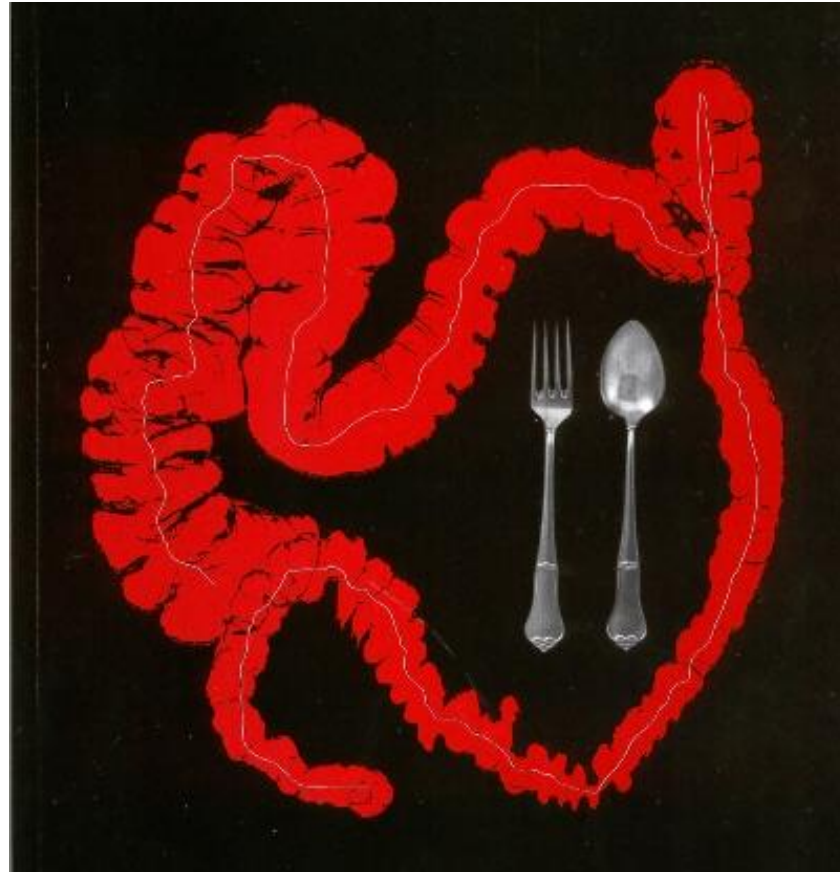
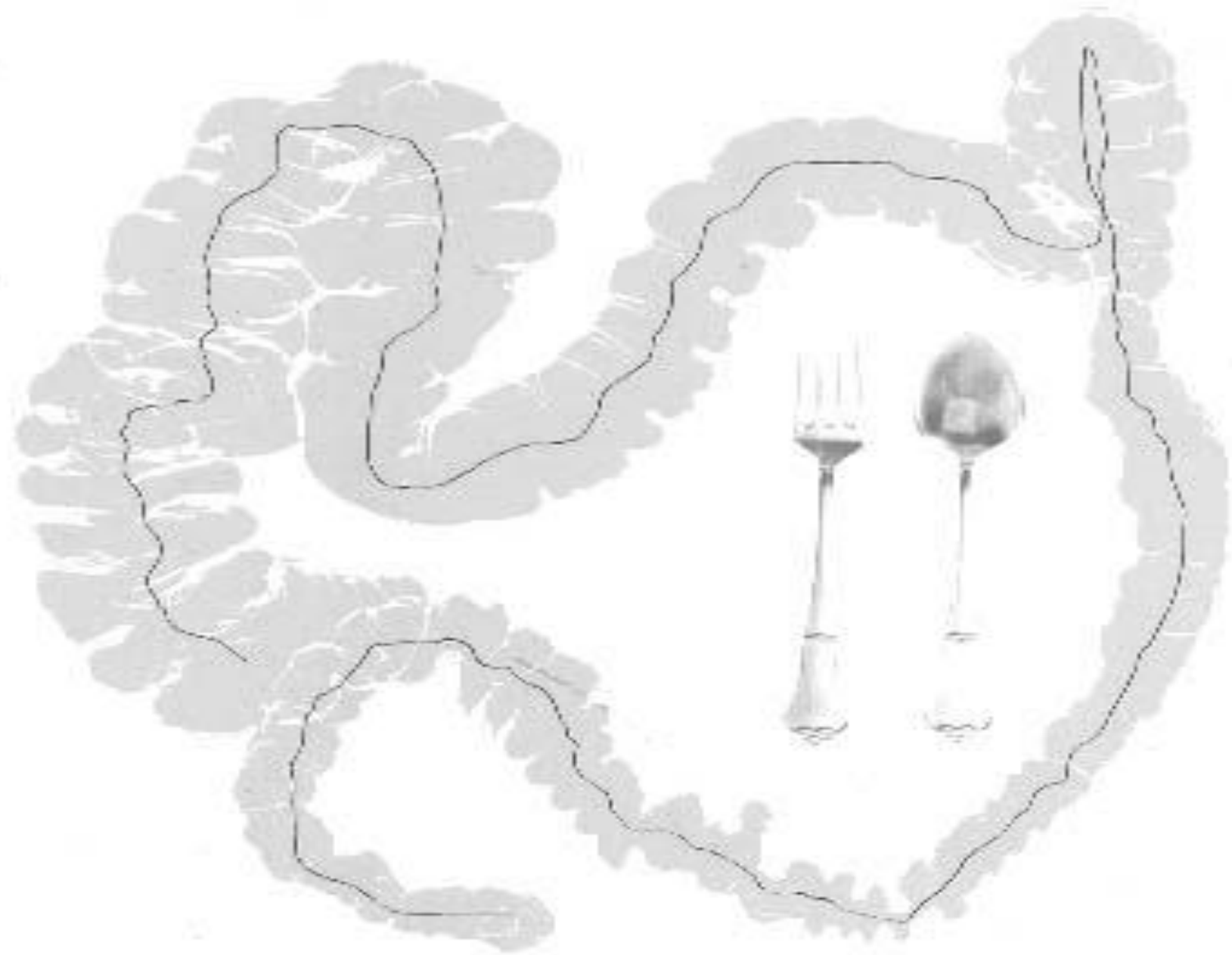
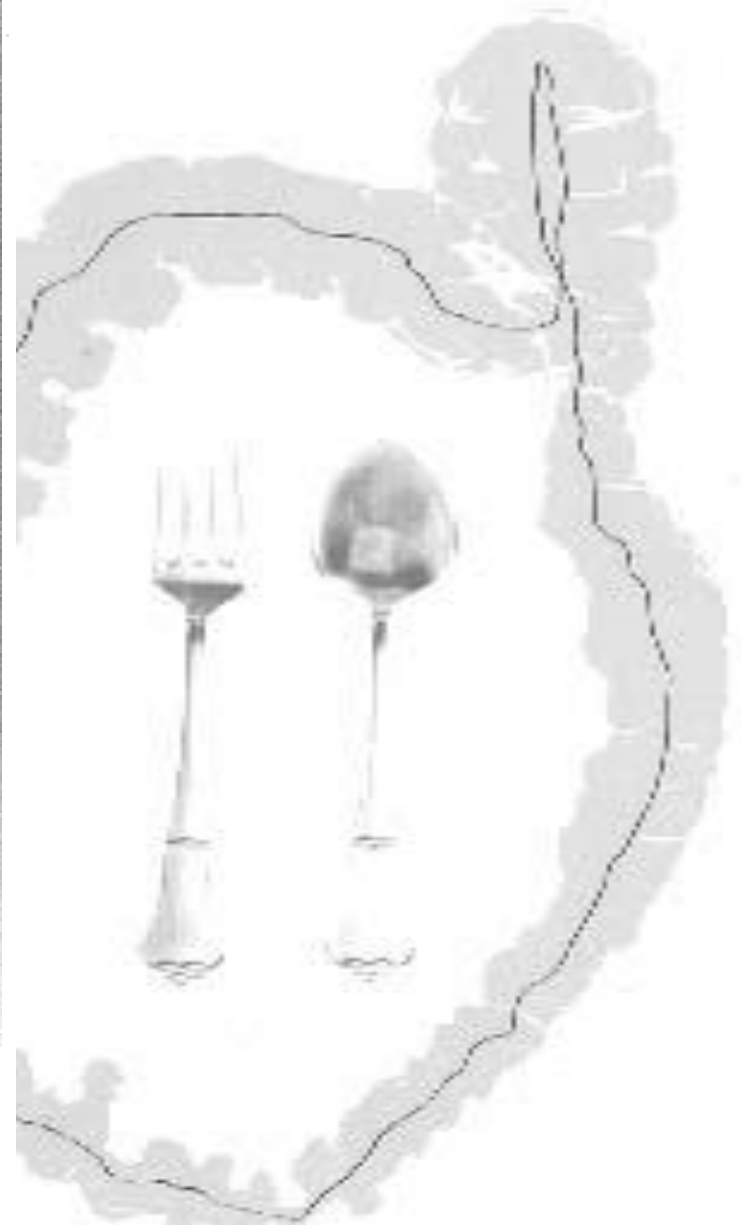
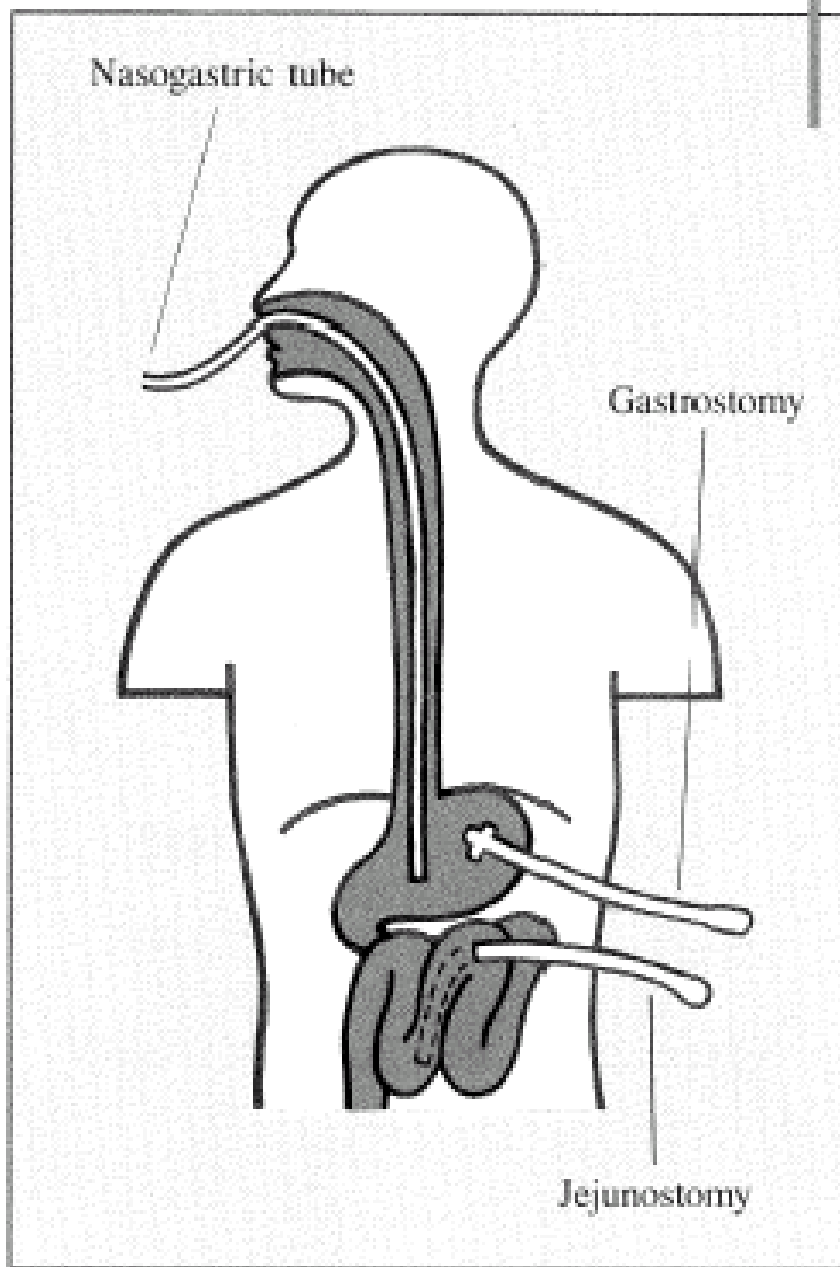


Enteral Nutrition Overview

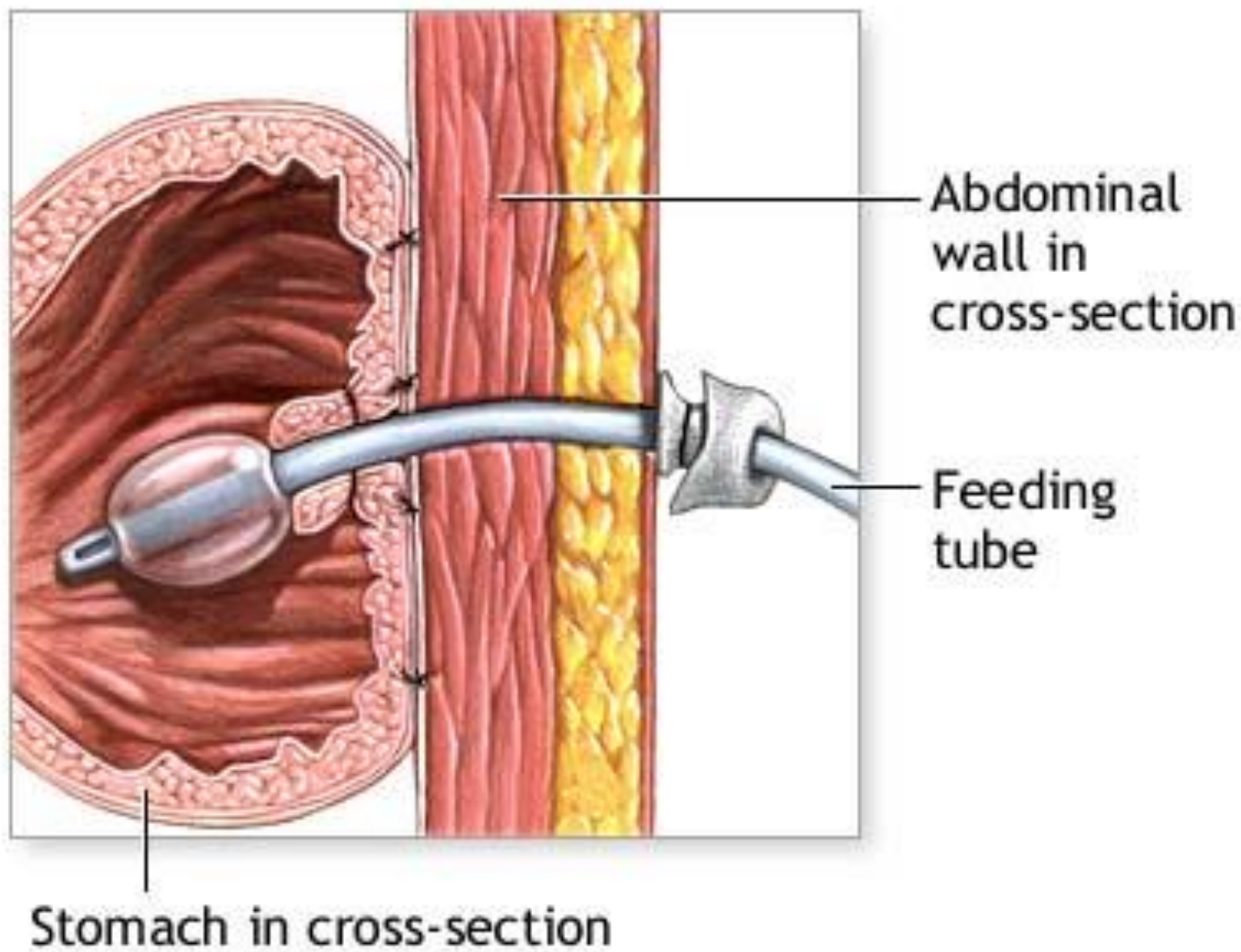


Christine Trapp PhD RD LD
Dietitian Consultant
Global Nutrition Services LLC



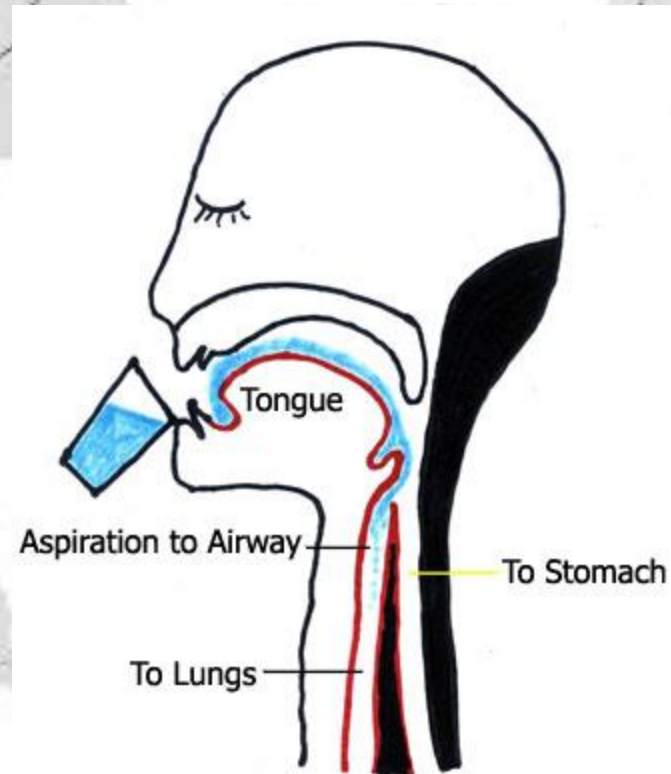


American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)(2006). Retrieved December 9, 2010 from <http://www.nutritioncare.org>



Indications for use

- Functional GI, but clinical conditions in which oral intake is
 - Impossible
 - Inadequate
 - Unsafe



NUTRITION ASSESSMENT



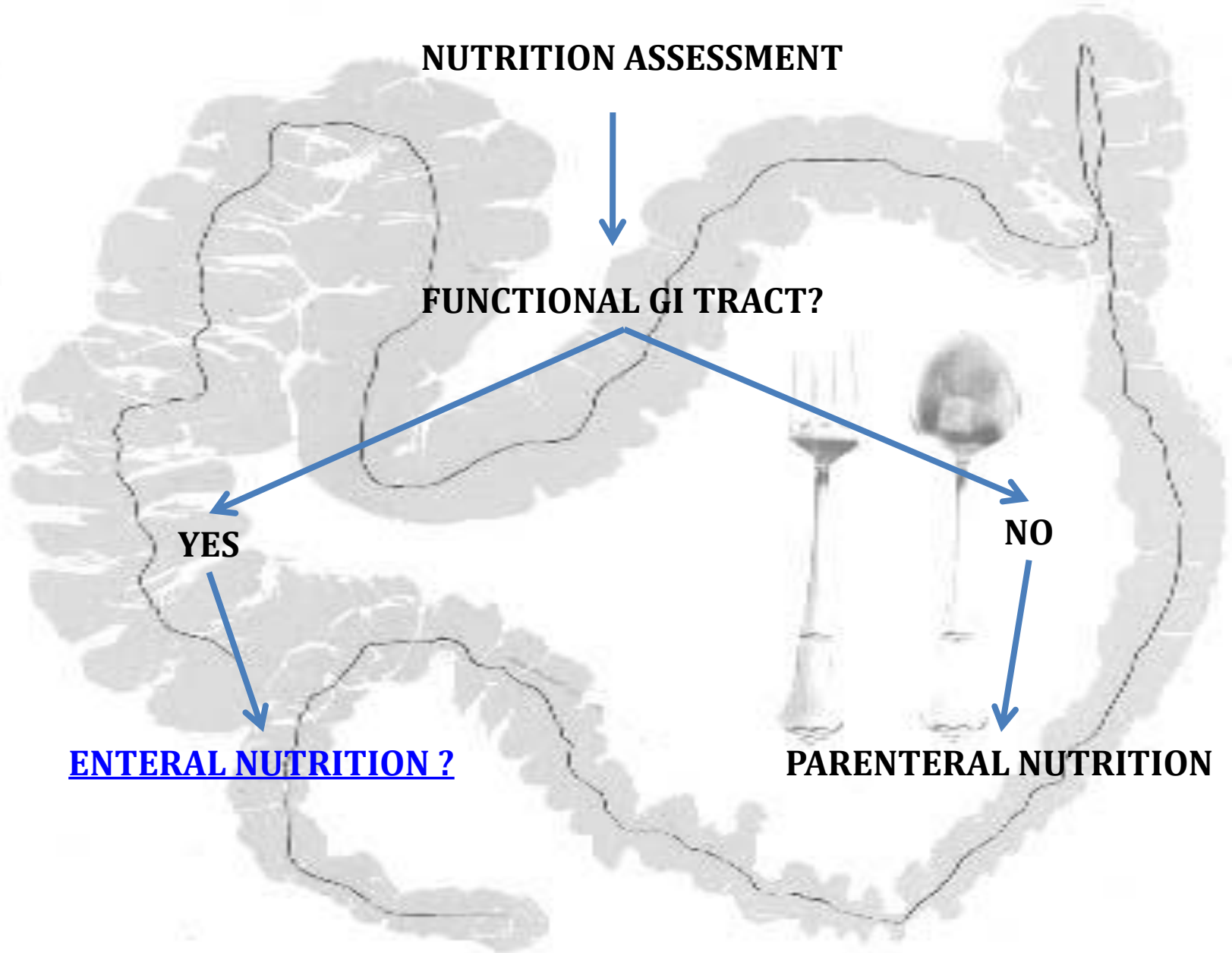
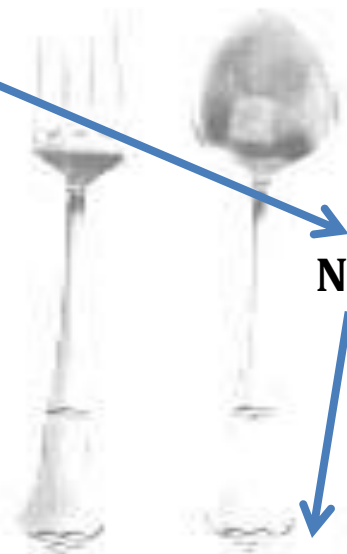
FUNCTIONAL GI TRACT?

YES

NO

ENTERAL NUTRITION ?

PARENTERAL NUTRITION



ENTERAL NUTRITION

Long-term
Gastrostomy
Jejunostomy

Short-term
Nasogastric
Nasoduodenal
Nasojejunal

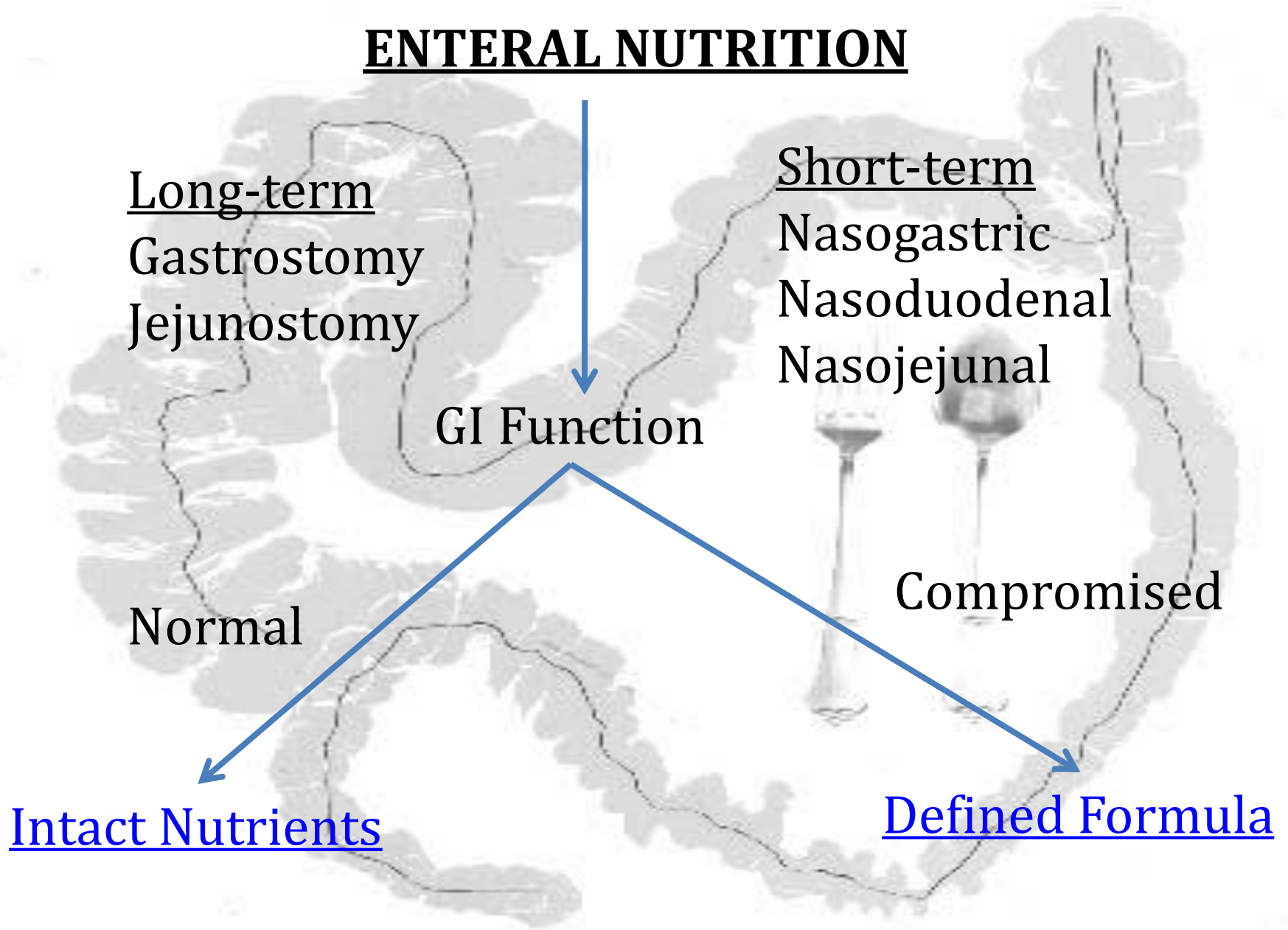
GI Function

Normal

Compromised

Intact Nutrients

Defined Formula



Intact
Nutrients

Defined
Formula

**NUTRIENT
TOLERANCE**

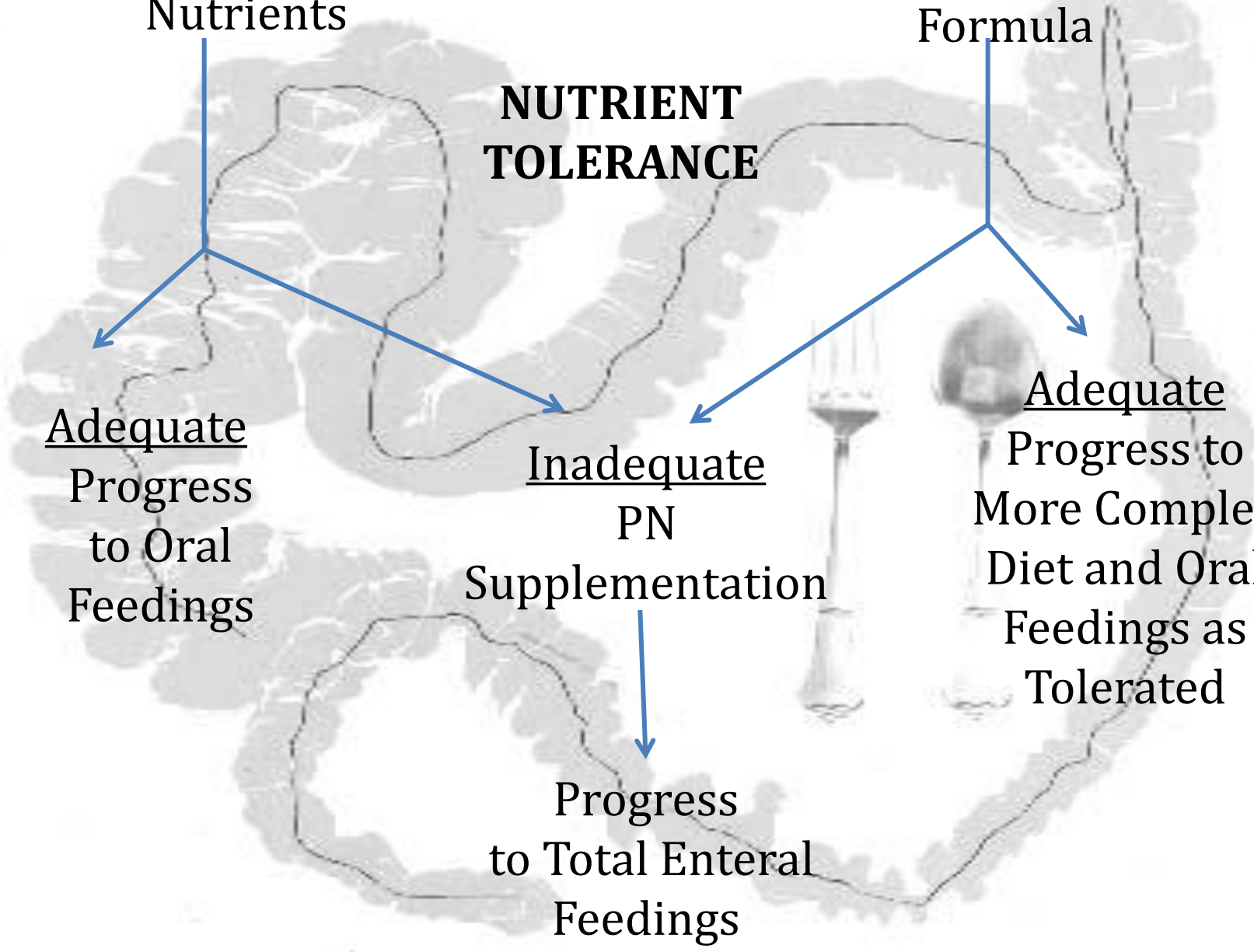
Adequate
Progress
to Oral
Feedings

Inadequate
PN

Adequate
Progress to
More Complex
Diet and Oral
Feedings as
Tolerated

Supplementation

Progress
to Total Enteral
Feedings



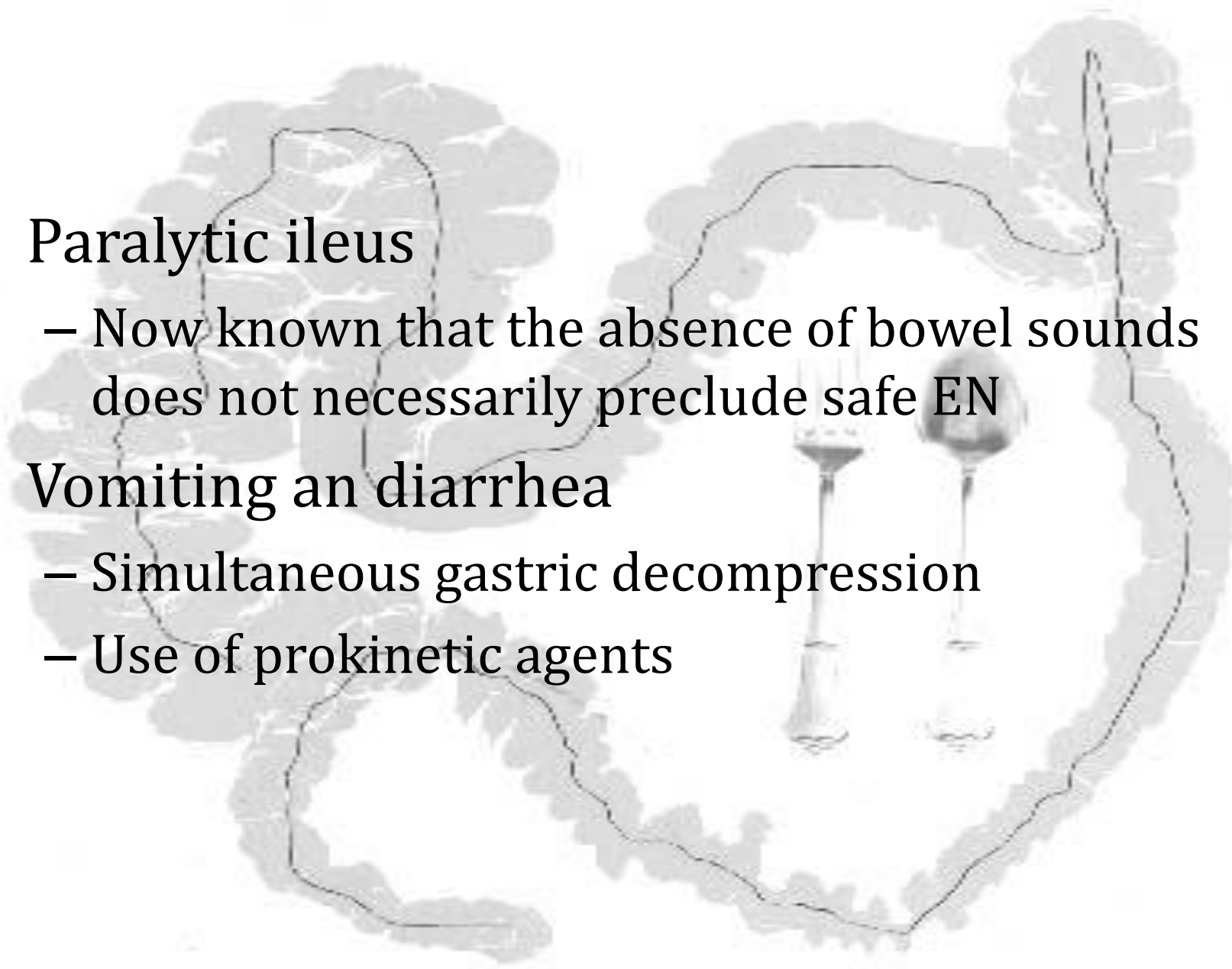
Important factors to consider

- Clinical status
- Diagnosis
- Prognosis
- Risks and benefits of therapy
- Discharge plans
- Quality of life
- Ethical issues
- Patient's and the family's wishes



Contraindications to EN support

- Non-operative mechanical GI obstruction
- Intractable vomiting/diarrhea refractory to medical management
- Severe short-bowel syndrome
- Paralytic ileus
- Distal high-output fistulas
- Severe GI bleed
- Severe GI malabsorption
- Inability to gain access to GI tract
- Need is expected for < 5-7 days for malnourished patients or 7-9 days if adequately nourished
- Aggressive intervention not warranted or not desired

- 
- Paralytic ileus
 - Now known that the absence of bowel sounds does not necessarily preclude safe EN
 - Vomiting and diarrhea
 - Simultaneous gastric decompression
 - Use of prokinetic agents

- Minimally functional digestive and absorptive capabilities
 - Elemental formula
 - Small peptide formula



A stylized, light gray map of the United States is centered on the page. The map is outlined with a thin black line and has a textured, slightly grainy appearance. In the center of the map, where the states of California, Nevada, and Arizona are located, there is a clear image of a silver fork and a silver spoon standing upright. The text "RISKS AND BENEFITS" is overlaid on the lower-left portion of the map.

RISKS AND BENEFITS

- First-pass metabolism (liver)
- Stimulates release of CCK
- Fiber, intact protein, peptides, specialized fatty acids
- Maintain normal intestinal pH and flora
- Fuel source for the bowel
- Reduces infectious complications
- Less costly than PN





- Early EN – may promote high gastric residuals
 - ↑ risk of aspiration pneumonia
 - ↑ Bacterial colonization of the stomach

Benefits significantly outweigh the Risks



**HOW TO DECIDE WHAT
FORMULA TO FEED**

Patient variables

- Nutritional status and requirements
- Electrolyte balance
- Digestive and absorptive capacity
- Disease state
- Renal function
- Medical or drug therapy
- Routes available for administration



Enteral Formulations

- General Characteristics
 - Digestibility/availability of nutrients
 - Nutritional adequacy
 - Viscosity
 - Osmolality
 - Ease of use
 - Cost



Standard/Polymeric Formulations

Carbohydrate	Fat	Protein
40-90% of calories		
Primarily corn syrup solids	Corn oil Soybean oil	Casein Soy protein isolates
Most formulas do NOT contain lactose		

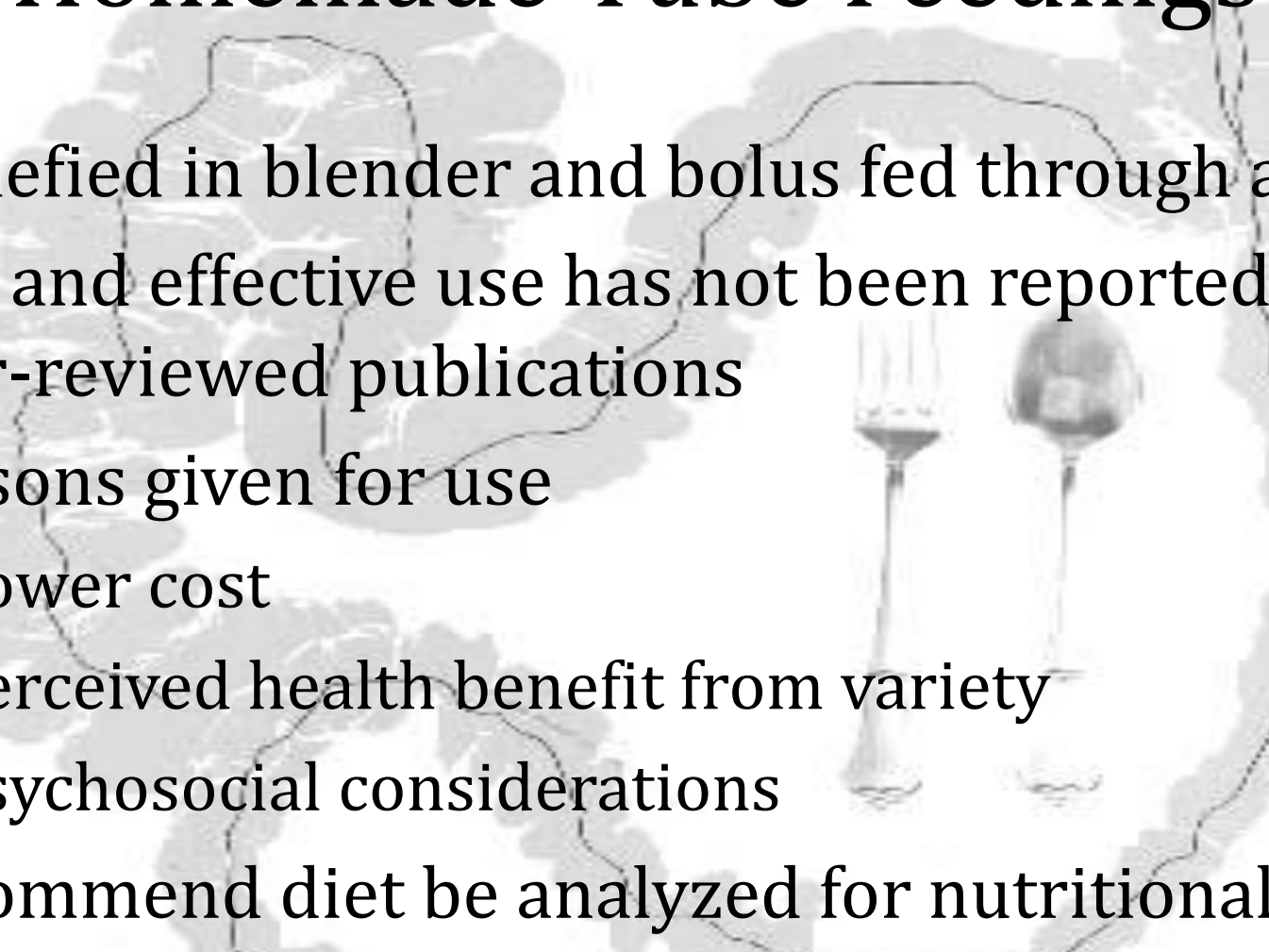
Standard Polymeric Formulas

	kcal/ml	PRO	CHO	FAT	PRO source	n6:n3	fiber (g/L)	osmlality
Nutren 1.0	1	16%	51%	33%	caseinate	4.1:1	(14)	315
Nutren Replete	1	25%	45%	30%	caseinate	2.3:1	(14)	300
Promote	1	25%	52%	23%	caseinate & soy protein isolate	5.3:1	(14.4)	340
Jevity 1 Cal	1.06	17%	54%	29%	caseinate & soy protein isolate	4.2:1	14.4	300
Osmolite 1 Cal	1.06	17%	54%	29%	caseinate & soy protein isolate	5:0:1	0	300
Fibersource HN	1.2	18%	53%	29%	soy protein isolate & soy protein concentrate	2.7:1	10	490
Jevity 1.2 Cal	1.2	19%	53%	29%	caseinate & soy protein isolate	4.2:1	18	450
Isosource HN	1.2	18%	53%	29%	soy protein isolate	2.7:1	0	490
Osmolite 1.2 Cal	1.2	19%	53%	29%	caseinate & soy protein isolate	5:0:1	0	360
Isosource 1.5 Cal	1.5	18%	44%	38%	caseinates	4.1:1	8	650
Jevity 1.5 Cal	1.5	17%	54%	29%	caseinate & soy protein isolate	5.4:1	22	525
Osmolite 1.5 Cal	1.5	17%	54%	29%	caseinate & soy protein isolate	NA	0	525
Nutren 2.0	2	16%	39%	45%	caseinate	4.6:1	0	746
TwoCal HN	2	17%	43%	40%	caseinates	NA	5	725

Blenderized formula

	kcal/ml	PRO	CHO	FAT	PRO source	n6:n3	fiber	osmolality
Compleat	1.07	18%	48%	34%	milk, chicken	3.0:1	6 g/L	340
Compleat Pediatric	1	15%	50%	35%	chicken, milk, pea puree	3.7:1	6g/0.9L	380

Homemade Tube Feedings

- Liquefied in blender and bolus fed through a GT
 - Safe and effective use has not been reported in peer-reviewed publications
 - Reasons given for use
 - Lower cost
 - Perceived health benefit from variety
 - Psychosocial considerations
 - Recommend diet be analyzed for nutritional adequacy
- 



- **Contraindications**

- Acute illness or immunosuppression
- GT size < 10 Fr in place (>14 Fr preferred)
- Fluid restrictions or intakes less than 30 oz/d
- Continuous drip feedings requiring a tube feeding unrefrigerated for more than 2h
- Jejunostomy tubes requiring continuous feeds
- Multiple food allergies/intolerances or special diet restrictions
- Lack of resources (electricity, refrigeration, hot water, etc.)

Diabetic formulas

- High in PRO
- Low in CHO
- High in FAT
- Caloric density varies from 1.0-1.5 formulas

- Glucerna 1.0
- Glucerna Select
- Glucerna 1.2
- Glucerna 1.5
- Nutren Glytrol
- Diabetasource AC
 - + arginine

Renal formulas

- Low in phosphorus, potassium, calcium and sodium
- High kcal (1.8-2.0 kcal/ml)
- Low CHO, high Fat

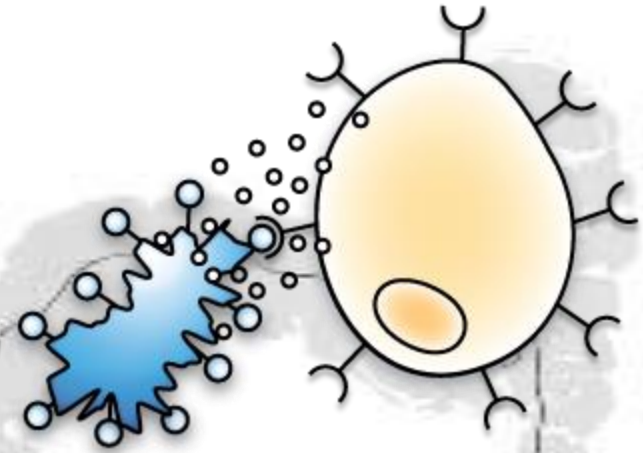
- **Nepro**
 - High protein – designed for pt's receiving dialysis
- **Suplena**
 - Low protein
- **Novasource Renal**
 - High protein, +arginine
- **RenalCal**
 - Low protein, +arginine

Pulmonary formulas

- Low CHO
 - ?-Decrease pCO₂
 - High Fat
 - High kcal (1.5 kcal/ml)
-
- Nutren Pulmonary
 - Pulmocare



Immune enhancing formulas



- Caloric density ranges from 1.0-1.5 kcal/ml
- CHO ranges from moderate to very low
- Typically additional arginine
 - to support proliferation and function of immune cells
- Some contain glutamine
 - for GI-tract integrity and energy for immune cells
- Typically, additional EPA/DHA
 - to help modulate inflammation and support immune function

- **Impact**

- 22% PRO, 53% CHO, 25% FAT
- 12.5 g arginine
- 1.7 g EPA/DHA

- **Impact Glutamine**

- 24% PRO, 46% CHO, 40% FAT
- 15 g glutamine
- 16.3 g arginine

- **Impact 1.5**

- 22% PRO, 38% CHO, 40% FAT
- 12.5 g arginine
- 1.7 g EPA/DHA

- **Oxepa**

- 17% PRO, 28% CHO, 55% FAT
- 4.6 g EPA

- **Pivot 1.5**

- 25% PRO, 45% CHO, 30% FAT
- 13 g arginine
- 6.5 g glutamine
- 2.6 g EPA
- 1.3 g DHA

Elemental and Semi-elemental Formulations

Carbohydrate	Fat	Protein
Hydrolyzed cornstarch Malodextrin	Fatty acid esters MCT Structured lipids Fish oil	Hydrolyzed Casein Hydrolyzed Whey protein Crystalline L-amino acids Hydrolyzed Lactalbumin Soy protein isolate

Semi-elemental formulas

- **Optimental**

- 67% whey protein hydrolysate, 28% partially hydrolyzed sodium caseinate, and 5% added arginine
- (21% PRO, 54% CHO, 25% FAT)

- **Peptamen and Peptamen with Prebio**

- enzymatically hydrolyzed whey protein
- (16% PRO, 51% CHO, 33% FAT)

- **Peptamen 1.5**

- enzymatically hydrolyzed whey protein
- (18% PRO, 49% CHO, 33% FAT)

Semi-elemental immune-enhancing formulas

- **Crucial**

- enzymatically hydrolyzed casein, L-arginine
- Supplemental arginine and omega-3 fatty acids to help support immune function
- (25% PRO, 36% CHO, 39% FAT)

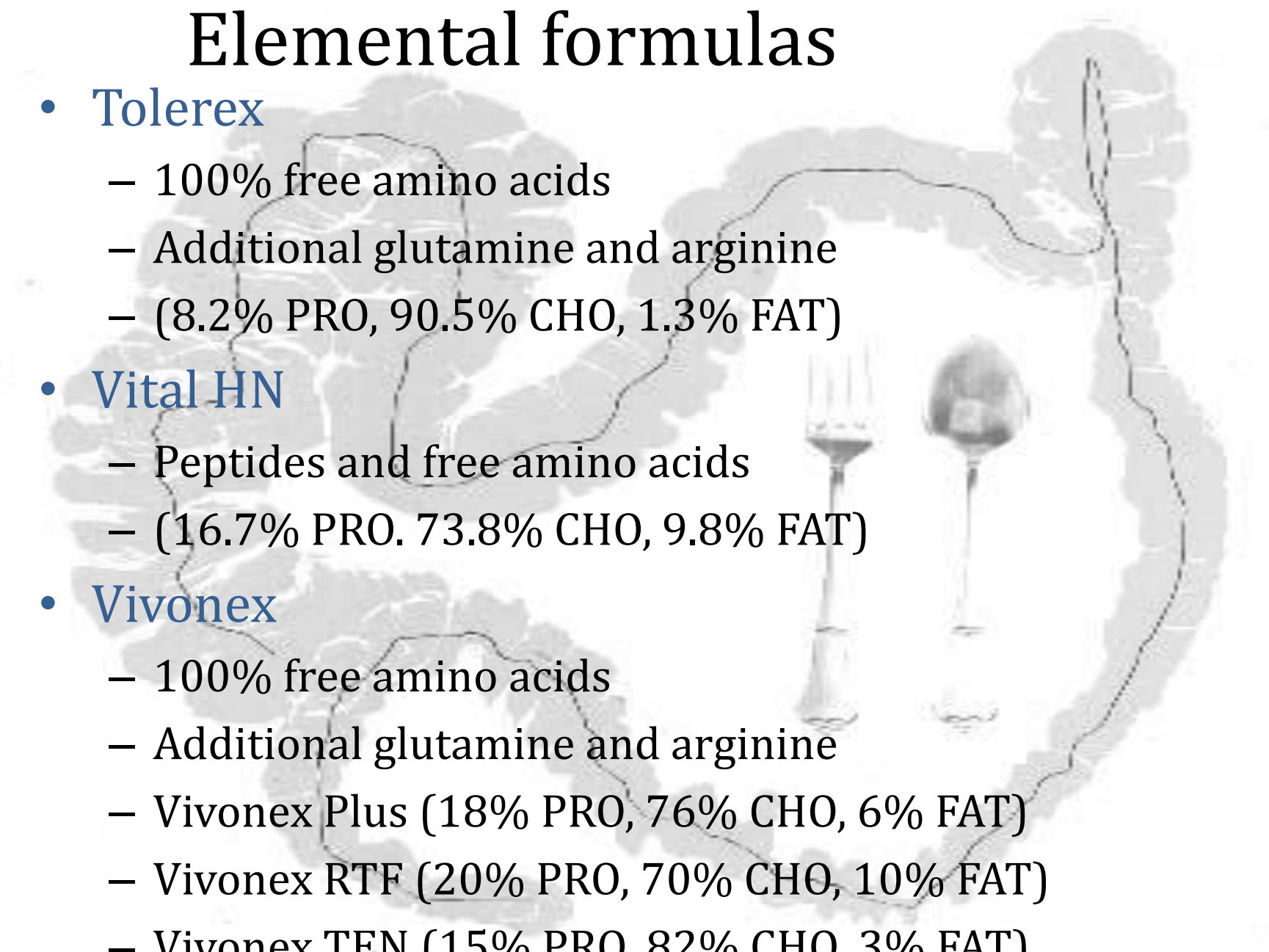
- **Peptamen AF**

- enzymatically hydrolyzed whey protein
- Omega-3 fatty acids to help modulate the inflammatory response
- (25% PRO, 36% CHO, 39% FAT)

- **Perative**

- Partially Hydrolyzed Sodium Caseinate, Whey Protein Hydrolysate
- Added arginine
- (21% PRO, 55% CHO, 25% FAT)

Elemental formulas

- **Tolerex**
 - 100% free amino acids
 - Additional glutamine and arginine
 - (8.2% PRO, 90.5% CHO, 1.3% FAT)
 - **Vital HN**
 - Peptides and free amino acids
 - (16.7% PRO, 73.8% CHO, 9.8% FAT)
 - **Vivonex**
 - 100% free amino acids
 - Additional glutamine and arginine
 - Vivonex Plus (18% PRO, 76% CHO, 6% FAT)
 - Vivonex RTF (20% PRO, 70% CHO, 10% FAT)
 - Vivonex TEN (15% PRO, 82% CHO, 3% FAT)
- 

Order Sets

- Enteral formula
- Route of delivery
- Advancement schedule
- Goal for formula delivery
- Monitoring parameters
- Routine aspects of care
 - Flushing protocols
 - Patency
 - Hydration
 - Aspiration precautions
- Assessment of tolerance



1.	<input type="checkbox"/> Physician authorizes dietitian to initiate, advance and monitor TF in consultation with physician. <input type="checkbox"/> Physician to select feeding schedule as ordered below.
2.	TUBE FEEDING TYPE:
	<input type="checkbox"/> NG <input type="checkbox"/> Peg Tube <input type="checkbox"/> J-Tube <input type="checkbox"/> Oral Gastric
3.	TUBE FEEDING FORMULA: Please choose one of the following
	<input type="checkbox"/> Standard with Fiber (1-1.2cal/ml) <input type="checkbox"/> Elemental (1-1.2cal/ml) <input type="checkbox"/> Renal (2cal/ml)
	<input type="checkbox"/> Diabetic (1-1.2cal/ml) <input type="checkbox"/> High Calorie/High Protein (2 cal/ml) <input type="checkbox"/> Other:
4.	TUBE FEEDING SCHEDULE: (HOB elevated to greater than or equal to 30° at all times unless contraindicated.) Please choose one of the following:
	<input type="checkbox"/> CONTINUOUS TUBE FEEDING (Rate = total volume divided by 24 hours) Start TF full strength 25 ml/hr, increase ___ ml every 4 hours until goal of 75 ml / hr x 24 hrs is reached. Dietitian to assess patient and order final TF rate to meet needs.
	<input type="checkbox"/> If TF is interrupted for test/procedures, Nursing to adjust TF rate of 1 to 1.2 cal/ml formulas as needed to meet patient's 24 hr volume goal ordered, and not to exceed maximum TF rate of <input type="checkbox"/> 150 ml/hr or <input type="checkbox"/> ___ ml / hr rate
	<input type="checkbox"/> CONTINUOUS CYCLIC (10-12 hrs per day/night) Max rate recommended = 150 ml / hr
	Start TF full strength at 25 ml/hr, increase ___ ml every 4 hours until goal of ___ ml / hr is reached. (Time of day ___ to ___)
	<input type="checkbox"/> INTERMITTENT BOLUS (by gravity). Max rate recommended = 500 ml / bolus.
	Start full strength bolus at 120 ml / bolus. Advance by ___ ml every 4 hours until goal (see below) is reached.
	Bolus goal volume = ___ ml / bolus, (frequency) ___ X (time) <input type="checkbox"/> 24 hrs / <input type="checkbox"/> from ___ to ___
5.	TUBE FEEDING FLUSHES:
	<input checked="" type="checkbox"/> Standard flush following Water Flush Guidelines (see page 2)
	<input type="checkbox"/> ___ ml additional water every ___ hours or <input type="checkbox"/> BID / <input type="checkbox"/> TID / <input type="checkbox"/> QID / <input type="checkbox"/> Daily
6.	TUBE OCCLUSION TX:
	<input checked="" type="checkbox"/> Viokase-8 tablet and sodium bicarbonate 325 mg per Tube Occlusion Guideline (see page 2).
7.	CHECK GASTRIC RESIDUAL (See Enteral Feeding Guidelines pg 2.) No residual check with small bowel tube placement.
	Gastric Residual greater than 200ml more than 2 consecutive hrs → replace 200 ml, discard the remainder, continue to hold TF and Notify physician: <input type="checkbox"/> anytime day or night; <input type="checkbox"/> only between these hours: _____
8.	BOWEL MANAGEMENT
	<input type="checkbox"/> Senna 187 mg NG/FT every evening PRN
	<input type="checkbox"/> Docusate Sodium 100 mg NG/FT BID PRN
	<input type="checkbox"/> Milk of Magnesia 30 ml NG/FT daily PRN <input type="checkbox"/> Bisacodyl Suppository 10 mg daily PRN <input type="checkbox"/> Other:
9.	LAB ORDERS:
	<input type="checkbox"/> Comprehensive Metabolic Panel, <input type="checkbox"/> Phosphorus, <input type="checkbox"/> Magnesium, <input type="checkbox"/> Prealbumin now and repeat weekly.
	<input type="checkbox"/> Repeat above labs (other frequency): _____
10.	Other:
	Brantley S L Nutr Clin Pract 2009;24:335-343
	Physician Signature: _____
	Date: _____ Time: _____

*Nutrition in
Clinical Practice*

- Factors Affecting Patency

- Characteristics of the formula

- Concentrated (thick)
 - High protein
 - Fiber-enriched

- The feeding tube

- Medication administration

- Flush tube

- at regular intervals with water

- Before and after medications with water

- Acidic irrigants (cranberry juice) tend to promote clogging!

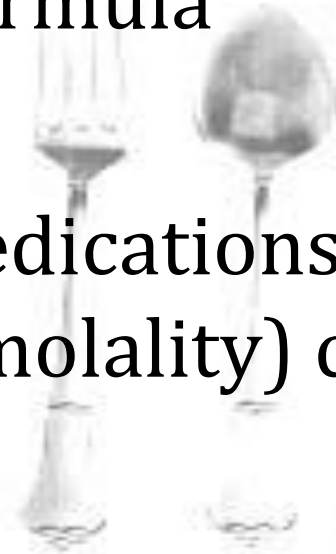


Infection control

- Adherence to basic principles of infection control
 - Hand washing
 - Cleansing tops of cans before opening
 - Wearing gloves during transfer of formula from cans to administration sets
 - Observing cutoffs for hang times for open delivery systems
 - Sterile open system (institution) 8h
 - Sterile open system (home) 12h
 - Sterile closed system (per manufacturer's guidelines 24-48h)
 - No “topping-of” existing feeding solutions
 - Avoid manipulation of prefilled closed system containers

Medication Administration

- Orally is preferred
- NEVER mix with enteral formula
- Flush before and after
- Other characteristics of medications (such as sorbitol content and osmolality) can contribute to diarrhea.



Oral Hygiene



- Patients/clients with no oral intake are vulnerable to dental problems.
- Poor oral hygiene and dental disease increase risk of aspiration pneumonia
- Appropriate oral hygiene
 - Brushing 2x/day
 - Rinsing with mouthwash
 - Lip balm to protect lips

Monitoring

Physical Assessment	Clinical signs of fluid and nutrient excess or deficiency.
Vital signs	
Actual fluid and nutrient intake	
Measurement of output	
Weight trend	
Laboratory data (initially, and at least every 3-6 mo)	CBC, glucose, BUN, creatinine, electrolytes, Ca, Mg, P, liver fxn tests, TG serum proteins, PT/INR, urine, CRP
Markers for nutritional adequacy	Albumin, prealbumin trend, nitrogen balance studies
Review of medications	
Changes in GI function	

Transitional Feeding

- Hold enteral feedings for an hour or so before scheduled meals to stimulate appetite
- Nocturnal infusion only
- When oral intake reaches $> 50\%$ of estimated needs x 2-3 days, feeding can be decreased

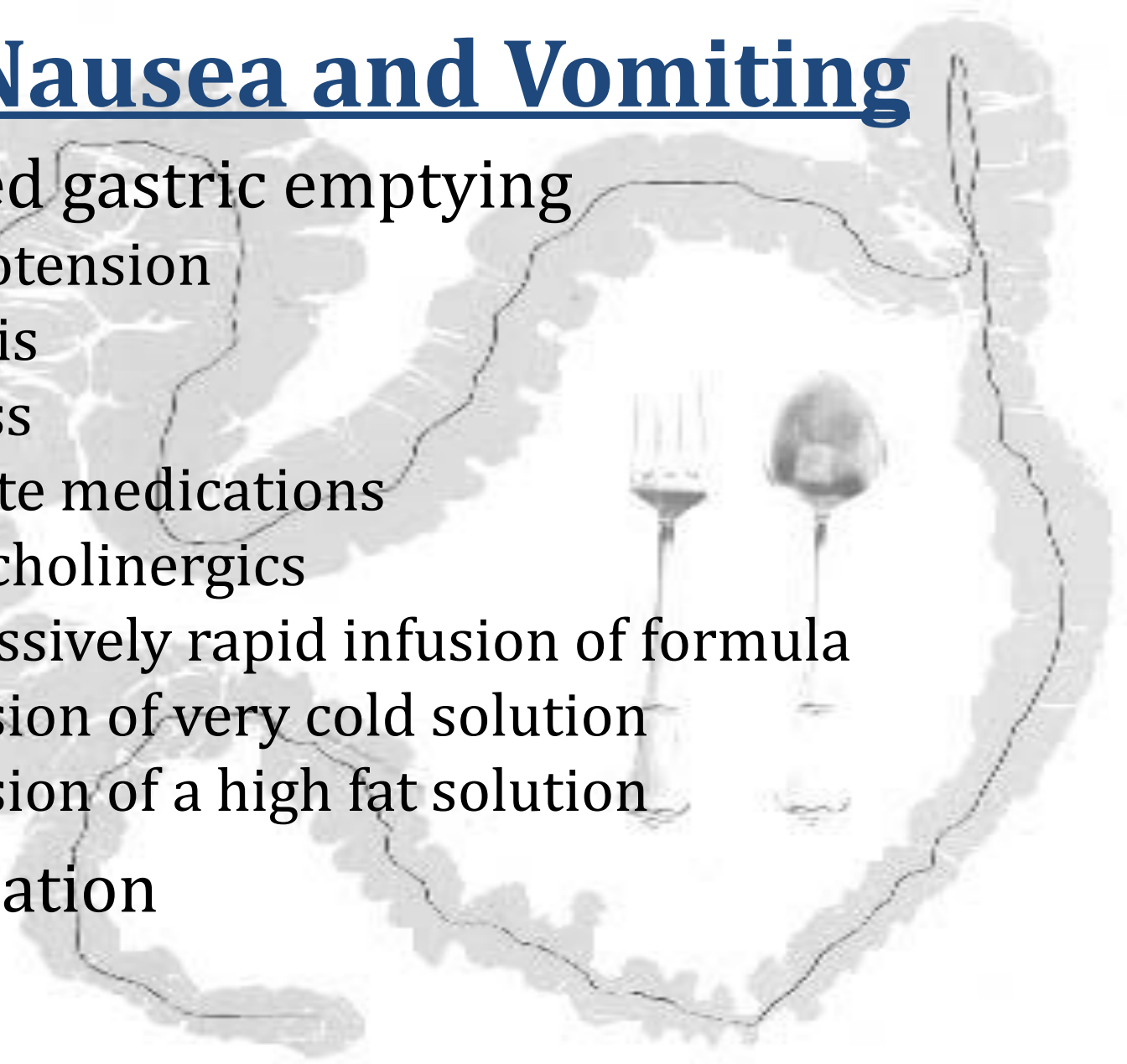


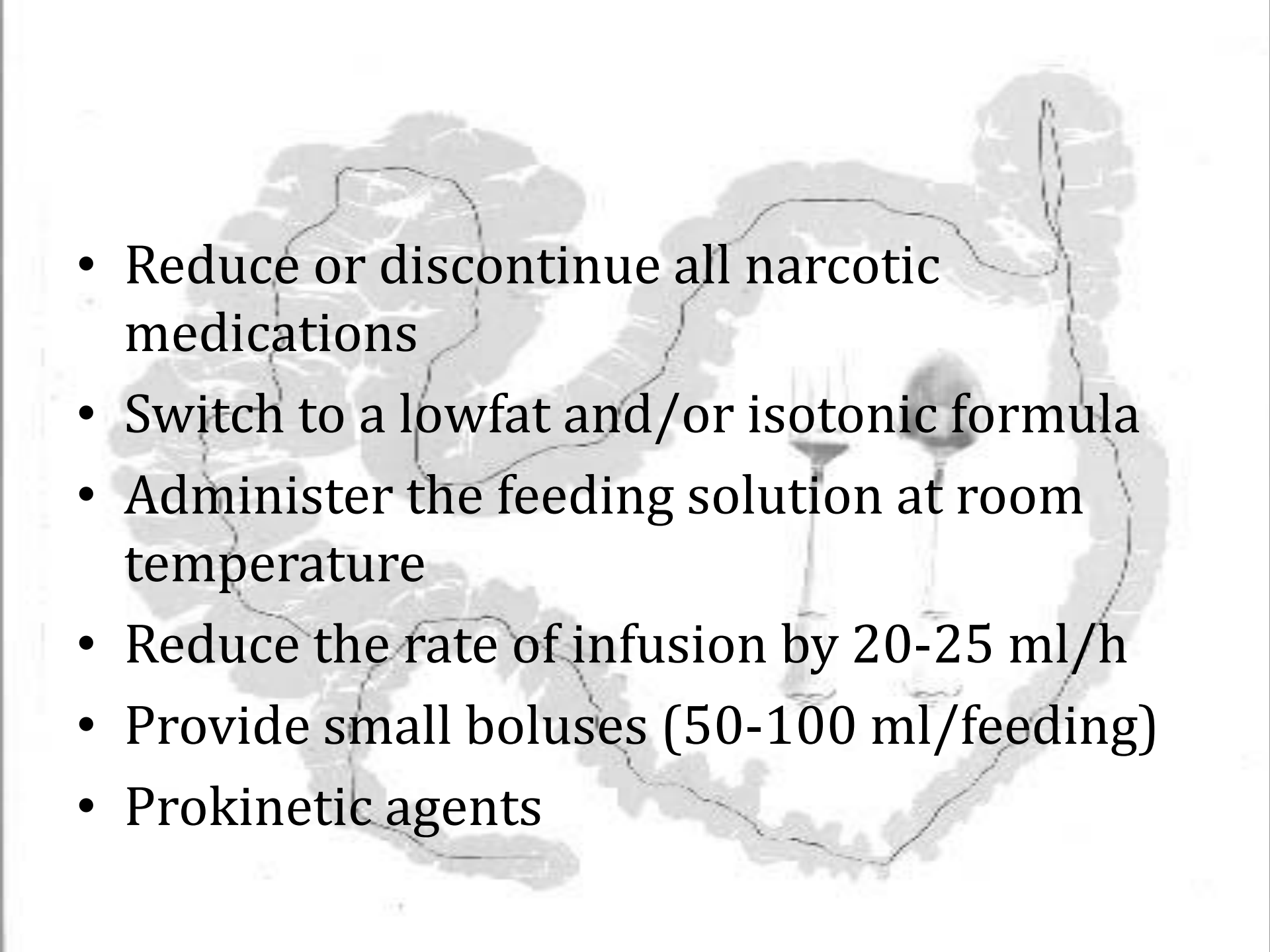


COMPLICATIONS

Nausea and Vomiting

- Delayed gastric emptying
 - Hypotension
 - Sepsis
 - Stress
 - Opiate medications
 - Anticholinergics
 - Excessively rapid infusion of formula
 - Infusion of very cold solution
 - Infusion of a high fat solution
- Obstipation
- C-diff



- 
- A faint, grayscale background image of a human torso. A feeding tube is visible, extending from the upper abdomen down towards the lower abdomen. Two bottles, likely containing feeding solutions, are positioned on the right side of the torso, connected to the tube. The image is semi-transparent, allowing the text to be clearly visible over it.
- Reduce or discontinue all narcotic medications
 - Switch to a lowfat and/or isotonic formula
 - Administer the feeding solution at room temperature
 - Reduce the rate of infusion by 20-25 ml/h
 - Provide small boluses (50-100 ml/feeding)
 - Prokinetic agents

Abdominal distension

- GI ileus
- Obstruction
- Obstipation
- Ascites
- Diarrheal illness



Maldigestion & Absorption



- Clinical manifestations

- Unexplained weight loss

- Steatorrhea

- Diarrhea

- Anemia

- Tetany

- Bone pain

- Pathological fractures

- Bleeding

- Dermatitis

- Neuropathy

- Glossitis

- Edema

Diagnostic studies

- Screening (gross & microscopic examination of the stool, radiological examination of intestinal transit time, serum carotene concentration)
- Maldigestion/malabsorption of specific nutrients
 - Lactose tolerance test
 - Schilling test (B12)
 - other
- Endoscopic small bowel biopsy
 - Celiac disease
 - Tropical sprue
 - Whipple's disease

Diarrhea

- Common causes
 - Medications (sorbitol-based, antibiotics)
 - Infection (C-difficile, nonclostridial bacteria)
 - Formula intolerance (osmolarity, fat content)
 - Specific component of the formula (lactose)

Algorithm for the Treatment of Diarrhea

1. Provide adequate fluids to maintain hydration & electrolyte balance

2. Reduce fluid & electrolyte losses

a. Provide soluble fiber

b. Change to continuous duodenal infusion

c. Reduce rate of infusion

3. Determine etiology

Enteric pathogen or inflammation or disease process?

YES

NO

Treat accordingly

Enteric Pathogen

C. difficile
Salmonella
Shigella
Campylobacter
Yersinia
E. coli

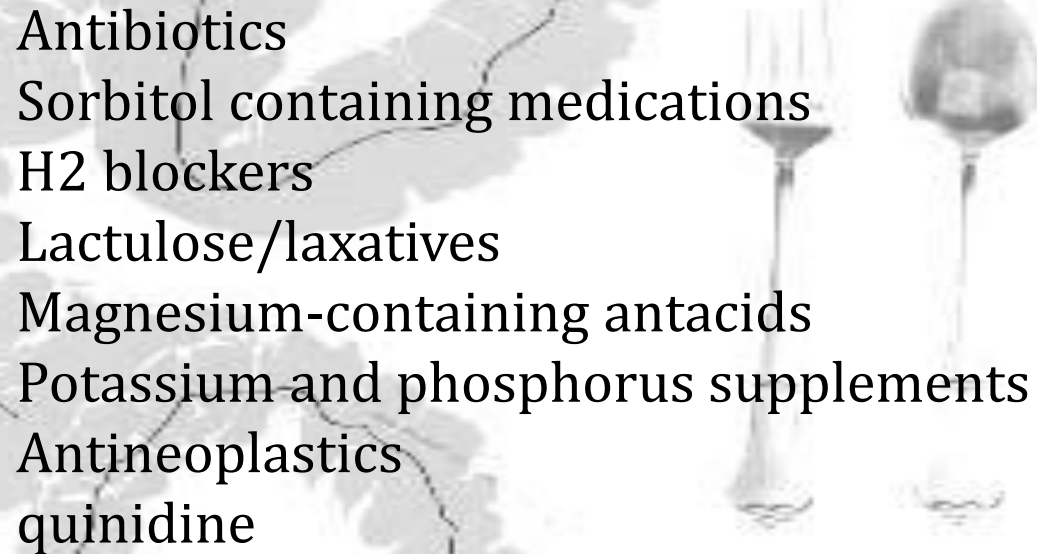
Disease/Inflammation

Malabsorption syndromes
Diabetes
Pancreatic insufficiency
Bile salt malabsorption
Fecal impaction

Diarrhea continues

Pharmacological

If possible, change offending medication



Antibiotics
Sorbitol containing medications
H2 blockers
Lactulose/laxatives
Magnesium-containing antacids
Potassium and phosphorus supplements
Antineoplastics
quinidine

Diarrhea continues

Antimotility medication

Loperamide HCl or diphenoxylate HCl, atropine sulfate
Codeine
Paregoric
Deodorized tincture of opium

Treatment worked

Gradually increase
TF rate to goal

Treatment didn't work

Change to peptide-based
or elemental formula

Treatment worked

Increase rate as
tolerated to goal

Treatment didn't work

D/C TF
Provide PN until diarrhea resolved
D5 1/4 NS via feeding tube

Constipation

- Dehydration
- Inadequate fiber
- Excessive fiber
- Minimum of 1 ml of fluid per kcal
- Inadequate physical activity
- Patients/clients may need stool softener



Aspiration

- HOB to 45 degrees during gastric feeding
- Check residuals
 - GRVs that exceed 200 ml should trigger a careful evaluation of the patient
- High risk patients may benefit from duodenal or jejunal feedings



**POSSIBLE
METABOLIC ALTERATIONS**

Fluid & electrolyte imbalances

Problem	Possible Causes
Hypertonic dehydration	<ul style="list-style-type: none">•Excessive fluid loss•Inadequate fluid intake•Concentrated formula administration to a patient who cannot express thirst
Over-hydration	<ul style="list-style-type: none">•Excessive fluid intake•Rapid refeeding•Catabolism of LBM w/ K⁺ loss•Refeeding syndrome •Renal, hepatic, or cardiac insufficiency

Problem	Possible causes
Hypokalemia	<ul style="list-style-type: none">•Refeeding syndrome•Catabolic stress•Depleted body cell mass •Effect of ADH and aldosterone•Diuretic therapy•Excessive losses (diarrhea)•Metabolic alkalosis•Insulin therapy•Dilution
Hyperkalemia	<ul style="list-style-type: none">•Metabolic acidosis •Poor perfusion (e.g. CHF)•Renal failure•Excessive K⁺ intake

Problem	Possible Causes
Hyponatremia	<ul style="list-style-type: none">•Dilution, from elevated levels•Hepatic, cardiac, or renal insufficiency •Reduced Na intake relative to output
Hypernatremia	<ul style="list-style-type: none">•Inadequate fluid intake w/ increased loss (sweating, osmotic diuresis)•Increased Na intake (IV fluid)
Hypophosphatemia	<ul style="list-style-type: none">•Refeeding syndrome•Excessive calories•Binding by epinephrine •Sucralfate, antacids•Insulin therapy
Hyperphosphatemia	<ul style="list-style-type: none">•Renal insufficiency

Acid-base disturbances

Problem	Possible Causes
Hypercapnea	<ul style="list-style-type: none">•Overfeeding energy•Excessive CHO provision in pt with respiratory dysfunction

Nutrient deficiencies

Problem	Possible Causes
Hypozincemia	<ul style="list-style-type: none">•Excessive losses (NGT, protein-losing, enteropathy, ostomy, wound)
Vitamin K deficiency	<ul style="list-style-type: none">•Inadequate vitamin K intake•Prolonged use of low-fat or low-vitamin K formula•Antibiotic use, cirrhosis, malabsorption, pancreatic insufficiency
Thiamin deficiency	<ul style="list-style-type: none">•Chronic alcoholism•Advanced age•Long-term malnutrition•Malabsorption•Antacid therapy•Dialysis
EFA deficiency	<ul style="list-style-type: none">•Inadequate linoleic acid intake

Glycemic control

Problem	Possible Causes
Hyperglycemia	<ul style="list-style-type: none">•DM, sepsis, catabolism, trauma, or other diseases states or conditions•Insulin resistance•Refeeding syndrome •Glucocorticoids•Excessive carbohydrates
Hypoglycemia	<ul style="list-style-type: none">•Abrupt cessation of ETF in patient receiving OHA or insulin

A faint, grayscale background image showing a person's face, possibly a patient, with a medical device or tube visible near the mouth. The image is semi-transparent and serves as a backdrop for the text.

- **Resources**

- Gottschlich, M.M. (Ed). (2007). *The A.S.P.E.N. Nutrition Support Core Curriculum: A Case-Based Approach – The Adult Patient*. Silver Spring, MD: American Society for Parenteral and Enteral Nutrition.
- Bankhead, R., et al. (2009). Enteral Nutrition Practice Recommendations. *Journal of Parenteral and Enteral Nutrition*, 33 (2) 122-167.
- Chen, Y and Peterson, S.J. (2009) Enteral Nutrition Formulas: Which Formula is Right for Your Adult Patient? *Nutrition in Clinical Practice*, 24 (3), 344-355.
- Mascarenhas, M.R., et al (2008) Outpatient Nutrition Management of the Neurologically Impaired Child. *Nutrition in Clinical Practice*, 23 (6) 597-607.
- Parrish, C.R. (2003) Enteral Feeding: The Art and the Science. *Nutrition in Clinical Practice*, 18 (2), 76-85.