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ABSTRACT

Nutrition is well-recognized as a necessary component of educational programs for physicians. This is to be valued in that of all factors affecting health in the United States, none is more important than nutrition. This can be argued from various perspectives, including health promotion, disease prevention, and therapeutic management. In all cases, serious consideration of nutrition related issues in the practice is seen to be one means to achieve cost-effective medical care. These modules were designed to provide more practical knowledge for health care providers, and in particular primary care physicians. This module is designed to present a variety of modes of nutritional intervention that can be used to forestall or correct the progressive stages of nutritional deterioration frequently seen in patients with chronic illness. Also, a longitudinal model of nutritional intervention is presented to help the physician choose the best form of dietary intervention for typical longitudinal-care patients. Highlighted is the nutritional care of cancer patients. Included are learning goals and objectives, self-checks of achievement with regard to goals, references for the physician and for the physician to give to the patient, and a list of laboratory signs of nutritional deficiency helpful in determining nutriture. (CW)

15 Nutritional Care of Deteriorating Patients

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Nutrition in Primary Care

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The Nutrition in Primary Care Series Contains These Modules:

1. Nutrient Content of Foods, Nutritional Supplements, and Food Fallacies
2. Appraisal of Nutritional Status
3. Nutrient and Drug Interactions
4. Normal Diet: Age of Dependency
5. Normal Diet: Age of Parental Control
6. Normal Diet: Adolescence
7. Normal Diet: Pregnancy and Lactation
8. Normal Diet: Geriatrics
9. Dietary Management in Obesity
10. Dietary Management in Diabetes Mellitus
11. Dietary Management in Hypertension
12. Dietary Management in Hyperlipidemia
13. Dietary Management in Gastrointestinal Diseases
14. Dietary Management for Alcoholic Patients
15. Nutritional Care of Deteriorating Patients
16. An Office Strategy for Nutrition-Related Patient Education and Compliance

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15 Nutritional Care of Deteriorating Patients

Nutrition in Primary Care

Tables

Introduction

The chronically ill patient is a prime candidate for malnutrition. Therefore, you must be constantly aware of the chronically ill patient's nutritional well-being and keenly alert to the early signs of nutritional failure. In addition, you must be knowledgeable of modes of dietary intervention which can help preclude the development of malnutrition or, if necessary, correct its presence.

Malnutrition, or cachexia, is characterized by anorexia, loss of total body weight, lean body mass, and adipose tissue. Other characteristics include elevated metabolic rate, altered carbohydrate metabolism, fluid and electrolyte imbalance, and anemia. Malnutrition can occur whether it is due to food deprivation or illness that precludes optimal intake or utilization of foodstuffs. Early dietary treatment of malnutrition is generally less traumatic to the patient than vigorous dietary treatment in correcting malnutrition. Therefore, the purpose of this module is to present a variety of modes of nutritional intervention that can be used to forestall or correct the progressive stages of nutritional deterioration frequently seen in patients with chronic illness. Also, a longitudinal model of nutritional intervention is presented to help you choose the best form of dietary intervention for typical longitudinal-care patients. The nutritional care of the cancer patient provides an excellent model to demonstrate both the preventive and therapeutic aspects of cachexia.

Goals

As a result of this unit of study, you should be able to:

1. *Describe the various modes of nutritional intervention — oral supplements, tube feedings, and total parenteral nutrition -- which are appropriate for care of the chronically ill patient;*

2. *Identify the risks and benefits of each mode;*

3. *Identify the nutrient composition of each mode when given a typical intake; and*

4. *Plan an appropriate nutritional intervention regimen after evaluating the nutritional status and needs of a cancer patient.*

Assessing Nutritional Status

There are a number of ways of detecting divergence from optimal dietary intake. The most obvious clue is loss of body weight and anorexia because the patient cannot, or will not, eat.

Even though the patient may appear "healthy," less obvious clues of malnutrition can be detected biochemically or by anthropometric measures (see Module 2 on appraisal of nutritional status). Sanstead, Carter, and Darby, physicians from Vanderbilt University, have recommended appropriate biochemical tests which are the best indicators of nutritional status (see Appendix A at the end of this module). A clinical dietitian can recommend these biochemical tests when appropriate and accurately assess the anthropometric measures; these tests and measures are invaluable in assessing a patient's nutritional well-being. However, many physicians do not have a fulltime or consulting dietitian and must rely on their own knowledge or more basic techniques to assess a patient's nutritional well-being.

The evaluation of the patient's typical daily intake is the first assessment parameter which is practical for physicians or nurses to perform in the physician's office when a patient complains of anorexia or slow weight loss. Evaluation usually is best done by eliciting a 24 hour recall and then asking the patient to indicate how the recall is different from a typical week's intake. An accurate method of obtaining an overall picture of a patient's dietary habits is taking a diet history of foods typically consumed over a week's period of time; however, it is time consuming and perhaps not feasible for you to accomplish. Suggestions offered in Module 1 on nutrient content of foods will help you elicit diet history information in a reasonable and rapid manner.

It is appropriate to use the Basic Four Food Groups as a guide for assessment of the elicited recall or history. The four groups and number of daily servings recommended for the adult are:

1. Milk group (2 servings).
2. Meat group (2 2-ounce servings).
3. Fruit and vegetable group (2 fruits, 1 a citrus fruit or juice daily, and 2 vegetables, 1 a deep green leafy or yellow vegetable every other day).
4. Bread/grain group (4 servings).

Questions to which you should seek answers when properly assessing your patient's dietary status include:

- How many times a week are milk, meats, fruits and vegetables, and breads and cereals consumed by the patient?
- Does the patient have difficulty planning a well-balanced diet? If so, how and why?
- Does the patient have difficulty purchasing a well-balanced diet?
- Does the patient live alone? Are finances or transportation a problem in obtaining food?
- Does the patient have chronic diarrhea or constipation?
- Does the patient find that food does not taste good? Has the patient's appetite changed recently?

Other questions you may want to ask yourself include:

- Is the patient elderly and functioning independently?
- Does the patient have a satisfying amount of socialization?
- Has the patient suffered a recent major illness? Is anyone else in the family seriously ill?
- Is the patient about to undergo major medical treatment or surgery?
- Is the patient receiving radiation therapy, chemotherapy, or any medications that could cause nausea, vomiting, malabsorption, or anorexia?
- Has the patient lost weight recently? If so, has it been a rapid or a slow progressive loss?

The answers to these questions can help identify those individuals who may not show overt signs of malnutrition yet who may be high risk candidates for nutritional deterioration. *It is at this point that the development of cachexia may be prevented!*

Modes of Dietary Intervention

If you suspect, based on the results of a 24 hour recall or diet history or answers to the questions posed above, that your patient is nutritionally deprived or is at high risk for nutritional deprivation, you need to select an appropriate mode for dietary intervention which will meet your therapeutic goals and be within the patient's ability to follow.

The three basic modes of dietary intervention which may be combined or used separately include the following:

1. Oral foods with or without nutritional supplementation.
2. Tube feedings through any of a number of available anatomical sites.
3. Total parenteral nutrition or hyperalimentation through either a central venous line or peripheral hyperalimentation line.

Oral Formulas

The most desirable means of treating the patient who is malnourished or suspected to be of high nutritional risk is to "push" oral intake. In other words, if the gut is functioning, use it.

How do you choose the most appropriate mode or modes of therapy?

If meals appear to be inadequate through evaluation of the elicited 24 hour intake or diet history or from answers to questions listed above *and* if the patient's gastrointestinal tract is functioning, it is wise to begin counseling the patient on ways to increase intake through oral foods with or without nutritional supplements.

Suggestions which are helpful to the patient in increasing oral intake, depending on the patient's financial status, include adding between-meal snacks such as fruits, juices, milk, milkshakes, eggnogs, custards, puddings, and sandwiches made of meat or cheese or peanut butter. You may also suggest nutritional supplementation of these snacks by:

- Adding 2 Tablespoons dried skim milk powder to milk, milkshakes, or eggnogs.
- Adding 1 to 2 Tablespoons table sugar to juices, especially sour lemonade, limeade, and grapefruit juices.
- Adding cream to fruit.
- Using double portions of butter, margarine, jelly, jams, or preserves on sandwiches or toast.

To make palatable yet inexpensive additions to the diet of the older, depressed, and poor-eating patient, the following suggestions might be offered:

- Use cooked legumes (pinto beans, navy beans, lima beans, white beans, and cow peas).
- Use enriched macaroni and cheese.
- Use enriched cooked cereal with milk.
- Use powdered fruit juice mixes which are high in vitamin C and need reconstitution with water.
- Increase use of eggs and nonfat dry milk.
- Use peanut butter on enriched or whole grain breads.
- Buy day-old enriched or whole grain breads.
- Buy non-brand-name or lesser known brand-name foods.

When you encourage patients to cook and eat for themselves, they will increase their interest in self-care. This has a positive influence on adherence to other suggested health care measures. It has been the experience of dietitians that it is of therapeutic importance to stress to the patient that he should eat and maintain weight status. Loss of weight results in anorexia; conversely, "the best way to keep the appetite good is to feed it!"

If the patient's intake is inadequate because of chewing and swallowing problems (such as ill-fitting dentures, surgery, or cancer), soft and semiliquid foods may help (puddings, custards, whole milk, milkshakes, eggnogs, juices, mashed potatoes, and puréed foods). Dairy products or other nutritious beverages, especially eggnogs, appear to be most acceptable to the cancer patient who is anorectic due to altered taste sensation. Again, nutritional supplementation as suggested above may be used to increase the protein and energy content of the diet.

Often, the patient is not motivated or is otherwise unable to prepare frequent feedings or special food products. Utilization of the clinical dietitian is especially important in these cases. If delegation to the dietitian is possible, the physician should not lose contact of this aspect of patient care. When delegation is not possible, commercial supplements suitable for oral ingestion should be added to or may completely replace other oral intake if necessary. Commercial supplements are listed in Table 15–1; as noted in the far righthand column, some products contain lactose and might therefore be contraindicated in patients with lactose intolerance or those suspected to be intolerant due to genetic background (Mediterranean, Oriental, black, Asian, and South American populations).

Table 15–1 Nutrient Content of Available Commercial Nutritional Supplement Products*

Product	Company	Kilocalories per Liter	Carbohydrate Grams per Liter	Protein Grams per Liter	Fat Grams per Liter
Sustacal	Mead Johnson & Company 2400 W. Pennsylvania Ave. Evansville, IN 47712	1,000	134	59	12
Ensure	Ross Laboratories 625 Cleveland Ave. Columbus, OH 43215	1,000	144	37	37
Ensure Plus	Ross Laboratories 625 Cleveland Ave. Columbus, OH 43215	1,500	196	54	54
Meritene (liquid)	Doyle Pharmaceutical Company Hwy. 100 & W. 23rd St. Minneapolis, MN 55416	1,000	115	60	33
Vital	Ross Laboratories 625 Cleveland Ave. Columbus, OH 43215	1,000	183	42	10
Polycose	Ross Laboratories 625 Cleveland Ave. Columbus, OH 43215	2,000	500	--	--

		Kilocalories per 6 oz of Water	Carbohydrate Grams per 6 oz of Water	Protein Grams per 6 oz of Water	Fat Grams per 6 oz of water
Citrotein	Doyle Pharmaceutical Company Hwy. 100 & W. 23rd St. Minneapolis, MN 55416	125	23.3	7.67	Trace

* Requires that 1.5 to 2 liters are consumed daily to meet the Recommended Dietary Allowances (RDA) for the adult.

Approx 1980 cost per 1,000 kilocalories	Other Comments
$3.40	Nutritionally complete.*
$1.70	Nutritionally complete.* No lactose.
$2.00	Nutritionally complete.* No lactose.
$2.00	Nutritionally complete.*
$6.10	Hydrolyzed protein product. Nutritionally complete.*
$3.40	Glucose polymers. Caloric supplement useful with fruits, juices. Not nutritionally complete.

Cost per Serving	
$ .50	One serving equals one packet in 6 ounces water. Supplement to be added to water or orange juice, slushes, carbonated beverages. Not nutritionally complete.

Products listed in Table 15–1 are available at most pharmacies and some supermarkets. A detail person representing a pharmaceutical manufacturer also can request that a store convenient to the patient carry the products. Most products can be delivered to the pharmacy or supermarket within 24 to 48 hours of request. Recipes utilizing these products are available on request from the companies; addresses are given in the Resources for the Patient section at the back of this module.

Tube Feeding Formulas

If the gut is functioning but oral intake is compromised, tube feedings may be the most feasible means of dietary intervention.

The patient may come to you already cachectic so that his nutritional status cannot be improved by oral intake alone. Oral lesions, strictures of the esophagus or pylorus of the stomach, dysphagia, or stroke may prevent intake of sufficient nutrition by mouth. A nasogastric tube or gastrostomy tube may be necessary for feeding patients with these limitations. These tube feedings allow use of the remaining functional gastrointestinal tract for digestion and absorption. Homemade or commercial formulas can provide the essential nutrients with a consistency suitable to pass through a tube. A list of nutritionally complete tube feeding products which require a functioning gastrointestinal tract for digestion and absorption is included in Table 15–2.

Tube feedings prepared at home may be less expensive than commercial products. The patient using home-prepared feedings may choose to use a tube-feeding solution made from recipes such as the one given in Table 15–2 or may choose to use regular table food by blenderizing each item separately and forcing the blendered food through the tube into the gastrointestinal tract by using a feeding syringe. Homemade products should be strained before being placed into the tube so that the tube will not become clogged; foods with seeds, nuts, whole grains and hulls, fresh fruits, and fresh vegetables must be avoided for this same reason. All homemade products and opened commercial products must be kept refrigerated and, if not used, discarded after 24 hours.

Unopened cans of commercial products *do not* need to be refrigerated, nor do commercial products need to be strained before they are placed into the feeding tube.

Tube Feeding Patient Work-up

Peristalsis of the gastrointestinal tract must be present prior to tube feeding administration. Assessment of gastrointestinal function should include auscultation of bowel sounds, observation of abdominal distention, and questioning the patient to ascertain recent bowel movements (constipation or diarrhea) and flatulence.

The patient should be sitting upright for both tube insertion and for feeding. He should be told to warm the feeding to room temperature if it has been refrigerated. The patient should also be instructed to insert the feeding syringe into the tube and elevate it 3 to 6 inches above the head. Any higher may cause too rapid gravity flow of water or formula into the gastrointestinal tract. One-fourth cup of water should be run through the tube before feeding to be sure that the tube is not plugged.

Tube Feeding Regimen

Tube feeding composition, volume, and rate of administration are based on the length of time the gastrointestinal tract has been at rest and the location of the indwelling tube.

The time interval since the last ingestion of food and the location of the indwelling tube should be considered when choosing the type of formula, its volume, and the method of administration. For patients in whom the gastrointestinal tract has been at rest for more than three days, the initial tube feeding of isotonic formula, such as Osmolite or Isocal diluted to ½ kilocalorie per milliliter, should be instituted at approximately 240 milliliters given over a four-hour period of time (60 milliliters per hour) followed by 120 milliliters of water. If the feeding is well tolerated, the volume or concentration, but not both, should be increased beginning an hour later. For this next feeding, ¾ kilocalorie per milliliter may be given at 60 milliliters per hour for the next 2 four-hour shifts, each followed by 120 milliliters of water. Full strength, 1 kilocalorie per milliliter, may be attempted 24 hours after institution of the tube feeding if no signs of patient intolerance occur. Use of full strength formulas which are higher in osmolality than isotonic formulas are advised as the next step. Volume should then be increased first up to 75 milliliters per hour for four hours and then be given at the rate of 100 milliliters per hour, which, if given by continuous drip, would equal 2,400 kilocalories per 24 hours.

Beginning a tube feeding at the standard 1 kilocalorie per milliliter is usually safe for patients in whom the gastrointestinal tract has been at rest less than three days. A wise progression would be to begin the standard formula by administering 240 milliliters over a two-hour period (120 milliliters per hour), followed by 120 milliliters of water, wait one hour, and then institute continuous or bolus feedings equaling 120 milliliters per hour which would result in a potential intake of 2,880 kilocalories.

Tube Feeding Administration Methods

Tube feedings can be administered either by continuous drip method or by the patient-administered piston syringe method.

Continuous drip and piston syringe bolus administration are the two major types of tube feeding administration. With the continuous drip method, administration of the formula is accomplished over a calculated time period. Continuous drip is used preferably to initiate and progress tube feedings until the patient can assume administration via a piston syringe. Advantages of continuous drip feeding include increased consumption of kilocalories over a 24 hour period, administration of formula without waking the patient, and minimized symptoms of intolerance. Piston syringe feeding, on the other hand, is a bolus administration of formula over a short period of time and is best given over a 15 to 30 minute minimum period. It is used for patient-administered tube feedings and administration of medication via an indwelling tube. It also allows for increased mobilization of the patient.

When a patient is receiving bolus tube feedings, water must be supplied in sufficient amounts to

Table 15–2 Nutrient Content of Commercially Available Tube Feedings and Homemade Formula Recipe Appropriate for Functional Gut Use

Product	Company	Kilocalories per Liter	Carbohydrate Grams per Liter	Protein Grams per Liter	Fat Grams per Liter	Approx 1980 cost per 1,000 kilocalories	Comments
Compleat-B	Doyle Pharmaceutical Company Hwy. 100 & W. 23rd Ave. Minneapolis, MN 55416	990	120	40	40	$3.40	Nutritionally complete* Contains beef and nonfat milk, corn oil, sucrose, vegetables, fruits and juices. Moderate residue.
Formula-2	Cutter Laboratories, Inc. 4th and Parker Sts. Berkeley, CA 94710	1,000	121	38	40	$3.00	Nutritionally complete*. Contains nonfat milk, beef, corn oil, egg yolks, sucrose, vegetables, juice, farina. Moderate residue.
Carnation Instant Breakfast	Carnation Company 5045 Wilshire Blvd. Los Angeles, CA 90036	1,120	140	60	32	$1.25	Nutritionally complete.* Contains nonfat milk, soy protein sucrose, corn syrup solids. Low residue. Figures include 32 oz milk.
Meritene Liquid	Doyle Pharmaceutical Company Hwy. 100 & W. 23rd Ave. Minneapolis, MN 55416	1,000	115	60	33	$2.00	Nutritionally complete.* Contains skim milk, vegetable oil, sucrose, corn syrup solids. Low residue.
Nutri-1000	Cutter Laboratories, Inc. 4th and Parker Sts. Berkeley, CA 94710	1,000	94.5	37.8	52	$1.81	Nutritionally complete.* Contains skim milk, corn oil, sucrose, corn syrup solids. Low residue.
Sustacal Liquid	Mead Johnson & Company 2400 W. Pennsylvania St. Evansville, IN 47712	1,000	134	59	12	$2.75	Nutritionally complete.* Contains casein, corn syrup solids, soy protein, soy oil, sucrose. Low residue. Now lactose-free.
Ensure	Ross Laboratories 625 Cleveland Avenue Columbus, OH 43215	1,000	144	37	37	$1.70	Nutritionally complete.* Contains no lactose, contains casein, soy protein, corn oil, corn syrup solids, sucrose. Low residue
Ensure Plus	Ross Laboratories 625 Cleveland Avenue Columbus, OH 43215	1,500	196	54	54	$2.00	Nutritionally complete*. Contains casein, soy protein, corn oil, corn syrup solids, sucrose. Low residue. Contains no lactose.
Isocal	Mead Johnson & Company 2400 W. Pennsylvania St. Evansville, IN 47712	1,000	132	34	44	$2.65	Nutritionally complete.* Contains no lactose. Contains casein, soy protein, soy oil, MCT, corn syrup solids. Is isotonic with blood plasma.
Osmolite	Ross Laboratories 625 Cleveland Avenue Columbus, OH 43215	1.000	144	37	37	$3.00	Nutritionally complete.* Contains no lactose. Contains corn syrup solids, casein, MCT, corn oil. soy protein, soy oil. Isotonic solution, 300 mOsm/kg. water. Low electrolytes and residue.
Sample Homemade Formula Evaporated milk - 2 1/2 cups Sugar - 50 gm Pureed liver - 1 jar (baby jar) Dried skim milk powder - 2 tablespoons Whole eggs - 1 jar Pureed vegetables - 1 jar (baby jar) Water - 1/2 cup Multiple vitamin concentrate - 0.6 cc		1,065	70	62	60	$1.00	Nutritionally complete.* Contains lactose and moderate residue.

* Requires that 1 5 to 2 liters are consumed daily to meet the Recommended Dietary Allowances (RDA) for the adult

keep the patient optimally hydrated and to ensure a clear tube prior to and after each feeding. A general rule of thumb when calculating how much fluid to supply is to give half as much water per feeding as the number of kilocalories in the feeding.

For example:

- For 100 milliliters tube feeding containing 100 kilocalories, give 50 milliliters water.
- For 200 milliliters tube feeding containing 100 kilocalories, give 50 milliliters water.

The patient receiving bolus feedings may keep the tube in at all times or, if he desires, may insert prior to each feeding and withdraw following the feeding. *Tube Feeding: Tips and Techniques* (see the Resources for the Physician section at the back of this module) is an excellent reference for teaching the patient how to insert and care for tubes.

Tube Feeding Monitoring and Problems

The purpose in providing the tube feeding initially at a slow rate is to avoid sudden distention and subsequent emptying of the stomach, which causes nausea, vomiting, cramps, and diarrhea.

Table 15–3 Nutrient Composition of Commercially Available Elemental Diets

Product	Company	Kilo calories per Liter	Carbohydrate Grams per Liter	Protein Grams per Liter	Fat Grams per Liter	Milliosmoles per Liter
Vivonex	Eaton Laboratories 17 Eaton Avenue Norwich, NY 13815	1,000	287	21	2	820–2,100*
Vivonex HN	Eaton Laboratories 17 Eaton Avenue Norwich, NY 13815	1,000	202	46	1	800–2,100*
Flexical	Mead Johnson and Company 2400 W. Pennsylvania St. Evansville, IN 47712	1,000	155	22	31	835
Vital	Ross Laboratories 625 Cleveland Avenue Columbus, Ohio 43215	1,000	183	42	10	450
Vipep	Cutter Laboratories 4th and Parker Sts. Berkeley, CA 94710	1,000	175	25	25	520
Precision	Doyle Pharmaceutical Company Hwy. 100 and W. 23rd St. Minneapolis, MN 55416	1,000	215	21	0.7	600

*Flavor packets add considerably to osmolality.

"Dumping" and diarrhea are frequent complaints of the tube-fed patient. Dumping occurs with the too rapid arrival of a hypertonic solution into the jejunum. The hypertonic fluid in the bowel causes movement of extracellular fluid from the plasma to the bowel lumen to achieve isotonicity, which in turn decreases circulating plasma volume and results in compensatory vasoconstriction. Symptoms include nausea, vomiting, epigastric fullness, pain, sweating, warmth, vertigo, fainting, and diarrhea.

You may advise the patient to slow down the feeding, dilute the formula temporarily until the symptoms subside, or ideally, administer an isotonic tube feeding in which osmolality equals normal body fluids. The patient who complains of diarrhea for other reasons may be advised to add bulk-forming foods to the feeding such as pectin (1 Tablespoon per liter), methylcellulose (3 grams per liter), applesauce (2 Tablespoons per liter), or bananas. Drugs that may be helpful include Lomotil, Paregoric, or Kaopectate.

Constipation may be a complication in tube-fed patients. Causes of constipation may include dehydration, low-residue tube feedings, or gastrointestinal obstruction. Treatment may include administration of an enema or cathartic, increased fruit or vegetable content of the tube feeding, increased water intake, or when appropriate, surgical intervention to relieve the obstruction.

You need to continually monitor the state of hydration of the patient, and check fluid intake and output, and serum osmolality. You should also monitor blood glucose levels, and daily note the presence of diarrhea or constipation.

Patients receiving tube feedings are often depressed by the change this type of feeding brings, especially if it must be a lifelong daily process. Much support, teaching, and reinforcement must be given to the patient and his family. It is desirable to have the patient and/or family become self-sufficient in tube feeding administration as soon as the patient is ready.

Approximate 1980 retail cost per 1,000 kilocalories (liter)	Composition
$6.40	Amino acids, simple sugars, vitamins, minerals.
	Amino acids, simple sugars, vitamins, minerals.
$6.50	Hydrolyzed protein, amino acids, simple sugars, soy and medium-chain triglycerides, vitamins, minerals.
$6.10	Hydrolyzed protein, amino acids, simple sugars, sunflower oil, vitamins, minerals.
$3.96	Hydrolyzed protein, amino acids, simple sugars, medium-chain triglycerides.
$6.80	Egg albumin, simple sugars, vitamins, minerals.

Elemental Formulas

Elemental diets for use in jejunostomy tube feedings are used when the stomach is unavailable. These formulas are high in amino acids, simple sugars, and other nutrients.

If the stomach is unavailable for mixing, several alternatives exist for treating the patient. Jejunostomy tube feedings are frequently used; the formula should be introduced past the site of entry of the common bile duct to avoid reflux, but this limits the mixing of the formula with pancreatic enzymes and bile.

Although costly, elemental formulas appropriate for jejunostomy tube feedings have been developed. They are nutritionally complete formulas which need little or no digestion, contain readily

absorbable nutrients, and are low in residue. The formulas contain amino acids or hydrolyzed protein composed of amino acids and some di- and tri-peptides, simple sugars except lactose, medium-chain triglycerides or vegetable oils, vitamins, and minerals. Table 15–3 contains the nutrient composition of several commercially available elemental formulas, or "defined formula diets" as they are often called.

The elemental diets that are composed of free amino acids generally have an unacceptable flavor. The products are more palatable if mixed with juices and served with ice or as a slush. Some products have accompanying flavor packets, and thus, increased acceptability, yet double the osmolality. Products composed of hydrolyzed protein contain di- and tri-peptides and are more acceptable to the patient than products composed of free amino acids; there is evidence that these peptides are readily absorbable despite lack of pancreatic enzymes. Because of their high free amino acid content and, therefore, fast release into the intestine from the stomach, sipping the elemental diets decreases the incidence of diarrhea, dumping, dehydration, and glucose intolerance. Uses of the elemental diet include patients with limited digestive function, preoperative catabolism, post-operative catabolism, and for correction of negative nitrogen balance with trauma, burns or sepsis, or whenever anabolism is desired.

Total Parenteral Nutrition Solutions

If the patient is severely malnourished and bypassing a malfunctioning alimentary tract is desirable, total parenteral nutrition is an alternative mode of nutritional intervention. Parenteral nutrition can provide the nutrients necessary to maintain positive nitrogen balance and achieve weight stability or gain in adults and normal growth and development in infants and children even under catabolic conditions. Current clinical indications for parenteral nutrition are numerous and basically are for support and management of patients who cannot or will not eat, who should not eat, or who cannot eat enough.

If the patient is severely malnourished and if oral or tube feedings are not enough to promote weight gain and improvement of other parameters of nutritional status, feeding by the parenteral route may be required. Total parenteral nutrition (TPN) is a means of providing nutrients intravenously, the patient must be hospitalized to institute TPN.

It is well-established that the chronic or seriously ill patient may require up to twice the caloric needs of healthy persons. Pending further study, appropriate parenteral nutrition should provide an energy-nitrogen ratio of 150 kilocalories per gram nitrogen. The two most important sources of energy for TPN solutions are carbohydrates and fats. Usually a 25% or 35% dextrose solution is used in TPN. A minimum of 100 grams of carbohydrate per day has been shown to prevent ketosis and decrease protein catabolism. At present, no carbohydrate source has been found to be more effective than glucose. Because hyperosmolar glucose solutions are used in TPN, they must be given in a central vein. Problems associated with hyperosmolar glucose solutions are discussed later in this module.

Due to the difficulty in infusing the required amount of energy in the form of carbohydrate, intravenous fat emulsions in combinations with not less than 20% of the kilocalories from carbohydrate have been shown to be advantageous. The great advantage of fat emulsions is that a large amount of energy (9 kilocalories per gram of fat) in an isotonic solution, which therefore has little effect on blood osmolality, can be given in a small amount of fluid through the peripheral vein. Use of fat emulsions has been shown to decrease some of the problems associated with high glucose administration. Decreased thrombophlebitis, decreased diuresis of nutrients, and prevention of essential fatty acid deficiency have been shown to occur with fat emulsion administration. Contraindications for the use of fat emulsions include hyperlipidemia, advanced hepatic injury, blood coagulation disturbances, and allergies. Intralipid (a 10% soybean oil emulsion with egg yolk, phospholipids, and glycerol) or Liposin (a safflower oil emulsion) are the major fat sources used in the US.

Sources of nitrogen available for TPN solutions include protein hydrolysates and mixtures of crys-

talline amino acids usually administered as 4.25% solutions. Because the requirements for amino acids depend on various metabolic and physiologic conditions, amino acid requirements increase as protein catabolism increases. Table 15–4 shows the amount of amino acids which are recommended for TPN administration:

Table 15–4 Recommended Amino Acid Intake for Patients Requiring TPN

Condition	Amount Amino Acids
	Grams/Kilograms Body Weight/Day
Renal insufficiency	0.4–0.6
Adults	0.8–1.6
Infants, pregnant women, and post-operative patients	2.0–3.0
Premature, hypotrophic and post-operative neonates	2.0–4.0

For optimal utilization of the amino acids given parenterally, energy requirements must be met by simultaneous infusion of non-protein energy sources. Recent research has indicated that the nitrogen-sparing effect of glucose is better than that of fat.

Table 15–5 includes several nutritional products frequently used in TPN solutions and a typical standard order for vitamin and mineral supplements. Remember that seriously ill patients requiring TPN may need amounts of vitamins and minerals greater than the levels suggested in Table 15–5 for the following reasons:

1. To reverse prior depletion.
2. To meet increased metabolic demands associated with fever, infection, stress.
3. To support needs associated with anabolic processes.
4. To compensate for excessive urinary losses secondary to TPN.

In order to assess the effectiveness of the vitamin and mineral content of TPN solutions, careful monitoring of blood levels and urinary loss is essential. Table 15–6 lists several blood, urine, and other parameters which should be closely monitored in TPN patients and also suggests the frequency of monitoring. An excellent reference for how to monitor patients on TPN is *Insights into Parenteral Nutrition* (see Resources for the Physician for this free booklet).

When initiating TPN it is best to begin with a 10% glucose solution and a 4.25% amino acid solution supplemented with vitamins and minerals, as shown in Table 15–5. Progression to 35% glucose and 4.25% amino acids can be started a few hours later. *When discontinuance of the TPN solution is warranted, do not abruptly stop solution administration; the decrease in solution administration should be tapered over three to four hours to allow for a decrease in insulin levels and therefore avoidance of a hypoglycemic episode.* If Intralipid fat emulsion is to be instituted, a peripheral line or T-tube with the central venous line, may be established; administration of Intralipid, or Liposin, 500 milliliters every other day or three times weekly greatly helps to supply adequate kilocalories. Signs of essential fatty acid deficiency (skin lesions and altered triene-tetraene fatty acid ratio) can be seen within two weeks on TPN without fat administration; essential fatty acid deficiency is quickly reversed with Intralipid administration. Deficiencies of fat-soluble vitamins, water-soluble vitamins, and major minerals should not be seen if adequate amounts of these nutrients are included in formulas. Deficiencies of trace elements, copper, magnesium, chromium, and iodine, have recently been identified. Trace elements must be an integral component of TPN, especially when TPN is administered on a long-term basis.

Nutritional and metabolic complications with TPN do occur. The most common complication associated with glucose stems from the body's inability to utilize high concentrations of glucose. Hyperosmolar non-ketotic hyperglycemia and coma can arise with surprising suddenness. Fever, osmotic diuresis, and blood sugars greater than 700 milligrams/100 milliliters are not uncommon. These patients must be treated with large amounts of intravenous insulin and all glucose-containing infusions stopped. Severe hypoglycemia may result secondary to the slowing of the infusion because of mechanical problems or because of excessive insulin infusion.

Table 15–5 Nutrient Composition for Products Used in Total Parenteral Nutrition Solutions

Product	Company	Amount	Kilo-calories per Liter	Carbohydrate Grams/ Liter	Amino Acid Grams/ Liter	Protein Grams/ Liter	Fat Grams/ Liter
Freamine II	McGaw	1 liter	312	0	78	78	0
Travasol (8.5%)	Travenol	1 liter	352	0	84	88	0
Glucose (25%)		1 liter	1,000	250	0	0	0
Intralipid (10%)	Cutter	500 ml= 50 ml fat	450	0	0	50	0
Multi-vitamin, Multi-mineral, and Trace elements Supplement (added to TPN solutions)		5 ml		0	0	0	0

Comments	Standard Order
Electrolytes, vitamins, and minerals must be added	Na 60 mEq/L K 40 mEq/L Ca 18 mEq/L PO_4 20 mEq/L Acetate 25 mEq/L
Available with and without electrolytes; vitamins and minerals must be added	With electrolytes, add Na 70 mEq/L Mg 10 mEq/L Acetate 100 mEq/L PO_4 60 mEq/L Cl 70 mEq/L
	Vitamin A 10,000 IU Vitamin D 1,000 IU Vitamin E 5 IU Thiamine 50 mg Riboflavin 10 mg Niacin 100 mg B_6 15 mg Pantothenic Acid 25 mg Ascorbic acid 500 mg Also trace elements, especially copper, zinc, chromium, and Manganese

Amino acid imbalances may also occur with TPN administration. Hyperchloremic metabolic acidosis may result from excessive chloride and monohydrochloride content of crystalline amino acids. Treatment includes administration of bicarbonate, lactate, or acetate. Hyperammonemia may also occur especially in premature infants, in patients with hepatic disease, or as a result of too much ammonia in protein hydrolysates or too little amino acids essential for urea cycle functioning in crystalline amino acid solutions.

With regard to vitamin and mineral aberrations, hypocalcemia and hypophosphatemia may result from inadequate calcium and phosphorus administration, respectively. Excessive calcium administration with or without vitamin D may result in hypercalcemia. Other vitamin and mineral complications may include hypo- or hyperkalemia, hypo- or hypermagnesemia, anemia, and hypervitaminosis A.

Because of the costs of TPN and risks of sepsis with use of a central venous catheter, this mode of nutrition intervention should be used with caution. Home TPN is available for patients who can afford it and can administer it properly. Use at home has its obvious advantages for the patient who must improve nutritional status before or after surgery. It may also be necessary for those for whom TPN is their only means of nutritional support.

Care Study

The cancer patient provides an excellent model of the deteriorating patient whose ability to consume and utilize adequate nutrients is compromised. Early in cancer therapy, the physician should encourage food consumption, especially of well-tolerated foods such as eggs and dairy products.

Mr. A.H., a 50-year-old man, was initially seen one year ago by his physician and diagnosed to have cancer of the mouth. His height was 5 feet 11 inches and weight, 190 pounds. At this time he reported some difficulty chewing and swallowing but unfortunately no diet instructions were given at that time. Radiation therapy was ordered.

Table 15–6 Recommended Monitoring for TPN Patients*

Parameter	Frequency of Monitoring
Urinary glucose	Every 6 hours
Urine specific gravity	Every 6 hours
Vital signs	Daily (with temperature 4 times per day)
Weight	Daily
Nitrogen balance (strict intake and output measurements)	Daily
BUN	Daily
Calcium, phosphorus, magnesium	Weekly
Prothrombin time	Weekly
Blood ammonia	Weekly
Serum protein	Daily until stable; then 2-3 times weekly
Serum glucose	Daily until stable; then twice weekly
Serum electrolytes	Daily until stable; then twice weekly
Hemoglobin, WBC and platelet count	Twice a week

*Insights into Parenteral Nutrition, © 1977 Used with permission of Travenol Laboratories, Inc , Deerfield, IL

(Comment: At this time it would have been wise for the physician to refer the patient to a registered clinical dietitian or to counsel the patient himself on the need to avoid any weight loss. Even though the patient was having difficulty chewing and swallowing, he should have been instructed to include between-meal supplements such as eggnogs, custards, gelatin products, ice cream, milkshakes, and others and to use supplemental products such as those listed in Table 15–1 to add kilocalories to his present diet. *The goal for the patient should have been weight maintenance!)*

After six months the patient returned to his physician. Biochemical parameters were essentially normal. His weight was 175 pounds which was 100% of ideal body weight (IBW). Ideal body weight for the adult male can be estimated as 106 pounds for the first 5 feet in height plus 6 pounds for each additional inch over 5 feet. Therefore, 106 pounds plus 11 inches times 6 pounds per inch, or 66 pounds, equals a total of 172 pounds approximate ideal body weight for Mr. A.H. The 15 pound weight loss in six months represented an 8% loss of initial body weight. At this visit Mr. A.H. reported some typical eating-related problems associated with cancer. Typical of cancer patients, Mr. A.H. reported nausea at the odor and sight of food, vomiting, increased difficulty in chewing food, and anorexia. Also, food did not "taste right" — a frequent expression of cancer patients. Radiation of the oropharyngeal area often causes destruction of the taste buds, altering the taste thresholds for bitter, sweet, sour, and salt leading to "mouth blindness." Patients frequently state that meats, especially beef and pork, have a bitter taste. A good way to get protein into these patients is to recommend consumption of milk and eggs either alone or in combination dishes since these foods appear to be well-tolerated. Other effects of radiation therapy to the oropharyngeal area include poor dentition, mucositis, oral ulcers, stomatitis, and esophagitis.

Knowing that the intestinal tract of Mr. A.H. was intact, the physician suggested the patient try smaller, more frequent feedings. Cold, high calorie, nutritious beverages such as those included in Tables 15–1 and 15–2 were encouraged since they seem to be acceptable to most cancer patients. Cancer patients frequently report increased tolerance for cold beverages and foods, stating they do not have the odor that warm-hot foods have and therefore are less anorexigenic. Highly sweet foods frequently appear to be unacceptable to cancer patients although this effect tends to vary both with the patient and the extent of the disease. The more progressed the disease, the greater the taste

abnormalities. If the patient reports no aversion to sweets, products such as Polycose and regular sugars added to juices, fruits, desserts, and other foods should be suggested. If the patient says that foods have no taste, encourage him to experiment by adding spices for the purpose of increasing the flavor of foods.

The patient was seen again in three months. Weight had further decreased to 140 pounds, and the patient had lost 25% of his original body weight, he was assessed to be critically malnourished. Mr. A.H. reported further loss of appetite and was obviously frustrated with his increasingly apparent deterioration. At this visit, it was noted that the tumor had increased in size so that the patient could not chew and swallow without great difficulty. The physician decided that surgery was indicated. Because of the patient's loss of weight, adipose tissue, and lean body mass, and the appearance of edema due to a low serum albumin and oncotic pressure, the physician decided that vigorous dietary therapy was in order to make the patient a better surgical risk.

If you were the physician, what would be the most logical choice of nutritional intervention at this point for this hospitalized patient? The easiest for the patient is a nasogastric tube feeding using a commercial product. Because the gut has been used within the past three days, you should order full-strength formula at a caloric density of 1 kilocalorie per milliliter (see Table 15–2). The patient's basal energy needs plus an elevated metabolic rate with the catabolic cancer state indicate high kilocalorie requirements. As a rule of thumb, you should strive for 50 kilocalories per kilogram body weight per day or a minimum of 2,500 kilocalories per day. Normal kilocalorie needs of an adult male with moderate exercise and without disease would be approximately 30 kilocalories per kilogram per day. If you order a continuous tube feeding regimen of 350 milliliters every two hours at a standard concentration of 1 kilocalorie per milliliter from 8:00 a.m. through midnight, will this meet the energy needs of Mr. A.H.? Yes, hopefully! Calculating the caloric content of this feeding regimen, you find that it provides 2,800 kilocalories in 2,800 milliliters (350 milliliters times 8 feedings times 1 kilocalorie per milliliter equals 2,800 kilocalories).

More appropriate for this cancer patient is an intake of 50 kilocalories per kilogram body weight (50 kilocalories per kilogram at 64 kilograms equals 3,200 kilocalories) which would require approximately 3.5 liters of formula per day! If 300 to 350 milliliters every two hours were given continuously around the clock at 1 kilocalorie per milliliter, this would be an appropriate diet request and would supply 3,600 to 4,200 kilocalories per day.

If this amount of tube feeding is not possible or if the patient can take oral supplements in addition to the tube feeding, a combination of feeding techniques may be acceptable. Table 15–7 lists a combination of modes of nutrition intervention.

Use of additional glucose (5% to 10%) by peripheral route can supplement the above nutritional support plan but, in some patients, may become an appetite depressant and negate any improvement in oral intake. TPN may be appropriate for Mr. A.H. since he is debilitated and has received preoperative radiation therapy.

After the patient has the tumor removed, he will need postoperative nutritional rehabilitation. The surgical patient has specific nutritional needs which are determined in part by changes in hormone balance as a result of the stress of surgery. Energy and protein needs are high; at least 40 to 50 kilocalories per kilogram body weight per day and 2.5 grams protein per kilogram body weight per day are recommended. These will need to be adjusted according to future changes in nutritional status. Nitrogen balance is usually negative following surgery secondary to hormonal involvement and despite the high intake of calories and protein. Increased fluid needs accompany increased energy and protein in the diet. TPN may again be recommended immediately postoperatively since this patient will not be able to resume oral intake soon enough to preserve body cell mass and promote wound healing. Tube feedings may be reinstated to assist in nutritional repletion.

Since Mr. A.H. has a partial glossectomy and hemimandibulectomy, he will have to learn to eat once again. What are the best foods to offer this patient initially? You might think that liquids are the best choice but that is not so! Foods of a thicker consistency seem to be easier for the patient to manipulate as he learns to eat. Semisolids such as mashed potatoes, puddings, custards, and finely ground meats should be suggested. Patients may be able to take liquids by using a straw.

Table 15–7 Sample Nutritional Support Regimen Using Combination of Nutrition Intervention Modes

Product	Density	Amount	Kilocalories	Protein Grams per Total Volume
Ensure	Full strength	2,400 milliliters	2,400	88
Freamine II	4.25%	1 liter	---	43
	25%	---	1,000 non-protein kilocalories	---
Intralipid	10%	500 milliliters	450	---
TOTAL			3,850	131

It is your responsibility to frequently follow up with Mr. A.H. and encourage him to resume as much of his usual lifestyle as possible; by doing so, it may be that the patient will learn to eat most foods again. Keep in mind that a glossectomy affects taste and salivary function. It may be that tube feedings will be the only means of nutritional support for Mr. A.H. If so, you must make sure that the formula is nutritionally adequate, is fed at a rate to maximize nutrient absorption, and is pleasing in aroma and taste. *Be sure to consult with a registered clinical dietitian, either at your local hospital or public health department. Not only can dietitians help prescribe appropriate dietary intervention but they will also work closely with the patient through all phases of health care and rehabilitation.*

Summary

The indication for the various modes of nutrition intervention are numerous as are the nutritional support regimens for the chronically ill patient. The patient who appears healthy may in fact have anorexia and weight loss. This patient must be treated early since prevention of malnutrition is far easier to achieve than repletion. Remember, too, that any patient who requires special feeding programs may feel depressed. Not only is he ill but he may no longer have full control over one of the basic comforts of life — eating. The dietitian should not be overlooked as a resource person. Dietitians are educated to evaluate the nutritional status of patients and plan and provide sound nutritional care to healthy and ill persons.

Test Your Knowledge

Mrs. P.S. is a 70-year-old woman who has been diagnosed as having cancer of the cervix. She is currently living in a nursing home. Her only son and his wife live nearby. Mrs. P.S. is receiving only social security and is on a limited budget. Her diet prior to admission has been a regular diet She is 5 feet, 3 inches tall and weighs 102 pounds. She has lost 10 pounds within the past three months. She complains of anorexia and has refused to eat on several occasions. She appears anemic, and the nursing home reports that she is weak and apathetic.

Pertinent laboratory data include:

Test	Patient's Values	Normal Values
Hemoglobin	8.4	12.0-16.0 gm/100 ml
Hematocrit	26.7	36.0-47.0 ml/100 ml
RBC count	2.74	4.0-5.6 millions/mm^3
Serum iron	28	56-183 micrograms/100 ml
Total iron binding capacity	250	277-379 micrograms/100 ml
Serum folate	1	6.0 nanograms/ml
Mean corpuscular volume	100	80-94 cubic microns
Total protein	5.8	6.0-8.0 grams/100 ml
Albumin	1.8	4.3-5.6 grams/100 ml
Globulin	2.0	1.3-2.7 grams/100 ml

Mrs. P.S. was ordered to receive a course of radiation and chemotherapy as an outpatient. Her appetite worsened and malabsorption became evident.

1. What is the patient's ideal body weight?

2. What would be her normal (non-disease state) caloric needs?

3. What are her caloric needs secondary to her disease state?

4. Mrs. P.S. has decreased total protein, albumin, and total iron binding capacity secondary to malabsorption, weight loss, and poor kilocalorie and protein intake. What nutrition-related signs can result from depressed serum and tissue protein levels?

5. What dietary protein level would you recommend for Mrs. P.S. knowing she is protein and calorically malnourished?

6. What are the characteristics of cancer cachexia?

7. If the patient is receiving radiation therapy generalized to the gastrointestinal tract, what diet modifications may be appropriate and why?

8. Anorexia, nausea and vomiting, stomatitis, mucositis, malabsorption, and diarrhea are common nutrition-related side effects of chemotherapy. TPN has been shown to decrease the deleterious effects of some chemotherapeutic agents, increase tolerance to chemotherapy, and prolong life. How do you explain Mrs. P.S.'s anorexia?

9. What suggestions can you offer which will attempt to maximize the chances that Mrs. P.S. will receive adequate nutrition while undergoing radiation and chemotherapy?

10. Once the patient has completed radiation and chemotherapy, what means can be employed to maintain or improve nutritional status?

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Resources for the Physician

Defined Formula Diets for Medical Purposes (1977)

American Medical Association
535 North Dearborn St.
Chicago, IL 60610

Handbook of Total Parenteral Nutrition, Grant, J. (1980)

W.B. Saunders
W. Washington Square
Philadelphia, PA 19105

Insights Into Parenteral Nutrition (1977)

Travenol Laboratories, Inc.
1 Baxter Pkwy.
Deerfield, IL 60015

Nutritional Problems in Cancer Patients (1976)

Ross Laboratories
625 Cleveland Ave.
Columbus, OH 43215

"Parenteral and Enteral Nutrition," Fischer, J.: *Disease-A-Month*, 24(9):June, 1978

Tube Feeding: Tips and Techniques (1973)

Eaton Laboratories
17 Eaton Ave.
Norwich, NY 13815

Resources for the Patient

Akers, S.: *A Guide to Good Nutrition During and After Chemotherapy and Radiation* (1976)

Medical Oncology Unit, Dietary Dept.
Fred Hutchinson Cancer Research Center
1124 Columbia St.
Seattle, WA 98104

Nutrition: A Helpful Ally in Cancer

Ross Laboratories
625 Cleveland Ave.
Columbus, OH 43215

For recipes using nutritional products, your physician may contact the local representative of the pharmaceutical manufacturers or you may contact them at the following addresses:

Customer Relations Department
Carnation Company
5045 Wilshire Blvd.
Los Angeles, CA 90036

Customer Relations Department
Cutter Laboratories, Inc.
4th and Parker Sts.
Berkeley, CA 94710

Customer Relations Department
Doyle Pharmaceutic ' Company
Hwy 100 and W. 23rd St.
Minneapolis, MN 55416

Customer Relations Department
Eaton Laboratories
17 Eaton Ave.
Norwich, NY 13815

Customer Relations Department
Mead Johnson & Company
2400 W. Pennsylvania St.
Evansville, IN 47712

Customer Relations Department
Ross Laboratories
625 Cleveland Ave.
Columbus, OH 43215

For patient education materials, the American Cancer Society is an excellent resource:

American Cancer Society
219 E. 42nd St.
New York, NY 10017

Answers

1. The patient's ideal body weight is about 115 pounds, or 52 kilograms. This figure was calculated from the rule of thumb using 100 pounds for the first 5 feet plus 5 pounds for each additional inch over 5 feet.

2. Normal kilocalorie needs for a moderately active, healthy, adult woman are approximately 30 kilocalories per kilogram of body weight per day. At 30 kilocalories per kilogram body weight per day, Mrs. P.S.'s normal caloric needs are 1,400 to 1,500 kilocalories per day.

3. Using the rule of thumb of approximately 50 kilocalories per kilogram body weight per day for combating hypermetabolism associated with disease, the energy needs of Mrs. P.S. are about 2,300 kilocalories or greater per day.

4. Plasma proteins, especially total iron binding capacity, transferrin, and lipid carrying proteins, are highly responsive to improvement in protein nutriture; total protein and albumin will return to normal at a rate slower than fast-turnover proteins. Mrs. P.S. has anemia which should be treated with supplemental iron and adequate protein and kilocalorie intake.

5. Ideally, up to 2.5 grams protein per kilogram of body weight per day is recommended for Mrs. P.S. This will be difficult to meet if supplementation is not employed. Remember that cancer patients have an aversion to proteinaceous foods, but tube feedings and drinking nutritional supplements that are egg- and milk-based are well tolerated in addition to being high in protein and kilocalories.

6. Some characteristics of cancer cachexia include:
   - Anorexia.
   - Taste acuity changes and food aversion.
   - Increased basal metabolic rate.
   - Total body weight loss.
   - Loss of lean body mass.
   - Loss of body fat.
   - Altered carbohydrate metabolism.
   - Fluid and electrolyte imbalances.
   - Anemia.
   - Depression and lethargy.
   - Edema.

7. If the patient can tolerate oral feedings or tube feedings, these are most appropriate. If not, the elemental diet is an appropriate means of dietary treatment if the gastrointestinal tract, due to its sensitivity to radiation, must be kept at rest. A high kilocalorie, high protein, and high bulk diet, if constipation occurs, is necessary. The elemental diet requires minimum digestive function. TPN should be used if oral feedings, tube feedings, and elemental diets are not feasible. Remember the axiom: **If the gut works, use it!**

8. Probable causes of Mrs. P.S.'s anorexia include her depression and apathy, chronic illness, weakness, nausea, and vomiting secondary to radiation and chemotherapy. She also has altered taste sensations and states that food does not taste good.

9. First of all, consult a dietitian! Involve the family in the feeding regimen of the patient whenever possible. Be sure that any supplemental products you order for the patient are available. And stress the hazards of cachexia to the nursing home personnel so that they will be more aware of the need to encourage Mrs. P.S. to eat.

10. Once Mrs. P.S. has completed therapy, encourage frequent oral feedings using nutritious beverages (homemade or commercial). Tube feedings may be used to supplement oral feedings, using elemental diets if necessary. If the gut continues to need rest, continue TPN. A most important point to consider is the psychological effect of both the disease process and the treatment on Mrs. P.S. All health care professionals and the family must work with her providing emotional support and encouragement to eat. Follow-up care is essential.

Appendix A

Laboratory Signs of Nutritional Deficiency Helpful in Determining Nutriture*

Blood and Serum Tests

Red blood cell count and hematocrit
Hemoglobin and hematocrit
Serum iron
Serum iron-binding capacity
Serum albumin
Serum vitamin A
Serum carotene
Serum vitamin E
Serum vitamin C
Serum vitamin B12
Serum folic acid
Alkaline phosphatase

Excretory Tests

Creatinine
Iodide
N-methylnicotinamide
Riboflavin
Thiamin

*Sansoad, H H , Carter, J P , and Darby, W.J.. "How to Diagnose Nutritional Deficiencies " *Nutrition Today* (Summer), 1969, p 26. Used with permission of Nutrition Today, Inc., © 1969, Annapolis, MD.

Some Abbrevations Used in the Nutrition in Primary Care Series

ATP	adenosine triphosphate
c	cup
cc	cubic centimeter
CNS	central nervous system
FDA	Food and Drug Administration
gm	gram
IBW	ideal body weight
IU	International Units
kcal	kilocalorie
kg	kilogram
lb	pound
lg	large
MCV	mean corpuscular volume
MDR	minimum daily requirement
med	medium
mEq	milliequivalent
mg	milligram
MJ	megajoule
ml	milliliter
oz	ounce
RDA	Recommended Dietary Allowances
RE	retinol equivalents
sl	slice
sm	small
Tbsp	Tablespoon
TPN	total parenteral nutrition
tsp	teaspoon
USDA	United States Department of Agriculture