

National Kidney
Foundation™

Your Kidneys: Master Chemists of the Body



National Kidney Foundation’s Kidney Disease Outcomes Quality Initiative (NKF-KDOQI™)

The National Kidney Foundation is developing guidelines for clinical care to improve patient outcomes. The information in this booklet is based on the KDOQI™ recommended guidelines for nutrition. All KDOQI™ guidelines provide information and assist your doctor or health care team in making decisions about your treatment. The guidelines are available to doctors and other members of the health care team. If you have any questions about these guidelines, you should speak to your doctor or the health care team at your treatment center.

Stages of Chronic Kidney Disease (CKD)

In February 2002, the National Kidney Foundation published clinical care guidelines for chronic kidney disease. These help your doctor determine your stage of kidney disease based on the presence of kidney damage and your glomerular filtration rate, which is a measure of your level of kidney function. Your treatment is based on your stage of kidney disease. (See the table below.) Speak to your doctor if you have any questions about your stage of kidney disease or your treatment.

Stages of Kidney Disease		
Stage	Description	Glomerular Filtration Rate (GFR)*
1	Kidney damage (e.g., protein in the urine) with normal GFR	90 or above
2	Kidney damage with mild decrease in GFR	60 to 89
3	Moderate decrease in GFR	30 to 59
4	Severe reduction in GFR	15 to 29
5	Kidney failure	Less than 15

*Your GFR number tells your doctor how much kidney function you have. As chronic kidney disease progresses, your GFR number decreases.

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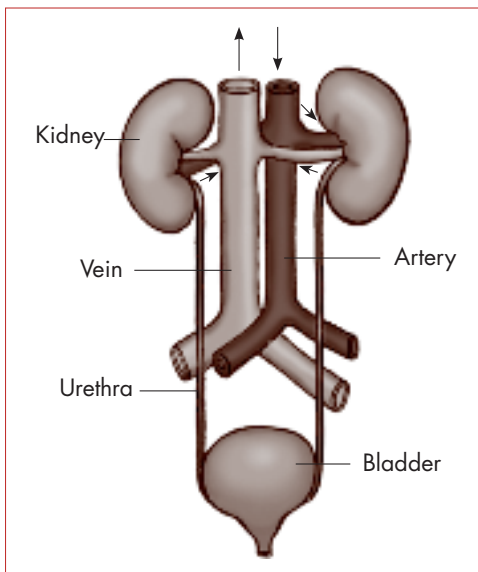
“Bones can break, muscles can atrophy, glands can loaf, even the brain can go to sleep without immediate danger to survival. But should the kidneys fail, neither bones, muscles, glands nor brain could carry on.” — Dr. Homer W. Smith, From Fish to Philosopher

Your kidneys perform crucial functions that affect every part of your body. As Dr. Smith said in the above quotation, many other organs in our bodies depend upon the kidneys to function normally. The kidneys perform complex functions that keep the rest of the body in balance. When the kidneys become damaged by disease, your body’s other organs are affected as well.

Your kidneys can be affected by a number of problems, including urinary tract infections, kidney stones and chronic kidney disease. Medical advances have improved our ability to diagnose and treat those who suffer from these problems. Even when the kidneys no longer function, treatments such as dialysis and transplantation have literally brought new life to hundreds of thousands of people. There is still much to learn, however, and we still need to support research efforts.

Why Are the Kidneys So Important?

Most people know that the major function of the kidneys is to remove waste products and excess fluids from the body in the form of urine. The production of urine is a highly complex process of excretion and



reabsorption. This process is necessary to maintain a stable chemical balance in our bodies.

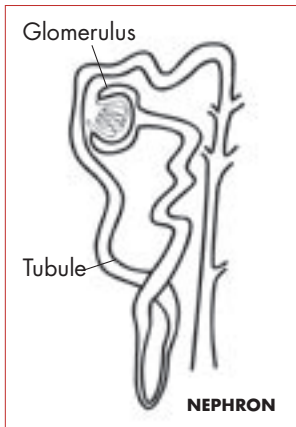
In addition to producing urine, your kidneys also regulate your body's salt, potassium and acid content and produce a variety of hormones that affect the way your other organs function. One hormone produced by

the kidneys stimulates the production of red blood cells. Others help regulate your blood pressure and help your body process calcium. In addition to these functions, your kidneys also:

- Remove waste products from your body
- Remove chemicals from your body
- Balance your body's fluids
- Release hormones that regulate your blood pressure
- Produce a form of vitamin D that promotes strong, healthy bones.

Where Are the Kidneys and How Do They Function?

You have two kidneys, each about the size of a fist, located on either side of your spine at the lowest level of the rib cage. Each kidney contains up to a million units called nephrons. A nephron



consists of a filtering unit of tiny blood vessels called a glomerulus. The glomerulus is attached to a tubule. When blood enters the glomerulus, it is filtered and the remaining fluid then passes along the tubule. In the tubule, chemicals and water are either added to or removed from this fluid, according to the body's needs. The final product is urine, which moves down to the bladder, where it will spend from 1 to 8 hours before being excreted from the body.

On an average day the kidneys will filter about 200 quarts of fluid. Two quarts will leave your body in the form of urine, the other 198 quarts are recovered and reused by your body.

What Is Chronic Kidney Disease and What Are Some of the Causes?

Chronic kidney disease (CKD) is defined by the presence of kidney damage and decreased kidney function regardless of the type of kidney disease (diabetic kidney disease, glomerulonephritis, etc.). Kidney damage is defined as an abnormality, such as protein in the urine, that lasts for three months or longer. Kidney function is best measured by estimates of glomerular filtration rate (GFR). A GFR less than 60 for three months or more indicates CKD.

There are many causes of CKD. Diabetes and high blood pressure are the two leading causes. Some conditions are inherited (run in families), while others are congenital; that is, people may be born with an abnormality that can affect their kidneys. The following are some of the most common types and causes of kidney damage.



Diabetes is a disease in which your body does not make enough insulin—the hormone that processes sugar—or cannot use normal amounts of insulin properly. This results in a high blood sugar level, which can cause problems in many parts of your body. Diabetes is the leading cause of kidney disease. (See National Kidney Foundation publication *Diabetes and Chronic Kidney Disease*.)

High blood pressure (also known as hypertension) is another common cause of kidney disease and other illnesses such as heart attacks and strokes. When high blood pressure is controlled, the risk of CKD is decreased. (See National Kidney Foundation publication *High Blood Pressure and Your Kidneys*.)

Glomerulonephritis (glo-mer-yoo-low-nef-rite-iss) is a disease that causes inflammation of the kidney's tiny filtering units—the glomeruli. Glomerulonephritis may occur suddenly, for example after a bout of strep throat, and the individual may get well again. However, the disease can also develop slowly over several years and it may cause progressive loss of kidney function. (See National Kidney Foundation publication *Glomerulonephritis*.)

Polycystic kidney disease is the most common form of inherited kidney disease. It is characterized by the formation of cysts on the kidneys. These cysts enlarge over time and can seriously damage the kidneys or even cause kidney failure. (See National Kidney Foundation publication *Polycystic Kidney Disease*.)

Kidney stones are a common problem, but they do not usually lead to chronic kidney disease. They may result from a variety of conditions, including urinary tract infections, obstructions in the urinary system or an inherited disorder that causes too much calcium to be absorbed from foods. Sometimes medications and diet can help to prevent recurrent stone formation. When kidney stones pass out of your body, they may cause severe pain in your back and side. Stones are sometimes too large to pass out of your body. In these cases the stones can be removed surgically or broken down into smaller pieces that can pass out of the body. (See National Kidney Foundation publication *About Kidney Stones*.)

Urinary tract infections occur when germs enter the urinary tract and multiply. Symptoms include an increased need to urinate, pain and/or burning during urination, cloudy or blood-tinted urine and a strong odor to urine. These infections most often affect the bladder, but they sometimes spread to the kidneys and they may cause you to run a fever and experience pain in your back. (See National Kidney Foundation publication *Urinary Tract Infections*.)

Congenital diseases may also affect the kidneys. These diseases usually begin with a problem that occurs in the urinary tract when a baby is developing in its mother's womb. One of the most common congenital diseases occurs when a valve-like mechanism in the bladder fails to work properly and allows urine to back up to the kidneys, causing infections and possible kidney damage.

Drugs and toxins can also cause kidney problems. Using large numbers of over-the-counter pain relievers for a long time can be harmful to the kidneys. Certain other medications, toxins, pesticides and "street" drugs such as heroin and crack can also cause kidney damage.

How is Chronic Kidney Disease Detected?

Early detection and treatment of CKD are the keys to preventing kidney failure. Some simple tests can be done to detect early kidney disease. They are:

- blood pressure monitoring.
- a test for protein in the urine. An excessive amount of protein in your urine may mean that your kidneys' filtering units have been damaged by disease. A single positive result could be due to a fever or heavy exercise, so your doctor will want to confirm your test over several weeks.
- an estimate of your GFR. Your doctor can use the results of your blood creatinine test, along with your age, gender and body size, to calculate your GFR. Your GFR will show how much kidney function you have.

It is especially important that people who have an increased risk for CKD have these tests. You may have an increased risk for kidney disease if you:

- are older (65 and up)
- have diabetes
- have high blood pressure
- have a family member who has CKD
- are African American, Hispanic American, Asian, Pacific Islander or American Indian.

If you fit one of the above categories, or think you may have an increased risk for kidney disease, ask your doctor about getting tested.

Can Kidney Disease Be Successfully Treated?

Many kidney diseases can be treated successfully. Careful control of diseases like diabetes and conditions like high blood pressure can help prevent kidney disease or keep it from getting worse. Kidney stones and urinary tract infections can usually be treated successfully. Unfortunately, the exact causes of some kidney diseases are still unknown, and specific treatments are not yet available for them.

Sometimes, CKD may progress to kidney failure, which requires dialysis or kidney transplantation. Treating high blood pressure with special medications called angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs) often helps to slow the progression of CKD. A great deal of research is being done to find more effective treatments for all of the conditions that can cause CKD.

How is Kidney Failure Treated?

Kidney failure can be treated with hemodialysis, peritoneal dialysis, or kidney transplantation. Hemodialysis can be performed either at a dialysis unit or at the patient's home. Treatments are usually performed three times a week. Peritoneal dialysis is generally done each day at home. Some forms of peritoneal dialysis require the use of a cycling machine, while others do not. A doctor who specializes in the diseases of the kidneys—called a nephrologist—can explain the different approaches and help patients make the best treatment choices.

Kidney transplants have high success rates. Kidneys often come from a living donor such as a family member or a friend. Sometimes the donated kidney will come from someone who has recently died. More information about hemodialysis, peritoneal dialysis, kidney transplantation and organ donation is available from your local affiliate of the National Kidney Foundation.

What Are the Warning Signs of Kidney Disease?

Kidney disease usually affects both kidneys. If the kidneys' ability to filter the blood is seriously damaged by disease, waste material and excess fluid may build up in the body. Although many forms of kidney disease do not produce symptoms until late in the course of the disease, kidney disease has a number of warning signs:

1. High blood pressure.
2. Protein and/or blood in the urine.



3. A glomerular filtration rate (GFR) less than 60. (GFR is a measure of how well your kidneys filter wastes from your blood. GFR may be estimated from your blood creatinine level).
4. More frequent urination, particularly at night; difficult or painful urination.
5. Puffiness around the eyes, swelling of the hands and feet.

You can find more information on the issues mentioned in this booklet online at the National Kidney Foundation's A to Z Guide: <http://www.kidney.org/atoz>.

Other Resources

Are You at Increased Risk for Chronic Kidney Disease? (Order No. 11-10-1814/En español: 11-10-1816)

What You Need to Know About Urinalysis (Order No. 11-10-1815/En español: 11-10-1817)

Home Hemodialysis (Order No. 11-10-0329)

Glomerular Filtration Rate: A Key to Understanding How Well Your Kidneys Are Working (Order No. 11-10-1813)

Diabetes and Chronic Kidney Disease (Order No. 11-10-0209/En español: 11-10-0242)

High Blood Pressure and Your Kidneys (Order No. 11-10-0204)

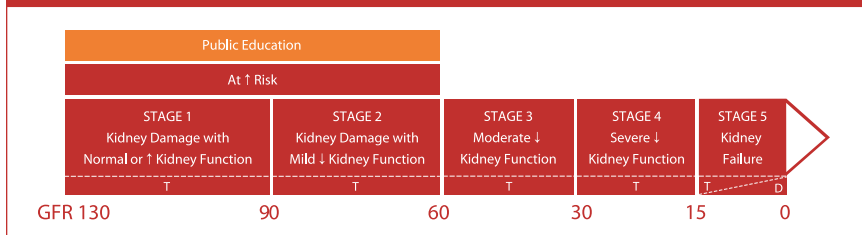
Urinary Tract Infections (Order No. 11-10-0205)

About Kidney Stones (Order No. 11-10-0207)

Polycystic Kidney Disease (Order No. 11-10-0206)

More than 20 million Americans—one in nine adults—have chronic kidney disease, and most don't even know it. More than 20 million others are at increased risk. The National Kidney Foundation, a major voluntary health organization, seeks to prevent kidney and urinary tract diseases, improve the health and well-being of individuals and families affected by these diseases, and increase the availability of all organs for transplantation. Through its 47 affiliates nationwide, the foundation conducts programs in research, professional education, patient and community services, public education and organ donation. The work of the National Kidney Foundation is funded by public donations.

Education Along the Continuum of Care



This arrow illustrates the potential scope of content for KLS resources. Lightshaded boxes indicate the scope of content targeted in this resource. GFR = Glomerular Filtration Rate; T = Kidney Transplant; D = Dialysis



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