Improving Outcomes in Chronic Kidney Disease

CDC Diabetes Translation Conference

Andrew S. Narva, MD
The Greatest Opportunity Is in Improving Care of Diabetics

Incident ESRD patients; rates adjusted for age, gender, & race.

USRDS ADR, 2008
Diabetes (DM) and Hypertension (HTN) Often Coexist in CKD

HP2010: Increase the Proportion of Persons With Type 1 or Type 2 Diabetes and Chronic Kidney Disease Who Receive Recommended Medical Evaluation. Goal = 36

Percent receiving (1) 2+ HbA1c and (2) 1 lipid and (3) 1 eye exam
Blood Pressure Control in CKD

Hypertensive patients in NHANES

USRDS 2008 ADR

https://www.kdigo.org/
HP2010: Increase the proportion of treated chronic kidney failure patients who have received counseling on nutrition, treatment choices, and cardiovascular care 12 months before the start of renal replacement therapy. Goal = 45%
Lack of Appropriate Care/Late Referral

- More rapid progression
- Worse health status at time of initiation
- Higher mortality after starting RRT
- Decreased access to transplant
Defining optimal care is not the primary barrier to improved outcomes.

Delivering appropriate care to those who need it is the problem we must overcome.
Health Disparities in CKD Must be Addressed

Incident ESRD patients; rates adjusted for age & gender.

USRDS ADR, 2007
Even Early Referral is Too Late to Intervene

![Graph showing the progression of kidney failure with different treatment options.](image)

- **GFR (mL/min/1.73²)**
- **Time (years)**

- **No Treatment**
- **Current Treatment**
- **Early Treatment**
Challenges to Improving CKD Care

- CKD remains under diagnosed
- Implementation of recommended care is poor
- Many clinicians feel inadequately educated
  - Uncertain about how to interpret diagnostic tests
  - Unclear about clinical recommendations
  - Low confidence in their ability to successfully manage CKD
  - Indications for, and process of, referral poorly defined
NKDEP aims to reduce the morbidity and mortality caused by kidney disease and its complications by:

- Improving early detection of CKD
- Facilitating identification of patients at greatest risk for progression to kidney failure
- Promoting evidence-based interventions to slow progression of kidney disease
- Supporting the coordination of Federal responses to CKD
The Chronic Care Model

Community
- Resources and Policies
- Self-Management Support

Health Systems
- Organization of Health Care
- Delivery System Design
- Decision Support
- Clinical Information Systems

Informed, Activated Patient
- Productive Interactions

Prepared, Proactive Practice Team

Improved Outcomes

Developed by The MacColl Institute
What Can Primary Care Providers Do?

- Recognize and test at-risk patients: monitor eGFR and UACR
- Screen for anemia (Hgb), malnutrition (albumin), metabolic bone disease (Ca, Phos., PTH)
- Treat cardiovascular risk, especially with smokers and hypercholesterolemia
- Refer to dietitian for nutritional guidance
- Educate patients about CKD and treatment
Materials

Quick Reference on UACR and GFR

Urine Albumin-to-Creatinine Ratio (UACR)

In Evaluating Patients with Diabetes for Kidney Disease

The two key markers for chronic kidney disease (CKD) are urine albumin and estimated glomerular filtration rate (eGFR).

Assess urine albumin excretion yearly to diagnose and monitor kidney damage in patients with type 1 diabetes for five years or more or with type 2 diabetes.

- More frequent monitoring may be indicated in patients with changing clinical status or after therapeutic interventions.
- Use a spot urine albumin-to-creatinine ratio (UACR). UACR estimates 24-hour urine albumin excretion. Twenty-four-hour collection and timed specimens are not necessary.

Urine albumin (mg/dL) = UACR in mg/g = Albumin excretion in mg/day

UACR is a ratio between two measured substances. Unlike a dipstick test for albumin, UACR is unaffected by variation in urine concentration.

Albuminuria1 is present when UACR is greater than 30 mg/g and is a marker for CKD.

Albuminuria is used to diagnose and monitor kidney disease. Change in albuminuria may reflect response to therapy and risk for progression. A decrease in urine albumin may be associated with improved renal and cardiovascular outcomes.

Estimated Glomerular Filtration Rate (eGFR)

In Evaluating Patients with Diabetes for Kidney Disease

The two key markers for chronic kidney disease (CKD) are estimated glomerular filtration rate (eGFR) and urine albumin.

Calculate eGFR from stable serum creatinine levels at least once a year in all patients with diabetes.

- eGFR is more accurate than serum creatinine alone. Serum creatinine is affected by muscle mass, and related factors of age, sex, and race.
- eGFR is not reliable for patients with rapidly changing creatinine levels, extremes in muscle mass and body size, or altered diet patterns.

See if your lab reports eGFR routinely. If it does not, ask your lab to do so. You can also calculate an eGFR yourself by using GFR calculators available on NKDEP’s website at www.nkdep.nih.gov/professional/gfr_calculators.

Interpreting eGFR Results

CKD may be present if UACR > 30 mg/g

(eGFR < 60 ml/min/1.73 m²)

If CKD is detected, it should be addressed as part of a comprehensive approach to the treatment of diabetes.

1Albuminuria is a term that describes all levels of urine albumin. Microalbuminuria is a term used to describe urine albumin levels not detected by a dipstick test, i.e., 30 mg/g—300 mg/g. Macroalbuminuria is sometimes used to describe albumin levels more than 300 mg/g.
How well are your kidneys working?

Explanation of Kidney Test Results

Your GFR result on _______ was _______.

☐ A GFR of 60 or higher is in the normal range.
☐ A GFR below 60 may mean kidney disease.
☐ A GFR of 15 or lower may mean kidney failure.

What is GFR?
GFR stands for glomerular filtration rate. GFR is a measure of how well your kidneys filter blood.

Your urine albumin result on _______ was _______.

☐ A urine albumin result below 30 is normal.
☐ A urine albumin result above 30 may mean kidney disease.

What is urine albumin?
Albumin is a protein found in the blood. A healthy kidney does not let albumin pass into the urine. A damaged kidney lets some albumin pass into the urine. The less albumin in your urine, the better.

Your blood pressure result on _______ was _______.

Keeping your blood pressure below 130/80 may help to protect your kidneys.

What your kidneys do
You have two kidneys. Their main job is to filter waste and extra water out of your blood and make urine.

How your kidneys are checked
Two tests are used to check for kidney disease.

☐ A blood test checks your GFR, which tells how well your kidneys are filtering.
☐ A urine test checks for albumin in your urine, a sign of kidney damage.

Why your kidneys are being checked
You need to have your kidneys checked because you can’t feel kidney disease. Kidney tests are very important for people who have diabetes, high blood pressure, or heart disease. These conditions can hurt your kidneys.

What happens if you have kidney disease
Kidney disease can be treated. The sooner you know you have kidney disease, the sooner you can get treatment to help delay or prevent kidney failure. Treating kidney disease may also help prevent heart disease.

Treatment goals are to:

☐ Keep your GFR from going down
☐ Lower your urine albumin

No matter what your results are:

☐ Keep your blood pressure below 130/80.
☐ Keep your blood glucose and blood cholesterol in your target range.
☐ Eat foods that are healthy for your heart and cut back on salt.
☐ Be physically active.
☐ Stop smoking.
☐ Take medicines the way your provider tells you to.

Notes: ____________________________________________

_________________________________________________

For more information, visit www.nkdep.niddk.gov or call 1-866-4 KIDNEY (1-866-454-3639). The National Kidney Disease Education Program (NKDEP) is an initiative of the National Institutes of Health (NIH).

NIH Publication No. 10-6220 • Revised January 2010
For Providers
Educating Patients About Chronic Kidney Disease

Four Key Concepts and Talking Points

1. Talk to patients about their kidneys, CKD, and their risk.
   - What is CKD? CKD (chronic kidney disease) means the kidneys are damaged and may no longer filter blood well. This damage happens over many years. As more damage occurs, the kidneys are unable to keep the body healthy—then dialysis or a kidney transplant may be needed.
   - How can I lower my risk for CKD? The steps you take to manage your diabetes and high blood pressure also help protect your kidneys. Diet, quitting smoking, and exercise are all important steps.

2. Communicate the importance of testing and how CKD is diagnosed.
   - What are the symptoms of CKD? Most people with CKD have no symptoms until their kidneys are about to fail. The only way to know if you have kidney disease is to get tested. The sooner kidney disease is found, the sooner you can take steps to begin treatment and keep your kidneys healthier longer.
   - How do you check for CKD? A blood test and a urine test are used to find kidney disease. Because you are at risk, you should get these tests regularly:
     - GFR—A blood test measures how much blood your kidneys filter each minute, which is known as your glomerular filtration rate (GFR).
     - Urine Protein—A urine test checks for protein in your urine. Protein can leak into the urine when the filters in the kidneys are damaged.

3. Explain the progressive nature of CKD and the basics of treatment.
   - Can CKD get better? CKD usually will not get better and is likely to get worse. Treatment helps slow kidney disease and keep the kidneys healthier longer.
   - How is CKD treated? Treatment includes keeping blood pressure below 130/80 mmHg, diet counseling to reduce salt and excessive protein, and controlling blood sugar if you have diabetes.
   - Are there medications for CKD? People with CKD often take medicines to lower blood pressure, control blood sugar, and lower blood cholesterol. Two types of blood pressure medications—ACE inhibitors and ARBs—can slow CKD and delay kidney failure, even in people who do not have high blood pressure.

4. Begin to speak about dialysis and transplantation.
   - Will I ever need dialysis? With proper management, you may never need dialysis or, at least, not for a very long time. But if your kidneys fail, we will need to choose a treatment that can replace the job of your kidneys. There are two types of dialysis—one is done at home daily and the other is done at a dialysis center three times a week.
   - Is kidney transplant an option? You may be able to receive a kidney transplant. The donated kidney can come from an anonymous donor who has recently died or from a living person. A kidney transplant is a treatment—not a cure.

For a more detailed version of these talking points or to order this tear-off pad, visit www.kidney.org or call 1-866-4 KIDNEY (1-866-454-3639).

The National Kidney Disease Education Program is an initiative of the National Institutes of Health.

NIH Publication No. 10-6220 • Revised January 2010
Chronic Kidney Disease

What Does it Mean for Me?
CKD means that your kidneys are damaged and can’t filter blood like they should. This damage can cause wastes to build up in your body. It can also cause other problems that can harm your health.

CKD is often a “progressive” disease, which means it can get worse over time. CKD may lead to kidney failure. The only treatment options for kidney failure are dialysis or a kidney transplant.

You can take steps to keep your kidneys healthier longer:

- Choose foods with less salt (sodium).
- Keep your blood pressure below 130/80.
- Keep your blood glucose in the target range, if you have diabetes.

You’ve been told that you have chronic kidney disease (CKD). What does that mean? And what does it mean for your health and your life? This booklet will help answer some of the questions you might have.

You have two kidneys, each about the size of your fist. Their main job is to filter wastes and excess water out of your blood to make urine. They also keep the body’s chemical balance, help control blood pressure, and make hormones.
How does my health care provider know I have CKD?

Chances are, you feel normal and were surprised to hear that you have CKD. It is called a “silent” disease, because many people don’t have any symptoms until their kidneys are about to fail. The only way to know is to get your kidneys checked with blood and urine tests.

1. A blood test checks your GFR, which tells how well your kidneys are filtering. GFR stands for glomerular filtration rate.

2. A urine test checks for albumin. Albumin is a protein that can pass into the urine when the kidneys are damaged. See picture below.

Inside a healthy kidney | Inside a damaged kidney
---|---
| filter | filter
| blood | blood
| urine | urine
| ▲ albumin | ▲ albumin

These two tests are used to monitor CKD and make sure that treatment is working. See pages 9 and 10 to learn more about these tests and track your results.

What causes CKD?

Diabetes and high blood pressure are the most common causes of CKD. There are other causes, too. Your provider will look at your health history and may do other tests. You need to know why you have CKD, so your treatment can also address the cause of the CKD.

What medicines are used to treat CKD?

People with CKD often take medicines to lower blood pressure, control blood glucose, and lower blood cholesterol. Two types of blood pressure medicines—ACE inhibitors and ARBs—may slow CKD and delay kidney failure, even in people who don’t have high blood pressure. Many people need to take two or more medicines for their blood pressure. They also may need to take a diuretic (water pill). The goal is to keep your blood pressure below 130/80.

Do I need to change my medicines?

Some medicines are not safe for people with CKD. Other medicines need to be taken in smaller doses. Tell your provider about all the medicines you take, including over-the-counter medicines (those you get without a prescription), vitamins, and supplements.
Can CKD affect my health in other ways?
People with CKD often have high blood pressure. They can also develop anemia (low number of red blood cells), bone disease, malnutrition, and heart and blood vessel diseases.

What tests will help track my CKD?
The blood and urine tests used to check for CKD are also used to monitor CKD. You need to keep track of your test results to see how you’re doing.

Track your blood pressure. In most cases, you should keep it below 130/80.
If you have diabetes, monitor your blood glucose and keep it in your target range. Like high blood pressure, high blood glucose can be harmful to your kidneys.
See page 9 of this booklet for more information on tracking your test results.

Will I have to go on dialysis?
Some people live with CKD for years without going on dialysis. Others progress quickly to kidney failure. You may delay dialysis if you follow your provider’s advice on medicine, diet, and lifestyle changes.
If your kidneys fail, you will need dialysis or a kidney transplant. Most people with kidney failure are treated with dialysis.

Will I be able to get a kidney transplant instead of going on dialysis?
Some people with kidney failure may be able to receive a kidney transplant. The donated kidney can come from someone you don’t know who has recently died, or from a living person—a relative, spouse, or friend. A kidney transplant isn’t for everyone. You may have a condition that makes the transplant surgery dangerous or not likely to succeed.
CKD and My Lifestyle

People with CKD can and should continue to live their lives in a normal way: working, enjoying friends and family, and staying active. They also need to make some changes as explained here.

Do I need to change what I eat?

What you eat may help to slow down CKD and keep your body healthier. Some points to keep in mind:

| Choose and prepare foods with less salt (sodium). Use less salt at the table. |
| Select the right kinds and smaller amounts of protein. |
| Choose foods that are healthy for your heart, like lean cuts of meat, skinless chicken, fish, fruits, vegetables, and beans. |
| Read the Nutrition Facts Label, especially for sodium, to help you pick the right foods and drinks. |

Your provider may refer you to a dietitian. Your dietitian will teach you how to choose foods that are easier on your kidneys. You will also learn about the nutrients that matter for CKD.

Do I need to change what I drink?

- **Water** — You don’t need to drink more water unless you have kidney stones. Drink as much water as you normally do.

- **Soda and other drinks** — If you are told to limit phosphorus, choose light-colored soda (or pop), like lemon-lime, and homemade iced tea and lemonade. Dark-colored sodas, fruit punch, and some bottled and canned iced teas can have a lot of phosphorus.

- **Juice** — If you are told to limit potassium, drink apple, grape, or cranberry juice instead of orange juice.

- **Alcohol** — You may be able to drink small amounts of alcohol. Drinking too much can damage the liver, heart, and brain and cause serious health problems.

Is smoking cigarettes bad for my kidneys?

Take steps to quit smoking as soon as you can. Cigarette smoking can make kidney damage worse.
CKD: Tracking My Test Results

You are the most important person on your health care team. Know your test results and track them over time to see how your kidneys are doing. Bring this card to your health care visits and ask your provider to complete it.

Blood pressure — The most important thing you can do to slow down CKD is keep your blood pressure below 130/80. This can delay or prevent kidney failure.

GFR — The GFR tells you how well your kidneys are filtering blood. You can’t raise your GFR. The goal is to keep your GFR from going down to prevent or delay kidney failure. See the dial picture below.

Urine albumin — Albumin is a protein in your blood that can pass into the urine when kidneys are damaged. You can’t undo kidney damage, but you may be able to lower the amount of albumin in your urine with treatment. Lowering your urine albumin is good for your kidneys.

A1C — A1C test is a lab test that shows your average blood glucose level over the last 3 months. The goal is less than 7 for most people with diabetes. Lowering your A1C can help you to stay healthy. (For people with diabetes only.)
**Where can I get more information?**

**National Kidney Disease Education Program**  
www.nkdep.nih.gov  
1-866-4 KIDNEY (1-866-454-3639)

**National Kidney and Urologic Disease Information Clearinghouse**  
www.kidney.niddk.nih.gov  
1-800-891-5390

**American Association of Kidney Patients**  
www.aakp.org  
1-800-749-2257

**American Kidney Fund**  
www.kidneyfund.org  
1-800-638-8299

**National Kidney Foundation**  
www.kidney.org  
1-800-622-9010

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For more information, visit www.clinicaltrials.gov.

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**Tips for People with CKD**
- Choose foods with less salt
- Keep your blood pressure below 130/80
- Track your test results
- Keep your blood glucose in the target range—if you have diabetes

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<table>
<thead>
<tr>
<th>Test</th>
<th>Result/Date</th>
<th>Result/Date</th>
<th>Result/Date</th>
<th>Result/Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
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<td></td>
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<tr>
<td>Goal: Less than 130/80</td>
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<tr>
<td>GFR</td>
<td></td>
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<tr>
<td>Goal: Keep from going down</td>
<td></td>
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<tr>
<td>Urine albumin</td>
<td></td>
<td></td>
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<tr>
<td>Goal: The lower the better</td>
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<tr>
<td>A1C (for people with diabetes)</td>
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<tr>
<td>Goal: Less than 7</td>
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</tbody>
</table>

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The National Kidney Disease Education Program (NKDEP) encourages people to get tested for kidney disease and educates those with kidney disease and their health care providers about treatments that can help delay or prevent kidney failure. NKDEP is a program of the National Institutes of Health (NIH).

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**Kidney Test Results**

**Name:** [Name]

**Date:** [Date]

### Chronic Kidney Disease (CKD) Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Results</th>
<th>Why It Is Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glomerular Filtration Rate (GFR)</td>
<td>CKD is less than 60</td>
<td>GFR estimates how well your kidneys are filtering blood. Your goal is to keep your GFR from going down.</td>
</tr>
<tr>
<td>Urine Albumin-to-Creatinine Ratio (UACR)</td>
<td>CKD is more than 30</td>
<td>Urine albumin checks for kidney damage. The lower the result, the better.</td>
</tr>
</tbody>
</table>

### Other Important Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Results</th>
<th>Why It Is Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure</td>
<td>Goal: Below 130/80</td>
<td>High blood pressure makes the heart work harder and can damage blood vessels in the kidneys.</td>
</tr>
<tr>
<td>Serum Albumin</td>
<td>Normal: 3.4 to 5.0*</td>
<td>Albumin is a protein that helps measure how well you are eating.</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>Normal: More than 22</td>
<td>Bicarbonate measures the acid level in your blood.</td>
</tr>
<tr>
<td>Blood Urea Nitrogen (BUN)</td>
<td>Normal: Less than 20</td>
<td>BUN checks how much urea, a waste product, is in your blood.</td>
</tr>
<tr>
<td>Potassium</td>
<td>Normal: 3.5 to 5.0*</td>
<td>Potassium affects how your nerves and muscles are working. High or low levels can be dangerous.</td>
</tr>
<tr>
<td>Calcium</td>
<td>Normal: 8.5 to 10.2*</td>
<td>Calcium keeps your bones strong and your heart rhythm steady. CKD can lower the amount of calcium in your bones.</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Normal: 2.7 to 4.6*</td>
<td>Phosphorus is important for strong bones and healthy blood vessels. High levels may cause soft bones, hard blood vessels and itchy skin.</td>
</tr>
<tr>
<td>Parathyroid Hormone (PTH)</td>
<td>Normal: Less than 65</td>
<td>PTH controls the calcium and phosphorus levels in your blood. It is needed to keep bones and blood vessels healthy.</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Normal: More than 30</td>
<td>Vitamin D is important for bones and heart health.</td>
</tr>
</tbody>
</table>

*Normal ranges may vary.

### Kidney Test Results Continued

<table>
<thead>
<tr>
<th>Other Important Tests, continued</th>
<th>Results</th>
<th>Why It Is Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1C (for patients with diabetes)</td>
<td>Goal: Less than 7</td>
<td>A1C measures average blood sugar levels over 2 – 3 months.</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>Normal: Less than 200</td>
<td>Cholesterol measures the amount of fat in your blood. Too much cholesterol can clog blood vessels or arteries in the heart and kidneys.</td>
</tr>
<tr>
<td>HDL Cholesterol</td>
<td>Normal: More than 40</td>
<td>HDL is the good cholesterol and clears bad fats out of your arteries.</td>
</tr>
<tr>
<td>LDL Cholesterol</td>
<td>Normal: Less than 100</td>
<td>LDL is the bad cholesterol and can clog your arteries.</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>Normal: Less than 150</td>
<td>Triglyceride is a type of fat in the blood.</td>
</tr>
<tr>
<td>Hemoglobin (Hgb)</td>
<td>Normal: 11 to 12*</td>
<td>Low hemoglobin is a sign of anemia. Anemia occurs when you don’t have enough red blood cells and feel tired.</td>
</tr>
</tbody>
</table>

*Normal ranges may vary.

**Notes:**

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For more information, visit [www.nkdep.nih.gov](http://www.nkdep.nih.gov) or call 1-866-4 KIDNEY (1-866-454-3639).
Chronic Kidney Disease (CKD) and Diet: Assessment, Management, and Treatment

Treating CKD Patients Who Are Not on Dialysis
An Overview Guide for Dietitians

National Kidney Disease Education Program
National Institutes of Health
This document, developed by the National Kidney Disease Education Program (NKDEP), is intended to help registered dietitians (RDs) provide effective medical nutrition therapy (MNT) to CKD patients who are not on dialysis.

I. About CKD

The kidneys regulate the composition and volume of blood, remove metabolic wastes in the urine, and help control the acid/base balance in the body. They activate vitamin D needed for calcium absorption, and produce erythropoietin needed for red-blood-cell synthesis.

CKD is typically a progressive disease. It is defined as:
- reduction of kidney function—defined as an estimated glomerular filtration rate (eGFR) <60 mL/min/1.73 m²; and/or
- evidence of kidney damage, including persistent albuminuria—defined as ≥30 mg of urine albumin per gram of urine creatinine.

Kidney failure is typically defined as an eGFR <15 mL/min/1.73 m².

CKD is detected and monitored by two tests:
- Estimated glomerular filtration rate (eGFR) and
- Urine albumin-to-creatinine ratio (UACR)

The purpose of diet therapy for CKD is to maintain good nutritional status, slow progression, and to treat complications. The key diet components to slowing progression of CKD are:
- controlling blood pressure by reducing sodium intake
- reducing protein intake, if excessive
- managing diabetes

CKD RISK FACTORS

- Diabetes
- Hypertension
- Family history of kidney failure
- Cardiovascular disease
- Recurrent urinary tract infections
- HIV infection
- Immunological diseases

As eGFR declines, complications occur more commonly and are more severe. These may include:
- malnutrition
- metabolic acidosis due to reduced acid (hydrogen ion) excretion
- hyperkalemia
- mineral imbalance and bone disorder (calcium, phosphorus, and vitamin D)
- anemia due to impaired erythropoiesis and low iron stores
- cardiovascular disease (CVD) (dyslipidemia)
## II. Assess Kidney Function and Damage

<table>
<thead>
<tr>
<th>Test and Its Relevance</th>
<th>Results</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| **Estimated Glomerular Filtration Rate (eGFR)**<br>eGFR estimates kidney function. As eGFR declines, complications are more likely and more severe. | eGFR (mL/min/1.73m²)<br>Normal >60<br>CKD 15-60<br>Kidney failure <15 | • Evaluate eGFR to assess kidney function; track over time to monitor effectiveness of diet therapy.  
• Stable eGFR may indicate therapy is working.  
• Decline of eGFR reflects progression of CKD. |
| **Urine Albumin-to-Creatinine Ratio (UACR)**<br>UACR is the preferred measure for screening, assessing, and monitoring kidney damage. UACR estimates 24-hour urine albumin excretion. Unlike a dipstick test for urine albumin, UACR is unaffected by variation in urine concentration. | UACR (mg/g)<br>Normal 0–29<br>Albuminuria >30 | • Evaluate UACR over time to assess response to therapy and monitor progression of CKD.  
• Change in albuminuria may reflect response to therapy and risk for progression.  
• A decrease in urine albumin may be associated with improved renal and cardiovascular outcomes. |

**Additional Information**

Each filtering unit of the kidney, or nephron, filters a tiny amount of plasma each minute. eGFR reflects the total filtration of all two million nephrons. As nephrons are damaged or destroyed, eGFR declines. The quantity or volume of urine may not change significantly as eGFR declines. However, what is excreted into the urine does change. Rapidly declining eGFR may warrant appropriate discussion of renal replacement therapies.

In adults, the best equation for estimating eGFR from serum creatinine is the Modification of Diet in Renal Disease (MDRD) Study equation (Levey, 1999). NKF/DOQI offers calculators online and as downloadable applications for estimating GFR. Serum creatinine level, age, gender, and race are needed. Many laboratories routinely report eGFR with all serum creatinine determinations.

Normally, functioning kidneys excrete very small amounts of albumin into the urine. Albuminuria usually reflects damage to the glomerulus—the "filter" of the nephron. Albuminuria is an independent risk factor for CKD progression (Hemmelgarn, 2010) and is considered a marker for CVD and mortality in hypertension. Reducing urine albumin to normal or near-normal levels may improve cardiovascular prognoses.
## III. Slow Progression

<table>
<thead>
<tr>
<th>Therapeutic Goal and Its Relevance</th>
<th>Ranges/Goals</th>
<th>Dietary Intervention</th>
</tr>
</thead>
</table>
| **Control Blood Pressure**        | Goal <130/80mm Hg | - Limit sodium intake to 2,300mg a day or less (Sacks, 2001).  
- Weight reduction may be beneficial.  
- Monitor serum potassium in patients on renin angiotensin system (RAS) antagonists; limit dietary potassium intake when serum potassium >5mEq/L.  
  
  **Additional Information**  
  For patients with hypertension, reduction of dietary sodium has been associated with improved blood pressure control in clinical trials and epidemiological studies.  
  Multiple medications may be required to control blood pressure. RAS antagonists, such as angiotensin-converting enzyme inhibitors (ACEI) or angiotensin receptor blockers (ARBs), are often used to control blood pressure, delay progression, reduce albuminuria, and protect against heart disease.  
  Diuretics are prescribed to treat fluid overload and high blood pressure, and may help control serum potassium levels. |
| **Reduce Albuminuria**             | Reduce or stabilize the amount of albumin lost in the urine (see UACR above on page 2). |  
- Limit excessive dietary protein as follows:  
  - Nondiabetic: 0.8g protein/kg/day  
  - Diabetic: 0.8-1.0g protein/kg/day  
  
  **Additional Information**  
  Limiting excessive protein may activate adaptive responses that decrease albuminuria and increase serum albumin, without increasing risk for protein malnutrition. |
<table>
<thead>
<tr>
<th>Therapeutic Goal and Its Relevance</th>
<th>Ranges/Goals</th>
<th>Dietary Intervention</th>
</tr>
</thead>
</table>
| Manage Diabetes                   | A1C <7%      | • Consider less-stringent control for patients with histories of hypoglycemia, the elderly, and patients with multiple co-morbid conditions.  
• Instruct patients to treat hypoglycemia with cranberry juice cocktail, grape or apple juice, glucose tablets, or 10 jelly beans to prevent hyperkalemia. |

Additional Information

As eGFR declines, renal metabolism of insulin and certain oral diabetes medications are reduced, potentially causing hypoglycemia in diabetes (Snyder, 2004). Unexplained improvement in glucose control may reflect progression of CKD.

Low-protein diets have been associated with improved insulin sensitivity and fasting serum insulin levels, lower insulin requirements and blood glucose levels; and a decrease in endogenous glucose production in patients with diabetes.
# IV. Prevent, Monitor, and Treat Complications

Data is limited for CKD. Many of the recommendations for CKD are extrapolated from renal replacement therapies literature.

<table>
<thead>
<tr>
<th>Complication and Its Relevance</th>
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<tbody>
<tr>
<td><strong>Malnutrition</strong></td>
<td></td>
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</tr>
<tr>
<td>Malnutrition is common in CKD: as eGFR declines, so may appetite. Malnutrition in CKD patients is associated with increased morbidity and mortality.</td>
<td>Albumin &gt;4g/dL  Normal range: 3.4-5.0g/dL  Serum albumin &lt;4g/dL, prior to initiation of dialysis, may predict morbidity and mortality (Lownie, 1990).  Blood urea nitrogen (BUN) &lt;20mg/dL</td>
<td>• Manage with adequate calories and nutrients.  • Water-soluble vitamin supplementation may be indicated due to the restricted protein intake. Vitamin C is typically not supplemented above the Dietary Reference Intake, as it may cause oxalosis. Vitamins A, E, and K can accumulate more rapidly in CKD and are not recommended for supplementation. Specific renal vitamin formulas are available for dialysis patients.</td>
</tr>
<tr>
<td><strong>Metabolic Acidosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients with CKD are at risk for metabolic acidosis as a result of reduced excretion of acid load.</td>
<td>Bicarbonate (CO₂) &gt;22mEq/L  Normal range: 21-28mEq/L</td>
<td>• Dietary protein is a source of metabolic acid. Serum bicarbonate levels may increase with dietary protein restriction.  • Sodium bicarbonate supplementation may be prescribed to improve nutritional parameters and slow rate of CKD progression (de Brito-Ashurst, 2009). Monitor blood pressure closely when this medication is used, as some patients may experience elevated blood pressure associated with increased sodium load.</td>
</tr>
</tbody>
</table>

## Additional Information

- Serum albumin is used to monitor nutritional status. Hypoalbuminemia may result from reduced protein and/or calorie intake, uremia, metabolic acidosis, albuminuria, inflammation, or infection.

- Although not used to indicate nutritional status, elevated BUN may be associated with aversion to certain high-biological-value protein foods. Appetite may improve in renal failure with adequate renal replacement therapy (i.e., dialysis treatment or kidney transplantation).
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</table>
| **Hyperkalemia**              | Potassium 3.5–5.0 mEq/L | • Counsel patients to restrict dietary potassium when serum level is 5mEq/L or higher.  
• Caution patients to avoid potassium-containing salt substitutes.  
• Instruct patients with diabetes to treat hypoglycemia with cranberry juice cocktail, grape or apple juice, glucose tablets, or 10 jelly beans to prevent hyperkalemia.  
• Counsel patients to adhere to sodium bicarbonate, if prescribed. Correction of acidosis may lower potassium. |
|                               | Hyperkalemia is usually not seen until CKD is advanced, but may be seen at a higher eGFR in diabetics. | |

**Additional Information**

The potassium content of most vegetables can be decreased through a process of leaching. Leaching entails slicing and soaking the vegetable overnight in water, then draining and boiling the vegetable in new water. A recent study, however, shows that white potatoes do not need to be soaked overnight (Bethke & Jansky, 2008). The potassium content of other tuberous root vegetables commonly eaten in the Caribbean and South America has been shown to be reduced somewhat by double-cooking, however, most still remained higher than 200mg per serving (Burrowes & Ramer, 2006).
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<tr>
<td><strong>CKD Mineral and Bone Disorder (CKD-MBD)</strong></td>
<td>See sections on calcium, phosphorus, parathyroid hormone (PTH), and vitamin D.</td>
<td>Existing guidelines on management of CKD-MBD reflect consensus rather than high-grade evidence. Early intervention may help prevent vascular calcification and secondary hyperparathyroidism. The kidneys maintain calcium and phosphorus levels and activate vitamin D. As kidney function declines, complex interactions occur that affect calcium, phosphorus, vitamin D, and the parathyroid gland. Abnormal levels of PTH (measured as intact or iPTH) may be seen. Mineral and bone disorders may result from these interactions. See the specific sections that follow.</td>
</tr>
</tbody>
</table>
| **Calcium** | Calcium 8.5-10.2mg/dL Maintain within normal range. Use formula to correct calcium with hypoalbuminemia: Corrected calcium (mg/dL) = total calcium (mg/dL) + 0.8 x [4-serum albumin (g/dL)] | **Additional Information** Depending on the type of renal bone disease, calcium, phosphorus, and iPTH may be normal, decreased, or elevated.  
- *Secondary hyperparathyroidism* is associated with high bone turnover, and elevated levels of calcium, phosphorus, iPTH, and alkaline phosphatase.  
- *Osteomalacia* results in low bone turnover with elevated serum calcium levels and normal-to-decreased serum phosphorus, iPTH, and alkaline phosphatase.  
- *Adynamic bone disease* results in low bone turnover and may be characterized by normal-to-low iPTH and alkaline phosphatase. Serum calcium and phosphorus may be normal to elevated.  
- *Mixed bone disease*, as the name implies, has features of both low and high bone turnover.  
- **Dietary calcium recommendations for CKD** have yet to be established.  
- *Calcium-based phosphate-binding medications* can increase total daily intake and elevate calcium.  
- *Supplementation with active vitamin D* increases the risk for hypercalcemia. |
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| **Phosphorus**                | Phosphorus 2.7-4.6mg/dL | - If serum phosphorus is elevated, dietary phosphorus restriction may be indicated. The recommended level of restriction has yet to be determined in CKD.  
- Dietary protein restriction decreases phosphorus intake. If further restriction is needed, counsel patients to reduce intake of foods with added phosphorus. (Uribarri, 2007)  
- Counsel patients to read ingredient lists for “phos” to identify foods with phosphate additives, as the additives may be absorbed more efficiently than food sources.  
- Limiting whole grains may help if further reduction is needed.  
- Phosphorus binders may be prescribed to lower phosphorus levels. Counsel patients to take binders with meals to help limit absorption of phosphorus from food and beverages. |
| Control of phosphorus and calcium levels helps control PTH. | Maintain within normal range.  
Serum phosphorus levels may be “normal” until CKD is advanced. |                                                                 |

**Additional Information**

Calcium acetate and calcium carbonate are common calcium-containing phosphate binders. Calcium citrate is not recommended as a phosphate binder for CKD patients, because it may increase aluminum absorption. Other binders, used more often in renal replacement therapy, are typically composed of resins (sevelamer carbonate) and earth metals (lanthanum carbonate).

| **Parathyroid hormone (PTH)** | Normal PTH <65pg/mL  
Measured as iPTH | Dietary phosphorus restriction and use of active vitamin D or its analogs may help control PTH levels in CKD. Calcium supplementation may help as well. |
|-----------------------------|------------------|---------------------------------------------------------------------|
| Secondary hyperparathyroidism (elevated PTH) is associated with the most common cause of bone disease in CKD. | PTH varies by level of kidney function and type of bone disease. | Additional Information  
PTH is the hormone that regulates serum calcium levels. Low levels of 1,25(OH)₂D₃, hypocalcemia and hyperphosphatemia stimulate PTH secretion. Its metabolic actions include mobilizing calcium and phosphorus from bone; increasing intestinal absorption and renal tubular reabsorption of calcium; and decreasing renal tubular reabsorption of phosphorus. PTH enhances conversion of 25(OH)D to 1,25(OH)₂D.  
Consensus guidelines endorse higher PTH therapeutic goal at lower levels of eGFR. |

*Ranges for phosphorus are typically based on laboratory values, with different institutions using guidelines to define “normal” ranges. The ranges provided here are for information purposes only and may vary by laboratory.**
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<td><strong>Vitamin D</strong></td>
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</table>
| The kidneys activate 25(OH)D (calcidiol) to 1,25(OH)₂D (calcitriol or active vitamin D). Reduction of kidney function results in decreased production and conversion of calcidiol to calcitriol. There may be corresponding imbalances of calcium, phosphorus, and PTH. | Vitamin D >30nmol/L  
Measured as 25(OH)D  
Maintain within normal range (Holick, 2007). | • Supplementation may be indicated. Specific requirements in CKD have yet to be determined.  
• Ergocalciferol (vitamin D₂) or cholecalciferol (vitamin D₃) may be used in early CKD to replete Vitamin D.  
• Active vitamin D (calcitriol) or its analogs (doxercalciferol, paricalcitol, or alfacalcidol) may be used as eGFR declines (ibid).  
Monitor for hypercalcemia and/or hyperphosphatemia when using supplements. Active vitamin D increases calcium and phosphorus absorption. |
| **Anemia**                     |               |                     |
| Anemia may develop early during the course of CKD due to inadequate synthesis of erythropoietin by the kidneys. | Hemoglobin 11-12g/dL  
*Without CKD*  
Women: 12-16  
Men: 14-17  
Transferrin Saturation (TSAT) >20%  
Ferritin >100ng/mL  
*Without CKD*  
Women: 18-160  
Men: 16-270 | Both iron supplementation and injectable erythropoiesis-stimulating agents (ESAs) have been used to correct anemia. The risks and benefits of these treatments in CKD are not yet defined.  
**Additional Information**  
Hemoglobin is used to assess anemia in CKD. Uncomplicated anemia of CKD is usually normocytic and normochromic.  
TSAT is a measure of iron saturation. Transferrin transports iron absorbed by the intestines. Ferritin levels reflect iron stores. |
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<td><strong>Cardiovascular Disease (CVD)</strong></td>
<td>Total cholesterol &lt;200mg/dL</td>
<td>Decreasing intake of saturated and trans fats (substituting for monounsaturated and polyunsaturated fats), along with physical activity, can help control hyperlipidemia and reduce inflammation.</td>
</tr>
<tr>
<td></td>
<td>LDL cholesterol &lt;100mg/dL</td>
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<tr>
<td></td>
<td>HDL cholesterol &gt;40mg/dL</td>
<td>Additional Information</td>
</tr>
<tr>
<td></td>
<td>Triglycerides &lt;150mg/dL</td>
<td>Controlling dyslipidemia may reduce the rate of decline in eGFR. To further decrease risk of developing CVD, pharmacological therapy may be necessary (Fried, 2001).</td>
</tr>
</tbody>
</table>

*Normal ranges may vary.
## Nephrology Referral

**NAME**

**DATE OF BIRTH**

**FACILITY/PRACTICE AND RECORD NUMBER**

### REASON FOR REFERRAL

### FOR DIABETICS

- **YEAR OF DIAGNOSIS**
- **RECENT AIC**
- **MONTH/YEAR**

### COMPLICATIONS

- **NEUROPATHY**
- **DIASTOLIC**
- **PYD**
- **OTHER**

### ALBUMINURIA

- **MONTH/YEAR**
- **MCP**
- **IF PRESENT, SINCE**

### HEMATURIA

- **MONTH/YEAR**
- **IF PRESENT, SINCE**

### URINARY SEDIMENT

### eGFR

- **MONTH/YEAR**

### BLOOD PRESSURE

- **AT LAST VISIT**
- **USUAL RANGE**

### ADDITIONAL EVALUATION

- **ANA**
- **RF**
- **C3**
- **C4**
- **HBA1C**
- **ANTIBODY**
- **SPEP**
- **UPEP**
- **RENAIULUS**
- **OTHER**

### FAMILY HISTORY

- **KIDNEY DISEASE**
- **IF YES, HOW RELATED**

### CURRENT MEDICATIONS (or attach list)

### KNOWLEDGE

- **DOES THE PATIENT KNOW HE/SHE HAS KIDNEY DISEASE?**
- **DOES THE PATIENT KNOW THE SEVERITY?**
- **IS THE PATIENT AWARE THAT HE/SHE MAY NEED DIALYSIS?**

### ADDITIONAL INFORMATION

**REFERRED BY**

**CONTACT TELEPHONE**

**DATE**

**EMAIL**

For more information about why these data are important to share with the nephrologist, visit www.nkdep.nih.gov.
Lessons Learned from Indian Health

- CKD is part of primary care
- Changing patterns of care requires changing “the system” (CCM)
- Improvement in care results from changes implemented by physicians and non-physician health professionals
- Implemented through diabetes care delivery system; not specialty clinic based
- Surveillance and prevention are part of multisystem chronic disease control
- Emphasis on ensuring that patient received care from competent and interested individual, not referral
Prevalent counts & adjusted rates by race

December 31 point prevalent ESRD patients; rates adjusted for age & gender.
Improving the care of people with CKD requires changing clinical practice in settings where high risk populations are served.

- People with kidney failure due to diabetes make up half of the ESRD population.
- Improving the kidney-related aspects of diabetes care offers the greatest opportunity to reduce the burden of CKD.
- NKDEP is a resource for state and local diabetes programs.
1. The diabetes educator is in a unique position to incorporate kidney education while providing continuity of self management skills and education to patients.

2. Each person with diabetes and DKD needs a personalized education plan, which incorporates kidney content into the AADE7™ Self-Care Behaviors.

3. Those patients who will require renal replacement therapy will be well served by early DKD education and discussion about renal replace therapy options.
Questions & Comments: andrew.narva@nih.gov

nkdep.nih.gov