Nutrition and Kidney Disease – Filtering Through the Stages
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Objectives
• Identify the diet recommendations for the stages of Chronic Kidney Disease (CKD)
  • Review the Stages of CKD
  • Understand the levels of protein, calories, sodium, phosphorus, potassium and fluid needs for the stages of CKD
  • Understand the vitamin/mineral derangements with the stages of CKD and recommended interventions
• Understand the effect CKD on common medications in diabetes

Resources for Information
• National Kidney Foundation (NKF) Kidney Disease Outcomes Quality Initiative (KDOQI)
  www.kidney.org
  • Clinical Guideline for Diabetes and Chronic Kidney Disease, 2007 (update to be released spring/summer 2012)
  • Clinical Guideline for Nutrition in Chronic Kidney Disease, 2000
  • Pocket Guide to Nutrition Assessment of the Patient with Chronic Kidney Disease, 4th edition, 2009

Resources for Information
• Academy of Nutrition and Dietetics (formerly American Dietetic Association)
  • Chronic Kidney Disease Evidence-Based Nutrition Practice Guidelines, 2010
    www.and evidencelibrary.com
  • Byham-Gray, L and K Weisen; A Clinical Guide to Nutrition Care in Kidney Disease, 2004 (update available summer/fall 2012)
    www.eatright.org/store
  • Franz, MJ, J Boucher and R Franzini Pereira; Lipid Disorders, Hypertension, Diabetes, and Weight Management, 2011
    www.eatright.org/store

Stages of Chronic Kidney Disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Goals (goals in parentheses)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incipient</td>
<td>may be normal (eGFR &gt; 60)</td>
<td>Evaluation</td>
</tr>
<tr>
<td>2</td>
<td>Established</td>
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<td>Education</td>
</tr>
<tr>
<td>3a</td>
<td>Moderately</td>
<td>may be reduced (eGFR 60-79)</td>
<td>Reduction</td>
</tr>
<tr>
<td>3b</td>
<td>Moderately</td>
<td>may be reduced (eGFR 60-79)</td>
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<tr>
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<td>Severe</td>
<td>may be severe (eGFR 30-59)</td>
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<tr>
<td>5a</td>
<td>Advanced</td>
<td>may be severe (eGFR 30-59)</td>
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</tr>
<tr>
<td>5b</td>
<td>Advanced</td>
<td>may be severe (eGFR 30-59)</td>
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NKF KDOQI Clinical Guideline for Diabetes and Chronic Kidney Disease
• Published in 2007
  • Screening for Diabetic Kidney Disease (DKD)
  • Management of Hyperglycemia
  • Management of Hypertension
  • Management of Hyperlipidemia
  • Nutritional Management
  • Management of Albuminuria
  • Multifaceted Approach to Intervention
  • Diabetes and CKD in Special Populations
  • Behavioral Self-Management
Unpublished 2011 Update to 2007 Guideline
- Represents literature review as of December 2011
- 7 questions were asked around glycemic control, lipid management, and interventions around albuminuria
- Unable to report guidelines prior to publication
  www.kidney.org

Screening for Diabetic Kidney Disease (DKD)
- 5 years after the diagnosis of Type 1
- At time diagnosis of Type 2
  - Urinary albumin-creatinine ratio (ACR) in a spot urine test
  - Serum creatinine and estimation of Glomerular Filtration Rate (eGFR)
- Elevated ACR
  - Microalbuminuria – ACR 30-300 mg/g
  - Macroalbuminuria – ACR >300 mg/g

Management of Hyperglycemia ***
- Target Hgb A1c >7.0 %

Management of Hypertension
- Persons with diabetes and hypertension stages 1-4 should be treated with an ACE inhibitor or an ARB, usually in combination with a diuretic
- Target blood pressure should be <130/80 mm Hg

Management of Hyperlipidemia ***
- Target low-density lipoprotein cholesterol in persons with Stage 1-4 CKD should be <100 mg/dL
- People with Stage 1-4 CKD with a LDL cholesterol ≥ 100 mg/dL should be treated with a statin
- Treatment with a statin should not be initiated in patients with Type 2 DM on maintenance hemodialysis UNLESS there is a specific cardiovascular indicator for treatment

Nutritional Management
- Target dietary protein intake (Stages 1-4)
  - 0.8 g protein per kg of body weight per day
  - Reduction in albuminuria
  - Stabilization of kidney function
  - High-protein diets increase albuminuria and may accelerate loss of kidney function
    - Glomerular hyperfiltration
  - Increase in carbohydrates and/or fats required for adequate calorie intake
  - Increase omega-3 and monounsaturated fats
Nutritional Management

- Intervention from a specialty-trained registered dietitian that includes individualized management of multiple nutritional aspects
  - At the time of diagnosis of CKD
  - Quarterly or as indicated
- Recommendations for other nutrient modifications are the same with or without diabetes
  - 2.3 grams sodium per day
  - Potassium and phosphorus restriction as indicated

Management of Albuminuria

- Normotensive people with diabetes and macroalbuminuria should be treated with an ACE inhibitor or an ARB
- Treatment with an ACE inhibitor or an ARB should be considered in normotensive people with microalbuminuria

Multifaceted Approach to Intervention

- Care of persons with DM and CKD should incorporate a multifaceted approach to intervention that includes instruction in healthy behaviors and treatment of risk factors
  - e.g., Therapeutic life style – diet and physical activity

Diabetes and CKD in Special Populations

- Screening and interventions should focus on populations at greatest risk
- Special considerations in the treatment of children, adolescents, and the elderly
- Specialist in high-risk pregnancy and kidney disease should co-manage pregnancy in women with diabetes and CKD
  - Treatment with RAS inhibitors before pregnancy may improve fetal and maternal outcomes; discontinued when pregnant
  - Insulin should be used to control hyperglycemia if a medication is needed
**Overall Guideline Objective**

- To provide MNT guidelines for chronic kidney disease to prevent and treat protein-energy malnutrition, mineral and electrolyte disorders, and to minimize the impact of other comorbidities on the progression of kidney disease, e.g., diabetes, obesity, hypertension and disorders of lipid metabolism.

**Target Population**

**Target Population Description**
Adults with Chronic Kidney Disease (CKD) (CKD stages 1 - 5, including post kidney transplant) not on dialysis.

Workgroup Completed Guidelines August 2010 (literature search through xxx)

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**CKD Guideline Topics**

- Medical Nutrition Therapy (Non-Dialysis)
- Assessment of Food/Nutrition-Related History
- Anthropometric Assessment Options
- Assessment of Biochemical Parameters
- Assess CKD-Mineral and Bone Disorders
- Assessment of Medical/Health History
- Protein Intake
- Energy Intake
- Phosphorus
- Calcium
- Vitamin D Therapy
- Anemia
- Management of Hyperglycemia in Diabetes and CKD
- Multi-Faceted Approach to Intervention in Diabetes and CKD
- Multi-Faceted Approach to Intervention in Dyslipidemias and CKD
- Education on Self-Management Behaviors
- Sodium
- Fish Oil/Omega-3 Fatty Acids
- Physical Activity
- Coordination of Care
- Multivitamin Supplementation
- Potassium
- Monitor and Evaluate Biochemical Parameters
- Monitor and Evaluate Adherence to Nutrition and Lifestyle

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**Executive Summary of Recommendations**

- Management of Hyperglycemia in Diabetes and CKD
- Multi-Faceted Approach to Intervention in Diabetes and CKD
- Multi-Faceted Approach to Intervention in Dyslipidemias and CKD
- Education on Self-Management Behaviors
- Sodium
- Fish Oil/Omega-3 Fatty Acids
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**CKD: Medical Nutrition Therapy**

- Medical nutrition therapy (MNT)
  - Individuals with chronic kidney disease (CKD, Stages One to Five including post-kidney transplant)
  - Prevents and treats protein-energy malnutrition and mineral and electrolyte disorders and minimizes the impact of other comorbidities on the progression of kidney disease (e.g., diabetes, obesity, hypertension and disorders of lipid metabolism)
  - Studies regarding effectiveness of MNT report significant improvements in anthropometric and biochemical measurements sustained for at least one year.

**Strong Imperative**
CKD: Initiation of Medical Nutrition Therapy

- Referral for MNT per federal or state guidelines
  - Initiated at diagnosis of CKD, in order to maintain adequate nutritional status, prevent disease progression and delay renal replacement therapy (RRT)
  - Initiated at least 12 months prior to the anticipation of RRT (dialysis or transplant).

Strong Imperative

CKD: Frequency of Medical Nutrition Therapy

- Monitor the nutritional status of individuals with CKD every one to three months and more frequently if there is:
  - Inadequate nutrient intake, protein-energy malnutrition, mineral and electrolyte disorders or the presence of an illness that may worsen nutritional status, as these are predictive of increased mortality risk.
  - Research related to the time requirements for MNT
  - Approximately two hours per month for up to one year may be required to provide an effective intervention for adults with CKD.

Strong Conditional

CKD: Initial Assessment and Re-Assessment of Food/Nutrition-Related History

- Assess the food- and nutrition-related history of adults with chronic kidney disease (CKD, including post kidney transplant), including but not limited to the following:
  - Food and nutrient intake (e.g., diet history, diet experience and intake of macronutrients [and micronutrients, such as energy, protein, sodium, potassium, calcium, phosphorus, and others], as appropriate)
  - Medication (prescription and over-the-counter), dietary supplements (vitamin, minerals, protein, etc.), herbal or botanical supplement use

Consensus Imperative

CKD: Use Clinical Judgment in Assessing Body Weight

- Absence of standard reference norms in the chronic kidney disease population (CKD, including post kidney transplant)
  - Clinical judgment to determine which data to include in estimations of body weight:
    - Actual measured weight
    - History of weight changes (both long-term and recent)
    - Serial weight measurements, monitored longitudinally
    - Adjustments for suspected impact of edema, ascites and polycystic organs.

Consensus Imperative
CKD: Use Clinical Judgment in Assessing Body Weight

Body weight estimates are used for calculation of nutritional needs, such as protein and energy requirements. Body weight can be difficult to determine because as kidney function declines, the ability to regulate fluid balance may be compromised and multiple factors must be considered.

CKD: Use Published Weight Norms with Caution

Other published weight norms in the anthropometric assessment of individuals with CKD (including post kidney transplant), but each norm has significant drawbacks and must be used with caution:

- **Ideal body weight (IBW)**
  - Associated with the lowest mortality for a given height, age, sex and frame size and is based on the Metropolitan Life Insurance Height and Weight Tables. [Caution: Not generalizable to the CKD population and data-gathering methods were not standardized.]

- **Hamwi Method**
  - Determines the optimal body weight. [Caution: A quick and easy method for determining optimal body weight, but has no scientific data to support its use.]

- **Standard Body Weight, NHANES II (SBW as per KDOQI Nutrition Practice Guidelines)**
  - Describes the median body weight of average Americans from 1976 to 1980 for height, age, sex and frame size. [Caution: Although data is validated and standardized and uses a large database of ethnically-diverse groups, data is provided only on what individuals weigh, not what they should weigh in order to reduce morbidity and mortality.]

- **Body Mass Index (BMI)**
  - Defines generalized obesity and CKD research, specific to dialysis patients, has identified that patients at higher BMIs have a lower mortality risk. [Caution: The researchers may not have statistically adjusted for all confounders related to comorbid conditions occurring in CKD on dialysis (diabetes, malignancy, etc) and it is unclear how it may relate to CKD patients not on dialysis.]

- **Adjusted Body Weight (ABW)**
  - Based on the theory that 25% of the excess body weight (adipose tissue) in obese patients is metabolically active tissue. KDOQI supports the concept of subtracting 25% for obese patients and adding 25% for underweight patients. [Caution: This has not been validated for use in CKD and may either overestimate or underestimate energy and protein requirements.]

CKD: Assessment of Body Composition

Studies suggest that CKD patients exhibit altered body composition, as compared to healthy individuals.
CKD: Methodologies for Body Composition Assessment

• No reference standard for assessing body composition in CKD patients and studies do not show that any one test is superior to another in assessing body composition among CKD patients

• Any valid measurement methodology, such as anthropometrics (including waist circumference and body mass index) and body compartment estimates

Fair
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CKD: Assess Biochemical Parameters

Assess various biochemical parameters in adults with chronic kidney disease (CKD, including post-kidney transplant), related to:

• Glycemic control
• Protein-energy malnutrition
• Inflammation
• Kidney function
• Mineral and bone disorders
• Anemia
• Dyslipidemia
• Electrolyte disorders
• Others as appropriate.

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CKD: Assess CKD-Mineral and Bone Disorders

• Assess measurements of mineral and bone disorders (MBD) in adults with chronic kidney disease (CKD, including post kidney transplant) for prevention and treatment

• Adults with CKD have altered mineral-bone metabolism and increased risk of vascular disease.

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CKD: Protein Intake for Diabetic Nephropathy

• Protein-controlled diet providing 0.8g to 0.9g of protein per kg of body weight per day

• Providing dietary protein at a level of 0.7g per kg of body weight per day may result in hypoalbuminemia

• Research reports that protein-restricted diets improved microalbuminuria.

Fair
Conditional

CKD: Protein Intake for Kidney Transplant

• For adult kidney transplant recipients (after surgical recovery, with an adequately functioning allograft)

• 0.8g to 1.0g per kg of body weight per day for protein intake, addressing specific issues as needed

• Adequate, but not excessive, protein intake supports allograft survival and minimizes impact on comorbid conditions.

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**CKD: Energy Intake**

• 23kcal to 35kcal per kg of body weight per day, based on the following factors:
  • Weight status and goals
  • Age and gender
  • Level of physical activity
  • Metabolic stressors

  Research reports that energy intakes between 23kcal to 35kcal per kg body weight per day are adequate to prevent signs of malnutrition.

  Fair
  Imperative

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**CKD: Phosphorus**

For adults with chronic kidney disease (CKD Stages Three to Five), the registered dietitian (RD) should recommend or prescribe a low-phosphorus diet providing 800mg to 1,000mg per day or 10mg to 12mg phosphorus per gram of protein. CKD patients have a predisposition for mineral and bone disorders. Phosphorus control is the cornerstone for the treatment and prevention of secondary hyperparathyroidism, renal bone disease and soft tissue calcification.

  Strong
  Conditional

**CKD: Adjust Phosphate Binders**

For adults with CKD (Stages Three to Five), the dose and timing of phosphate binders should be individually adjusted to the phosphate content of meals and snacks to achieve desired serum phosphorus levels. Serum phosphorus levels are difficult to control with dietary restrictions alone.

  Strong
  Conditional

**CKD: Phosphorus Management for Kidney Transplant**

For adult kidney transplant recipients exhibiting hypophosphatemia, the registered dietitian (RD) should recommend or prescribe a high-phosphorus intake (diet or supplements) to replete serum phosphorus as needed. Hypophosphatemia is common post kidney transplant.

  Consensus
  Conditional

**CKD: Calcium**

For adults with chronic kidney disease (CKD Stages Three to Five, including post kidney transplant), the registered dietitian (RD) should recommend a total elemental calcium intake (including dietary calcium, calcium supplementation and calcium-based phosphate binders) not exceeding 2,000mg per day. CKD patients have a predisposition for mineral and bone disorders. Serum calcium concentration is the most important factor regulating parathyroid hormone (PTH) secretion affecting bone integrity and soft tissue calcification.

  Consensus
  Conditional

**CKD: Calcium**

For adults with chronic kidney disease (CKD Stages Three to Five, including post kidney transplant), the registered dietitian (RD) should recommend a total elemental calcium intake (including dietary calcium, calcium supplementation and calcium-based phosphate binders) not exceeding 2,000mg per day. CKD patients have a predisposition for mineral and bone disorders. Serum calcium concentration is the most important factor regulating parathyroid hormone (PTH) secretion affecting bone integrity and soft tissue calcification.

  Consensus
  Conditional
**CKD: Iron Supplementation**

In adults with chronic kidney disease (CKD, including post kidney transplant), the registered dietitian (RD) should recommend oral or IV iron administration if serum ferritin is below 100ng per ml and TSAT is below 20%. CKD patients have a predisposition for anemia. Sufficient iron should be recommended to maintain adequate levels of serum iron to support erythropoiesis.

Consensus
Conditional

**CKD: Vitamin B12 and Folic Acid for Anemia**

In adults with CKD (including post kidney transplant), the RD should recommend vitamin $B_12$ and folic acid supplementation if the MCV is over 100ng per ml and serum levels of these nutrients are below normal values. CKD patients have a predisposition for anemia and all potential causes should be investigated.

Consensus
Conditional

**CKD: Vitamin C for Treatment of Anemia**

If the use of vitamin C supplementation is proposed as a method to improve iron absorption for adults with CKD (including post kidney transplant) who are anemic, the RD should recommend the DRI for vitamin C. There is insufficient evidence to recommend the use of vitamin C supplementation above the DRI in the management of anemia in patients with CKD, due to risk of hyperoxalosis.

Consensus
Conditional

**CKD: L-Carnitine for Treatment of Anemia**

For adults with CKD (including post kidney transplant) who are anemic, the RD should not recommend L-carnitine supplementation. There is insufficient evidence to recommend the use of L-carnitine in the management of anemia in adults with CKD including post kidney transplant.

Consensus
Conditional

**CKD: Management of Hyperglycemia in Diabetes and CKD**

For adults with diabetes and chronic kidney disease (CKD, including post kidney transplant), the registered dietitian (RD) should implement medical nutrition therapy (MNT) for diabetes care to manage hyperglycemia to achieve a target A1C of approximately 7%. Intensive treatment of hyperglycemia, while avoiding hypoglycemia, prevents diabetic kidney disease (DKD) and may slow progression of established kidney disease.

Strong
Conditional

**CKD: Multi-Faceted Approach to Intervention in Diabetes and CKD**

For adults with diabetes and chronic kidney disease (CKD, including post kidney transplant), the registered dietitian (RD) should implement Medical Nutrition Therapy (MNT) using a multi-faceted approach, including education and counseling in healthy behaviors, treatment to reduce risk factors and self-management strategies. Multiple risk factors are managed concurrently in adults with diabetes and CKD and the incremental effects of treating each of these risk factors results in substantial clinical benefits.

Consensus
Conditional
CKD: Multi-Faceted Approach to Intervention in Dyslipidemias and CKD
For adults with dyslipidemia and chronic kidney disease (CKD, including post kidney transplant), the registered dietitian (RD) should implement medical nutrition therapy (MNT), using a multi-faceted approach, including education and counseling in therapeutic lifestyle changes (TLC), treatment to reduce risk factors and self-management strategies. Multiple risk factors are managed concurrently in adults with dyslipidemia and CKD and the incremental effects of treating each of these risk factors results in substantial clinical benefits.

Fair
Conditional

CKD: Education on Self-Management Behaviors
For individuals with chronic kidney disease (CKD, including post kidney transplant), the registered dietitian (RD) should provide education and counseling regarding self-management behaviors. Therapy must take into consideration the patient's perception of the health-care provider's advice and prescriptions, factors that may influence self-management behaviors and the likelihood that the patient will adhere to recommendations.

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CKD: Control Sodium Intake in CKD
For adults with chronic kidney disease (CKD) including post-kidney transplant, the Registered Dietitian (RD) should recommend/prescribe a sodium intake of less than 2.4g (Stages One to Five), with adjustments based on the following:
- Blood pressure
- Medications
- Kidney function
- Hydration status
- Acidosis
- Glycemic control
- Catabolism
- Gastrointestinal issues, including vomiting, diarrhea and constipation.

Dietary and other therapeutic lifestyle modifications are recommended as part of a comprehensive strategy to reduce cardiovascular disease risk in adults with CKD.

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CKD: Fish Oil/Omega-3 Fatty Acids
If the use of fish oil or omega-3 fatty acid supplementation is proposed as a method to improve renal function, the registered dietitian (RD) should advise on the conflicting evidence regarding effectiveness of this strategy. Research reports that renal outcomes were inconsistent among patients with IgA nephropathy who received fish oil supplementation. There is insufficient evidence to support fish oil therapy to improve renal function and patient or graft survival for kidney transplant patients. However, evidence does support a benefit of fish oil supplementation in reducing oxidative stress and improving lipid profile in adults with chronic kidney disease (CKD, including post kidney transplant).

Fair
Conditional

CKD: Physical Activity
If not contraindicated, the registered dietitian (RD) should encourage adults with chronic kidney disease (CKD, including post kidney transplant), to increase frequency or duration of physical activity as tolerated. Studies report that physical activity may minimize the catabolic effects of protein restriction and improve quality of life.

Fair
Conditional
CKD: Coordination of Care

For adults with chronic kidney disease (CKD, including post-kidney transplant), the Registered Dietitian (RD) should implement Medical Nutrition Therapy (MNT) and coordinate care with an interdisciplinary team, through:

- Requesting appropriate data (biochemical and other)
- Communicating with referring provider
- Indicating specific areas of concern or needed reinforcement.

This approach is necessary to effectively integrate MNT into overall management for patients with CKD

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CKD: Multivitamin Supplementation

In adults with chronic kidney disease (CKD, including post-kidney transplant), with no known nutrient deficiency (biochemical or physical) and who may be at higher nutritional risk due to poor dietary intake and decreasing GFR, the registered dietitian (RD) should recommend or prescribe a multivitamin preparation. Sufficient vitamin supplementation should be recommended to maintain indices of adequate nutritional status

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CKD: Control Potassium Intake in CKD

For adults with chronic kidney disease (CKD), including post-kidney transplant who exhibit hyperkalemia, the registered dietitian (RD) should recommend or prescribe a potassium intake of less than 2.4g (Stages Three to Five), with adjustments based on the following:

- Serum potassium level
- Blood pressure
- Medications
- Kidney function
- Hydration status
- Acidosis

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CKD: Control Potassium Intake in CKD

- Glycemic control
- Catabolism
- Gastrointestinal (GI) issues, including vomiting, diarrhea, constipation and GI bleed.

Dietary and other therapeutic lifestyle modifications are recommended as part of a comprehensive strategy to reduce cardiovascular disease risk in adults with CKD. The degree of hypokalemia or hyperkalemia can have a direct effect on cardiac function, with potential for cardiac arrhythmia and sudden death.

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CKD: Monitor and Evaluate Biochemical Parameters

The registered dietitian (RD) should monitor and evaluate various biochemical parameters in adults with chronic kidney disease (CKD, including post-kidney transplant), related to:

- Glycemic control
- Protein-energy malnutrition
- Inflammation
- Kidney function
- Mineral and bone disorders
- Anemia

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CKD: Monitor and Evaluate

Biochemical Parameters
- Dyslipidemia
- Electrolyte disorders
- Others as appropriate

For list of biochemical parameters, click here. Monitoring and evaluation of the above factors is needed to determine the effectiveness of Medical Nutrition Therapy (MNT) in adults with CKD and post kidney transplant.

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CKD: Monitor and Evaluate Adherence to Nutrition and Lifestyle Recommendations

The registered dietitian (RD) should monitor the following in adults with chronic kidney disease (CKD, including post kidney transplant):

- Food and nutrient intake (e.g., diet history, diet experience and intake of macronutrients and micronutrients, such as energy, protein, sodium, potassium, calcium, phosphorus and others, as appropriate)
- Medication (prescription and over-the-counter), dietary supplements (vitamin, minerals, protein, etc.), herbal or botanical supplement use

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Stage of Diabetic Nephropathy

Stage 1: Hyperglycemia leads to increased kidney filtration due to osmotic load and toxic effects of high blood glucose.
  - Increased GFR with enlarged kidneys. Blood glucose control can reverse changes.

Stage 2: (2-3 years after diagnosis) Clinically silent phase, but continued kidney hyperfiltration and hypertrophy.

Stage 3: (7-10 years after diagnosis)
- Microalbuminuria (incipient nephropathy) – defined as an albumin-creatinine ratio (ACR) of 30-300 mg/g creatinine.
- 20% develop nephropathy within 5 years with standard care; 50% do not progress; is a better predictor of progression in type 1 than type 2; predicts macrovascular disease; is associated with high HbA1c (>8.1).
- Macroalbuminuria is defined as an ACR >300 mg/g creatinine
Stage of Diabetic Nephropathy

Stage 4: Overt nephropathy
- Almost always with hypertension; >300 mg/24 hr of albumin in the urine; about 10% have nephrotic range of proteinuria; GFR is decreased.
- Over 25-30 years (10 years after microalbuminuria begins); >50% type I DM progress to stage 5.
- Over 25 years, about 10% of patients with type II progress to stage 5.
- Requires insulin adjustment due to diminished insulin degradation.

Stage 5: CKD needing kidney replacement therapy; GFR is <10 mL/min, serum creatinine is typically elevated.
- Over 25-30 years (10 years after microalbuminuria begins); >50% type I DM progress to stage 5.
- Over 25 years, about 10% of patients with type II progress to stage 5.
- Requires insulin adjustment due to diminished insulin degradation.

Treatments to Slow Progression in Stages 1-4

1. ACE or ARB: reduces microalbuminuria and the progression, independent of hypertension; usually in combination with diuretic. Target blood pressure <130/80.
2. Mild protein restriction: 0.8 gm/kg; balanced nutrient intake.
3. Maintain HbA1c <7.0: reduces development of microalbuminuria; reduces development of macroalbuminuria; reduces rate of GFR decline.
4. Maintain normal BMI: 18.5-24.9 kg/m²; may reduce risk for loss of kidney function and CVD.


Recommended Nutrition Goals

Other Nutrition Considerations

Hyperglycemic Agents and Chronic Kidney Disease

- Risk of hypoglycemia in CKD Stages 4 and 5
  - Decreased clearance of insulin and some of the oral agents
  - Impaired renal gluconeogenesis
  - 1/3 of insulin degradation is in the kidneys leading to increased ½ life of insulin
  - 5 fold increase in severe hypoglycemia in persons with Type 1 diabetes with a creatinine of ≥ 2.2 mg/dl

Hyperglycemic Agents and Chronic Kidney Disease

- Sulfonylureas
  - Decreased clearance of sulfonylureas or their metabolites
    - Avoid 1st generations sulfonylureas (e.g., chlorpropamide, tolazamide)
    - 2nd generation sulfonylureas (e.g., Glipizide, glyburide) preferred
- Metformin
  - Does not cause hypoglycemia
  - Lactic acidosis
    - FDA black-box warning
      - Males with Cr ≥ 1.5 mg/dl
      - Females with Cr ≥ 1.4 mg/dl
KDOQI Hyperglycemic Agents and Recommendations for Using in CKD

More Research Needed
- Effects of glycemic control on early and late GFR loss and health outcomes
- Validation studies of HgbA1c and potentially other markers of long-term glycemic control in patients with DM and CKD

Thank you
Questions?