



National Kidney
Foundation®

HIV AND CHRONIC KIDNEY DISEASE

**UNDERSTANDING GFR
IN PEOPLE WITH HIV**



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HIV AND CHRONIC KIDNEY DISEASE: UNDERSTANDING GFR IN PEOPLE WITH HIV



People with the human immunodeficiency virus (HIV) infection are at increased risk for chronic kidney disease (CKD). But most people with HIV don't know they are at risk.

As someone who is closely involved with HIV education, you can help people learn about their risk for CKD and how to prevent it. One important term everyone needs to know when learning about CKD is *glomerular filtration rate (GFR)*.

This booklet explains all about CKD, with a special focus on how GFR is measured, why it is important for people with HIV to know their GFR number, and how they can help guard against kidney disease.



CHRONIC KIDNEY DISEASE

Q: | WHAT ARE KIDNEYS AND WHAT DO THEY DO?

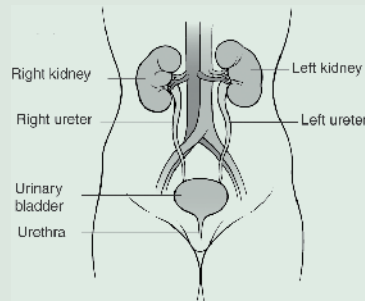
Kidneys are important because they keep the rest of the body's systems in balance.

Kidneys:

- Remove waste products from the body
- Balance the body's fluids
- Help keep blood pressure under control
- Keep bones healthy
- Help make red blood cells



Kidneys and Urinary Tract



The human body has 2 kidneys. Each kidney is about the size of a fist. They are located near the middle of the back, just below the rib cage. Each kidney has about 1.5 million filters, called **nephrons**. Nephrons remove waste and extra fluid from blood

in the form of urine. The urine flows through 2 tubes, called ureters, to the bladder. The urine is stored there until it is passed during urination. The waste comes from the breakdown of food eaten, and medicine taken, plus normal muscle and organ activity.

Q: | WHAT IS GLOMERULAR FILTRATION RATE (GFR)?

One of the kidney's most important jobs is to remove wastes and excess fluid from blood. GFR measures how effectively the kidneys are doing this. A person's GFR number tells the doctor how well a person's kidneys are working.

Q: | WHAT IS CHRONIC KIDNEY DISEASE?

Chronic kidney disease (CKD) means the kidneys are damaged. Kidneys can become damaged from a physical injury or a disease like diabetes, high blood pressure, or HIV infection. Once the kidneys are damaged, they cannot filter blood nor do their other jobs as well as they should.

Q: | ARE THERE DIFFERENT STAGES OF KIDNEY DISEASE?

There are 5 stages of kidney disease. They are shown in this table. A doctor determines which stage of kidney disease a person has based on the presence of kidney damage and the GFR result, which estimates kidney function (see page 16).

Stages of Chronic Kidney Disease (CKD)		
Stage	Description	Glomerular Filtration Rate (GFR)*
1	Kidney damage (eg, protein in the urine) with normal GFR	90 or above
2	Kidney damage with mild decrease in GFR	60–89
3	Moderate decrease in GFR	30–59
4	Severe reduction in GFR	15–29
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.



Q: | IS KIDNEY DISEASE SERIOUS?

Yes. Kidney disease is a serious disease, and it requires treatment. Without treatment, kidney disease can get worse. In the early stages of the disease, most people do not have any symptoms. But as kidney disease gets worse, wastes and fluid may build up in the blood and cause symptoms, such as swelling, increased blood pressure, nausea and vomiting, and poor appetite.

Eventually kidney disease can lead to *kidney failure*. A person who has kidney failure will need regular dialysis treatments or a kidney transplant to stay alive. That is why it is so important for people with HIV to be tested for kidney disease. **With early detection and treatment, it is possible to prevent kidney disease and its complications from getting worse.**

Q: | HOW DOES SOMEONE KNOW IF THEY HAVE KIDNEY DISEASE?

The best way to find out is to be tested for it. There are 3 simple tests to screen for kidney disease:

1. Test for protein in the urine

The human body needs protein. But it should be in the blood, not in the urine. Having protein in the urine (called *proteinuria*) may mean that a person has kidney damage. This can be a sign of early kidney disease.

2. Blood test for creatinine

A doctor tests the blood for *creatinine*. Creatinine is a waste product that comes from muscle tissue. When the kidneys are damaged, they have trouble removing creatinine from blood. The blood test for creatinine helps doctors find out how well the kidneys are working. The creatinine result is used in a math formula to find out the person's GFR number.

3. Regular blood pressure checks

Having high blood pressure puts people at risk for kidney disease. High blood pressure can also be caused by kidney disease. In other words, it is both a risk factor for kidney disease *and* a complication of kidney disease.

Monitoring blood pressure closely helps doctors find and treat high blood pressure. This helps reduce the risk for getting kidney damage and for kidney damage getting worse.



Q: | WHAT IF A PERSON'S SCREENING TESTS ARE ABNORMAL?

The doctor will do additional tests to make sure of the diagnosis. These tests may include:

- Repeating the blood test to confirm GFR
- Doing more urine tests to get information about:
 - **Protein.** The doctor will check to see how much protein and what type of protein is in the urine. This helps give the doctor clues about the type of kidney disease a person has.



- **Red blood cells.** Blood in the urine is an abnormal finding and requires further evaluation.
- **White blood cells.** These may indicate an infection.
- **Other cell types.** Abnormal urinary cells may be seen under a microscope and may be a sign of kidney damage or give clues about the type of kidney disease a person has.

Other tests may be needed:

- **Kidney ultrasound (sonogram)**

This is a painless, noninvasive test that uses sound waves to create a picture of the kidneys. It can show whether a person has kidney stones, tumors, blockages, or other problems. It also shows the size of the kidneys, which can be helpful in diagnosing kidney disease.

- **Kidney biopsy**

In this test, small pieces of kidney tissue are examined under a microscope to check for specific types of kidney damage.

Q: | WHAT ARE THE SYMPTOMS OF KIDNEY DISEASE?

Most people with early kidney disease do not have symptoms. That is why it is so important for people with HIV to be tested. In the later stages of kidney disease, the person may:

- Feel tired or short of breath
- Have trouble thinking clearly
- Not feel like eating; feel nauseated
- Have trouble sleeping
- Have dry, itchy skin
- Have muscle cramping at night
- Need to go to the bathroom more often, especially at night
- Have swollen feet and ankles
- Have puffiness around the eyes, especially in the morning

Q: | CAN KIDNEY DISEASE CAUSE OTHER SERIOUS HEALTH PROBLEMS?

A person with kidney disease may develop other complications. These include:

- Heart and blood vessel disease
- High blood pressure
- Anemia (low red blood cell count)
- Bone problems



- Nerve damage
- Poor nutritional health
- Reduced ability to perform activities of daily living
- Reduced quality of life

Complications may be the result of decreased kidney function or other disorders of the urinary system. Some complications may be problems in themselves or they may increase the risk for other problems. For example, high blood pressure is a complication of CKD, but it also increases the risk of heart disease and stroke.

Q: DOES THE RISK OF COMPLICATIONS INCREASE IF A PERSON'S KIDNEY DISEASE GETS WORSE?

The risk of complications like heart disease, anemia, or high blood pressure increases as the GFR falls below 60. Patients with a GFR less than 60 (CKD stage 3 or higher) should be tested to see if they have any of the complications listed previous page and above.

HIV AND THE KIDNEY

Q: ARE PEOPLE WITH HIV AT GREATER RISK FOR GETTING KIDNEY DISEASE?

Yes. Having HIV increases the risk for developing kidney disease. In fact, CKD is a common complication of HIV infection. If someone has HIV, the chances of getting kidney disease are even greater if the person:

- Has a high viral load (a large amount of HIV in the blood)
- Has a low CD4⁺ cell count (a low number of the blood cells that help fight diseases such as HIV)
- Is African American, Hispanic American, Asian, Pacific Islander, or Native American
- Has diabetes, high blood pressure, or hepatitis C
- Has a family member who has kidney disease
- Is 65 years of age or older
- Has used medications over the course of many years that damage the kidneys

Each risk factor increases the chance of getting kidney disease. The more risk factors a person has, the greater the risk.



Q: IS IT COMMON FOR PEOPLE WITH HIV TO GET KIDNEY DISEASE?

It's hard to know exactly how common it is, but some experts believe that 7 to 30 percent of people with HIV have problems with their kidneys.

Q: HOW DOES HIV INCREASE THE RISK OF KIDNEY DISEASE?

This happens because:

- HIV can harm the nephrons (filters) in the kidneys. When this happens, the filters do not work as well as they should.
- HIV can infect the cells in the kidneys
- Some of the medicines used to treat HIV can harm the nephrons in the kidneys

Q: HOW OFTEN SHOULD PEOPLE WITH HIV BE TESTED FOR KIDNEY DISEASE?

Everyone with HIV should be tested for kidney disease at least once. This should happen when HIV is diagnosed. People should be encouraged to find out if they have been tested for kidney disease, and request testing if they have not. People with HIV who have other risk factors for kidney disease should be tested at least once a year. (For a list of additional risk factors, see page 12.)

Q: | CAN SOME MEDICATIONS CAUSE KIDNEY DAMAGE?

Yes. Regular use of some anti-inflammatory pain-relieving medicines (such as ibuprofen) and certain antibiotics that are used to treat infections can cause kidney damage. Medications that have the potential to damage the kidneys are called *nephrotoxic*. People with HIV should check with their doctor before taking any medications, including over-the-counter or herbal medicines.



Q: | CAN THE DRUGS USED TO TREAT HIV CAUSE KIDNEY DAMAGE?

The drugs that are used to treat HIV infection are called *antiretrovirals*. Several antiretrovirals have been associated with kidney damage, so it is important that all medications are carefully monitored by the person's doctor. This is especially true when a person is:

- First diagnosed with HIV
- Before starting new medications
- During HIV treatment

To minimize the risk of further kidney damage in people with CKD, a doctor may need to adjust the dosage of a person's antiretroviral medicine, especially if the person's GFR number is below 60. If a person with HIV has CKD, they should ask their doctor if the dose of their HIV medicine needs to be adjusted.



Q: CAN ANTIRETROVIRAL MEDICATIONS HELP PREVENT KIDNEY DISEASE IN PEOPLE WITH HIV?

It is possible that treatment with antiretroviral medicines may protect the kidney in some people. In one study, a 60 percent reduction in the risk of developing kidney disease was found in people taking highly active antiretroviral therapy (HAART). In other studies, patients experienced a slight improvement in kidney function after beginning HAART. However, these findings are not conclusive.

Q: WHEN SHOULD PEOPLE WITH HIV SEE A KIDNEY SPECIALIST?

A doctor who specializes in treating CKD or other kidney problems is called a *nephrologist*. People with HIV who have kidney disease should be referred to a nephrologist for a consultation if they have:

- Stage 3, 4, or 5 CKD (see staging chart on page 6)
- A high level of potassium in their blood (called *hyperkalemia*)
- Kidney side effects from their medications that are difficult to manage
- High blood pressure that is hard to control
- An increased risk for worsening of kidney disease
- Sudden or severe heart and blood vessel problems

GLOMERULAR FILTRATION RATE (GFR)

Q: | HOW IS GFR MEASURED?

GFR is the best way to measure kidney function and determine a person's stage of kidney disease. A doctor or medical laboratory calculates a person's GFR number from the person's blood creatinine level, age, race, and gender.



Q: | WHAT IS A NORMAL GFR?

In most healthy people without CKD, the normal GFR is 90 or higher.

Q: | WHAT GFR RESULT INDICATES A PERSON HAS CKD?

When GFR is below 60 for 3 months or more, CKD is present. A result between 60 and 89 for 3 months or more along with kidney damage (such as constant protein in the urine) means early kidney disease.



Q: DOES AGE AFFECT GFR?

Yes. GFR declines gradually with age, even in people without kidney disease. This table shows the average values of estimated GFR by decade in people without CKD, based on a small study.

Average Estimated GFR by Age in People Without CKD		
Average Estimated GFR (mL/min/1.73 m ²)		
Age (years)	Men	Women
20–29	128	118
30–39	116	107
40–49	105	97
50–59	93	86
60–69	81	75
70–79	70	64
80–89	58	53

Q: WHAT IF GFR IS BETWEEN 60 AND 89, BUT THERE IS NO SIGN OF KIDNEY DAMAGE?

In these cases a doctor may decide to:

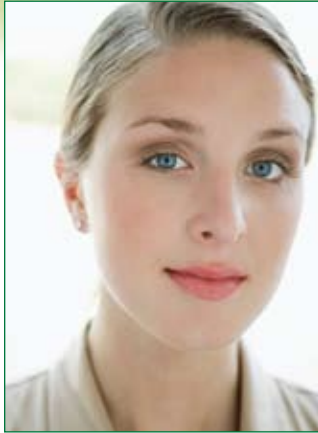
- Check the person's GFR more often
- Ask the person to avoid medications that can damage the kidneys (such as ibuprofen)
- Adjust the dosage of medications that are removed by the kidney
- Refer the person to a nephrologist for further evaluation

Q: DO SOME MEDICINES AFFECT THE ACCURACY OF GFR TESTS?

Most drugs do not affect the accuracy of GFR tests. However, if a doctor suspects that a drug could affect the GFR test, it might be possible to repeat the GFR test after the patient stops taking the drug.

Q: WHY IS IT IMPORTANT TO MEASURE GFR IN PEOPLE WITH HIV?

Estimating kidney function makes it easier to prescribe the correct dose of antiretrovirals and other medications. Doses may need to be changed in people who have kidney disease or kidney failure. If there is no evidence of kidney disease when a person is diagnosed with HIV, those at high risk of developing kidney disease should be tested every year (see risk factors on page 12).



HELPFUL WORDS TO KNOW

As you help educate people about chronic kidney disease, you may need to understand some unfamiliar terms. Here are some important definitions that relate to the kidneys, kidney disease, or complications of kidney disease.

A

acquired immune deficiency syndrome (AIDS)

The most serious and advanced stage of HIV infection.

acute kidney failure

The loss of kidney function that occurs suddenly, because of surgery, illness, injury, drug reaction, or other cause. It often resolves with treatment, but sometimes does not. It is important to note that acute kidney failure is not the same condition as chronic kidney disease.

albuminuria

A condition in which the urine level of albumin (a type of protein) is too high. Albuminuria may be an early sign of kidney disease, especially in people with diabetes.

analgesics

Medications that help relieve pain, such as aspirin, acetaminophen, and non-steroidal anti-inflammatory drugs (NSAIDs).

anemia

A condition caused by a reduced number of red blood cells. People with chronic kidney disease often get anemia due to insufficient amounts of a hormone that is needed to signal the body to make red blood cells.

antibodies

Proteins, made by white blood cells, that attack foreign substances in the body and fight infections.

anti-hypertensive medications

Medications used to lower high blood pressure.

antiretrovirals

Drugs that work against HIV infection by slowing down the replication of the HIV virus in the body. The drugs are often referred to as: antiretrovirals, anti-HIV drugs, or HIV antiviral drugs.

antiretroviral treatment

This is the main type of treatment for HIV or AIDS. It is not a cure, but it can stop people from becoming ill for many years. The treatment consists of drugs that have to be taken every day for the rest of the person's life (see **highly active antiretroviral therapy**).

autoimmune disease

Any disorder in which antibodies are produced against the body's own tissues. Medicines to lower the body's immune activity are part of the treatment of these diseases.

B

bladder

The organ in the urinary system that holds the urine produced by the kidney.



blood pressure

The force of the blood pushing against the walls of the arteries.

blood urea nitrogen (BUN)

Urea nitrogen is a normal waste product in the blood that comes from the protein a person eats and from one's own body stores of protein. Healthy kidneys remove BUN, but when kidney function is lost, BUN levels go up.

bone mineral density (BMD)

BMD tests measure bone mass to determine risk for a fracture. Usually, the lower the bone density, the higher the risk for fracture. People with CKD are at increased risk for bone disorders.

C

calcium

A mineral in the blood that is important for maintaining healthy bones and teeth. People with CKD often develop problems with their bones due to abnormal calcium levels.

cholesterol

A fat-like substance found in the blood. Too much cholesterol in the blood is a risk for heart and blood vessel disease. There are different kinds of cholesterol: Low-density lipoprotein, or LDL, is known as "bad" cholesterol; high-density lipoprotein, or HDL, is known as "good" cholesterol. These and other fats make up your total cholesterol level.

chronic kidney disease (CKD)

The irreversible loss of normal kidney function. A person with CKD has reduced ability to remove waste and extra fluid from the blood. In the US, the 2 main causes of CKD are diabetes and high blood pressure (see CKD stages chart on page 6).

creatinine

A waste product in the blood that comes from muscle activity. Healthy kidneys remove creatinine from the blood, but when kidney function is reduced, the creatinine level in the blood rises. Dialysis and kidney transplantation are treatments for kidney failure that also remove creatinine from blood.

D

diabetes

A disease in which the main problem is regulating blood glucose level. People with diabetes either cannot make or use effectively the hormone insulin that is essential to regulating blood glucose. Type 1 diabetes occurs when the body does not make enough insulin. Type 2 diabetes occurs when the body cannot properly use the insulin it makes. Complications of diabetes affect many organs of the body, including the kidneys. Diabetes is the leading cause of kidney disease in the US.

diabetic kidney disease

Kidney disease resulting from diabetes.

dialysis

A treatment for kidney failure. The 2 major types of dialysis are hemodialysis and peritoneal dialysis.

dietitian

A person trained to provide care, education, and counseling on nutrition. A registered dietitian (RD) has met specific educational standards of the American Dietetic Association.

diuretic

A drug that helps the kidneys eliminate excess water from the body.



E

erythropoietin

A hormone made by the kidney that signals the body to produce red blood cells. Lack of this hormone causes anemia (low red blood cell count).

G

glomerular filtration rate (GFR)

An estimate of kidney function. The GFR can be calculated from your blood creatinine level, age, gender, and race.

H

heart and blood vessel disease (cardiovascular disease)

Any disease or disorder involving the heart, arteries, or veins. Examples include high blood pressure, hardening of the arteries (arteriosclerosis), stroke, enlarged heart, congestive heart failure, and heart attack (myocardial infarction).

hemodialysis (HD)

A treatment method for replacing the function of the kidneys by circulating blood through a machine with tubes made of porous membranes. These tiny tubes, which make up the dialyzers, are bathed by solutions that selectively remove wastes and excess fluids. Treatments typically last for 3 to 4 hours, 3 times each week, and take place at home or in a dialysis center. Treatments can also be done during the night while sleeping, and last from 6 to 10 hours, utilizing a slower blood and dialysate flow rate than is used for the shorter treatment time.

hemoglobin

The part of red blood cells that carries oxygen to the cells and tissues of the body. If the hemoglobin number is too low, the person has anemia.

high blood pressure (hypertension)

A condition that occurs when the blood vessels become narrow or stiff, forcing the heart to pump harder to push blood through the body. High blood pressure is a leading cause of kidney disease, and also a complication of CKD. If blood pressure is high, a person should follow all the steps in their prescribed treatment. These steps may include taking blood pressure medications, cutting down on the amount of sodium (such as table salt) in their diet, losing weight if they are overweight, and following a regular exercise program.

highly active antiretroviral therapy (HAART)

A term that is used to describe a treatment for HIV in which a person takes a combination of 3 or more anti-HIV drugs.

hormone

A natural chemical produced in the body and released into the bloodstream to regulate particular body functions. The kidney releases three hormones: **erythropoietin** (for red blood cell production), **renin** (for blood pressure control), and the form of **vitamin D** needed for healthy bones.

human immunodeficiency virus (HIV)

A virus that infects and damages the immune system. If untreated, HIV can lead to AIDS.

hyperkalemia

Elevated potassium level in the blood; occurs in people with kidney failure when potassium is no longer removed sufficiently in the urine (see **potassium**).



hyperphosphatemia

Elevated phosphate level in the blood; occurs in people with chronic kidney disease when phosphorus is no longer removed sufficiently in the urine (see **phosphorus**).

hypertension (high blood pressure)

See high blood pressure.

hypokalemia

Low potassium level in the blood; can occur when taking diuretic medications, or if a person has diarrhea or vomiting.

hypotension

Low blood pressure.

I

immune system

The body's system for protecting itself against diseases, viruses, bacteria, or any 'non-self' substance or tissue.

inflammation

The heat, swelling, and redness caused by infection or injury to muscle or tissue.

K

kidney failure

The stage of CKD at which someone needs treatment with either dialysis or a kidney transplant to maintain life; occurs when GFR is less than 15.

kidneys

Two organs, each about the size of a fist, located on either side of the spine at the lowest level of the rib cage. Kidneys remove waste products from the body, balance the body's fluids, and release hormones that control blood pressure, production of red blood cells, and healthy bones.

M

microalbuminuria

A condition of having a small, but significant, amount of albumin (which is a kind of protein) in the urine. This is an early sign of diabetic kidney disease. It is also an early warning sign of cardiovascular disease (see **diabetic kidney disease**).

N

nephrologist

A medical doctor who specializes in diagnosis and treatment of kidney and urinary tract disease.

nephrons

The tiny structures of the kidney that perform the filtering and regulatory processes essential for health; each kidney has about 1 million nephrons.

nephrotoxins

Drugs or chemicals that are toxic or poisonous to the kidneys.

non-steroidal anti-inflammatory drugs (NSAIDs)

A group of drugs that helps to relieve pain and reduce inflammation. They are sold over-the-counter or by prescription. NSAIDs can cause kidney damage (they are nephrotoxic) if used regularly over time. Examples are ibuprofen, ketoprofen, and naproxen sodium.



P

peritoneal dialysis (PD)

A treatment for kidney failure that removes wastes and excess fluids from the blood using the abdominal membrane as a filter.

phosphorus

A mineral in the blood that is essential to cells and bones. Kidneys keep the blood phosphorus level in balance. A high phosphorus level can lead to weak bones. People with CKD need to have their phosphorus levels monitored so imbalances can be treated early.

potassium

A mineral in the blood that helps the heart and muscles work properly. Kidneys are essential to keeping blood potassium levels in balance. A potassium level that is too high (hyperkalemia) or too low (hypokalemia) can be harmful and needs to be treated to bring the level to normal range.

protein

An essential component of all living cells; essential for tissue growth and repair.

proteinuria

The presence of protein in the urine. This may be an early sign of kidney damage.

R

red blood cells

The cells that contain hemoglobin, which carries oxygen through the bloodstream to all cells and tissues of the body.

S

sodium

A mineral necessary for normal nerve and muscle function. Sodium is found in table salt and many foods, especially packaged and processed foods. High sodium intake causes the body to retain water, which may lead to increased blood pressure. People with CKD and high blood pressure may need to limit their salt intake.

stages of chronic kidney disease

The stages of CKD are determined by the GFR number. The lower the GFR, the higher the stage of CKD (see table on page 6).

T

toxins

Any drug or chemical that is poisonous to the body; may also refer to waste products that build up in the blood of people with kidney disease.

transplantation

An operation that replaces a diseased organ, such as a heart, kidney, liver, or pancreas, with a healthy organ donated by another person. A kidney transplant may come from a living donor, usually a relative or close friend, or from a deceased donor.

triglyceride

Type of fat found in the blood. A high triglyceride level along with high levels of total and LDL cholesterol may increase the risk of heart and blood vessel disease.



U

urea

A waste product found in the blood that comes from normal breakdown of protein in the body; normally removed from the blood by the kidneys and excreted in the urine. Urea builds up in the blood of people with kidney disease. High levels are associated with many adverse effects. Dialysis therapies remove urea from the blood.

ureters

Tubes that carry the urine from the kidney to the bladder.

urethra

Tube that carries urine out of the bladder during urination.

urinalysis

A test conducted on the urine to detect abnormal substances or presence of cells which can indicate a disease, infection, or tumor, or other disorder of the kidneys, ureter, or bladder.

urinary tract

The organs and structures responsible for the production, transport, and elimination of urine; comprised of the kidneys, ureters, bladder, and urethra.

urine culture

A test done to detect and identify bacteria or other organisms causing an infection in the urinary tract.

urine protein

Protein that has filtered into the urine. A simple test can be done to detect protein in the urine. Constant protein in the urine is an early sign of chronic kidney disease.

urologist

A surgeon who specializes in the treatment of problems of the kidneys, ureter, bladder, and urethra.

urology

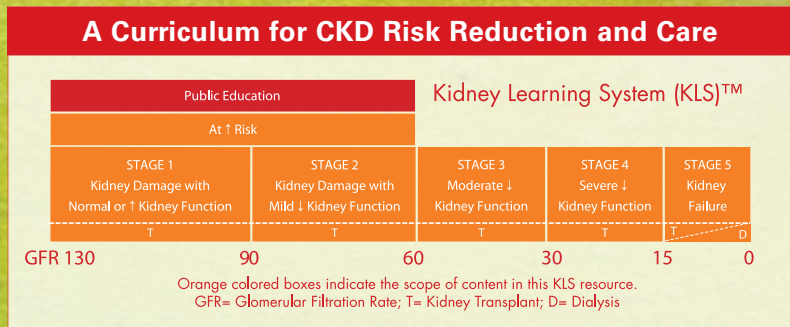
The branch of medicine concerned with the surgical treatment of diseases of the urinary tract.



NOTES

More than 26 million American adults¹ and thousands of American children have chronic kidney disease. Most do not know they have this condition. Further, millions of people with diabetes, hypertension, and other diseases do not realize they are at risk for developing kidney disease. 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 Affiliates and Divisions nationwide, the Foundation conducts programs in research, professional education, patient advocacy and community services, public education, and organ donation.

1. Coresh J, et al. Prevalence of chronic kidney disease in the United States. *JAMA*. 2007;298(17):2038-2047.



**National Kidney
Foundation®**

30 East 33rd Street
New York, NY 10016
800.622.9010
www.kidney.org



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