



Treatment Methods for Kidney Failure

HEMODIALYSIS



U.S. Department
of Health and
Human Services

NIDDK

NATIONAL INSTITUTES OF HEALTH
National Kidney and Urologic Diseases
Information Clearinghouse

Treatment Methods for Kidney Failure
HEMODIALYSIS



NATIONAL INSTITUTES OF HEALTH
National Institute of Diabetes and Digestive and Kidney Diseases



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Hemodialysis is the most common method used to treat advanced and permanent kidney failure. Since the 1960s, when hemodialysis first became a practical treatment for kidney failure, we've learned much about how to make hemodialysis treatments more effective and minimize side effects. In recent years, more compact and simpler dialysis machines have made home dialysis increasingly attractive. But even with better procedures and equipment, hemodialysis is still a complicated and inconvenient therapy that requires a coordinated effort from your whole health care team, including your nephrologist, dialysis nurse, dialysis technician, dietitian, and social worker. The most important members of your health care team are you and your family. By learning about your treatment, you can work with your health care team to give yourself the best possible results, and you can lead a full, active life.



When Your Kidneys Fail

Healthy kidneys clean your blood by removing excess fluid, minerals, and wastes. They also make hormones that keep your bones strong and your blood healthy. When your kidneys fail, harmful wastes build up in your body, your blood pressure may rise, and your body may retain excess fluid and not make enough red blood cells. When this happens, you need treatment to replace the work of your failed kidneys.



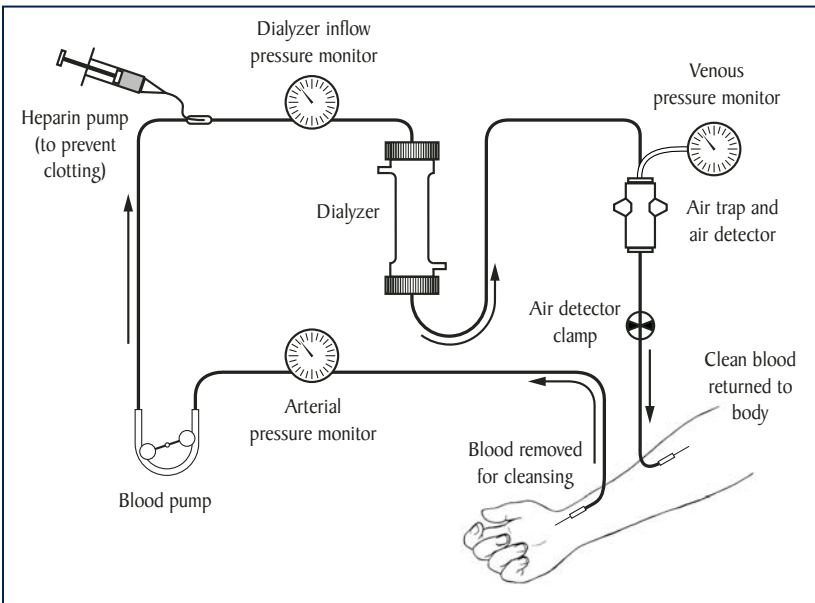
How Hemodialysis Works

In hemodialysis, your blood is allowed to flow, a few ounces at a time, through a special filter that removes wastes and extra fluids. The clean blood is then returned to your body.

Removing the harmful wastes and extra salt and fluids helps control your blood pressure and keep the proper balance of chemicals like potassium and sodium in your body.

One of the biggest adjustments you must make when you start hemodialysis treatments is following a strict schedule. Most patients go to a clinic—a dialysis center—three times a week for 3 to 5 or more hours each visit. For example, you may be on a Monday-Wednesday-Friday schedule or a Tuesday-Thursday-Saturday schedule. You may be asked to choose a morning, afternoon, or evening shift, depending on availability and capacity at the dialysis unit. Your dialysis center will explain your options for scheduling regular treatments.

Researchers are exploring whether shorter daily sessions, or longer sessions performed overnight while the patient sleeps, are more effective in removing wastes. Newer dialysis machines



Hemodialysis.

make these alternatives more practical with home dialysis. But the Federal Government has not yet established a policy to pay for more than three hemodialysis sessions a week.

Several centers around the country teach people how to perform their own hemodialysis treatments at home. A family member or friend who will be your helper must also take the training, which usually takes at least 4 to 6 weeks. Home dialysis gives you more flexibility in your dialysis schedule. With home hemodialysis, the time for each session and the number of sessions per week may vary, but you must maintain a regular schedule by giving yourself dialysis treatments as often as you would receive them in a dialysis unit.



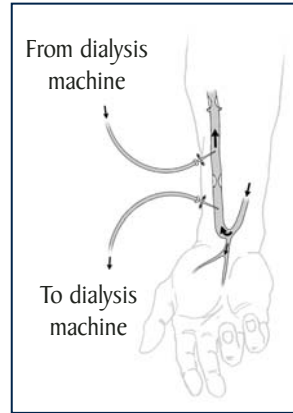
Adjusting to Changes

Even in the best situations, adjusting to the effects of kidney failure and the time you spend on dialysis can be difficult. Aside from the “lost time,” you may have less energy. You may need to make changes in your work or home life, giving up some activities and responsibilities. Keeping the same schedule you kept when your kidneys were working can be very difficult now that your kidneys have failed. Accepting this new reality can be very hard on you and your family. A counselor or social worker can answer your questions and help you cope.

Many patients feel depressed when starting dialysis, or after several months of treatment. If you feel depressed, you should talk with your social worker, nurse, or doctor because this is a common problem that can often be treated effectively.

Getting Your Vascular Access Ready

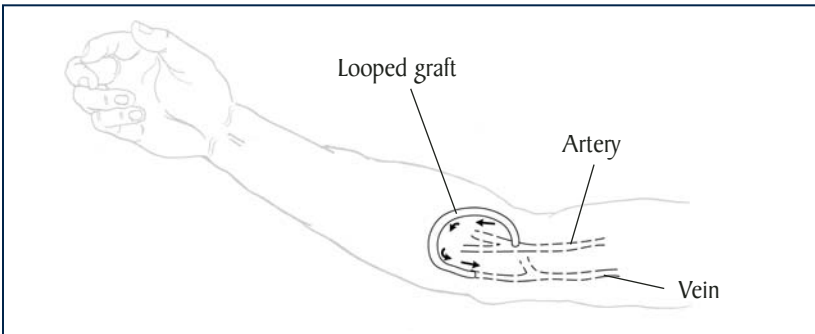
One important step before starting hemodialysis is preparing a vascular access, a site on your body from which your blood is removed and returned. A vascular access should be prepared weeks or months before you start dialysis. It will allow easier and more efficient removal and replacement of your blood with fewer complications. For more information about the different kinds of vascular accesses and how to care for them, see the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) fact sheet *Vascular Access for Hemodialysis*.



Arteriovenous fistula.

Equipment and Procedures

When you first visit a hemodialysis center, the mix of machines and people may seem complicated. But once you learn how the dialysis procedure works and you become familiar with the equipment, you'll be more comfortable.



Graft.

Dialysis Machine

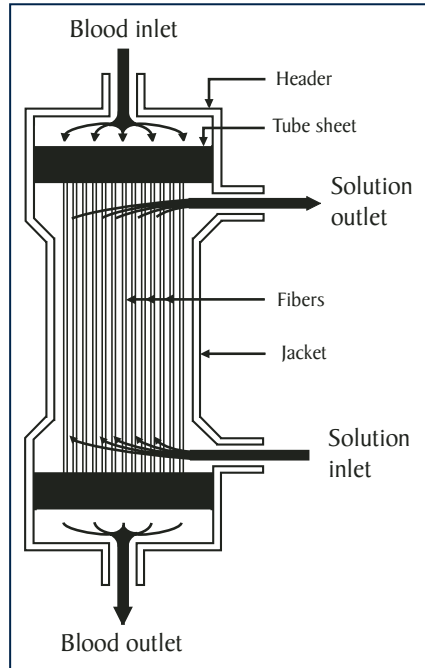
The dialysis machine is about the size of a dishwasher. This machine has three main jobs:

- pump blood and watch flow for safety
- clean wastes from blood
- watch your blood pressure and the rate of fluid removal from your body

Dialyzer

The dialyzer is a large canister containing thousands of small fibers through which your blood is passed. Dialysis solution, the cleansing fluid, is pumped around these fibers. The fibers allow wastes and extra fluids to pass from your blood into the solution, which carries them away. The dialyzer is sometimes called an artificial kidney.

- **Reuse.** Your dialysis center may use the same dialyzer more than once for your treatments. Reuse is considered safe as long as the dialyzer is cleaned before each use. The dialyzer is tested each time to make sure it's still working, and it should never be used for anyone but you. Before each session, you should be sure that the dialyzer is labeled with your name and check to see that it has been cleaned, disinfected, and tested.



Structure of a typical hollow fiber dialyzer.

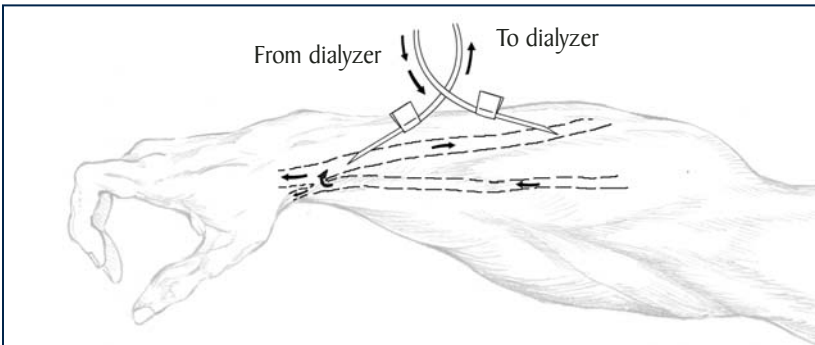
Dialysis Solution

Dialysis solution, also known as dialysate, is the fluid in the dialyzer that helps remove wastes and extra fluid from your blood. It contains chemicals that make it act like a sponge. Your doctor will give you a specific dialysis solution for your treatments. This formula can be adjusted based on how well you handle the treatments and on your blood tests.

Needles

Many people find the needle sticks to be one of the hardest parts of hemodialysis treatments. Most people, however, report getting used to them after a few sessions. If you find the needle insertion painful, an anesthetic cream or spray can be applied to the skin. The cream or spray will numb your skin briefly so you won't feel the needle.

Most dialysis centers use two needles—one to carry blood to the dialyzer and one to return the cleaned blood to your body. Some specialized needles are designed with two openings for two-way flow of blood, but these needles are less efficient and require longer sessions. Needles for high-flux or high-efficiency dialysis need to be a little larger than those used with regular dialyzers.



Arterial and venous needles.

Some people prefer to insert their own needles. You'll need training on inserting needles properly to prevent infection and protect your vascular access. You may also learn a "ladder" strategy for needle placement in which you "climb" up the entire length of the access session by session so that you don't weaken an area with a grouping of needle sticks. A different approach is the "buttonhole" strategy in which you use a limited number of sites but insert the needle back into the same hole made by the previous needle stick. Whether you insert your own needles or not, you should know these techniques to better care for your access.



Tests to See How Well Your Dialysis Is Working

About once a month, your dialysis care team will test your blood by using one of two formulas—URR or Kt/V —to see whether your treatments are removing enough wastes. Both tests look at one specific waste product, called blood urea nitrogen (BUN), as an indicator for the overall level of waste products in your system. For more information about these measurements, see the NIDDK fact sheet *Hemodialysis Dose and Adequacy*.



Conditions Related to Kidney Failure and Their Treatments

Your kidneys do much more than remove wastes and extra fluid. They also make hormones and balance chemicals in your system. When your kidneys stop working, you may have problems with anemia and conditions that affect your bones, nerves, and skin. Some of the more common conditions caused by kidney failure are extreme tiredness, bone problems, joint problems, itching, and “restless legs.” Restless legs will keep you awake as you feel them twitching and jumping.

Anemia and Erythropoietin (EPO)

Anemia is a condition in which the volume of red blood cells is low. Red blood cells carry oxygen to cells throughout the body. Without oxygen, cells can't use the energy from food, so someone with anemia may tire easily and look pale. Anemia can also contribute to heart problems.

Anemia is common in people with kidney disease because the kidneys produce the hormone erythropoietin, or EPO, which stimulates the bone marrow to produce red blood cells. Diseased kidneys often don't make enough EPO, and so the bone marrow makes fewer red blood cells. EPO is available commercially and is commonly given to patients on dialysis.

For more information about the causes of and treatments for anemia in kidney failure, see the NIDDK fact sheet *Anemia in Kidney Disease and Dialysis*.

Renal Osteodystrophy

The term “renal” describes things related to the kidneys. Renal osteodystrophy, or bone disease of kidney failure, affects 90 percent of dialysis patients. It causes bones to become thin and weak or formed incorrectly and affects both children and

adults. Symptoms can be seen in growing children with kidney disease even before they start dialysis. Older patients and women who have gone through menopause are at greater risk for this disease.

For more information about the causes of this bone disease and its treatment in dialysis patients, see the NIDDK fact sheet *Renal Osteodystrophy*.

Itching (Pruritus)

Many people treated with hemodialysis complain of itchy skin, which is often worse during or just after treatment. Itching is common even in people who don't have kidney disease; in kidney failure, however, itching can be made worse by wastes in the bloodstream that current dialyzer membranes can't remove from the blood.

The problem can also be related to high levels of parathyroid hormone (PTH). Some people have found dramatic relief after having their parathyroid glands removed. The four parathyroid glands sit on the outer surface of the thyroid gland, which is located on the windpipe in the base of your neck, just above the collarbone. The parathyroid glands help control the levels of calcium and phosphorus in the blood.

But a cure for itching that works for everyone has not been found. Phosphate binders seem to help some people; these medications act like sponges to soak up, or bind, phosphorus while it is in the stomach. Others find relief after exposure to ultraviolet light. Still others improve with EPO shots. A few antihistamines (Benadryl, Atarax, Vistaril) have been found to help; also, capsaicin cream applied to the skin may relieve itching by deadening nerve impulses. In any case, taking care of dry skin is important. Applying creams with lanolin or camphor may help.

Sleep Disorders

Patients on dialysis often have insomnia, and some people have a specific problem called the sleep apnea syndrome, which is often signaled by snoring and breaks in snoring. Episodes of apnea are actually breaks in breathing during sleep. Over time, these sleep disturbances can lead to “day-night reversal” (insomnia at night, sleepiness during the day), headache, depression, and decreased alertness. The apnea may be related to the effects of advanced kidney failure on the control of breathing. Treatments that work with people who have sleep apnea, whether they have kidney failure or not, include losing weight, changing sleeping position, and wearing a mask that gently pumps air continuously into the nose (nasal continuous positive airway pressure, or CPAP).

Many people on dialysis have trouble sleeping at night because of aching, uncomfortable, jittery, or “restless” legs. You may feel a strong impulse to kick or thrash your legs. Kicking may occur during sleep and disturb a bed partner throughout the night. The causes of restless legs may include nerve damage or chemical imbalances.

Moderate exercise during the day may help, but exercising a few hours before bedtime can make it worse. People with restless leg syndrome should reduce or avoid caffeine, alcohol, and tobacco; some people also find relief with massages or warm baths. A class of drugs called benzodiazepines, often used to treat insomnia or anxiety, may help as well. These prescription drugs include Klonopin, Librium, Valium, and Halcion. A newer and sometimes more effective therapy is levodopa (Sinemet), a drug used to treat Parkinson’s disease.

Sleep disorders may seem unimportant, but they can impair your quality of life. Don’t hesitate to raise these problems with your nurse, doctor, or social worker.

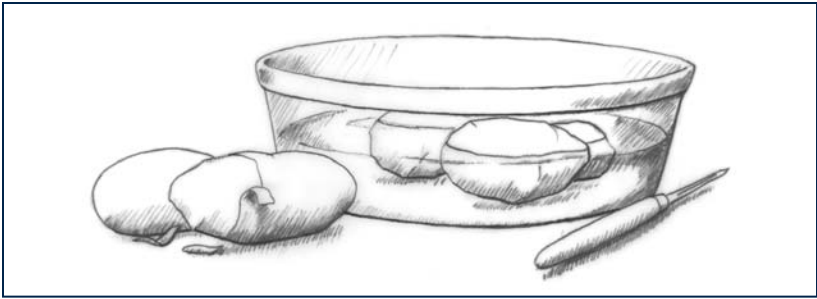
Amyloidosis

Dialysis-related amyloidosis (DRA) is common in people who have been on dialysis for more than 5 years. DRA develops when proteins in the blood deposit on joints and tendons, causing pain, stiffness, and fluid in the joints, as is the case with arthritis. Working kidneys filter out these proteins, but dialysis filters are not as effective. For more information, see the NIDDK fact sheet *Amyloidosis and Kidney Disease*.

How Diet Can Help

Eating the right foods can help improve your dialysis and your health. Your clinic has a dietitian to help you plan meals. Follow the dietitian's advice closely to get the most from your hemodialysis treatments. Here are a few general guidelines.

- **Fluids.** Your dietitian will help you determine how much fluid to drink each day. Extra fluid can raise your blood pressure, make your heart work harder, and increase the stress of dialysis treatments. Remember that many foods—such as soup, ice cream, and fruits—contain plenty of water. Ask your dietitian for tips on controlling your thirst.
- **Potassium.** The mineral potassium is found in many foods, especially fruits and vegetables. Potassium affects how steadily your heart beats, so eating foods with too much of it can be very dangerous to your heart. To control potassium levels in your blood, avoid foods like oranges, bananas, tomatoes, potatoes, and dried fruits. You can remove some of the potassium from potatoes and other vegetables by peeling and soaking them in a large container of water for several hours, then cooking them in fresh water.



You can remove some potassium from potatoes by soaking them in water.

- **Phosphorus.** The mineral phosphorus can weaken your bones and make your skin itch if you consume too much. Control of phosphorus may be even more important than calcium itself in preventing bone disease and related complications. Foods like milk and cheese, dried beans, peas, colas, nuts, and peanut butter are high in phosphorus and should be avoided. You'll probably need to take a phosphate binder with your food to control the phosphorus in your blood between dialysis sessions.
- **Salt (sodium chloride).** Most canned foods and frozen dinners contain high amounts of sodium. Too much of it makes you thirsty, and when you drink more fluid, your heart has to work harder to pump the fluid through your body. Over time, this can cause high blood pressure and congestive heart failure. Try to eat fresh foods that are naturally low in sodium, and look for products labeled "low sodium."
- **Protein.** Before you were on dialysis, your doctor may have told you to follow a low-protein diet to preserve kidney function. But now you have different nutritional priorities. Most people on dialysis are encouraged to eat as much high-quality protein as they can. Protein helps you keep muscle and repair tissue, but protein breaks

down into urea (blood urea nitrogen, or BUN) in your body. Some sources of protein, called high-quality proteins, produce less waste than others. High-quality proteins come from meat, fish, poultry, and eggs. Getting most of your protein from these sources can reduce the amount of urea in your blood.

- **Calories.** Calories provide your body with energy. Some people on dialysis need to gain weight. You may need to find ways to add calories to your diet. Vegetable oils—like olive, canola, and safflower oils—are good sources of calories and do not contribute to problems controlling your cholesterol. Hard candy, sugar, honey, jam, and jelly also provide calories and energy. If you have diabetes, however, be very careful about eating sweets. A dietitian’s guidance is especially important for people with diabetes.
- **Supplements.** Vitamins and minerals may be missing from your diet because you have to avoid so many foods. Dialysis also removes some vitamins from your body. Your doctor may prescribe a vitamin and mineral supplement designed specifically for people with kidney failure. Take your prescribed supplement after treatment on the days you have hemodialysis. **Never take vitamins that you can buy off the store shelf, since they may contain vitamins or minerals that are harmful to you.**

You can also ask your dietitian for recipes and titles of cookbooks for patients with kidney disease. Following the restrictions of a diet for kidney disease might be hard at first, but with a little creativity, you can make tasty and satisfying meals. For more information, see the NIDDK booklet *Eat Right to Feel Right on Hemodialysis*.

Financial Issues

Treatment for kidney failure is expensive, but Federal health insurance plans pay much of the cost, usually up to 80 percent. Often, private insurance or State programs pay the rest. Your social worker can help you locate resources for financial assistance. For more information, see the NIDDK fact sheet *Financial Help for Treatment of Kidney Failure*.

Hope Through Research

The NIDDK, through its Division of Kidney, Urologic, and Hematologic Diseases, supports several programs and studies devoted to improving treatment for patients with progressive kidney disease and permanent kidney failure, including patients on hemodialysis.

- **The End-Stage Renal Disease Program** promotes research to reduce medical problems from bone, blood, nervous system, metabolic, gastrointestinal, cardiovascular, and endocrine abnormalities in kidney failure and to improve the effectiveness of dialysis and transplantation. The research focuses on evaluating different hemodialysis schedules and on finding the most useful information for measuring dialysis adequacy. The program also seeks to increase kidney graft and patient survival and to maximize quality of life.
- **The HEMO Study**, completed in 2002, tested the theory that a higher dialysis dose and/or high-flux membranes would reduce patient mortality (death) and morbidity (medical problems). Doctors at 15 medical centers recruited more than 1,800 hemodialysis patients and randomly assigned them to high or standard dialysis

doses and high- or low-flux filters. The study found no increase in the health or survival of patients who had a higher dialysis dose, who dialyzed with high-flux filters, or who did both.

- **The U.S. Renal Data System (USRDS)** collects, analyzes, and distributes information about the use of dialysis and transplantation to treat kidney failure in the United States. The USRDS is funded directly by the NIDDK in conjunction with the Centers for Medicare & Medicaid Services. The USRDS publishes an *Annual Data Report*, which identifies the total population of people being treated for kidney failure; reports on incidence, prevalence, death rates, and trends over time; and develops data on the effects of various treatment approaches. The report also helps identify problems and opportunities for more focused special studies of renal research issues.
- **The Hemodialysis Vascular Access Clinical Trials Consortium** is conducting a series of multicenter, clinical trials of drug therapies to reduce the failure and complication rate of arteriovenous (AV) grafts and fistulas in hemodialysis. These studies are randomized and placebo controlled, which means the studies meet the highest standard for scientific accuracy. AV grafts and fistulas prepare the arteries and veins for regular dialysis. See the NIDDK fact sheet *Vascular Access for Hemodialysis* for more information. Recently developed drugs to prevent blood clots may be evaluated in these large clinical trials.



Resources

Organizations That Can Help

American Association of Kidney Patients

3505 East Frontage Road

Suite 315

Tampa, FL 33607

Phone: 1-800-749-2257

Email: info@aakp.org

Internet: www.aakp.org

American Kidney Fund

6110 Executive Boulevard

Suite 1010

Rockville, MD 20852

Phone: 1-800-638-8299 or 301-881-3052

Email: helpline@kidneyfund.org

Internet: www.kidneyfund.org

Life Options Rehabilitation Program

c/o Medical Education Institute, Inc.

414 D'Onofrio Drive

Suite 200

Madison, WI 53719

Phone: 1-800-468-7777 or 608-232-2333

Email: lifeoptions@MEIresearch.org

Internet: www.lifeoptions.org

www.kidneyschool.org

National Kidney Foundation, Inc.

30 East 33rd Street

New York, NY 10016

Phone: 1-800-622-9010 or 212-889-2210

Internet: www.kidney.org

Additional Reading

If you would like to learn more about kidney failure and its treatment, you may be interested in reading

AAKP Patient Plan

A series of booklets and newsletters that cover the different phases of learning about kidney failure, choosing a treatment, and adjusting to changes.

American Association of Kidney Patients

3505 East Frontage Road

Suite 315

Tampa, FL 33607

Phone: 1-800-749-2257

Email: info@aakp.org

Internet: www.aakp.org

Getting the Most From Your Treatment series

A series of brochures based on the National Kidney Foundation's Dialysis Outcomes Quality Initiative (NKF-DOQI). Titles include *What You Need to Know About Peritoneal Dialysis*, *What You Need to Know Before Starting Dialysis*, and *What You Need to Know About Anemia*.

Additional patient education brochures include information on diet, work, and exercise.

National Kidney Foundation, Inc.

30 East 33rd Street

New York, NY 10016

Phone: 1-800-622-9010 or 212-889-2210

Internet: www.kidney.org

Medicare Coverage of Kidney Dialysis and Kidney Transplant Services

Publication Number CMS-10128

U.S. Department of Health and Human Services

Centers for Medicare & Medicaid Services

7500 Security Boulevard

Baltimore, MD 21244-1850

Phone: 1-800-MEDICARE (1-800-633-4227)

TDD: 1-877-486-2048

Internet: www.medicare.gov/publications/pubs/pdf/10128.pdf

You Can Live: Your Guide for Living with Kidney Failure

Publication Number CMS-02119

U.S. Department of Health and Human Services

Centers for Medicare & Medicaid Services

7500 Security Boulevard

Baltimore, MD 21244-1850

Phone: 1-800-MEDICARE (633-4227)

TDD: 1-877-486-2048

Internet: www.medicare.gov/publications/pubs/pdf/02119.pdf

Newsletters and Magazines

Family Focus Newsletter (published quarterly)

National Kidney Foundation, Inc.

30 East 33rd Street

New York, NY 10016

Phone: 1-800-622-9010 or 212-889-2210

Internet: www.kidney.org

For Patients Only (published six times a year)

ATTN: Subscription Department

18 East 41st Street

20th Floor

New York, NY 10017-6222

Renalife (published quarterly)

American Association of Kidney Patients

3505 East Frontage Road

Suite 315

Tampa, FL 33607

Phone: 1-800-749-2257

Email: info@aakp.org

Internet: www.aakp.org

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Kim Bayer, M.A., R.D., L.D.
BMA Dialysis
Bethesda, MD

Cora Benedicto, R.N.
Clinic Director
Gambro Health Care
N Street Clinic
Washington, DC

About the Kidney Failure Series

You and your doctor will work together to choose a treatment that's best for you. The booklets and fact sheets of the NIDDK Kidney Failure Series can help you learn about the specific issues you will face.

Booklets

- *Eat Right to Feel Right on Hemodialysis*
- *Kidney Failure: Choosing a Treatment That's Right for You*
- *Kidney Failure Glossary*
- *Treatment Methods for Kidney Failure: Hemodialysis*
- *Treatment Methods for Kidney Failure: Peritoneal Dialysis*
- *Treatment Methods for Kidney Failure: Transplantation*

Fact Sheets

- *Amyloidosis and Kidney Disease*
- *Anemia in Kidney Disease and Dialysis*
- *Financial Help for Treatment of Kidney Failure*
- *Hemodialysis Dose and Adequacy*
- *Kidney Failure: What to Expect*
- *Peritoneal Dialysis Dose and Adequacy*
- *Renal Osteodystrophy*
- *Vascular Access for Hemodialysis*

Learning as much as you can about your treatment will help make you an important member of your health care team.

The NIDDK will develop additional materials for this series as needed. Please address any comments about this series and requests for copies to the National Kidney and Urologic Diseases Information Clearinghouse. Descriptions of the publications in this series are available on the Internet at www.kidney.niddk.nih.gov/kudiseases/pubs/kidneyfailure/index.htm.

National Kidney and Urologic Diseases Information Clearinghouse

3 Information Way

Bethesda, MD 20892-3580

Phone: 1-800-891-5390

Fax: 703-738-4929

Email: nkudic@info.niddk.nih.gov

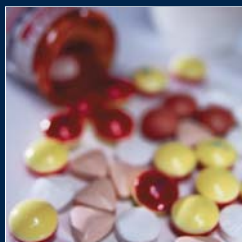
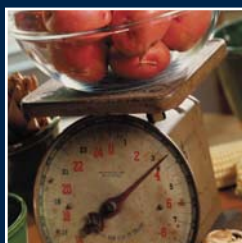
Internet: www.kidney.niddk.nih.gov

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Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts.

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This booklet is also available at www.kidney.niddk.nih.gov.



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