Chronic Kidney Disease: A "Quiet Epidemic"

by Sylvie Mulvaney

EMT Objectives

After reading this article, the EMT will be able to:

- define chronic kidney failure, list three of its risk factors and three potential complications;
- define acute kidney failure and three of its possible causes;
- describe generally how the kidneys work and explain why they are so important to the body;
- describe generally what dialysis does;
- identify at least two types of access for dialysis patients.

"Your kidneys are like little chemical factories, removing waste and regulating your body. And if the factory stops working, so does your body."

– from the National Kidney Foundation website

Introduction

More than 26 million Americans – 13 percent of our adult population – have chronic kidney disease (CKD), which puts them at risk for kidney (or renal) failure, heart disease and other life-threatening complications, according to the National Kidney Foundation.

Like hypertension, CKD is known as a "silent" disease or "quiet epidemic" because people often don't realize they have it until it reaches advanced stages or until they become symptomatic. It is labeled CKD when the kidneys become too diseased or damaged to function well enough on their own to keep a person healthy. Stage 1 of the disease is the least severe; physicians and patients can attempt to slow the disease with medications, special diets and monitoring. Depending how sick a person is, progression to Stage 5 (also known as end stage renal disease or ESRD) can take months or years. When the disease reaches Stage 5, dialysis becomes necessary to replace the work of the kidneys. For the lucky few, a successful kidney transplant can be a long-term solution.

Chronic renal failure (CRF) is slow, progressive and irreversible, often caused by risk factors such as: diabetes; hypertension; chronic kidney infections; birth defects; a family history of kidney failure; being of black, Hispanic, Native American or Asian heritage; and being over age 60.

Because kidney disease affects such a large portion of our population, there's a good chance EMTs have encountered or will encounter these patients on calls. Hopefully, this article will provide a better understanding of the disease, its magnitude in our society and its impact on our national health system.

The kidneys are incredibly complex organs with numerous miniscule, but vital structures. The purpose of this article is not to study the kidneys, themselves, in depth, but rather to provide the EMT with a general understanding of what they do, what causes them to fail, what occurs when they stop working adequately, and what options are available to patients. In addition, we'll discuss things EMTs can do to better help their dialysis-dependent patients, and things they should avoid when caring for them.

When Chronic Kidney Disease (CKD) reaches Stage 5, dialysis becomes necessary.

First, we'll review a few statistics and kidney basics before delving into what happens when things go wrong.

Statistics from various sources:

- 1 in 3 American adults is currently at risk for developing kidney disease.
- Diabetes and high blood pressure are the two leading causes of chronic kidney disease.
- Black Americans are three times more likely and Hispanics 1.5 times more likely than white Americans to develop kidney failure.
- 350,000 Americans currently are on dialysis, and 70,000 are on a kidney-transplant waiting list.
- Almost 60,000 ESRD patients die each year, making kidney disease America's ninth leading cause of death.
- Federal health insurance plans such as Medicare usually cover about 80 percent of costs for kidney disease patients.
- Treating ESRD patients cost the

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United States more than $40 billion in public and private funds in 2009; in 1998, the cost was less than $17 billion.

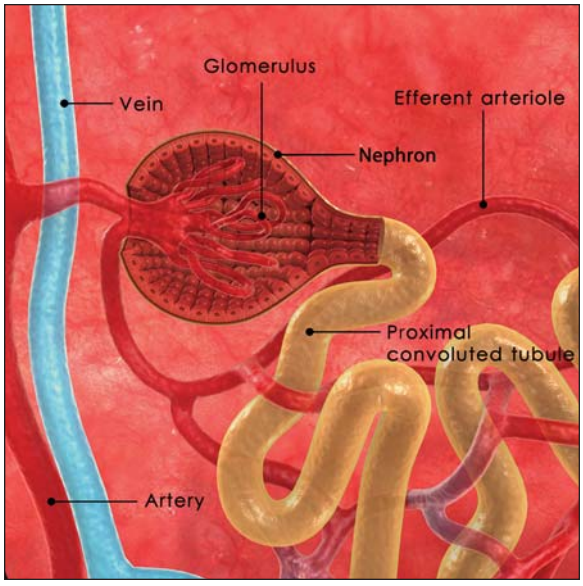
How The Kidneys Work

The renal system is the primary regulator of the body's internal environment, and therefore essential for life. Without adequate renal function, the body cannot maintain a stable internal environment, and all of its systems are adversely affected.

Although the human body can function well with only one kidney, most people have two. The kidneys are two bean-shaped organs, each about the size of a fist, located just below the posterior rib cage, one on each side of the spine. *(See the illustration on the cover of this issue.)*

Each kidney contains approximately one million blood filters called ***nephrons,*** which purify blood and remove waste products 24 hours a day. Each nephron includes a filter, called the ***glomerulus,*** and a ***tubule.*** The glomerulus lets fluid and waste products pass through it, but prevents blood cells and large molecules, mostly proteins, from passing. The filtered fluid then passes through the tubule, which sends minerals back to the bloodstream and removes wastes. *(See Figure 1)* The nephrons filter about 200 quarts of fluid daily – enough to fill a large bathtub – reabsorbing all but approximately two liters of toxins, waste and excess fluid, which leave the body as urine. Urine flows from each kidney through a thin, muscular tube called a ureter, and empties into the bladder. The bladder then empties through another tube called the urethra. *(See Figure 2)*

Figure 1 - Nephron, Glomerulus, Tubule



Through this filtering process, the kidneys help control blood pressure and make hormones the body needs to stay healthy, such as the one that stimulates bone marrow production of red blood cells. In addition, the kidneys help maintain a stable balance of body chemicals, such as sodium, potassium, calcium and acid content.

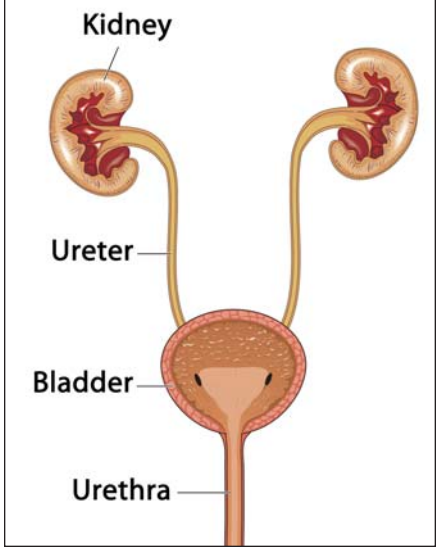
The glomerulus lets fluid and waste products pass through it, but prevents blood cells and large molecules, mostly proteins, from passing.

The glomerular filtration rate (GFR) test is most often used to check how well the kidneys are functioning. It estimates how much blood passes through the glomeruli each minute. Physicians calculate it from the results of a blood creatinine test – which measures how well the kidneys filter creatinine, a chemical waste molecule – and factoring age, body size and gender. A low GFR signifies the kidneys are not working as well as they should. *(See Figure 3)* As kidney disease worsens, the GFR number decreases.

Stages of CKD

One kidney working at 20 percent capacity – or with as few as 300,000 nephrons – can keep a person healthy. Below that, toxins begin to accumulate, causing fluid collection or overload, tissue swelling, lung congestion and high blood pressure. The body begins to feel tired and weak. At this point, dialysis or transplantation is needed to sustain life.

Figure 2 - Ureter, Bladder, Urethra



Kidney disease is divided into five stages:

Stage 1 – Kidney function is normal, but there is evidence of kidney disease, such as proteinuria, or an abnormal amount of protein in the urine, or hematuria, blood in the urine. Hematuria can be visible or microscopic. Patients are asymptomatic.

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Figure 3 - Chronic Kidney Disease Stages and GFR

Stage	Description	GFR (Glomerular Filtration Rate)
1	Kidney damage with normal kidney function	90+
2	Kidney damage with mildly reduced kidney function	89-60
3a	Mild to moderately reduced kidney function	59-45
3b	Moderately reduced kidney function	44-30
4	Severely reduced kidney function	29-15
5	Kidney failure	<15

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Stage 2 – Mildly decreased kidney function is noted, with proteinuria or hematuria, for example. Patients are asymptomatic.

Stage 3 – Moderate decrease in kidney function is noted. A person in Stage 3 CKD is more likely to develop complications such as hypertension, heart disease, anemia or early bone disease. Some of the following symptoms can begin:

- Fatigue
- Edema, or swelling, of the extremities due to fluid retention
- Changes in appearance of urine (foamy, dark or bloody, for example) and urinating more or less often
- Back pain
- Restless legs that cause sleep problems

In Stage 3 CKD, some of the following symptoms can begin: fatigue, edema, changes in appearance of urine, back pain, restless legs.

Stage 4 – Due to severely reduced kidney function, waste products build up in the body, and can become toxic if they reach high levels. This is called uremia. Patients in Stage 4 CKD often progress to Stage 5 before long, and can experience any of the above symptoms, as well as:

- Nausea, vomiting, decreased appetite
- Metallic taste in the mouth, bad breath
- Numbness or tingling in the fingers or toes
- Difficulty concentrating

Stage 5 – End-stage renal disease occurs when the kidneys can no longer adequately filter waste products and fluid from the body. The kidneys' other functions, such as blood pressure regulation, production of the hormone that helps make red blood cells and activation of vitamin D for healthy bones also are compromised. Dialysis or transplant is required to keep the person alive. Some symptoms during Stage 5 kidney disease include those mentioned above and:

- Itching and dry skin
- Headaches
- Weight loss without trying
- Abnormally light or dark skin
- Nail changes
- Bone pain
- Excessive thirst
- Bruising easily, nosebleeds or blood in the stools
- Sexual dysfunction

Although so far we've discussed chronic kidney disease and failure, acute renal failure (ARF) is also possible. ARF is the sudden deterioration of renal function, resulting in the accumulation of uremic toxins in the blood, or azotemia. It can develop suddenly over a period of hours or days, as the result of an insult to the body. Many conditions can cause ARF, including:

- Volume depletion – excessive fluid loss due to hemorrhage, trauma, severe burns, vomiting, diarrhea or frequent urination, to name only a few
- Vasodilation (widening of the blood vessels due to relaxation of their muscular walls) – sepsis, anaphylaxis, certain drugs
- Impaired cardiac function – dysrhythmias, cardiogenic shock, heart failure, myocardial infarction, for example
- Obstruction – kidney stones, blood clots, enlarged prostate, urinary catheter obstruction, postoperative edema
- Decreased renal perfusion – damage to the kidney tissue itself due to prolonged or severe insult, such as those mentioned above

Acute renal failure (ARF) can develop suddenly over a period of hours or days, as the result of an insult to the body. It is often reversible.

ARF often is reversible if diagnosed and treated early. If left undiagnosed or inadequately treated, it can cause permanent damage.

When Kidneys Fail

Dialysis filters toxins from the blood. During treatment, a special fluid mixture of pure water and chemicals pulls waste, salt and extra water from the blood, leaving behind essential substances such as potassium and other electrolytes. Not surprisingly, many people report feeling much better after dialysis treatments.

There are two types of dialysis treatments for people with ESRD: ***hemodialysis*** and ***peritoneal dialysis***.

Hemodialysis can be performed in a dialysis center or in a patient's home with assistance from a trained care

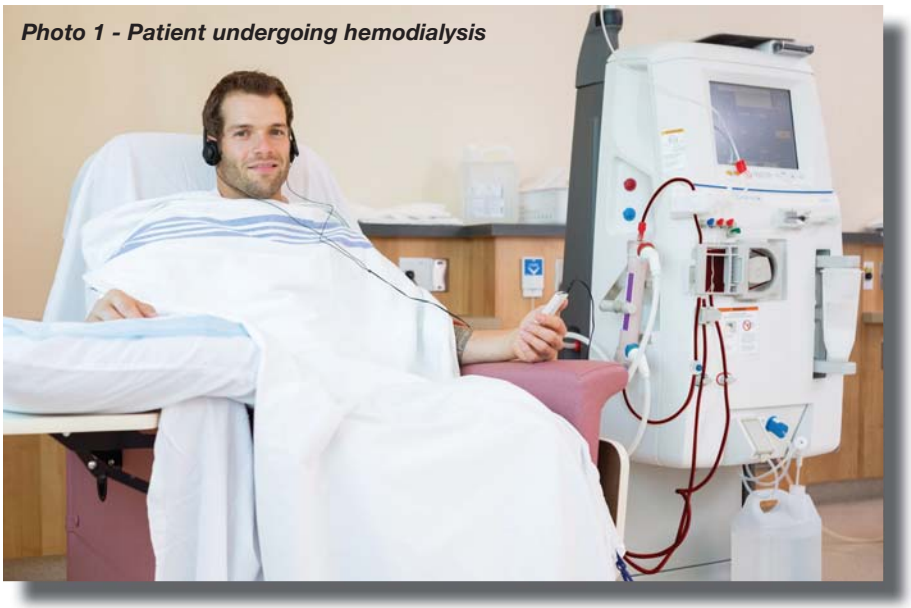

Photo 1 - Patient undergoing hemodialysis

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partner. During treatment, the patient is attached via needle stick to a special-access area of the body (discussed in more detail several paragraphs down) to a dialysis machine about the size of a dishwasher. *(See Photo 1)* The patient's blood passes through a large canister called a dialyzer – often called an artificial kidney – which contains thousands of small fibers. Dialysate, the cleansing solution, contains chemicals that make it act like a sponge. It is pumped around the fibers, allowing waste and extra fluids to pass from the blood into the solution, and out of the body. The filtered blood is then returned to the body.

There are two types of dialysis treatments for people with ESRD: hemodialysis and peritoneal dialysis.

Most hemodialysis patients require treatment three days a week, usually Monday-Wednesday-Friday or Tuesday-Thursday-Saturday, for as much as four hours a day. During treatments, patients can sleep, read, write, talk or watch TV. Of course, there are times when emergent dialysis is needed on a Sunday or during the night. Some patients also choose nocturnal hemodialysis, which can take place at a center, overnight, while they sleep. The nocturnal dialysis process takes longer and some patients report difficulty sleeping during the procedure, while others prefer it because it provides them more free time during daylight hours to live their lives.

There are two permanent types of hemodialysis access.

An arteriovenous (AV) fistula is the most dependable type of access. It is made by directly connecting an artery to a vein beneath the skin, usually in the upper arm or forearm. *(See Photo 2, next page)* As blood flows to the vein from the newly connected artery, the vein grows bigger and stronger, and can provide good, dependable blood flow for many years of hemodialysis. Fistulas tend to last longer than grafts, and are less likely to incur complications, such as infections or blood clots. For this reason, fistulas widely are considered "the gold standard" access choice. Fistulas need several months to heal, or mature, before they can be used for hemodialysis.

An AV graft is made by inserting a small, soft tube between an artery and a vein, also usually in the upper arm or forearm, but sometimes in the thigh near the groin. *(See Figure 4)* Grafts are a good choice for patients with small veins, and sometimes can be used as soon as one week after placement. Grafts might not last as long as fistulas, however, and are more likely to become infected or narrow and cause blood clots.

For patients requiring hemodialysis before their fistula or graft is ready for use, a short-term central venous

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catheter (CVC) might be placed in the neck or chest. A CVC often is a double-lumen access placed in the right anterior chest wall.

Peritoneal dialysis (PD) is a needle-free treatment patients can perform themselves at home or at work. Via a surgically placed catheter in the abdomen, PD uses the lining of the patient's abdomen to filter blood. This lining, called the peritoneal membrane, acts as the artificial kidney. There are three types of PD available, which need not be discussed here.

Generally, PD works like this: a dialysis solution of certain minerals and dextrose, or sugar, water travels through the catheter into the patient's abdomen. The dextrose pulls waste, chemicals and extra water from the peritoneal membrane's tiny blood vessels into the dialysis solution. After several hours of "dwell time," the solution is drained from the abdomen through the same catheter, taking the wastes from the blood with it. *(See Figure 5)* The abdomen is again filled with fresh dialysis solution, and the cycle is repeated. The draining-refilling process is called an exchange.

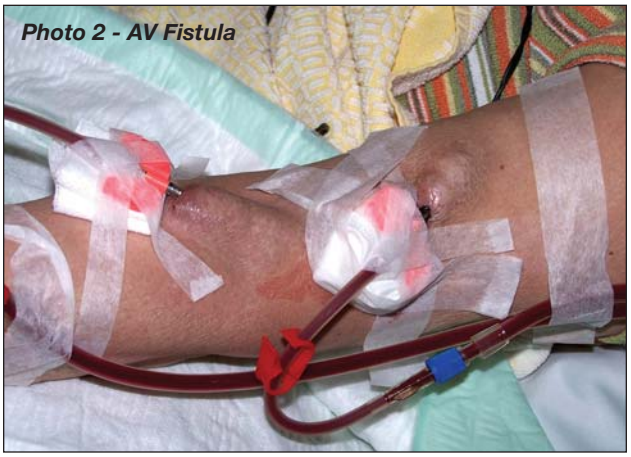

Photo 2 - AV Fistula

The most common problem with PD is peritonitis, a serious abdominal infection, which can occur if the catheter insertion site becomes infected or if contamination occurs during the draining-refilling procedure. Some people report reserving one room in their home as their PD sterile room, restricting access to family members, visitors and pets in an effort to maintain as clean an environment as possible.

Depending on their overall health, patients can be on dialysis for many years before a suitable donated organ is found, or until their health declines and they ultimately die.

Kidney transplant is a third option for ESRD patients. Patients can opt to join a waiting list for a cadaverous kidney – one reason many people in the general population choose to be organ donors when they die – or they can attempt to find a living donor. Both processes, however, are lengthy, arduous and not without risks, and might never yield a suitable kidney for some patients. Between 85 and 90 percent of transplants from deceased donors are working one year after surgery, according to the National Institute of Diabetes and Digestive and Kidney Diseases. Transplants from living relatives often work better than those from unrelated or deceased donors because they're usually closer matches. Even when a suitable donor is found, though, organ rejection or failure is always possible, often due to noncompliance with anti-rejection, or immunosuppressant, medications.

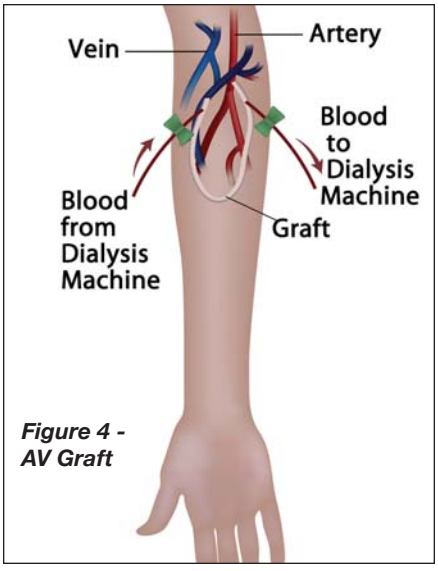

Figure 4 - AV Graft

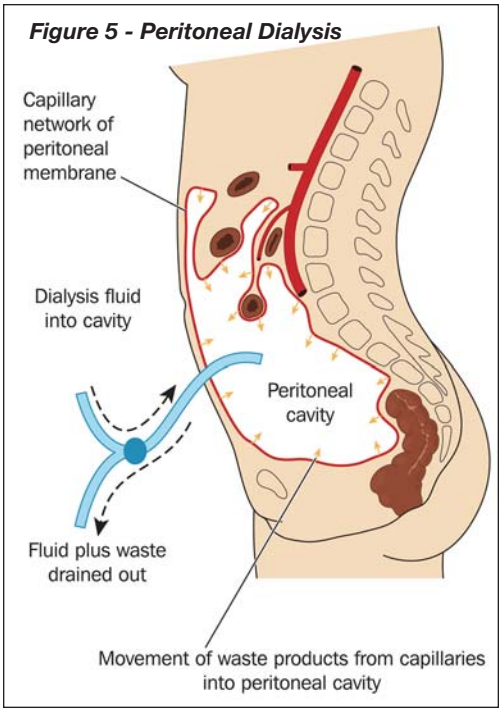

Figure 5 - Peritoneal Dialysis

Palliative care, or comfort care, is available for patients who refuse or withdraw from dialysis treatment. For some patients, especially those who are very sick and have multiple ***comorbidities,*** dialysis may be viewed as a burden that only prolongs their suffering. Patients have the right to refuse or withdraw from dialysis, just as they can change their minds at any time and resume treatment. Depending on their health and remaining kidney function, patients who stop dialysis treatments can live for a few days or a few weeks. During this time, a patient's physician can approve medications to help keep the person comfortable. (*Author's note:* Several years ago, after many years on dialysis, a friend's mother opted to discontinue her treatments. She passed away a week later, on her terms, with her family's blessing.)

ESRD patients can opt to join a waiting list for a cadaverous kidney, or they can attempt to find a living donor.

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EMT Dos & Don'ts

Health-care workers can find caring for kidney-disease patients, specifically those in the later stages of the process, a challenging proposition. Not only are these patients very sick, they typically have at least one comorbidity with the ESRD that has the potential to make them even sicker. ***Do*** make sure you, your crew, ambulance and equipment are prepared for the inevitable 2 a.m. call from the morbidly obese, non-ambulatory, noncompliant senior citizen dialysis patient with a history of emphysema, diabetes, congestive heart failure and hypertension, complaining of chest pain and shortness of breath while reeking of cigarettes. ***Don't*** judge, ***do*** try to show compassion.

In addition, as the time nears for their next dialysis treatment, with the toxins and waste building up in their bodies, some patients understandably just don't feel well. They can be grumpy, stubborn, and argumentative or lash out. ***Don't*** take anything personally. This patient doesn't need snarky remarks, but rather a professional ambulance crew to get him to the hospital as quickly and safely as possible.

For the dialysis patient, that fistula or graft is her lifeline. ***Don't*** attempt to place a blood pressure cuff on the limb with the lifeline. If you're unsure, ask, "Does it matter/do you have a preference which arm I use to measure your blood pressure?" Most patients will tell you if they have a limb restriction. (*Author's note:* I've had a couple of patients insist that I take a blood pressure on one of their legs because both arms have either working or old grafts or fistulas.) The same goes for IV placements and glucose finger sticks. You are the patient's advocate; if you see an EMS provider attempting to do anything with the lifeline limb, ***do*** speak up.

If, while taking a patient's SAMPLE history, you discover the patient has been noncompliant with medications, ***do*** ask why, but ***don't*** preach.

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Glossary

azotemia: the accumulation of uremic toxins, including creatinine, in the blood

comorbidities: two or more coexisting medical conditions that are additional to an initial diagnosis

creatinine: a chemical waste product filtered from the blood through the kidneys

dialysis: a process for removing waste and excess water from the blood, used as an artificial replacement for lost kidney function in people with renal failure

glomerulus: a cluster of capillaries located in the nephron; its primary function is to filter blood cells and large molecules

glomerular filtration rate (GFR): an estimation of blood flow through the kidneys; it helps determine how well kidneys are functioning

uremia: urea in the blood; clinical symptoms of azotemia

nephron: a functional unit of the kidney

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Sometimes the noncompliance is due to lack of insurance, inability to afford medications, confusion regarding multiple medications taken throughout the day, or the patient's dislike of a medication's side effects. And yes, sometimes there is no good reason for the noncompliance. ***Do*** make a note of the patient's answers for your report to the hospital staff when you arrive.

If you discover the ESRD patient has been noncompliant with medications, you may ask why, but don't preach. Make a note of his answers for your report.

Summary

Anyone can develop kidney disease. Many people can decrease their chances of developing it by exercising most days of the week, having regular checkups with their primary care physician or appropriate specialist, eating a diet low in salt and fat, avoiding tobacco, limiting alcohol and taking their medications as prescribed.

Hopefully this article helped clarify at least some aspects of a rather complex subject. The next time you respond to a call involving a patient with a history of kidney disease, or even a patient on dialysis, let's hope some of the information from this article will spring to mind, and you'll have a better understanding of what's going on with your patient.

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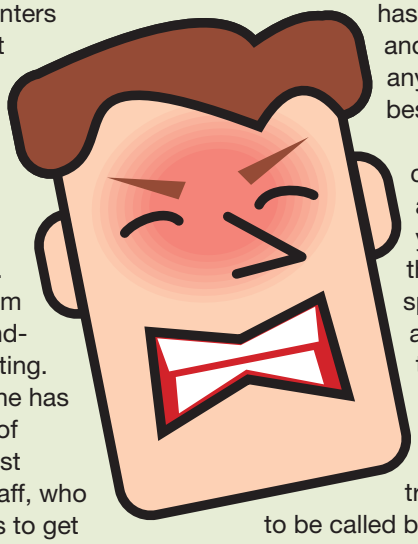
Resources:

- Centers for Disease Control and Prevention - www.cdc.gov
- National Kidney Foundation - www.kidney.org/
- National Institutes of Health - www.nih.gov
- American Kidney Fund - www.kidneyfund.org
- American Association of Kidney Patients - www.aakp.org/
- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) Clearinghouse - www.kidney.niddk.nih.gov
- Mayo Clinic - www.mayoclinic.org
- The Renal Association - www.renal.org
- DaVita - www.davita.com

From The Patient's Perspective...

Mr. F is a regular in one of the emergency departments (EDs) where I work. He arrives three times a week in his motorized scooter for hemodialysis treatments. Rumor has it he comes to the hospital for his treatments because he's been banned from several dialysis centers for being a difficult patient. I have to admit that when he first started coming and I had him as a patient, the rumor wasn't so hard to believe. At times I found him to be rude, demanding and even insulting. Over time, I think he has developed a kind of rapport with at least some of the ED staff, who know what it takes to get him in and out as quickly as possible: EKG, draw a couple of tubes of blood, and if everything looks OK, down to dialysis. These days, whenever I see him, whether he's my patient or not, I greet him, ask how he's doing and offer him juice or crackers from our galley kitchen area, or a warm blanket. He is usually pleasant, returns my greeting and most of the time declines whatever I've offered.



If, however, the EKG or bloodwork shows an abnormality such as an elevated potassium level that requires immediate intervention, be prepared to deal with the not-so-pleasant Mr. F. As do many dialysis patients, Mr. F has terrible veins. Because of the dialysis access in his left arm, needle sticks are restricted to his right arm. Obtaining IV access to administer medications in an effort to correct emergent abnormalities is challenging at best – and not just because of the veins. Mr. F quickly becomes impatient with anyone who cannot establish the IV with one attempt, and despite the danger, has in the past loudly and angrily refused any interventions besides dialysis.

It would be easy to characterize Mr. F as just a jerk, until you try seeing things from his perspective. Three days a week he is forced to spend hours at the hospital, sometimes waiting to be triaged, then waiting to be called back to a room, waiting to be seen by the physician, then for someone to draw his blood. After enduring multiple sticks for the blood, he's waiting for the results, then waiting to be called for dialysis, where he will spend several more hours. Sometimes patients go through all the initial steps only to be told that, based on the EKG and blood work, they don't require dialysis that day, and they should return the next day to start the process all over again. Who wouldn't be annoyed?

My point is, it's often easy to dismiss people as "difficult" or any other negative adjective if you don't try to see things the way they do. Yes, sometimes the person really is a jerk, but the next time you are dealing with such a patient, ask yourself why. *- SM*