

The content on the *UpToDate* website is not intended nor recommended as a substitute for medical advice, diagnosis, or treatment. Always seek the advice of your own physician or other qualified health care professional regarding any medical questions or conditions. The use of this website is governed by the [UpToDate Terms and Conditions](#) ([click here](#)) ©2007 UpToDate, Inc.

Patient information: Hemodialysis

[Jeffrey S Berns, MD](#)

UpToDate performs a continuous review of over 375 journals and other resources. Updates are added as important new information is published. The literature review for version 15.3 is current through August 2007; this topic was last changed on August 29, 2006. The next version of UpToDate (16.1) will be released in March 2008.

INTRODUCTION — Renal replacement therapies are treatments for severe kidney failure, also called renal failure, stage 5 chronic kidney disease, and end-stage renal disease. When the kidneys are no longer working effectively, waste products and fluid build up in the blood. Renal replacement therapies take over a portion of the function of the failing kidneys to remove the fluid and waste. ([See "Patient information: Renal replacement therapy"](#)).

Renal replacement therapy is typically needed when about 90 percent or more of kidney function is lost. This usually takes many months or years after kidney disease is first discovered, although sometimes severe kidney failure is discovered in patients not previously known to have kidney disease. Early in the course of kidney disease, other treatments are used to help preserve kidney function and delay the need for replacement therapy. Treatments are directed at the underlying disease, secondary factors (such as hypertension) that promote disease progression, and the complications of chronic kidney disease.

Abnormalities in blood chemistries, malnutrition, high blood pressure (hypertension), bone disease, and anemia can also occur as a direct result of kidney failure. When these problems reach a critical stage, renal replacement therapy is required.

CHOICE OF THERAPY — Once it is determined that renal replacement therapy will be required, the patient (along with their physicians) should consider the advantages and disadvantages of the three types of therapy: hemodialysis (in-center or at home), peritoneal dialysis, and renal transplantation (living donor or deceased organ donor, also called a cadaveric donor).

Kidney transplantation is the treatment of choice for many patients with end-stage renal disease in whom a successful kidney transplant improves the quality of life and reduces the mortality risk when compared with maintenance dialysis. However, not all patients are appropriate candidates for this therapy because of its risks and limits. Specialists in kidney transplantation are often consulted to help patients and their doctors make appropriate decisions as to the benefit and risks of kidney transplantation.

The choice between hemodialysis or peritoneal dialysis is influenced by a number of considerations such as availability, convenience, underlying medical problems, home situation, and age. This choice is best made by discussing the risks and benefits of each type of dialysis with a healthcare provider. ([See "Patient information: Renal replacement therapy"](#)).

TIMING — The decision to begin dialysis is made by the patient and doctor as kidney disease progresses and after considering a number of factors. The patient's kidney function (as measured by blood and urine tests), overall health, nutritional status, symptoms, quality of life, personal preferences, and other factors impact the decision. Healthcare providers recommend that dialysis begin well before kidney disease has advanced to the point where life threatening complications can occur.

Certain clinical signs indicate that dialysis must be started immediately. If blood tests indicate the kidneys are working very poorly or not at all, or if there are symptoms such as mental confusion or bleeding that is related to kidney disease, dialysis should be started at once.

PREPARING FOR HEMODIALYSIS — Preparations for hemodialysis should be made at least several months before it will be needed. In particular, easy access to a patient's blood stream must be established so that the access is available when dialysis begins.

Vascular access — A surgically created path called a vascular access (usually referred to as an access or shunt) is required for patients who will be treated with hemodialysis. Access is most often created in the non-dominant arm; for a right-handed person this would be their left arm. The access creates a way for blood to be removed from the body, circulate through the dialysis machine, and then return to the body at a rate that is higher than can be achieved through a normal vein. There are three major types of access: primary AV fistula, synthetic AV bridge graft, and central venous catheter.

The access should be created before hemodialysis begins because it needs time to heal before it can be used. Discussions about venous access should begin even earlier, since care must be taken not to traumatize blood vessels that will eventually be used for access. Placement of an intravenous line (IV) and frequent blood drawing in the arm that will be used for access can damage the veins, which could prevent them from being used for a hemodialysis access.

Primary AV fistula — A primary AV fistula is the preferred type of vascular access. It requires a surgical procedure that creates a direct connection between an artery and a vein. This is often done in the lower arm, but can be done in the upper arm as well. Sometimes a vein that would not normally be useful for creating an AV fistula can be moved so that it is more accessible; this is often done in the upper arm.

Regardless of its location or how it is created, the path (fistula), is located under the skin. During dialysis, two needles are inserted into the fistula vein. Blood flows out through one needle, circulates through the dialysis machine, and flows back through the other needle.

A fistula usually needs two to four months to heal before it can be used for dialysis.

Synthetic bridge graft — Sometimes, a patient's veins are not suitable for creating a fistula. In these cases, the surgeon uses a flexible tube to create a path between an artery and vein. This is called a synthetic bridge graft. The graft sits under the skin and is used in much the same way as the fistula except that the needles used for hemodialysis are placed into the graft material rather than the patient's own vein.

Grafts heal more quickly than fistulas and can often be used about two weeks after they are created. However, complications such as narrowing of the blood vessels or infection are more common with grafts than with AV fistulas.

Central venous catheter — A central venous catheter uses a thin flexible tube that is placed into a large vein (usually in the neck). It may be recommended if dialysis must be started immediately and the patient does not have a functioning AV fistula or graft. This type of access is usually used only on a temporary basis. In some cases, however, there can be problems maintaining an AV fistula or graft, and the central venous route is used for long-term access.

Catheters have the highest risk infection and the poorest function compared to other access types; they should be used only if a primary fistula or synthetic bridge graft cannot be maintained.

Dietary changes — Some patients, especially those who receive dialysis in a center, will need to make changes in their diet before and during hemodialysis treatment. These changes ensure that a patient does not become overloaded with fluid and that they consume the correct balance of protein, calories, vitamins, and minerals. A diet that is low in sodium, potassium, and phosphorus may be recommended, and the amount of fluids (in drinks and foods) may be limited. A dietitian can help patients to choose foods that are compatible with hemodialysis treatment.

LOCATION OF HEMODIALYSIS TREATMENT — Hemodialysis can be done at a dialysis center or at home.

Home treatment — Home treatment requires that the patient and their family receive special training and ongoing support from healthcare providers who are experienced in treating patients with home hemodialysis, usually including a nephrologist (kidney specialist) and specially trained nurses.

Patients treated with home hemodialysis can often lead more independent lives and may have improved survival outcomes compared to those treated in a dialysis center. This is due in part to home hemodialysis patients receiving more frequent or longer dialysis treatments than those treated in a dialysis center.

Home dialysis is generally done three to seven times per week and takes between three and ten hours per session. Daily dialysis is often done for about three to four hours, four to seven days each week. Overnight dialysis (called nocturnal hemodialysis) is typically done three to seven times weekly while the patient is sleeping. Additional time is needed to prepare and clean up. Home dialysis can be done at a time that is convenient for the patient. Patients are generally required to have someone else (a family member, friend, or technician) to assist them before, during, and after dialysis. A healthcare provider must be available by telephone in case questions or problems arise; some machines allow the patient to be monitored remotely via the telephone or internet.

A daily (or nightly) dialysis schedule provides substantial benefits compared to in-center, three times weekly hemodialysis. More frequent dialysis results in a significant improvement in patient well being, reduces symptoms during and between dialyses, and improves quality of life. Home hemodialysis can improve a patient's quality of life because it allows them to assume more responsibility for their own care and allows them to remain in the comfort of their home during treatment. In addition, patients who use home hemodialysis are often able to continue working.

Equipment — Home hemodialysis requires that the patient have a dialysis machine in their home; depending upon the machine, additional supplies may be needed, including water treatment tanks, dialyzers, bottles of dialysate, bleach and disinfectant, syringes, needles, medications, blood tubes, and water test kits. Some machines require electrical and plumbing modifications in the area of the home where dialysis will be done. Currently available home hemodialysis machines are approximately the size of a bedside table.

Newer home hemodialysis systems are portable and can be used while traveling, although many patients who use home hemodialysis and wish to travel make arrangements for in-center dialysis at the location where they will be traveling ([see "Travel options" below](#)).

Dialysis center treatment — Dialysis may be done in a hospital, a clinic associated with a hospital, or a free-standing clinic. Centers are staffed with physicians, nurses, and technicians, all of whom participate in the patient's care. In general, in-center hemodialysis takes between three and five hours (the average is three and a half to four hours) and is done three times a week. Patients are able to read or sleep during treatment, and usually have access to a television. Eating, drinking, and visitors are usually restricted in a dialysis center.

Travel options — Dialysis centers are located throughout the United States and in many locations around the world. Patients who require dialysis but wish to travel can make an appointment at a dialysis center in the location where they will be traveling (called a transient center). Many dialysis centers have a staff member, either a nurse or social worker, who can help arrange the appointment; planning should begin six to eight weeks in advance to ensure that space is available. The dialysis center where the patient normally receives dialysis treatments will need to provide information to the transient center about the patient's medical history, including recent test results and treatment records, a list of medications, insurance information, and any special requirements.

Patients with chronic medical problems, including those who require dialysis, should plan carefully for travel away from home. This may include carrying extra medications and written prescriptions, a medical identification device, and a list of healthcare provider contact information. ([See "Patient information: General travel advice"](#)).

PROCEDURE — To begin hemodialysis, a nurse or dialysis technician inserts two needles into the patient's access. To numb the skin and prevent pain, a cream may sometimes be used; this is not necessary for most patients. Patients may also learn to insert their own needles.

In patients with a central venous hemodialysis catheter, the dialysis machine tubing is connected directly to the catheter without needles.

Each needle is attached to flexible plastic tubing that connects to the dialysis machine; one tube removes blood from the access and sends it to the hemodialysis machine while the other tube returns blood back to the patient through the access needle after it has passed through the hemodialysis machine. The patient's blood is pumped through the dialysis machine to remove waste products and excess fluids.

- The tubing connected to the blood stream access is also connected to a filter, called a dialyzer or artificial kidney. The machine works by putting the patient's blood in contact with a solution called dialysate. The blood is separated from the dialysate by very thin membranes inside the dialyzer that allow certain substances to move (diffuse) between the blood and dialysate. Substances that are in high concentrations in the blood, such as waste products the kidney normally removes, are in lower concentration or not present in the dialysate.

The process of diffusion causes these substances to move from the blood across the membrane and into the dialysate. The blood is continuously returned to the body and the dialysate is continuously replaced with new solution.

- Excess fluid that accumulates between dialysis treatments is removed by a process called ultrafiltration.

Monitoring — Patients who use hemodialysis, both at home and in-center, will be monitored to ensure that the time and type of dialysis treatments (called dialysis prescription) are optimal. Studies have shown that the correct dialysis treatment improves health, prevents complications, and prolongs survival. Blood testing is done at least once per month, and adjustments to the dialysis prescription may be made based upon the results of testing.

Because kidneys that are failing cannot remove enough fluid from the body, dialysis must perform this task. Overaccumulation of fluid can lead to complications. Most patients will be weighed before and after dialysis, and will be asked to monitor their weight on a daily basis at home. If a patient's weight increases more than usual between treatments, the healthcare provider should be notified.

Access blood flow must also be monitored in hemodialysis patients. It is possible for the access to become narrowed or to develop blood clots, both of which slow the rate of blood flow and potentially interfere with the amount of blood treated during hemodialysis treatment. Flow monitoring is usually done once per month, and uses ultrasound (sound waves) to measure the speed of blood flow during dialysis treatment. Sometimes the access can clot completely, requiring that the clot be removed. The cause of the clot must also be identified and fixed; the cause is usually narrowing of the blood vessels or synthetic graft material.

Caring for the access — Patients should take care of their access to prevent problems such as infection and clotting. These problems can occur even if patients are careful, but are much less common if the following precautions are observed.

- Wash the access with soap and warm water each day, and always before dialysis. Do not scratch the area or try to remove scabs.
- Check the area daily for signs of infection, including warmth and redness.
- Check that there is blood flow in the access daily. There should be a vibration (called a thrill) over the access. If this is absent or changes, a healthcare provider at the dialysis center should be notified.
- Take care to avoid traumatizing the arm where the access is located; do not wear tight clothes, jewelry, carry heavy items, or sleep on the arm. Do not allow anyone to take blood or measure blood pressure on this arm.
- Rotate needle sites on the access. Use gentle pressure to stop bleeding when the needle is removed. If bleeding occurs later, apply gentle pressure; call a healthcare provider if bleeding does not stop within 30 minutes or if bleeding is excessive.

Access problems — Access infection or clot is possible, even in patients who are careful.

SIDE EFFECTS — Most patients tolerate hemodialysis well. However, side effects can occur. Low blood pressure is the most common complication and can be accompanied by lightheadedness, shortness of breath, abdominal cramps, muscle cramps, nausea, or vomiting.

Treatments and preventive measures are available for the discomforts that can occur during dialysis. Many of these side effects are related to gain of excess salt and fluid between dialysis treatments, which can be minimized by careful attention to dietary instructions about salt and fluid restriction.

WHERE TO GET MORE INFORMATION — Your healthcare provider is the best source of information for questions and concerns related to your medical problem. Because no two patients are exactly alike and recommendations can vary from one person to another, it is important to seek guidance from a provider who is familiar with your individual situation.

This discussion will be updated as needed every four months on our web site (www.patients.uptodate.com). Additional topics as well as selected discussions written for healthcare professionals are also available for those who would like more detailed information.

A number of web sites have information about medical problems and treatments, although it can be difficult to know which sites are reputable. Information provided by the National Institutes of Health, national medical societies and some other well-established organizations are often reliable sources of information, although the frequency with which they are updated is variable.

- National Library of Medicine
(www.nlm.nih.gov/medlineplus/healthtopics.html)

- National Institute of Diabetes and Digestive and Kidney Diseases
(www.niddk.nih.gov)
- National Kidney Foundation
(800) 922-9010
(www.kidney.org)
- Home Dialysis Central
(www.homedialysiscentral.org)
- Kidney School
(www.kidneyschool.org)
- United Network for Organ Sharing (UNOS)
(888) 894-6361
(www.unos.org)

[1-3]

Use of *UpToDate* is subject to the [Subscription and License Agreement](#).

REFERENCES

1. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. *Am J Kidney Dis* 2002; 39:S1.
2. Galla, JH. Clinical practice guideline on shared decision-making in the appropriate initiation of and withdrawal from dialysis. The Renal Physicians Association and the American Society of Nephrology. *J Am Soc Nephrol* 2000; 11:1340.
3. Williams, AW, Chebrolu, SB, Ing, TS, et al. Early clinical, quality-of-life, and biochemical changes of "daily hemodialysis" (6 dialyses per week). *Am J Kidney Dis* 2004; 43:90.