RESEARCH
Research and Practice Innovations

Medical Nutrition Therapy in Adults with Chronic Kidney Disease: Integrating Evidence and Consensus into Practice for the Generalist Registered Dietitian Nutritionist

Judith A. Beto, PhD, RDN, FAND, LD; Wendy E. Ramirez, PharmD; Vinod K. Bansal, MD

ARTICLE INFORMATION

Article history:
Accepted 25 November 2013

Keywords:
Chronic kidney disease
Medical nutrition therapy
Hemodialysis
Renal nutrition
Nutrition care process

2212-2672/$36.00
http://dx.doi.org/10.1016/j.jand.2013.12.009

ABSTRACT

Chronic kidney disease is classified in stages 1 to 5 by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative depending on the level of renal function by glomerular filtration rate and, more recently, using further categorization depending on the level of glomerular filtration rate and albuminuria by the Kidney Disease Improving Global Outcomes initiative. Registered dietitian nutritionists can be reimbursed for medical nutrition therapy in chronic kidney disease stages 3 to 4 for specific clients under Center for Medicare and Medicaid Services coverage. This predialysis medical nutrition therapy counseling has been shown to both potentially delay progression to stage 5 (renal replacement therapy) and decrease first-year mortality after initiation of hemodialysis. The Joint Standards Task Force of the American Dietetic Association (now the Academy of Nutrition and Dietetics), the Renal Nutrition Dietetic Practice Group, and the National Kidney Foundation Council on Renal Nutrition collaboratively published 2009 Standards of Practice and Standards of Professional Performance for generalist, specialty, and advanced practice registered dietitian nutritionists in nephrology care. The purpose of this article is to provide an update on current recommendations for screening, diagnosis, and treatment of adults with chronic kidney disease for application in clinical practice for the generalist registered dietitian nutritionist using the evidence-based library of the Academy of Nutrition and Dietetics, published clinical practice guidelines (ie, National Kidney Foundation Council on Renal Nutrition, Renal Nutrition Dietetic Practice Group, Kidney Disease Outcomes Quality Initiative, and Kidney Disease Improving Global Outcomes), the Nutrition Care Process model, and peer-reviewed literature.
J Acad Nutr Diet. 2014;■:■-■.

CHRONIC KIDNEY DISEASE (CKD) HAS BEEN DEFINED as abnormalities in kidney function or structure present for more than 3 months. Kidney function has been classified in stages 1 to 5 by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative. The 2012 Kidney Disease Initiative Global Outcomes recently revised the classification terminology to combine the level of organ function measured as estimated glomerular filtration rate (eGFR) with the degree of albuminuria as shown in Table 1.[1,2]

The services of a registered dietitian nutritionist (RDN) to deliver medical nutrition therapy (MNT) to patients with CKD stages 3 to 4/GFR categories G3 to G4 not on renal replacement therapy (RRT), such as hemodialysis or peritoneal dialysis, have been covered since 2002 within the Center for Medicare Services (CMS) under diagnostic code 585.[3] This reimbursement is based on clinical evidence that MNT, particularly protein modification, can slow or delay the progression to kidney failure requiring RRT.[4] The 2012 US Renal Data System Annual Data Report estimated 2010 RRT Medicare annual cost per person per year was $87,561 for hemodialysis, $66,751 for peritoneal dialysis, and $32,914 for transplantation ($97,935 for total inpatient/outpatient combined transplantation costs).[5] The use of an RDN to perform MNT services for the purpose of delaying the progression of CKD, therefore, is cost effective.

The coverage of comprehensive nutrition care services for adults in stage 5/G5 kidney failure undergoing RRT is detailed under CMS guidelines. The CMS Conditions for Coverage require a "minimum of one year's professional work experience in clinical nutrition as a registered dietitian" to deliver MNT care (specialty level of practice) to these patients.[6] Reimbursement is paid through a "bundling" of interdisciplinary services paid directly to the dialysis provider by CMS that covers medical, nursing, social service, and nutrition components. The generalist RDN might encounter stage 5/G5 patients intermittently within their practice and need to be aware of MNT parameters.

Table 1. Kidney Disease Improving Global Outcomes' terminology used to describe varying degrees of chronic kidney disease function and persistent albuminuria[a]

CKD[b] stages	GFR[c] category	Description and GFR range
1	G1	Normal/high GFR ≥90 mL/min/1.73 m^2
2	G2	Mildly decreased GFR 60 to 89 mL/min/1.73 m^2
3	G3a	Mildly to moderately decreased GFR 45 to 59 mL/min/1.73 m^2
3	G3b	Moderately to severely decreased GFR 30 to 44 mL/min/1.73 m^2
4	G4	Severely decreased GFR 15 to 29 mL/min/1.73 m^2
5	G5	Kidney failure GFR <15 mL/min/1.73 m^2
Persistent albuminuria category		**Description and albuminuria range**
A1		Normal/mildly increased <30 mg/g or <3 mg/mmol
A2		Moderately increased 30 to 300 mg/g or 3 to 300 mg/mmol
A3		Severely increased >300 mg/g or >30 mg/mmol

[a]Data from references 1 and 2.
[b]CKD=chronic kidney disease.
[c]GFR=glomerular filtration rate.

The Joint Standards Task Force of the American Dietetic Association (now the Academy of Nutrition and Dietetics) Renal Nutrition Dietetic Practice Group and the National Kidney Foundation Council on Renal Nutrition in 2009 published Standards of Practice and Standards of Professional Performance for RDs in Generalist, Specialty, and Advanced Practice in Nephrology Care.[7] The purpose of this article is to provide recommendations for screening, diagnosis, and treatment of adults classified in CKD stages 1 to 5/G1 to 5 for application to clinical practice for the generalist RDN using the evidence-based library of the Academy of Nutrition and Dietetics,[7] published clinical practice guidelines (ie, Kidney Disease Outcomes Quality Initiative, Kidney Disease Improving Global Outcomes, Renal Nutrition Dietetic Practice Group, and National Kidney Foundation Council on Renal Nutrition),[8-15] the Nutrition Care Process (NCP) model,[16] and peer-reviewed literature.

SCREENING

Who Is at Risk for CKD and Should Be Screened?

The purpose of screening is to identify adults at risk for developing CKD using reasonable cost and time factors. Screening tests for kidney function can be affected by hydration status, diet composition, and extreme exercise variables. The assessment by an RDN at the time of screening can aid in the evaluation of these mediating factors. Common populations identified as at risk for CKD include those with hypertension with and without cardiovascular disease; type 1 and type 2 diabetes mellitus; a family history of kidney disease, particularly genetic familial, such as polycystic; and unique ethnicity (eg, American Native Indians, African Americans, and Hispanics) or lifestyle risk factors (eg, obesity) for which epidemiological evidence exists to document greater risk.[1,2]

Individuals with hypertension are at increased risk due to kidney damage caused by inadequate blood pressure control. Diabetes mellitus increases risk of nephrotic damage due to glomerular changes that typically occur gradually over time. Because of a natural decline in kidney function over time, individuals older than the age of 60 years are also considered at higher risk in general, but should not be screened based on age alone.[17] Recent epidemiological surveys have begun to identify long-term obesity as a potential screening factor, particularly in Hispanics.[18]

What Are the Components of Adequate Screening?

The eGFR is often found on many routine laboratory reports, but the method of calculation can vary.[19] The Kidney Disease Improving Global Outcomes most recently recommended calculation of the eGFR using the 2009 Chronic Kidney Disease Epidemiology Collaboration equations grouped by sex and serum creatinine level. Some laboratories may calculate and report eGFR based on other equations, such as the Modification of Diet in Renal Disease. eGFR values can be affected by common variables, such as extreme age (older

than 85 years of age), very low or very high body mass index, or individuals consuming a very low or very high protein diet. A cohort of medications can also affect eGFR by changing the excretion of serum creatinine (ie, trimethoprim, sulfamethoxazole, ciprofloxacin, and fenofibrate). A single serum creatinine level is a poor single measure of kidney function.[1,2,19]

Macroscopic/microscopic urine albumin detection by a single random dipstick often is sufficient to at least identify need for further investigation. Urinary albumin is not widely reported as part of a standard analysis. The albumin/creatinine ratio value is another quick method that aids in rapid screening. The use of 24-hour urine collections has significantly declined because of the availability of these tests and the difficulty in obtaining a full-volume collection for analysis.[1,2]

CLASSIFICATION AND MEDICAL DIAGNOSIS

What Are the CKD Categories of Classification?

CKD stages 1 to 5/G1 to G5 (Table 1) are grouped by eGFR level. The level of persistent albuminuria (categories A1 to A3) is combined with eGFR to further define as low risk, moderate increased risk, high risk, and very high risk of progression. The etiology of CKD is multifactorial and often does not play a role in treatment. Rather, CKD classification drives interventions to delay progression to kidney failure through regular monitoring to evaluate the treatment response.[2]

Stages 2 to 3/G2 to G3 (eGFR 30 to 89 mL/min/1.73 m^2), representing kidney damage with mild to moderate impairment, are key early-intervention MNT opportunities to potentially delay CKD progression for the generalist RDN. Stage 4/G4 (eGFR 15 to 29 mL/min/1.73 m^2) can focus on more complicated MNT parameters to both delay progression and maintain nutritional adequacy before RRT.[1-3,7,8,15] Patients who have received kidney transplants are categorized using the same nomenclature based on eGFR and albuminuria.

What Are Common CKD Symptoms?

Most patients are asymptomatic. Some may present with vague symptoms of fatigue due to underlying anemia. Others may present with nonspecific nausea, vomiting, and decreased appetite due to uremia. Urine output typically does not change until kidney failure (stage 5/G5).

NUTRITION ASSESSMENT

What Are Some Components of Nutrition Assessment?

The nutrition assessment stage of the NCP in CKD is similar to the core standards of practice parameters for the generalist RDN. The patient needs to be evaluated for basic knowledge, health literacy, motivation factors, and barriers to change. Earlier MNT and health interventions should be integrated into the assessment. The RDN collects general information on food intake, food preferences, and compliance levels. Establishing a baseline nutrition assessment as defined in the NCP is important when monitoring patients over time.[7-9,15,16,20]

Basic dietary intake information can be obtained by a variety of methods, such as diet recalls or food records.[7-9,15,20] A more interactive and creative assessment method is ask the patient to create a lifestyle timeline by taking a photographic cell phone picture each time a snack, meal, or food item is ingested for 1 day before the next scheduled visit. The visual interactive teaching format often provides important data and promotes general conversation. This strategy might also provide a more accurate objective estimation of intake, particularly when using computerized diet analysis to evaluate intake for protein sources and renal-specific nutrients (ie, sodium, potassium, and phosphorus).

What Are Appropriate Physical Examination and Laboratory Findings?

A generalist RDN should use the data provided in the medical record to aid in initial physical assessment. A measured height and body weight, rather than self-reported, should be performed to insure accuracy.[7-9] A generalist RDN is not expected to perform an advanced nutrition-focused physical examination, but could use subjective global assessment.[7] Fluid retention, edema, or shortness of breath are seldom present in early CKD (stages 2 to 4/G2 to G4) unless combined with comorbidities, such as congestive heart failure. Key changes in laboratory values should be noted for serum albumin, hemoglobin, creatinine, and blood urea nitrogen. Glycemic (if diabetic) and blood pressure control should be individualized and monitored per recommended guidelines for non-CKD patients.[7-9,14,15] The Figure lists selected highlights of the NCP Algorithm for Screening, Referral, and Assessment from the Academy-CKD Evidence-Based Nutrition Practice Guidelines.[8]

What Are Some Pharmacological Considerations, Including Potential Drug–Nutrient Interactions?

Drug–nutrient interactions are complicated in CKD.[13,14,21-23] Some selected potentially nephrotoxic medications that have been identified include aminoglycosides, radiographic contrast agents used without adequate post-test hydration, and long-term use of nonsteroidal anti-inflammatory agents and cyclooxygenase-2 inhibitors. Patients should be queried regarding their use of over-the-counter supplements, natural remedies, and health practices in detail. A recent analysis of the 1999-2008 National Health and Nutrition Examination Survey conservatively identified at least 8.0% of adults self-reported consuming at least 1 of the 37 herbs identified as potentially nephrotoxic in the last 30 days.[24] Expanding the visual timeline previously described under nutrition assessment to include medications can help in understanding the potential opportunities and barriers. Medication burden is high in this population, with an average estimate of 19 pills per day.[25]

Patients should be asked to bring their medications and dietary supplements to each visit. Individualized education is necessary to establish an effective treatment regimen.[25] Many adherence strategies exist, including taking a pill during a similar time frame each day, which also can aid in medication effectiveness, implementing a pill organization system (eg, weekly or daily box or keychain), and use of technology reminders (eg, text message, alarm, or alert notification).

Selected Recommendations for NCP	Evidence rating
NCP Screening and Referral	
MNT provided by an RDN has been shown to be effective in demonstrating significant improvements in anthropometric and biochemical measures sustained longer than 1 year.	Strong Imperative
MNT should be initiated at least 12 months before anticipation of RRT; recommended to be initiated at CKD diagnosis to maintain adequate nutritional status, prevent disease progression, and delay RRT.	Strong Imperative
The RDN should monitor every 1 to 3 months, conditional on nutritional status, comorbidities, and disease-progression risk.	Strong Conditional
Recommended RDN time requirements for MNT of approximately 2 hours/month for up to 1 year may be required to provide effective care.	Strong Conditional
NCP Nutrition Assessment	
Food/nutrition-related history should be assessed and related to changes, including but not limited to food and nutrient intake with biochemical parameters, medication and dietary supplements, knowledge and beliefs, access to food.	Consensus Imperative
Body weight for the purpose of calculating nutritional needs should be estimated and assessed using clinical judgment, preferably with serial weight measures within the context of CKD (changes in fluid status, kidney function, and body composition).	Consensus Imperative
Biochemical parameters, preferably integrating data over time, should be assessed to effectively determine nutrition diagnosis and nutrition prescription.	Consensus Imperative
Body composition in CKD has no current methodology or assessment reference standard and appears to be altered compared with healthy individuals; clinical judgment and serial measures over time are suggested.	Fair Imperative
Mineral and bone disorders should be assessed, preferably integrating data over time, due to increased risk of cardiovascular disease.	Consensus Imperative
A medical and health history should be assessed for the presence of comorbidities which may affect risk of progression of CKD and nutritional needs.	Strong Imperative
NCP Nutrition Intervention	
Vitamin D supplementation should be recommended to maintain adequate levels of serum 25-hydroxyvitamin D of 30 ng/mL or 75 nmol/L.[a]	Consensus Conditional
Anemia management should be monitored within specified target ranges. Nutritional recommendations are based on clinical judgment and biochemical parameters. Interventions may include iron supplementation (oral or intravenous) if serum ferritin is $<$100 ng/mL[b] or transferrin saturation $<$20% or vitamin B-12 and folic acid when serum levels are inadequate and mean corpuscular volume is $>$100 fL.	Consensus Conditional
With diabetic nephropathy, MNT interventions should achieve a target hemoglobin A1c of approximately 7%.	Strong Conditional

(continued on next page)

Figure. Selected recommendations from the chronic kidney disease (CKD) Academy of Nutrition and Dietetics evidence-based nutrition practice guidelines executive summary for medical nutrition therapy (MNT) for target population of adults older than 18 years of age with CKD (stages 1 to 5), with or without renal replacement therapy (RRT) by a registered dietitian nutritionist (RDN) using the Nutrition Care Process (NCP). Guideline ratings: strong (practitioners should follow unless a clear and compelling rationale for alternative is present; quality of evidence reviewed was excellent/good), fair (practitioners should generally follow but should be alert to new information; quality of evidence reviewed was not as strong), consensus (practitioners should assess and follow flexibly; expert opinion supported the recommendation but quality of evidence was lacking). Statement ratings: conditional (specific situation) or imperative (broadly applicable). Adapted from reference 8; refer to the Academy's evidence-based library for the complete report and auxiliary materials.

NCP Nutrition Monitoring and Evaluation	
The RDN should monitor and evaluate biochemical parameters in relationship to nutritional status and goals.	Consensus Imperative
The RDN should monitor and evaluate adherence to nutrition and lifestyle recommendations, including food and nutrient intake, medication, readiness to change (knowledge, beliefs, attitudes, behavior).	Consensus Imperative

[a]To convert ng/mL 25-hydroxyvitamin D to nmol/L, multiply ng/mL by 2.496. To convert nmol/L 25-hydroxyvitamin D to ng/mL, multiply nmol/L by 0.4. 25-hydroxyvitamin D of 30 ng/mL=74.88 nmol/L.

[b]To convert ng/mL ferritin to pmol/L, multiply ng/mL by 2.247. To convert pmol/L ferritin to ng/mL, multiply pmol/L by 0.445. Ferritin of 100 ng/mL=224.7 pmol/L.

Figure. *(continued)* Selected recommendations from the chronic kidney disease (CKD) Academy of Nutrition and Dietetics evidence-based nutrition practice guidelines executive summary for medical nutrition therapy (MNT) for target population of adults older than 18 years of age with CKD (stages 1 to 5), with or without renal replacement therapy (RRT) by a registered dietitian nutritionist (RDN) using the Nutrition Care Process (NCP). Guideline ratings: strong (practitioners should follow unless a clear and compelling rationale for alternative is present; quality of evidence reviewed was excellent/good), fair (practitioners should generally follow but should be alert to new information; quality of evidence reviewed was not as strong), consensus (practitioners should assess and follow flexibly; expert opinion supported the recommendation but quality of evidence was lacking). Statement ratings: conditional (specific situation) or imperative (broadly applicable). Adapted from reference 8; refer to the Academy's evidence-based library for the complete report and auxiliary materials.

The use of photographic cell phone pictures discussed earlier in the section nutrition assessment can be used to identify current lifestyle habits. These existing habits, both good and bad, can be linked to medications taken in conjunction with foods or liquids. For example, an evening medication could be coupled with an evening habit, such as brushing teeth before going to bed. Active problem-solving conversations aid in determining if a patient is taking the correct medications and understands their purpose. Pill appearance can change between prescriptions when generics that are different in color or shape are substituted. Patients can purchase alternative over-the-counter brands that can contribute to confusion. Appropriate NCP nutrition assessment information should be documented and shared with the interdisciplinary team.[7,8,16,26]

NUTRITION DIAGNOSIS, INTERVENTION, MONITORING, AND EVALUATION

The specific goal of the subsequent NCP steps (ie, nutrition diagnosis, intervention, and monitoring/evaluation) in patients with CKD stages 3 to 4/G3 to G4 is to reduce metabolic byproducts from dietary intake to stop or slow progression to kidney failure. The overall goal is to match dietary intake with existing kidney function or renal replacement therapy while preventing nutrition deficiencies.[7-9,16,26] The Figure provides an overview of selected recommendations from the NCP Algorithm for nutrition diagnosis, intervention, monitoring, and evaluation from the Academy's CKD evidence-based published guidelines.[8]

What Are Some Common Nutrition Diagnoses in CKD?

Nutrition diagnoses are formulated using critical-thinking and problem-solving skills applied to NCP assessment data. For example, a nutrition diagnosis term (NI-5.7.2) of excessive protein intake could be linked to the objective findings of an elevated serum creatinine or blood urea nitrogen serum level. Selected common diagnoses might include excessive or inadequate dietary intake (eg, protein, sodium, potassium, phosphorus), body composition changes (eg, weight loss, muscle mass change), or behavioral/compliance status (eg, knowledge deficit, motivation, or lifestyle issues).

One or more focused problem-etiology-symptom statements will be the result of this stepwise process. The conclusion of the assessment and diagnosis NCP steps will create a nutrition prescription that summarizes the next intervention, monitoring, and evaluation steps.[7-9,16,26]

What Are Some Common Nutrition Interventions in CKD?

Nutrition interventions are tailored to eliminate, improve, or decrease the nutrition diagnosis. For example, a nutrition diagnosis term of excessive protein intake accompanied by an elevated serum creatinine or blood urea nitrogen level could potentially be addressed with an intervention of an education session linking protein intake to kidney function (NE-E-1.4). An intervention typically involves an action or an active change expectation. Some selected nutrition interventions in CKD might include education (eg, patient-adapted learning materials) or initiation of an intervention (eg, calorie count, change in timing of meals or medications, ordering a dietary supplement or change in diet prescription).[7-9,16,20,26]

What Are Some Strategies for Effective Monitoring and Evaluation in CKD?

Patients with CKD stages 3 to 4/G3 to G4 require progressive cycles of monitoring and evaluation activities due to the chronic nature and progressive risk of kidney injury. As with any education strategy to enact change, RDNs need to use a multitude of tools and techniques tailored to the patient's

needs and skill level. When multiple nutrition diagnoses are present, the RDN needs to work with the patient to prioritize them to achieve meaningful sustained results rather than intermittent success.[16,20,26]

How Often Should Patients Be Monitored?

The generalist RDN often must take the lead in designing and initiating a monitoring and evaluation plan. The NCP process algorithm from the Academy-CKD evidence-based practice literature recommending an RDN visit every 1 to 3 months in stages 3 to 4/G3 to G4 of at least 2 hours/month for up to a year of visits was supported by strong conditional evidence (see Figure, NCP Screening and Referral). [3,7-9,26,27]

NUTRITIONAL PARAMETERS IN CKD

What Are the Key Medical Nutrition Therapy Components in CKD?

MNT in CKD is a complicated, multifaceted nutrition prescription. The primary focus is to match dietary intake with kidney function to reduce the accumulation of metabolic byproducts and/or decrease the risk of progression to further kidney damage. Each patient must receive individualized assessment matched to intervention at each encounter, as kidney function might not be stable over time.

The generalist RDN is in a unique position to be a key member of the interdisciplinary team for planning and monitoring. Communication among team members is essential to deliver coordinated care.[3,7-9,26] Understanding the role of each component in the nutrition prescription will help connect rationale with application. The priority of each component often changes in conjunction with variables of treatment, medical complications, comorbid conditions, medications, and social/behavior issues. Table 2 provides selected recommended nutrition guidelines.

Protein/Calories. Protein is the key nutrient for control of metabolic byproducts that cannot be handled effectively by the damaged kidney. Serum creatinine and blood urea nitrogen along with eGFR help assess requirements. At least 50% high biological value protein is recommended to provide adequate essential amino acids for tissue repair and maintenance. Vegetarian diets will require specific protein awareness and strategies.[28] An adequate serum albumin should be maintained for nutrition adequacy.[7-9,15]

Adequate calories (25 to 35 kcal/kg body weight) are needed to drive the use of protein for repair rather than energy. Controversy continues on appropriate body weight to use for assessment. Establishing a goal body weight requires clinical judgment in coordination with current and long-term weight and body composition changes.[7-9,15,29] Body weight status is also controversial because higher incidence of kidney disease has been linked to obesity.[18] Conversely, higher body mass index was reported with lower mortality in CKD kidney failure stage 5/G5.[34] A recent comparative analysis focused on a more comprehensive examination of body mass composition adults, such as the possible protective effect of body fat stores for energy during acute hospitalizations. A low body mass index can also hide a malnutrition-inflammation state, which increases mortality risk.[30,34,35] Recently, the use of gastric bypass procedures to reduce obesity has been extensively explored in CKD patients, both as a means to reduce CKD risk and as a means to reduce potential transplantation surgical risk.[36] The generalist RDN will need to use critical-thinking and problem-solving skills to guide protein and calorie balance while addressing strategies required post bypass in conjunction with CKD.[7-9,15]

Dietary Fat/Cardiovascular Disease. Adults with CKD have been shown to be at higher cardiovascular disease risk than the general population. The Kidney Disease Outcomes Quality Initiative guidelines have recommended the use of the Adult Treatment Panel III and American Heart Association guidelines in CKD, which include modifications to type and amount of fat. Although no direct clinical trials have been conducted on the CKD population, the benefit has been considered to outweigh the risk. The use of statins in CKD stages 3 to 4/G3 to G4 has been shown to be effective in clinical trials. In stage 5/G5, clinical trials using statins have been less conclusive in showing cardiovascular disease risk reduction. The lipid profile is often atypical in these patients, which complicates monitoring and evaluation.[11,12,31,37-39]

Sodium/Potassium. Blood pressure control is a measurable outcome that can be enhanced by dietary intervention.[7-9,13,15] Diet in conjunction with other lifestyle modifications can reduce the dose of antihypertensive medications or enhance their effectiveness. The high sodium content of the commercial food supply is a clear challenge in the United States.

Controversy exists in actual dietary sodium target levels for CKD. The Dietary Approaches to Stop Hypertension demonstrated that blood pressure could be lowered with reduced dietary sodium of 2.4 g/day in non-CKD patients, but the Dietary Approaches to Stop Hypertension dietary pattern might not be suitable without substantial modification for CKD stages 3 to 4/G3 to G4. The 2010 Dietary Guidelines for Americans recommended a similar daily dietary intake for the general population.[15,40]

A recent 2013 Institute of Medicine Report suggested a range of 1.5 to 2.3 g/day for the general population, including population subgroups with diabetes, CKD, or cardiovascular disease. This report also acknowledged that these subpopulations have been shown to have a potentially higher risk of adverse events at the lower end of this range, particularly in conjunction with congestive heart failure. Professional judgment is required to evaluate the evolving evidence in this area.[32]

Serum potassium can be elevated in stages 3 to 4/G3 to G4, but hyperkalemia is more typically observed closer to stage 5/G5 kidney failure. Selective medications are the more common etiology of hyperkalemia in stages 3 to 4/G3 to G4 rather than excessive dietary intake. A large cohort of drugs and drug combinations have been linked to risk for elevated serum potassium, including certain cyclooxygenase-2 inhibitors and selected potassium-sparing diuretics (ie, spironolactone, amiloride, and triamterene), particularly when used in conjunction with antibiotic combinations (such as trimethoprim-sulfamethoxazole). Long-term use of antihypertensive medications, such as angiotensin-converting enzyme inhibitors or angiotensin receptor blockers can cause changes in potassium cell transport. Hyperkalemia increases risk of heart function arrhythmias and cardiac arrest. A clinical pharmacist as a member of the interdisciplinary

Table 2. Recommended nutrition guidelines for adults with chronic kidney disease[a]

Nutrient	CKD[b] stages 3 to 5 without RRT[c] (GFR[d] categories 3 to 5)	CKD stage 5 with RRT (kidney failure)	Post-transplantation (guided by CKD stage/ category of kidney function)
Protein[e]	0.6 to 0.8 g/kg of BW[f]/day with at least 50% HBV[g] to potentially slow disease progression (particularly in patients with diabetes) and achieve/ maintain adequate serum albumin	1.1 to 1.5 g/kg of BW/day (HD[h] with at least 50% HBV to achieve/maintain adequate serum albumin levels in conjunction with sufficient protein-sparing caloric intake	0.8 to 1.0 g/kg of BW/day with 50% coming HBV
Energy	25 to 35 kcal/kg of BW/day to achieve or maintain goal body weight	25 to 35 kcal/kg of BW/day to achieve or maintain goal body weight; include estimated caloric absorption from PD[i] fluid as applicable	25 to 35 kcal/kg of BW/day to achieve or maintain goal body weight
Fat	General population recommendation of <30% of total calories from fat; emphasis on healthy fat sources	Focus on type of fat and carbohydrate to manage dyslipidemia, if present	Focus on type of fat and carbohydrate to reduce cardiovascular risk or manage immunosuppressant medication adverse effect (eg, dyslipidemia, glucose intolerance)
Saturated fat	Same as for general population; <7% of total fat	Reduce and substitute saturated fat sources with healthier fat sources	Reduce and substitute saturated fat sources with healthier fat sources
Sodium	General population recommendation of ≤2.4 g/day	2.0 to 3.0 g/day (HD) to control interdialytic fluid gain; 2.0 to 4.0 g/day (PD) to control hydration status	General population recommendation of ≤2.4 g/day
Potassium	Typically not restricted until hyperkalemia is present, then individualized	2.0 to 4.0 g/day or 40 mg/kg of BW/day in HD or individualized in PD to achieve normal serum levels	No restriction unless hyperkalemia is present, then individualized
Calcium	No restriction	2 g elemental/day from dietary and medication sources	Individualized to kidney function
Phosphorus	Typically not restricted until hyperphosphatemia is present, then individualized to maintain normal serum levels by diet and/or phosphate binders	800 to 1,000 mg/day to achieve goal serum level of 3.5 to 5.5 mg/dL[j] or below; coordinate with oral phosphate binder prescription	Individualized to stage of kidney function
Fiber	Same as general population; 25 to 35 g/day	Same as general population; 25 to 35 g/day	Same as general population; 25 to 35 g/day
Fluid	No restriction	1,000 mL/day (+ urine output if present) in HD; greater in PD individualized to fluid status	No restriction; matched to urine output if appropriate

[a]Data from references 7-15 and 28-33.
[b]CKD=chronic kidney disease.
[c]RRT=renal replacement therapy (hemodialysis, peritoneal dialysis).
[d]GFR=glomerular filtration rate.
[e]See special considerations for vegetarians in Pagenkemper.[28]
[f]BW=body weight; see text for discussion of body weight determination factor.
[g]HBV=high biological value.
[h]HD=hemodialysis.
[i]PD=peritoneal dialysis.
[j]To convert mg/dL phosphorus to mmol/L, multiply mg/dL by 0.323. To convert mmol/L phosphorus to mg/dL, multiply mmol/L by 3.10. Phosphorus of 3.10 mg/dL=1.00 mmol/L.

team can help in medication assessment. Salt substitutes contain potassium chloride and should be avoided.[7-9,13,15]

A common dietary interventional strategy to reduce potassium contained in tuberous vegetables (eg, turnip, taro, and potato) is to peel and cut into small pieces to increase surface area and then boil in large amounts of water to leach out potassium content.[41,42] Potassium dietary control is further challenged because it cannot be tasted like "salty" sodium and values are not typically listed on nutrition labels. Dietary modifications should be individualized in relation to these factors.[7-9,15] Underlying infection and other nondietary etiology, such as the medications previously discussed, should be explored.[43]

Phosphorus/Calcium/Parathyroid Hormone. Metabolic changes linked to CKD show elevations of serum parathyroid hormone, calcium, and phosphorus as early as stage 3/G3. These abnormalities subsequently trigger other changes such as increases in fibroblast growth factor-23 and decreases in 1,25-dihydroxyvitamin levels. Recent evidence focuses on the synergy of these abnormalities as an interdependent cohort rather than viewing any interaction and effect separately. Adverse clinical outcomes include mineral and bone disorders, vascular changes linked to calcification, and secondary hyperparathyroidism.[33,44-47]

Maintaining normal serum levels is key to interdisciplinary focus of care. Calcium and phosphorus are widely found in most American diets. Patient awareness and control of dietary sources is an essential education strategy. Nutrition labeling, however, does not typically provide calcium and phosphorus contents, yet many common food additives and preservatives contain them as components. The intake of dairy products often needs to be controlled, which is in direct conflict with the Dietary Approaches to Stop Hypertension diet, which promotes these sources. In addition, fortification of foods with calcium (eg, orange juice) is prevalent.[7-10,15,40,48,49]

Oral phosphate binders are commonly taken to bind dietary phosphorus in the gut, but can also contain substantial amounts of calcium. A recent short-term metabolic study in CKD stages 3 to 4/G3 to G4 suggested the positive calcium balance attained within 3 weeks of prescribing calcium-containing binders can promote soft-tissue calcification.[45]

Fluid. Fluid retention is usually not observed in CKD categories G3 to G4/stages 3 to 4 unless complicated by comorbidities, such as congestive heart failure. In polycystic kidney disease, typically GFR reduction is accompanied by abnormal urine dilution. Patients are typically monitored for rapid increases in weight change unrelated to lean body mass. The health care team needs to work interactively to establish, continually re-evaluate, and coordinate fluid assessment in this population.[7-9,15,29]

Additional Nutrition Components. The majority of CKD patients will require additional dietary modifications to attain and maintain optimal nutrition status. Each patient needs to be assessed and monitored for changes as appropriate, which can be either constant or intermittent. For example, anemia is a common complication of CKD that can be addressed by iron supplementation (diet or intravenous), but is often more effectively treated with medications such as erythropoietin.

Adequate fiber content can aid in gut motility. Phosphate binders and other medications can contribute to constipation, which in turn can promote reabsorption. Most patients can increase the fiber content of their diet through whole-grain cereals, whole grains (eg, barley), or selected fruits and vegetables that contain soluble fiber, such as applesauce, while incorporating potassium-content awareness.[15]

Fish-oil supplementation has been shown to be of some value in patients with immunoglobulin A glomerulonephritis. Research on use of fish oils in other renal populations is largely unexplored on a long-term basis. L-carnitine has not been shown to be effective. Oral nutritional vitamin D has been recommended as with the general population. A CKD-focused multivitamin may be appropriate for daily use.[8,9]

What Are Some Important Metabolic Systems Adapting to CKD Progression?

The gastrointestinal system is an important source of metabolic adaptation during CKD. The absorption of many nutrients and electrolytes are changed in response to declining kidney function. For example, normal kidney function would sense and regulate electrolytes, such as sodium and potassium, through excretion or absorption. In CKD, the gastrointestinal system adapts by potentially providing greater excretion through the stool. Therefore, a healthy gut and timely waste elimination are necessary to prevent colon reabsorption back into the serum during constipation.[43,44] Constipation can be reduced by evaluating the type and amount of dietary fiber, particularly when fluid is controlled. The use of prebiotics and probiotics has been marginally studied.

Phosphate binders are prescribed to maintain normal serum phosphorus in conjunction with dietary restriction. The binders "grab" the dietary phosphorus present in the gastrointestinal tract and eliminate it through the stool, avoiding absorption into the bloodstream. Timing of the binder with the phosphorus-containing food is the key to efficacy.[8,10,15,33,48] A common education technique is using a small re-sealable plastic bag representing the binder with a small object inside representing a food item. This illustrates how the food must be present at the same time as the binder so the phosphorus in the food can be "contained" by the binder and moved out of the body without absorption.

What Are Some Considerations in Patients Who Have CKD and Diabetes?

Generalist RDNs often encounter patients with diabetes in various categories of CKD risk. The 2012 US Renal Data System annual report using the 2005-2010 National Health and Nutrition Examination Survey data observed a fourfold CKD risk in patients with diabetes compared with patients without diabetes, along with a 29.1% incidence of CKD (stage 2/G2 with persistent albuminuria of >30 mg/g) in patients with diabetes.[5] Kidney damage often occurs slowly over time, even before key metabolic biomarkers can indicate risk. The goal of glycemic control in CKD categories G3 to G4/stages 3 to 4 is to achieve a hemoglobin A1c goal of $\leq 7\%$.[7-9,14,15,47,50]

What Are Physical Activity Guidelines for Patients Who Have CKD?

Physical activity should be encouraged to both promote and maintain muscle mass and general overall health. The level of physical activity should be matched to the patient ability. Regular activity, particularly post transplantation, may aid in obesity control.[51]

What Are Some Patient Education Resources or Compliance Strategies for This Population?

Strategies in CKD are similar to other chronic disease conditions. A recent commentary on the dietary debate in chronic obesity management emphasized the only consistent finding among clinical trials was the degree of patient adherence and motivation regardless of the intervention chosen.[52] Eating is a daily challenge. Food habits are complicated and often seasonal. Time constraints often make gathering comprehensive dietary intake information difficult. It is necessary to incorporate an integrative understanding of cultural and community issues, such as cost, access, familiarity, health literacy, family setting.[23,48]

Available technology (eg, cell phone capabilities, "apps," text alerts, online "face" time with caregivers) can promote active patient involvement rather than passive learning. The multidimensional data gathered can help gain a broad assessment of barriers and opportunities. Interactive actions, such as health coaching, motivational interviewing, peer mentoring, and self-management tools, can help involve the patient in constructive solutions.[20,25,53,54]

As kidney failure progresses, the current dietary environment and balance must undergo constant evaluation and nutrient priority assessment. An RDN, even at the generalist level, can help patients control and potentially delay CKD progression in stages 3 to 4/G3 to G4.[7-9,15,25] There are many resources available to the generalist RDN for application to CKD patients.[7-16,25,33,48,55,56]

RECOMMENDATIONS FOR PRACTICE IMPROVEMENT AND RESEARCH

What Are Some Opportunities for Practice?

A recent study of adults who started dialysis between 2005 and 2007 reported 88% had not seen an RDN until dialysis was initiated. Patients who had seen an RDN in the 12 months before dialysis had a 19% relative risk reduction of death.[27] Clearly, the need for more aggressive awareness and referral is warranted.

There are strict guidelines for CMS billing, including maximum billing hours. Patients must meet clear criteria (diabetes type 1, 2, or gestational; CKD; and 6 to 36 months post transplantation). RDNs must become Medicare providers and a physician referral is currently required. The ability to access laboratory values and medication records is often dependent on the practice setting and health team relationships. The scope of practice of a generalist RDN includes this important role in CKD management.[7]

What Are Some Opportunities for Research?

The published literature lacks well-designed studies and long-term data on the cost efficacy of services rendered to the CKD population by RDNs. Sustained motivation is necessary to achieve treatment goals. There is limited research in the chronic education setting directly linking RDN services to delay or slowing of kidney function progression, decreased hospitalization (morbidity), and/or mortality. Additional research is also needed in areas such as probiotic and prebiotic use, management of malnutrition and inflammation, and use of antioxidant-rich foods. Most of the early metabolic studies were completed several decades ago and might not represent today's diet, nutrition, and lifestyle issues. Both qualitative and quantitative data are needed that document the essential role of an RDN.

A recent study linked higher diet quality with Americans who had diet-related chronic diseases.[57] The role of the RDN in CKD as a chronic disease education opportunity is vast. Although CKD is very complex, early intervention has been shown to be effective. RDN services are covered using CMS guidelines for stages 3 to 4/G3 to G4, as well as stage 5/G5 kidney failure. There is a large cohort of evidence-based guidelines that have been highlighted in this article and directed toward generalist RDN practice. The generalist RDN has an exciting opportunity to become a very visible reimbursed health care team member central to the care of CKD patients.

References

1. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. http://www.kidney.org/professionals/kdoqi/guidelines_ckd/toc.html. Accessed February 15, 2013.
2. Kidney Disease Improving Global Outcomes. 2012 Clinical practice guideline for the evaluation and management of chronic kidney disease. http://www.kidgo.org/clinical_practice_guidelines/CKD.php. Accessed May 30, 2013.
3. Department of Health and Human Services, Centers for Medicare and Medicaid Services. Transmittal B-01-48, August 2001. http://www.cms.gov/Regulations_and_Guidance/Guidance/Transmittals/downloads/B0148.pdf. Accessed February 15, 2013.
4. Klahr S, Levey AS, Betch GJ, et al, for the Modification of Diet in Renal Disease Study Group. The effects of dietary protein restriction and blood-pressure control on the progression of chronic renal disease. *N Engl J Med*. 1994;330(13):877-884.
5. US Renal Data System. *USRDS 2012 Annual Data Report: Atlas of End-Stage Renal Disease in the United States*. Bethesda, MD: National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health; 2012.
6. US Department of Health and Human Services, Centers for Medicare and Medicaid Services, 42 CFR Parts 405, 410, 413, et al. Medicare and Medicaid Programs: Conditions for Coverage for End-Stage Renal Disease Facilities: Final Rule. Federal Register, April 15, 2008.
7. The Joint Standards Task Force of the American Dietetic Association Renal Dietitians Dietetic Practice Group and the National Kidney Foundation Council on Renal Nutrition. American Dietetic Association and the National Kidney Foundation Standards of Practice and Standards of Professional Performance for Registered Dietitians (Generalist, Specialty, and Advanced) in Nephrology Care. *J Am Diet Assoc*. 2009;109(9):1617-1625.
8. Academy of Nutrition and Dietetics Evidence Analysis Library. Chronic kidney disease. Evidence-based nutrition practice guideline. June 2010. http://andevidencelibrary.com/topic.cfm?cat=3927. Published June 2010. Accessed June 15, 2012.
9. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines for nutrition in chronic renal failure. http://www.kidney.org/professionals/kdoqi/guidelines_updates/doqi_nut.html. Accessed February 15, 2013.
10. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines for bone and mineral management. http://www.kidney.org/professionals/kdoqi/guidelines_bond/index.html. Accessed February 15, 2013.

11. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines for management of dyslipidemias in patients with kidney disease. http://www.kidney.org/professionals/kdoqi/guidelines_lipids/index.html. Accessed February 15, 2013.
12. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines for cardiovascular disease in dialysis patients. http://www.kidney.org/professionals/kdoqi/guidelines_cvd/index.html. Accessed February 15, 2013.
13. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines on hypertension and antihypertensive agents in chronic kidney disease. http://www.kidney.org/professionals/kdoqi/guidelines_bp/index.html. Accessed February 15, 2013.
14. National Kidney Foundation. Kidney Disease Outcomes Quality Initiative clinical practice guidelines for diabetes and chronic kidney disease. http://www.kidney.org/professionals/kdoqi/guidelines_diabetes-ckd-update=2012.pdf Accessed February 15, 2013.
15. Byham-Gray L, Stover J, Wiesen K, eds. *Renal Dietitians Dietetic Practice Group of the Academy of Nutrition and Dietetics and the Council on Renal Nutrition of the National Kidney Foundation. A Clinical Guide to Nutrition Care in Kidney Disease*. 2nd ed. Chicago, IL: The Academy of Nutrition and Dietetics; 2013.
16. *International Dietetics and Nutritional Terminology (IDNT) Reference Manual*. 4th ed. Chicago, IL: Academy of Nutrition and Dietetics; 2012.
17. Hallan SI, Matsushita K, Sang Y, et al. Age and association of kidney measures with mortality and end-stage renal disease. *JAMA*. 2012;308(22):2349-2360.
18. Kopple JD, Feroze U. The effect of obesity on chronic kidney disease. *J Ren Nutr*. 2011;21(1):66-71.
19. Earley A, Miskulin D, Lamb EJ, Levey AS, Uhlig K. Estimating equations glomerular filtration rate in the era of creatinine standardization: A systematic review. *Ann Intern Med*. 2012;156(11):785-795.
20. Holli BB, Beto JA. *Nutrition Counseling and Education Skills for Dietetics Professionals*. 6th ed. Philadelphia, PA: Wolter Kluwer, Lippincott Williams and Wilkins; 2013.
21. Physicians' Desk Reference. http://www.pdrnet.com. Accessed January 15, 2013.
22. Bidani AK, Griffin KA, Epstein M. Hypertension and chronic kidney disease progression: Why the suboptimal outcomes? *Am J Med*. 2012;125(12):1057-1062.
23. Upadhyay A, Earley A, Haynes SM, Uhlig K. Systemic review: Blood pressure target in chronic kidney disease and proteinuria as an effect modifier. *Ann Intern Med*. 2011;154(8):541-548.
24. Grubbs V, Plantinga LC, Tuoi SC, et al, on behalf of the Centers for Disease Control and Prevention CKD Surveillance Team. Americans' use of dietary supplements that are potentially harmful in CKD. *Am J Kidney Dis*. 2013;61(5):739-747.
25. Browne T, Menghi JR. Barriers to adult hemodialysis patients' self-management of oral medications. *Am J Kidney Dis*. 2010;56(3):547-557.
26. Memmer D. Implementation and practical application of the nutrition care process in the dialysis unit. *J Ren Nutr*. 2013;23(1):65-73.
27. Slinin Y, Guo H, Gilbertson DT, et al. Prehemodialysis care by dietitians and first-year mortality after initiation of hemodialysis. *Am J Kidney Dis*. 2011;58(4):583-590.
28. Pagenkemper J. Vegetarian diets in chronic kidney disease. *Ren Nutr Forum*. 2012;31(2):21-23.
29. Harvey KS. Methods for determining healthy body weight in ESRD. *J Ren Nutr*. 2006;16(3):269-279.
30. Carrero JJ, Stenvickel P, Cupparti L, et al. Etiology of the protein-energy wasting syndrome in chronic kidney disease: A consensus statement from the International Society of Renal Nutrition and Metabolism (ISRNM). *J Ren Nutr*. 2013;23(2):77-90.
31. Beto JA, Bansal VK, Ramirez WE. Dyslipidemia. In: Byham-Gray L, Burrowes JD, Chertow GM, eds. *Nutrition in Kidney Disease*. 2nd ed. New York, NY: Springer Science and Business Media. http://dx.doi.org/10.1007/978-1-62703-685-6_9.
32. Institute of Medicine of the National Academies. Report on sodium intake in populations: Assessment of evidence. http://www.iom.med/Reports/2013/Sodium-Intake-in-Populations-Assessment-of-Evidence.aspx. Accessed June 10, 2013.
33. McCann L. Interpreting and applying the Kidney Disease Improving Global Outcomes (KDIGO) Guidelines for Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD): A guide for renal dietitians. *Ren Nutr Forum*. 2012;31(1):1-13.
34. Kalantar-Zadeh K, Streja E, Molnar EZ, et al. Mortality prediction by surrogates of body composition: An examination of the obesity paradox in hemodialysis patients using composite ranking score analysis. *Am J Epidemiol*. 2012;175(8):793-803.
35. Kalantar-Zadeh K, Kopple JD, Block G, Humphreys MH. A malnutrition-inflammation score is correlated with morbidity and mortality in maintenance hemodialysis patients. *Am J Kidney Dis*. 2001;38(6):1251-1263.
36. Majorowicz RR. Nutrition management of gastric bypass in patients with chronic kidney disease. *Ren Nutr Forum*. 2012;31(2):1-7.
37. Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: The American Heart Association's strategic impact goal through 2020 and beyond. *Circulation*. 2010;121(4):586-613.
38. Palmer SC, Craig JC, Navaneethan SD, Tonelli M, Pellegrinin F, Strippoli GF. Benefits and harms of statin therapy for persons with chronic kidney disease. *Ann Intern Med*. 2012;157(4):263-275.
39. Upadhyay A, Earley A, Lamont JL, Haynes S, Wanner C, Balk EM. Lipid-lowering therapy in persons with chronic kidney disease. *Ann Intern Med*. 2012;157(4):251-262.
40. US Department of Health and Human Services. DASH eating plan. http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf/ Accessed February 5, 2013.
41. Bethke PC, Jansky SH. The effects of boiling and leaching on content of potassium and other minerals in potatoes. *J Food Sci*. 2008;75(8):H80-H85.
42. Burrowes JA, Ramen NJ. Removal of potassium from tuberous vegetables by leaching. *J Ren Nutr*. 2006;16(4):304-311.
43. Beto J, Bansal V. Hyperkalemia: Evaluating dietary and nondietary etiology. *J Ren Nutr*. 1992;2(1):28.
44. Evenepoel P, Wolf M. A balanced view of calcium and phosphate homeostasis in chronic kidney disease. *Kidney Int*. 2013;83(5):789-791.
45. Hill KM, Martin BR, Wastney ME, et al. Oral calcium carbonate affects calcium but not phosphorus balance in stage 3-4 chronic kidney disease. *Kidney Int*. 2013;83(5):959-966.
46. Alvarez JA, Law J, Coakley KE, et al. High-dose cholecalciferol reduces parathyroid hormone in patients with early chronic kidney disease: A pilot, randomized, double-blind, placebo-controlled trial. *Am J Clin Nutr*. 2012;96(3):672-679.
47. Kovesdy CP, Lu JL, Malakauskas SM, Andress DL, Kalantar-Zadeh K, Ahmadzadeh S. Paricalcitol versus ergocalciferol for secondary hyperparathyroidism in CKD categories G 3 and 4: A randomized controlled trial. *Am J Kidney Dis*. 2012;59(1):58-66.
48. Calderia D, Amaral T, David C, Sampaio C. Educational strategies to reduce serum phosphorus in hyperphosphatemic patients with chronic kidney disease: A systematic review with meta-analysis. *J Ren Nutr*. 2011;21(4):285-294.
49. Kalantar-Zadeh K, Guekunst L, Mehrotra R, et al. Understanding sources of dietary phosphorus in the treatment of patients with chronic kidney disease. *Clin J Am Soc Nephrol*. 2010;5(3):519-530.
50. Raffaitin C, Lasseur C, Chauveau P, et al. Nutritional status in patients with diabetes and kidney disease: A prospective study. *Am J Clin Nutr*. 2007;85(1):96-101.
51. Johansen KL, Painter P. Exercise in individuals with CKD. *Am J Kidney Dis*. 2012;59(1):126-134.
52. Pagato SL, Appelhans BM. A call for the end to the diet debates. *JAMA*. 2013;310(7):687-688.
53. Melko CN, Terry PE, Camp K, Xi M, Healey ML. Diabetes health coaching improves medication adherence: A pilot study. *Am J Lifestyle Med*. 2010;4(1):187-194.
54. Paes-Barreto JG, Silva MI, Qureshi AR, et al. Can renal nutrition education improve adherence to a low-protein diet in patients with stage 3 to 5 chronic kidney disease? *J Ren Nutr*. 2013;23(3):164-171.
55. American Kidney Fund. Take charge: Protect your kidneys. http://www.kidneyfund.org. Accessed February 15, 2013.
56. National Institutes of Health. National Kidney Disease Education Program. http://nkdep.nih.gov. Accessed July 15, 2012.
57. Chen X, Cheskin LJ, Shi L, Wang Y. Americans with diet-related chronic diseases report higher diet quality than those without these diseases. *J Nutr*. 2011;141(8):1543-1551.

AUTHOR INFORMATION

J. A. Beto is a research associate and V. K. Bansal is medical director, dialysis, Loyola Healthcare System, Maywood, IL. W. E. Ramirez is a clinical pharmacist, Evergreen Healthcare System, Kirkland, WA.

Address correspondence to: Judith A. Beto, PhD, RDN, FAND, LD, Dialysis, Loyola University Healthcare System, 1201 Roosevelt Rd, Maywood, IL 60153. E-mail: jbeto@lumc.edu

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

There is no funding to disclose.