift can lead to decreased serum phosphorus, magnesium, and potassium levels as total body stores are depleted. Furthermore, to maintain osmotic neutrality within the plasma, the body retains sodium and water, which can lead to development of fluid overload and its clinical consequences (congestive heart failure, pulmonary edema, and arrhythmias), especially in critically ill patients.[74,75] Vitamin and mineral deficiencies can also be observed in refeeding syndrome. In particular, thiamin, a cofactor for glycolysis, can quickly become depleted with weight loss and malnutrition. Thiamin deficiency in a malnourished patient has led to Wernicke encephalopathy in patients given PN with high carbohydrate loads.[74,76]

Prevention, treatment, and monitoring of refeeding syndrome should include identifying at-risk patients and conservative carbohydrate initiation and advancement. Examples of patients with risk for refeeding syndrome are those with anorexia nervosa, history of excessive alcohol consumption, and those with chronic disease states causing undernutrition (cancer, chronic obstructive pulmonary disease, malabsorption syndromes).[74]

Special attention should be paid to correction of critical electrolytes prior to the initiation of nutrition and concomitantly with the nutrition therapies.[74] In addition to the daily requirements provided by IV multivitamin preparations, additional supplementation with 50–100 mg/d of thiamin for 5–10 days should be provided to patients at risk for thiamin deficiency or refeeding syndrome. The significance of other vitamin deficiencies is less clear in refeeding syndrome, but administering other supplemental vitamins when deficiency is suspected may also be warranted.[74,76]

PN-Associated Liver Disease

PN-associated liver disease (PNALD) encompasses a multitude of conditions, including cholestasis (decrease in bile flow), cholelithiasis (gallstones), and hepatic steatosis (fat accumulation in the liver).[77] Mild elevations of transaminases and alkaline phosphatase concentration usually occur 2 weeks after PN is initiated. These mild elevations may return to normal while the patient is still receiving PN but almost always normalize when PN is discontinued. Adults may develop complications of steatosis and steatohepatitis, which are generally asymptomatic and rarely result in permanent liver damage.[78] The complication of PN-associated cholestatic syndrome is seen more frequently in the pediatric population than in adults. Both age groups will have complications of biliary sludge and cholelithiasis.[77] Diagnostic features include increases in biochemical markers such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin (TB), direct bilirubin (DB), and alkaline phosphatase. Total bilirubin increase >2 mg/dL is considered reflective of cholestasis.[77]

Although limited data exist, PN has been linked to the development of PNALD. Excess energy intake in any form, as well as dextrose rates >4–5 mg/kg/min, results in increased insulin levels and lipogenesis. This can lead to fat deposition in the liver and steatosis.[79] Limiting dextrose infusion rates and avoidance of overfeeding reduce the risk of hepatic steatosis.[78]

Dose and IVFE composition has been associated with the development of PNALD. Soybean oil–based IVFE contains high concentrations of phytosterols and ω-6 fatty acids. Phytosterols may produce biliary sludge and stones as they are not metabolized effectively by the liver.[80] It has been postulated that both the phytosterol content along with ω-6 content of soybased IVFE contribute to hepatic disease seen in long-term PN patients.[81] Cholestasis and PNALD have been associated with excessive IVFE doses. Following recommended dosing limits for adults with available products can help prevent PNALD.[82]

Other strategies to manage and prevent PNALD include ruling out other causes of liver damage (ie, hepatotoxic medications or supplements, infectious hepatitis, sepsis), increasing enteral intake, and cycling PN. Loss of enteral intake decreases cholecystokinin, the regulatory hormone responsible for stimulating gallbladder contractions, and leads to cholestasis and cholelithasis.[78] Not using the enteral route has also been associated with mucosal atrophy and decreased immunity, causing overgrowth of hepatotoxin-producing anaerobic intestinal bacteria. Introducing EN early is the best method to prevent this complication, but other methods, including using ursodeoxycholic acid and exogenous cholecystokinin, as well as treating small bowel bacterial overgrowth, have been proposed.[79,82] Cycling PN (infusing PN over 10–16 hours) has limited evidence to support its use in PNALD but has historically been thought to decrease both incidence and severity of disease by reducing prolonged hyperinsulinemia.[77]

Metabolic Bone Disease

Metabolic bone disease (MBD) represents a range of bone problems from osteopenia and osteomalacia to overt osteoporosis. Often multifactorial, this bone loss is associated with many medical conditions (diabetes mellitus, liver cirrhosis, sclerosing cholangitis, hyperthyroidism, hyperparathyroidism, pancreatic insufficiency, short bowel syndrome, Crohn's disease, and postgastrectomy syndrome) as well as immobilization.[83–85] Medications can also contribute to MBD, with commonly implicated ones including corticosteroids, anticonvulsants,

heparin, antiretrovirals, warfarin, and overreplacement of levothyroxine. Aluminum contamination in PN and tobacco and alcohol use have also been associated with increased risk of MBD development.[85,86] Exact prevalence of PN-associated MBD is unknown, and it is unclear if PN accelerates or causes bone loss as most patients receiving long-term PN have at least one other risk factor.

Symptoms of MBD range from asymptomatic to bone pain, limited mobility, and fractures. Chemical markers for disease include hypercalcemia or hypocalcemia, low to normal parathyroid hormone (PTH) level, elevated urine calcium, and increased alkaline phosphatase.[84,85]

Numerous elements of PN nutrient composition have been postulated to affect bone metabolism. Therefore, careful PN admixture design for the long-term PN patient is important to minimize risk. It is known that to maintain optimal bone health, adequate amounts of protein, energy, calcium, phosphorus, magnesium, and vitamins D and K are necessary. Less understood is the effect of providing these and other nutrients intravenously on bone density. Several components of PN have been shown to either affect urinary calcium excretion or alter bone metabolism. Table 11 lists PN components thought to be factors associated with MBD as well as suggested admixture modifications. Identifying these factors and preparing PN admixture accordingly can improve bone mineralization and reduce risk for development of MBD in patients receiving PN. Patients at risk or with osteoporosis should be counseled on lifestyle modification such as smoking cessation, reduction of caffeine intake, and limiting alcohol consumption. It is reasonable for long-term PN patients to receive bone density measurements at baseline and annually.[87]

Parenteral Nutrient Systems for Delivery

Admixtures (2-in-1 vs Total Nutrient Admixture)

Often called a 2-in-1 PN, this formulation is a mixture of dextrose and AAs in which electrolytes, vitamins, and trace elements are added and IVFE may be infused separately. A total nutrient admixture (TNA), also known as a 3-in-1, is an admixture that contains IVFE as well as components of PN provided in a 2-in-1 admixture in a single container.

Many organizations and home care providers have elected to transition to the TNA system for convenience and cost advantages. These advantages are significant but must be evaluated against the disadvantages. Following is a brief discussion of the pros and cons summarized in Figure 3.[20,88–95]

As PN components were developed and refined, the practice standards as well as systems for delivery also evolved. Traditionally, 2-in-1 systems with separate IVFE infusions have been the standard infusion practice. In an effort to simplify administration procedures and diminish potential for microorganism growth, the approach of adding the IVFE directly to the admixture, providing one large container for daily infusion, was developed and researched. IVFE preparations do not contain preservatives and thus can support the growth of gram-positive and gram-negative bacteria and fungi.[94,95] Furthermore in 2002, the Centers for Disease Control and Prevention put forth guidelines limiting the hang

times of single-container IVFE infused alone to 12 hours maximum.[96] When combining IVFE with AAs and dextrose, the microbial growth is inhibited, allowing for the TNA that includes IVFE to hang for 24 hours.[97,98] Because IVFE particle size is larger, a 1.2-micron air-eliminating filter for TNA is recommended. This is in contrast to 2-in-1 admixtures, which contain particulates of smaller size, allowing the use of a 0.22-micron

Table 11. PN Components and Factors Associated With Metabolic Bone Disease.[84–87]

Nutrient	Effect on Urinary Calcium Excretion	Mechanism	Consideration in PN Preparation
Amino acids	n	Hypercalciuria caused by increasing renal blood flow, leading to increased GFR	Avoid high doses of protein, reduce dose to maintenance after repletion
Sodium	n	Increased GFR	Avoid excessive doses; provide only enough to meet losses
Calcium	n	IV Ca^{2+} increases urinary loss; higher dose = higher loss	Provide enough to promote positive balance; 10–15 mEq/d
Phosphorus	p	Enhances renal tubular reabsorption	Ratio Ca^{2+} to phosphorus 1:2; 20–40 mmol/d
Metabolic acidosis	n	Increased acid urinary concentration; calciuria is directly related to urinary net acid excretion	Treat cause of metabolic acidosis; provide acetate to normalized serum bicarbonate
Nutrient	**Effect on Bone Metabolism**	**Mechanism**	**Consideration**
Magnesium deficiency	p Mobilization of Ca^{2+} from bone	Chronic severe levels inhibit PTH, n phosphorus urinary excretion, n release of Mg^{2+} ions on bone surface in exchange for Ca^{2+} ions from serum	Maintain adequate Mg^{2+} intake, account for losses in stool or ostomy
Vitamin D	Variable	Excess can suppress PTH secretion and promote bone resorption; deficiency can result in bone disease and poor mineralization	Limited, as there is no vitamin preparation without vitamin D if dose reduction desired; if deficient, no IV preparation available and thus supplementation is with oral dose
Aluminum	Interferes with calcification of osteoid bone, resulting in osteomalacia	Excessive concentration impairs mineralization, binds phosphorus and p Ca^{2+} bone uptake, alters conversion of vitamin D to active form	Minimize aluminum contamination to <4–5 mcg/kg/d

Ca^{2+}, calcium; GFR, glomerular filtration rate; IV, intravenous; Mg^{2+}, magnesium; PN, parenteral nutrition; PTH, parathyroid hormone.

Advantages

Decrease nursing time
Decrease risk of touch contamination during administration
–Fewer manipulations, decreasing CLABSI
Cost savings
–Less lines and pumps
Ease of storage and administration
Better fat utilization
–Continuous IVFE better tolerated than intermittent shorter infusion
Retarded bacterial growth if contamination does occur when compared to separate IVFE
Streamlining process by removing need for 2 separate infusions thus reducing medication errors
Disadvantages
Diminished stability and compatibility
Impaired visual inspection of precipitate or particulate material in admixture

Figure 3. Advantages and disadvantages of the 3-in-1 or total nutrient admixture preparation.[20,88–95] CLABSI, central line–associated bloodstream infection; IVFE, intravenous fat emulsion. air-eliminating filter.[51,99] Administration sets and filters on all PN should be changed with each new PN container or every 24 hours due to possibility for contamination of the filter.[44,96]

Stability and compatibility of ingredients should be considered when comparing delivery systems. IVFEs are most stable at a manufactured pH of 8, and adding IVFE to an acidic admixture of dextrose and AAs increases the risk for "cracking," or separation of fat droplets from emulsion.[51,100] IVFE can also be destabilized by higher concentrations of monovalent (Na^+, K^+) and divalent (Mg^{2+}, Ca^{2+}), with the latter two being more disruptive. Furthermore, trivalent cations (Fe^{3+}) are highly disruptive and should not be added to a TNA. The opaque nature of a TNA

Advantages
Ease of preparation
Potentially lower costs for some institutions
Reduced risk of microbial contamination
Prolonged shelf life
–Reactive components in individual containers
–Reduction of air and oxygen in gas-tight containers
–Light protective overwraps to prevent photodegradation
Disadvantages

Availability of products in United States limited
Use in critically ill or obese is limited as they may have higher protein requirements
Use in fluid restricted limited
Use in organ dysfunction limited
Inability to allow for changes in electrolytes
Product labeling not consistent with safety consensus recommendations

Figure 4. Advantages and disadvantages of multichamber bags.[44,101–106]

makes visualization of particulates or precipitates such as calcium phosphate impossible.[51] These complications can be prevented by following safe practice guidelines.[5,44,51] Several aspects of safe PN practice include standardizing prescribing and ordering processes as well as using technology to aid the practitioner in identifying possible unstable or incompatible preparations. Due to the complexity of PN preparations, it is vital for a pharmacist to review and verify all PN orders as well as healthcare facilities to standardize labeling, compounding, and administration procedures.[44]

Multichamber Bags vs Compounded

Multichamber bags (MCBs) and pharmacy-compounded PNs are the available modalities for PN. When considering which system to use at your institution, one should evaluate safety, efficacy, and cost. Until recently, only dual-chamber products containing AAs and dextrose were available in the United States. On August 25, 2014, the FDA approved indications for use of triple-chamber bags containing AAs, dextrose, and IVFE in a single bag. The macronutrient components are separated by an internal membrane meant to be broken and mixed prior to administration. To date, there are no randomized controlled studies comparing dualchamber with triple-chamber bags. Potential advantages and disadvantages to choosing an MCB compared with compounding a PN are reviewed in Figure 4.[44,101–106] The MCB fixed combinations available in the United States are summarized in Table 12.[107–109]

Safety. The safety profile of MCBs has been shown to be superior to that of compounded products due to fewer preparation steps (minimizing compounding mistakes) and less contamination from product manipulation.[101,105,106,110–112] Turpin et al[105,111] showed fewer adverse events related to infections and a 30% decrease in the probability of developing a bloodstream infection with MCBs compared with compounded products. A study completed in South America found an increased rate of bloodstream infections with TNA-compounded products compared with TNA MCBs. While this study aligns with other literature, it is difficult to generalize the results because the IVFE used (olive oil and MCT/LCT combination) is not available in the United States.[88]

Efficacy. Literature is lacking when comparing MCBs to compounded PN for efficacy. Several studies have shown standardized PN preparations are as effective as compounded in controlling serum electrolytes in both adults and pediatrics.[113–115] One small study done by Pounds et al[101]

comparing dual-chamber bags and compounded product found no difference in normal, abnormal, high, and low laboratory values or a difference in ICU length of stay or length of PN therapy, suggesting that dual-chamber bags are as efficacious as compounded products.

Cost. Several studies have shown MCBs to be less costly compared with compounded products.[101,105,116] Each study evaluated different aspects of cost associated with PN, making interpretation of data difficult. Turpin et al[105] showed an average acquisition cost for MCBs of $164 compared with $239 for a compounded PN admixture. Pounds et al[101] showed that a 1-year charge for ingredients in an MCB preparation was $242,178 compared with $284,112 for the charge of ingredients in a compounded product, estimating around a $40,000 cost savings per year when using MCBs. However, this study did not evaluate personnel cost associated with compounding a PN and should be interpreted with caution. Pichard et al[116] found MCBs to be more cost-effective than compounded PN due to reduction of labor cost and pharmacy overhead cost. This study was done in Switzerland, making comparison to other countries' salaries and cost of PN product difficult. Based on the available literature comparing MCBs with compounded PN, MCBs may be a safer product with similar efficacy and might be a cost-effective option for some institutions. More well-designed studies are needed to fully assess safety, efficacy, and cost in all patient populations.

Table 12. Commercially Available Parenteral Nutrition Multichamber Products.[107–109]

Type	Product	Manufacturer	Volume Available	Strength (Amino Acids/ Dextrose/Fats)	IVFE Contained	Comments
Dual chamber (2-in-1)	Clinimix[a]	Baxter	1 L 2 L	Peripheral administration: 2.75/5[b] 4.25/5	None	IVFE can be added; can add other medications but check for incompatibilities; calcium addition is the chloride salt
			1 L 2 L	Central administration: 2.75/10 4.25/10 5/15 5/20 5/25	None	
Triple chamber (3-in-1)	Kabiven	Fresenius Kabi	1026 mL 1540 mL 2053 mL 2566 mL	Central administration: 3.31/9.8/3.9	Soybean oil: contains vitamin K	Can add other medications but check for incompatibilities; calcium addition is the chloride salt; phosphate addition is sodium glycerophosphate
	Perikabiven		1440 mL 1920 mL 2400 mL	Peripheral and central administration: 2.36/6.8/3.5		

IVFE, intravenous fat emulsion.
[a]Available with and without electrolytes.
[b]Only available in 1 L.

Conclusion

The nutrition support clinician has the essential task of creating a safe and effective PN for the wide variety of patients who are otherwise unable to be fed enterally. PNs are complex prescriptions that require appropriate indications for use, route of administration, initiation, and monitoring parameters as well as accurate admixture design. Being familiar with new methods for feeding, therapy options, and systems of delivery empowers clinicians to create and manipulate admixture design to prevent the vast array of complications that can arise with PN. It is an exciting time for nutrition support, with new products coming to market and new curricula for PN competencies. This article provides the foundation for PN admixtures and nutrition support to help provide the safest and most effective PN in the adult patient.

Statement of Authorship

K. Derenski, J. Catlin, and L. Allen equally contributed to the conception and design of the manuscript. All authors drafted the manuscript, critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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ASPEN Recommendations for Appropriate PN Dosing

Appropriate Dosing for Parenteral Nutrition: ASPEN Recommendations

Persistent shortages of parenteral nutrition (PN) components have led to a tendency of practitioners providing less than adequate dosing, which can lead to nutrient deficiencies and impair growth and healing. Clinicians who have entered practice within the last 10 years may have never cared for patients receiving PN therapy without a shortage of PN components. This document provides both the appropriate PN nutrient requirements and dosing recommendations for adult, neonatal, and pediatric patients. Please share with your colleagues.

Topline Recommendations

- **Do not ration nutrients for PN if the supply of those components is sufficient to provide the full daily dose.**
- **During component shortages, follow PN management recommendations available on the ASPEN website at nutritioncare.org/ProductShortageManagement/**
- **Return to appropriate dosing as soon as the component shortage has resolved.**
- **Rationing and conservation strategies are intended to be used only during shortages.**
- **The lack of observed adverse events/deficiencies and the potential cost savings associated with "partial" dosing should not be the impetus to continue less than optimal dosing.**

Note: These recommendations are general ranges and a patient's clinical condition and organ function should be taken into account. These recommendations do not constitute medical or other professional advice and should not be taken as such. To the extent that the information published herein may be used to assist in the care of patients, this is the result of the sole professional judgment of the attending healthcare professional whose judgment is the primary component of quality medical care. The information presented in here is not a substitute for the exercise of such judgment by the healthcare professional. Circumstances in clinical settings and patient indications may require actions different from those recommended in this document and in those cases, the judgment of the treating professional should prevail.

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TABLE 1. MACRONUTRIENTS

Disease/Clinical Condition	Protein/Amino Acids (g/kg/d)	Total Energy (kcal/kg/d)	PN Dextrose (mg/kg/min)	Component ILE* (g/kg/d)	Fluid (mL/kg/d)
Stable	0.8-1.5	20-30	4-5	1	30-40
Critically ill, trauma, sepsis	1.2-2.5	20-30	<4	<1	Minimal to provide adequate macronutrients
Different Amino Acid Requirements than Above	**Protein Amino Acids (g/kg/d)**	**Total Energy (kcal/kg/d)**			
Traumatic brain injury	1.5-2.5				
Burns	1.5-2				
Open abdomen	Additional 15-30 g/L exudate				
Acute kidney injury	0.8-2.0				
Continuous renal replacement therapy	Additional 0.2 g/kg/d not to exceed 2.5 g/kg/d)				
Chronic kidney failure with maintenance hemodialysis	1.2				
Hepatic failure	1.2-2 (based on "dry" weight and tolerance)				
Obese	2-2.5 (based on IBW)	22-25 (based on IBW)			

in the US provides the above requirements.

TABLE 3. DAILY REQUIREMENTS FOR ADULT PARENTERAL VITAMINS*

Vitamin	Standard Daily Requirement
Thiamin (B_1)	mg
Riboflavin (B_2)	3.6 mg
Niacin (B_3)	mg
Folic acid	mcg
Pantothenic acid	mg
Pyridoxine (B_6)	mg
Cyanocobalamin (B_{12})	mcg
Biotin	mcg
Ascorbic acid	mg
Vitamin A	mcg
Vitamin D	mcg
Vitamin E	mg
Vitamin K	mcg

** Prescribe full daily dose unless patient able to ingest and/or absorb orally/enterally. Full dose of most multivitamin products available*

TABLE 4. DAILY REQUIREMENTS FOR ADULT

IBW = ideal body weight

Soybean oil-based emulsion. For indications and dosing of other lipid injectable emulsions (ILE), see manufacturer's product literature.

TABLE 2. ELECTROLYTE AND MINERAL

Nutrient	Standard Daily Requirement	Factors That Increase Needs
Calcium*	10-15 mEq	High protein intake
Magnesium	8-20 mEq	GI losses, medications, refeeding
Phosphorus*	20-40 mmol	High dextrose intake, refeeding
Sodium	1-2 mEq/kg*	Diarrhea, vomiting, NG suction, GI losses
Potassium	1-2 mEq/kg*	Diarrhea, vomiting, NG suction, GI losses, medications, refeeding
Acetate	As needed to maintain acid-base balance	Renal insufficiency, metabolic acidosis, GI losses of bicarbonate
Chloride	As needed to maintain acid-base balance	Metabolic alkalosis, volume depletion

Use caution in prescribing calcium and phosphorus related to compatibility. GI = Gastrointestinal

PARENTERAL TRACE ELEMENTS*

Trace Element	Standard Daily Requirement
Chromium	<1 mg
Copper	0.3-0.5 mg
Manganese	mcg
Selenium	60-100 mcg
Zinc	3-5 mg

** Prescribe full daily dose unless patient able to ingest or absorb orally/enterally.*

Note: These requirements are different than the multi-trace element products currently available in the US.

TABLE 5. DOSING FOR INITIATION AND ADVANCEMENT OF PN MACRONUTRIENTS

	Initiation		Advance By		Goals	
Infants (<1 y)	**Preterm**	**Term**	**Preterm**	**Term**	**Preterm**	**Term**
Protein (g/kg/d)*	1-3 (3–4 max)	2.5–3	—	—	3–4	2.5–3
Dextrose (mg/kg/min)	6–8	6–8	1–2	1–2	10–14 (max 14–18)	10–14 (max 14–18)
ILE (g/kg/d)**	0.5–1	0.5–1	0.5–1	0.5–1	3 (max 0.15 g/kg/h)	2.5–3 (max 0.15 g/kg/h)
Children (1–10 y)						
Protein (g/kg/d)	1.5–2.5		—		1.5–2.5	
Dextrose (mg/kg/min)	3–6		1–2		8–10	
ILE (g/kg/d)**	1–2		0.5–1		2–2.5	
Adolescents						
Protein (g/kg/d)	0.8–2		—		0.8–2	
Dextrose (mg/kg/min)	2.5–3		1–2		5–6	
ILE (g/kg/d)**	1		1		1–2	

**Protein does not need to be titrated; protein needs are increased with critical illness.*

*** ILE dosing based on soybean oil-based emulsion. See manufacturer's product information for dosing of other ILE products.*

ILE= Lipid injectable emulsion

GIR = glucose infusion rate; GIR calculation (mg/kg/m) = [dextrose (g/d) x 1000] / [24 (h/d) x 60 (m/hr) x weight (kg)]

TABLE 6. PN ELECTROLYTE AND MINERAL DAILY DOSING*

	Preterm Neonates	Children Infants/Children than 50 kg	Adolescents & Greater
Sodium	2-5 mEq/kg	2-5 mEq/kg	1-2 mEq/kg
Potassium	2-4 mEq/kg	2-4 mEq/kg	1-2 mEq/kg
Calcium	2-4 mEq/kg	0.5-4 mEq/kg	10-20 mEq

Phosphorus	1-2 mmol/kg	0.5-2 mmol/kg	10-40 mmol
Magnesium	0.3-0.5 mEq/kg	0.3-0.5 mEq/kg	10-30 mEq
Acetate	As needed to maintain acid base-balance		
Chloride	As needed to maintain acid base-balance		

**Use caution in prescribing calcium and phosphorus related to compatibility.*

TABLE 7. PN DAILY MULTIPLE VITAMIN PRODUCT DOSING

Manufacturer Recommendations†		NAG-AMA Recommendations◊	
Weight (kg)	**Dose (mL)**	**Weight (kg)**	**Dose (mL)**
Less than 1	1.5	Less than 2.5	2 mL/kg
1 to less than 3	3.25	Greater than or equal to 2.5	5 mL
Greater than 3	5		

† Infuvite Pediatric (Baxter) and M.V.I. Pediatric (Hospira) ◊ Nutrition Advisory Group-American Medical Association

TABLE 8. PN TRACE ELEMENT DAILY DOSING*

Trace Element	Preterm Neonates	Term Neonates 3-10 kg	Children 10-40 kg	Adolescents Greater than 40 kg
Zinc	400 mcg/kg	250 mcg/kg	50 mcg/kg (max 5000 mcg/d)	2-5 mg
Copper	20 mcg/kg	20 mcg/kg	20 mcg/kg (max 500 mcg/d)	200-500 mcg

Manganese	1 mcg/kg	1 mcg/kg	1 mcg/kg (max 55 mcg/d)	40-100 mcg
Chromium	0.05-0.3 mcg/kg	0.2 mcg/kg	0.2 mcg/kg (max 5 mcg/d)	5-15 mcg
Selenium	2 mcg/kg	2 mcg/kg	2 mcg/kg (max 100 mcg/d)	40-60 mcg

**Note: These requirements are different than the multi-trace element products currently available in the US.*

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Standards for Nutrition Support: Adult Hospitalized Patients

Standards for Nutrition Support: Adult Hospitalized Patients

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Abstract

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The American Society for Parenteral and Enteral Nutrition defines standards as benchmarks representing a range of performance of competent care that should be provided to assure safe and efficacious nutrition care in most circumstances. Standards are documents that define the structure needed to provide competent care. These Standards for Nutrition Support for Adult Hospitalized Patients are an update of the 2010 Standards. These practice-based standards are intended for use by healthcare professionals charged with the care of adult hospitalized patients receiving nutrition support therapy in any hospital with or without a formal nutrition support service or team. These Standards address professional responsibilities as they relate to patient assessment, diagnosis, education, care plan development, implementation, clinical monitoring, evaluation, and professional issues around nutrition support. (*Nutr Clin Pract.* 2018;33:906–920)

Keywords
enteral nutrition; hospitalization; nutrition assessment; nutrition support; parenteral nutrition; standard of care

Introduction

The American Society for Parenteral and Enteral Nutrition (ASPEN) is dedicated to improving patient care by advancing the science and practice of clinical nutrition and metabolism. Founded in 1976, ASPEN is an interdisciplinary organization whose members are involved in the provision of clinical nutrition therapies, including parenteral and enteral nutrition. With more than 6,500 membersfromaroundtheworld,ASPENisacommunityof dietitians, nurses, pharmacists, physicians, scientists, students, and other health professionals from every facet of nutrition support clinical practice, research, and education. ASPEN envisions an environment in which every patient receives safe, efficacious, and high-quality nutrition care. ASPEN's mission is to improve patient care by advancing the science and practice of clinical nutrition and metabolism. These Standards for Nutrition Support for Adult Hospitalized Patients are an update of the 2010 standards.[1] They are intended for use by any hospital with or without a formal nutrition support service (or team).

ASPEN defines standards as benchmarks representing a range of performance of competent care that should be provided to assure safe and efficacious nutrition care in most circumstances.[2] Standards are documents that define the structure needed to provide competent care. Standards usually address professional responsibilities as they relate to patient assessment, diagnosis, education, care plan development, implementation, clinical monitoring, evaluation, and professional issues. ASPEN publishes discipline-based (eg, dietitian, nurse, pharmacist, or physician) and practicebased (eg, adult hospitalized patients, pediatric hospitalized patients, home and alternate site care) standards. Standards are presented in the most generic terms possible. The details of specific tests, therapies, and protocols are left to the discretion of individual healthcare facilities. Each healthcare facility shall strive to provide the best nutrition support care that is possible given the resources of the organization. The standards aim to ensure sound and efficient nutrition care for those in need of nutrition support therapy.

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Important Note

These standards do not constitute medical or other professional advice and should not be taken as such. To the extent that the information published herein may be used to assist in the care of patients, this is the result of the sole professional judgment of the attending healthcare professional whose judgment is the primary component of quality medical care. The information presented in these standards is not a substitute for the exercise of such judgment by the healthcare professional. Circumstances in clinical settings and patient indications may require actions different from those recommended in this document and in those cases, the judgment of the treating professional should prevail.

Audience for Standards

These practice-based standards are intended for use by healthcare professionals charged with the

care of adult hospitalized patients receiving nutrition support therapy.

Level of Care

As limited by the *Important Note* above, these Standards of Practice present a range of performance of competent care that should be provided by healthcare professionals caring for adult hospitalized patients receiving nutrition support therapy. Terminologies included in each standard are specified as:

(a) *"Shall"*: Indicates standards to be followed strictly.
(b) *"Should"*: Indicates that among several possibilities one is particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.
(c) *"May"*: Indicates a course of action that is permissible within the limits of recommended practice.

These standards have been developed by the ASPEN Task Force on Standards for Nutrition Support: Adult Hospitalized Patients, reviewed by the ASPEN Clinical Practice Committee, and approved by the ASPEN Board of Directors on July 25, 2018. These Standards of Practice should be used in conjunction with the previously published ASPEN Clinical Guidelines, Standards, Position Papers, and other Board Approved documents, which can be accessed at the ASPEN Documents Library, http://www.nutritioncare.org/Clinical_Practice_Library/.

Chapter I: Organization

Standard 1. Nutrition Support Service (or Team)

A nutrition support service (or team) should assess and in collaboration with patients' primary teams, manage the nutrition support therapy of patients who require or may require nutrition support therapy. These patients are often, but not always, determined to be nutritionally-at-risk at admission or upon subsequent evaluation.[3] Organized nutrition support services (or teams) are associated with improved patient outcomes, decreased length of hospitalization, and improved cost effectiveness.[4-19] If a hospital does not have a designated nutrition support service (or team), the care used to provide nutrition support therapy should be interprofessional. The scope and design of the nutrition support service (or team) and their respective activities vary according to the unique attributes of each hospital. Among various organizations, management of nutrition support may comprise a spectrum of activities including no formal structure, an administrative nutrition committee only, a consultative nutrition support service (or team), or a nutrition support service (or team) that assumes responsibility for the nutrition care of patients who receive nutrition support therapy.

1.1 When an organized nutrition support service (or team) exists, it shall be directed by a clinician who has appropriate education, specialized training, patient care experience, or experience in managing nutrition support services (teams).

1.2 An organized nutrition support service (or team) should include a physician, nurse, dietitian, and pharmacist, each following the standards of practice for their discipline, as available.[20-23]

1.3 If a nutrition support service (or team) is not established, nutrition support therapy should be managed with an interprofessional approach that includes the patient's physician, nurse, dietitian, and pharmacist.

Standard 2. Policies and Procedures

Written policies and procedures for providing nutrition support therapy shall be current.

2.1 Thepoliciesandproceduresshallbedevelopedwith the input of and review by all members of the nutrition support service (or team) and/or nutrition support committee.

2.2 The policies and procedures shall be reviewed periodically and revised as appropriate to define optimalpatientcareandtherapeuticoutcomes.(See

3.2.)

Standard 3. Performance Improvement

The nutrition support service (or team) and/or nutrition support committee shall regularly review and report on service performance, quality indicators, patient outcome data, and adverse events related to nutrition support therapies.[24] These reports shall be shared with all internal stakeholders and reported to external agencies as required.

3.1 The nutrition support service (or team) and/or nutrition support committee shall recommend policy, procedure,orprotocolchangesthatimproveand/or enhancethesafetyandefficacyof nutritionsupport therapy.

3.2 The review of service performance should assess the appropriateness and effectiveness of nutrition support therapy.

Chapter II: Nutrition Care

Nutrition care and the administration of nutrition support therapy shall proceed according to a series of steps with feedback loops. These steps include nutrition screening, formal nutrition assessment, creation of a nutrition care plan, implementation of the plan, patient monitoring, evaluation of the plan, evaluation of the care setting, and reformulation of the plan or termination of therapy. (See Figure 1: ASPEN Adult Nutrition Care Pathway.)

Standard 4. Nutrition Screening

Nutrition screening is defined as "a process to identify an individual who is malnourished or who is at risk for malnutrition to determine if a detailed nutrition assessment is indicated."[1] Patients who are nutritionally-at-risk shall be identified by a validated screening process and by periodic rescreening per institutional policy or standard.[3,25-33] This process should be created, approved, and regularly reviewed by a group with organizational authority, preferably a designated nutrition committee.

4.1 Results of the nutrition screening shall be documented and communicated and appropriate intervention shall be initiated within the time frame specified by the hospital or as clinically indicated.

4.2 A procedure for rescreening of patients not immediately identified as nutritionally-at-risk should be implemented and regularly reviewed.

Standard 5. Nutrition Assessment

All patients identified as nutritionally-at-risk based on the nutrition screening shall undergo a nutrition assessment.[3,27-33] This nutrition assessment shall be documentedandmadeavailabletoallpatientcareproviders. The intent of the nutrition assessment is to document baseline nutrition parameters, identify nutrition risk factors and specific nutrition deficits, determine individual nutrition needs, and identify medical, psychosocial, and socioeconomic factors that may influence the prescription and administration of nutrition support therapy.[34,35]

5.1 The nutrition assessment shall be performed within the time frame specified by the hospital and by a dietitian or a clinician with documented specialized expertise in nutrition.

5.2 The nutrition assessment shall include evaluation of the patient's current nutrition status and nutrition requirements.

5.2.1 A malnutrition diagnosis, if present, and degree of malnutrition shall be

clearly documented to facilitate appropriate diagnosis coding.

5.2.2 Degree of obesity (ie, class I, class II, or class III), if applicable, shall also be documented.

5.3 The patient's nutrition requirements shall be summarized based on the findings of the nutrition assessment and should include energy, macronutrient (protein, and as appropriate, carbohydrate and fat), as well as fluid, electrolyte, and micronutrient requirements, as appropriate.

5.4 Nutrition assessment shall include a review and documentation of factors relevant to delivery of nutrition support therapy. Relevant factors may include, but are not limited to, the following: ability to eat safely and adequately, patient's goals, assessment of aspiration risk, functional status of the gastrointestinal tract, cognitive function/abilities, enteral and vascular access, and results of tests and invasive procedures.

Chapter III: The Nutrition Care Plan

Standard 6. Goals

The process of nutrition care is multifactorial and shall include multiple levels of intervention including screening for nutrition risk factors. The nutrition care plan shall be created from a comprehensive review and analysis of information gathered from many aspects of the patient's care. The nutrition care plan should include "statements of nutrition goals and monitoring/evaluation parameters, the most appropriate route of administration of nutrition therapy, method of nutrition access, anticipated duration of therapy, and training and counseling goals and methods."[2]

A formal nutrition assessment provides the basis for the nutrition care plan. The nutrition care plan guides comprehensive nutrition therapy by defining its rationale, describing appropriate intervention and monitoring, and delineating recommended reassessment and reevaluation parameters. This process facilitates changes in care

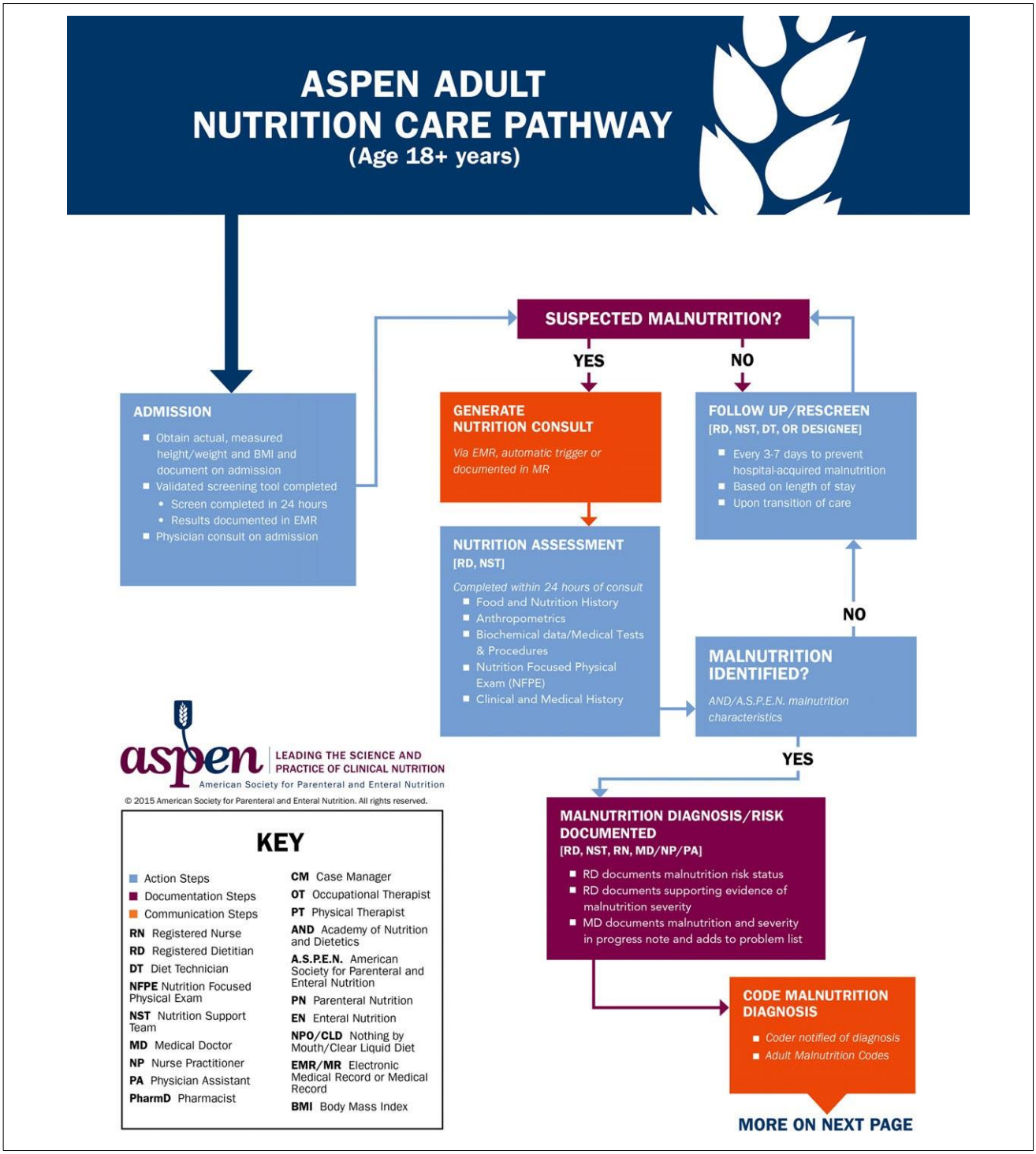

Figure 1. The American Society for Parenteral and Enteral Nutrition adult nutrition care pathway. appropriate to the clinical setting while considering the *Standard 7. Interprofessional Approach* continuumof care.Revisionof thenutritioncareplanbased on changes in clinical status and achievement of goals of The nutrition care plan should be developed using an intertherapy should occur before discontinuation of nutrition professional

team approach involving the patient, caregiver support therapy. (if applicable), the nutrition support service (or team), the

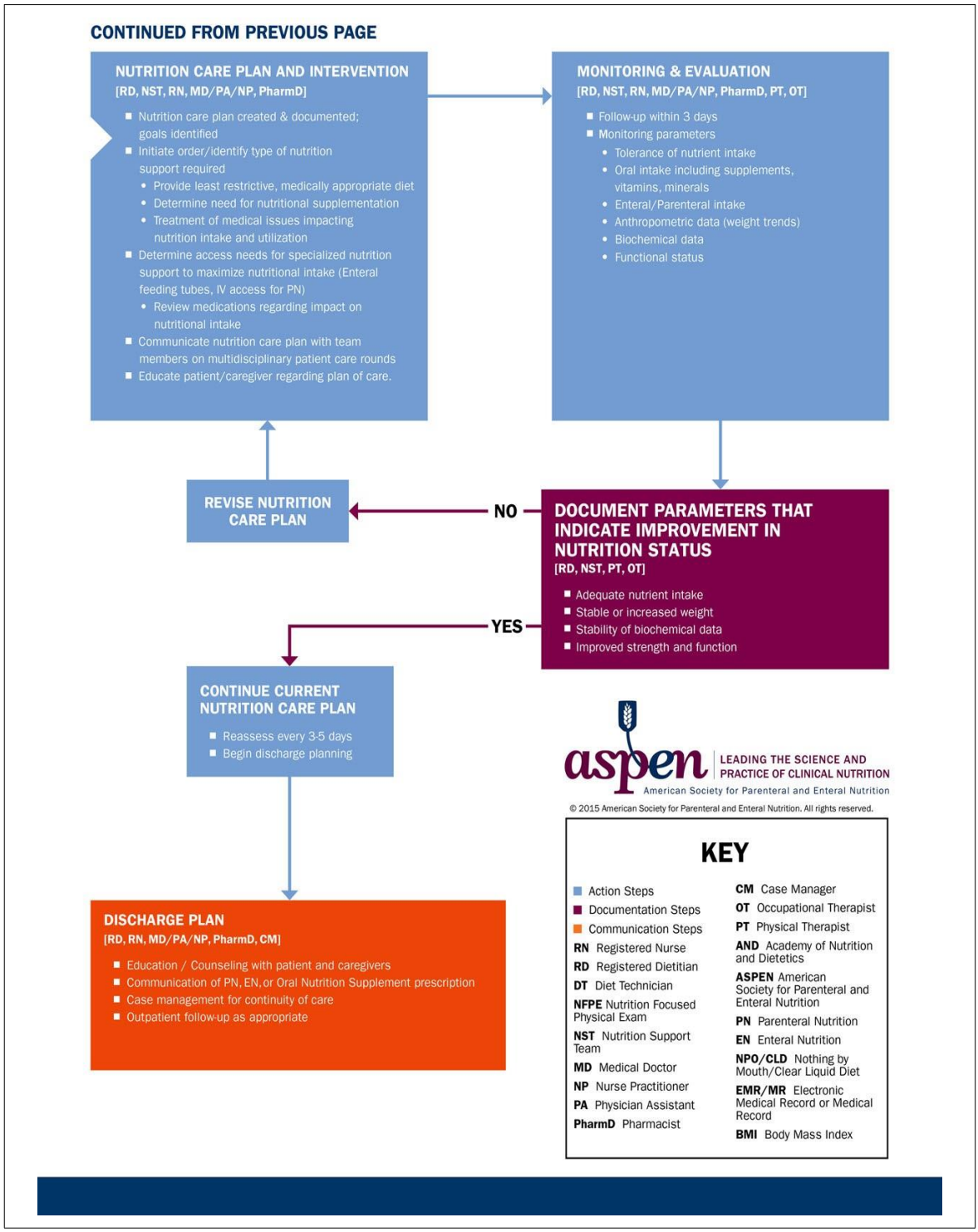

Figure 1. *Continued.*

patient's physician(s), dietitian(s), nurse(s), pharmacist(s), and other appropriate healthcare professionals.

Standard 8. Patient and Caregiver Communication

The nutrition care plan should include patient and/or caregiver(s) education about nutrition support therapy, goals, and expectations and should incorporate the wishes of the patients and/or caregiver(s). Appropriate routes of administration shall be defined, identification of intake goals shall be included, and estimated duration of therapy as well as criteria for discontinuation of therapy should be addressed. *Standard 9. Selection of Route*

Therouteselectedtoprovidenutritionsupporttherapyshall be appropriate to the patient's clinical status or condition and shall periodically be assessed for continued appropriateness as well as for its adequacy in meeting goals of the nutritioncareplan.[36] (SeeFigure2:Routeof administration algorithm.)

Standard 10. Selection of Formulation

The enteral nutrition (EN) or parenteral nutrition (PN) formulation shall be appropriate for the patient's disease process and compatible with the route of access.[37,38]

10.1 TheENorPNformulationshallbeadjustedasappropriate based on the patient's clinical response.

10.2 The EN or PN formulation shall be adjusted accordingly when significant amounts of nutrients are provided (eg, parenteral infusions, medications) through means other than the EN formula or PN admixture or lost/eliminated through mechanical procedures or anatomical defects (eg, renal replacement therapy, enterocutaneous fistula) .

Chapter IV: Implementation

Standard 11. Ordering Process

Implementation of the nutrition care plan shall follow nutrition assessment and development of a formal nutrition care plan.

11.1 Authority to prescribe nutrition support therapy shall be determined by hospital policy and applicable professional licensure laws.

11.1.1 Hospital policy should clearly articulate the appropriate credentials, training, and/or certifications and competencies required for clinicians who prescribe nutrition support therapy.

11.1.2 As delineated by clinical privileges and applicable professional licensure laws, a nutrition support clinician may enter/write ordersforfeedingformulations,laboratory tests, and adjunctive therapy (eg, intravenous [IV] fluids, insulin, IV/oral electrolytes) and adjust regimens based on response to therapy, changing clinical condition(s), altered laboratory values, and nutrition assessment parameters.

11.1.3 Hospital policy should include a competency for nutrition support therapy prescribing.[39]

11.2 Orders for nutrition support therapy shall be documented in the patient's medical record before administration.

11.2.1 A standardized order format and review process for nutrition support therapies orders shall be used to minimize the risk of adverse events and error. This process shall include standardized electronic orders (eg, computerized provider order entry [CPOE] system) for prescribing PN and EN. Handwritten order to prescribe PN and EN should be avoided due to potential for error. Verbal and telephone orders and text messaging of orders should be avoided.[40,41] See ASPEN Parenteral Nutrition Safety Consensus Recommendations[39] and ASPEN Safe Practices for Enteral Nutrition Therapy[40] for details of the prescribing process for PN and EN.

11.3 Nutrition care plans shall be implemented to promotesafe,accurate,andeffectivenutritionsupport therapy based on the patient's needs and clinical condition and will provide resource-efficient and fiscally responsible care.

Standard 12. Nutrition Support Access

Access for nutrition support therapy shall be achieved and maintained in a manner that minimizes risk to the patient and optimizes therapeutic outcome(s).[36,40-43]

12.1 Standard techniques and policies should be established and followed for access device insertion and routine care. (See section 16.5.)

12.1.1 The selection of a venous access site (central vs peripheral vein) should depend on expected duration of therapy, nutrition requirements, and patient's vascular condition and preferences.[40,43,44] When PN is

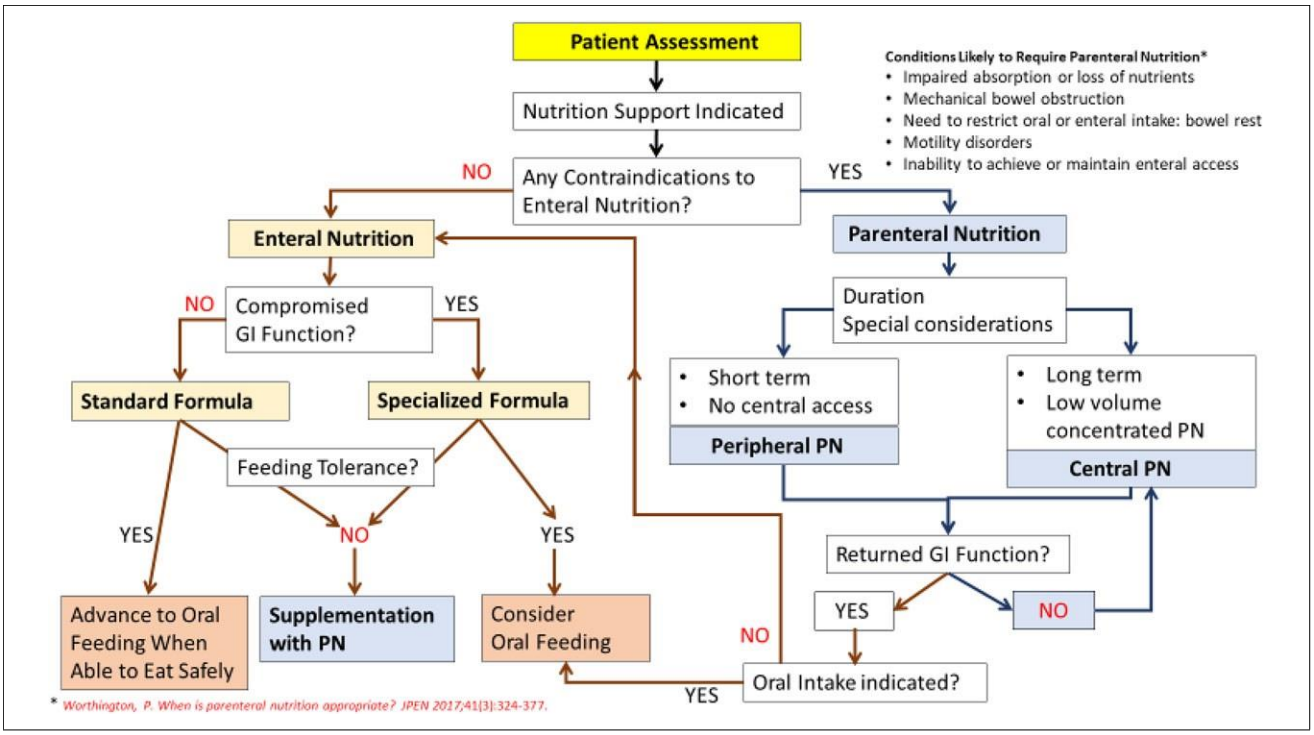

Figure 2. Route of administration algorithm. GI, gastrointestinal; PN, parenteral nutrition.

administered via a central access device, the femoral vein site should be avoided, especially in the obese, to minimize infection risks associated with nontunneled central venous catheters (CVCs).[43,45-48] Peripherally inserted central catheters (PICC) should not be used as a strategy to reduce central line-associated bloodstream infection (CLABSI).[46] A CVC with the fewest number of lumens or ports required for that patient should be used for PN administration.[46]

12.1.2 The selection of an enteral access device (nasoenteric vs enterostomy [ie, gastrostomy, jejunostomy]) should depend on the patient's disease state, needs and goals, ethical situation, gastrointestinal anatomy and function, expected duration of EN therapy, and the ability to safely access the gastrointestinal tract via radiologic, surgical, endoscopic techniques, or other guided technology.[41,42,49-51] (See Table 1: Selection of Enteral Access Based on Gastric Tolerance and Anticipated Feeding Duration.)

12.1.3 Appropriate access devices shall be placed by a physician, nurse, or trained healthcare professional who is competent to

Table 1. Selection of Enteral Access Based on Gastric Tolerance and Anticipated Feeding Duration[41].

	Duration	
Normal Gastric Motility	Short Term (4–6 Weeks)	Long Term (Longer Than 6 Weeks)
Yes	Nasogastric	Gastrostomy

No	Nasoduodenal Nasojejunal	Jejunostomy

place the specific access device. Guidance technology for placement of central venous access and enteral access devices should be used only by clinicians who have completed prerequisite training and credentialing required by the respective institution.[50,52,53] Professionals with knowledge in preventing, recognizing, and managing complications associated with the placement and maintenance of the access devices should monitor the use of the access devices.[41,43,44,46-48]

12.1.4 Proper placement of central venous access devices shall be confirmed using appropriate technology and documented in the medical record before initial use.[43,44] For enteral access devices, the auscaltatory method shall not be relied upon to differentiate between pulmonary, gastric, and small bowel placement of a nasoenteric tube.[50] When using enteral access system or guidance technology to place enteral access devices, if any difficulty occurs during insertion, confirmation of the final tube position should be done per institution protocol.[53] Radiographic confirmation is the gold standard for determining the exact tube position after insertion and should be used.[41,49-52]

12.1.5 Central venous access should be used for the delivery of PN admixtures with an osmolarity greater than 900 mOsm/L.[54] The catheter tip should be positioned in the lower segment of the superior vena cava adjacent to the cavo-atrial junction.[43] Peripheral PN may be administered, if indicated, through a peripheral access device provided the osmolarity of the admixture is less than or equal to 900 mOsm/L. Lipid injectable emulsion (ILE) may be concurrently infused.[43,44,54]

12.1.6 Monitoring procedures for nutrition support therapy administration shall include visual inspection of the patient's enteral or parenteral access devices and insertion site.

12.2 Complications related to an access device and outcome(s) of the interventions to manage the complication(s) shall be clearly documented in the medical record.

Standard 13. PN Admixture Preparation

PN shall be prepared accurately as prescribed and stored safely according to United States Pharmacopeia (USP) General Chapter<797>: Pharmaceutical Compounding-Sterile Products.[55]

13.1 PN formulations shall be prepared using current policies and procedures regarding manufacturing, compatibility,andstability.Theseproceduresshall be supervised by a licensed pharmacist with appropriate credentials and experience.[40,44]

13.1.1 A hospital-specific standardized process for PN preparation shall be used. This may include the use of standardized PN

formulations when appropriate.[40,56]

13.1.2 A pharmacist shall review the contents of a PN order for appropriateness and compare it with previous orders when applicable.[40,56]

13.2 In hospitals that use automated compounding devices (ACDs) for preparation of PN formulations, policies and procedures shall be developed to address responsibilities for operation and maintenance, staff training, and monitoring ACD performance (ie, quality assurance).[40,57]

13.2.1 Adequate training of personnel shall include use of computer software to assist in daily use and trouble shooting of ACDs.[40]

13.2.2 PNsubstratedosinglimitalertsshallbeactivated in the computer software and used in the assessment of the PN formulation prior to compounding.[40]

13.2.3 Documents generated by the ACD or other electronic devices shall be compared with the ordered PN formulation.[40]

13.2.4 The pharmacist and/or pharmacy technician shall monitor the equipment during the preparation process to assure proper operation.[40]

13.2.5 End-product and validation testing of PN admixtures should be completed.

13.3 In hospitals that outsource preparation of PN admixtures, policies and procedures shall be developed for appropriate ordering, storage, preparation,labeling,anddispensingof PNadmixtures. Hospitals should ensure that the outsource agency prepares PN formulations in accordance with USP General Chapter <797>: Pharmaceutical Compounding-Sterile Products.[55]

13.4 In hospitals that use standardized, commercially available PN products, policies and procedures shall be developed for appropriate ordering, storage, preparation, labeling, and dispensing of PN admixtures.[40,56]

13.5 PN admixtures shall be sterile and free from physical contaminants (foreign materials and physical matter) and minimize patient exposure to aluminum.[40,59]

13.6 A pharmacist should refer to ASPEN, American Society of Health-system Pharmacists (ASHP), FDA Drug Shortages, or other appropriate resource(s) on managing shortages and outages of PN components and develop hospital-specific strategies to provide optimal PN therapy during shortages.

13.7 Nonnutrient medication (eg, insulin) should be addedtoPNonlywhensupportedbyphysiochemical compatibility and stability data.[54]

13.8 A pharmacist shall conduct a visual inspection of the final PN admixture prior to dispensing.[39]

13.10 Additions to PN admixture shall not be made outside of the pharmacy sterile compounding environment.

Standard 14. EN Formula Preparation

EN formulas and products shall be prepared accurately and safely as prescribed and stored according to the manufacturers' directions and published safety consensus recommendations.[41]

14.1 EN formulas shall be prepared by trained personnel under professional supervision in a clean environment. Aseptic technique shall be used in the preparation of EN formulas.[41]

14.1.1 Preparation equipment shall be sanitized regularly.

14.1.2 Open-system containers shall be filled with EN formula using aseptic technique.

14.2 Any addition of modular products or water to the formula shall be ordered by the prescribing clinician or designee.

14.2.1 Additions to EN formulas shall not be done at the bedside.

14.2.2 Additions to closed-system EN containers shall not be made.

Standard 15. Packaging and Labeling

PN admixtures and EN formula containers shall be appropriately packaged and labeled in a standardized fashion according to hospital policy and procedure.

15.1 PN admixtures shall be packaged in administration containers that can assure maintenance of sterility and allow visual inspection during preparation, storage, and infusion.

15.1.1 The PN admixtures and ILE administered as a separate infusion shall be labeled with the following as described in the ASPEN Parenteral Nutrition Safety Consensus Recommendations:[40]

Two patient identifiers (eg, name, medical record number, date of birth)

Patient location or address

Administration date and time

Beyond-use date and time

Route of administration (central vein vs peripheral vein) Prescribed volume

Methodof administration(continuous vs cyclic)

Complete name of all ingredients expressed in the same units of measure as the PN order

All PN ingredients shall be ordered as amount per day (ie, grams per day, mEq per day)

Name of compounding institution or pharmacy

15.1.2 Auxiliary labels should be affixed to PN admixture packaging to reduce risk of error (eg, for central line only).

15.1.3 The PN admixture shall be stored in a refrigerator (per established guidelines), unless the admixture will be administered

immediately to the patient.[40,45,55]

15.2 EN formulas shall be packaged in administration containers, which assure accuracy of volume, cleanliness, and minimize the risk for contamination.[41]

15.2.1 Open-system administration containers should be used if the EN formula will be modifiedwithmodularproducts.However, the addition of modular products to an open-system container may result in an unacceptable risk of contamination in hyperthermal environments.[41]

15.2.2 Hospital-prepared EN formulas shall be stored in a refrigerator (per established guidelines), unless the formula will be administered immediately to the patient.

15.3 EN labels shall be standardized.

15.3.1 EN formula containers shall be labeled accurately with the contents and 2 patient identifiers (eg, name, medical record number, date of birth), product name and strength, additives, volume, and appropriate hang time.[41]

15.3.2 EN formula container labels shall also containdeliverysite/access,route(enteral), and method of administration (eg, continuous, cyclic, bolus).[41]

15.3.3 EN formula container labels shall contain a statement indicating that the product is for enteral administration only.[41]

15.3.4 EN formula container labels shall contain a statement indicating that the product is not for IV administration.[41]

Standard 16. Administration of Nutrition Support Therapy

EN formulas and PN admixtures shall be administered safely and accurately in accordance with the prescribed order and consistent with the patient's tolerance.[40,41]

16.1 Nutrition support therapy shall be administered by or under the supervision of trained personnel.

16.2 Hospital-specific procedures shall exist regarding techniques used to administer nutrition support therapy. Organizations should use infusion pumps with the ability to reduce errors.[40]

16.3 Acute care facilities should establish a policy that prohibits the use of a PN admixture prepared for administration at home or in subacute or long-term care facilities. PN should be discontinued prior to discharge or transport to another

facility.[40]

16.4 Each PN admixture should be inspected prior to and during administration. If visual changes are present, the admixture shall not be administered, and the pharmacy shall be notified.[40,60]

16.5 Before nutrition support therapy is administered to the patient, the label on the container shall be checked against the order and the patient's identity shall be verified per hospital policy to assure the prescribed formulation is delivered to the appropriate patient and administered by the correct route at the designated/intended time.[40,41,61,62] Administration tubing should be attached to PN containers immediately prior to use.[40]

16.6 The administration rate of the prescribed nutrition support therapy shall be checked each time a new volume is ordered or initiated and periodically during its administration.[40,41] Use of an independent double-check verification should be performed by a second clinician prior to beginning a PN infusion.[40,41,62]

16.7 Procedures shall be written to prevent and manage vascular or enteral access device occlusion and IV extravasation.[41,42,44,63]

16.8 EN and PN processes shall be documented in the patient's medical record including tolerance, administration volumes, and hourly rates. The amount of nutrition therapy ordered vs amount administered should be noted and reasons for discrepancies evaluated.[41]

16.9 Policies and procedures shall exist to prevent, diagnose, manage, and monitor patient infections caused by contamination of the PN admixture or the equipment/devices used in its administration, as PN is an independent risk factor for CLABSI.[46-48,64]

16.9.1 Infection prevention strategies shall be used to minimize CLABSI including a bundle of targeted, evidence-based catheter insertion and maintenance practices.[46-48]

16.9.2 Access ports shall be disinfected with an appropriate antiseptic prior to catheter manipulation and manipulation should be minimized; vascular access devices used for PN should not be used for blood sampling.[46,47,64] Coinfusion of fluids or medications into the PN system should be avoided, if possible. If no alternatives are available, a pharmacist shall review the compatibility and stability data for coinfusion prior to administration.[40,44]

16.9.3 Unit-specific data regarding CLABSI shall be shared with all internal stakeholders and reported to external agencies as required.[47]

16.9.4 PN admixtures shall be labeled with the beyond-use date and time and discarded as indicated. Once the delivery system is accessed, the administration of a PN admixture shall be completed within 24 hours.[40,44-46,55]

16.9.5 Administration sets for PN shall be changed every 24 hours or with each new PN container. A 1.2-micron filter shall be used for all total nutrient admixtures and a 0.22-micron filter for dextrose/amino acids (2-in-1) admixtures.[40,44,65]

16.9.6 ILE administered separately from PN admixtures (dextrose/amino acids) shall be infused through a 1.2-micron filter and be completed within 12 hours of initiating the infusion.[40,44,65]

16.10 A policy shall exist regarding the maximal rate of administration for ILE. Manufacturers'recommendations should be considered in formulating this statement.

16.11 Cycling of PN admixtures should be considered for patients with or at risk for liver dysfunction, on long-term PN, or those who are stable, active, and may benefit from infusion-free time.[66,67]

16.12 Prevention strategies shall be used to minimize the risk of microbial contamination of EN formulations. (Refer to the Enteral Nutrition Practice Recommendations[41] and Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient[31] for details.)

16.13 Procedures and protocols to minimize the risk of regurgitation and aspiration of EN formulations should be implemented.[41]

16.13.1 All patients receiving EN shall be assessed for risk of aspiration and steps employed to reduce aspiration risk and pneumonia.[31,41,68-70]

16.13.2 The head of the bed should be elevated 30–45° during EN administration unless contraindicated.[31,41,69-71]

16.14 An enteral feeding protocol should be designed to assure that optimal nutrients are delivered and unnecessary interruption of feeding minimized. Gastric residual volumes may be used to assess EN tolerance as part of a multifaceted approach.[31,41,68]

16.15 Policies and procedures shall exist to minimize the risk of enteral misconnections.[41,72-74]

16.15.1 Hospitals should conform to International Organization of Standardization (ISO) standard 80369-3 that is driving the production of products with incompatible connectors by designing features that make incorrect connections impossible (eg, ENFit).[41,74-77] Enteral delivery devices (administration sets, feeding tubes, and enteral syringes) with connectors that can physically connect with other nonenteral connectors shall not be purchased.

16.15.2 Standard Luer syringes shall not be used to administer oral or enteral medications or EN formula.[41,74]

16.15.3 Tubes or catheters shall be traced from the patient to the point of origin before connecting any new device or

infusion.[41,74,76]

16.15.4 Tubes and catheters having different purposes should be routed in different, standardized directions (eg, IV lines routed toward the head; enteric lines toward the feet) and labeled at proximal and distal tubing ends.[73]

16.16 Protocols shall be established for administering medications and modular products through an enteral access device.[41]

16.16.1 Medications should not be mixed directly with EN formulas due to potential drug-drug and drug-nutrient interactions.[41,78-81]

16.16.2 Medication orders should specify the route of delivery (eg, PO, NG tube, G tube, J tube) and be administered according to current guidelines. Special considerations include use of proper dosage form,administrationof thedrugseparate from the EN formula and other drugs, and the location of drug delivery in the gastrointestinal tract.[41,78-83]

16.16.3 Enteral access device(s) should be flushed appropriately before and after each medication administration and restarting EN administration to help prevent occlusion.[41,80,82]

Standard 17. Adverse Events Management

An adverse event, including sentinel events related to the administration of nutrition support therapy and the equipment/access devices, shall be documented and reported according to hospital protocol to promote a culture of patient safety. Protocols should be developed and followed to decrease the risk of adverse events.

Chapter V: Monitoring and Reevaluating the Nutrition Care Plan

Standard 18. Parameters and Frequency

A plan for monitoring the effect of nutrition support therapy interventions should be stated in the nutrition care plan.[36,40,41]

Monitoringparametersarechosenrelativetothetherapy goalsof thenutritioncareplan.Thenutritioncareplanshall berevisedtooptimizenutritionsupporttherapyandachieve predetermined goals, as indicated.

18.1 The frequency of monitoring should depend on severity of illness, level of metabolic stress, nutrition status, as well as the patient's clinical condition.[31,36,40,41]

18.1.1 Daily or more frequent monitoring should berequiredinpatientswhoarecriticallyill, havedebilitatingdiseases(eg,diabetesmellitus) or infection, are at risk for refeeding

syndrome complications, are transitioning between PN or EN and oral diet, or have experienced complications associated with nutrition support therapy.

18.1.2 Weekly or as clinically indicated monitoring may be needed in patients who are clinically and metabolically stable with documented stable laboratory parameters.

18.2 Monitoring parameters should include the following:

Physicalassessment,includingclinicalsignsof fluid and nutrient excess or deficiency

Functional status

Vital signs

Actual nutrient intake (oral, enteral, and parenteral)

Weight

Laboratory data

Diagnostic tests

Review of all medications

Changes in gastrointestinal function

Input and output/fluid balance

18.3 Appropriate changes in nutrition support therapy shall be made based on results of monitored parameters. Recommended changes in nutrition supporttherapyincludingENformula/PNadmixture or administration route and resulting outcomes shall be documented in the nutrition care

plan.[84]

18.4 Protocols should be established to maintain blood glucose control in patients receiving EN or

PN.[85-87]

Standard 19. Reevaluation of Nutrition Care Plan

The patient shall be monitored for progress toward shortand long-term goals as defined in the nutrition care

plan.[36,41]

19.1 Appropriate parameters should be measured serially during nutrition support therapy and documented.[36,40,41] Parameters may include weight change, changes in laboratory data, adequacy of intake, ability to transition to oral diet, functional status performance, and quality of life.

19.2 The monitoring parameters should be compared with the goals of the nutrition care plan. If goals arenotbeingmet,anewclinicalissueorcomplication develops, and/or an adverse event occurs, the nutrition care plan should be modified.

Chapter VI: Transition of Therapy

Standard 20. Adequacy of Intake

The transition of nutrition therapies shall be monitored. Recommendations for improving oral and EN intake shall be documented. Adequacy of energy and nutrient intake is based on clinical judgment and shall be assessed and documented before discontinuation of nutrition support therapy.[31,35,40] (See Figure 2: Route of administration algorithm.)

Standard 21. Continuity of Care

Continuity of the nutrition support therapy shall occur through active communication with all members of the patient care team, the patient, and caregiver(s). (See Figure 1: Adult nutrition care pathway.)

21.1 A plan shall be developed for transition of nutrition support therapy to an alternate healthcare facility or to home care and should include identification of the primary clinician responsible for coordinating, monitoring, providing education, and ordering home nutrition support

therapy.[31,36,40,41,87,88]

21.2 Indications for home nutrition support therapy shall be documented.

21.3 Appropriate education should be provided to patient and/or caregiver(s) and documented before discharge. Communication with home infusion and healthcare agencies and with the patient's home nutrition support management team should be established prior to hospital discharge.

21.4 The nutrition support therapy prescription and administration schedule should be documented and communicated with home infusion and home

healthagenciesbeforedischarge.[36,40,41,45,88] Specifically, with PN, there should be pharmacistto-pharmacist communication to the alternate healthcare facilities or home agencies.

21.5Periodic monitoring should be recommended de-

pending on patient's condition.[35,39,40,86]

Standard 22. Nutrition Therapy at End-of-Life Care

The decision on nutrition support therapy in an end-oflife setting should be determined by patient autonomy and the patient's family member(s) or surrogate decision maker. The patient or the patient's family member(s) or surrogate decision maker shall decide on acceptance or

refusal of medical therapy.[36,41,86,88-90]

22.1 The clinician has no obligation to provide nutrition support therapy and hydration to a patient in the end-of life situation.[88-90]

22.2 Decisions at end-of-life are often made based on healthcare and spiritual literacy of the patient and his/her family; they shall be involved in the healthcare process of end-of-life.

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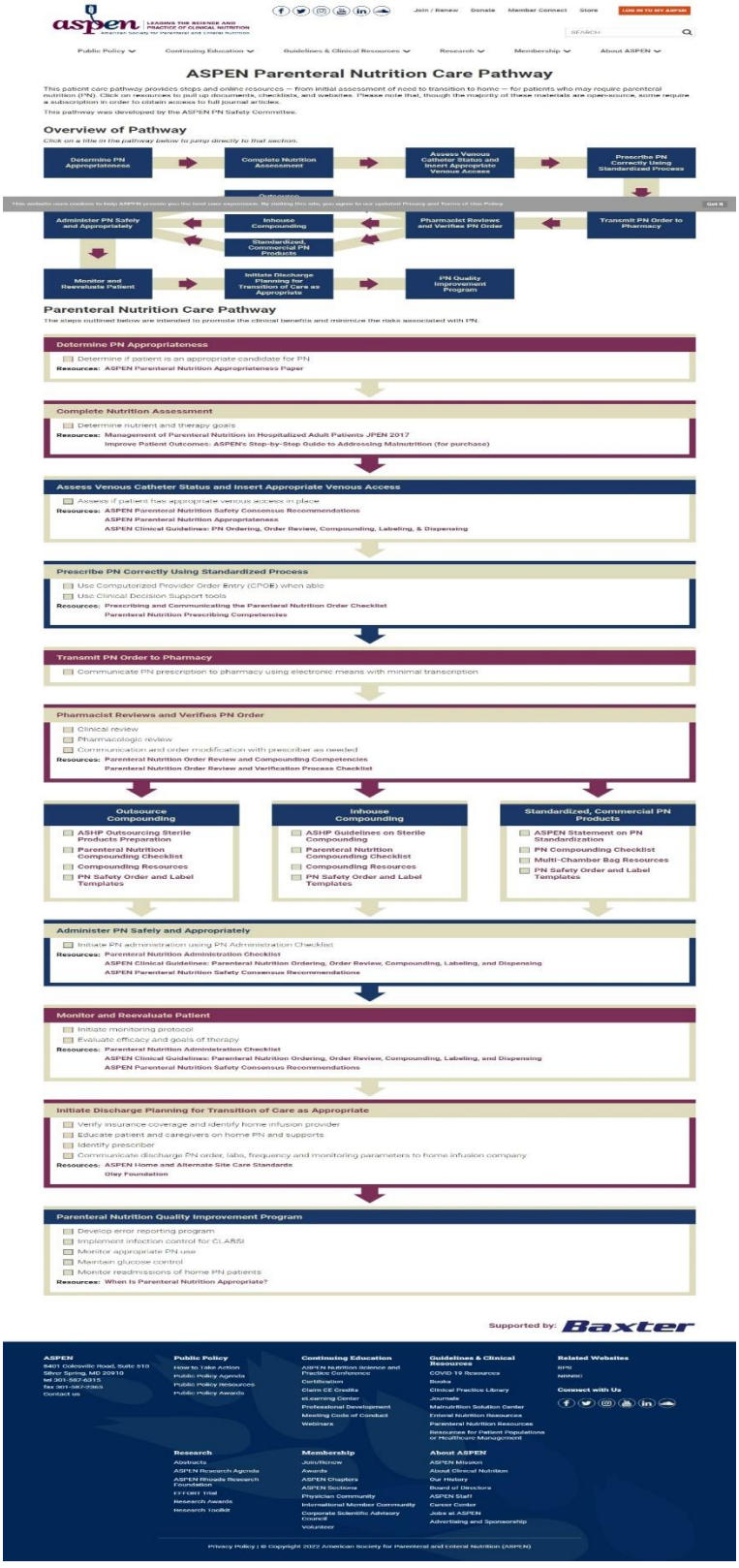
ASPEN Parental Nutrition Care Pathway



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ASPEN Parenteral Nutrition Care Pathway

This patient care pathway provides steps and online resources — from initial assessment of need to transition to home — for patients who may require parenteral nutrition (PN). Click on resources to pull up documents, checklists, and websites. Please note that, though the majority of these materials are open-source, some require a subscription in order to obtain access to full journal articles.

This pathway was developed by the ASPEN PN Safety Committee.

Overview of Pathway

Click on a title in the pathway below to jump directly to that section.

Determine PN Appropriateness → Complete Nutrition Assessment → Assess Venous Catheter Status and Insert Appropriate Venous Access → Prescribe PN Correctly Using Standardized Process → Transmit PN Order to Pharmacy → Pharmacist Reviews and Verifies PN Order → Outsource Compounding / Inhouse Compounding / Standardized, Commercial PN Products → Administer PN Safely and Appropriately → Monitor and Reevaluate Patient → Initiate Discharge Planning for Transition of Care as Appropriate → PN Quality Improvement Program

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Parenteral Nutrition Care Pathway

The steps outlined below are intended to promote the clinical benefits and minimize the risks associated with PN.

Determine PN Appropriateness

- ☐ Determine if patient is an appropriate candidate for PN

Resources: ASPEN Parenteral Nutrition Appropriateness Paper

Complete Nutrition Assessment

- ☐ Determine nutrient and therapy goals

Resources: Management of Parenteral Nutrition in Hospitalized Adult Patients JPEN 2017
Improve Patient Outcomes: ASPEN's Step-by-Step Guide to Addressing Malnutrition (for purchase)

Assess Venous Catheter Status and Insert Appropriate Venous Access

- ☐ Assess if patient has appropriate venous access in place

Resources: ASPEN Parenteral Nutrition Safety Consensus Recommendations
ASPEN Parenteral Nutrition Appropriateness
ASPEN Clinical Guideline: PN Ordering, Order Review, Compounding, Labeling, & Dispensing

Prescribe PN Correctly Using Standardized Process

- ☐ Use Computerized Provider Order Entry (CPOE) when able
- ☐ Use Clinical Decision Support tools

Resources: Prescribing and Communicating the Parenteral Nutrition Order Checklist
Parenteral Nutrition Prescribing Competencies

Transmit PN Order to Pharmacy

- ☐ Communicate PN prescription to pharmacy using electronic means with minimal transcription

Pharmacist Reviews and Verifies PN Order

- ☐ Clinical review
- ☐ Pharmacologic review
- ☐ Communication and order modification with prescriber as needed

Resources: Parenteral Nutrition Order Review and Compounding Competencies
Parenteral Nutrition Order Review and Verification Process Checklist

Outsource Compounding

- ☐ ASHP Outsourcing Sterile Products Preparation
- ☐ Parenteral Nutrition Compounding Checklist
- ☐ Compounding Resources
- ☐ PN Safety Order and Label Templates

Inhouse Compounding

- ☐ ASHP Guidelines on Sterile Compounding
- ☐ Parenteral Nutrition Compounding Checklist
- ☐ Compounding Resources
- ☐ PN Safety Order and Label Templates

Standardized, Commercial PN Products

- ☐ ASPEN Statement on PN Standardization
- ☐ PN Compounding Checklist
- ☐ Multi-Chamber Bag Resources
- ☐ PN Safety Order and Label Templates

Administer PN Safely and Appropriately

- ☐ Initiate PN administration using PN Administration Checklist

Resources: Parenteral Nutrition Administration Checklist
ASPEN Clinical Guideline: Parenteral Nutrition Ordering, Order Review, Compounding, Labeling, and Dispensing
ASPEN Parenteral Nutrition Safety Consensus Recommendations

Monitor and Reevaluate Patient

- ☐ Initiate monitoring protocol
- ☐ Evaluate efficacy and goals of therapy

Resources: Parenteral Nutrition Administration Checklist
ASPEN Clinical Guideline: Parenteral Nutrition Ordering, Order Review, Compounding, Labeling, and Dispensing
ASPEN Parenteral Nutrition Safety Consensus Recommendations

Initiate Discharge Planning for Transition of Care as Appropriate

- ☐ Verify insurance coverage and identify home infusion provider
- ☐ Educate patient and caregivers on home PN and supports
- ☐ Identify prescriber
- ☐ Communicate discharge PN order, labs, frequency and monitoring parameters to home infusion company

Resources: ASPEN Home and Alternate Site Care Standards
Oley Foundation

Parenteral Nutrition Quality Improvement Program

- ☐ Develop error reporting program
- ☐ Implement infection control for CLABSI
- ☐ Monitor appropriate PN use
- ☐ Maintain glucose control
- ☐ Monitor readmissions of home PN patients

Resources: When Is Parenteral Nutrition Appropriate?

Supported by: Baxter

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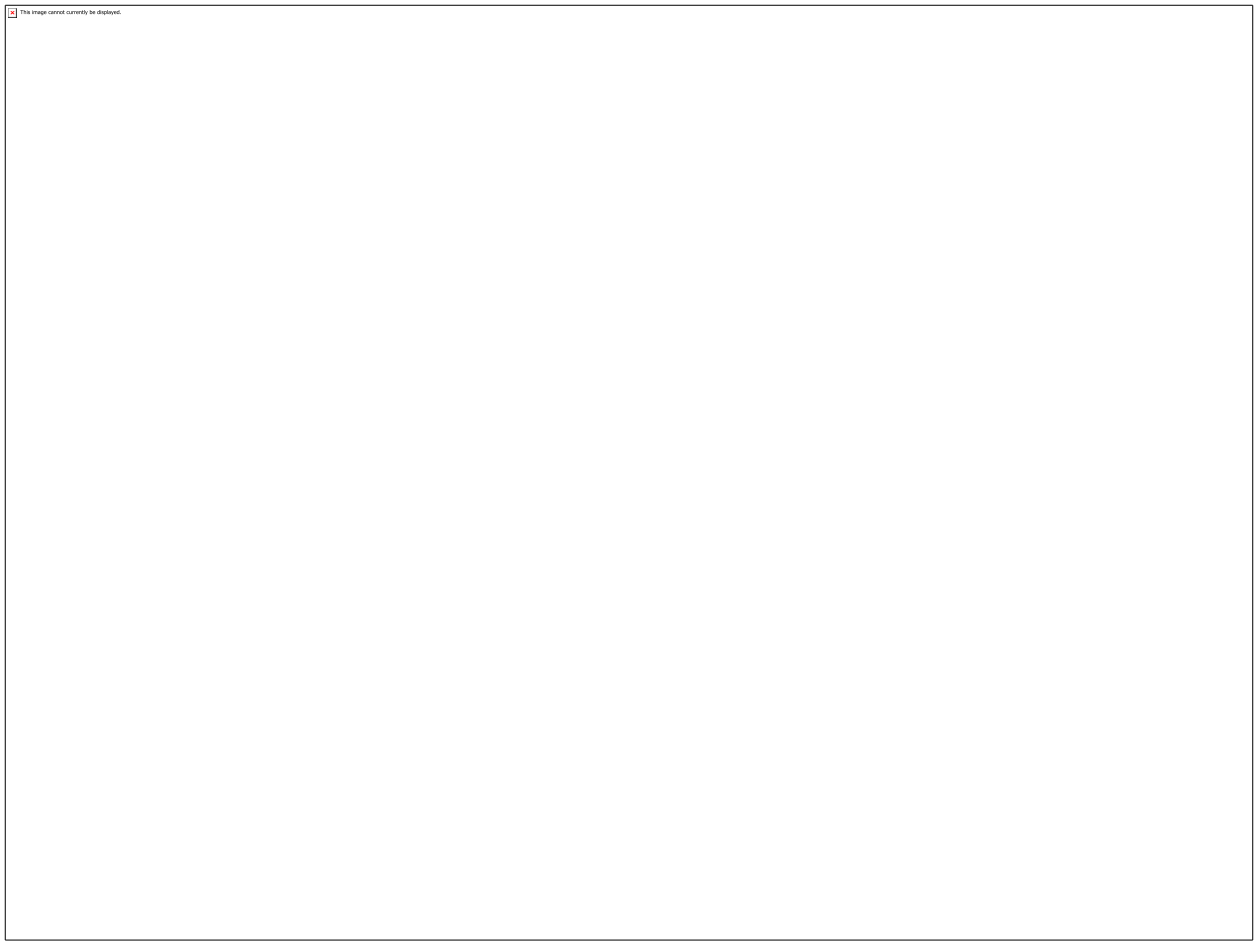
PN Calculation Worksheet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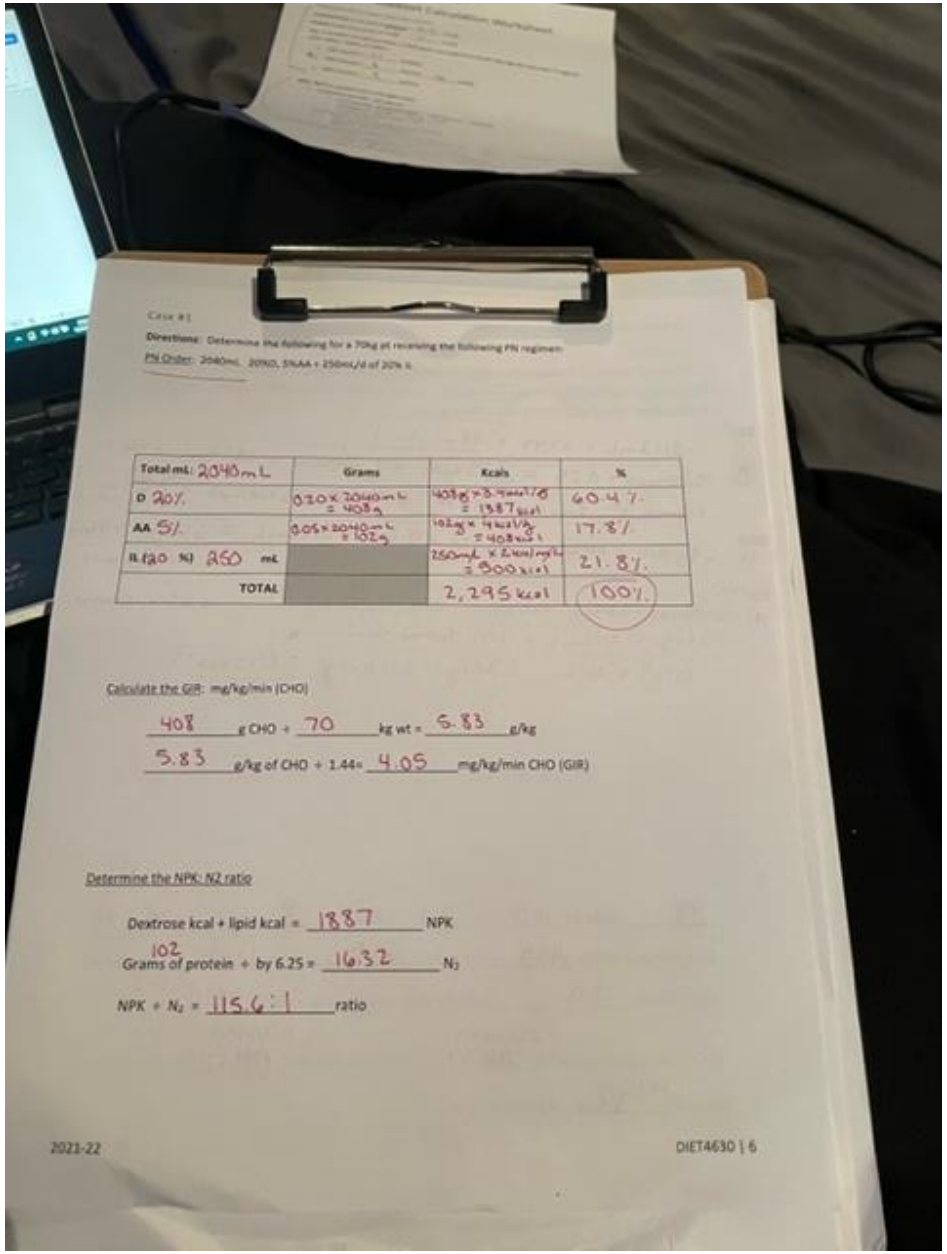


Case #1

Directions: Determine the following for a 70kg pt receiving the following PN regimen:

PN Order: 2040mL 20%D, 5%AA + 250mL/d of 20% IL

Total mL: 2040mL	Grams	Kcals	%
D 20%	0.20 × 2040mL = 408g	408g × 3.4kcal/g = 1387kcal	60.4%
AA 5%	0.05 × 2040mL = 102g	102g × 4kcal/g = 408kcal	17.8%
IL (20 %) 250 mL		250mL × 2kcal/mL = 500kcal	21.8%
TOTAL		2,295 kcal	100%

Calculate the GIR: mg/kg/min (CHO)

408 g CHO ÷ 70 kg wt = 5.83 g/kg

5.83 g/kg of CHO ÷ 1.44= 4.05 mg/kg/min CHO (GIR)

Determine the NPK: N2 ratio

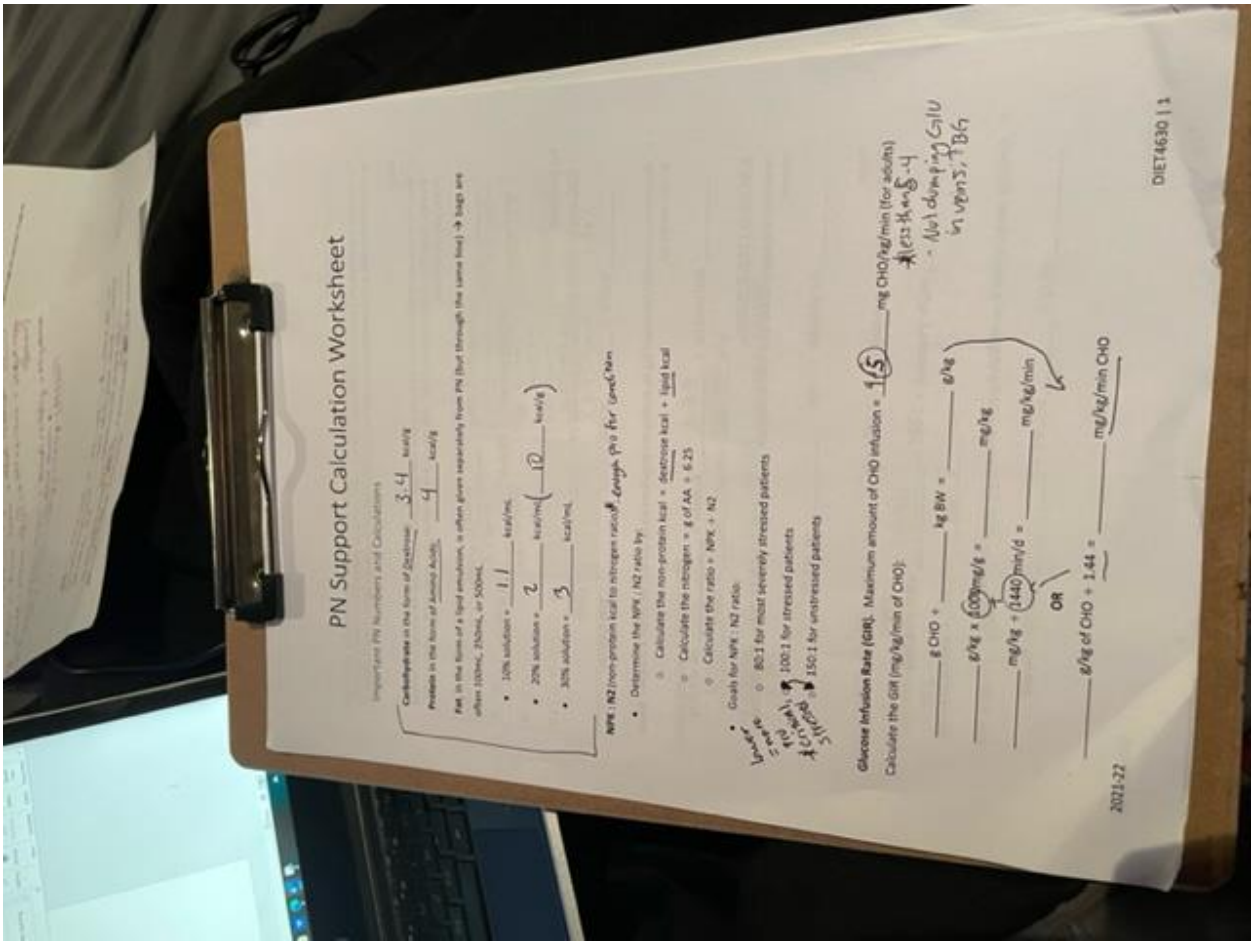
Dextrose kcal + lipid kcal = 1887 NPK

Grams of protein (102) ÷ by 6.25 = 16.32 N_2

NPK ÷ N_2 = 115.6 : 1 ratio

2021-22

DIET4630 | 6



PN Support Calculation Worksheet

Important PN Numbers and Calculations

Carbohydrate in the form of Dextrose: 3.4 kcal/g

Protein in the form of Amino Acids: 4 kcal/g

Fat, in the form of a lipid emulsion, is often given separately from PN (but through the same line) → bags are often 100mL, 250mL, or 500mL

- 10% solution = 1.1 kcal/mL
- 20% solution = 2 kcal/mL (12 kcal/g)
- 30% solution = 3 kcal/mL

NPK : N2 (non-protein kcal to nitrogen ratio) Energy (Pro for Protein

- Determine the NPK : N2 ratio by
  - Calculate the non-protein kcal = dextrose kcal + lipid kcal
  - Calculate the nitrogen = # of AA ÷ 6.25
  - Calculate the ratio = NPK ÷ N2
- Goals for NPK : N2 ratio
  - 80:1 for most severely stressed patients
  - 100:1 for stressed patients
  - 150:1 for unstressed patients

Glucose Infusion Rate (GIR): Maximum amount of CHO infusion = 1.5 mg CHO/kg/min (for adults)

Calculate the GIR (mg/kg/min of CHO):

_____ g CHO ÷ _____ kg BW = _____ g/kg

_____ g/kg x 1000 mg/g = _____ mg/kg

_____ mg/kg ÷ 1440 min/d = _____ mg/kg/min

OR

_____ g/kg of CHO ÷ 1.44 = _____ mg/kg/min CHO

2021-22

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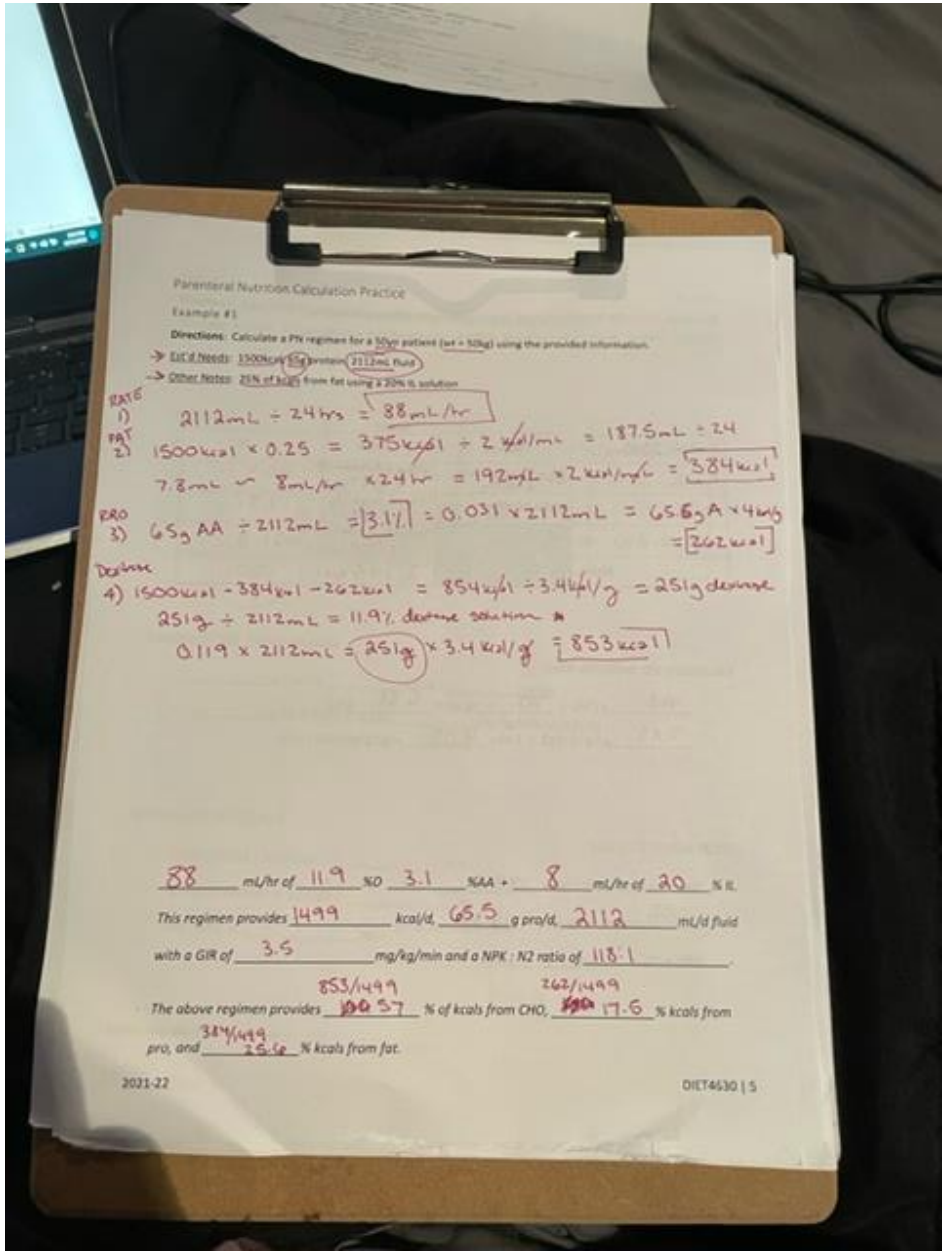
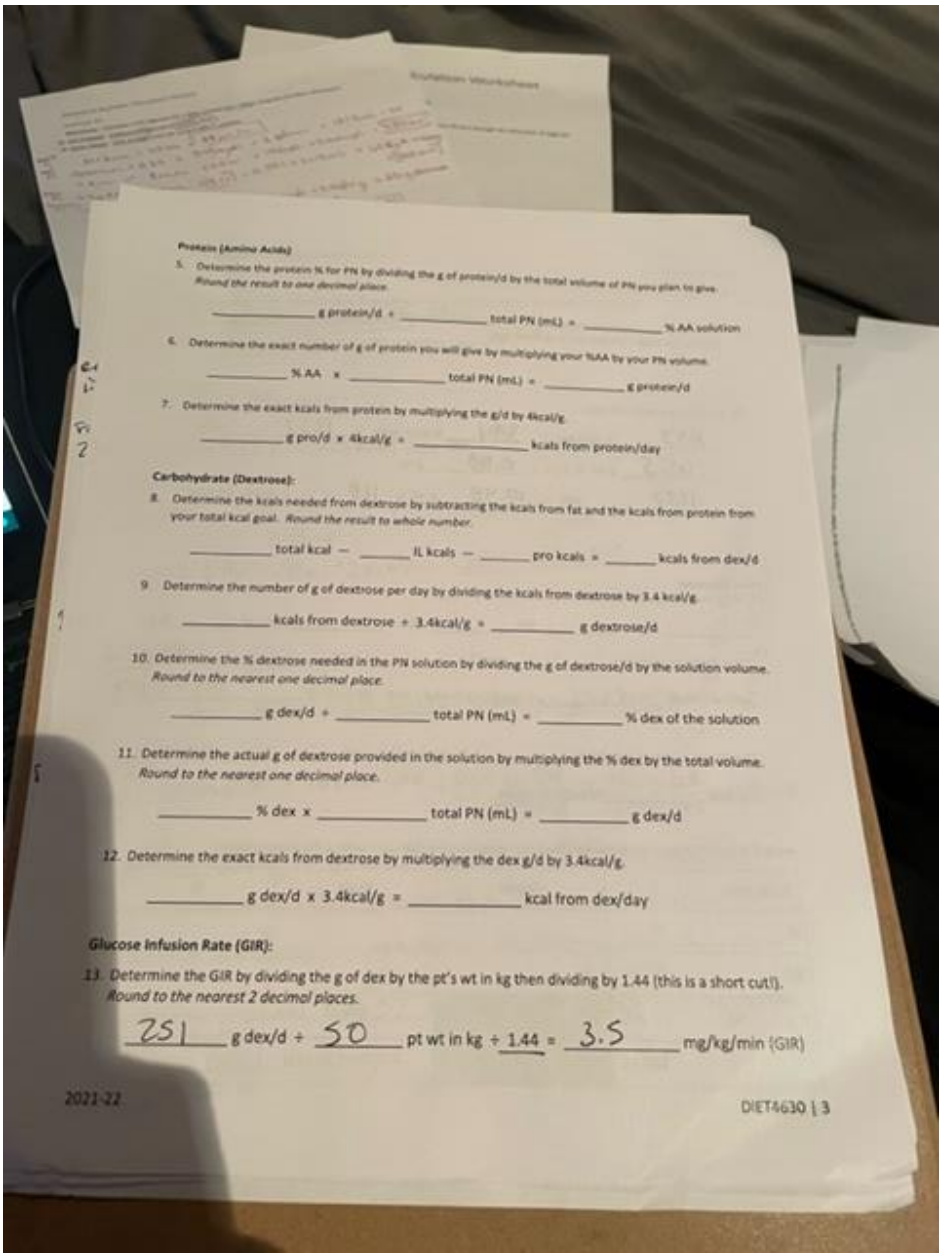

Parenteral Nutrition Calculation Practice
Example #1
Directions: Calculate a PN regimen for a 50yr patient (wt = 50kg) using the provided information.
Est'd Needs: 1500kcal/d, 65g protein, 2112mL fluid
Other Notes: 25% of kcals from fat using a 20% IL solution
RATE
1) 2112mL ÷ 24hrs = 88mL/hr
FAT
2) 1500kcal × 0.25 = 375kcal ÷ 2kcal/mL = 187.5mL ÷ 24
7.8mL ~ 8mL/hr ×24hr = 192mL ×2kcal/mL = 384kcal
PRO
3) 65g AA ÷ 2112mL = 3.1% = 0.031 × 2112mL = 65.6g AA × 4kcal/g = 262kcal
Dextrose
4) 1500kcal - 384kcal - 262kcal = 854kcal ÷ 3.4kcal/g = 251g dextrose
251g ÷ 2112mL = 11.9% dextrose solution
0.119 × 2112mL = 251g × 3.4kcal/g = 853kcal
88 mL/hr of 11.9 %D 3.1 %AA + 8 mL/hr of 20 % IL
This regimen provides 1499 kcal/d, 65.5 g pro/d, 2112 mL/d fluid
with a GIR of 3.5 mg/kg/min and a NPK : N2 ratio of 118:1
853/1499
The above regimen provides 57 % of kcals from CHO, 262/1499 17.6 % kcals from
384/1499
pro, and 25.6 % kcals from fat.
2021-22
DIET4630 | 5



Protein (Amino Acids)

5. Determine the protein % for PN by dividing the g of protein/d by the total volume of PN you plan to give. *Round the result to one decimal place.*

_____ g protein/d ÷ _____ total PN (mL) = _____ % AA solution

6. Determine the exact number of g of protein you will give by multiplying your %AA by your PN volume.

_____ % AA x _____ total PN (mL) = _____ g protein/d

7. Determine the exact kcals from protein by multiplying the g/d by 4kcal/g.

_____ g pro/d x 4kcal/g = _____ kcals from protein/day

Carbohydrate (Dextrose):

8. Determine the kcals needed from dextrose by subtracting the kcals from fat and the kcals from protein from your total kcal goal. *Round the result to whole number.*

_____ total kcal – _____ IL kcals – _____ pro kcals = _____ kcals from dex/d

9. Determine the number of g of dextrose per day by dividing the kcals from dextrose by 3.4 kcal/g.

_____ kcals from dextrose ÷ 3.4kcal/g = _____ g dextrose/d

10. Determine the % dextrose needed in the PN solution by dividing the g of dextrose/d by the solution volume. *Round to the nearest one decimal place.*

_____ g dex/d ÷ _____ total PN (mL) = _____ % dex of the solution

11. Determine the actual g of dextrose provided in the solution by multiplying the % dex by the total volume. *Round to the nearest one decimal place.*

_____ % dex x _____ total PN (mL) = _____ g dex/d

12. Determine the exact kcals from dextrose by multiplying the dex g/d by 3.4kcal/g.

_____ g dex/d x 3.4kcal/g = _____ kcal from dex/day

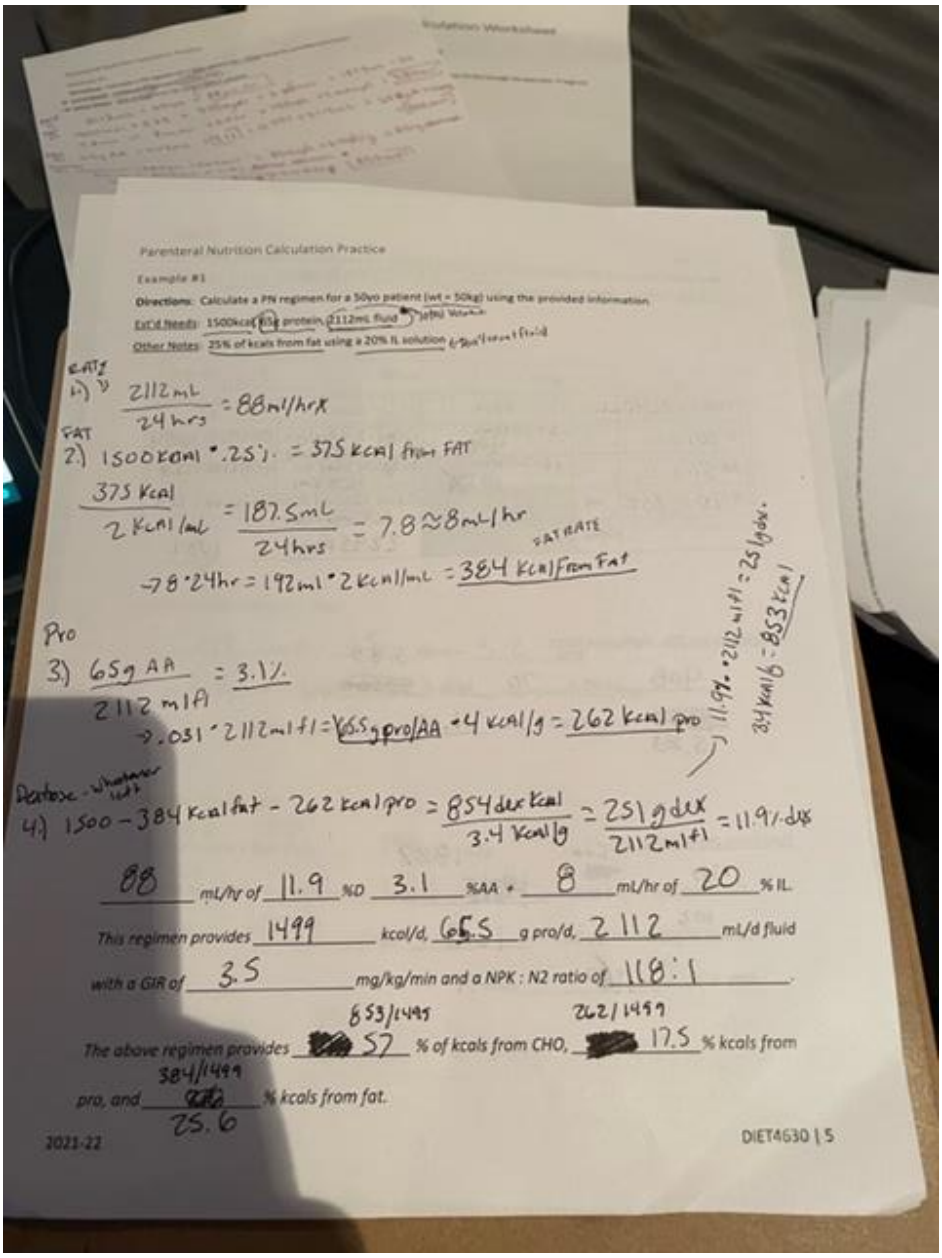
Glucose Infusion Rate (GIR):

13. Determine the GIR by dividing the g of dex by the pt's wt in kg then dividing by 1.44 (this is a short cut!). *Round to the nearest 2 decimal places.*

251 g dex/d ÷ 50 pt wt in kg ÷ 1.44 = 3.5 mg/kg/min (GIR)

2021-22

DIET4630 | 3



Parenteral Nutrition Calculation Practice

Example #1

Directions: Calculate a PN regimen for a 50yo patient (wt = 50kg) using the provided information.

Est'd Needs: 1500kcal, 65g protein, 2112mL fluid

Other Notes: 25% of kcals from fat using a 20% IL solution

FAT

1.) $\frac{2112\,mL}{24\,hrs} = 88\,ml/hr$

FAT

2.) $1500\,kcal \cdot .25 = 375\,kcal$ from FAT

$\frac{375\,kcal}{2\,kcal/mL} = \frac{187.5\,mL}{24\,hrs} = 7.8 \approx 8\,mL/hr$ FAT RATE

$\rightarrow 8 \cdot 24hr = 192ml \cdot 2\,kcal/mL = 384\,kcal$ From Fat

Pro

3.) $\frac{65g\,AA}{2112\,mlAA} = 3.1\%$

$\rightarrow .031 \cdot 2112\,ml\,fl = 65.5\,g\,pro/AA \cdot 4\,kcal/g = 262\,kcal\,pro$

$11.9\% \cdot 2112\,ml\,fl = 251\,g\,dex$

$3.4\,kcal/g = 853\,kcal$

Dextrose - whatever is left

4.) $1500 - 384\,kcal\,fat - 262\,kcal\,pro = 854\,dex\,kcal$

$\frac{854\,dex\,kcal}{3.4\,kcal/g} = \frac{251\,g\,dex}{2112\,ml\,fl} = 11.9\%\,dex$

88 mL/hr of 11.9 %D 3.1 %AA + 8 mL/hr of 20 %IL

This regimen provides 1499 kcal/d, 65.5 g pro/d, 2112 mL/d fluid

with a GIR of 3.5 mg/kg/min and a NPK : N2 ratio of 168:1

853/1499 262/1499

The above regimen provides [redacted] 57 % of kcals from CHO, [redacted] 17.5 % kcals from

384/1499

pro, and [redacted] 25.6 % kcals from fat.

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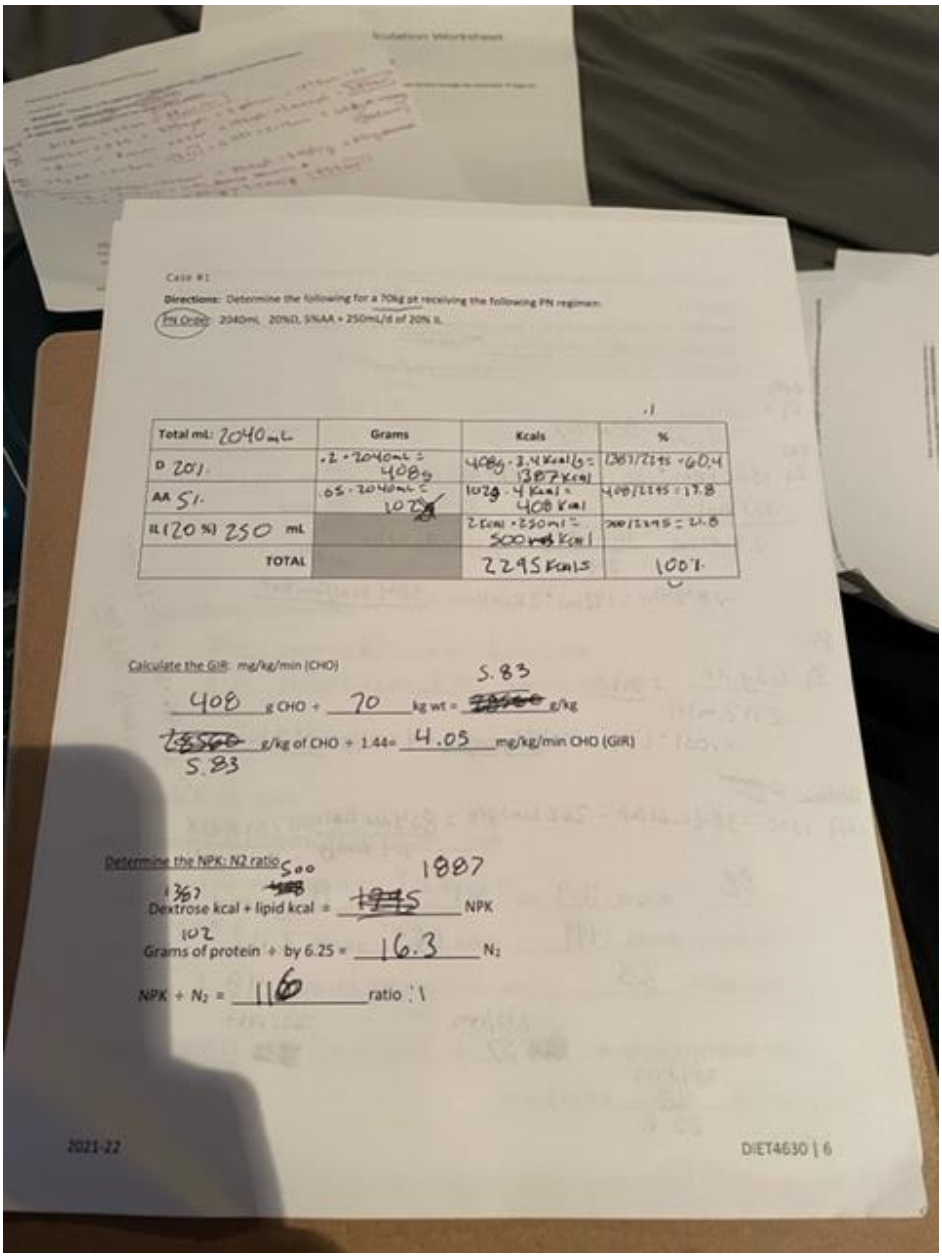


Case #1

Directions: Determine the following for a 70kg pt receiving the following PN regimen:

PN Order: 2040mL 20%D, 5%AA + 250mL/d of 20% IL

Total mL: 2040mL	Grams	Kcals	%
D 20%	.2 · 2040mL = 408g	408g · 3.4 Kcal/g = 1387 Kcal	1387/2295 = 60.4
AA 5%	.05 · 2040mL = 102g	102g · 4 Kcal = 408 Kcal	408/2295 = 17.8
IL (20%) 250 mL		2 Kcal · 250 ml = 500 Kcal	500/2295 = 21.8
TOTAL		2295 Kcals	100%

Calculate the GIR: mg/kg/min (CHO)

408 g CHO ÷ 70 kg wt = 5.83 g/kg

5.83 g/kg of CHO ÷ 1.44 = 4.05 mg/kg/min CHO (GIR)

Determine the NPK: N2 ratio

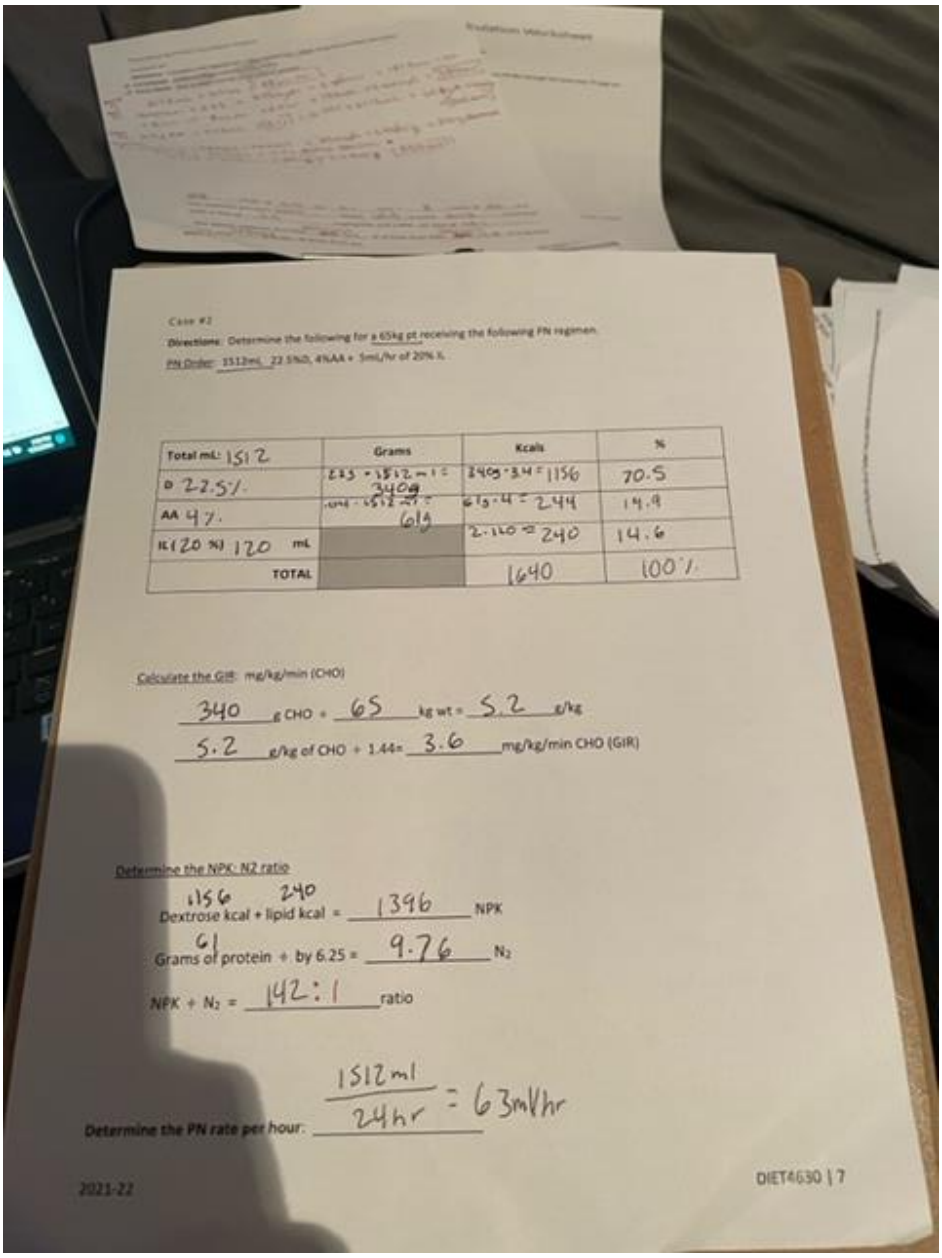
1387 Dextrose kcal + 500 lipid kcal = 1887 NPK

102 Grams of protein ÷ by 6.25 = 16.3 N_2

NPK ÷ N_2 = 116 ratio : 1

2021-22

DIET4630 | 6



Case #2

Directions: Determine the following for a 65kg pt receiving the following PN regimen.

PN Order: 1512mL 22.5%D, 4%AA + 5mL/hr of 20% IL

Total mL: 1512	Grams	Kcals	%
D 22.5%	.225 × 1512 mL = 340g	340 × 3.4 = 1156	70.5
AA 4%	.04 × 1512 mL = 61g	61 × 4 = 244	14.9
IL (20 %) 120 mL		2 × 120 = 240	14.6
TOTAL		1640	100%

Calculate the GIR: mg/kg/min (CHO)

340 g CHO ÷ 65 kg wt = 5.2 g/kg

5.2 g/kg of CHO ÷ 1.44 = 3.6 mg/kg/min CHO (GIR)

Determine the NPK: N2 ratio

1156 240

Dextrose kcal + lipid kcal = 1396 NPK

61

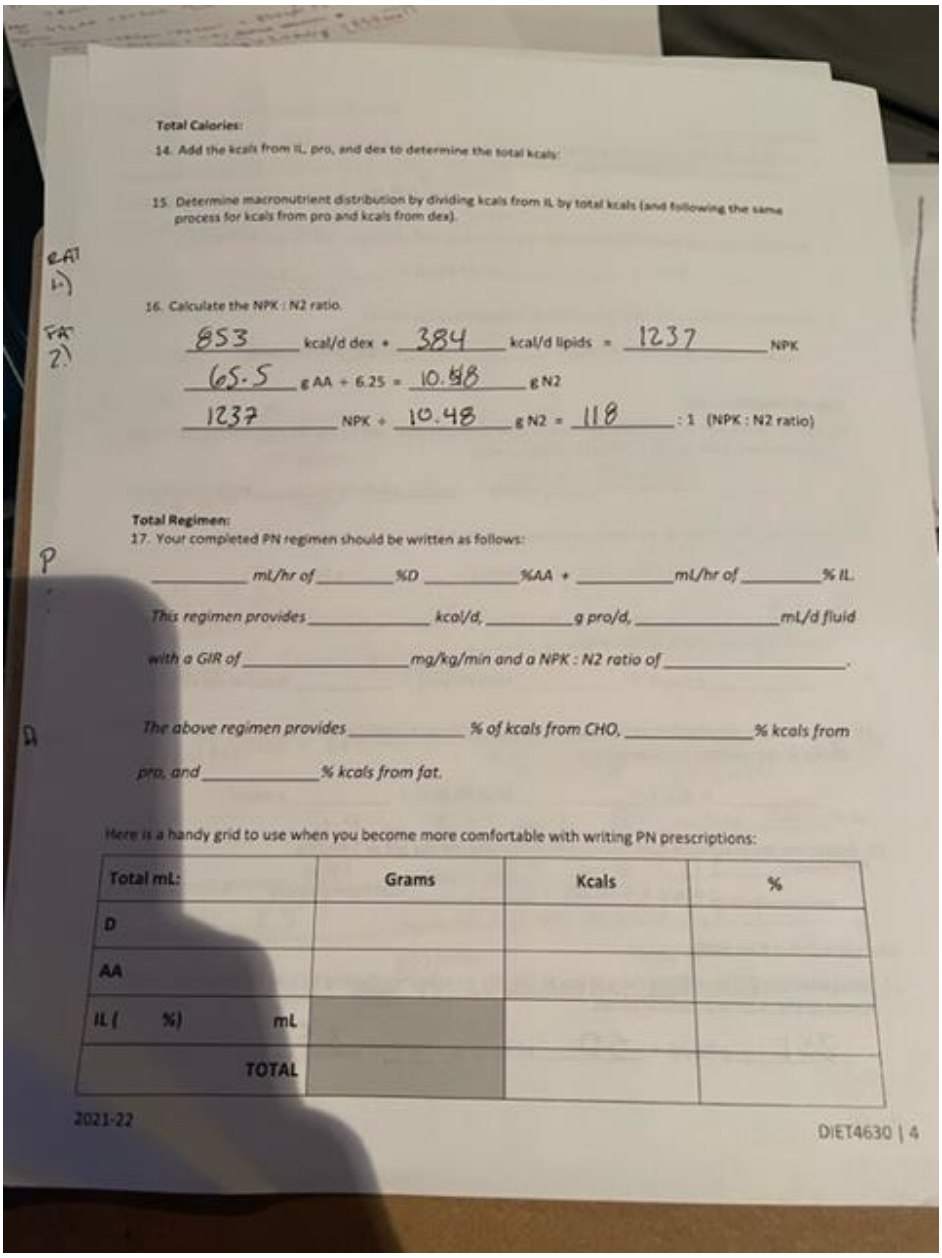
Grams of protein ÷ by 6.25 = 9.76 N_2

NPK ÷ N_2 = 142:1 ratio

Determine the PN rate per hour: $\frac{1512\text{ml}}{24\text{hr}} = 63\text{ml/hr}$

2021-22

DIET4630 | 7



Total Calories:

14. Add the kcals from IL, pro, and dex to determine the total kcals.

15. Determine macronutrient distribution by dividing kcals from IL by total kcals (and following the same process for kcals from pro and kcals from dex).

16. Calculate the NPK : N2 ratio.

853 kcal/d dex + 384 kcal/d lipids = 1237 NPK

65.5 g AA ÷ 6.25 = 10.48 g N2

1237 NPK ÷ 10.48 g N2 = 118 : 1 (NPK : N2 ratio)

Total Regimen:

17. Your completed PN regimen should be written as follows:

_____ mL/hr of _____ %D _____ %AA + _____ mL/hr of _____ % IL

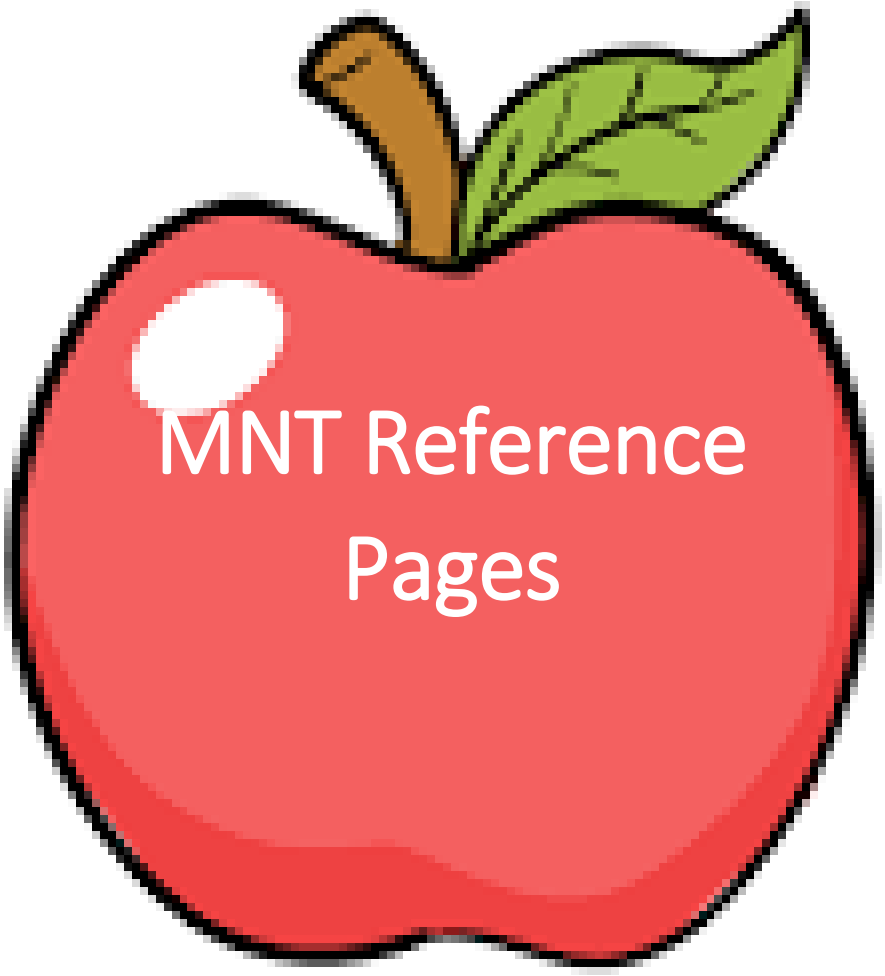
This regimen provides _____ kcal/d, _____ g pro/d, _____ mL/d fluid

with a GIR of _____ mg/kg/min and a NPK : N2 ratio of _____.

The above regimen provides _____ % of kcals from CHO, _____ % kcals from pro, and _____ % kcals from fat.

Here is a handy grid to use when you become more comfortable with writing PN prescriptions:

Total mL:	Grams	Kcals	%
D			
AA			
IL (%) mL			
TOTAL			


MNT Reference
Pages

Malnutrition

Refeeding Syndrome MNT Reference Page

Refeeding Syndrome

Definition: "severe shifts in fluid and and electrolyte levels, in particular phosphate levels, from extracellular to intracellular spaces in severy malnourished patients who have total body phosphorous depletion and are undergoing refeeding, whether orally, enterally, or parenterally" (Katzman, 2005).			
Macronutrient Distribution	65 %CHO	15 %PRO	20 %FAT
Calories	**Initial:**	**Advancement:**	**Goal:**
Protein			
Fluid	Watch for fluid overload,		
Supplementation Needs	Phosphorous, 200mg thiamine (given before initiation of nutrition support), potassium and magnesium		
Monitoring Criteria	Cardiac functioning and electrolyte levels/ fluid overload.		
OTHER NOTES: **Hypophosphatemia is the hallmark**			

Minor Risk Factors High Risk (2 or more of the following)	Major Risk Factors High Risk (1 or more of the following)	VERY High Risk
BMI <18.5kg/m^2	BMI <16kg/m^2	BMI <14kg/m^2
Little or no nutrient intake for >5 days	Little or no nutrient intake for >10 days	Little or no nutrition for >15 days
Unintentional wt loss of >10% in the past 3-6 months	Unintentional wt loss of >15% in the past 3-6 months	
History of alcohol misuse or drugs (including insulin, chemo, diuretics, or antacids)	Low levels of potassium, phosphate, magnesium prior to feeding	

may show early, rapid weight gain after initiation of nutrition support because of third spacing of fluid due to fluid and sodium intolerance.

References:

Nutritioncaremanual.org

Lecture

Refeeding Fish

HIV/ AIDS SLM Worksheet

HIV & AIDS

Self-Learning Assessment Worksheet

UNAIDS Fact Sheet

Answer the following questions:

In 2018, *there were __37.9_____ million people globally living with HIV*.

In 2018, _____*770,000*_____ *people died from AIDS-related illnesses*.

In 2018, __23.3_____ million people living with HIV were accessing antiretroviral therapy, up from _____7.7_____ million in 2010. ___62_____ % of all people living with HIV were accessing treatment.

Since 2010, new HIV infections among children have declined by ___41_____%.

AIDS-related deaths have been reduced by more than ____55_____% since the peak in 2004.

For antiretroviral therapy to be effective, adherence to medication schedules must be at least 95%

Review the "Regional Data—2018" table (p. 5) and "Regional Treatment Coverage—2018" table (p. 6) to answer the following questions:

__20.6_____ million people in Eastern and South Africa were living with HIV in 2018 and ___67___% of all people living with HIV accessed antiretroviral therapy.

__5_____ million people in Western and Central Africa were living with HIV in 2018 and __51____% of all people living with HIV accessed antiretroviral therapy.

___2.2____ million people in Western and Central Europe and N. America were living with HIV in 2018 and ____79__% of all people living with HIV accessed antiretroviral therapy.

In Eastern and Southern Africa there were ____800,000_____ new HIV infections in 2018.

In Western and Central Europe and N. America there were _____68,000_____ new HIV infections in 2018.

KRAUSE'S FOOD AND THE NUTRITION CARE PROCESS

Directions: Refer to chapter 37 in Krause's Food & The Nutrition Care Process.

Definitions:

AIDS: acquired immune deficiency syndrome cause by human immunodeficiency (HIV).

ART: antiretroviral therapy; slow the replication of the virus but don't get rid of the HIV infection

CD4+ cells: used as the major indicator of immune function in people with HIV infection. It is used to determine when to initiate ART and is the strongest predictor of disease progression

HALS: a syndrome that commonly includes any single component or a combination of all the above

HIV: human immunodeficiency (HIV), affects the body's ability to fight off infection and disease, which can ultimately lead to death

HIV Medications

There are MANY additional medications—this is a small sample of the ART medication classifications that may be prescribed to patients with HIV/AIDS. Refer to pages 760-763 for additional information.

Classification	Common Side Effects
Nucleoside and Nucleoside Reverse Transcriptase Inhibitors (NRTIs)	Hepatomegaly with steatosis Lactic acidosis—may cause persistent fatigue, abdominal pain or distension, N/V, dyspnea and shortness of breath, and hepatomegaly
Protease Inhibitors (PIs)	Hypercholesterolemia and hypertriglyceridemia which may increase the risk of CVD Lipodystrophy, onset or worsening of diabetes, and increased bleeding in hemophiliacs Immune Reconstitution Inflammatory Syndrome (IRIS) may occur as the immune system regains strength, s/sx of inflammation from previous infections may occur after anti-HIV treatment is initiated
Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs)	Rash IRIS (see above)

Use your text to answer the following questions:

Refer to Table 37-3 (p. 765)—note the HIV-related conditions and nutrition implications of each.

Refer to Table 37-6 (p. 769)—note the common micronutrient deficiencies and indications for supplementation.

Zinc is most commonly found in which of the following: Meats, Milk, dried legumes

ASPEN CORE CURRICULUM

Directions: Access the ASPEN Adult Nutrition Support Core Curriculum, 3rd edition on reserve at the Harborside Library. You are not required to read the entire chapter, as there is a lot of detailed information. Focus on the prompt questions below—answers are found in order throughout the text.

Background

In the US, which populations have the highest prevalence of HIV?

Young black males MSM

HIV is found in all body fluids except _____*urine*_____ *and* _____*sweat*_____. _____*seminal fluids*_____ *and* _____*blood*_____ *are the most infectious*.

A patient with an acute HIV infection is likely to experience 2-4 weeks of flu-like symptoms, loss of appetite, and wt loss- true

HIV/ AIDS patients are at increasedrisk of a variety of types of cancer including cervical cancer and lymphoma. – true

The diagnosis of AIDS is made when the CD4 count decreases below 200

List the 4 modes of transmission of the HIV virus including the examples provided (refer to Table 32-3):

TABLE 32-3 Modes of HIV Transmission

Route	Examples
Percutaneous	Contaminated transfusion, intravenous drug use sharing of needles, contaminated surgical or dental instruments, or during an occupational exposure
Mucous membrane	Sexual contact (vaginal, anal, or oral), occupational (eg, eye splash)
Cutaneous contact of nonintact skin with large volume of infected fluids and/or for a prolonged duration	Occupational contact with abraded skin
Maternal-fetal	Intrauterine, intrapartum (ie, during labor and delivery), postpartum (ie, breastfeeding)

Adapted from reference 24: Centers for Disease Control and Prevention. Transmission facts. http://www.cdc.gov/hiv/pubs/facts/transmission.htm. Accessed December 8, 2010.

Briefly, what is GALT and how is it impacted by HIV?

GALT is gut associated lymphoid tissue, a crucial cimpinent of the mucosal immune system and contains most of the bodys memory CF4+. Allows HIV to propagate rapidly, with serve and largely irreversible loss of gut T cells occurring within days of HIV acquisition

What is the primary goal of cART (antiretroviral) therapy?

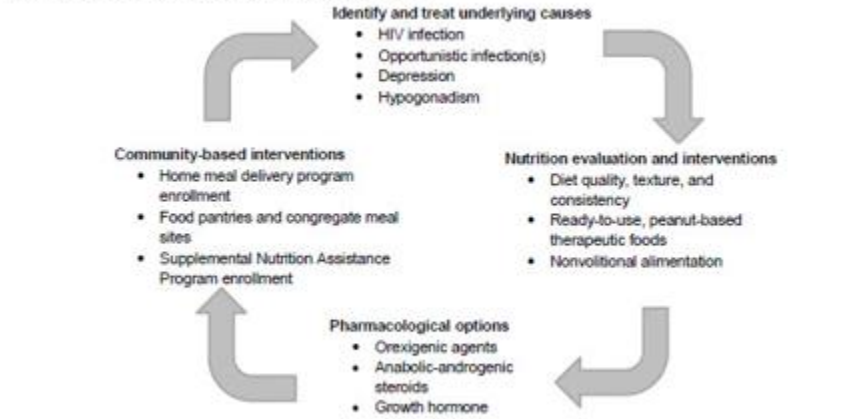
Facilitate the reconstitution of CD4+ T lymphocytes by the long term suppression of viral replication. Increase CD4+T lymphocytes and decrease viral load

Kaposi's sarcoma is best described as a cancerous growth found beneath the skin.

Wasting Syndrome/Disease

What are the 4 Wasting Treatment Strategies (Figure 32-2) listed? Provide examples of each.

FIGURE 32-2 Wasting Treatment Strategies



Which strategies are suggested for nutrition support of the wasted patient?

Nutrition support of the wasted patient may include the following: the avoidance of food odors during periods of nausea, the alteration of foods (texture, consistency, acidity) to facilitate intake in the presence of oropharyngeal or esophageal lesions, ready-to-use therapeutic foods, orexigenic agents, electrolyte management, and feeding by intragastric or enteric tube or IV alimentation (Table 32-6). Nutrition interventions should focus on adequate nonprotein-energy and protein-energy intake, particularly during episodes of secondary or opportunistic infection; micronutrient adequacy; facilitating antimicrobial and/or antiretroviral absorption; and tolerance. Pharmaceutical agents are available to create the sensation of hunger, for physiological hormone replacement, and to promote preferential accrual of skeletal muscle (Table 32-7).

Describe the candidates for the following:

Enteral Nutrition:

Enteral Nutrition

HIV-infected patients who are candidates for tube feeding include those with neurologic disease (eg, progressive multifocal leukoencephalopathy), oropharyngeal or esophageal lesions, profound anorexia with or without nausea, or impaired gut function, and those who are unable to achieve significant volitional dietary intake. Intragastric feeding tubes are strongly preferred to

Parenteral Nutrition: small bowel disease

AND Nutrition Care Manual

Directions: Access the AND Nutrition Care Manual through the MNT LibGuide (link in ulearn). From the Nutrition Care drop-down, choose Conditions, and find HIV / AIDS from the list under **Nutrition Care**.

Overview

As little as ____5___% weight loss was associated with an increased risk of mortality as well as opportunistic infection (OI) rates in HIV positive patients.

Energy needs for repletion are recommended to be between 40 and 50 kcal/kg daily.

Why is therapeutic food modification often necessary for patients with chronic HIV infection?

However, therapeutic food modification is often necessary based on how the disease and tolerance of treatment are manifested in an individual patient

List the 7 conditions mentioned that complicate nutrition management in chronic HIV infection:

Hypertension, cardiovascular disease, diabetes, liver dysfunction, renal dysfunction and bone mineral density loss.

Chronic diarrhea may cause dehydration, malabsorption, and food/ nutrient losses. Generally, diarrhea is defined as >3 watery/loose stools per day; chronic diarrhea last for two weeks or longer

Breastfeeding is <u>not</u> the recommended feeding method for most infants including those born to HIV+ mothers.

Nutritional Indicators

The timeline for referral of patients categorized by nutritional risk is as follows:

High risk: seen by RDN within 1 week

Moderate risk: seen by RDN within 1 month

Low risk: seen by RDN annually

Nutrition risk criteria include:

HIV/AIDS diagnosis, unintended wt loss/ gain, BMI below 20 and barriers to adequate intake such a poor appetite, fatigue, substance abuse, food insecurity and depression.

In addition to wt change, the NCM suggests inflammation, stage of disease, comorbidities, medications and Ols may contribute to increase energy in pt with HIV/AIDS

Anthropometric Measurements

The RDN should include the following anthropometric measurements in the initial assessment:

Body comp/ growth history/ wt history, ht/ length, wt, frame size, BMI & children; growth pattern indices.

HIV-associated wasting (and lipodystrophy) has been identified as meeting one of the following criteria:

Loss of 10% of body wt within 1 year, loss of 5% of body wt in 6 months and/ or BMI below 20

Biochemical Data, Medical Tests, and Procedures

Which biochemical parameters should be monitored/evaluated in HIV+ patients?

Immune profile:

Viral load, CD4

Inflammatory markers:

C-reactive protein, cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, GLU, insulin, triglyercides

Organ function:

Alk phosphatase, alanine aminotransferase, amylase, blood urea nitrogen, creatinine

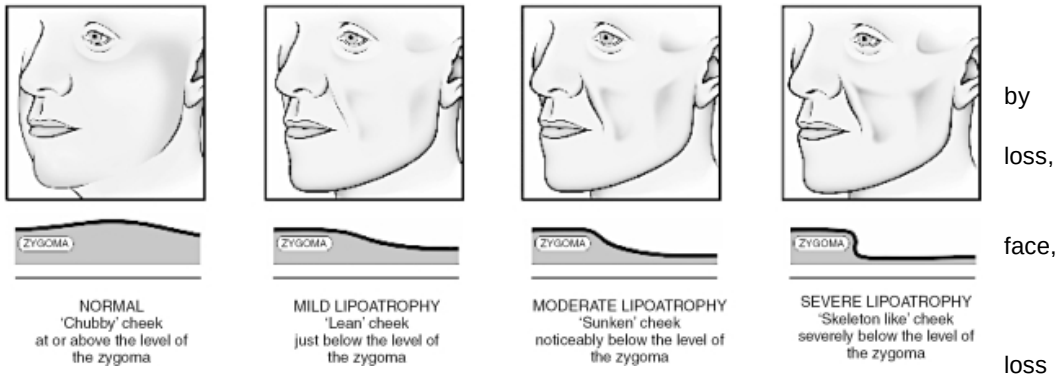
Anemias:

Hematocrit, hemoglobin, iron, red blood cell count, red blood cell folate level, vit b12

Nutrition-Focused Physical Findings

Define the following, include how they are characterized, and discuss the risk factors associated with each:

Lipoatrophy:



characterized by subcutaneous adipose tissue loss, which generally occurs in the face, buttocks, and periphery. Subcutaneous adipose tissue loss has also been associated with insulin resistance, dyslipidemia, and increased systemic inflammation

Lipohypertrophy:

Lipohypertrophy is characterized by adipose tissue deposition, which generally leads to an increase in abdominal fat in the visceral adipose tissue compartment. Some patients also have a coexisting dorsocervical fat pad deposition and/or enlargement of breasts.

Mixed lipodystrophy:

HALS was reported with increased frequency after the widespread use of highly active ART (HAART) medications began. HALS is characterized by a combination of body shape changes and metabolic abnormalities; however, since individuals do not necessarily present HALS similarly, no consensus exists on how to define this condition.

Comparative Standards

REE may be increased by as much as _5____ to __17___% in people with HIV infection, compared with healthy individuals, although a*ctivity levels can be significantly decreased in HIV-infected individuals, leading to overall TEE _____similar_____ to that of healthy individuals*.

Factors related to increased energy needs in people with HIV infection include:

stage of disease, opportunistic infections and comorbidities, inflammation, and effects of medications

Nutrition Intervention

Describe the role of fiber in patients with HIV/AIDS:

Improves insulin sensitivity

Which patients may benefit from fish oil (n-3 fatty acids) and why?

HIV and hypertriglyceridemia pt, lowering triglycerides

Client Forms—HIV/AIDS

Print and review the *HIV/AIDS Managing Diarrhea*, *HIV/AIDS Micronutrients (Vitamins and Minerals)*, and *HIV/AIDS Nutrition Therapy* Client Forms.

Managing Diarrhea

Diarrhea is a common problem for people with human immunodeficiency virus (HIV) infection. In general, diarrhea is defined as 3 or more loose or watery stools per day. Diarrhea is classified as chronic if it lasts more than 2 weeks and may cause dehydration, malabsorption, and food and nutrient losses. Diarrhea can also make it difficult for your medications to work their best.

If diarrhea lasts only a few days, antidiarrheal medications may give you the most immediate relief. You should report diarrhea of any kind if it lasts more than just a couple of days to your doctor. Your doctor will need to look into the causes of large losses of fluids and nutrients that occur for more than 2 weeks.

Remember that it is easy to become dehydrated when you have diarrhea. Drinking plenty of fluids and restoring other nutrients that may be lost will be important to recovery.

Causes of Diarrhea

Diarrhea may be caused by an infection, lactose or other “intolerances” to food substances, or medication side effects. Ask yourself if you have cramps and diarrhea after:

Eating or drinking dairy products?

Drinking 1 or more cups of coffee or other beverages with caffeine? Drinking 1 or more alcoholic beverages?

Reducing or eliminating caffeine or alcoholic beverages is a good starting point.

If milk causes diarrhea, cramping, or bloating, ask your registered dietitian nutritionist (RDN) about lactase enzymes or foods with less lactose (such as yogurt and cheese) that may be used to keep your eating plan balanced.

Fat malabsorption or loss of fat in the stool (sometimes accompanied by feeling full too fast and bloating or smelly, floating stools) can be helped by consuming a low-fat meal or using special enzymes (ask your doctor about pancrelipase supplemental enzymes) with meals that contain a moderate amount of fat. Consuming low-fat meals and taking pancrelipase supplemental enzymes are recommended for pts experiencing fat malabsorption.

See the tips below for other ways to help manage diarrhea.

 HIV/AIDS
Managing Diarrhea—Page 1

Tips for Managing Diarrhea

Take a look at some of the suggestions below to keep diarrhea in check:

Set a goal to replace fluids and nutrients that may be lost as a result of loose stools:

Drink plenty of liquids, especially water (avoid beverages that contain alcohol or caffeine).

Try juices or diluted juices if diarrhea has been severe.

Talk with your pharmacist and RDN about medical nutrition supplements.

Consume small, frequent meals instead of large ones.

Eat foods at or near room temperature to slow down the gastrointestinal tract (hot foods can sometimes speed up the movement of foods through the gut).

Reduce irritating spices such as cinnamon, pepper, or chili pepper.

Reduce fat:

Use low-fat alternatives such as fat-free (skim) or low-fat (1%) milk ○ Take skin off of chicken, trim fat from other meats, and avoid fried foods.

Reduce the use of butter, gravies, fatty sauces (Alfredo sauce, for instance), and other sources of added fat.

Reduce crude or insoluble fibers:

Use processed flour-based breads and cereals (such as white bread, saltine crackers, cream of rice cereal, cornflakes, and others).

Stay away from whole grains (such as whole, cracked, or sprouted wheat; brown or wild rice; old-fashioned rolled oats; granola; or other grains with the husk).

Cook vegetables until soft or use canned fruits and vegetables.

Increase soluble fibers:

Try applesauce, apple juice, or pear juice. ○ Try oatmeal or mashed or baked potatoes.

Talk with your doctor or RDN about adding a psyllium fiber supplement.

If milk seems to cause diarrhea, try low-lactose alternatives:

Use lactase enzyme capsules or drops before consuming dairy products.

Try small amounts of yogurt, cheese, or lactose-reduced milk.

Talk with your RDN about dairy substitutes.

Use specialized nutrition products if weight loss and diarrhea persist.

Easy-to-digest oral nutrition supplements such as medium chain fat (MCT) and peptide formulas (Peptamen or ProCal powder)

Probiotics such as Lactobacillus ○ L-Glutamine (amino acid to aid in restoring gut health)

Zinc deficiency in both acute and chronic diarrhea

Micronutrients

Name _____ **Date** _____

Email _____ **Phone** _____

HIV/AIDS Micronutrients (Vitamins and Minerals)

Getting enough vitamins and minerals in your diet is important for keeping you healthy. The chart on this handout lists food sources of vitamins and minerals.

It is better to eat a balanced variety of foods to make sure you are getting all the nutrients you need each day. But when you don't or can't eat well, vitamin or mineral supplements may be needed. Supplements are not perfect substitutes for foods, but they can be helpful.

Your registered dietitian nutritionist (RDN) will tell you about taking supplements if you need them. See the tips on this handout for more information about taking supplements safely.

Food Sources of Vitamins and Minerals (Micronutrients)

Micronutrient	Notable Food Sources
Boron (mineral)	Vegetables
Calcium (mineral)	Milk, yogurt, cheeses, legumes (such as dried peas and beans), darkgreen leafy vegetables
Chromium (mineral)	Red meats, whole grains, spices
Copper (mineral)	Liver, green vegetables, soy beans, tofu, potatoes
Flouride (mineral)	Fluoridated water (Note: The amount of fluoride in water varies from location to location.)
Folate (vitamin)	Avocados, dark-green leafy vegetables, liver, brewer's yeast, amaranth, oranges, chickpeas
Iodine (mineral)	Seafood, milk, cheeses, cereals, iodized salt
Iron (mineral)	Meats, liver, dark-green leafy vegetables, grains, prune juice, soy beans, dried beans, molasses
Magnesium (mineral)	Green vegetables, grains
Molybdenum (mineral)	Legumes
Niacin (vitamin B-3)	Peanuts, enriched breads and cereals, lean meats, poultry (such as chicken or turkey), fish
Phosphorous (mineral)	Milk, cheeses, grains, meat
Potassium (mineral)	Root vegetables, green vegetables, bananas, plantains

Micronutrient	Notable Food Sources
Pyridoxine (vitamin B6)	Avocados, bananas, dried beans, dark-green leafy vegetables, potatoes
Riboflavin (vitamin B2)	Soy beans, nuts, milk, cheese, yogurt, brewer's yeast, whole grains, eggs, dark-green leafy vegetables, liver and other organ meats
Selenium (mineral)	Nuts, fish, meat, eggs, milk, grains (Note: amount of selenium in grains depends on the selenium content of the soil the grains were grown in)
Thiamin (vitamin B-1)	Whole grains, pork, lamb, fish, poultry (such as chicken or turkey), liver
Vitamin A (as retinol)	Meat, fortified milk products, liver and other organ meats, egg yolks, fish liver oils
Vitamin A (as beta carotene)	Red, orange, and yellow fruits (including melons and papayas) and many vegetables (including broccoli, carrots, dark-green leafy vegetables, pumpkins, spinach, sweet potatoes, yams, and zucchini)
Vitamin B-12	Organ meats, lean meats, fish, shellfish, milk products, brewer's yeast
Vitamin C	Citrus fruits, tomatoes, peppers, dark-green leafy vegetables, potatoes, papayas
Vitamin D	Fatty fish, fortified milk products, liver, egg yolks
Vitamin E	Vegetable oils, nuts, wheat germ, whole grains, seeds, dried beans, dark green leafy vegetables, sweet potatoes
Vitamin K	Broccoli, cabbage, vegetable oils, seaweed, dark-green leafy vegetables, yogurt, egg yolks, liver, soy beans, potatoes, chickpeas, milk products
Zinc (mineral)	Red meats, cheeses, milk, dried legumes

Vitamin and Mineral Supplement Safety

Vitamin and mineral supplements can (like medications) be toxic if you take too much. Safety limits are usually 100% to 200% of the nutrient's Dietary Reference Intake. Some nutrients in supplement form can be more toxic than others:

Vitamins A and D are most safely obtained through eating food.

Zinc and selenium are important to your body's ability to fight infections and diseases, but they are also toxic at fairly low doses.

Because each person has a different tolerance level, your use of supplements should be monitored by your health care team. They will need to look for any side effects or potential interactions with other nutrients and medications.

 HIV/AIDS Micronutrients (Vitamins and Minerals)—Page 2

Nutrition Therapy

Name _____ Date _____

Email _____ Phone _____

HIV/AIDS Nutrition Therapy

Good nutrition supports the immune system, helps with weight issues, and can improve the quality of your life. Eating healthy keeps your body working well and supports your medications and other therapies. Good nutrition also helps with other concerns, such as high blood glucose (sugar) and body shape changes.

Write down how much food you eat and what you weigh. Ask yourself these questions, and talk to your doctor and registered dietitian nutritionist (RDN) about ways to improve your nutritional status:

Have you gained or lost any weight during the last year? How much weight, and during what amount of time?

Are you having any problems that make you want to eat less? For example, have you experienced diarrhea, nausea, vomiting, appetite loss, taste changes, or other issues?

Have you had problems with constipation?

Do any foods seem to cause problems for you? Which ones? What kinds of problems?

How many meals do you eat in a day? Do you have any problems having enough food to eat? Do you ever go hungry?

Do you exercise regularly? What kind of activities? How often? How long?

Do you know what to eat and not to eat with your medications?

Do you take any vitamins or other nutrition supplements? Which ones?

Do you have any other medical conditions, such as diabetes, kidney disease, high cholesterol or triglycerides (high fat in your blood), or high blood glucose levels?

Have you noticed any changes in your body shape?

Special Eating Problems

To gain weight after an unplanned weight loss, you will need to address the problem that caused it (such as infection, loss of appetite, vomiting, and diarrhea) and then eat well to replace nutrients lost.

You may gain weight in unusual places. This happens when your body gains fat and fluid without the usual gain in muscle. If this happens, don't restrict your eating. Instead, ask your RDN about which foods to eat and other ways to work on this problem.

Ask your RDN for nutrition tips for diarrhea, nausea, vomiting, and loss of appetite.

Food Group Planner

Together with your RDN, you can refer to the Daily Food Plans section of the Choose My Plate website (**myplate.gov**) and select the level of calories that matches your goal of maintaining, losing, or gaining weight. Then use the chart below to develop your food plan. Your plan will include a variety of healthy foods such as plenty of fruits and vegetables as they are packed with vitamins, minerals, fiber, and antioxidants to help maintain your health.

Food Group	Serving Size	Notes
Grains ____ servings	1 slice bread ½ bagel or English muffin 1 small tortilla ½ hamburger bun ½ cup cooked rice, pasta, cereal, or potatoes 4 to 6 crackers 1 cup ready-to-eat cereal	Good sources of carbohydrates, calories, and B vitamins. Whole grains are also a source of iron, magnesium, selenium, and zinc.
Fruits ____ servings	½ cup cooked or canned fruits ½ cup fruit juice 1 cup fresh fruits	Follow food safety guidelines for raw fruits. Good sources of carbohydrates, vitamins and minerals, fiber, and antioxidants.
Vegetables ____ servings	cup raw or cooked vegetables ½ cup vegetable juice cups raw leafy vegetables	Follow food safety guidelines for raw vegetables. Good sources of vitamins and minerals, fiber, and antioxidants.
Dairy Products ____ servings	1 cup low-fat milk or yogurt 1½ ounces cheese 1½ cups frozen yogurt or ice cream	Use pasteurized products. Good sources of protein, calcium, carbohydrates, B vitamins, and minerals.
Protein Foods ____ servings	1 ounce cooked meat, chicken, or fish 1 cooked egg 1 ounce nuts tablespoon peanut butter ¼ cup tofu, dried beans, lentils, or peas tablespoons hummus	Best sources of protein and good sources of B vitamins and minerals. For meats, 3 ounces is about the size of a deck of cards.

You can use the Food Group Planner to determine how well you are doing each day and where you need to change your eating habits. For example, if you had a meal of a grilled cheese sandwich, milk, and carrot sticks, you have consumed 2 grain servings, 1½ to 2 dairy servings, and 1 vegetable serving. After you have recorded everything you eat for a day, look to see where you need more from a food group and where you might cut back a bit.

Notes:

PowerPoint Slides and Required Videos

Directions: Take notes on the PowerPoint slides printouts and required videos.

Zinc, B12, Carnitine, and Copper are the most common vitamin/ mineral deficiencies seen with ART

Vit B12 is most commonly found in Brewer's yeast, Meats, Milk, and Seafood

Zinc and selenium are most associated with impaired immune function (weakened) in HIV patients

Deficiencies Worksheet

Renal Disorders

Chronic Kidney Disease (CKD 1-4) MNT Reference Page

Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT
Calories	**Initial: 25kcal.kg**	**Advancement:**	**Goal:35 kcal/g**
Protein			

Fluid	Urine volume: 2-2.5L/d, drink as much as 3L/d, kinda unlimited compared to stage 5
Supplementation Needs	Low K+ foods, limit phos in the diet
Monitoring Criteria	Limit sodium, increase vit k
OTHER NOTES: ↑'d F+V intake to improve BW, BP and net acid productio	
References:	

ESRD (CKD 5)/ Dialysis (HD and PD) MNT Reference Page

Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT
Calories	**Initial:30 kcal/kg**	**Advancement:**	**Goal: 35 kcal/kg**
Protein	1.0 – 1.3+ g/kg ≥50% HBV		

Fluid	UOP +1000mL, cannot over/ under hydrate
Supplementation Needs	Multivitamin, all water-souble viramine
Monitoring Criteria	Evaluate appetite, dietary intake, wt changes, biochem data, anthropometric measurements and nutrition focused physical finding
OTHER NOTES: Mediterranean Diet to improve lipid levels	
References: Ncm.org	

NCM Materials

Client Name: Date:

RDN/NDTR: Email: Phone:

Chronic Kidney Disease Stage 3-5 Nutrition Therapy

Choosing healthy food, staying physically active and taking medicines as prescribed by your health care provider may help slow down the progression of kidney disease. There is not one eating plan that is right for everyone with kidney disease. Your registered dietitian nutritionist (RDN) will help you identify what's best for you to eat.

Why is nutrition important in kidney disease?

Your kidneys help keep nutrients and minerals balanced in your body and remove the waste products from your blood. With kidney disease, your kidneys may not be able to do this job very well. You may need to make some changes to your diet.

You may need to control the amount of protein, sodium, potassium, phosphorus or calcium in your diet. You will also still need to follow diet recommendations for any other conditions you have, like heart disease or diabetes. Fortunately, these diets are similar.

Your nutrition care plan might change over time depending on the status of your condition. Your registered dietitian nutritionist or health care provider will tell you if changes are needed based on your blood test results.

Tips

How to plan a kidney-friendly meal

- Fill a 9-inch or 10-inch plate with:
  - Fruits and/or vegetables
  - Breads, cereals, or grains
  - Protein
  - A healthy fat

- Your body needs protein to help build muscle, repair tissue, and fight infection. If you have kidney disease, eating less protein can help protect your kidneys if you are not on dialysis. The most effective way to protect your health is to eat less red meat such as beef or pork and smaller protein portions and to choose plant-proteins as a meat alternative. If you are on dialysis, the protein serving is the size of your palm. If you are not on dialysis, the protein serving is ⅓ to ½ the size of your palm. Your RDN will discuss how much protein you should eat.
- Eat at least 6 servings of grain daily and choose whole grains for at least half those servings.
- Fruits and vegetables are an important part of a healthy diet and help increase your intake of fiber. Eat at least 5 servings of fresh, frozen, or canned fruits and vegetables daily. These foods are a source of potassium but you only need to limit how much you eat if your potassium level is high.
- Products labeled as "low sodium" may use potassium chloride in place of sodium. Check the ingredient list to make sure you can safely eat low-sodium foods.
- You can enjoy ____servings of dairy and dairy alternatives. Your RDN will make a specific recommendation based on your individual needs.
- Your health care provider will let you know if you need to limit fluid intake. Less fluid will help you manage urine output, and avoid fluid retention which can cause shortness of breath, swelling, high blood pressure, and increased strain on your heart and blood vessels.

Nutrients to Monitor

You may need to pay attention to sodium, phosphorus, and potassium in your diet. Your RDN can provide you handouts on potassium and/or phosphorus for more details and strategies to manage these nutrients.

Tips to limit sodium:

- Eat home-cooked meals made from fresh ingredients.
- Choose foods and condiments with 200 milligrams of sodium or less per serving.
- Use frozen or packaged meals with 600 milligrams or less sodium per serving if you are too tired to cook.
- Check labels to avoid foods that have more than 200 milligrams of sodium per serving. These foods may include canned soups or soup mixes, packaged foods, pickled foods, sauces, and seasonings.
- Limit how much salt you add to foods or avoid it altogether. Salt-free seasonings like herbs, spices, lemon juice, and vinegar will flavor to your food without adding salt.
- Ask your RDN which frozen and convenience foods, fast foods, or restaurant meals may be ok for you.

If you also have diabetes and/or heart disease:
It is easy to manage these multiple diets because they are similar in many ways.

- Eat a variety of healthy foods.
- Choose whole grain foods.
- Eat a moderate amount of protein and choose low-fat, lean, and heart-healthy options.
- Eat at least 5 servings/day of fruits and vegetables. Your blood potassium level will affect which fruits and vegetables you can safely eat.
- Eat less food with added salt, sugars, and fats.

Your RDN can provide you with additional recommendations if necessary.

Foods to Choose or Limit

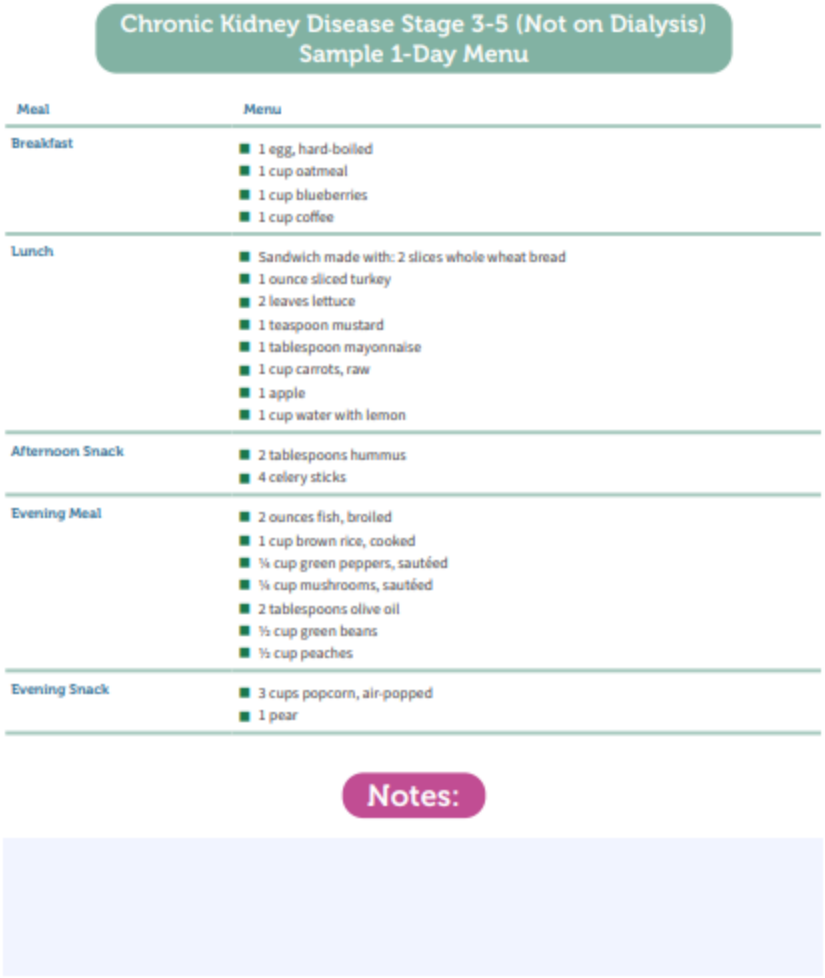
Your RDN will tell you if you need to limit phosphorus or potassium in your diet and provide you separate handouts about foods to choose or limit.

Food Group	Choose	Limit
Grains	▶ Whole grain cereal ▶ Oats, oatmeal ▶ Whole wheat bread, pita ▶ English muffin ▶ Corn tortillas ▶ Whole wheat pasta ▶ Brown rice ▶ Quinoa ▶ Couscous ▶ Grits ▶ Popcorn ▶ Rice cakes ▶ Whole wheat crackers	▶ Grains with more than 200 milligrams of sodium per serving ▶ Boxed biscuit, cake, pancake/waffle mixes and other convenience foods ▶ Snacks and sweets should be eaten in moderation
Protein Foods	▶ Eggs or egg whites ▶ Lean beef, wild game, and "all natural" chicken, fish, pork, seafood, or turkey ▶ Legumes/Pulses: Beans (such as black, kidney, or white beans), lentils, split peas, black-eyed peas ▶ Soy: Tofu, edamame ▶ Nuts and nut butters	▶ Protein with more than 200 mg sodium per serving ▶ Processed or frozen protein foods ▶ Salty processed meats (such as bacon, bologna, salami and other lunch meats), ham, hot dogs, sausage, breakfast sausage, and pre-seasoned meats
Dairy and Milk Alternatives	▶ Lower-phosphorus milk alternatives include unfortified almond, rice, soy or other plant beverages ▶ Lower-phosphorus cheeses include brie, goat, cream cheese, mozzarella, parmesan, or ricotta cheese	▶ Processed cheeses, such as American cheese, cheese spreads, boxed macaroni and cheese ▶ Milk-based or cheese-based soups or sauces ▶ Nondairy creamers

Food Group	Choose	Limit
Vegetables	▶ Fresh, frozen, or no-salt **added canned vegetables**	▶ Processed vegetables or vegetable juice with more than 200 milligrams sodium per serving. ▶ Pickled foods, such as olives, sauerkraut, pickles, kimchi ▶ Vegetables **with added sauces**
Fruit	▶ Fresh, frozen, or canned fruit	▶ Canned fruit in syrup or with added sugars
Fats and Oils	▶ Healthy fats such as olive oil, vegetable oil or lower sodium salad dressings ▶ Butter, margarine, mayonnaise, and sour cream in moderation	▶ Dressing, condiments and other sauces with more than 200 mg of sodium per serving
Beverages/ Fluids **(Fluids include anything that is liquid at room temperature. You may need to limit how much you drink if you are producing less urine.)**	▶ Water ▶ Coffee ▶ Tea ▶ Lemonade ▶ Seltzer	▶ Processed beverages (such as most colas, sports drinks, energy drinks, some flavored waters, drink mixes., some bottled teas and others) ▶ Canned soups with more than 200 mg sodium per serving ▶ Beer and wine
Other	▶ Herbs, spices, lemon juice, vinegars to flavor food instead of salt ▶ Stocks or broths labeled as "no salt added" ▶ Condiments and sauces with less than 200 mg sodium per serving	▶ **Salt, and** salt substitutes ▶ Bouillon and broths with more than 200 milligrams per serving ▶ Broths and soups labeled as "low sodium" ▶ Condiments and sauces with more than 200 mg sodium per serving

Chronic Kidney Disease Stage 5 (on Dialysis) Sample 1-Day Menu

Meal	Menu
Breakfast	■ 1 egg, hard-boiled ■ 1 cup oatmeal ■ ½ cup blueberries ■ ½ cup soy yogurt ■ 1 cup coffee
Lunch	■ Sandwich made with: 2 slices whole wheat bread ■ 2 ounces sliced turkey ■ 2 leaves lettuce ■ 1 teaspoon mustard ■ 1 tablespoon mayonnaise ■ 1 cup carrots, raw ■ 1 apple ■ 1 cup water with lemon
Afternoon Snack	■ 2 tablespoons peanut butter ■ 4 celery sticks
Evening Meal	■ 3 ounces fish, broiled ■ ½ cup brown rice, cooked ■ ¼ cup green peppers, sautéed ■ ¼ cup mushrooms, sautéed ■ 1 tablespoon olive oil ■ ½ cup green beans ■ ½ cup peaches
Evening Snack	■ 3 cups popcorn, air-popped topped with: ■ 1 teaspoon parmesan cheese ■ 1 pear



Chronic Kidney Disease Stage 3-5 (Not on Dialysis)
Sample 1-Day Menu

Meal	Menu
Breakfast	■ 1 egg, hard-boiled ■ 1 cup oatmeal ■ 1 cup blueberries ■ 1 cup coffee
Lunch	■ Sandwich made with: 2 slices whole wheat bread ■ 1 ounce sliced turkey ■ 2 leaves lettuce ■ 1 teaspoon mustard ■ 1 tablespoon mayonnaise ■ 1 cup carrots, raw ■ 1 apple ■ 1 cup water with lemon
Afternoon Snack	■ 2 tablespoons hummus ■ 4 celery sticks
Evening Meal	■ 2 ounces fish, broiled ■ 1 cup brown rice, cooked ■ ¼ cup green peppers, sautéed ■ ¼ cup mushrooms, sautéed ■ 2 tablespoons olive oil ■ ½ cup green beans ■ ½ cup peaches
Evening Snack	■ 3 cups popcorn, air-popped ■ 1 pear

Notes:

Cancer

Cancer MNT Reference Page

Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT
Calories	**Initial:**	**Advancement:**	**Goal:**

Protein	
Fluid	
Supplementation Needs	
Monitoring Criteria	
OTHER NOTES:	
References:	

Cancer Case Assignment SOAP/ ADIME Note

SOAP / ADIME Hybrid Form (Nutrition ADIME)

Patient Name: Mariana Luna DOB: 02/12/1972

Subjective Assessment of Interval History/Admission:

50 yr F, recent dx w/ early stage breast cancer, outpatient chemo, nervous about 1st chemo treatment, 1 cm adenocarcinoma of the left breast, Adriamycin & cyclophosphamide given on day 1 every 14 day for 4 cycles, one daughter, divorced

PMH:

Adenocarcinoma of the left breast, left breast lumpectomy 2 wks ago, father died @81 yr r/t SCLC, OA for 2 yr, HTN for 10 yrs, mild depression/ anxiety for 12 yr, GERD for 18 yrs

Anthropometrics:

Ht:	62 in	IBW	110	% IBW:	131%
Adm Wt:	145 #	AIBW:		BMI (w/ class):	25- overweight
Current Wt:	138 #	UBW:		%UBW:	
Est. Dry Wt:		Wt Hx:	Loss 7 # within 1 month		

Physical Assessment / NFPE:

Lost wt, over wt, clavcle somewhat visible, normal handgrip, no edema note, ambulates independently, tires quixkly.

Diet Rx (with Assessment):

Limited energy to prepare food at home, decreased appetite 3-4 wks PTA. 3 small meals (cheese and butter crackers, an egg & a piece of bread/oatmeal/yogurt, fruit), 1 snack, drinks water all day, some 2% milk, some ice tea. Reports cannot finish a "regular size" sandwich, doesn't feel hungry. Family members suggest juicing kale and green veggies to help heal the cancer. MNA score: 8 (at risk for malnutrition)

Relevant Meds (with Assessment):

Amlodipine 10mg PO q24h- HTN; calcium blocker Ibuprofen 600mg q4-6h prn- relieve aches/ pain Fluoxetine 20mg PO q24h- antidepressant; serotonin uptake inhibitor (more acceptable side-effects profile than traditional antidepressants Ranitidine 150mg PO q24h-gastrointestional ulcer treatment, GERD

Relevant Labs (with Assessment):

BUN 28mg/dL- high Glu 189 mg/dL- high Hgb 11.6 g/dL – low Alk phos 180Iu/L- high CO2 22mEq/L Albumin 3.2 g/dL

Food / Nutrition History:

Dietary restrictions:	NKA,
Food preferences:	Likes: pepper jack, applesauce, raspberries, oranges, plain yogurt, pudding, over-easy eggs, mashed potatoes, pasta, rice, cantaloupe, ham. Dislikes: rosemary, fish, ginger, soda, cinnamon, bell peppers, no fried foods. Notes Ensure (& others) taste like vitamins.
Assistance with meals:	

Nutrient Needs / Intake:

Calc. wt: _____	Est. Needs *(based on)*	Previous Intake	% Goal Met
Calories	MSJ: (9.99 × 62.6) + (6.25 × 157.5) – (4.92 × 50) – 161= 625+984-246-161=2016 TEE: 1.2 AF* 2016= 2419-500=1919 kcal		
Protein	1.2 * 62.6= 75g pro		
Fluid	HSM: 62.6-20= 42.6=43*15ml= 645+1500= 2145 ml		

Nutrition Diagnosis:

Nonsevere moderate disease/condition related malnutrition r/t poor appetite AEB 7lb (5%) wt loss within 1 month. Inadequate protein intake r/t tiring quickly AEB clavicle is slightly protrude. Not ready for a lifestyle change r/t feeling nervous AEB pt reports not eating like she used to and doesn't feel hungry due to "nerves".

Nutrition Goals:

Gain 5 # (lean) by eating foods that are high in protein- within 4 weeks Lose excess body fat by eating 5 servings of greens/ vegetables a day for 4 weeks.

Interventions / Recommendations:

Can make trailmix with nuts, seeds and dried fruit can add protein and natural sweetness. Making a smoothie with tofu and greens will add protein and can be used for a serving of greens.

Monitoring / Evaluation (with Anticipated D/C needs):

Check back with pt within 4 days to see progress of diet

Signature and Credentials: _____Katharina Daniel_____

Cancer Chapter Worksheets

Cancer Prevention, Treatment & Recovery

Chapter 36 Worksheet

DEFINITIONS

Directions: Refer to chapter 35 (pp. 729-754) in Krause's Food & The Nutrition Care Process and reliable outside resources as needed to define/describe the following terms.

Oncology: branch of medicine that specializes in the diagnosis and treatment of cancer

Oncologist:a doctor who has special training in diagnosing and treating cancer in adults using chemotherapy, hormonal therapy, biological therapy, and targeted therapy.

Carcinogen: causing or tending to cause cancer

Carcinogenesis: the process by which normal cells are transformed into cancer cells

Oncogenes:a gene that is mutated form of a gene involved in normal cell growth

Tumor suppressor genes: a type of gene that makes a protein (tumor suppressor protein) that helps control cell growth

Apoptosis: a type of cell death in which a series of molecular steps in a cell lead to its death

Tumor angiogenesis: the growth of new blood vessels that tumors need to grow

Metastasis: the spread of cancer cells from the place where they first formed to another part of the body

Neoplasm: abnormal mass of tissue that forms when cells grow and divide more than they should or do not die when they should

Xerostomia: dry mouth

Mucositis: a complication of some cancer therapies in which the lining of the digestive system becomes inflamed

Odynophagia: painful swallowing

Cancer cachexia: loss of body wt and muscle mass, and weakness that may occur in pt w cancer, AIDS or other chronic diseases

CANCER PREVENTION

Use your text (pp. 731-8) to answer the following questions:

You will be responsible for the information found in the table below—*a summary has been provided for you since the textbook has a bit too much detail (pp. 734-8).*

Energy balance / exercise	Risk increases as BMI increases and exercise levels decrease
Fat	Possible increased risk w/ total high fat and SFA; particularly prostate, breast and lung cancer
Protein	Possible increased risk w/ excessive protein intake, especially from red meat; particularly prostate and colon cancer
Soy proteins / phytoestrogens	Modest intake may be protective against breast cancer → caution in those w/ hormone sensitive cancers (prostate, breast, etc.)
Fiber	Increase may be protective
Fruits and vegetables	Increased intake may be protective d/t antioxidants (vits C, E and selenium) and phytochemicals
Alcohol	Overall increased risk
Nitrates, nitrites and nitrosamines	Increased intake → increased risk
Food preparation / preservatives	High heat cooking / smoking → increased aromatic carbons and hetrocyclic amines
Chemoprevention	Reverse carcinogenesis in the premalignant phase → example: vitamin E, β-carotene, and selenium reduced stomach cancer per study in China

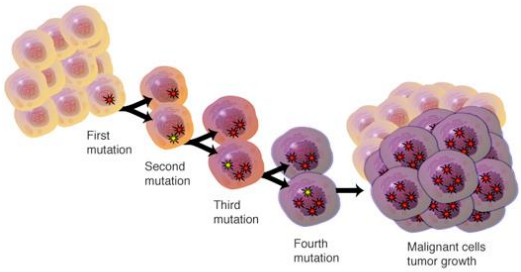
Complete the table below (using Table 36-1, p. 731). Note the bolded phytochemicals—these are the ones most likely to be on a quiz/exam.

Color	Phytochemical	Vegetables and Fruits
Red	**Lycopene**	Tomatoes and tomato products, pink grapefruit, watermelon
Red and purple	**Anthocyanins**, polyphenols	Berries, grapes, red wine, prunes
Orange	α-, **β-carotene**	Carrots, mangoes, pumpkin
Orange and yellow	β-cryptoxanthin, flavonoids	Cantaloupe, peaches, oranges, papaya, nectarines
Yellow and green	Lutein, zeaxanthin	Spinach, avocado, honeydew, collard/turnip greens
Green	Sulforaphanes, indoles	Cabbage, broccoli, Brussels sprouts, cauliflower
White and green	Allyl sulphides	Leeks, onion, garlic, chives

CANCER PROGRESSION & WARNING SIGNS

Use your text (pp. 731-49) and recorded lecture to answer the following questions:

Define/describe the 4 stages of cancer (i.e. phases of carcinogenesis):

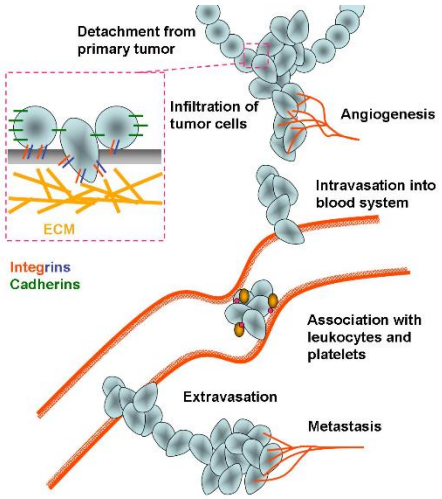


Initiation: involoves transformation of cells produced by the interaction of chemicals, radiation, or viruses w cellular deoxyribonucleic acid (DNA).

Promotion: initiated cells multiply and escape the mechanisms set in place to protect the body from growth and spread of such cells.

Tumor progression: tumor cells aggregate and grow into a tumor

Metastasis: the neoplasm has the capcity for tissue invasion that ca organs



List/define the s/sx of cancer (p. 737 in your textbook):

Change in bowel or bladder habits

A sore that does not heal

Unusual bleeding or discharge

Thickening or lump in breast or elsewhere

Indigestion or difficulty swallowing/ chewing

Obvious change in wart/ mole

Nagging cough or hoarseness

CANCER TREATMENT

Common Side Effects of Cancer Treatment

Therapy	Notable Side Effects
Chemotherapy	Anemia, fatigue, nausea, vomiting, loss of appetite, mucositis, changes in taste and smell, xerostomia, dysphagia, diarrhea, constipation
Immunotherapy	Fatigue, chills, fever, flu-like symptoms, decreased food intake
Radiation	Fatigue, loss of appetite, skin changes, site-specific effects
Surgery	Fatigue, pain, loss of appetite

List and define the nutritional therapies used with the treatments listed, as well as the nutritional concerns of the treatments (as outlined in your text, pp. 743-9).

Radiation Therapy

Therapy Location	Nutritional Therapies	Nutritional Concerns

Head / Neck	PEG feeding tube	Xerostomia, mucositis, sore mouth and throat, dysphagia, alterations to taste/ smell, fatigue, loss of appetite
Thorax	EN, swallowing therapy	Heart burn, dysphagia, esophagitis, fatigue, loss of appetite, fibrosis
Abdomen / Pelvis	Antidiarrheals, increase fiber and fluid intake	Changes in bowel function, changes in urinary function, lactose intolerance, chronic colitis
TBI	Hematopoietic cell transplantation (HCT)	Hyperglycemia associated with corticosteroids

Surgery

Surgical Location	**Nutritional Therapies**	**Nutritional Concerns**
Head / Neck	Long term/ short term EN support	Chewing and swallowing difficulties, high risk for malnutrition
Esophagus	G tube	Reflux, dumping syndrome, dysmotility, gastroparesis, early satiety, vomiting and fluid/ electrolyte imbalances
Stomach	EN support	Dumping syndrome, dehydration, early satiety, gastroparesis, fat malabsorption, vit/ mineral malabsorption
Pancreas	More frequent small meals	Gastroparesis, fluid and electrolyte imbalance, hyperglycemia, fat malabsorption
GI Tract	Diet low in fat	Gastropareisis, hyperglycemia, fluid and electrolyte imbalance, fat malabsorption, vit/ mineral malabsorption
GVHD (graft verus host disease)	Total bowel reset, PN until diarrhea stops	Gastropareisis, abdominal pain, nausea, vomiting, heavy secretory diarrhea

Describe the nutrition intervention strategies for each of the symptoms/side effects in the table below.

Nutrition Intervention Strategies for the Patient with Cancer

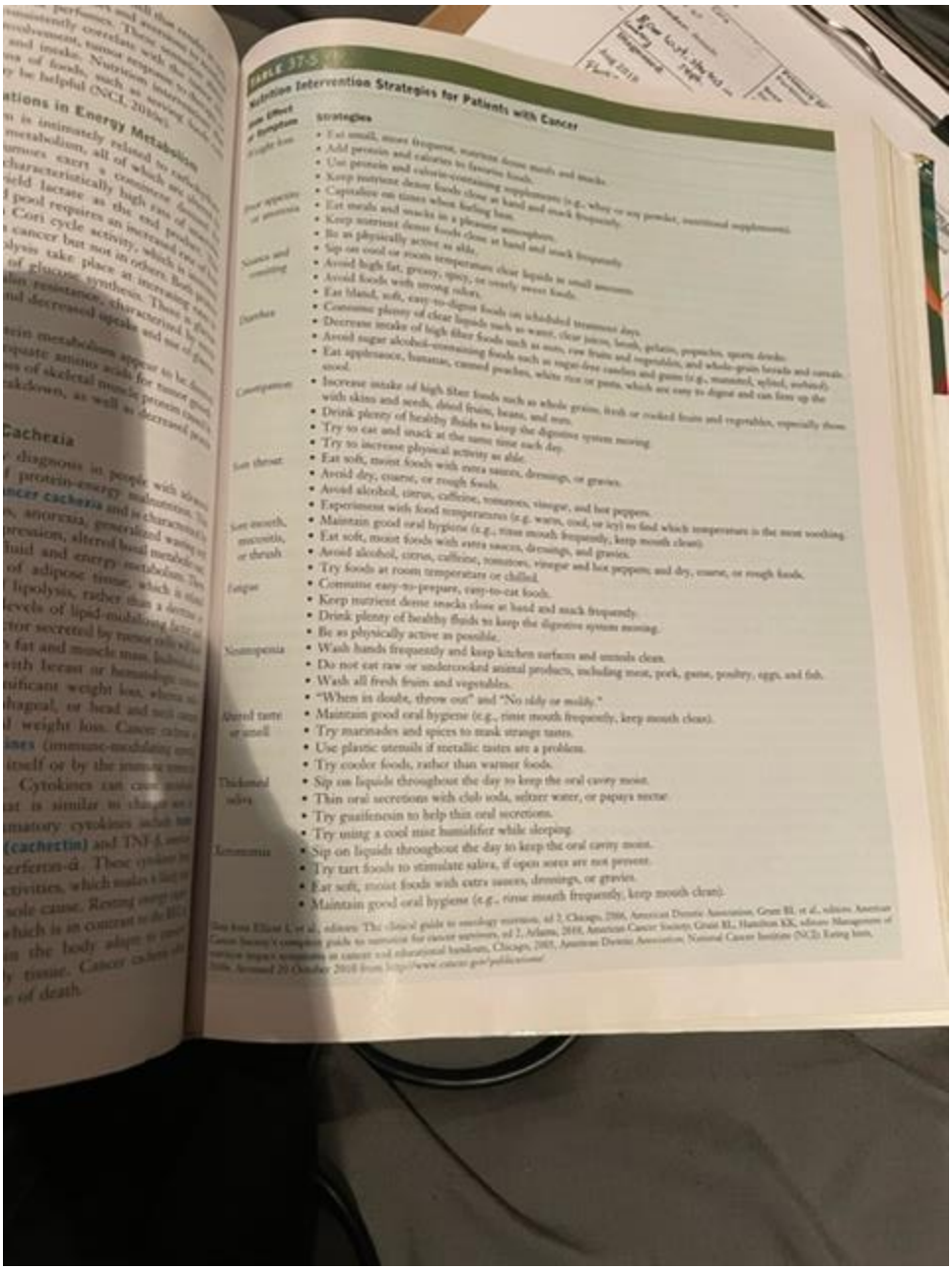


TABLE 37-5

Nutrition Intervention Strategies for Patients with Cancer

Side Effect or Symptom	Strategies
Weight loss	• Eat small, more frequent, nutrient dense meals and snacks. • Add protein and calories to favorite foods. • Use protein and calorie-containing supplements (e.g., whey or soy powder, nutritional supplements). • Keep nutrient dense foods close at hand and snack frequently. • Capitalize on times when feeling best.
Poor appetite or anorexia	• Eat meals and snacks in a pleasant atmosphere. • Keep nutrient dense foods close at hand and snack frequently. • Be as physically active as able.
Nausea and vomiting	• Sip on cool or room temperature clear liquids in small amounts. • Avoid high fat, greasy, spicy, or overly sweet foods. • Avoid foods with strong odors. • Eat bland, soft, easy-to-digest foods on scheduled treatment days.
Diarrhea	• Consume plenty of clear liquids such as water, clear juices, broth, gelatin, popsicles, sports drinks. • Decrease intake of high fiber foods such as nuts, raw fruits and vegetables, and whole-grain breads and cereals. • Avoid sugar alcohol–containing foods such as sugar-free candies and gums (e.g., mannitol, xylitol, sorbitol). • Eat applesauce, bananas, canned peaches, white rice or pasta, which are easy to digest and can firm up the stool.
Constipation	• Increase intake of high fiber foods such as whole grains, fresh or cooked fruits and vegetables, especially those with skins and seeds, dried fruits, beans, and nuts. • Drink plenty of healthy fluids to keep the digestive system moving. • Try to eat and snack at the same time each day. • Try to increase physical activity as able.
Sore throat	• Eat soft, moist foods with extra sauces, dressings, or gravies. • Avoid dry, coarse, or rough foods. • Avoid alcohol, citrus, caffeine, tomatoes, vinegar, and hot peppers. • Experiment with food temperatures (e.g. warm, cool, or icy) to find which temperature is the most soothing.
Sore mouth, mucositis, or thrush	• Maintain good oral hygiene (e.g., rinse mouth frequently; keep mouth clean). • Eat soft, moist foods with extra sauces, dressings, and gravies. • Avoid alcohol, citrus, caffeine, tomatoes, vinegar and hot peppers; and dry, coarse, or rough foods. • Try foods at room temperature or chilled.
Fatigue	• Consume easy-to-prepare, easy-to-eat foods. • Keep nutrient dense snacks close at hand and snack frequently. • Drink plenty of healthy fluids to keep the digestive system moving. • Be as physically active as possible.
Neutropenia	• Wash hands frequently and keep kitchen surfaces and utensils clean. • Do not eat raw or undercooked animal products, including meat, pork, game, poultry, eggs, and fish. • Wash all fresh fruits and vegetables. • "When in doubt, throw out" and "No ripe or moldy."
Altered taste or smell	• Maintain good oral hygiene (e.g., rinse mouth frequently, keep mouth clean). • Try marinades and spices to mask strange tastes. • Use plastic utensils if metallic tastes are a problem. • Try cooler foods, rather than warmer foods.
Thickened saliva	• Sip on liquids throughout the day to keep the oral cavity moist. • Thin oral secretions with club soda, seltzer water, or papaya nectar. • Try guaifenesin to help thin oral secretions. • Try using a cool mist humidifier while sleeping.
Xerostomia	• Sip on liquids throughout the day to keep the oral cavity moist. • Try tart foods to stimulate saliva, if open sores are not present. • Eat soft, moist foods with extra sauces, dressings, or gravies. • Maintain good oral hygiene (e.g., rinse mouth frequently, keep mouth clean).

Define cytokines and describe their role in *cancer cachexia*.

Immune- modulating agents; cancer cachexia is caused in part by cytokines produced by the cancer itself or by the immune system in response to the cancer.

What are *antiemetics* (most common = Zofran/ondansetron) and how may they be used?

A drug that prevents or reduces nausea and vomiting; blocking vital processes in bacteria, killing the bacteria or stopping them from multiplying.

COMPLEMENTARY AND ALTERNATIVE THERAPIES

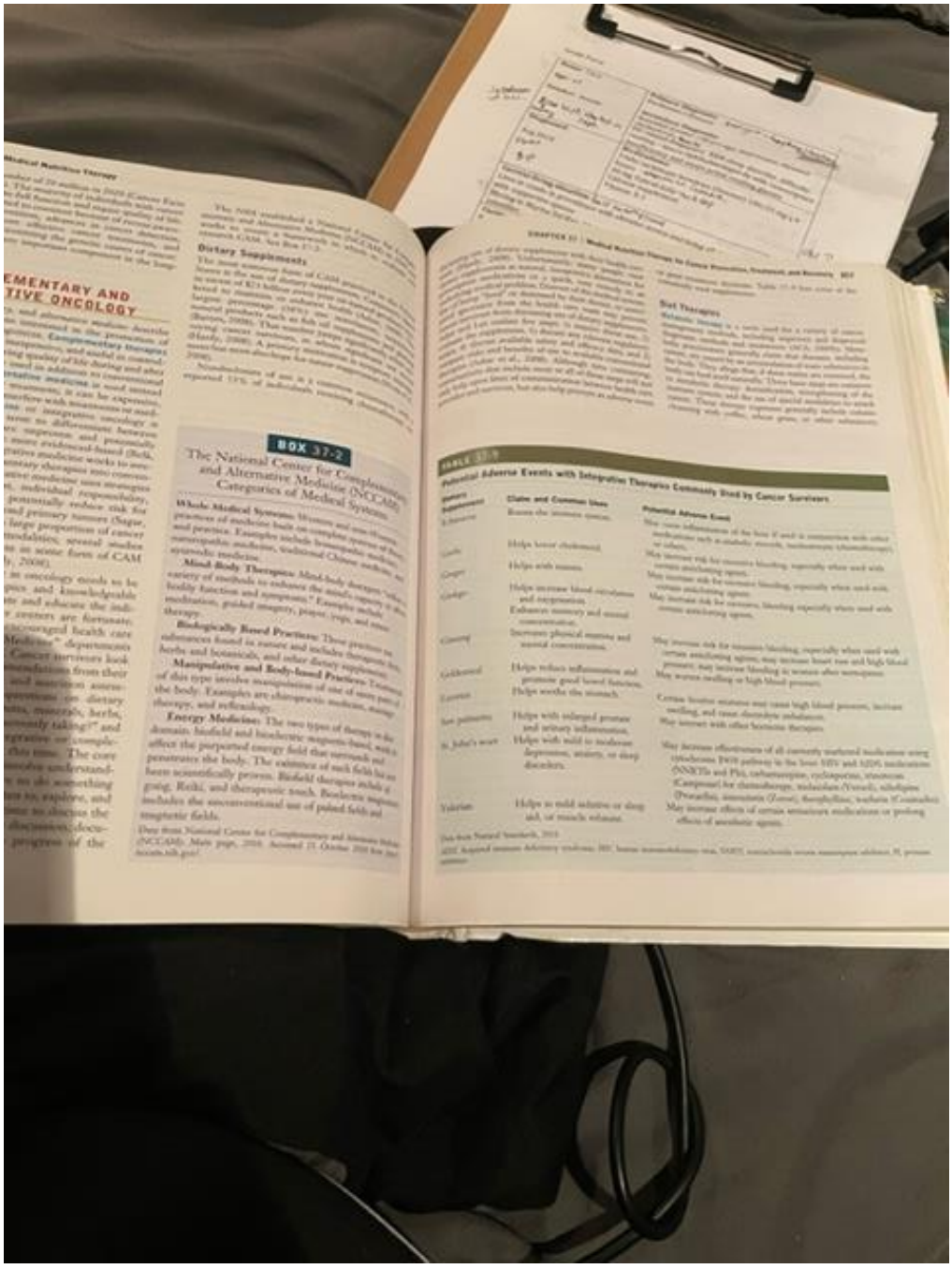
Use your text (pp. 750-2) and recorded lecture to answer the following questions:

What percentage of cancer survivors participate in some form of complementary or integrative therapy during or after treatment?

90%

Briefly describe the following and give examples of each:

Describe how the following may be used to manage cancer symptoms, and when used in supplement form, describe the possible undesirable side effects.



Seattle Cancer Care Alliance Diet Guidelines for BMT/ PBSCT Patients

Seattle Cancer Care Alliance
Fred Hutch · Seattle Children's · UW Medicine

Medical Nutrition Therapy Services

Diet Guidelines for Immunosuppressed Patients

Overview

You may have decreased immune function because of chemotherapy and/or radiation therapy or from taking medications to suppress your immune system. This means that you are at increased risk of developing a foodrelated infection. The purpose of this diet is to help you avoid specific foods that are more likely to contain infection-causing organisms while allowing maximum healthy food choices. Choose foods from the "May Eat" column. Do not eat foods in the "Do Not Eat" column. You may want to discuss the safety of these or other foods with your dietitian.

This diet should be followed before and after all conditioning therapy (chemotherapy and/or radiation)and while on immunosuppressive medications. Your health care provider and dietitian will let you know when the diet is no longer required. In general, we recommend the following:

- **For autologous transplant patients undergoing chemotherapy treatment only:** follow this diet during the first three months after chemotherapy or transplant.

- **For allogeneic transplant patients:** follow the diet until you are off all immunosuppressive therapy such as cyclosporine, prednisone, Tacrolimus®, Myfortic®, sirolimus, or MMF.

Before end of these time periods, you and your caregiver should talk to your health care provider and dietitian regarding whether or not to continue any part of the diet.

Food Groups	May Eat	Do Not Eat
 **Dairy**	• All pasteurized, grade "A" milk and milk products including eggnog, yogurt, ice cream, frozen yogurt, sherbet, ice cream bars, milkshakes, processed cheese slices and spreads, cream cheese, cottage cheese and ricotta cheese • Dry, refrigerated, or frozen pasteurized whipped topping • Commercially packaged hard and semisoft cheeses such as cheddar, mozzarella, parmesan, Swiss, Monterey Jack, etc. • Cooked and pasteurized soft cheeses such as brie, goat, camembert, feta, farmer's cheese. Though not completely risk free, the risk of contracting food borne illness from COOKED soft cheeses is low.	• Non-pasteurized or raw milk and milk products made from non-pasteurized or raw milk. • Cheeses from delicatessens • Cheese containing chili peppers or other uncooked vegetables • Cheeses with molds (such as blue, Stilton, Roquefort, gorgonzola)

Food Groups	May Eat	Do Not Eat
	• Mexican-style soft cheese such as queso fresco, queso blanco (Unless made with pasteurized milk and cooked) • Commercially sterile ready-to-feed and liquid-concentrate infant formulas (avoid powdered infant formulas if a ready-tofeed or liquid concentrate alternative is available)	
Meat and Meat Substitutes 	• All meats cooked to well done (see temperature guide attached) or canned meats (beef, pork, lamb, poultry, fish, shellfish, game, ham, bacon, sausage, hot dogs) • Eggs cooked until both white and yolk are firm • Pasteurized eggs and egg substitutes (such as Egg Beaters®), and powdered egg white (all can be used uncooked) • Commercially-packaged salami, bologna, hot dogs, ham and other luncheon meats, heated until steaming	• Raw or undercooked meat, poultry, fish, game, tofu[2] • Raw or undercooked eggs and nonpasteurized egg substitutes; no eggs over easy, soft-boiled eggs, or poached eggs. • Meats and cold cuts from delicatessens • Hard cured salami in natural wrap • Uncooked refrigerated smoked, seafood such as salmon or trout labeled as “nova-style,” “lox,” “kippered,” “smoked” or “jerky” • Pickled fish • Tempe (tempeh) products

	• Canned and shelf-stable[27] smoked fish (refrigerate after opening) • Pasteurized or cooked tofu[28] • Refrigerated smoked seafood such as salmon or trout if cooked to 160□F or contained in a cooked dish or casserole	

[27] Shelf-stable refers to unopened canned, bottled, or packaged food products that can be stored before opening at room temperature; container may require refrigeration after opening.

[28] 2 Aseptically packaged, shelf-stable tofu and pasteurized tofu do not need to be boiled. Unpasteurized tofu must be cut into 1-inch cubes or smaller, and boiled a minimum of five minutes in water or broth before eating or using in recipes.

 **Fruits and Nuts**	• Well washed[29] raw and frozen fruit; foods containing well washed raw fruits • Cooked, canned and frozen fruit • Pasteurized juices and frozen juice concentrates • Dried fruits • Canned or bottled roasted nuts	• Unwashed raw fruits • Unroasted raw nuts • Roasted nuts in the shell • Non-pasteurized fruit and vegetable juices • Fresh fruit salsa found in the grocery refrigerator case

Food Groups	May Eat	Do Not Eat
	• Shelled, roasted nuts and nuts in baked products • Commercially-packaged nut butters (such as peanut butter, almond butter, soybean butter)	Non-pasteurized items containing raw fruits found in the grocery refrigerator case
Entrees, Soups 	All cooked entrees and soups	All miso products (such as miso soup and miso paste)

[29] 3 Rinse under clean, running water before use, including produce that is to be cooked or peeled (such as bananas, oranges and melon).

Vegetables 	• Well washed[3] raw and frozen vegetables • All cooked fresh, frozen or canned vegetables, including potatoes • Shelf-stable[1] bottled salsa (refrigerate after opening) • Cooked vegetable sprouts (such as mung bean sprouts) • Fresh, well washed[3] herbs and dried herbs and spices (added to raw or cooked foods)	• Unwashed raw vegetables or herbs • Fermented vegetables such as kimchi or sauerkraut • Fresh, non-pasteurized vegetable salsa found in the grocery refrigerator case • Non-pasteurized items containing raw vegetables found in the grocery refrigerator case • All raw vegetable sprouts (alfalfa sprouts, clover sprouts, mung bean sprouts, all others) • Salads from delicatessens and restaurants
Bread, Grain, and Cereal Products 	• All breads, bagels, rolls, English muffins, muffins, pancakes, sweet rolls, waffles, French toast • Potato chips, corn chips, tortilla chips, pretzels, popcorn • Cooked grains and grain products, including pasta and rice • All cereals, cooked and ready-to-eat	□ Raw (not baked or cooked) grain products (such as raw oats)

Beverages	• Boiled well water[30] • Tap water and ice made from tap water[5] • Commercially-bottled distilled, spring and natural waters[31] • All canned, bottled and powdered beverages • Instant and brewed coffee and tea; cold	• Unboiled well water • Cold-brewed tea made with warm or cold water • Non-pasteurized fruit and vegetable juices • Mate´ tea • Kombucha
Food Groups	**May Eat**	**Do Not Eat**
	brewed tea made with boiling water • Herbal teas brewed from commerciallypackaged tea bags • Commercial nutritional supplements, • both liquid and powdered • Commercially sterile ready-to-feed and liquid-concentrate infant formulas (avoid powdered infant formulas if a ready-tofeed or liquid concentrate alternative is available)	• Wine, unpasteurized beer • (Note: All alcoholic beverages should only be consumed following health care provider approval)

[30] Bring tap water to a rolling boil and boil for 15-20 minutes. Store boiled water in the refrigerator. Discard water not used within 48 hours (2 days). [5] Recommend using boiled or bottled water if using a water service other than city water service. Please see *Water Safety Guidelines* in "Food Safety Guidelines".

[31] See *Water Safety Guidelines* in "Food Safety Guidelines" for approved bottled water treatments.

Desserts 	• Refrigerated commercial and homemade cakes, pies, pastries and pudding • Refrigerated cream-filled pastries • Cookies, both homemade and commercially prepared • Shelf-stable[3] cream-filled cupcakes (such as Twinkies®, Ding Dongs®) and fruit pies (such as Poptarts® and Hostess® fruit pies) • Canned and refrigerated puddings • Ices, popsicles and similar products • Candy, gum	Unrefrigerated cream-filled pastry products (not shelf-stable[3])
Fats 	• Vegetable oils and shortening • Refrigerated lard, margarine, butter • Commercial, shelf-stable[3] mayonnaise and salad dressings including Blue Cheese and other cheese-based salad dressings (refrigerate after opening) • Cooked gravy and sauces	Fresh salad dressings (stored in the grocer's refrigerated case) containing raw eggs or cheeses listed as "Do Not Eat" under "Dairy".
Other 	• Commercial pasteurized Grade A honey[7] • Salt, granulated sugar, brown sugar • Jam, jelly, syrups (refrigerate after opening) • Catsup, mustard, BBQ sauce, soy sauce, other condiments (refrigerate after opening) • Pickles, pickle relish, olives (refrigerate after opening) • Vinegar	• Raw honey; honey in the comb • Herbal and nutrient supplement preparations (refer to Guidelines for Use of Herbal and Nutrient Supplements in Patient & Caregiver Resource Manual) • Brewer's yeast, if uncooked

7 Honey products are not allowed for any child less than one year of age and not allowed for children with SCIDS until 9 months posttransplant.

This education resource was intended to be given as a part of a nutrition consult by an SCCA dietitian.

Questions? Ask an SCCA dietitian at nutrition@seattlecca.org

Wound Care

Prevention and Treatment of Pressure Injuries and Wounds MNT Reference Page

Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT
Calories	**Initial:**	**Advancement:**	**Goal:**
Protein			
Fluid			
Supplementation Needs			

Monitoring Criteria	
OTHER NOTES:	
References:	

Wound Care SLM Worksheets

Pressure Ulcers and Wounds

Self-Learning Assessment Worksheet

DEFINITIONS

Directions: Refer to chapter 21 in the ASPEN Adult Nutrition Support Core Curriculum, Krause's Food & The Nutrition Care Process, AND's NCM, the journal articles located in the Wounds/Pressure Ulcer SLA ulearn folder, and other reliable sources to *briefly* define the following terms.

Atrophy: decrease in size of body part

Bulla: a large blister seen in burns

Contusion: injury to tissue without breaking the skin but ruptures the blood capillaries beneath

Debride: to remove dead/ contaminated/ adherent tissue and/ or foreign material

Decubitus ulcer: *somewhat outdated term for pressure ulcer; impaired skin integrity and/or formation of a wound d/t prolonged pressure*

Dehiscence: a spontaneous opening of the edges of a surgical wound

Erythema: redness or swelling caused by capillary congestion

Eschar: a hard crust/ mass of dead tissue caused by a thermal burn or gangrene

Exudate: fluid collections that contains a significant amount of protein that is deposited in tissues or oozes from tissue surfaces

Fistula: an abnormal tubelike passage through the body

Granulation: progressing from the inflammatory phase of healing to the proliferative phase of healing

Inflammation: redness, swelling, pain, and/ or a feeling of heat in an area of the body

Maturation / "remodeling" phase:

Necrosis: death of tissues or bone

Pallor: paleness, decrease in skin coloration

Petechiae: a minute reddish or purplish spot containing blood that appears in skin or mucous membrane as a result of localized hemorrhage

Pressure ulcer: injuries to skin and underlying tissue resulting from prolonged pressure on the skin

Proliferation: growth of tissue cells

Pruritus: itching

Purulent: containing gas

Pus: fluid matter that is formed as part of an inflammatory response

Serous: thin and watery like serum

Shear: force generated when the skin is moved against a fixed surface

Stasis: slowing/ stoppage of the normal flow of bodily fluid/ semifluid.

NUTRITION CARE MANUAL

Directions: Refer to the AND's Nutrition Care Manual (Conditions > Surgical And Chronic Wounds) to answer the following questions.

Surgical And Chronic Wounds

What are the 3 phases of wound healing listed?

Proliferation phase: The proliferative phase generally follows and overlaps with the inflammatory phase; it is characterized by epithelial proliferation and migration over the provisional matrix within the wound (re-epithelialization). In the first week, fibroblasts produce glycosaminoglycans, proteoglycans, and collagen, which are the main extracellular substances of granulation tissue.

Maturation/remodeling phase: Key elements of maturation include collagen cross-linking, collagen remodeling, wound contraction, and repigmentation. In this phase, the collagen is remodeled into a more organized structure with increased tensile strength.

Inflammatory stage: This stage is characterized by redness, swelling, pain, and loss of function. It occurs immediately after acute skin injury and hemostatic mechanisms and pathways commence.

What are the 11 factors associated with nonhealing?

Impaired arterial or venous circulation, Immune compromise, Older age (65 years or older), Diseases (diabetes mellitus, uremia, keloids, fibrosis, heredity healing disorders, jaundice), Dehydration, Immobility, Neuropathy, Spinal cord injuries, Obesity, Malnutrition, and Specific nutrient deficiencies

How can malnutrition (including nutrient deficiencies) impair wound healing?

affecting collagen synthesis, prolonging inflammation, decreasing phagocytosis, causing dysfunction of B and T cells, and decreasing the mechanical strength of the skin (Wild, 2010).

Define the following:

Diabetic Ulcers: foot ulcers are a significant health problem and can result from arterial insufficiency or neuropathy. Complications of foot ulcers are a leading cause of hospitalization and amputation in patients with diabetes mellitus

Venous Ulcers: most common type of chronic wounds treated and may be caused by valve incompetence in perforating veins or when there is a history of deep vein thrombophlebitis and/or thrombosis (Armstrong, 2012). They are often associated with edema and are found on the lower leg or ankle.

Arterial Ulcers: ischemic ulcers, are caused by poor perfusion (delivery of nutrient-rich blood) to the lower extremities. The overlying skin and tissues are then deprived of oxygen, killing these tissues and causing the area to form an open wound.

Surgical Wounds: most common complication after surgery is wound infection. Surgical site infections account for 14% to 16% of the estimated 2 million nosocomial infections affecting hospitalized patients in the United States

Pressure Ulcers

What are the 8 risk factors for pressure ulcer development?

Exposure to fecal incontinence, steroid use, cognitive impairment, a healed ulcer, impaired blood flow, and diabetes.

What are the 9 nutritional risk factors?

Hypermetabolism, poor appetite, chewing problems, poor dental health, inability to self-feed, and alcohol abuse.

Provide the recommendations for the nutrients listed below for patients with or at risk of developing wounds:

Energy: 30-35 kcal/kg of body weight per day for adults with a pressure injury who are malnourished or at risk for malnutrtion

Protein: 1.2-1.5 g/kg per day for older adults with acute or chronic disease and suggests that those with servere illness/ injury may need 2 g/kg per day

Fluid: adequate for pt; goal is to prevent dehydration. Can use energy-based equation.

Micronutrients: vitamin a, c & e, copper, iron and zinc

Confirmed/suspected zinc deficiency: Zn SO4 220mg (50mg elemental zinc) 2-3 wks = repletion

A.S.P.E.N. ADULT NUTRITION SUPPORT CORE CURRICULUM

Directions: Refer to chapter 21 in the ASPEN Adult Nutrition Support Core Curriculum, 3rd edition to answer the following questions.

List and *briefly* describe the layers of the skin (from outside inward)

The epodermis; outer most layer, does not contail nerve endings or blood vessels but is responsible for epithelialization (skin closure) of wounds.

The dermis; thickest tissue layer of the skin,

Basement membrane; separes the epidermis from the dermis

Hypodermis; aka superficial fascia, beneath the dermis and cover the muscle, ligaments, tendon and bone

Describe the difference between *partial thickness* and *full thickness wounds:*

Partial thickness wounds are swallow wounds involving full or partial epidermal loss and partial loss of the dermal layer

Full thickness wounds involve total loss of both epidermal and dermal layers, extending to at least the subcutaneous tissue layer and possibly as deep as the fascia, muscle layer and the bone

Chronic wounds are defined as wounds that have not healed within __12__ *weeks of the initial injury. Chronic wounds often begin as minor acute wounds, but they become chronic because various factors that adversely affect the healing process—including* __infection__, __malnutrition__, __medications__, *the presence of* __comorbidities__, *and so on—delay healing.*

Adequate protein and energy has been shown to enhance healing in both groups

How long is the inflammatory phase of wound healing?

4-6 days following tissue injury

What role do each of the following nutrients have in wound healing (refer to Table 21-3):

Vitamin A:

Vitamin C:

Zinc: if a zinc deficiency is confirmed or suspected, Zn SO4 220mg (50mg elemental Zn) BID for <2-3 weeks. Zinc is needed for cell growth and immune function.

Micronutrients

As noted earlier in the chapter and summarized in Table 21-3 several micronutrients are essential to wound healing.[1,2,8] The NPUAP/EPUAP/PPPIA guidelines recommend a multivitamin with minerals be considered when an individual with a pressure injury is not consuming a balanced diet or a deficiency is suspected or confirmed.[2] Refer to Chapter 8 for additional information on micronutrient requirements and signs and symptoms of toxicity or deficiency.

TABLE 21-3 Role of Micronutrients in Wound Healing

	Function in Wound Healing	Effects of Deficiency or Toxicity
Vitamin A	• Maintains integrity of epithelial and mucosal surfaces • Stimulates fibroblasts, which increase collagen synthesis; cross-linking and remodeling of collagen • Antagonizes inhibitory effects of glucocorticoids	• Vitamin A deficiency is associated with widespread alterations in immune function (altered epithelial and mucosal surfaces, T and B cell function, and antibody response). • Deficiency increases risk of infection (diarrheal and respiratory). • In patients with vitamin A deficiency, impaired collagen synthesis with delayed wound healing may occur with high doses of glucocorticoids.
Vitamin E	• Antioxidant, which when combined in a high-calorie oral nutritional supplement enriched with arginine, zinc and other antioxidants, promotes healing • Inhibits collagen synthesis, decreases tensile strength of wounds	• No clinically significant effects of vitamin E deficiency on wound healing are known.
Vitamin C	• Required for fibroblast maturation as well as hydroxylation of proline and lysine in collagen synthesis • Required for angiogenesis • Affects immune function (leukocyte function and complement production)	• Vitamin C deficiency is associated with reduced wound tensile strength and increased wound dehiscence due to impaired fibroblast and collagen maturation. • Deficiency may contribute to increased capillary fragility and angiogenesis with increased wound hemorrhage. • Old wounds may break down in very severe vitamin C deficiency.
Vitamin K	• Cofactor for synthesis of prothrombin and clotting factors VII, IX, and X	• If vitamin K is deficient, excessive bleeding can occur in wounds and predispose patients to wound infection.
Iron	• Cofactor in hydroxylation of lysine and proline for collagen synthesis • Oxygen transport to wounded tissue • Component of many enzymes (eg, required in oxidative burst of phagocytosis)	• When low hemoglobin concentration is due to iron deficiency anemia, it may be a factor in tissue hypoxia and impair wound healing if compensatory mechanisms cannot maintain adequate tissue perfusion. • Impaired hydroxylation of collagen due to iron deficiency is rarely seen in clinical practice. • Iron deficiency may contribute to impaired immune response (T cell and phagocytic function).
Zinc	• Component of many enzyme systems (eg, various growth factors, synthesis of fibroblasts, DNA, and RNA) • Affects multiple aspects of immune function • Production of metalloproteinases is zinc-dependent	• Zinc deficiency is associated with impaired wound strength (decreased fibroblast proliferation, collagen synthesis, and rate of epithelialization). • Depressed immunity is seen even in mild deficiency; susceptibility to a variety of pathogens is increased. • Zinc deficiencies occur secondary to diseases that impair intestinal absorption and/or increase zinc losses.

What is the new term for *pressure ulcer* in the new NPUAP injury staging system?

Pressure injury

What are the goals for Nutrition Support in wound healing?

Restore and maintain adequate nutrition status, enhance wound healing and immune function, and reduce susceptibility to wound infection (prevent infection).

Review the practice scenarios provided in the chapter.

NUTRITION, ANABOLISM AND THE WOUND HEALING PROCESS ARTICLE

Directions: Refer to the article titled "Nutrition, Anabolism and the Wound Healing Process: An Overview" to answer the following questions.

What does the author list as conditions associated with the development of PEM? *Refer to Table 1*

DEMLING

Table 1. *Conditions associated with development of protein-energy malnutrition*

Catabolic illness, "the stress response," eg, trauma, surgery, wounds, infection, corticosteroids
Involuntary weight loss exceeding 10% of ideal, for any reason
Chronic illnesses, eg, diabetes, cancer, mental impairment, arthritis, renal failure
Wounds, especially chronic
Increase in nutritional losses; open wounds, enteral fistulas
Intestinal-tract diseases impairing absorption

gir

What are the complications associated with loss of lean body mass? *Refer to Table 4*

Table 4. *Complications relative to loss of lean body mass*[*]

Lean body mass (% loss of total)[*]	Complications (related to lost lean mass)	Associated, mortality, %
10	Impaired immunity, increased infection	10
20	Decreased healing, weakness, infection, thinning of skin	30
30	Too weak to sit, pressure sores develop pneumonia, no healing	50
40	Death, usually from pneumonia	100

[*]Assuming no preexisting loss.

At **10**% loss, patients develop impaired immunity and are at increased risk of infection. At **20**% loss, decreased healing, weakness, infection, and thinning of skin occur, and at **30**%, patients become too weak to sit, develop pressure sores, and are unable to heal. Finally, at 40% loss, death occurs--usually from **pneumonia (PNA)**.

What are the major metabolic changes that occur with the injury-induced stress response? *Refer to Table 5*

Table 5. *Major metabolic abnormalities with response to injury "stress response"*

Increased catabolic hormones (cortisol and catechols)
Decreased anabolic hormones (human growth hormone and testosterone)
Marked increase in metabolic rate
Sustained increase in body temperature
Marked increase in glucose demands and liver gluconeogenesis
Rapid skeletal muscle breakdown with amino acid use as an energy source (counter to normal nutrient channeling)
Lack of ketosis, indicating that fat is not the major calorie source
Unresponsiveness of catabolism to nutrient intake

What macronutrient distribution is recommended for wound healing according to the author?

Approximately 55% to 60% of total calories should be delivered as complex carbohydrates instead of simple sugars. Each gram of carbohydrate generates 3.3 kcal. Excess carbohydrates will lead to hyperglycemia, a major complication resulting in impeded healing and immune dysfunction. Maximum glucose utilization is considered to be 7 µg/kg/min.[48,57]

Approximately 20% to 25% of calories should be provided by fat, but not more than 2 g/kg/day. Values in excess will likely not be cleared from serum. Triglyceride levels should be kept below 250 mg/dL. Fat provides 10 kcal/g.

Because normal protein preservation in LBM is not maintained with a wound stress response, approximately 20% to 25% of total calories need to be provided as protein. Inadequate intake will not prevent protein use for calories, as LBM becomes the source.

Elbows, heels, inner knees & ears are common locations for pressure injuries to develop.

2014 NPUAP Guidelines: provide a multivitamin/ mineral supplement only when an individual is unable to consume a balanced diet or a deficiency is suspected/ confirmed.

Branden Scale

BRADEN SCALE – For Predicting Pressure Sore Risk

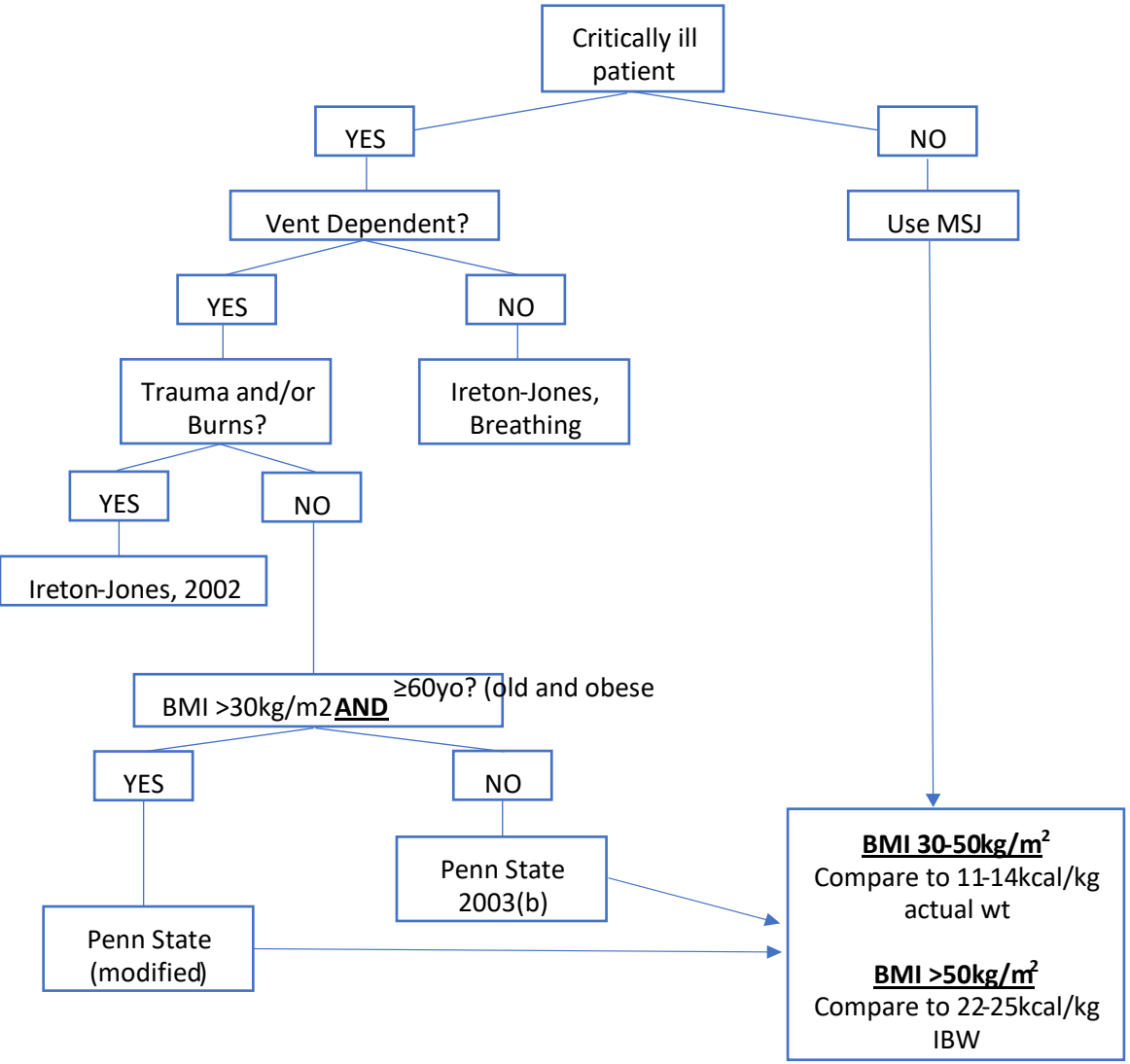
SEVERE RISK: Total score ≤ 9 **HIGH RISK:** Total score 10-12
MODERATE RISK: Total score 13-14 **MILD RISK:** Total score 15-18

DATE OF ASSESS ➡

RISK FACTOR	SCORE/DESCRIPTION				1	2	3	4
SENSORY PERCEPTION Ability to respond meaningfully to pressure-related discomfort	**1. COMPLETELY LIMITED** – Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation, **OR** limited ability to feel pain over most of body surface.	**2. VERY LIMITED** – Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness, **OR** has a sensory impairment which limits the ability to feel pain or discomfort over ½ of body.	**3. SLIGHTLY LIMITED** – Responds to verbal commands but cannot always communicate discomfort or need to be turned, **OR** has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	**4. NO IMPAIRMENT** – Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.				
MOISTURE Degree to which skin is exposed to moisture	**1. CONSTANTLY MOIST** – Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	**2. OFTEN MOIST** – Skin is often but not always moist. Linen must be changed at least once a shift.	**3. OCCASIONALLY MOIST** – Skin is occasionally moist, requiring an extra linen change approximately once a day.	**4. RARELY MOIST** – Skin is usually dry; linen only requires changing at routine intervals.				
ACTIVITY Degree of physical activity	**1. BEDFAST** – Confined to bed.	**2. CHAIRFAST** – Ability to walk severely limited or nonexistent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	**3. WALKS OCCASIONALLY** – Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.	**4. WALKS FREQUENTLY** – Walks outside the room at least twice a day and inside room at least once every 2 hours during waking hours.				
MOBILITY Ability to change and control body position	**1. COMPLETELY IMMOBILE** – Does not make even slight changes in body or extremity position without assistance.	**2. VERY LIMITED** – Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	**3. SLIGHTLY LIMITED** – Makes frequent though slight changes in body or extremity position independently.	**4. NO LIMITATIONS** – Makes major and frequent changes in position without assistance.				
NUTRITION Usual food intake pattern [1]NPO: Nothing by mouth. [2]IV: Intravenously. [3]TPN: Total parenteral nutrition.	**1. VERY POOR** – Never eats a complete meal. Rarely eats more than 1/3 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement, **OR** is NPO[1] and/or maintained on clear liquids or IV[2] for more than 5 days.	**2. PROBABLY INADEQUATE** – Rarely eats a complete meal and generally eats only about ½ of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement **OR** receives less than optimum amount of liquid diet or tube feeding.	**3. ADEQUATE** – Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products) each day. Occasionally refuses a meal, but will usually take a supplement if offered, **OR** is on a tube feeding or TPN[3] regimen, which probably meets most of nutritional needs.	**4. EXCELLENT** – Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.				
FRICTION AND SHEAR	**1. PROBLEM** – Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures, or agitation leads to almost constant friction.	**2. POTENTIAL PROBLEM** – Moves feebly or requires minimum assistance. During a move, skin probably slides to some extent against sheets, chair, restraints, or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	**3. NO APPARENT PROBLEM** – Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair at all times.					
TOTAL SCORE	**Total score of 12 or less represents HIGH RISK**							

ASSESS	DATE	EVALUATOR SIGNATURE/TITLE	ASSESS.	DATE	EVALUATOR SIGNATURE/TITLE

Critical Care



ICU Energy Needs Decision Tree

ICU Energy Needs Equation Decision Tree

For use with critically ill patients when Indirect Calorimetry is not available

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Energy Equations

THE MIFFLIN-ST. JEOR EQUATION

Male: $(9.99 \times wt) + (6.25 \times ht) - (4.92 \times age) + 5$

Female: $(9.99 \times wt) + (6.25 \times ht) - (4.92 \times age) - 161$

THE IRETON JONES EQUATION FOR CRITICALLY ILL PATIENTS

Spontaneously Breathing (1992):

TEE = 629 – 11(age in years) + 25(wt in kg) – 609(1 for obesity, 0 if normal wt)

Vent Dependent (revised 2002):

TEE = 1784 – 11(age in years) + 5(wt in kg) + 244(1 M, 0 F) + 239(1 T, 0 for none) + 804(1 for B, 0 for none)

T = trauma; B = burns; M = male, F = females

PENN STATE EQUATIONS

Modified (2010)

Vent Dependent (BMI ≥30kg/m^2 and >60yo): RMR = MSJ(0.71) + Tmax(85) + VE(64) - 3085

2003b

Vent Dependent (BMI <30kg/m^2 or <60yo with a BMI ≥30kg/m^2):

RMR = MSJ(0.96) + VE (31) + Tmax(167) – 6212

MSJ = Mifflin St. Jeor; VE = minute ventilation (L/min); T_{max} = max temp (in C)

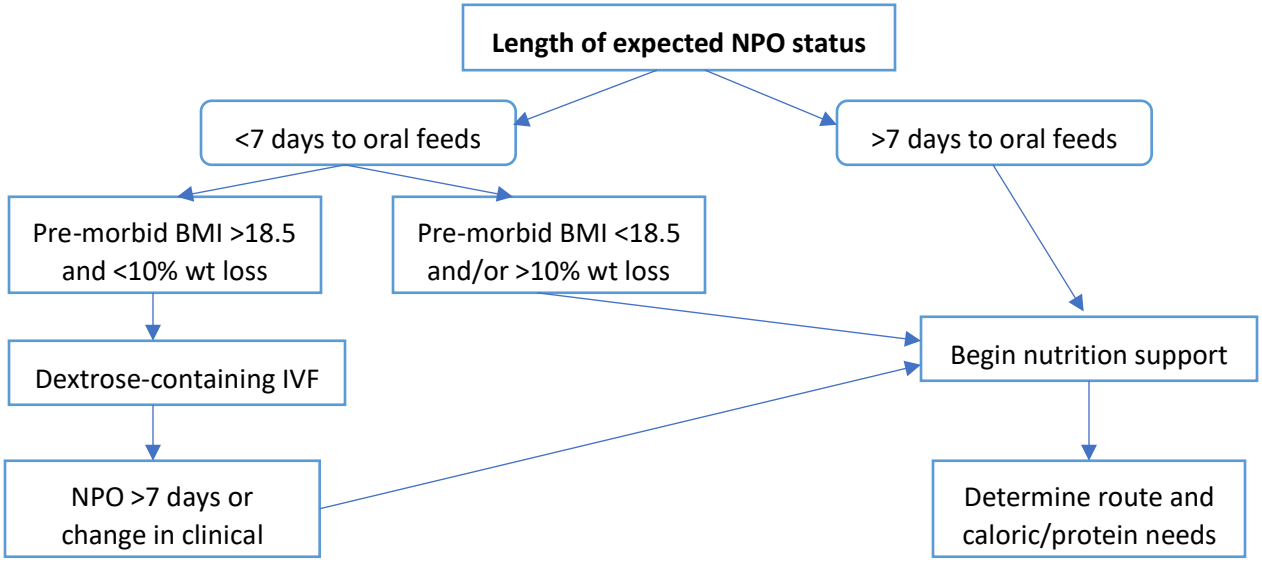
Critical Care Reference Page

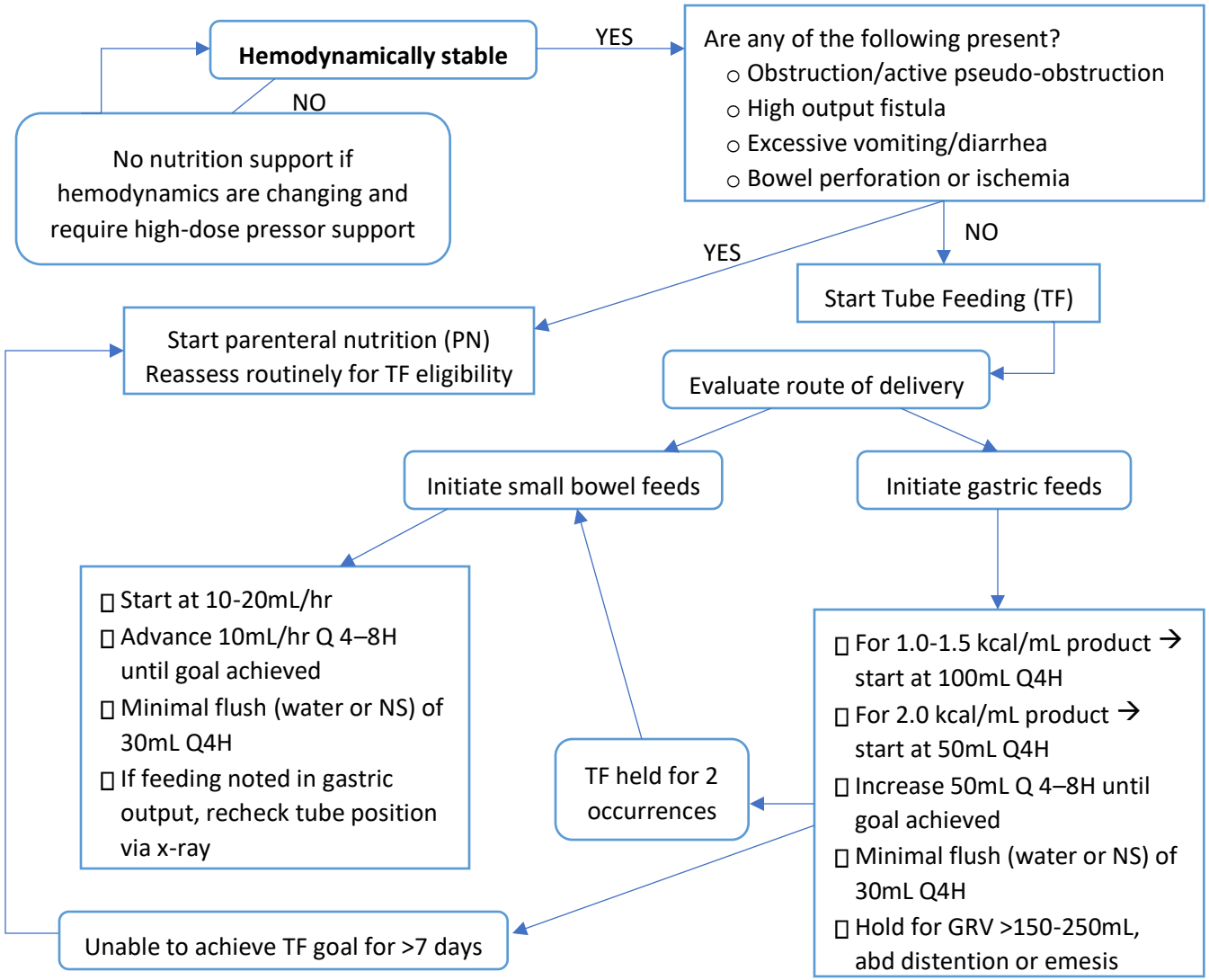
Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT

Calories	**Initial:**	**Advancement:**	**Goal:**
Protein			
Fluid			
Supplementation Needs			
Monitoring Criteria			
OTHER NOTES:			
References:			

MNT for Acute Pancreatitis Decision Tree

Timing and Route of Nutrition Support in the Critically Ill Patient





Reference: Taylor, B., Winkler, M. F., & Malone, A. M. (2017). Medical nutrition therapy in critical care. In L. K. Mahan, & J. L. Raymond, *Krause's food & the nutrition care process* (14th ed., pp. 775-89). St. Louis, MO: Elsevier.

Critical Care, Trauma & Burns Chapter Worksheets

Critical Care Nutrition: Metabolic Stress & Trauma

Chapter 38 Worksheet

DEFINITIONS

Directions: Refer to chapter 38 (pp. 775-7, 779-87) in Krause's Food & The Nutrition Care Process and reliable outside resources as needed to define/describe the following terms.

Ebb phase: occurring immediately following injury, is associated with hypovolemia, shock, and tissue hypoxia

Flow phase: increase cardiac output, oxygen consumption, body temperature, energy expenditure and total body protein catabolism

Hemodynamic stability (HD): stable blood flow

TBSA: total body surface area

ORGAN RESPONSE TO STRESS

You will be responsible for the information found in the table below—*a summary has been provided for you (refer to your lecture, and pgs. 776-7 for additional information).*

ORGAN / SYSTEM	RESPONSE TO STRESS
GI / Liver	Bacterial translocation; GALT damage; villous atrophy; ileus / poor motility, obstruction, gastroparesis; possible liver failure / dysfunction. Special considerations for pts w/ an open abdomen
CNS	Encephalopathy; polyneuropathy; disrupted sleep / wake cycles
Circulation	Hypotension / poor perfusion; capillary leak; DIC; heart failure
Skeletal muscle	Loss of LBM (used for energy), wasting
Lungs	Pulmonary edema, hypoxemia, ARDS, tachypnea; possible ventilatory support

Kidneys	Oliguria, AKI, hypoperfusion injury; possible need for HD/PD/CRRT
Endocrine	Hyperglycemia: *see lecture for BG control recommendations*.
Misc.	Possible fluid overload (multifactorial); fluid losses w/ burns / large wounds; electrolyte derangement; increase in free radicals w/ inflammatory response; increased risk of infection.

MNT FOR METABOLIC STRESS

Use your text (pp. 779-82) to answer the following questions:

The critically ill patient typically enters an intensive care unit (ICU) because of a _____cardiopulmonary_____ diagnosis, _____intraoperative_____ or _____postoperative_____ complication, multiple _____trauma_____, _____burn_____ injury, or _____sepsis_____.

Ideally, _____Indirect calorimetry (IC)_____ should be used to determine energy requirements for critically ill patients.

What are some factors that may lead to invalid results when using IC studies with critically ill patients?

High oxygen requirement, the presence of a chest tube, acidosis, and the use of supplemental oxygen

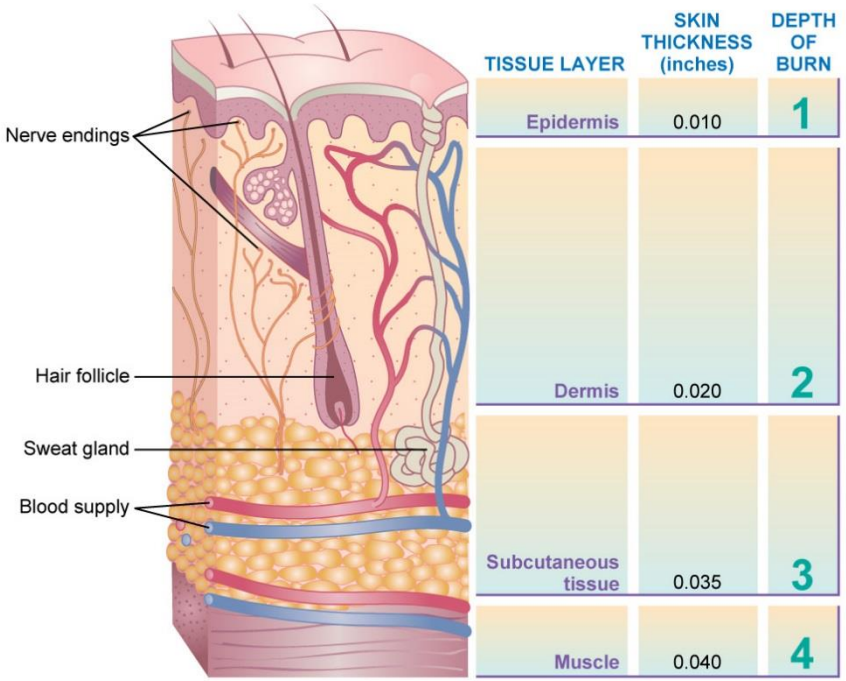
Avoidance of overfeeding in the critically ill patient is important. Although adequate energy is essential for metabolically stressed patients, excess calories can result in complications such as:

Hyperglycemia, hepatic steatosis and excess carbon dioxide production

MAJOR BURNS

Use your text (pp. 784-7) and recorded lecture to answer the following questions:

Note the diagram below (Figure 38-7, pg. 784) to interpret burn classification:



TISSUE LAYER	SKIN THICKNESS (inches)	DEPTH OF BURN
Epidermis	0.010	1
Dermis	0.020	2
Subcutaneous tissue	0.035	3
Muscle	0.040	4

Energy requirements can increase as much as _____100_____% above resting energy expenditure, depending on the extent and depth of the injury.

The first ____24_____ to ___48_____ hours of treatment for thermally injured patients are devoted to _____fluid resuscitation_____.

List the goals of nutrition support therapy after major burn injury:

Minimize metabolic stress by: controlling environmental temperature, maintaining fluid and electrolyte balance, controlling pain and anxiety, covering wounds early

Meet nutritional needs by: providing adequate calories to prevent wt loss of >10% of UBW, providing adequate pro for positive nitrogen balance and maintenance or repletion or circulating proteins, providing vit and mineral supplementation as indicated

Prevent Curling stress ulcer by; providing antacids or continuous enteral feedings

Provision of adequate calories to meet energy needs while minimizing associated metabolic complications, prevention or correction of specific nutrient deficiencies, and fluid and electrolyte management for adequate urine output and normal homeostasis

Many burn patients will be able to _____ and nutrition counseling should focus on selection of:

ICU MEDICATIONS

Refer to your recorded lecture and other appropriate resources to fill out the following tables.

These medications are discussed in the recorded lecture—use additional resources as needed.

IV Drips

Medication		**Use / Notes**
	Dopamine	Improvement of kidney & bowel perfusion
	Dobutamine	Treats cardiac decompensation due to weakened heart muscle
	Epinephrine	Pts requiring hemodynamic support; inotrpic & Vasopressor agent
	Norepinephrine / Levophed	Pts w septic shock
	Vasopressin	Treats vasodilatory shock, primarily in sepsis

	Nipride	Reduce blood pressure
	Amiodarone	Treats a variety of arrhythmias
	Lasix / Furosemide	Diuretic
	Propofol	Treats tracheal intubation and mechanical ventilation
	Fentanyl	Opioid analgesic
	Versed	Helps tolerate a medical procedure (sleepiness/ memory loss)
	Albumin	Pts with severe sepsis, especially pts who are not responding to crystalloid infusion

These are not found in your text. Some guidelines are in your recorded lecture, but specifics as to the composition are not. Please use other reliable resources to fill in the chart.

IV Fluids

Solution	**Abbrev.**	**Na^{++} mEq**	**Cl^{-} mEq**	**K^{+} mEq**	**Ca^{++} mEq**	**Lactate mEq**	**Glucose g/L**	**Osmolality**

0.9% normal saline	NS	154	154	0	0	0	0	308
Lactated Ringer's	LR	130	109	4.5	2.7	28	0	280
5% dextrose in water	D5W	0	0	0	0	0	50	154
0.45% normal saline with 5% dextrose	D5 ½NS	77	77	0	0	0	50	405

JOURNAL ARTICLE QUESTIONS

Refer to the journal article *Nutrition in the Acute Phase of Critical Illness* by Casaer and Van den Berghe (*NEJM* 2014; 370: 1227-36) to answer the following questions.

1. In the introduction/abstract, the authors refer to the "cumulative energy deficit" that occurs in ICU patients. What do they mean by *energy deficit*? What factors contribute to the *cumulative energy deficit*?

   Unless such patients are provided with macronutrients in the form of enteral or parenteral nutrition, they accumulate an energy deficit that rapidly reaches proportions that contribute to lean-tissue wasting and that are associated with adverse outcomes.

2. In the Enteral Nutrition section, they mention "trophic feedings". What are *trophic feedings*? What benefits may *trophic feedings* provide?

   Studies in animals and humans have shown a trophic effect of enteral nutrients on the integrity of the gut mucosa, a finding that has provided the rationale for instituting enteral nutrition early during critical illness. In observational studies, patients in the ICU who were fed early through the enteral route have had a better outcome than those who were not.25 However, the inability to provide enteral nutrition early may be a marker of the severity of illness (i.e., patients who can be fed enterally are less ill than those who cannot) rather than a mediator of complications and poor outcomes.

3. It is generally thought that *trophic feedings* do benefit patients, but what do the authors suggest could be a confounding factor in the belief that trophic feedings benefit patients?

   It remains unknown whether early parenteral nutrition is beneficial for patients who have an absolute and more prolonged contraindication to enteral nutrition. Since the avoidance of parenteral feeding results in prolonged fasting, such patients are often excluded from studies. A meta-analysis of seven randomized, controlled trials published between 1981 and 1994 (involving a total of 798 patients) showed that parenteral nutrition, as compared with no feeding, was associated with a higher rate of infection.42 In a post hoc subgroup analysis of the EPaNIC trial, 517 patients who were admitted to the ICU with a surgical contraindication for enteral feeding had fewer infections and an increased likelihood of earlier live discharge from the ICU if they were not assigned to receive early parenteral nutrition.14 For these patients, starvation was tolerated for 1 week in the ICU and resulted in improved clinical outcomes.14 Thus, the most effective time at which the initiation of parenteral nutrition can produce a clear clinical benefit during critical illness remains un

4. Why are ICU patients likely to receive less than the prescribed amount of enteral nutrition?

   Because of interruptions in feeding for a variety of reasons and delayed gastric emptying, patients often receive less than the prescribed amount of enteral nutrition. Failure to deliver the prescribed nutrition has been considered to be one of the reasons that the use of enteral nutrition has not improved the outcome in critically ill patients. This hypothesis was supported by a small, randomized, controlled trial involving patients with traumatic brain injury, which showed that delivering enteral nutrition to reach an estimated energy target immediately after ICU admission, rather than to reach gradually increasing targets over the first week in the ICU, resulted in a reduced rate of infection.31

5. Why are *gastric residual volumes* (GRVs) of concern in ICU patients? Based on the studies presented in the paper, are GRVs associated with poor outcomes? Why or why not?

   Among patients in the ICU, gastric emptying is often slow or impaired, which can result in large gastric residual volumes with enteral feeding. Since regurgitation of gastric content can lead to aspiration pneumonia, enteral feeding is often discontinued in patients who are found to have large gastric residual volumes. For this reason, there is a longstanding controversy about whether the presence of large gastric residues is acceptable. Two recent randomized, controlled trials addressed this question. The Gastric Residual Volume during Enteral Nutrition in ICU Patients (REGANE) trial (involving 329 patients) showed that gastric residual volumes up to 500 ml could be safely tolerated.10 The Effect of Not Monitoring Residual Gastric Volume on the Risk of Ventilator-Associated Pneumonia in Adults Receiving Mechanical Ventilation and Early Enteral Feeding (NUTRIREA 1) trial (involving 449 patients) showed that the omission of the measurement of gastric residual volumes did not increase the incidence of aspiration or related complications.11 Interestingly, the two studies showed that allowing large gastric residual volumes increased the amount of enteral feeding that was administered early during critical illness but did not affect clinical outcomes.

6. What do the authors mean by "prokinetic" agents? Which medications do they list as *prokinetics*?

   Among patients in the ICU, gastric emptying is often slow or impaired, which can result in large gastric residual volumes with enteral feeding. Since regurgitation of gastric content can lead to aspiration pneumonia, enteral feeding is often discontinued in patients who are found to have large gastric residual volumes. For this reason, there is a longstanding controversy about whether the presence of large gastric residues is acceptable. Two recent randomized, controlled trials addressed this question. The Gastric Residual Volume during Enteral Nutrition in ICU Patients (REGANE) trial (involving 329 patients) showed that gastric residual volumes up to 500 ml could be safely tolerated.10 The Effect of Not Monitoring Residual Gastric Volume on the Risk of Ventilator-Associated Pneumonia in Adults Receiving Mechanical Ventilation and Early Enteral Feeding (NUTRIREA 1) trial (involving 449 patients) showed that the omission of the measurement of gastric residual volumes did not increase the incidence of aspiration or related complications.11 Interestingly, the two studies showed that allowing large gastric residual volumes increased the amount of enteral feeding that was administered early during critical illness but did not affect clinical outcomes.

7. Based on <u>European</u> guidelines, when should PN be started in ICU patients? When should PN be considered based on <u>American</u> and <u>Canadian</u> recommendations?

   Although European guidelines have recommended the early initiation (within 48 hours after admission to the ICU) of parenteral nutrition so that the accumulating nutritional deficit is prevented as soon as possible, American and Canadian guidelines have advised allowing hypocaloric enteral nutrition for 1 week in well-nourished patients before considering parenteral nutrition.3,4 The latter advice was based on the observation of complications (e.g., liver-function abnormalities, hyperglycemia, hypertriglyceridemia, and infections) associated with parenteral nutrition and overfeeding reported in older studies.28,35-37

8. What hazards are cited in the paper as reasons for delaying PN in ICU patients?

   Unexpectedly, patients who received insufficient enteral nutrition had an earlier live discharge from the ICU and hospital, a lower incidence of new ICU infections and of ICU-acquired weakness,38 and a lower duration of vital-organ support than did patients receiving insufficient enteral nutrition supplemented with parenteral nutrition.14 There were substantial cost savings in the group not receiving the parenteral nutrition, which were explained largely by a reduced need for antibacterial and antifungal drugs.39 Results were consistent regardless of the type or severity of illness.14,40

9. Why is it thought that *glutamine* may be *conditionally essential* in ICU patients?

   Glutamine is the most abundant nonessential free amino acid. It is synthesized predominantly in skeletal muscle; low glutamine levels have been associated with a poor outcome in critical illness. Low glutamine levels were considered to be the consequence of muscle wasting, since with the loss of muscle mass, the production of glutamine may not match increased glutamine requirements

of immune cells, enterocytes, and hepatocytes. Thus, glutamine was labeled a "conditionally essential" amino acid during critical illness, which led to the hypothesis that glutamine supplementation would improve outc

10. What was the outcome from the three combined studies that increased the ratio of omega-3 to omega-6 fatty acids via EN?

    These results are consistent with those of a smaller randomized, controlled trial involving 240 patients, in which patients with a variety of illnesses who were in the ICU were assigned either to an approach that allowed underfeeding or to one that targeted full feeding. Patients who were assigned to the approach that allowed underfeeding received fewer calories but had outcomes that were at least as good as those in patients assigned to early full feeding.9

Sepsis & Acute Pancreatitis Chapter Worksheets

Critical Care Nutrition: Sepsis & Pancreatitis

Chapter 38 + 29 Worksheet

Directions: Refer to chapters 38 (pp. 777-9) and 29 (pgs. 580-3) in Krause's Food & The Nutrition Care Process and your recorded lectures to answer the following questions.

SEPSIS

Use your text (pp. 777-9) and recorded lecture to answer the following questions:

Define the following:

Sepsis: SIRS + Infection

Shock: Severe sepsis + hypotension

MODS: Common complication → multiple organ dysfunction syndrome (MODS)

Respiratory, hepatic, cardiac, intestinal and renal failure

Describe SIRS: systemic inflammatory response syndrome; May occur w/ pancreatitis, ischemia, burns, multiple trauma, hemorrhagic shock and organ injury

Briefly describe the diagnostic criteria for SIRS:

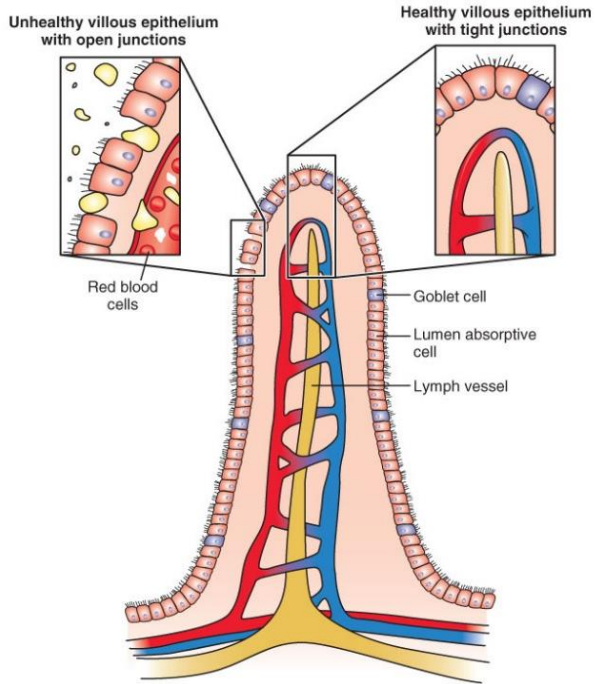
SIRS

Temp. <36 or >38°C, HR >90, RR >20 or $PaCO_2$ <32,
WBC <4,000 or >12,000 cells/mL, or >10% Bands

Patients with SIRS and MODS are clinically _____*hypermetabolic*_____ *and exhibit high* _____*cardiac output*_____, *low* ____*oxygen*_____ *consumption, high venous* _____*oxygen*_____, *and* _____*lactic*_____ *acidemia.*

Use the image below (Figure 38-4, pg. 778) to describe why it is important to consider SIRS when thinking about nutrition support in the ICU.

EN may have a role in maintaining tight junctions between the intraepithelial cells, stimulating blood flow and inducing the release of trophic factors. Tight junctions in the intestinal villus, supporting gut membrane integrity.



What role may enteral nutrition play in the GI health of patients with sepsis?

Common nutrition diagnosis is altered GI function (vomiting, diarrhea, constipation)

With central parenteral nutrition (PN), _____*mucosal atrophy* _____ *an*
*function (EBF)*_____ *may occur.*

PANCREATITIS

Use your text (pp. 580-3) to answer the following questions:

Describe the following:

Pancreatitis: inflammation of the pancreas

Acute pancreatitis (AP): mild-> severe; high mortality, hypermetabolic (muscle catabolism), N/V, anorexia, similar to sepsis, partially related to the secretory mechanisms of pancreatic enzymes and bile. CL diet

Chronic pancreatitis: evidence of permanent damage, associated w/ ETOH abuse, flares similar to acute pancreatitis, delayed gastric emptying, obstruction, evolves insidiously over many years, recurrent attacks of epigastric pain of long duration that may radiate into the back

What is "Ranson's Criteria"?

Identified 11 signs that could be measured during the 1st 48 hours of admission and that have prognostic significance. one can determine the likely outcome of hospitalization

List and briefly describe the biochemical tests of pancreatic function:

Secretin stimulation test- measures pancreatic secretion, particularly bicarbonate, in response to secretin stimulation.

Glucose tolerance test- assesses endocrine function of the pancreas by measuring insulin response to a glucose load.

72- hr stool fat test- assesses exocrine function by the pancreas by measuring sat absorption that reflects pancreatic lipase secretion

List the factors that affect the risk of developing pancreatitis:

Alcohol use, smoking, body wt, diet, genetic factors and medications.

Describe the changes that occur (serum, physiological, etc.) in patients with pancreatitis:

Calcium: depressed serum, hypoalbuminemia occurs

Albumin: bound to calcium

Fluid: during acute attacks- hydration is maintained intravenously. In severe attacks, a clear liquid diet w negligible fat may be given in a few days.

Describe severe acute pancreatitis (SAP): results in a hypermetabolic, catabolic state with immediate metabolic alterations in the pancreas and in remote organs

What may happen with the failure to use the gastrointestinal tract (GIT) in patients with SAP?

Exacerbate the stress response and disease severity, leading to more complications and prolonged hospitalization.

Because the placement of a nasogastric feeding tube is easier than a jejunal tube, it is reasonable to consider _____gastric_____ feedings for AP and reserve _____jejunal_____ feedings for those who are intolerant to gastric feeding. For those patients with severe AP complicated by _____organ failure_____, pancreatic _____necrosis_____, or _____fluid_____ collections, nasojejunal feeding is the preferred method of delivery to minimize _____pancreatic stimulation_____.

What can occur with steatorrhea in patients with chronic pancreatitis?

Malabsorption of fat- soluble vitamins

What can occur with a deficiency of pancreatic protease in patients with chronic pancreatitis?

Necessary to cleave vit B12 from it carrier protein, could potentially lead to a vit d deficiency.

AGA Institute Guideline on Initial Management of Acute Pancreatitis

Directions: Refer to the article *American Gastroenterological Association Institute Guideline on Initial Management of Acute Pancreatitis (Gastroenterology, 2018;154:1096-1101)* to answer the following questions.

11. *Briefly* describe the diagnostic features of acute pancreatitis (AP):

    The diagnosis of AP requires at least 2 of the following features: characteristic abdominal pain; biochemical evidence of pancreatitis (ie, amylase or lipase elevated >3 times the upper limit of normal); and/or radiographic evidence of pancreatitis on cross-sectional imaging.9

12. What is the "revised Atlanta classification" used for?

Presentations of AP occur along a clinical spectrum, and can be categorized as mild, moderately severe, or severe, based on the recent revised Atlanta classification.9 Most cases of AP (around 80%)10 are mild, with only interstitial changes of the pancreas without local or systemic complications.

13. When do the early and late phases occur in AP?

    The early phase of AP takes place in the first 2 weeks after disease onset, and the late phase can last weeks to months thereafter.9

14. List and *briefly* describe the following recommendations (include the strength of evidence):

Table 3. Summary of Recommendations of the American Gastroenterological Association Clinical Guidelines for the Initial Management of Acute Pancreatitis

Recommendation	Strength of recommendation	Quality of evidence
1A. In patients with AP, the AGA suggests using goal-directed therapy for fluid management. *Comment: The AGA makes no recommendation whether normal saline or Ringer's lactate is used.*	Conditional	Very low
1B. In patients with AP, the AGA suggests against the use of HES fluids.	Conditional	Very low
2. In patients with predicted severe AP and necrotizing AP, the AGA suggests against the use of prophylactic antibiotics.	Conditional	Low
3. In patients with acute biliary pancreatitis and no cholangitis, the AGA suggests against the routine use of urgent ERCP.	Conditional	Low
4. In patients with AP, the AGA recommends early (within 24 h) oral feeding as tolerated, rather than keeping the patient nil per os.	Strong	Moderate
5. In patients with AP and inability to feed orally, the AGA recommends enteral rather than parenteral nutrition.	Strong	Moderate
6. In patients with predicted severe or necrotizing pancreatitis requiring enteral tube feeding, the AGA suggest either NG or NJ route.	Conditional	Low
7. In patients with acute biliary pancreatitis, the AGA recommends cholecystectomy during the initial admission rather than after discharge.	Strong	Moderate
8. In patients with acute alcoholic pancreatitis, the AGA recommends brief alcohol intervention during admissior	Strong	Moderate

NG, nasogastric; NJ, nasojejunal.

Table 2. Interpretation of Strength of Recommendation Categories

Strength of recommendation	Wording in the guideline	For the patient	For the clinician
Strong	"The AGA recommends..."	Most individuals in this situation would want the recommended course of action and only a small proportion would not.	Most individuals should receive the recommended course of action. Formal decision aids are not likely to be needed to help individuals make decisions consistent with their values and preferences.
Conditional	"The AGA suggests..."	The majority of individuals in this situation would want the suggested course of action, but many would not.	Different choices will be appropriate for different patients. Decision aids may be useful in helping individuals in making decisions consistent with their values and preferences. Clinicians should expect to spend more time with patients when working toward a decision.
No recommendation	"The AGA makes no recommendation..."		The confidence in the effect estimate is so low that any recommendation is speculative at this time

-

Surgery

MNT Reference Page

Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT
Calories	**Initial:**	**Advancement:**	**Goal:**
Protein			
Fluid			
Supplementation Needs			
Monitoring Criteria			
OTHER NOTES:			
References:			

Surgery Chapter Worksheets

MNT for Surgery

Chapter 38 + 28 Worksheet

Directions: Refer to chapters 38 (pp. 783-4, 787-9) and 28 (pp. 549-56) in Krause's Food & The Nutrition Care Process and your recorded lectures to answer the following questions.

MNT IN CRITICAL CARE

Trauma and the Open Abdomen

After major abdominal trauma, bowel _____distention_____, and states of shock, some patients experience increased intraabdominal pressure leading to _____hypoperfusion_____ and _____ischemia_____ of the intestines and other peritoneal and retroperitoneal structures.

Describe abdominal compartment syndrome, including the consequences:

Occurs when there is increased intraabdominal pressure, often following major abdominal trauma/ sepsis

Describe an "emergent decompressive laparotomy":

Because the abdominal cavity wall has become too small, management consists of emergent decompressice laparotomy to relieve the intraabdominal pressure

Patients with an open abdomen have severe ____metabolic alteration _____, increased loss of _____fluids_____, and elevated nutritional requirements. The open abdomen also may be a significant source of _____protein_____ loss depending on the amount of drainage.

The priorities for management of intestinal fistulas are to restore _____blood volume_____, replace _____fluid_____ losses, treat sepsis, control fistula _____drainage_____, protect the surrounding skin, and provide optimal _____nutrition support therapy.

Surgery

If a malnourished patient is expected to undergo major surgery, and EN is not feasible, what should the nutrition plan be for pre- and post-operation?

PN should be initiated 5-7 days if the duration of therapy is anticipated to be longer than 7 days

What are the benefits of using CHO-rich beverages in the pre-operative period?

Has been shown to enhance glycemic control 7 decrease losses of nitrogen, lean body mass, and muscle strength following abdominal and colorectal surgery.

Postoperative patients who are critically ill and in the ICU should receive early __EN_____ unless there is an absolute contraindication… If the patient is malnourished, however, the use of _____PN is indicated to provide perioperative support until patients are able to tolerate goal enteral ____ feeding regimens.

The timing of introduction of solid food after surgery depends on which two factors?

The pt degree of alertness and condition of the GI tract.

ERAS Journal Article

Directions: Refer to the article *American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on Nutrition Screening and Therapy Within a Surgical Enhanced Recovery Pathway (Anesthesia & Analgesia,* 2018;126(6):1883-95) to answer the following questions.

In the introduction section, the authors note that "[s]ome of the most striking recent data on the role of nutrition delivery in the perioperative period have demonstrated in patients undergoing oncologic surgery in an [enhanced recovery pathway], delivery of nutrition on the first postoperative day is an independent predictor" of what?

postoperative survival at 5 years.18

Refer to the Preoperative Screening section and Figure 3.

What does PONS stand for, and what are the risk assessment questions/criteria?

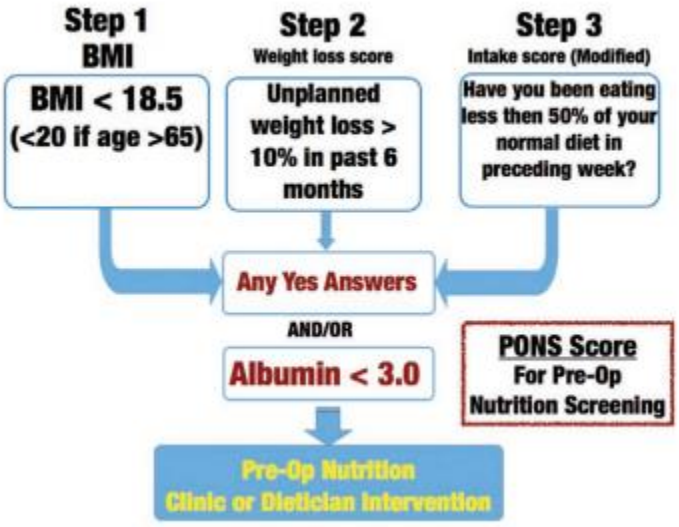


Figure 3. PONS assessment tool. BMI indicates body mass index; PONS, preoperative nutrition score.

After literature review, we developed and proposed the perioperative nutrition screen (PONS). As shown in Figure 3, the PONS is a modified version of the malnutrition universal screening tool28 that has been altered for use perioperatively. The PONS determines the presence of nutrition risk based on a patient's body mass index (BMI), recent changes in weight, reported recent decrease in dietary intake, and preoperative albumin level.

Refer to the Preoperative Intervention section.

How much protein should stressed patients consume per day and per meal? What is the reasoning behind the recommendation for protein in a single meal?

1.2-2.0g pro/kg/d

Although optimal protein intakes for surgery are currently not clearly defined, nonsurgical nutrition guidelines suggest that stressed patients should consume at least 1.2–2.0 g of protein/kg/d.22

Describe the following types of oral nutrition supplementation (ONS):

Immunonutrition (IMN) ONS:

High-protein ONS:

This may be achieved with either of the following: immunonutrition (IMN, containing arginine/fish oil) or high-protein ONSs (2–3× a day, minimum of 18 g protein/dose).

Do the authors suggest delaying surgery for any reason? If so, for what reasons and for how long?

It is possible in patients found to be malnourished as judged by PONS score components, such as >10% weight loss in past 3 months or reduced oral intake preoperative nutrition therapy can be achieved. Although the optimal time period for preoperative optimization is yet to be determined, it is likely that at least 2 weeks (and perhaps 4 weeks or more) may be a reasonable timeframe as discussed in the high-risk nutrition pathway below. The risk of delaying surgery versus operating on a patient with known malnutrition must be carefully considered

Refer to the Minimizing Preoperative Fasting and Role of Preoperative Oral Carbohydrate Loading section.

Perioperative fasting can exacerbate surgical _____stress response_____, aggravate _____insulin resistance_____, exaggerate _____protein_____ losses, and impair _____GI function_____.

Preoperative fasting is associated with a number of patient-centered consequences including:

thirst, hunger, headaches, and anxiety.

…clear fluids taken up until 2 hours before induction [of anesthesia] do not increase ____gastric_____ _____volumes_____, therefore they pose no risk for _____aspiration_____, and in fact have been found to stimulate _____gastric emptying_____.

Briefly describe the best method to accomplish carbohydrate loading in a pre-operative period:

Delivery of sufficient exogenous carbohydrate is considered the best method to induce a metabolically fed state preoperatively. Carbohydrate loading is accomplished with the consumption of 50 g carbohydrates as a clear liquid 2–3 hours preoperatively and in some studies/centers 100 g the evening before. The use of preoperative carbohydrate-loading strategies has been associated with a statistically significant reduced LOS, especially in major abdominal surgery (mean difference, −1.66 days; 95% CI,

−2.97 to −0.34).66 For best results, the dose 2–3 hours before surgery should be consumed within 5–10 minutes (not sipped over time) to enhance insulin secretion.

Refer to the Role of Peri-operative INM section.

Briefly describe the role of arginine and omega-3 fatty acids in modulating the surgical stress response:

Arginine, omega-3 fatty acid, and antioxidants are delivered in combination at high levels in various EN and ONS formulas. Conditionally essential arginine is rapidly depleted after surgical stress but can be supplemented with IMN.68 A

Refer to the Postoperative Nutrition section.

Is early resumption of oral intake after surgery safe? If so, what are the benefits?

Early resumption of oral intake after surgery is now clearly realized to be safe86 and vital for optimizing postoperative outcomes. Early oral feeding immediately after major surgery, including GI surgery, is associated with a decrease in postoperative complications, LOS, and costs.87,88 In fact, multiple meta-analyses now report that feeding within 24 hours after GI surgery decreases mortality as well as major morbidities.15,16,89

…*a high-protein* [should] *be initiated on ____day of _____ surgery in most cases, with the exception of*: with bowel not in continuity, bowel ischemia, or persistent bowel obstruction.

The authors suggest that the "type of nutrition support delivered in the postoperative setting is primarily determined by the patient's ability to achieve calorie… and protein… goals and tolerance of oral intake."

Patients tolerating 50-100% of nutrition goals: should receive high-protein ONS

Patients consuming <50% via the oral route: EN via tube feeds should be given

If >50% of protein/kcal needs are not met via oral/EN route for >7 days: PN should be utilized

Refer to the Role of Nutrition in Optimizing Recovery From Surgery Posthospital Discharge section.

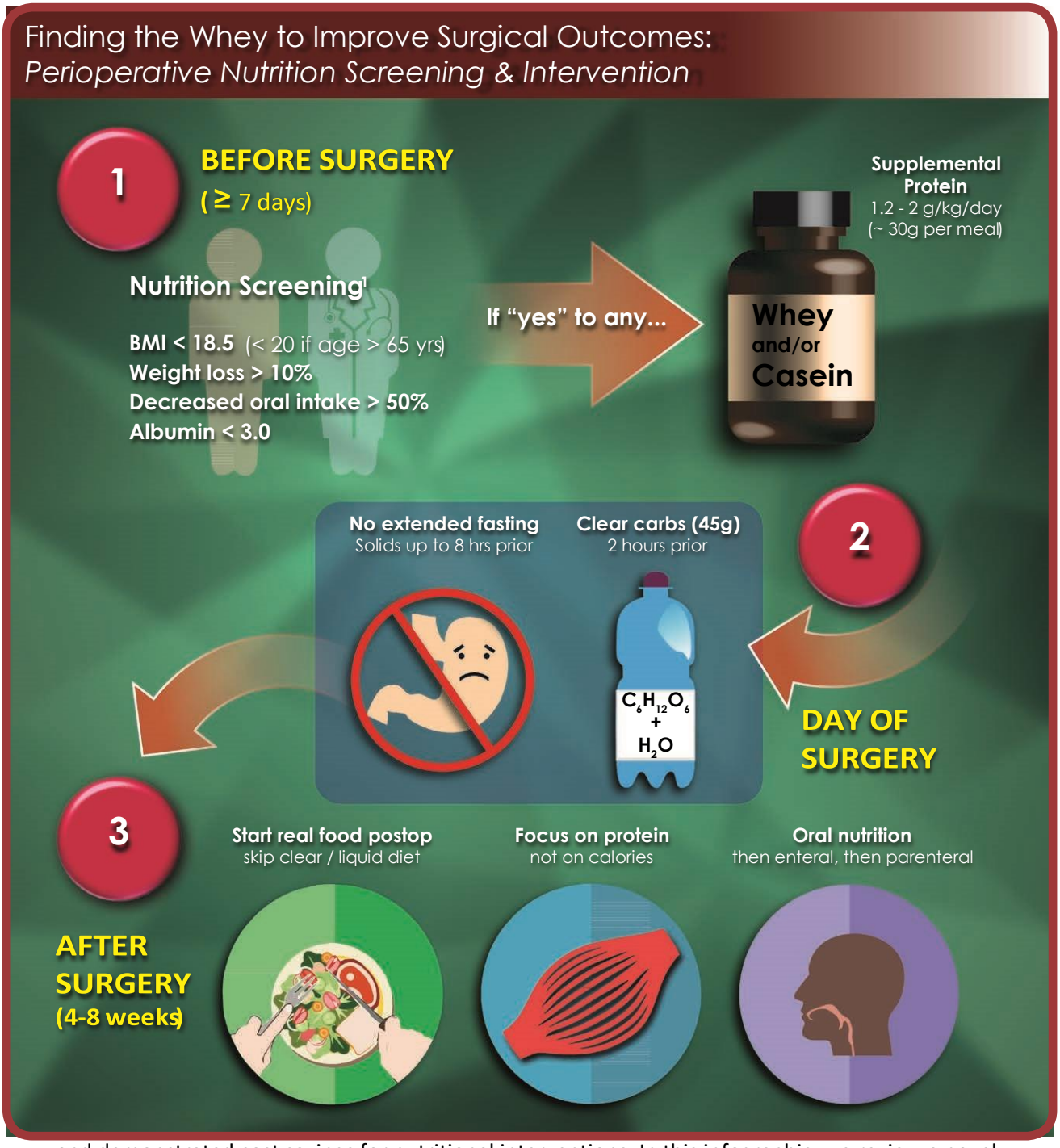
In the concluding sentences, what do the authors suggest for post-operative ONS?

As such, we suggest 4–8 weeks minimum of postoperative HP-ONS in all patients having major surgery, and as long as 3–6 months postoperatively in more severely malnourished patients or those with prolonged postoperative or ICU stays. Further research focused on highrisk postoperative patients is needed in this critical period of recovery

Peri-Op Nutrition Infographic

While the majority of patients presenting for gastrointestinal surgery are malnourished and data have shown an associated increased risk for postoperative morbidity and mortality, only a small portion of patients receive any preoperative nutrition intervention, as few hospitals have a formal nutrition

screening process. This is in spite of surgeons' belief in adequate nutrition for outcome improvement



and demonstrated cost savings for nutritional interventions. In this infographic, we review a novel perioperative nutrition screening tool and strategy for improving perioperative nutritional status, which optimally begins weeks before the planned surgery and extends months beyond hospital discharge until the patient has achieved full recovery.

IARS International Anesthesia Research Society

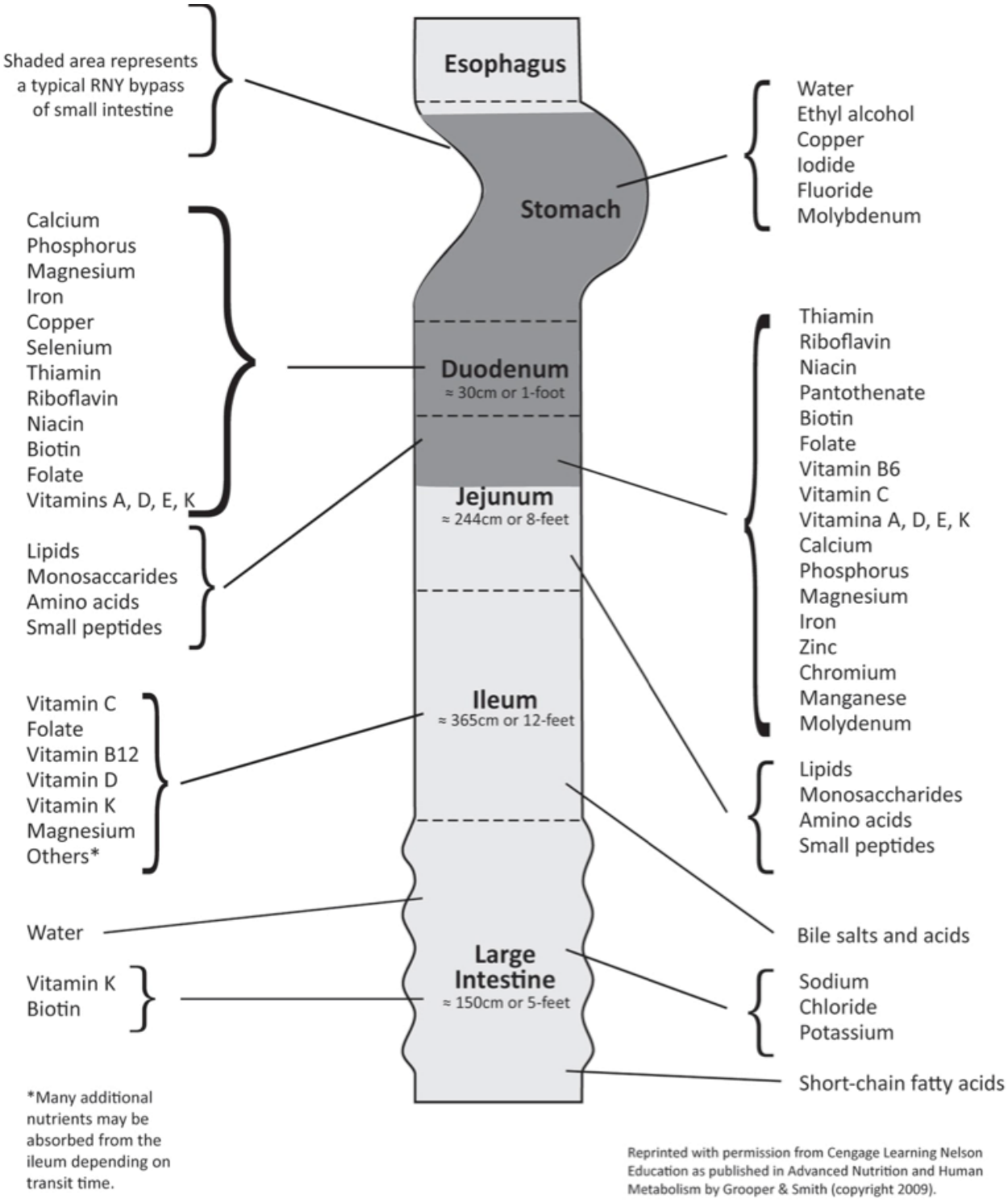
The Infographic is composed by Jonathan P. Wanderer, MD, MPhil, Vanderbilt University School of Medicine (jon.wanderer@vanderbilt.edu), and Naveen Nathan, MD, Northwestern University Feinberg School of Medicine (n-nathan@northwestern.edu). Illustration by Naveen Nathan, MD.

The authors declare no conflicts of interest.

REFERENCE

1. Weischmeyer PE, Carli F, Evans DC, et al. American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on nutrition screening and therapy within a surgical enhanced recovery pathway. *Anesth Analg*. 2018;126:1883–1895.

Intestinal Absorption Graphic



NCM Materials

Ileostomy:

Food And Feeding Issues

Nutrition therapy and nutrition education can assist in minimizing symptoms a patient may experience with an ileostomy. In addition to following nutrition therapy for ileostomy, other interventions may include the following:

- Avoid practices that may contribute to swallowed air and gas formation, such as the following:
- Chewing gum o Use of drinking straws o Carbonated beverages o Smoking o Chewing tobacco o Eating quickly
- Take small bites of foods and chew thoroughly
- Eat foods at a regular time each day
- Smaller, more frequent meals may be better tolerated
- Drink liquids separately from meals
- Add salt
- Oral rehydration beverages may assist in maintaining fluid and electrolyte balance
- Eating the largest meal in the middle of the day may assist with decreasing stool output at night
- Add foods that may decrease odor, such as the following:
- Buttermilk o Parsley o Yogurt o Kefir o Cranberry juice
- Add foods that may thicken stool, such as the following:
- Banana flakes o Applesauce o Pectin o Pasta o Potatoes o Cheese

(Rees Parrish, 2005).

Nutrition Care Manual®

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Nutrition Intervention

When working with clients post ileostomy surgery, the registered dietitian should prioritize:

- Promoting optimal healing postoperatively
- Correcting and preventing development of nutrient deficiencies
- Preventing dehydration and electrolyte imbalances
- Providing nutrition education that will promote optimal nutritional intake and minimize symptoms of malabsorption and/or maldigestion as well as prevent gas, odor, and obstruction

Nutrition Interventions for those with ileostomies may include the following:

- Successful progression of an oral eating plan postoperatively to meet nutrition needs and optimize postoperative healing
- Correction and prevention of nutrient deficiencies
- Provision of short-term or long-term enteral or parenteral feeding
- Provision of nutrition education for food choices that will facilitate the following:
- Decrease risk of obstruction
    - Maintain normal fluid and electrolyte balance
    - Reduce excessive fecal output
    - Minimize gas and flatulence (to reduce odor and inflation of the appliance)
    - Prevent development of oxalate kidney stones (Rees Parrish, 2005; Beyer, 2004; Escott-Stump, 2002; NahikianNelms, 2004; Nahikian-Nelms, 2007)

See the Nutrition Interventions in the Resource section for more information on Goal Setting and Developing a Nutrition

Prescription and further details regarding planning, setting, and using the Nutrition Intervention.

Colostomy:

Nutrition Prescription

- For initial oral intake postoperatively, begin clear liquids.
- Progress to low-fiber nutrition therauy. with adequate energy, protein, fluid, and electrolytes individualized for the patient.
- Begin with smaller, more frequent meals.
- Limiting fluids with meals may be helpful in those experiencing high output.
- Monitor lactose tolerance.
- Monitor for fat malabsorption.
- Encourage higher sodium intake.
- Restrict foods high in oxalate.
- Rehydration beverages may be of benefit, especially in environments resulting in excessive fluid loss. (See nutrition theraw for treatment of diarrhea.)

(Rees Parrish, 2005; Escott-Stump, 2002; Nahikian-Nelms, 2004; Nahikian-Nelms, 2007)

Fluid Management

Fluids need to be managed carefully by the medical care team following bowel surgery and continuing after hospital discharge, especially for those patients with an ileostomy. In general, oral intake should exceed ostomy output. Limitations on fluid may be needed when fistulas occur. It is estimated that patients with an ileostomy may initially lose 1 .2 L/day in output but that will decrease to

approximately 600 ml/day (Rees Parrish, 2005). Coexisting medical problems such as congestive heart failure and renal disease may require judicious management of fluid intake as well.

Methods of estimation of fluid requirements can be found in the Conditions section (Conditions > Hydration).

Another method (based on nitrogen and energy intake): 1 ml/kcal + 100 ml/g nitrogen (N) (Whitmire, 2001)

Keep in mind that fluids should be provided intravenously when a patient is indicated as nothing by mouth (nil per os, or NPO) and appropriate fluids given via total parenteral nutrition or enteral feedings. Patients with increased ostomy output will need additional fluid to maintain hydration.

Fluid status, including the following, should be monitored as often as deemed necessary by the primary health care team.

- Laboratory parameters (eg, eletrolytes)
- Clinical observations (edema, dehydration)
- Weight fluctuations
- Intake and output records

(Willcutts, 2005)

- Promote adequate fluid intake

Food And Feeding Issues

Nutrition therapy and nutrition education can assist in minimizing symptoms that a patient may experience with a colostomy. In addition to following nutrition therapy for colostomy, other interventions may include the following:

- Avoiding practices that may contribute to swallowed air and gas formation, such as the following:
  - Chewing gum
  - Use of drinking straws
  - Carbonated beverages
  - Smoking
  - Chewing tobacco
  - Eating quickly
- Taking small bites of foods and chewing thoroughly
- Avoid foods which may cause gas and/or odor
  - Alcohol
  - Asparagus
  - Beans
  - Broccoli
  - Brussel sprouts
  - Cabbage
  - Cauliflower
  - Eggs
  - Fish
- Adding foods that may decrease odor, such as the following:
  - Buttermilk
  - Parsley
  - Yogurt
  - Kefir
  - Cranberry juice
- Adding foods that may thicken stool, such as the following:
  - Applesauce
  - Bananas/ banana flakes
  - Cheese
  - Pasta
  - Pectin
  - Potatoes
  - Rice

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Nutrition Prescription

- For initial oral intake postoperatively, begin clear liquids.
- Promote adequate fluid intake.
- Progress to low-fiber nutrition therapy (see Colostomy Nutrition Theraw.) with adequate energy and protein individualized for the patient.
- Avoid odor-causing foods.
- Avoid gas-producing foods.
- Avoid foods that may cause obstruction.
- Avoid foods that may cause diarrhea.
- This diet is highly individualized. Once stool output has stabilized, some foods may be added back to diet one at a time.
  Try each new food and establish tolerance.

(Escott-Stump, 2002; Nahikian-Nelms, 2004; Schulman, 2005; Nahikian-Nelms, 2007)

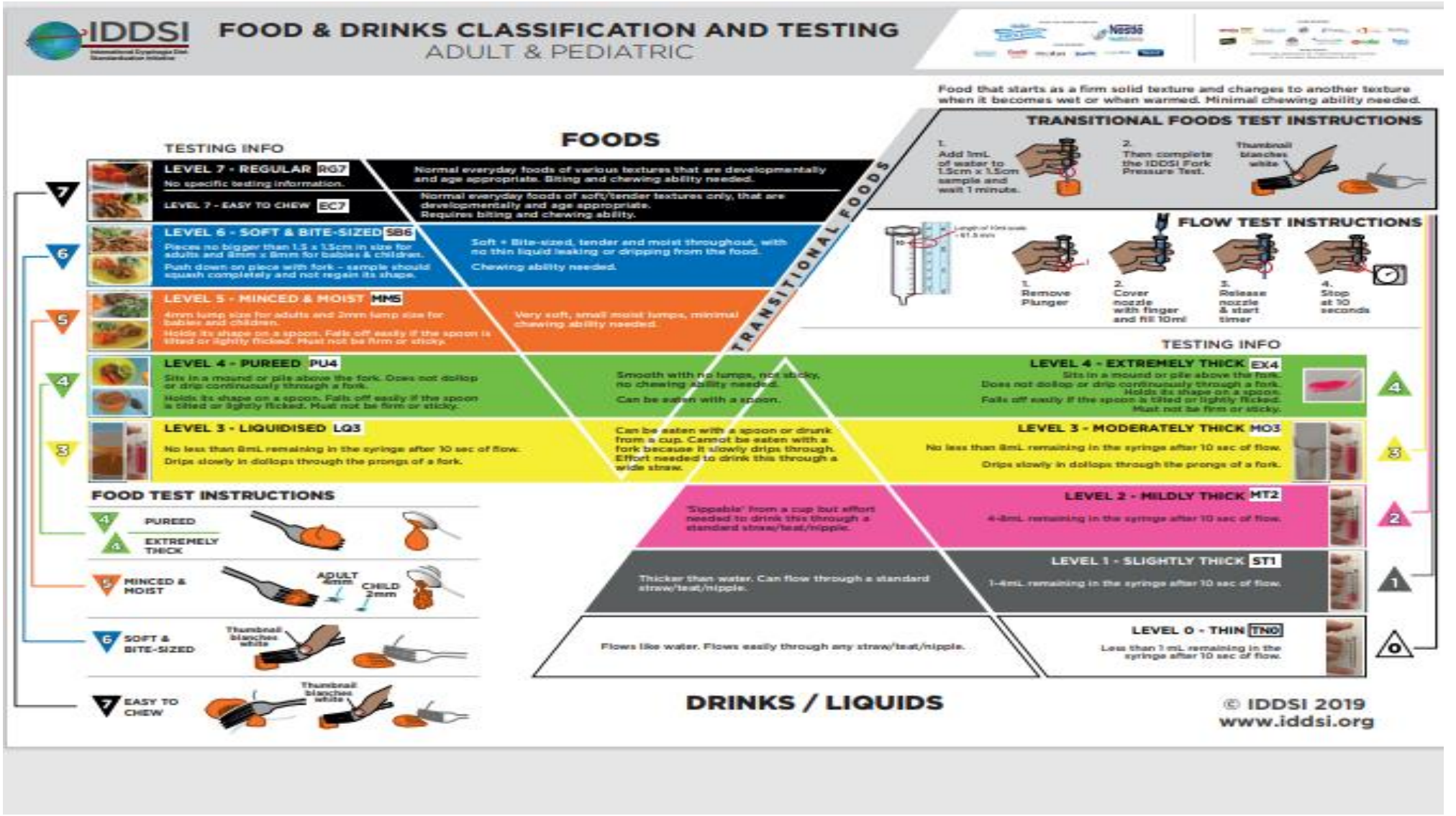
Neurology

MNT Reference Page

Definition:			
Macronutrient Distribution	%CHO	%PRO	%FAT
Calories	**Initial:**	**Advancement:**	**Goal:**
Protein			

Fluid	
Supplementation Needs	
Monitoring Criteria	
OTHER NOTES:	
References:	

IDDSI Framework Map



Solid Food and Liquid Modifications Table: 0-7

Neurology SLM Worksheets

Neurological Disorders

Chapter 40 Worksheet

Directions: Refer to chapter 40 (pp. 813-837) in Krause's Food & The Nutrition Care Process.

Definitions:

Transient Ischemic Attack (TIA): temporary period of symptoms similar to those of a stroke

Embolic stroke: usually caused by a blood clot that forms elsewhere in the body (embolus) and travels through the bloodstream to the brain

Thrombotic stroke: caused by a thrombus that develops in the arteries supplying the blood to the brain

Subarachnoid Hemorrhage (SAH): bleeding in the space that surrounds the brain

Aphasia: loss of ability to understand/ express speech caused by brain damage

Ataxia: poor muscle control that causes clumsy voluntary movements caused by damage to a part of the brain known as the cerebellum

Apraxia: inability to perform particular purposive actions, as a result of brain damage, even though they understand the command

Subdural hematoma: type of bleed inside your head (between the skull and the surface of the brain

Tetraplegia (quadriplegia): paralysis of all 4 extremeties

Neurotrauma / Traumatic Brain Injury (TBI):

Anomia:memory loss where the names of objects are forgotten

Echolalia: meaningless reptition of another persons spoken words as a symptom of psychiatric disorder

Agnosia: inability to interpret sensations and hence to recognize things, typically as a result of brain damage

Hemianopsia: describes blindness in ½ of the field of vision

Use your text (and recorded lecture) to answer the following questions:

Fill in the table below by briefly describing each of the following neurological diseases/disorders and highlighting any significant MNT/nutritional interventions to consider. (Refer to p. 813 in addition to the specific disease/disorder paragraphs throughout the textbook and in the recorded lecture slides.)

Disease	MNT / Nutrition Interventions

Alzheimer's Disease	Assess nutritional status, minimize distractions at meal time, hand guidance to initiate eating, provide nutrient-dense foods and frequent snacks
Amyotrophic Lateral Sclerosis (ALS)	Provide nutrient-dense foods and ω-3 fatty acids. Intervene to prevent malnutrition and dehydration. Monitor dysphagia. Antioxidant use (vitamins C, E, selenium, methionine) is well tolerated, but not proven.
Epilepsy	Ketogenic diet, medications may affect nutritional status, phenobarbital, anticonvulsants * Altered vitamin D, vitamin K, and folic acid metabolism; may require extra calcium
Guillain-Barre Syndrome (GBS)	Attain positive energy balance with high-energy, high-protein tube feedings. Assess dysphagia. Result in pt becoming hypermetabolic
Migraine Syndrome	Follow general recommendations for food avoidance. Maintain adequate dietary and fluid intake. Keep extensive records of symptoms and foods.
Myasthenia Gravis	Provide nutritionally dense foods at beginning of meal. Small, frequent meals are recommended. Limit physical activity before meals. Place temporary feeding tube.
Multiple Sclerosis (MS)	Maximize nutritional intake, evaluate vit D intake, evaluate neurologic deficits and dysphagia, distribute fluids throughout waking hours, increase fiber and fluids for constipation
Parkinson's Disease	Focus on drug-nutrient interactions. Minimize dietary protein at breakfast and lunch. Recommend antioxidants and anti inflammatory diet.

Fill in the table below:

Disease	**Nutrient Deficiency**	**Physiologic Effect / Symptoms**	**Treatment**
Wernicke-Korsakoff Syndrome (alcoholism)	thiamin	range from mild confusion to coma, adequate hydration, Encephalopathy, involuntary eye movements, impaired movement, amnesia	Diet high in thiamin foods, avoid all alcohol, and pro may be restricted
Pernicious Anemia	B12	Lesions occur in myelin sheaths of optic nerves, cerebral white matter, peripheral nerves	Monthly vitamin B12 injections Oral vitamin B12 supplements

*Dry Beriberi	Thiamin	Peripheral or central neurologic dysfunction	Thiamin supplementation
Pellagra	niacin	Memory loss, hallucinations, dementia	Niacin supplementation

**Note: the textbook calls this "wet" Beriberi, however wet Beriberi refers to cardiovascular symptoms*

How are hemiplegia and paraplegia different?

Hemiplegia- one side of body

Paraplegia- lower half of the body

Refer to the recorded lectures to answer the following questions:

Describe the possible impact of an injury located in each brain location listed below:

Temporal lobes: memory, emotion (not visible), word understanding

Occipital lobes: Vision

Frontal lobes: Word production, problem solving, planning, behavioral control, emotion, hypersomnia

Cerebellum & brainstem: loss of coordination of motor movement, inability to judge distance

Spinal cord: fractures, dislocates, crushes or compresses one or more of your vertebrae

Pituitary gland & hypothalamus: decrease human growth hormone & no longer control temperature

Describe the phases of swallowing:

Oral: food is placed in the mouth, where it is combined with saliva, chewed if necessary, and formed into a bolus by the tongue.

Pharyngeal: s initiated when the bolus is propelled past the faucial arches. Four events must occur in rapid succession during this phase. The soft palate elevates to close off the nasopharynx and prevent oropharyngeal regurgitation.

Esophageal: The final or esophageal phase, during which the bolus continues through the esophagus into the stomach, is completely involuntary. Difficulties that occur during this phase are generally the result of a mechanical obstruction, but neurologic disease cannot be ruled out. For example, impaired peristalsis can arise from a brainstem infarct.

Coordination of swallowing ____thin_____ liquids is most difficult (in comparison to foods and liquids of other textures) and may result in aspiration pneumonia. _____Enteral_____ nutrition support may be indicated in severe cases of dysphagia to meet energy and/or fluid requirements. As was covered in the Enteral Nutrition support module, an ___nasograstic_____-tube may be used in the short term although oftentimes a __ percutaneous endoscopic gastrostomy (PEG)_____ or _____ gastrostomy-jejunostomy (PEG/J)_____-tube is required for longterm use.

It is important to note after spinal cord injury (SCI) an ileus may occur for 7-10+ days, so parenteral nutrition support may be required.

Generally speaking, what are the common nutritional deficiencies seen with anticonvulsant medications (i.e. Tegretol, Keppra, Phenobarbital, Depakote, and Topamax)?

Vit d, k and folic acid

Refer to the recorded lectures, textbook and required videos to answer the following questions:

What are some examples of how aroma, piping, slurries and layering/swirling may be used to promote intake?

Good- smelling food and a pleasant atmosphere may increase appetite and improve consumption

Plate presentation

Easy swallow

With regard to interventions for behavioral problems common to individuals with dementia, what are some recommendations if an individual does one of the following:

Forgets to swallow: have the person have handheld food items to have all day long

Plays with food: food in stages, buffet/ finger food style is preferred

Eats too slowly: have the person have hand held food items to have all day long

Chews constantly: meal replacement drinks if needed, soft textured food

Refer to the recorded lecture as well as the IDDSI materials to answer the following questions:

List and describe the 3 levels of dysphagia diets (from the recorded lecture) and indicate the IDDSI number that it most closely correlates with. *NOTE: the IDDSI guidelines were implemented starting in May 2019, after the recorded lectures were completed*.

Level 3 Advanced: soft solid foods, no crust on bread, most food is cut into small pieces; no hard/ crunchy foods, sticky and very dry foods.

Level 2 mechanically altered: ground, moist/ semi soild foods thar require some chewing, mashed fruits and veg, meat with gravy; no bread products/ dry foods, nuts, seeds, whole grains

Level 1 puree: pureed foods, pudding, no eggs of any kind, no food that is not completely smooth when pureed

List and describe the 4 different textures of liquids that may be used for individuals with dysphagia (from the recorded lecture) and indicate the IDDSI number that it most closely correlates with. *NOTE: the IDDSI guidelines were implemented starting in May 2019, after the recorded lectures were completed*.

Thin Level 0- flows like water; >1 remaining in the syrings after 10 sec of flow

Nectar Level 1- thicker than water; 1-4 ml

Nectar Level 2- sippable from a cup, effort needed; 4-8ml

Honey Level 3- 8ml; drips slowly

Pudding Level 4- mound or pile, no drip.

THE KETOGENIC DIET

Refer to the recorded lecture and supplementary materials to answer the following questions:

Who may benefit from the ketogenic diet?

Epilepsy

Describe the ketogenic diet.

What types of foods may be included or excluded? Sliced hot dog, avocado, a small handful of spinach, flaxseed meal, heavy cream

What are the common types of fats used? (e.g., 36% heavy whipping cream, oils, butter, mayonnaise), The diet provided was comprised of 10–15 grams of carbohydrates per day, 1 gram/kg of protein, and the remaining calories from fat, For significant dyslipidemia, the ratio can be lowered or polyunsaturated fatty acids substituted.

What type of fat may be added to the diet if serum triglycerides are high on the traditional diet?

Over half of the children who go on the ketogenic diet have at least a 50 % reduction in seizure activity and about 10 to 15 % become seizure free.

What are the common ratios used for a "typical" ketogenic diet?

A 4:1 ratio fat to CHO & pro is stricter than a 3:1 ratio and is typically used for most children.

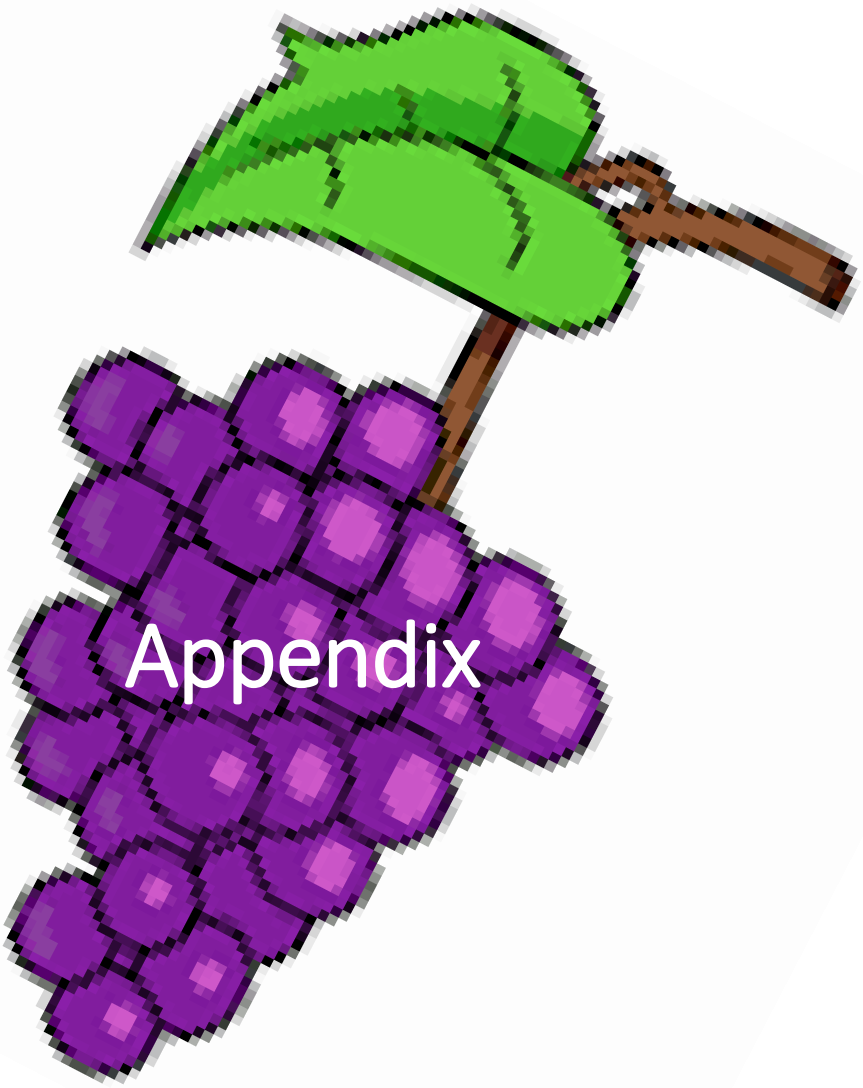
A 3:1 ratio is typically used for infants, adolescents, and children who require higher amounts of protein or carbohydrate for some other reason.

When initiating a ketogenic diet in the hospital, the patient's liquid medications are typically switched to tablets, sprinkles, or orally ingested intravenous (in veins) preparations, to ensure they are free of carbohydrates.

Families with children on the ketogenic diet must monitor intake of dietary CHO and protein, *all prescription and over-the-counter medications (e.g. pain relievers, cold remedies, mouthwash,*

_____toothpaste_____ and _____lotions_____) must be scrutinized for sugar content to minimize carbohydrates.

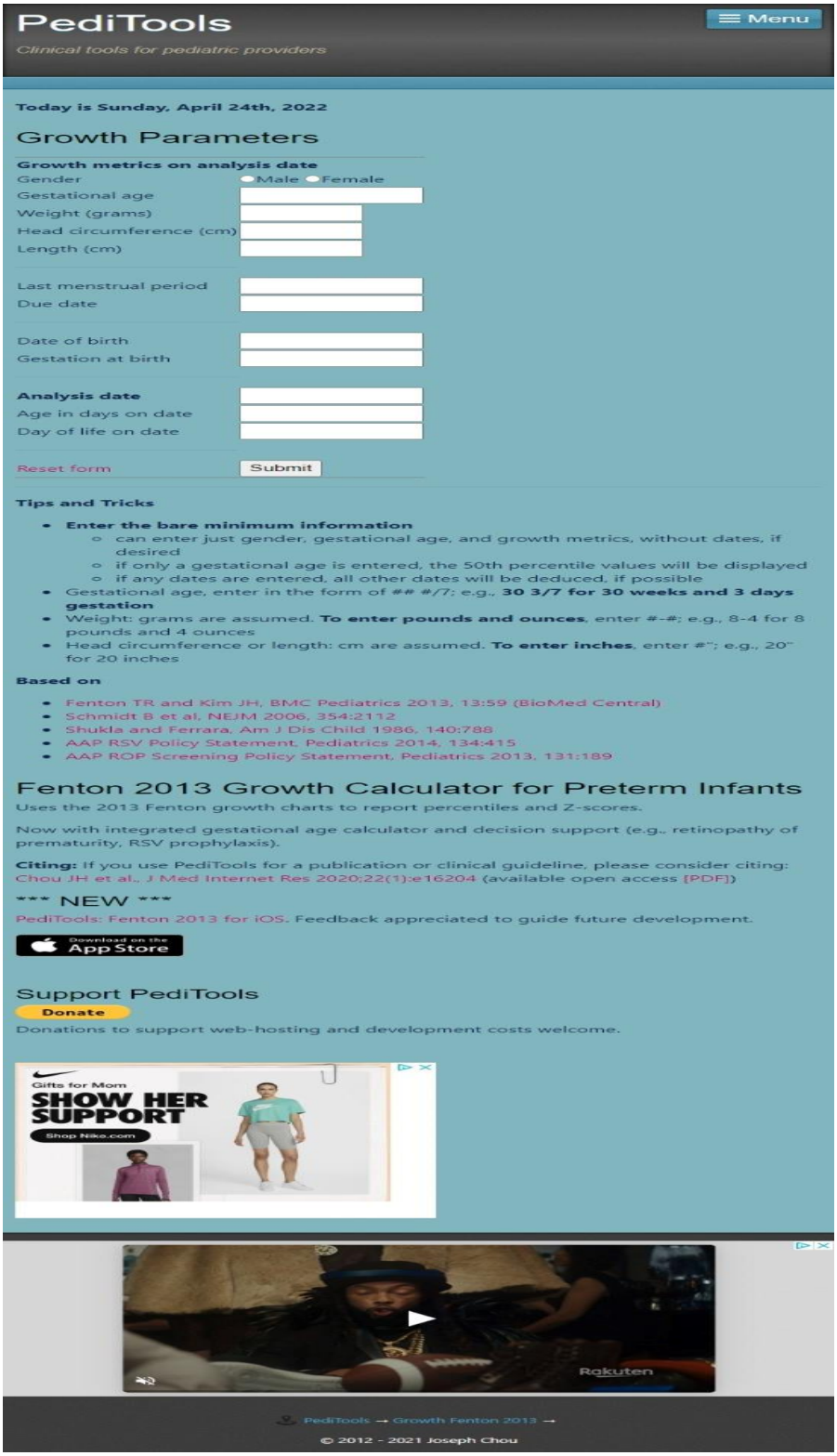
Sundown syndrome is acute agitation and/or restlessness that may occur on or around sunset and/or overnight in individuals with dementia, Alzheimer's disease, or other types of cognitive impairment. The Hebrew Home at Riverdale addresses this by offering a safe overnight program for individuals who live with relatives during the day. In the program, they allow patients to participate in activities, sleep, and eat while supervised by program staff.



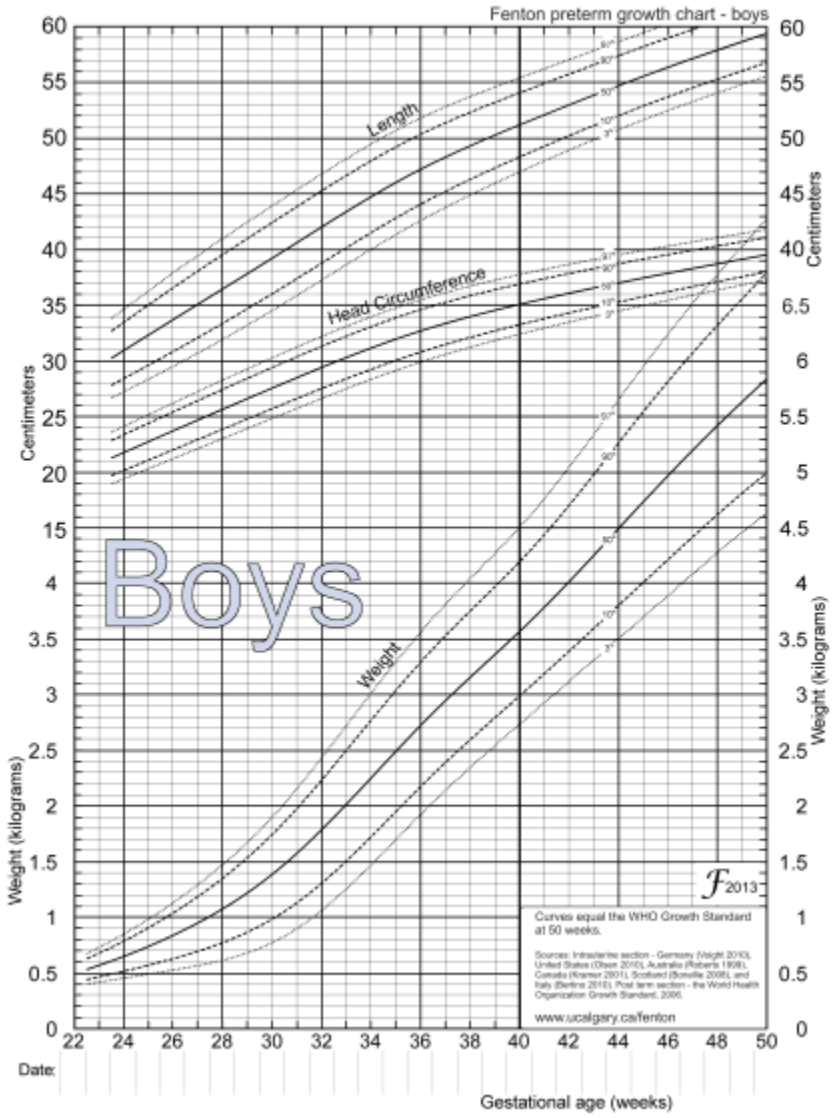
Appendix

Fenton Growth Charts

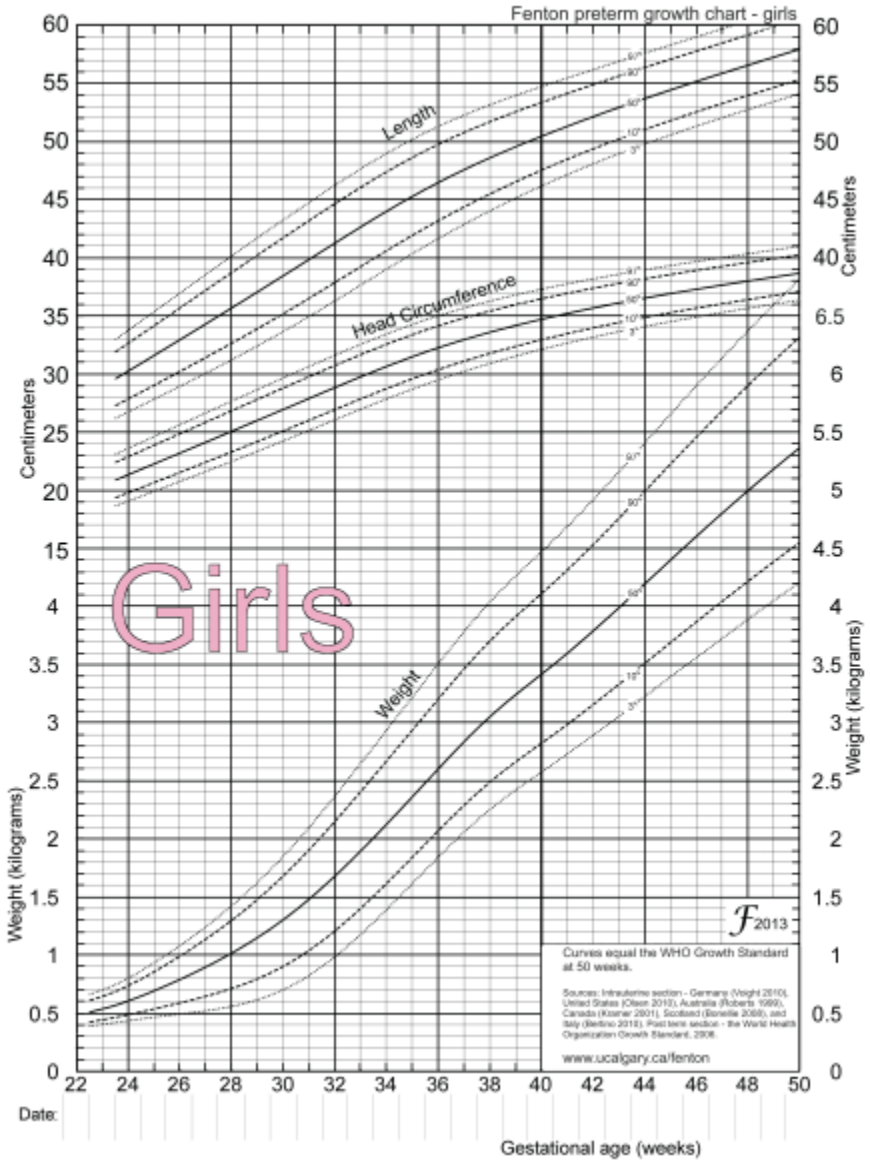
Prematurity Z-Scores



Boys


Fenton preterm growth chart - boys
Length
Head Circumference
Weight
Boys
Centimeters
Weight (kilograms)
Gestational age (weeks)
Date:
Curves equal the WHO Growth Standard at 50 weeks.
www.ucalgary.ca/fenton
2013

Girls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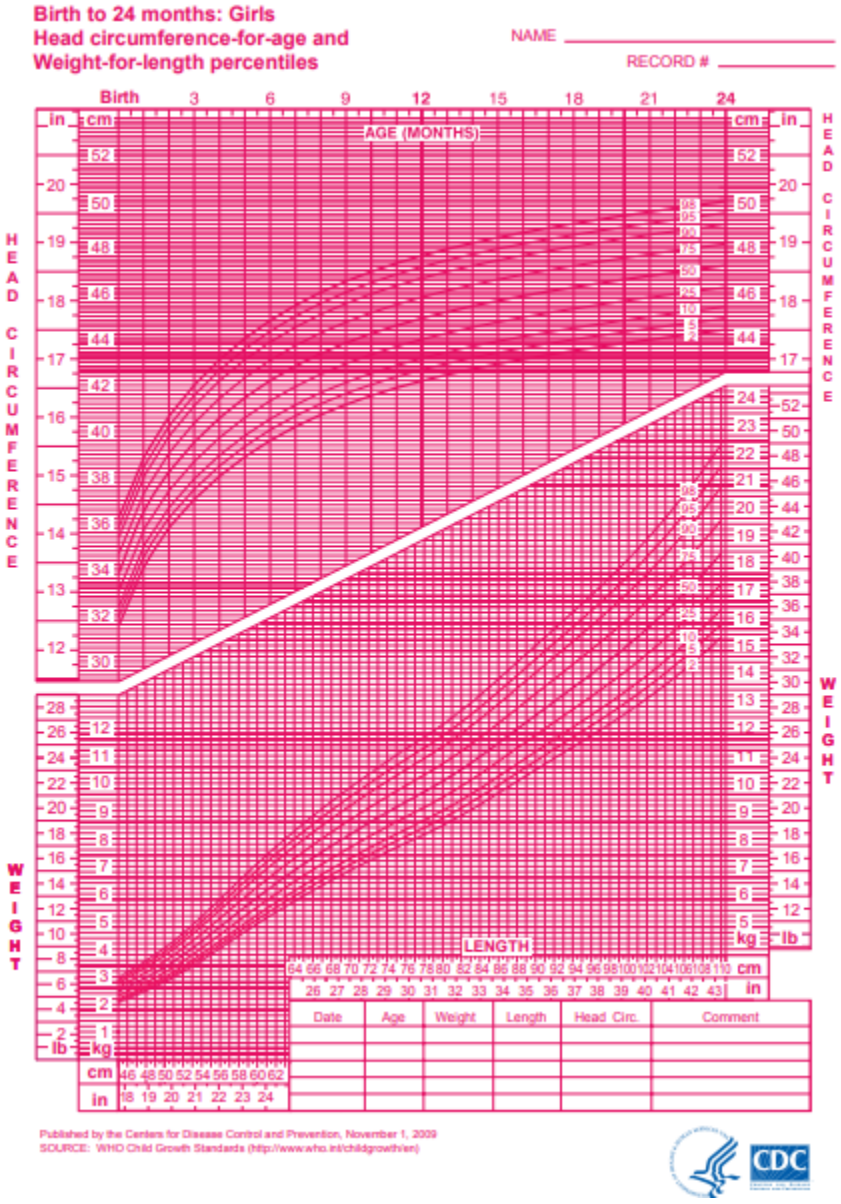
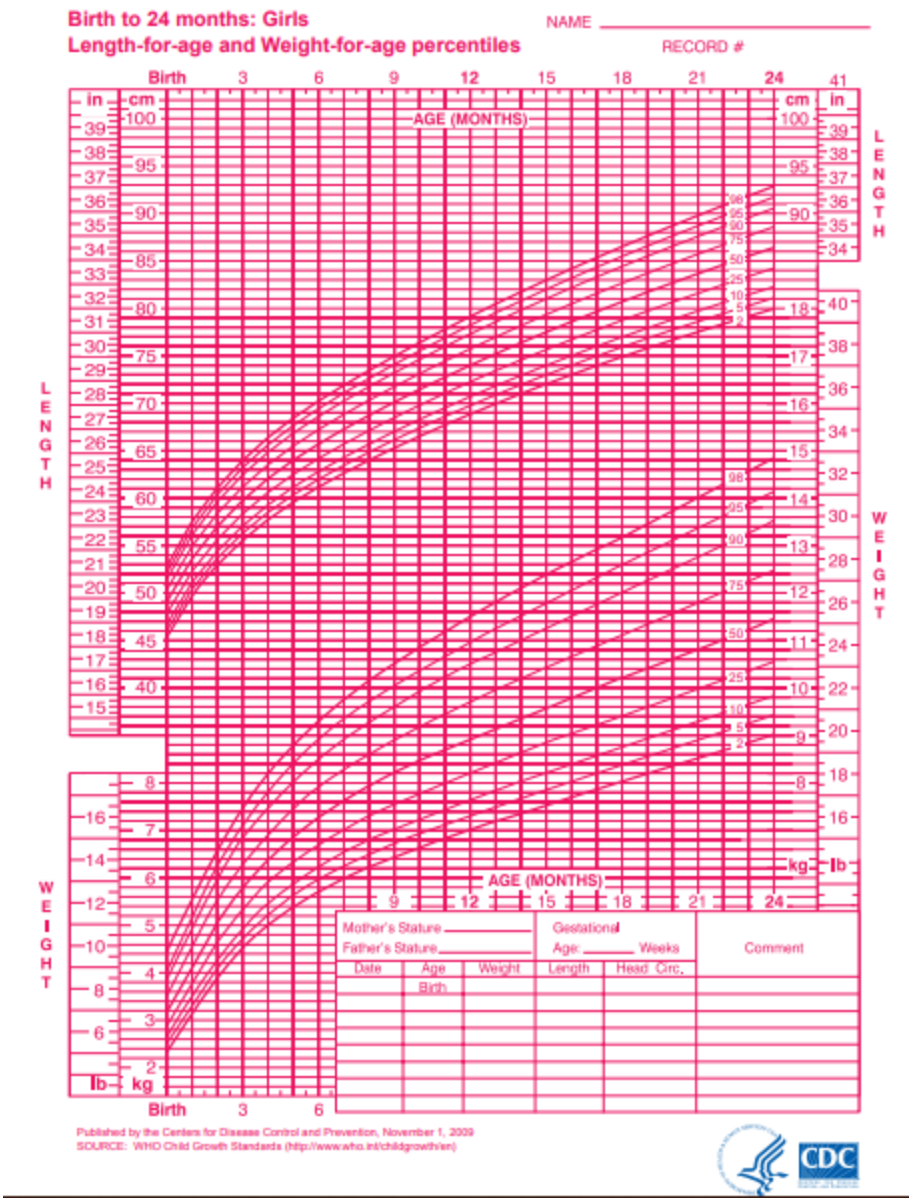
Length
Head Circumference
Weight
Girls
Centimeters
Weight (kilograms)
Gestational age (weeks)
Date:
Curves equal the WHO Growth Standard at 50 weeks.
www.ucalgary.ca/fenton
2013

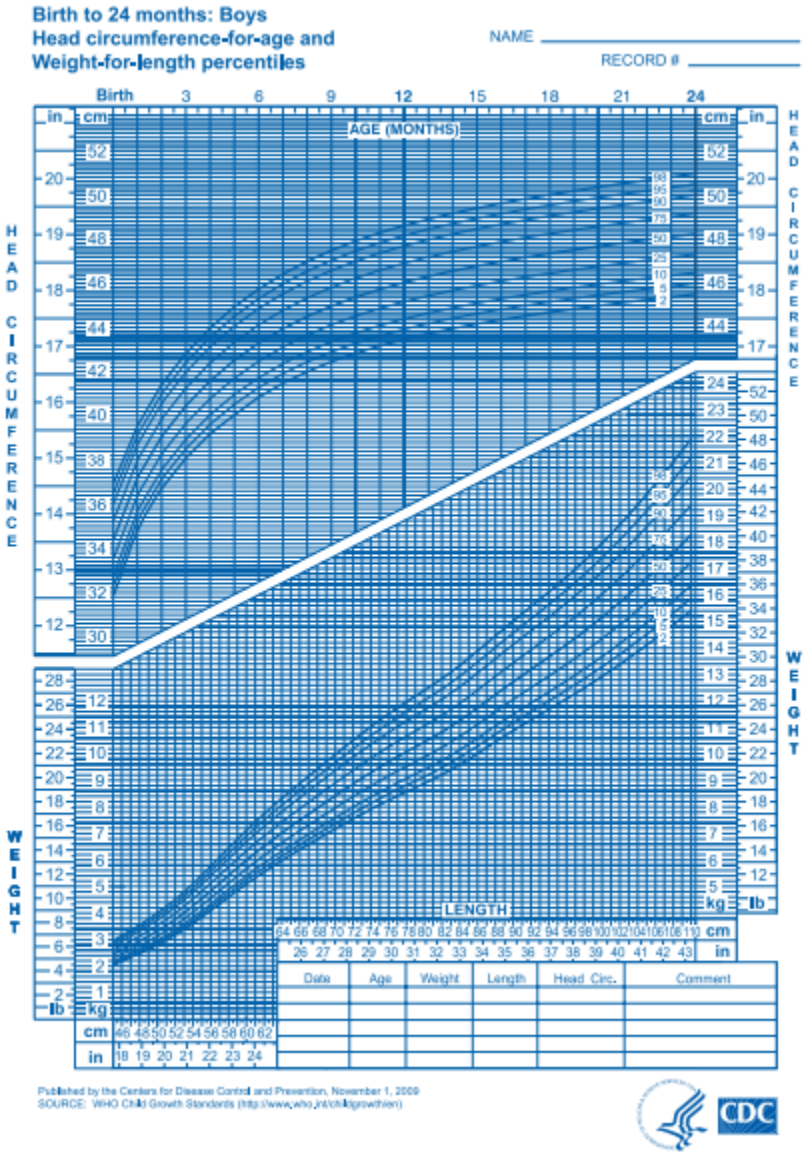
WHO Growth Charts

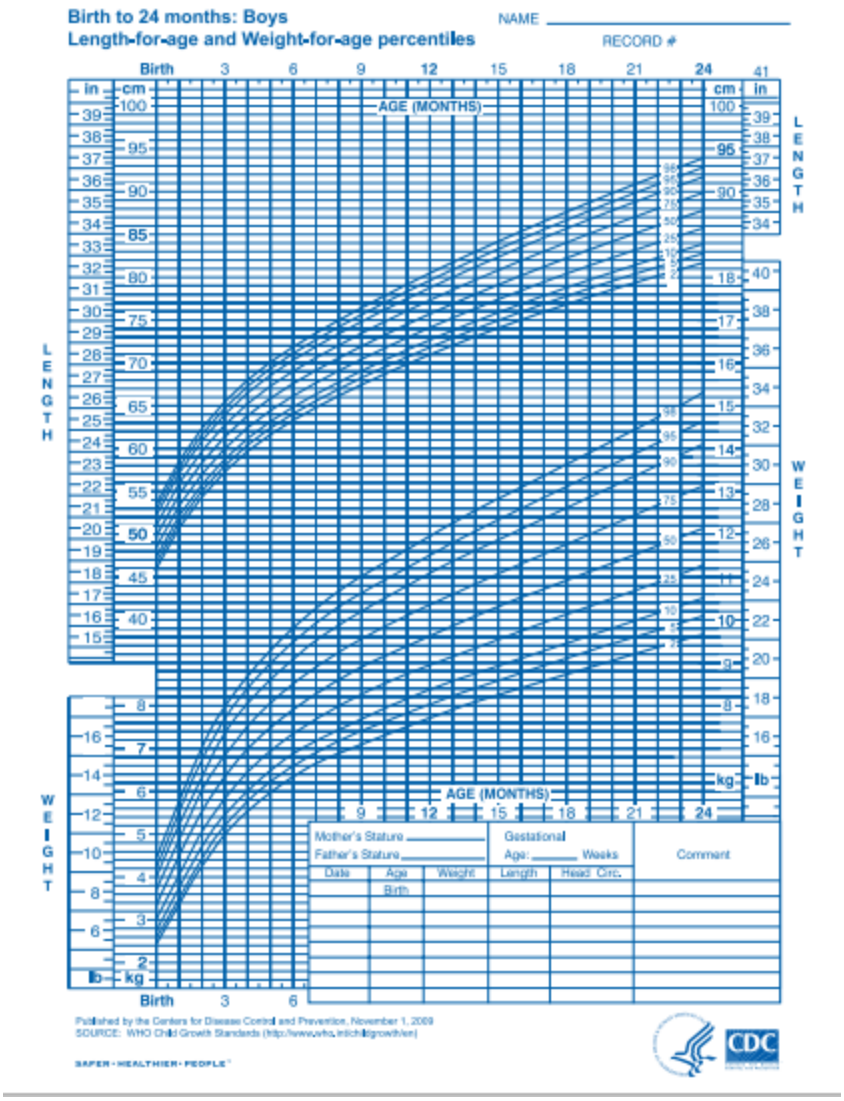
Girls: Birth- 24 Months



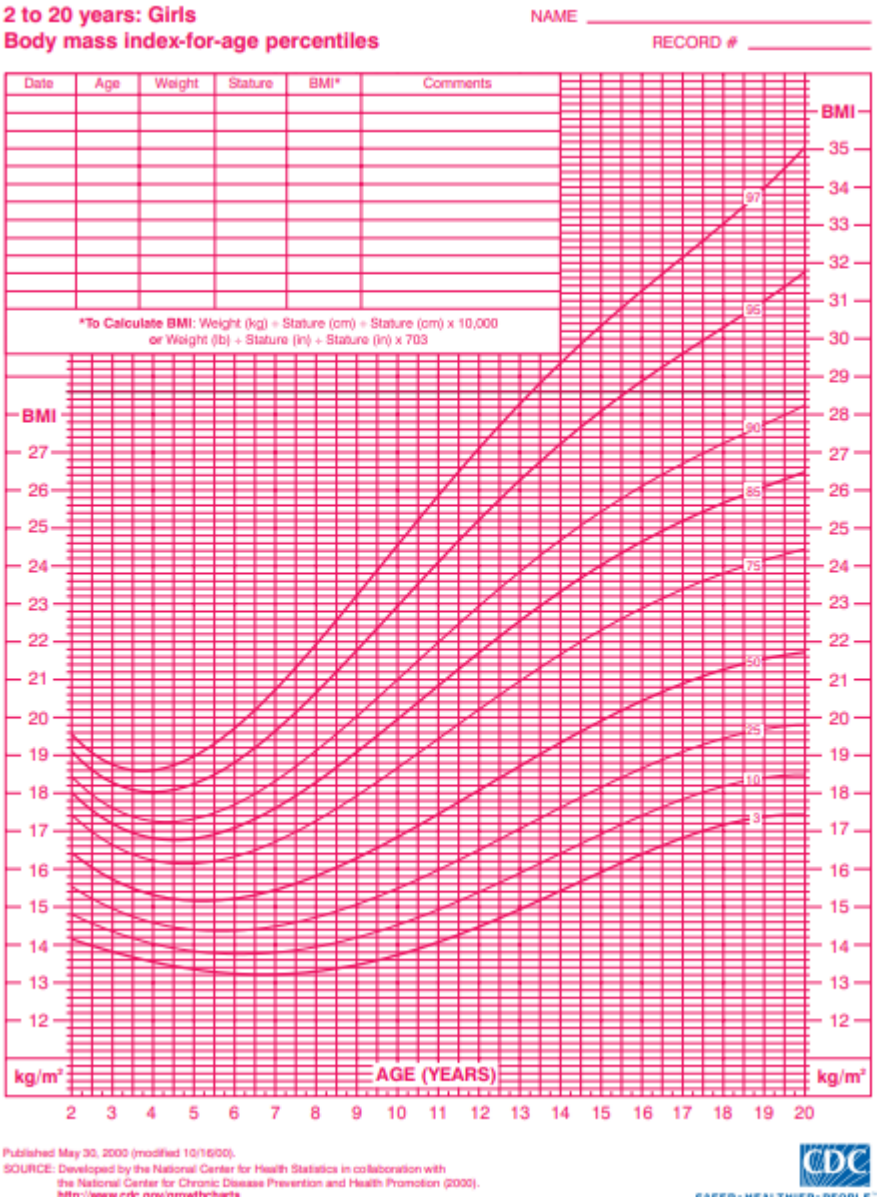

Birth to 24 months: Girls
Length-for-age and Weight-for-age percentiles
NAME
RECORD #
AGE (MONTHS)
LENGTH
WEIGHT
Mother's Stature
Father's Stature
Gestational Age: Weeks
Comment
Date
Age
Weight
Length
Head Circ.
Birth
Published by the Centers for Disease Control and Prevention, November 1, 2009
SOURCE: WHO Child Growth Standards (http://www.who.int/childgrowth/en)
CDC

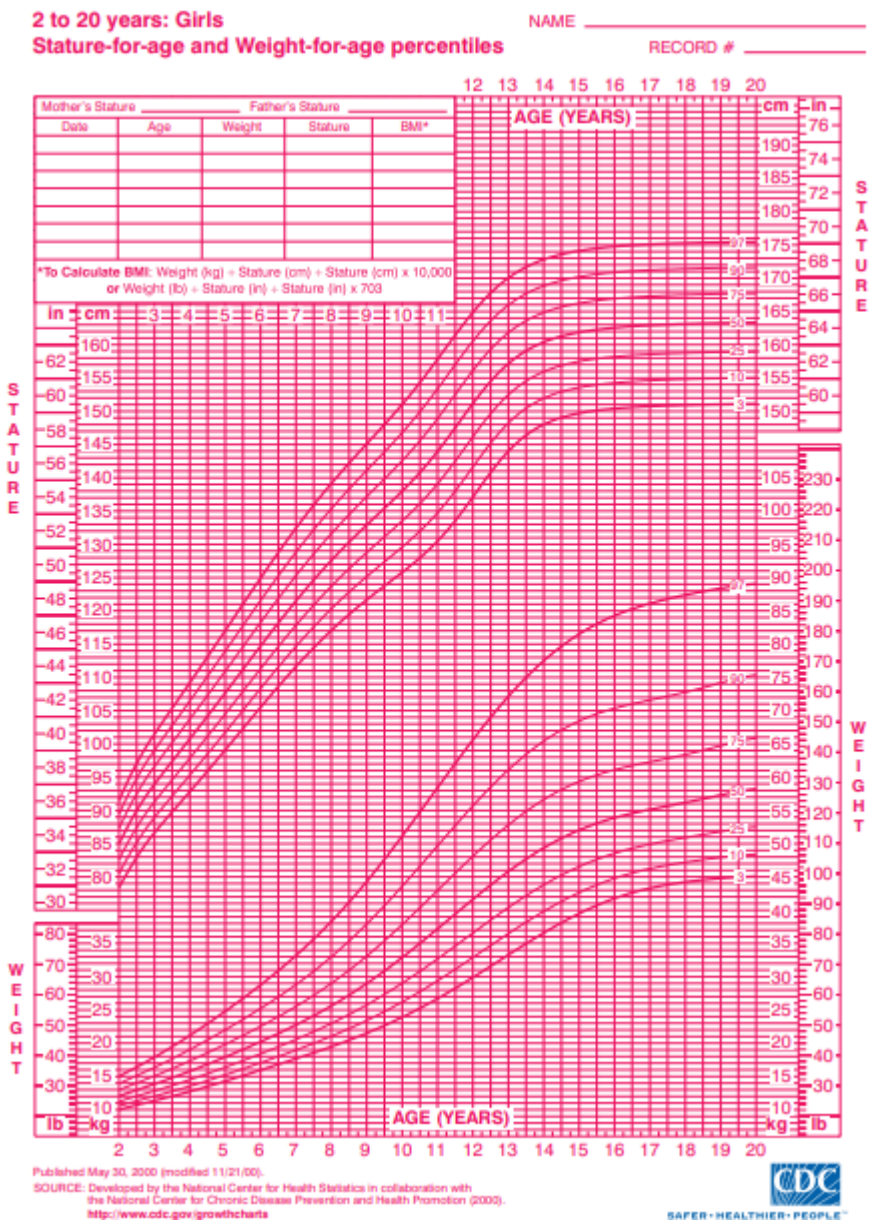
Boys: Birth- 24 Months



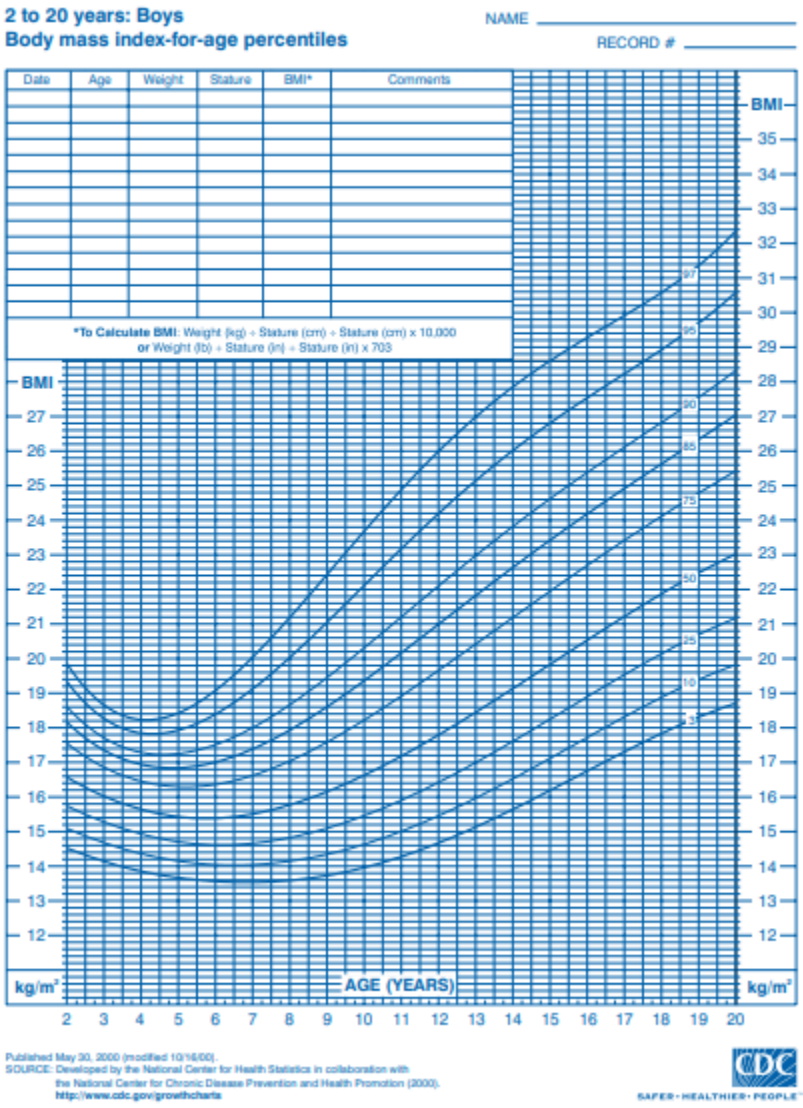

Birth to 24 months: Boys
Length-for-age and Weight-for-age percentiles
NAME
RECORD #
AGE (MONTHS)
LENGTH
WEIGHT
Mother's Stature
Father's Stature
Gestational Age: Weeks
Comment
Date
Age
Weight
Length
Head Circ.
Birth
Published by the Centers for Disease Control and Prevention, November 1, 2009
SOURCE: WHO Child Growth Standards (http://www.who.int/childgrowth/en)
SAFER · HEALTHIER · PEOPLE™
CDC

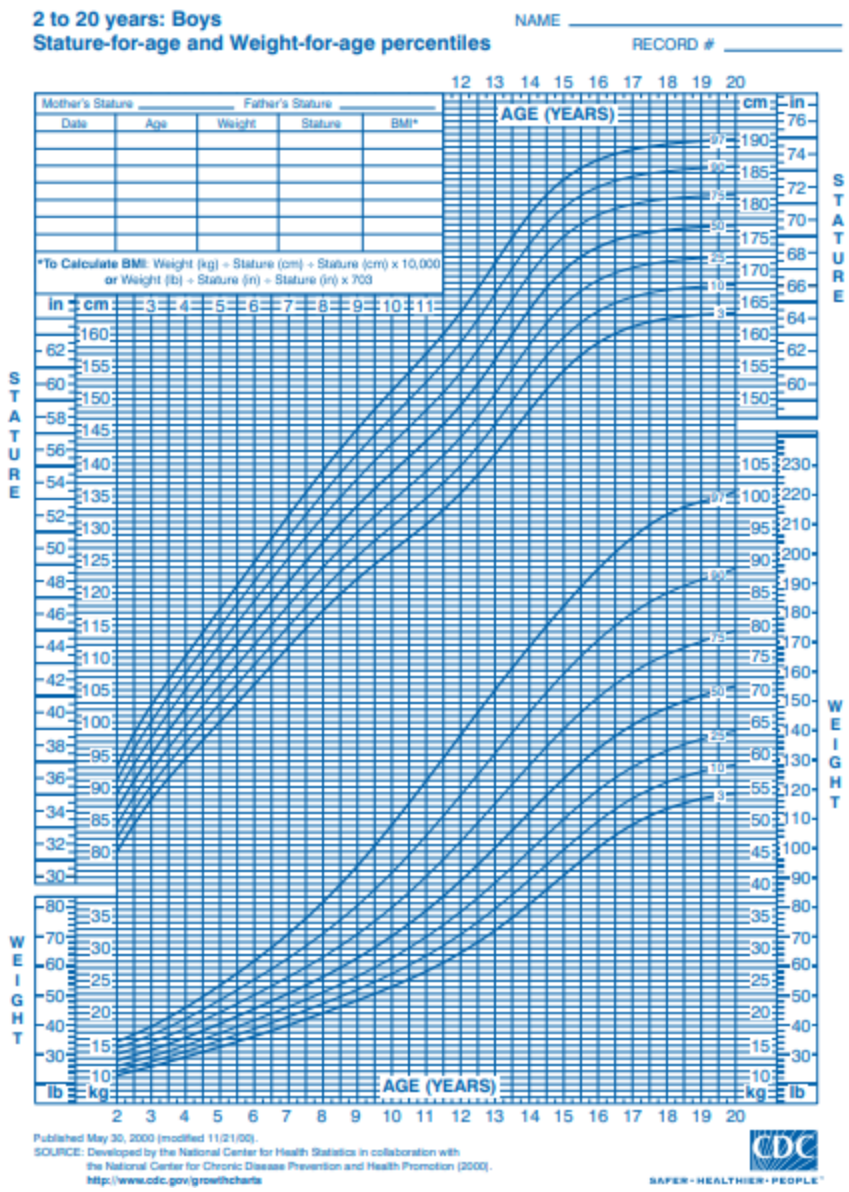
Girls: 2-20 Years




2 to 20 years: Girls
Stature-for-age and Weight-for-age percentiles
NAME
RECORD #
Mother's Stature
Father's Stature
Date
Age
Weight
Stature
BMI*
*To Calculate BMI: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703
AGE (YEARS)
STATURE
WEIGHT
cm
in
lb
kg
97
90
75
50
25
10
3
Published May 30, 2000 (modified 11/21/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts
CDC
SAFER·HEALTHIER·PEOPLE™

Boys: 2-20 Years





Rate vs Volume- Based EN Journal Article Essay

Rate-Based Tube Feeding vs. Volume-Based Tube Feeding

Introduction

Volume-based tube feedings (VBTF) is a daily injection of nutrition through the ordered correct amount of protein, fluid, and other important nutrients. VBTF has shown to increase

delivery without disrupting gastrointestinal issues. Rate- based tube feedings (RBTF) is an hourly rate of infusion. The intensive care unit is for patients that require around-the-clock care because of their condition/ illness. Critical care patients require at least 80% of their enteral nutrition from tube feeding, however, the patients have not been getting the requirement. Getting the necessary amount of nutrition is essential to the amount of time the patient stays in the ICU, the time on a ventilator, decrease mortality rate, and preventing infectious complications. Understanding why enteral nutrition delivery is important in the ICU, there are studies comparing and studying the differences and similarities of rate-base tube feedings and volume-based tube feedings.

Presentation of Research

A Quality Improvement Study

This study is a comparison of rate- based and volume- based tube feedings. Using a total of 283 patients in the study (VBF=77 & RBF=206). When looking at the number of females in the RBTF, the VBF had a huge number of females in the study. To find whether patients received inadequate nutrition, it was determined by calculating averaging nutrition caloric intake across all the days on a particular protocol and comparing whether that average daily caloric intake was at least 80% of EER (Swiatlo etal., 2019)

Table 3. Comparison of Inadequate Nutrition Results.

Outcomes	VBTF (n = 77)	RBTF (n = 206)	*P*-value
Patients who received inadequate nutrition, % (frequency)	11.7 (9)	63.6 (131)	<0.001
Days of inadequate nutrition, % (frequency/total tube feed days)	11.6 (34/294)	49.6 (472/951)	<0.001
% (Frequency) of days of inadequate nutrition due to:			
Physician Order	14.7 (5)	13.1 (62)	0.260
Patient condition	0.0 (0)	4.7 (22)	<0.001
Procedure	26.4 (9)	8.7 (41)	0.001
Tube occlusion/ displaced	20.6 (7)	3.8 (18)	0.024
Residuals	0.0 (0)	1.3 (6)	0.014
Initiation/advancement phase	0.0 (0)	18.6 (88)	<0.001
Other	20.6 (7)	5.9 (28)	0.001
No documentation	17.7 (6)	43.9 (207)	0.001

RBTF, rate-based tube feeding; VBTF, volume-based tube feeding.

Table 3 shows the inadequate nutrition results. Looking at the "Days of inadequate nutrition, RBTF have a close to 50% of days. Half of the days for this study, the RBTF group has shown to not get the proper nutrition needed. On the other hand, the VBTF group had close to 12% of days that their members did not get adequate nutrition. It is a huge gap and is one of the reasons to have VBTF. However, there was 34 days of inadequate nutrition for the VBTF participates with approximately 18% of the days did not have documentation for any interruption. Overall, the patients who received inadequate nutrition is RBTF. 131 out of 206 participants were not getting the correct nutrition needed compared to the 9 of 77 participants in the VBTF who were not getting proper nutrition. VBTF patients statistically received more nutrition than the RBTF patients (Swiatlo et al., 2019).

Volumed-Based Feeding to Optimize Delivery of Enteral Nutrition

From March 1, 2018, to March 1, 2019, medical-surgical intensive care unit (MSICU), patients participated in a study of volume-based feedings. A total of 163 patients received VBTF and 73 of these patients were included in the study. 10 patients were receiving RBTF before

there was a practice change to the VBTF. The patient's injuries included stroke, cardiac diagnoses, sepsis, and complex respiratory diagnosis. The limitations include the RBTF group being a smaller number than the VBTF. In this study, the VBTF group was able to surpass the goal of 80% enteral nutrition delivery (Bonomo et al., 2021).

Table 3 Nutrition intake and patient outcomes[a]

Characteristic	RBF group (n=10)	VBF group (n=63)	χ^2	*P*
Percentage of target volume achieved[b]	67.5 (62-75)	99.8 (69-108)	9.1	.003
Days of EN	6.5 (2-22)	7 (2-32)	0.0	.84
Days of mechanical ventilation	6.5 (0-23)	5 (0-30)	0.2	.70
Days in the ICU	10 (3-23)	10 (3-34)	0.1	.77
Days in the hospital	15 (3-23)	15 (3-49)	0.6	.43
MAP <70 mm Hg, No. (%)	0 (0)	8 (13)	1.4	.23
Patient died, No. (%)	5 (50)	17 (27)	2.2	.14

Abbreviations: EN, enteral nutrition; ICU, intensive care unit; MAP, mean arterial pressure; RBF, rate-based feeding; VBF, volume-based feeding; VI, volume infused.

[a] Values are presented as median (range) unless otherwise indicated.
[b] Calculated as mean volume infused/volume ordered × 100.

According to table 3, the percentage of the target volume achieved was 99.8% successful with the VBTF group. Comparing to the 67.5% of the volume target achieved by the RBTF, the VBTF group has a great amount of success. These groups did not have any significant differences other than the number of participants in each group (Bomomo et al., 2021). Based on this study, volume-based feedings have shown to be the optimal practice for tube feedings.

Supporting Articles

A United Kingdom cohort study has been the first to prove the increase of protein delivery from VBTF by itself. A study takes place from January 2015 to March 2017 to address whether VBTF is a safe and more effective method than RBF in improving energy and protein delivery in mechanically ventilated ICU patients. 82 patients were selected by a registered dietitian for both rate-based and volume-based feedings. 27 patients were given rate-based feedings while 55

patients were given volume-based feedings. The study found 81% of VBTF patients were getting more energy than the 52% of the RBTF patients, as well as protein amount was seen higher in the VBTF (Bharal et al., 2019). Table 3 from this study shows the safety and outcomes of the patients that participated in the study. The results from this table show the VBTF can be delivered without significant issues in the gastrointestinal tolerance.

Table 3. Safety and patient outcomes.

Outcome	Analysis	Rate based feeding (n = 27)	Volume based feeding (n = 55)	Difference[a] (95% CI)	P value
Glycaemic control					
Hypoglycaemic event	Unadjusted	1 (4%)	3 (5%)	–	1.00
Highest blood glucose	Unadjusted	11.7 ± 3.2	11.6 ± 2.8	−0.2 (−1.5, 1.2)	0.80
concentrations (mmol/l)	Adjusted[b]	–	–	0.1 (−1.9, 2.0)	0.94
Morning blood glucose	Unadjusted	8.4 ± 1.9	8.6 ± 1.3	0.2 (−0.5, 0.9)	0.57
concentrations (mmol/l)	Adjusted[b]	–	–	0.5 (−0.5, 1.6)	0.33
Insulin (daily units)	Unadjusted	4 [0, 52]	18 [0, 53]	1.83 (0.78, 4.34)	0.17
	Adjusted[b]	–	–	1.21 (0.36, 4.10)	0.75
Gastrointestinal tolerance					
Vomiting	Unadjusted	7 (26%)	5 (9%)	0.29 (0.08, 1.01)	0.05
	Adjusted[b]	–	–	0.21 (0.04, 1.21)	0.08
⩾1 GRVs > 250 ml	Unadjusted	2 (7%)	7 (13%)	1.82 (0.35, 9.44)	0.47
	Adjusted[b]	–	–	1.82 (0.18, 18.7)	0.62
Prokinetic use	Unadjusted	5 (19%)	5 (9%)	0.44 (0.12, 1.67)	0.23
	Adjusted[b]			0.39 (0.05, 3.04)	0.37
Mechanical ventilation	Unadjusted	6 [4, 10]	9 [6, 15]	1.76 (1.23, 2.51)	0.002
days	Adjusted[b]			1.46 (0.91, 2.35)	0.12
Length of ICU stay	Unadjusted	10 [6, 15]	11 [7, 19]	1.24 (0.88, 1.75)	0.22
(days)	Adjusted[b]	–	–	1.02 (0.63, 1.66)	0.93
Length of hospital stay	Unadjusted	13 [10, 44]	23 [11, 48]	1.14 (0.75, 1.73)	0.52
(days)	Adjusted[b]	–	–	0.90 (0.49, 1.64)	0.72
Mortality					
ICU mortality	Unadjusted	3 (11%)	10 (18%)	1.78 (0.45, 7.08)	0.42
	Adjusted[b]	–	–	8.67 (0.95, 79.4)	0.06
Hospital mortality	Unadjusted	6 (22%)	12 (22%)	0.98 (0.32, 2.96)	0.97
	Adjusted[b]	–	–	3.64 (0.66, 20.1)	0.14

GRV: gastric residual volumes; ICU: intensive care unit.
Summary statistics are mean ± standard deviation, median [interquartile range] or number (%) in each category
[a]Difference between groups reported as mean difference (normally distributed continuous variables), ratios (skewed continuous variables) or odds ratios (binary variables).
[b]Adjusted for APACHE II score, admission type, method of estimated energy requirement, time to start enteral nutrition.

Another article describes how the use of Enhanced Protein-Energy Provision via the Enteral Route Feeding Protocol (PEP uP) is used with volume-based feedings. The result from this study determines it is a safe (shows results of less frequent episodes of hyperglycemia) and effective way to give more energy and protein than rate-based feedings. The highest safety concern was emesis (vomiting), which seemed to not be an issue throughout the study (Prest et al, 2019). Overall, both articles determine that volume-based tube feedings are proven to give more energy and protein needs than rate-based tube feedings and that there is limited to no safety concerns with volume-based feedings.

Conclusion

After reviewing and understanding these articles, the choice of rate-based feedings versus volume- based feedings for ICU patients is determined by the number of proper enteral nutrition delivered (energy and protein needs are met) and the safety of the effects of each. Volume- based feedings have shown to surpass the required 80% enteral nutrition needed while not effecting the glycemic control nor the gastrointestinal tolerance.

References

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