PROTEIN-CONTROLLED DIET FOR ACUTE AND REFRACTORY HEPATIC ENCEPHALOPATHY

Description
Adjustment of the amount and type of protein characterizes the Protein-Controlled Diet for Hepatic Encephalopathy. Energy and protein are provided to attempt maintenance of nitrogen balance and support liver regeneration.

Indications
The diet is used in the treatment of acute and refractory hepatic encephalopathy associated with hepatic disorders, which may include the following:

- hepatitis
- cholestatic liver disease
- cirrohosis with acute and/or chronic encephalopathy

Liver disease causes numerous metabolic problems that can affect all major nutrients and the assessment parameters commonly used to evaluate nutritional status of the patient with hepatic disease. The classic signs of liver disease are anorexia, weight loss, and nausea with marked deficiencies in energy, protein, vitamins, and minerals (1,2). Because of the high risk for malnutrition in persons with hepatic diseases the American Society for Enteral and Parenteral Nutrition (ASPEN) recommends protein restriction be no less than 0.6 to 0.8 g/kg and reserved to those patients during acute or refractory episodes of encephalopathy. Normal protein intake should be resumed of 1 to 1.2 g/kg after the cause of encephalopathy has been identified and treated (3). The widespread practice of protein restriction for all patients with cirrhosis is not justified and often leads to iatrogenic protein malnutrition (3).

Although malnutrition does not correlate with the type of liver disease, therapeutic modifications vary according to the type and severity of hepatic insufficiency. Generally, fatty liver requires little to no nutrition intervention, while cirrhosis necessitates major changes in the patient's food intake. A major goal of medical nutrition therapy in liver disease is to prevent and treat hepatic encephalopathy (1,3).

Hepatic disease can profoundly affect the nutritional status of the patient because of its effects on carbohydrate, fat, protein, vitamin, and mineral metabolism. Metabolic disorders of the following are commonly seen in the clinical setting of patients with hepatic insufficiency:

- Carbohydrates: Adverse effects can include hypoglycemia or hyperglycemia. Hypoglycemia is most frequently seen in acute hepatitis or fulminant liver disease, probably due to impaired gluconeogenesis (1,3). Hyperglycemia is commonly observed secondary to counteracting catabolic hormones and insulin resistance when superimposed by acute stress and injury (1). Soluble fiber may be beneficial in managing hepatic encephalopathy. Soluble fiber is fermented in the colon by the same mechanism as lactulose, which eliminates ammonia in the form of ammonium ion and bacterial proteins (3).
- Fats: Malabsorption may occur because of inadequate production of bile salts. This may lead to steatorrhea, which could lead to deficiencies in fat-soluble vitamin and calcium levels. Researchers have found an increase in serum lipids, reflecting lipolysis (1,3).
- Protein: The effect of hepatic injury on protein metabolism is more dramatic than is carbohydrate or fat metabolism. There is a decrease in synthesis of serum albumin, the transportation of proteins, and the clotting factors (1,3). The ability of the liver to synthesize urea decreases, which results in an accumulation of ammonia and a decrease in serum urea level. This derangement in metabolism elevates the serum aromatic amino acids (AAAs) (phenylalanine, tryptophan, and tyrosine) and methionine and decreases the serum branched-chain amino acids (BCAAs) (valine, isoleucine, and leucine). The only enzymes that metabolize AAAs are located in the hepatocytes. In hepatic insufficiency, there is a decrease in hepatic oxidation of AAAs, leading to an increase in circulation of AAAs in the plasma. In contrast, BCAAs are metabolized primarily by the skeletal muscle. There is an increase in BCAA oxidation in the peripheral tissue during stress, causing a drop in plasma circulation (1).

- Vitamins and minerals: Hepatic injury results in decreased absorption, transport, and storage and may alter the metabolism of vitamins and minerals. Cirrhotic livers have been reported to store decreased levels of thiamine; folate; riboflavin; niacin; pantothenic acid; vitamins B_6, B_{12}, and A; zinc; and cobalt (1,4). In chronic liver disease, the hydroxylation of dietary and endogenous vitamin D to the active form (25-hydroxy derivative) is impaired and may lead to a deficiency state with concomitant osteomalacia. Although there are possibilities of vitamin and mineral deficiencies, supplementation should be administered only when a specific nutrient deficiency is identified. Supplementation should be monitored. Vitamin K deficiency may be induced from malabsorption with steatorrhea, dietary deficiency, impaired hepatic storage, and/or decreased production of gut flora due to intake of antibiotics. If vitamin K deficiency occurs, the rate at which prothrombin is converted to thrombin is affected, thus hampering the coagulation process and producing inadequate clotting factors (1). Intravenous or intramuscular vitamin K often is given for 3 days to rule out hypopothrombinemia due to deficiency (4).

Nutritional Adequacy

Diets containing less than 50 g of protein may be inadequate in thiamin, riboflavin, calcium, niacin, phosphorus, and iron based on the *Statement on Nutritional Adequacy* in Section IA. Supplementation may be indicated but should be assessed on an individual basis. This diet should be considered a transitional diet. Normal protein intake should be resumed soon after the cause of encephalopathy has been identified and treated. Long-term protein restriction should only be considered in patients with refractory encephalopathy (3).

How to Order the Diet

The diet order should specify the grams of protein required from food. Base the grams of protein ordered on the patient's actual weight or use ideal body weight in cases where weight cannot be measured or accurately accessed due to fluid issues (e.g, with ascites). To calculate weight, see Section II (Estimating Energy Expenditures, or Weight for Height Calculation – 5' Rule). If a special formula is requested, the amount should be specified. Specify any restriction such as sodium, fluid, or other nutrients.

Planning the Diet

The table below outlines the recommended nutrient prescription according to type of hepatic disease (3,5,6).

Type of Hepatic Disease	Nutrient Prescription
Fatty liver/steatosis	Abstinence from ethanol Weight reduction, if attributable to obesity Reduced energy and dextrose intake, especially if patient is receiving total parenteral nutrition (PN)
Hepatitis (acute/chronic/alcoholic)	Energy: 30 – 35 kcal/kg Protein: 1 – 1.2 g/kg
Cirrhosis (uncomplicated)	Energy: 30 – 35 kcal/kg Protein: 1 – 1.2 g/kg
Cirrhosis (complicated)	Energy: 30 – 35 kcal/kg Protein: 1 – 1.2 g/kg (with malnutrition)
Esophageal varices	Liberal diet consistency, normal consistency is encouraged as tolerated
Ascites	Sodium restriction: 2 g/day with diuretics Fluid restriction: use clinical judgment Fat-soluble vitamin supplement up to 100% RDA may be necessary in cholestatic cirrhosis (see steatorrhea)
Hepatic encephalopathy	Energy: 35 kcal/kg Protein: 0.6 – 1.2 g/kg. Start at 0.6 g/kg per day and progress to 1 – 1.2 g/kg as tolerated. Do not give products enriched with glutamine. Consider high soluble fiber diet

Type of Hepatic Disease(Cont.)	**Nutrient Prescription**
Hepatic coma	Use tube-feeding Protein: Start at 0.6g/kg per day and progress to 1 – 1.2 g/kg day as tolerated. Do not give products enriched with glutamine.
Steatorrhea >10 g/day or Cholestatic liver disease with weight loss	Fat: 40 g/day (long-chain triglycerides) Supplement with medium-chain triglycerides to provide additional energy. Oral supplement with calcium, 1,25 hydroxy-vitamin D, and calcitonin may be required. May require supplementation of fat-soluble vitamins.

Meal size and frequency: Some patients require small portions and frequent feedings because ascites limits the capacity for gastric expansion. Studies have shown that the metabolic profile after an overnight fast in patients with cirrhosis is similar to normal individuals undergoing prolonged starvation without any associated stress. Cirrhosis can be considered a disease of accelerated starvation with early recruitment of alternative fuels. A small-scale study showed patients with cirrhosis who received an evening snack to supply energy during sleeping hours were able to maintain a greater positive nitrogen balance than did other patients who were fed less frequently (2).

Commercial supplements: Supplementation with enteral formulas is often necessary to increase the patient's intake. Modular products of carbohydrates and fat can increase energy intake without increasing protein intake. The usefulness of special products containing BCAAs is controversial, and these products generally have a higher cost. The guidelines for nutrition therapy in liver disease developed by the American Society for Enteral and Parenteral Nutrition (ASPEN) restrict the use of BCAA enriched formulas to patients with refractory encephalopathy not responding to medical therapy (7).

SAMPLE MENU
(50 g of protein)

Breakfast	**Noon**	**Evening**
Orange Juice (½ c)	Garden Green Salad (1 oz)	Cranberry Juice Cocktail (½ cup)
Oatmeal (½ c)	with Dressing (1 Tbsp)	Oven Fried Chicken (2 oz)
Toast (2 slices)	Roast Beef Sandwich	Buttered Rice (½ c)
Margarine (2 tsp)	Roast Beef, Shaved (1 oz)	Seasoned Green Beans (½ c)
Jelly (1 Tbsp)	Bread (2 slices)	Dinner Roll (1)
Milk (½ c)	Mayonnaise (2 Tbsp)	Margarine (2 tsp)
Sugar	Sliced Tomato (1 oz)	Sliced Peaches (½ c)
Coffee; Tea	Fresh Fruit Salad (½ c)	Lemonade
Nondairy Creamer	Fruit Punch	

Snack	**Snack**	**Snack**
Hard Candy (6 pieces)	Fruit Ice (3 oz)	Banana (1)
Jelly Beans (1 oz)		Dry Cereal (¾ oz)
		Milk (½ c)

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PROTEIN-BASED EXCHANGES

Exchange	Protein (g)
Meat and Meat Substitutes	7
Milk	4
Starch/Bread	2.5
Vegetables	2
Fruit	Negligible
Low-Protein Products	0.2
Sweets	Negligible
Fats	Negligible

	Portion	Variances in Portion or Protein Content (0.2 g) Noted
Meat and meat substitutes (7 g protein)		
Egg	1 large	1 medium egg = 5.7 g
Cheese (natural hard or semisoft)	1 oz	
Cheese, processed (eg, American)	1 oz	6.6 g
Cottage Cheese	¼ cup	
Meat, fish, poultry (lean portion, cooked)	1 oz	
Meat (ground or flaked)	¼ cup (1 oz)	
Legumes (cooked):	½ cup	
Black beans		7.6 g
Garbanzo beans		7.3 g
Kidney beans		6.7 g
Lentils		8.9 g
Lima beans		7.3 g
Pinto beans		7 g
Black-eyed peas (Cow Peas)		5.7 g
Peanut butter	2 Tbsp	7.9 g
Milk (4 g protein)		
Cream, Half-and-Half	½ cup	3.6 g
Cream, light	½ cup	3.3 g
Cream, heavy (whipping)	¾ cup	3.7 g
Cream, heavy (fluid)	¾ cup	3.6 g
Cream cheese	2 Tbsp	2.1 g
Milk, whole, low-fat, nonfat, or chocolate	½ cup	
Yogurt, fruited	½ cup	4.5 g
Yogurt, plain, low-fat, vanilla	1/3 cup	
Custard	1/3 cup	
Pudding	½ cup	
Starch/Bread (2.5 g protein)		
Bread, white, rye, whole wheat	1 slice	
Biscuit	1	Approx. 1 oz biscuit = 2 g
Cereal (cooked)		
Cream of rice	6 oz	1.6 g
Farina	6 oz	2.6 g
Grits	6 oz	2.7 g
Maltex	4 oz	2.9 g
Oatmeal	4 oz	3 g
Ralston	4 oz	2.8 g
Rolled wheat	4 oz	2.5 g
Wheatena	4 oz	2.8 g

Protein-Based Exchanges (Cont.)

	Portion	Variances in Portion or Protein Content (0.2 g) Noted
Starch/Bread (Cont)		
Cereal (ready-to-eat)		
40% Bran Flakes	1 oz	3.6 g
Corn flakes	1 box (¾ oz)	1.7 g
Crisp rice	1 box (5/8 oz	1.2 g
Puffed rice	½ oz	0.9 g
Puffed wheat	½ oz	2.1 g
Shredded wheat	1 oz	3.1 g
Crackers		
Graham	4 squares	2.3 g
Saltines	6	3 g
Muffin, corn	1	Approx. 1½ oz = 2.8 g
Pasta, rice, noodles (cooked)	½ cup	
Ice cream	½ cup	2.4 g
Ice milk	½ cup	2.6 g
Starchy Vegetables (2.5 g protein)		
Corn	½ cup	
Peas, green	½ cup	½ cup = 4.1 g
Potato (baked)	1 (5 oz)	3.2 g
Potatoes, french fried (2 – 3 inches long)	10	3.2 g
Potato (mashed)	½ cup	2 g
Potato (peeled and boiled)	1 small (5 oz)	
Sweet potato or yam (canned)	½ cup	
Winter squash	½ cup	1.5 g
Other Vegetables (2 g protein)		
All others (cooked)	½ cup	
Except those in *Starch/Bread* and *Meat and Meat Substitutes* groups		
Fruits (negligible protein)		
All		
Low-Protein Products (each exchange contains 0.2 g protein)		
Low-protein bread	1 slice (1½ oz)	
Low-protein rusks	2 slices	
Low-protein macaroni or noodles	½ cup, cooked (¼ cup dry)	
Low-protein gelatin	½ cup, prepared (negligible protein)	
Low-protein cookies	2	

Sweets (negligible protein)

- Candy: hard candy, lollipops, jelly beans, gum drops, marshmallows
- Carbonated beverages
- Lemonade; Limeade
- Noncarbonated soft drinks
- Jam; jelly
- Popsicles; fruit ice, italian ice
- Sugar; syrup; honey

Fats (negligible protein)

- Butter or Margarine
- Oil or Shortening
- Mayonnaise
- Salad Dressing (except sour cream based or cream cheese)
- Nondairy Creamer
- Gravy (meat drippings with fat, thickened with cornstarch)

MEDICAL NUTRITION THERAPY FOR CHRONIC KIDNEY DISEASE

Description

The approach to medical nutrition therapy is based on the stage and progression of kidney disease, existing comorbid conditions (eg, diabetes mellitus), and therapies. Medical nutrition therapy is provided based on the individualized needs of the patient and uses a diet approach that is modified in one or more constituents: protein, sodium, potassium, total fluid, and phosphorus. The diet may also be modified to provide adequate amounts of energy, vitamins, and minerals. The publication *Guidelines for Nutrition Care of Renal Patients* has recently been updated to serve as a framework for providing care to renal patients in specific care settings (1). These guidelines are consistent with the language and terms used for reimbursement in Medicare beneficiaries.

Indications

Management of Chronic Kidney Disease

In chronic kidney disease (CKD), a progressive decline in renal function results in a reduced ability to control body water volume, acid-base balance, hormonal regulation, and electrolyte concentrations (2). The leading cause of CKD is diabetes mellitus, which accounts for 30% to 40% of patients needing renal replacement therapy (RTT) (2). Other causes of CKD include hypertension, vascular disease, urologic disorders, and primary glomerular or interstitial diseases of the kidney (2). Symptoms of uremia such as nausea, anorexia, and altered taste sensation can lead to reduced oral intake and the risk of malnutrition in patients with CKD (2). The goals for dietary management in CKD are to minimize uremic toxicity, prevent wasting and malnutrition, and slow the progression of renal insufficiency or complement the renal replacement therapy regimen.

Typically, chronic kidney disease progresses until treatment by renal replacement therapy (dialysis) or transplantation is required. Dietary modifications and practice guidelines outlining the scope of nutrition therapy are based on the classification or stage of the disease (1). Patients with CKD are classified in two groups (1):

- Pre-end stage renal disease (pre-ESRD): patients who do not yet require renal replacement therapies (dialysis); management is primarily by diet modifications and medication, or
- Dialysis: patients whose disease has progressed to the point of requiring renal replacement therapy (eg, hemodialysis, or peritoneal dialysis).

The scope of this section focuses on medical nutrition therapy for CKD as classified above. Refer to *Guidelines for Nutrition Care of Renal Patients* (1) for specific guidelines for Nutrition Care of Adult Transplant Patients, Nutrition Care of Adult Pregnant ESRD, and Nutrition Care of Adult Acute Renal Failure Patients. Additional information on Acute Renal Failure can be found in Table G-2 in this section as well as Section III: Management of Adult Renal Failure: Acute Renal Failure and Chronic Kidney Disease, and Acute Renal Failure Medical Nutrition Therapy Protocol, found in *Nutrition Care Protocols for the Acute Care Setting*, Atlanta, Ga: Morrison Management Specialists Inc, 2003.

Renal Replacement Therapies

Currently there are three primary types of renal replacement therapy (RRT), hemodialysis (HD), peritoneal dialysis, and continuous ambulatory peritoneal dialysis (CAPD). The following describes each of the RRT therapies.

Hemodialysis

Hemodialysis uses an artificial kidney (hemodialyzer) to cleanse the blood. This process can return the body to a more normal state by removing excess fluid and waste products. It does not replace the endocrine functions of the kidney. The average treatment lasts 3 to 5 hours and is usually required three times a week. Treatment is based on adequate urea clearance to equal a urea reduction rate (URR) of 65 or a Kt/V (clearance of the dialyzer $\times$ time/volume) of 1.2. The URR is the percentage of change in blood (serum) urea nitrogen (BUN) in a single dialysis treatment: $BUN_1 - BUN_2/100$. Hemodialysis removes some water-soluble vitamins such as vitamin C and pyridoxine; minerals and electrolytes, especially potassium; and to a lesser extent phosphorus and magnesium (2). Hemodialysis also may increase energy requirements because of the lymphocyte stimulation and may complement activation (2).

Peritoneal Dialysis

This type of dialysis involves the removal of waste products and water within the peritoneal cavity, using the peritoneal membrane as a filter. In peritoneal dialysis, the dialysis solution (dialysate) is instilled through the peritoneal catheter into the peritoneal cavity or peritoneum. The many blood vessels and capillaries throughout the peritoneum are separated from the peritoneal cavity by a layer of mesothelium. Passive movement from the peritoneal capillaries into the dialysate removes the uremic toxins. The high osmolality of the dialysate due to the high dextrose concentration results in the removal of extracellular fluid. There are two major types of peritoneal dialysis (intermittent peritoneal dialysis also is available; however, it is not used as a standard treatment):

- Continuous ambulatory peritoneal dialysis (CAPD), whereby a continuous presence of a dialysate in the peritoneal cavity is interrupted intermittently for drainage and instillation of fresh dialysate. The exchanges are usually done four times a day, with only a 30- to 35-minute interruption of daily activity for each exchange. The dialysate is allowed to dwell in the peritoneal cavity for 3½ to 4 hours during the day and about 8 to 10 hours at night.
- Continuous cyclic peritoneal dialysis (CCPD), which allows for more daytime freedom by decreasing the catheter connections to two a day. A cycler machine is used to deliver three or four exchanges each night, lasting 2½ to 3 hours each. Approximately 2 L of dialysate is left in the peritoneal cavity during the day. The residual fluid remains in the abdomen for 12 to 15 hours and is drained when the patient begins the nightly routine again.

Peritoneal dialysis can increase the risk for hypokalemia, since most commercially available solutions do not contain potassium (2). Potassium can be easily added to the dialysate if needed. Peritoneal dialysis can provide a substantial amount of energy from glucose to the patient via the dialysate. The amount of total kilocalories absorbed depends on the volume infused, its dwell time, and the concentration of dextrose used (2). See Determination of Glucose Absorption During Peritoneal Dialysis later in this section. Common complaints of patients using peritoneal dialysis include bloating, abdominal fullness, and loss of appetite from the indwelling dialysate, which can affect nutritional intake (2).

Alternative Dialytic Treatments: Continuous RRT

Continuous arteriovenous hemofiltration (CAVH) and continuous venovenous hemofiltration (CVVH) use a polysulfane] membrane to remove some of the solutes. No dialysis is used because adequate clearance of nitrogenous waste and other byproducts of metabolism and fluids can be achieved. This procedure is often used in the critical care setting where patients are hemodynamically unstable. When CAVH is used, protein requirements should be estimated in a range of 1.5 to 1.8 g/kg per day because the losses of small peptides and amino acids can be high (2-4). Use of continuous RRT often makes it possible to provide nutrition support without the need to restrict protein and fluid (2).

Transplantation

A transplant offers a relatively favorable long-term outlook and adds several productive years for some individuals with end-stage renal disease (ESRD), especially young children. A functioning transplanted kidney performs the excretory and regulatory functions of a normal kidney. Successful transplantation frees the patient from the time-consuming demands of dialysis and a strict dietary regimen. Refer to *Guidelines for Nutrition Care of Renal Patients* (1) for specific nutrition guidelines before and after transplantation for adults.

Nutritional Adequacy

Because individual diets in renal disease may vary widely as to the nutrients controlled, a general statement on nutritional adequacy is not given. Refer to statements for each constituent in the respective sections:

- Section IF: Nutrition Management of Potassium Intake
  Sodium-Controlled Diets
  Nutrition Management of Phosphorus Intake
- Section IG: Protein-Controlled Diet
- Section IC: Modification of Carbohydrate and Fat

See Section III: Clinical Nutrition Management
MANAGEMENT OF ADULT RENAL FAILURE: ACUTE RENAL FAILURE AND CHRONIC KIDNEY DISEASE

How to Order the Diet

Refer to the "How to Order the Diet" instructions for each of the components required in the respective chapters. See Nutritional Adequacy on the preceding page. Also refer to Nutrition Management of Fluid Intake in Section IA.

Planning the Diet

Refer to Table G-2: Nutritional Requirements for Adults with Renal Disease Based on Type of Therapy

Energy

Energy requirements in CKD without dialysis are similar to that of healthy individuals and are influenced by age, sex, and physical activity (5). According to studies, resting metabolic rates were similar for patients with CKD and controls by direct and indirect calorimetry. Nitrogen balance studies using < .8 g protein/kg/IBW (RDA) reported a neutral or positive nitrogen balance when energy intakes were 35 to 45 kcal/kg/IBW (5) and a negative nitrogen balance when energy intakes were 15 to 25 kcal/kg/IBW. Therefore energy intakes should be greater in patients following diets containing less than the RDA for protein (Grade I) (5). The energy intake for persons with CKD should be adequate to maintain or achieve reasonable body weight and positive nitrogen balance. In patients with pre-ESRD and those receiving dialysis, an energy intake of 35 kcal/kg of ideal body weight (IBW) (1,6) has been suggested. Thirty to 35 kcal/kg IBW is recommended for individuals 60 years or older (1,6,7). More recently, The American Dietetic Association explored evidence that reported the accuracy and application of various methods used to measure energy expenditure. For additional information, refer to Section II: Nutrition Assessment: Estimating Energy Expenditure.

In peritoneal dialysis, glucose is absorbed from the dialysate. Dietary energy may need to be decreased to prevent excess weight gain and obesity. An average weight gain of 5 kg/year has been reported. Glucose absorption varies in each patient due to individual peritoneal permeability. Some patients undergoing CAPD or CCPD have been shown to absorb more than 800 kcal/day from the dialysate, depending on which exchange concentrations are used. See Determination of Glucose Absorption in Peritoneal Dialysis later in this section. It is suggested that kilocalories absorbed from dialysate be subtracted from daily energy intake (1,6).

Protein

Pre-ESRD: It is thought that a low protein intake reduces intraglomerular pressure, solute load, and overall nephron activity and may preserve renal function or delay the progression of decline in renal function (2). Evidence from the Modification of Diet in Renal Disease (MDRD) trial indicates that protein restriction can slow progression of CKD (8). The most recent guidelines recommend that the protein be based on the patient's creatinine clearance, glomerular filtration rate (GFR), and urinary protein losses (1). The general recommendation is 0.6 to 1.0 g/kg of IBW , with 50% of protein source coming from high biological value (HBV) animal and/or plant sources (1,6). More specific recommendations for dietary protein in progressive renal failure have been suggested (3,7,9). They include 0.8 g/kg per day, 50% HBV, along with sufficient energy in the patient with no symptoms of uremia and when the GFR is greater than or equal to 55 mL/min. When the GFR is 25 to 55 mL/min, the use of 0.6 g/kg per day of protein, 50% HBV, has been found to be beneficial in terms of reducing or eliminating uremic symptoms and slowing the loss of renal function (3,7,9).

Hemodialysis: The protein recommendation for patients undergoing hemodialysis three times a week is 1.1 to 1.4 g/kg of IBW per day (1,6). Some researchers recommend an additional 0.2 g/kg per day as protein or essential amino acids (4,6,10). In a single hemodialysis treatment in a nonfasting patient, 10 to 13 g of amino acids and small peptides are lost (2). About 30% to 40% of the amino acids lost during hemodialysis are essential. Therefore, HBV protein should represent at least 50% of the total protein content of the diet (1,6). Reuse of dialyzers may increase amino acid losses, depending on the composition of the dialyzer.

Peritoneal dialysis: In peritoneal dialysis, the patient's requirement for protein is increased to 1.2 to 1.5 g/kg IBW (1,6). Protein requirements may even be higher depending on stress or metabolic needs. When used for long-term management of CKD, peritoneal dialysis has been associated with progressive wasting and malnutrition (2). Several factors contribute to this wasting, including anorexia (caused by inadequate dialysis, superimposed additional and secondary illnesses, discomfort, fullness, or severe dietary restriction); losses to dialysate of protein, amino acids, and vitamins; and peritonitis leading to catabolism. (During episodes of peritonitis, there are increased protein losses, which continue several days to 1 week after the clinical signs of peritonitis subside. Some researchers believe this loss may continue for even longer periods.) Protein and albumin losses with the dialysate vary from patient to patient but are fairly consistent within an individual. Of

the protein lost, 66% to 80% is albumin. Protein losses in patients undergoing CCPD approximate those in patients receiving CAPD. A minimum protein intake of 1.2 to 1.3 g/kg of IBW per day has been suggested for clinically stable patients undergoing CAPD (7).

Fat

Elevated lipoproteins and abnormalities in lipid metabolism are common in patients with CKD (1). The National Kidney Foundation Task Force on Cardiovascular Disease has recommended the use of the National Cholesterol Education Program (NCEP)Adult Treatment Panel III guidelines for patients with chronic renal disease (1). For patients with renal disease, the target goals for cholesterol are modified slightly because of data from morbidity and mortality studies (1). For therapeutic lifestyle diet modifications, see Section C: Medical Nutrition Therapy for Disorders of Lipid Metabolism.

Table G-1: Recommended Lipid Levels in Renal Failure

Stage of Renal Failure	Recommended Levels*
Pre-ESRD	Cholesterol 120-240 mg/dL Triglycerides (fasting) <200 mg/dL
Dialysis	Cholesterol 150-250 mg/dL

*Levels listed may be measured as nonfasting levels except where indicated.
Source: Wiggins KL, ed. *Guidelines for Nutrition Care of Renal Patients*. Chicago, Ill: American Dietetic Association; 2002.

Sodium and Fluid

Pre-ESRD: The sodium recommendation for patients with pre-ESRD should be individualized; a range of 1 to 3 g/day is suggested (1,6). Fluid requirements should be sufficient to maintain appropriate hydration status (1,6).

Hemodialysis: The allowance for the hemodialysis patient can vary from 2 to 3 g of sodium per day and depends largely on urine output (1,6). The more urine the patient produces, the more sodium the patient may eliminate via the urine. Under steady-state conditions, urinary output usually provides a good guide for the fluid intake. Urine output per day plus 500 to 750 mL of fluid is recommended to maintain fluid weight gain between hemodialysis treatments of less than 5% interdialytic weight (1,6). If the patient is anuric, 1,000 mL per day is recommended (6).

Peritoneal dialysis: Sodium balance and blood pressure can be well controlled with CAPD or CCPD. As much as 5,700 mg/day of sodium can be removed with CAPD. The patient must be aware of the symptoms of hypotension and the methods for avoiding it. For sodium requirements, each patient must be individually evaluated for parameters such as weight (dry weight vs fluid weight), blood pressure (hypotension or hypertension), shortness of breath, and edema. Most patients' sodium should be in the range of 2 to 4 g/day (1,6). Fluid generally is not restricted for patients receiving CAPD or CCPD, but patients should know how to monitor their weight and blood pressure. Adjustments in fluid balance can be made by altering the quantity or strength of hypertonic solutions. Patients must take their own blood pressure readings and weigh themselves regularly to determine the concentration of exchanges necessary to maintain fluid balance (1,6).

Potassium

Pre-ESRD: The potassium requirements should be individualized based on laboratory values in patients with pre-ESRD (1,6).

Hemodialysis: For patients receiving hemodialysis, 40 mg/kg of IBW is recommended, or based on laboratory values (1,6). Hemodialysis does remove potassium; therefore, monitoring levels and ensuring adequate intake is important (2).

Peritoneal dialysis: Patients receiving CAPD or CCPD may not need potassium restrictions; however, a final assessment should be based on interpretation of the laboratory values (1,6). Peritoneal dialysis can increase the risk for hypokalemia, since most commercially available solutions do not contain potassium (2). Potassium can be easily added to the dialysate if needed.

Phosphorus

Pre-ESRD: Phosphorus should be individualized, or 8 to 12 mg/kg of IBW. A phosphate binder may be required (1,6). Hemodialysis and peritoneal dialysis: Phosphorus is individualized, or $\leq$17 mg/kg of IBW (1,6). Hyperphosphatemia usually develops when the GFR falls below 25 mL/minute. Phosphate binders may be initiated as early as when the GFR is 60. Hyperphosphatemia is harmful because it contributes to secondary hyperparathyroidism. Control of serum phosphorus is usually not possible by diet alone. Phosphate binders are given at mealtimes to bind the phosphate from food. The prescribed amount should be individualized according

to the amount of phosphate present in a meal. The general dietary recommendation is less than or equal to 17 mg/kg of IBW (1,6). Approximately 60% to 70% of phosphorus (PO_4) ingested is absorbed (11-13) . One gram of calcium carbonate ($CaCO_3$) binds roughly 40 to 60 mg of PO_4, and 1 g of calcium acetate binds 39 mg of PO_4. Whereas $CaCO_3$ contains 40% elemental calcium, calcium acetate is composed of 25% elemental calcium. As a standard, calcium acetate contains 167 mg of elemental calcium in each tablet, and $CaCO_3$ contains 500 mg. With an elevated calcium/PO_4 product, sevelamer hydrochloride may be more effective and will not contribute to elevated phosphorus and calcium levels. One, two, or three tablets of calcium acetate would be replaced with one, two, or three tablets of sevelamer hydrochloride (14,15). If calcium and phosphorus levels are at the high end of normal range, use of a calcium binder may make the calcium/phosphorus product exceed the normal range and contribute to soft-tissue calcification. The goal is for the serum calcium-phosphorus product to be under 55 mg^2/dL^2 (11). Aluminum-containing phosphate binders are generally not recommended due to risk for aluminum toxicity, which can lead to osteodystrophy, anemia, and encephalopathy (2).

Calcium

Pre-ESRD: Calcium intake should be individualized based on calcium, phosphorus, and parathyroid hormone (PTH) laboratory values; use of vitamin D; and use of supplements that impact the calcium level should also be considered (1,6).

Hemodialysis and peritoneal dialysis: Calcium intake should be approximately 1,000 to 1,500 mg/day or individualized based on calcium, phosphorus, PTH laboratory values, and use of vitamin D supplementation (1,6). Calcium supplementation frequently is prescribed. Intestinal absorption of calcium is impaired in uremia due to the lack of the active form of vitamin D (2). Also, diets prescribed for patients with pre-ESRD tend to be low in calcium because of the restriction of dairy products. Calcium supplements containing 1 to 2 g/day of elemental calcium may be given. As in Pre-ESRD, the general dietary recommendation depends on the serum level and other factors (see above discussion. Calcium supplements are taken between meals and are not to be confused with those used to bind phosphorus. An activated form of vitamin D (calcitriol) also can be used to enhance calcium absorption.

Magnesium

The kidney is the organ primarily responsible for the normal maintenance of serum magnesium. Most patients with uremia should avoid the use of laxatives, enemas, antacids, or phosphate binders containing magnesium. Hypermagnesemia may occur when the tap water used to prepare the dialysate contains excess magnesium. The usual hemodialysis solution magnesium level is 0.5 to 1 mEq/L (16). Excess magnesium accumulates largely in bone, where it is deleterious to bone metabolism. Symptoms include muscle weakness, hypotension, electrocardiographic changes, sedation, and confusion. Magnesium may be decreased in dialysate and used as a phosphate binder along with $CaCO_3$.

Guidelines for Vitamin and Trace Mineral Supplementation in CKD

Vitamins: Studies do not support routine supplementation of fat-soluble vitamins other than vitamin D for patients consuming well-balanced, adequate diets. Patients can be supplemented with 1,25 dihydroxyvitamin D, the most active metabolite of vitamin D metabolism, to maintain normal calcium homeostasis and prevent osteomalacia (2). Patients can receive supplementation with vitamin D analogs for the treatment of secondary hyperparathyroidism.. Paricalcitol (Zemplar) and doxercalciferol (Hectorol) are presently available. The advantage of using the analogs as opposed to calcitriol is decreased absorption of phosphorus and calcium in the gut (17). Supplementation with 1,25-dihydroxycholecalciferol, the active form of vitamin D in the presence of $CaCO_3$, must be individualized and its effects on calcium levels must be frequently monitored (10). Vitamin K may be considered for the patient who has been receiving antibiotic therapy. Vitamin A should not be supplemented if RRT is not used, since excessive amounts can lead to toxicity (2). Water-soluble vitamins, especially vitamin C, folate, and pyridoxine should be evaluated, as deficiencies may occur secondary to poor appetite, altered metabolism, uremia, removal by dialysis, and restricted diet (2). According to recent guidelines, each patient should be evaluated and treated with vitamins according to individual need and after appropriate assessment of biochemical levels (1,6). It has been recommended to provide 70 to 100 mg/d of vitamin C in adults receiving RRT; however, doses greater than 200 mg/d have shown to elevate blood oxalate levels, which can result in deposition of oxalate in the heart, kidney and blood vessels (2). Recommendations for folate and pyridoxine remain controversial (2). Pyridoxine supplementation of 5 mg/d or 50 mg three times a week has been advised in patients on CAPD (2). Folic acid recommendations of 1 mg/day have been suggested for all patients receiving RRT (2).

Trace minerals: Patients with CKD experience alterations in trace mineral metabolism. Serum or tissue levels or both can be high or low. Trace minerals should be supplemented or restricted only after appropriate biochemical assessments have been made (1,6).

Diabetes Management in Patients with CKD

Medical nutrition therapy for people with diabetes mellitus and kidney disease is complex and requires an individualized approach (6). In addition to the nutrient modifications required for managing renal disease, consistent carbohydrate intake is a primary goal for persons with diabetes mellitus complicated by CKD. The treatment approach should follow the same guidelines outlined in Section IC: Medical Nutrition Therapy for Diabetes Mellitus. The 2002 version (second edition) of the National Renal Diet (*Healthy Food Guide for People With Chronic Kidney Disease* and *Healthy Food Guide for People on Dialysis*) focuses on complementing the patient's existing diabetes meal planning approaches (eg, constant carbohydrate meal plan, carbohydrate counting meal plan, or exchange meal plan) (5). It also recommends strategies that best meet the needs of the patient and that promotes or maintains glucose tolerance.

Table G-2: Nutritional Requirements for Adults with Renal Disease Based on Type of Therapy

Therapy/ Diagnosis	Energy	Protein	Fluid	Sodium	Potassium	Phosphorus
Acute renal failure	30 to 40 kcal/kg*, or determine via indirect calorimetry	0.5-0.8 g/kg* with no dialysis, 1.0-2.0 g/kg* with dialysis	Anuric/oliguric phase: 500 mL + total output (urine, vomitus, and diarrhea) per day Diuretic phase: large volume of fluids may be needed; assess frequently	Anuric/ oliguric phase <2,000 mg/d Diuretic phase: replace based on urine output, edema, need for dialysis and serum sodium levels	Anuric/ oliguric phase: individualize Diuretic phase: replace losses depending on urine volume, serum potassium levels, need for dialysis and medication	Individualize based on laboratory values
Pre-ESRD	35 kcal/kg* [30-35 kcal/kg* if >60 y of age]	0.6-1.0 g/kg* >50% HBV	Individualize to maintain appropriate hydration status	Individualize or 1-3 g/d	Individualize per lab values	Individualize per lab values, or 8-12 mg/kg* , may require phosphate binder therapy
Hemodialysis	35 kcal/kg* [30-35 kcal /kg* if >60 y of age]	1.1-1.4 g/kg* >50% HBV	Urine output + 500-750 mL/d	Individualize or 2-3 g/d	Individualize per lab values, or 40 mg/kg* IBW	Individualize or ≤17 mg/kg*, usually requires phosphate binder
Peritoneal dialysis	35 kcal/kg* [30-35 kcal/kg* if >60 y of age] Subtract kilocalories absorbed from dialysate from daily energy prescription	1.2-1.5 g/kg* >50% HBV	Individualize to maintain fluid balance and blood pressure	Individualize or 2-4 g/d	3-4 g/d Adjust to serum levels	Individualize or ≤17 mg/kg*, usually requires phosphate binder

*To calculate above requirements, use IBW. In some instances using actual body weight may be more appropriate. In all cases, the individual practitioner should consider his or her own clinical judgment and expertise in determining which method to use (1). Auric/oliguric phase refers to less than 500 mL of urine output per 24 hours (2).

Sources: Wiggins KL, ed. *Guidelines for Nutrition Care of Renal Patients*. Chicago, Ill: American Dietetic Association; 2002; *National Renal Diet Professional Guide*. 2nd ed. Chicago, Ill: Renal Practice Group of the American Dietetic Association; 2002

DETERMINATION OF GLUCOSE ABSORPTION IN PERITONEAL DIALYSIS

Energy requirements and nutrient intake calculations for patients receiving continuous ambulatory peritoneal dialysis (CAPD) should take into account carbohydrate absorption from the dialysate. The D/D_0 formula has recently been advocated as a more accurate method than the traditionally used Grodstein formula (18). The D/D_0 formula is individualized for the patient's modality and transport characteristics and is easy to calculate from readily available information (1,18).

Formula (1,14)
To calculate the grams of glucose absorbed, the formula is as follows:

$$\text{Glucose (g)} = (1 - D/D_0) \times G_i$$

Where:

D_0	= Initial dextrose in the dialysate at zero hours (g)
D	= Remaining dextrose in the dialysate after an appropriate dwell time (g)
D/D_0	= Fraction of glucose remaining in the dialysate
G_i	= Initial grams glucose instilled: 13 g/L for 1.5 % dextrose 22 g/L for 2.5 % dextrose 38 g/L for 4.25% dextrose

In patients on CAPD, the D/D_0 is determined after a 4-hour dwell from the peritoneal equilibrium test. Explanations of the method for performing the peritoneal equilibrium test are available in references 19 and 20. For patients receiving automated peritoneal dialysis, the formula uses the cycler dwell time D/D_0.

Example (adapted from reference 1):

A patient on CAPD uses 4 L of 2.5% and 4 L of 4.25% solution.

Initial Grams Glucose Installed = $(4\text{ L} \times 22\text{g/L}) + (4\text{ L} \times 38\text{ g/L}) = 240\text{ g}$

D/D_0 Obtained From Peritoneal Equilibrium Test = 0.58

Grams of Glucose Absorbed = $(1 - 0.58) \times 240\text{ g} = 100.8\text{ g}$

Calories Absorbed = $(100.8\text{ g}) \times (3.7\text{ kcal/g}^*) = 372\text{ kcal}$

*To calculate total kilocalories, use a conversion factor of 3.7 kcal/g dextrose.

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DIETARY MANAGEMENT USING THE HEALTHY FOOD GUIDE FOR PEOPLE WITH CHRONIC KIDNEY DISEASE

Before determining a patient's diet prescription and calculating his or her meal plan, the dietitian should perform a complete nutrition assessment, with special attention to the following factors:

1. Medical history.
2. Physician's orders.
3. Treatment modality (pre-end-stage renal disease [pre-ESRD], hemodialysis, or peritoneal dialysis). Nutrition management of the renal patient depends on the method of treatment as well as on medical and nutritional status. A comparison of treatment methods and primary concerns in each is summarized in the table below.
4. Presence of other chronic diseases that may affect the nutritional status. As a result, the diet prescription also will be affected.

Comparison of Treatment Approaches for Patients With CKD

Stage of CKD	Treatment	Renal Replacement Therapy (RTT)	Duration	Metabolic Concerns
Pre-ESRD	Diet and medications	None	Indefinite	Glomerular hyperfiltration; rise in BUN; bone disease Hypertension; glycemic control in diabetes
Hemodialysis	Diet and medications; hemodialysis	Dialysis using vascular access for waste product and fluid removal	3-5 h 2-3 d/wk	Amino acid loss; interdialytic electrolyte and fluid changes Bone disease; hypertension
CAPD or CCPD	Diet and medications; peritoneal dialysis	Dialysis using peritoneal membrane for waste product and fluid removal	3-5 exchanges 7 d/wk	Protein loss into dialysate; glucose absorption from dialysate Bone disease; weight gain; hyperlipidemia; glycemic control in diabetes

[a]CAPD indicates continuous ambulatory peritoneal dialysis; CCPD, continuous cyclic peritoneal dialysis; and BUN, blood (serum) urea nitrogen.

The second edition of the National Renal Diet (1) and educational guides, *Healthy Food Guide For People With Chronic Kidney Disease* (2), and *Healthy Food Guide for People on Dialysis* (3) is recommended by the Renal Practice Group of the American Dietetic Association as the meal planning approach for persons with CKD (1-3). This edition uses an approach that is flexible and encourages self-management training and individualization for both the patient and registered dietitian (1). Foods are divided into groups or "choices" according to nutrient content and are categorized based on the amount of protein, energy, sodium, potassium, and phosphorus content.

The following information and tables are reprinted with permission from the American Dietetic Association, *National Renal Diet: Professional Guide* (1), *Healthy Food Guide for People With Chronic Kidney Disease* (2), and *Healthy Food Guide for People on Dialysis* (3), 2002.

Overview of the National Renal Diet

The *National Renal Diet,* second edition, version 2002, simplifies the approach to medical nutrition therapy management for persons with CKD. The newer versions focus on two primary diet approaches, one for use

with pre-ESRD patients *(Healthy Food Guide for People with Chronic Kidney Disease [Pre-ESRD)* (2) and one for use with patients on dialysis (*Healthy Food Guide for People on Dialysis*) (3). The intent of the revised version is to simplify the diet approach and allow for more flexibility and self-management training opportunities with the patient. The *National Renal Diet Professional Guide,* second edition, can be used to provide detail review of these two diet approaches (1).

The guides for CKD (pre-ESRD) and dialysis are very similar but differ somewhat in how foods are grouped and categorized. Differences in how foods are grouped are based on the unique needs of persons with pre-ESRD compared with those on dialysis. A summary can be reviewed in Tables G3.1 to G3.5: Healthy Food Guide for People With Chronic Kidney Disease (pre-ESRD) (1,2) and Tables G4.1 to G4.6: Healthy Food Guide for People on Dialysis (1,3). In both guides, food lists that are provided are limited to the most common foods. The dietitian will need to work with the patient to address serving limits, serving sizes, and additional food choices that may not be included on the lists provided. Food choices in both guides are grouped according to the amount of protein, calories, sodium, potassium, and phosphorus. Nutrient composition of foods can vary greatly, depending on the size, variety, growing conditions, processing, packaging, and final preparation (1). Nutritionists IV and V (First Data Bank) were used to update food lists for the revised National Renal Diet guides (1).

Tables G3.1-G3.5: Healthy Food Guide for People with Chronic Kidney Disease (Pre-ESRD)

Table G3.1: High-Protein Foods

High-Protein Food Choices: The high protein food list includes sources of protein from both animals and vegetables that provide a high-biological source of protein (providing 6 to 8 g protein per serving). Foods that provide a high source of phosphorus and sodium are identified (see footnotes).

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
High protein	6-8	50-100	20-150	50-150	50-100
Higher phosphorus proteins	6-8	50-100	20-150	50-350	100-300 (if marked **a***)
Higher sodium proteins	6-8	50-100	200-450 (if marked with **b****)	50-150	50-100

*a—food contains 100-300 mg phosphorus per serving.
**b—food contains 200-450 mg sodium per serving.

Table G3.2: Low-Protein Foods

Lower-Protein Food Choices: The low-protein food choices include vegetables as well as breads, cereals, and other grain foods, and desserts that provide 2 to 3 g protein per serving. The foods contained in this group help to complete the protein, nutrient, and calorie needs of the patient. Most CKD patients do not need to monitor potassium intake, but if necessary, vegetables are grouped by potassium content.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Vegetables (separated by potassium content)	2-3	10-100	0-50	1) 20-150 2) 150-250 3) 250-550	10-70
Breads, rolls, cereals, grains, crackers, snacks, desserts	2-3	50-200	0-150	10-100	10-70
Higher sodium and/or phosphorus grain foods	2-3	50-200	150-400 (if marked with **b****)	10-100	100-200 (if marked with **a***)

*a—food contains 100-200 mg phosphorus per serving.
**b—food contains 150-400 mg sodium per serving.

Table G3.3: Fruit Choices

Fruit Choices: Fruits add very little protein to the diet (0 to 1 g per serving) but provide necessary vitamins, calories, fiber, and flavor. The fruit lists are grouped according to potassium content for those needing to monitor potassium intake.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Fruits (grouped by potassium content)	0-1	20-100	0-10	1) 20-150 2) 150-250 3) 250-550	1-20

Table G3.4: Calorie and Flavoring Choices

Calorie and Flavoring Choices: Foods grouped in this category help to add extra calories and flavor to foods to help enhance caloric intake and can be added to the diet to prevent weight loss.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Calorie choices	0-1	100-150	0-100	0-100	0-100
Flavor choices	0	0-20	250-300	0-100	0-20

Table G3:5: Vegetarian Protein Choices

Vegetarian Choices: The section on vegetarian choices is intended for patients who avoid animal foods. It can replace the protein choices section (Tables G3.1 to G3.2). Table G3.5 provides nutrient values of vegetarian proteins and foods categorized in this group. Choosing vegetarian proteins over animal proteins may result in a higher phosphorus load. If this is a concern, phosphorus binders may be needed, or the patient may need to limit other high-phosphorus foods (See the dairy and phosphorus choices, Table G4.3, in A *Healthy Food Guide for People on Dialysis*.)

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Protein foods	6-8	70-150	10-200	60-150	80-150
Higher sodium, potassium, or phosphorus proteins	6-8	70-150	250-400 (marked with **b****)	250-500 (marked with **c*****)	200-400 (marked with **a***)

*a—food contains 200-400 mg phosphorus per serving.
**b—food contains 250-400 mg sodium per serving.
***c—food contains 250-500 mg potassium per serving.

Calculating Food Choices for People with CKD (Pre-ESRD) (1,2)

1. Refer to Section IG, Table G-2: Nutritional Requirements for Adults with Renal Disease Based on Type of Therapy to determine nutrition needs.
2. Once nutrition needs are known, calculate and identify protein needs and determine choices from Tables G3.1 to G3.2. At least 50% of the protein should come from the High-Protein Food List (Table G3.1) to ensure high-biological proteins are consumed. Choices from the higher phosphorus and sodium groups can be included as needed by the dietitian's discretion to meet the patient's nutrition needs.
3. Lower-protein foods can then be selected to fulfill protein and nutrient requirements (refer to Table G3.2). Most CKD patients do not need to monitor potassium intake, but if necessary, vegetables are grouped by potassium content.
4. After protein needs have been met, fruit choices (also grouped by potassium content) and calorie and flavoring choices can be used to provide balance, flavor, and additional calories to meet nutrition needs and complete the patient's meal plan (refer to Tables G3.3 to G3.4).

HIGH-PROTEIN FOOD LIST
Serving 1 oz

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
6-8	50-100	20-150	50-150	50-100
Beef (1 oz) Egg substitutes (¼ cup) Eggs (1 large) Fish (1 oz) Lamb (1 oz) Pork (1 oz) Poultry (1 oz) Shellfish (1 oz) Veal (1 oz) Wild game (1 oz)				

High-Protein and High-Phosphorus Food Lists

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
6-8	50-100	20-150	50-350	100-300 (if marked **a***)
Cheese (1 oz) [a] Cooked dried beans and peas (½ cup) [a] Evaporated milk (½ cup) [a] Milk, all kinds (1 cup) [a] Nut butters (2 tbsp) [a] Nuts (¼ cup) [a] Organ meats (1 oz) [a] Soy milk (1 cup)[a] Sweetened condensed milk (½ cup) [a] Tofu (¼ cup) [a] Yogurt (1 cup) [a]				

*a—food contains 100-300 mg phosphorus per serving.

High-Protein and High-Sodium (Salt) Food Lists

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
6-8	50-100	200-450 (if marked with **b****)	50-150	50-100
Bacon (4 slices)[b] Breakfast sausage (3 links or 1½ patties) [b] Canned tuna, salmon (1 oz or ¼ cup) [b] Cottage cheese (¼ cup) [b] Deli-style roast beef, ham, turkey (1 oz) [b] Frankfurters, bratwurst, Polish sausage (2 oz) [b] Luncheon meats, bologna, liverwurst, salami, etc (2 oz) [b]				

**b—food contains 200-450 mg sodium per serving.

LOWER-PROTEIN FOOD LISTS: VEGETABLES
Serving: ½ cup unless otherwise noted

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
2-3	10-100	0-50	1) 20-150 2) 150-250 3) 250-550	10-70

Lower-Protein Food Lists: Vegetables (Cont.)

Group 1: 20-150 mg	Group 2: 150-250 mg	Group 3: 250-550 mg
Alfalfa sprouts	Asparagus	Artichokes
Bamboo shoots (canned)	Broccoli	Avocado
Bean sprouts	Celery	Bamboo shoots (fresh, raw)
Beets	Kale	Beets (fresh)
Cabbage	Mixed vegetables	Brussels sprouts
Carrots	Peas	Chard
Cauliflower	Peppers	Greens (beet, collard, mustard, etc)
Corn	Summer squash, boiled	Kohlrabi
Cucumber	Turnips	Okra
Endive	Zucchini	Parsnips
Eggplant		Potatoes
Green beans		Pumpkin
Lettuce		Rutabagas
Mushrooms		Spinach
Onions		Sweet potatoes
Radishes		Tomatoes
Summer squash, raw		Tomato sauce, puree
Water chestnuts (canned)		V-8 juice
Watercress		Wax beans
		Winter squash
		Yams

LOWER-PROTEIN FOOD LISTS: BREADS AND ROLLS, CEREALS AND GRAINS, CRACKERS AND SNACKS, AND DESSERTS

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
2-3	50-200	0-150	10-100	10-70
2-3	50-200	150-400 (if marked with **b****)	10-100	100-200 (if marked with **a***)

Breads and Rolls:
Bagel (½ small)
Bread, all kinds (1 slice or 1 oz)
Bun, hamburger or hot dog type (½)
Cornbread, homemade (1 piece or 2 oz)
Danish pastry or sweet roll (½ small)
Dinner roll or hard roll (1 small)
Doughnut (1 small)
English muffin (½)
Pita or pocket bread (½ 6-inch diameter)
Tortilla, flour (1- to 6-inch diameter)

Desserts:
Sugar cookie (4 cookies)
Shortbread cookie (4 cookies)
Sugar wafer (4 cookies)
Vanilla wafer (10 cookies)

Cereals:
Low-salt cereals (Corn Pops, Coca Puffs, Sugar Smacks, Fruity Pebbles, Puffed Wheat, Puffed Rice) (1 cup or 1 oz)
Cereals, cooked (Cream of Rice or Wheat, Farina, Malt-o-Meal) (½ cup)
Grits, cooked (½ cup)
Pasta, cooked (noodles), macaroni, spaghetti) (½ cup)
Rice, cooked (½ cup)
Crackers, unsalted (4 2-inch crackers)
Graham crackers (3 squares)
Melba toast (3 oblong)
Popcorn, unsalted (1½ cups, popped)
Pretzel, unsalted sticks or rings (3/4 oz, 10 sticks)
Tortilla chips, unsalted (3/4 oz, 9 chips)

Added salt and phosphorus:
Biscuits, muffins (1 small)[a,b]
Cake (1/20 round cake or 2 × 2-inch square) [a,b]
Cornbread, from mix (1 piece or 2 oz) [a,b]
Fruit pie (1/8 pie) [b]
Granola, oatmeal (½ cup) [a]
Pancakes, waffles (1-4 inches) [a,b]
Pretzels, salted sticks or rings (3/4 oz or 10 sticks) [b]
Dry cereals, most brands (3/4 cup) [b]
RyKrisp (3 crackers) b
Sandwich cookie (4 cookies) b
Whole-wheat cereals, bran cereals (1/2 cup) a,b

*a—food contains 100-200 mg phosphorus per serving.
**b—food contains 150-400 mg sodium per serving.

FRUIT LISTS

Serving: ½ cup unless otherwise noted

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Fruits (grouped by potassium content)	0-1	20-100	0-10	1) 20-150 2) 150-250 3)250-550	1-20

Group 1: 20-150 mg	Group 2: 150-250 mg	Group 3: 250-550 mg
Apple, raw (without skin)	Apple, raw (with skin)	Gooseberries (raw)
Apple juice (½ cup)	Grape juice (canned/bottled)	Peach, dried (5)
Applesauce	Peach , raw (with skin)	Pear, dried (5)
Apricot nectar	Pear, raw (with skin)	Figs, dried (5)
Blackberries	Cherries, raw (10)	Apricots, dried (10)
Blueberries	Cantaloupe	Apricots, raw (3)
Cranberries	Figs (2 whole)	Banana (1 small)
Cranberry juice cocktail	Grapefruit, raw	Dates (¼ cup)
Fruit cocktail	Grapefruit juice	Honeydew melon
Gooseberries, canned	Mango	Kiwifruit
Grape juice (frozen concentrate)	Papaya	Nectarine
Grapes	Rhubarb	Orange juice
Lemon, lime (1 raw)		Orange
Lemon, lime juice		Prune juice
Papaya nectar		Prunes (5)
Peach nectar		Raisins
Peach, canned		
Pear, canned		
Pear nectar		
Pineapple, fresh or canned		
Plum, raw or canned		
Raspberries, raw or frozen		
Strawberries, raw or frozen		
Tangerine, raw		
Watermelon, raw		

CALORIE AND FLAVORING CHOICES FOOD LISTS

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Calorie choices	0-1	100-150	0-100	0-100	0-100
Flavor choices	0	0-20	250-300	0-100	0-20

Chewy fruit snacks and candies (1 oz)	Mints, peppermint patties (13 mints or ½ large)
Cranberry sauce or relish (¼ cup)	Nondairy creamers, half-and-half (¼ cup)
Cream cheese (2 tbsp)	Nondairy creamers, half-and-half
Fruit chews (4 or 1 oz)	Nondairy whipped topping (½ cup)
Fruit drinks (1 cup)	Popsicles, juice bars (1 bar)
Fruit roll up (2)	Salad dressing (1½ tbsp)
Gumdrops (8)	Soda pop (1 cup)
Hard candy (4 pieces)	Sorbet (½ cup)
Honey (2 tbsp)	Sour cream (¼ cup)
Jam or jelly (2 tbsp)	Sugar, brown or white (2 tbsp)
Jelly beans (15)	Sugar, powdered (3 tbsp)
Lifesavers (13)	Syrup (2 tbsp)
Margarine or butter (1 tbsp)	Tartar sauce (2 tbsp)
Marmalade (2 tbsp)	Vegetable oil (1 tbsp)
Marshmallows (5 large)	Whipped cream (¼ cup)
Mayonnaise (1½ tbsp)	

VEGETARIAN PROTEIN FOOD LISTS (ALSO REFER TO LOWER-PROTEIN FOOD LISTS)

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Protein foods	6-8	70-150	10-200	60-150	80-150
Higher sodium, potassium, or phosphorus proteins	6-8	70-150	250-400 (marked with **b****)	250-500 (marked with **c*****)	200-400 (marked with **a***)

Cheese, all kinds (1 oz)	Okra (1 cup) [c]
Eggs (1 large)	Soy cheese (1 oz) [a,b]
Nut butters (1½ tbsp)	Soy milk (1 cup) [c]
Tempeh (½ cup)	Soy nuts (2 tbsp) [b]
Tofu, firm type (¼ cup)	Soy protein isolate (½ oz) [c]
Tofu, soft type (½ cup)	Soy sprouts (1 cup) [c]
	Soy yogurt (1 cup) [c]
Higher phosphorus (a), sodium (b), or potassium (c):	Tofu hotdog (1 oz) [b]
	Tuno (1/3 cup) [b]
Cottage cheese (¼ cup)[b]	Vegetarian meat analogs (Gardenburgers, Bocaburgers) (2 oz) [b]
Dried beans, peas (½ cup)[c]	
Milk (1 cup) [a,c]	Yogurt (1 cup) [a,c]
Miso (¼ cup) [b]	
Natto (¼ cup) [c]	
Nuts (¼ cup) [b,c]	

*a—food contains 200-400 mg phosphorus per serving.
**b—food contains 250-400 mg sodium per serving.
***c—food contains 250-500 mg potassium per serving.

Tables G4.1-G4.6: Healthy Food Guide for People on Dialysis

Table G4.1: Protein Choices
Protein Choices: The foods included in this list include sources of protein from both animals and vegetables that provide a high-biological source of protein (generally 6 to 8 g protein per serving). Foods that provide a high source of sodium, potassium, and/or phosphorus are identified.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Animal protein	6-8	50-100	20-150	50-150	50-100
Higher sodium, potassium, or phosphorus proteins	6-8	50-100	200-500 (if marked **b****)	250-450 (if marked **c*****)	100-300 (if marked **a***)

a*—food contains 100-300 mg phosphorus per serving.
**b—food contains 200-500 mg sodium per serving.
***c—food contains 250-450 mg potassium per serving.

Table G4.2: Fruit and Vegetable Choices (grouped by potassium content)
Fruit and Vegetable Choices: Fruits and vegetables are grouped by potassium content. Most patients can choose one high-potassium food, two medium-potassium foods, and three low-potassium foods per day. Choices will vary depending on the serum potassium level and dialysis therapy.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Low potassium	0-3	10-100	1-50	20-150	0-70
Medium potassium	0-3	10-100	1-50	150-250	0-70
High potassium	0-3	10-100	1-50	250-550	0-70

Table G4.3: Dairy and Phosphorus Choices

Dairy and Phosphorus Choices: The foods in this group contain 100 to 120 mg phosphorus per serving, and 2 to 8 g protein per serving. Most patients can choose one or two high-phosphorus foods a day, depending on lab values, use of phosphate binders, and type/frequency of dialysis therapy.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Dairy and phosphorus	2-8	100-400	30-300	50-400	100-120

Table G4.4: Bread, Cereal, and Grain Choices

Bread, Cereal, and Grain Choices: This group of foods generally provides 2 to 3 g protein per serving. Grain foods with higher values of sodium, potassium, and/or phosphorus are identified. These foods can be integrated in the meal plan to meet nutrition needs. Laboratory values, use of phosphate binders, and type/frequency of dialysis therapy should be considered to determine servings recommended per day.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Breads, rolls, cereals, grains, crackers, snacks, desserts	2-3	50-200	0-150	10-100	10-70
Higher sodium and/or phosphorus grain foods	2-3	50-200	150-400 (if marked with **b****)	10-100 (if marked with **c*****)	100-200 (if marked with **a***)

a*—food contains 100-200 mg phosphorus per serving.
**b—food contains 150-400 mg sodium per serving.
***c—food contains 10-100 mg potassium per serving.

Table G4.5: Calorie and Flavoring Choices

Calorie and Flavoring Choices: Foods grouped in this category help to add extra calories and flavor to foods to help enhance caloric intake and can be used to help prevent weight loss.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Calorie choices	0-1	100-150	0-100	0-100	0-100
Flavor choices	0	0-20	250-300	0-100	0-20

Table G4:6: Vegetarian Protein Choices

Vegetarian Choices: The section on vegetarian choices is intended for patients who avoid animal foods. It can replace the protein choices section (Table G4.1). Table G4.6 provides nutrient values of vegetarian proteins and foods categorized in this group. Choosing vegetarian proteins over animal proteins may result in higher intakes of potassium and phosphorus per gram of protein. Higher sodium, potassium, and phosphorus foods are identified and often can be used once or twice per week depending on lab values, fluid weight gains, and dialysis therapy.

Food List	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Protein foods	6-8	70-150	10-200	60-150	80-150
Higher sodium, potassium, or phosphorus proteins	6-8	70-150	250-400	250-500 (marked with b)	200-400 (marked with a)

Calculating Food Choices for People on Dialysis (1,3)

1. Refer to Table G-2: Nutritional Requirements for Adults With Renal Disease Based on Type of Therapy to determine nutrition needs. Priorities in meal planning for people on dialysis will vary with their nutrition status, laboratory values and type/frequency of dialysis therapy.

2. Once nutrition needs are known, calculate and identify protein needs and determine choices. At least 50% of the protein should come from the Protein Choices Food List (Table G4.1) to ensure high-biological proteins are consumed. Choices from the higher sodium, potassium, and phosphorus groups can be included as needed by the dietitian's discretion to meet the patient's nutrition needs.
3. Other protein foods can then be selected to fulfill protein and nutrient requirements (refer to Tables G4.2 to G4.4.). The amount of sodium, potassium, and phosphorus should be determined based on the patient's laboratory values, medications (eg, phosphorus binders) and type/frequency of dialysis.
4. Calorie and flavoring choices can be used to provide balance, flavor, and additional calories to meet nutrition needs and complete the patient's meal plan (refer to Table G4.5).

PROTEIN CHOICES FOOD LIST
Animal Protein: Serving 1 oz

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
6-8	50-100	20-150	50-150	50-100
Beef (1 oz) Egg substitutes (¼ cup) Eggs (1 large) Fish (1 oz) Lamb (1 oz) Pork (1 oz) Poultry (1 oz) Shellfish (1 oz) Veal (1 oz) Wild game (1 oz)				

High Sodium, Potassium, Phosphorus, Protein Food Lists

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
6-8	50-100	200-500 (if marked **b****)	250-450 (if marked **c*****)	100-300 (if marked **a***)
Bacon, breakfast sausage [b] (4 slices, 1 ½ patties, or 3 links) Canned tuna, canned salmon, or sardines [a,b] (¼ cup) Cheeses, all kinds [a,b] (1 oz) Cooked, dried beans and peas [a,c] (½ cup) Cottage cheese [b] (¼ cup) Deli-style roast beef, ham, turkey (1 oz) [b] Frankfurters, bratwurst, polish sausage (2 oz) [b] Luncheon meats, bologna, liverwurst, salami, etc (2 oz) [b] Milk (1 cup) [a,b] Nut butters (2 tbsp) [a] Nuts (¼ cup) [a,c] Organ meats (1 oz) [a] Soy milk (1 cup) [c] Tofu (¼ cup) [a] Vegetarian meat analogs (garden burgers, soy burgers, etc) (2 oz) [b] Yogurt (1 cup) [a,b,c]				

***a- food contains 100-300 mg phosphorus/serving** ****b- food contains 200-500 mg sodium/serving**
*****c- food contains 250-450 mg potassium/serving**

FRUIT AND VEGETABLE CHOICES FOOD LISTS (grouped by potassium content)

Food List*	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Low potassium	0-3	10-100	1-50	20-150	0-70
Medium potassium	0-3	10-100	1-50	150-250	0-70
High potassium	0-3	10-100	1-50	250-550	0-70

*Refer to Vegetable Lists and Fruit Lists under Healthy Food Guide for People With Chronic Kidney Disease (Pre-ESRD), this section.

DAIRY AND PHOSPHORUS CHOICES FOOD LISTS

Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
2-8	100-400	30-300	50-400	100-120

Biscuits, muffins (1 small)
Cake (1 slice, 2 × 2 inches)
Cheese (1 oz)
Cooked dried beans and peas (½ cup)
Condensed and evaporated milk (¼ cup)
Cottage cheese (¼ cup)
Granola, oatmeal (½ cup)
Ice milk or ice cream (½ cup)
Light cream or half-and-half (½ cup)
Milk, all kinds (½ cup)
Milkshake (½ cup)
Nut butters (2 tbsp)
Nuts (¼ cup)
Nondairy milk substitutes (1 cup)
Organ meats (1 oz)
Pancakes, waffles (1-4 inches)
Pudding, custard (½ cup)
Sardines (1 oz)
Soy milk (1 cup)
Tofu (¼ cup)
Tortillas, corn (2- to 6-inch diameter)
Vegetarian meat analogs (Garden burgers, Bocaburgers, etc) (2 oz)
Whole-wheat cereals, bran cereals (½ cup)
Yogurt, plain or fruit flavored (½ cup)

BREAD, CEREAL, AND GRAIN CHOICES FOOD LISTS

Food List***	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Breads, rolls, cereals, grains, crackers, snacks, desserts	2-3	50-200	0-150	10-100	10-70
Higher sodium and/or phosphorus grain foods	2-3	50-200	150-400 (if marked with **b****)	10-100	100-200 (if marked with **a***)

*a—food contains 100-200 mg phosphorus per serving.
**b—food contains 150-400 mg sodium per serving.
***Refer to Bread, Cereal, and Grain Choices Food Lists under Healthy Food Guide for People With Chronic Kidney Disease (Pre-ESRD), this section.

CALORIE AND FLAVORING CHOICES

Food List*	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Calorie choices	0-1	100-150	0-100	0-100	0-100
Flavor choices	0	0-20	250-300	0-100	0-20

*Refer to Calorie and Flavoring Choices Food List under Healthy Food Guide for People With Chronic Kidney Disease (Pre-ESRD), this section.

VEGETARIAN PROTEIN CHOICES

Food List****	Protein (g/serving)	Calories (kcal/serving)	Sodium (mg/serving)	Potassium (mg/serving)	Phosphorus (mg/serving)
Protein foods	6-8	70-150	10-200	60-150	80-150
Higher sodium, potassium, or phosphorus proteins	6-8	70-150	250-400	250-500 (marked with **c***)	200-400 (marked with **a***)

*a—food contains 200-400 mg phosphorus per serving.
***c—food contains 250-500 mg potassium per serving.
****Refer to Vegetarian Protein Food Choices Lists under Healthy Food Guide for People With Chronic Kidney Disease (Pre-ESRD), this section.

References

1. *National Renal Diet Professional Guide*. 2nd ed. Chicago, Ill: Renal Practice Group of the American Dietetic Association; 2002.
2. Schiro Harvey K. *A Healthy Food Guide for People With Chronic Kidney Disease*. 2nd ed. Chicago, Ill: Renal Practice Group of the American Dietetic Association; 2002
3. Schiro Harvey K. A *Healthy Food Guide for People on Dialysis*. 2nd ed. Chicago, Ill: Renal Practice Group of the American Dietetic Association; 2002.

MEAL PATTERNS USING HEALTHY FOOD GUIDE (SAMPLE)

Sample Meal Pattern for CKD (Pre-ESRD)
Based on 70 kg reference person

Food Choice	Number of Choices	Breakfast	Noon	Evening
High-Protein Choices	3	1	1	1
High-Protein, High Phosphorus Choices	1	1		
Vegetable Choices				
Group 1	1		1	
Group 2	1		1	
Group 3	1			1
Bread, Cereal and Grain Choices	8	3	2	3
Fruit Choices				
Group 1	1			1
Group 2	1		1	
Group 3	1	1		
Calorie and Flavoring Choices	6-7	2-3	2	2

Approximate Totals:
61 g Protein
2,130 calories
2,090 mg sodium
2,160 mg potassium
840 mg phosphorus

Sample Meal Pattern for CKD (Dialysis)
Based on 70 kg reference person

Food Choice	Number of Choices	Breakfast	Noon	Evening
High-Protein Choices	8	2	3	3
Dairy and Phosphorus Choices	1	1		
Vegetable Choices				
Group 1	1		1	
Group 2	2		1	1
Group 3				
Bread, Cereals and Grain Choices	9	3	3	3
Fruit Choices				
Group 1	1			1
Group 2	1		1	
Group 3	1	1		
Calorie and Flavoring Choices	6-7	2-3	2	2
Fluid Choices	3			

Approximate Totals:
84 g Protein
2350 calories
2150 mg sodium
2220 mg potassium
1100 mg phosphorus
960 cc fluid

SIMPLIFIED RENAL DIET

Description
The Simplified Renal Diet mildly restricts sodium, potassium, phosphorus, and fluid intake.

Indications
- patients in predialysis stage
- patients receiving hemodialysis and having difficulty adhering to the Renal Diet

Nutritional Adequacy
The diet is inadequate in calcium according to the Dietary Reference Intakes (DRIs) as outlined in the *Statement on Nutritional Adequacy* in Section IA.

How to Order the Diet
The diet should be ordered "No Added Salt Diet (NAS) _____ cc fluid restriction, Simplified Renal Diet." For patients who require a renal-diabetic restriction, order "Consistent Carbohydrate, NAS Diet with _____ cc fluid restriction, Simplified Renal Diet."

Planning the Diet

Guidelines for the Simplified Renal Diet follow:

1. Limit milk and milk products to ½ cup/day.
2. Limit foods high in potassium to one serving per day. Such foods include cantaloupe and honeydew, potatoes, prunes, oranges, orange juice, prune juice, dried beans and peas, nuts and peanut butter, chocolate, bananas, apricots, and tomatoes. (The renal choice list may be used for guidelines of a serving.)
3. Eliminate salt substitutes and light salt.
4. If phosphorus restriction is required, limit bran cereal, whole wheat bread, nuts, and dried beans to one serving per day.
5. For protein requirements, provide 6 oz of meat or meat entree per day. Offer an egg for breakfast at least every other day.

Bibliography

Ecklund K. Handling the dialysis diet in long-term care. *Consultant Dietitian.* 1992; 17 (1): 1.