



Module 10

Getting Adequate Dialysis



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Please Note

Use of Kidney School does not replace the need to talk with your health care team about your care and your options.

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d	(8)	d	(4)
d	(7)	c	(3)
c	(6)	b	(2)
c	(5)	b	(1)

Congratulations, you've finished the quiz! Here are the correct answers so you can see how you did:

Module 10 – Kidney Quiz Answers





When Leroy, age 61, learned he needed dialysis, he was scared. But his nephrologist said he'd start feeling much better in a few weeks, as extra water and wastes were removed from his body. It didn't quite work that way.

After a few weeks of standard in-center hemodialysis (HD), Leroy still felt awful. He was sick to his stomach. He had a metal taste in his mouth that made food taste bad. And he itched like crazy. Leroy didn't even have the energy to help his grandson work on his basketball jump shot. He made an appointment with his nephrologist.

From his doctor, Leroy learned that standard in-center HD replaces only a small fraction of the work of healthy kidneys. Healthy kidneys are on the job 24 hours a day, 7 days a week—that's 168 hours a week!

It turned out that Leroy was not yet getting the right amount of HD. He needed more treatment to get *adequate* HD—enough to keep him feeling good so he could keep doing the things he loves. His doctor adjusted his treatment. In a few weeks, he really was feeling better, and he started coaching basketball again.

Leroy, now on dialysis for 4 years, learned something he hasn't forgotten: dialysis is *not* a one size fits all treatment. So how do you know if you're getting enough dialysis? And what happens if you don't get all you need? This module will answer these questions and more.

Getting adequate dialysis helps you feel better and live longer, and improves your overall health. And since it is *your* health, it makes sense for you to take an active role in getting the dialysis you need.

Taking an active role means:

- Understanding your dialysis prescription
- Making sure you get all of the dialysis your doctor prescribes
- Knowing when you're getting adequate dialysis

By the time you finish this module, you will know how to do your part and get all the dialysis you need. So, let's get started!

Your Dialysis Prescription

Just like a drug, dialysis is given with a prescription from a doctor. The prescription is designed to make sure you get enough treatment to feel well and keep doing the things you enjoy.

To decide on the right prescription for you, your doctor starts with a careful look at:





- 1 Your weight and height
- 2 Your lab test results
- 3 Your medical condition(s)
- 4 Your *residual kidney function* (how much filtering your kidneys are still doing)

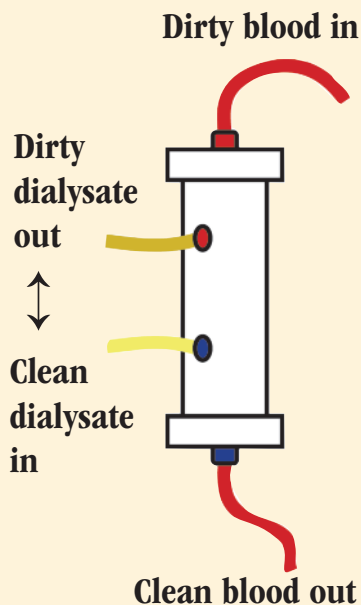
A prescription will be custom made for you, based on your unique needs.

To understand your prescription, first you need

How Does a Hollow Fiber Dialyzer Work?

A dialyzer for HD is a collection of thousands of hollow plastic fibers, each thinner than a hair. The fibers are gathered into a clear plastic cylinder. At each end of the tube, the fibers are held in place by a clay-like potting material. Blood enters the dialyzer through the red port on one end, passes through the insides of the hollow fibers, and leaves through the blue port on the other end.

Dialysate enters through the blue port on the side of the dialyzer, flows around the outside of the hollow fibers, and then leaves through the red port on the side. Wastes from the blood are carried away in the used dialysate.



to know a little bit about how dialysis cleans the blood. Wastes in the blood are mainly removed through a natural process called *diffusion*.

Diffusion happens when fluids are on both sides of a semipermeable membrane—like a tea bag. *Semipermeable* means the membrane has tiny holes that let tiny particles through, like tea, but not larger ones, like tea leaves. Blood cells and protein are too big to pass through the membrane, so these stay in your body during treatment.

In dialysis, the membrane can be one of two things:

- In peritoneal dialysis (PD), the membrane is the *peritoneum*, which lines the abdomen.
- In HD, the membrane is thousands of hollow, plastic fibers called a *dialyzer*.

On one side of the membrane is your blood. On the other side of the membrane is a fluid called *dialysate*, or “bath.” Wastes from your blood diffuse through the membrane and into the bath. Once used, the bath is thrown away.

How does dialysis remove only the wastes? The secret is in the bath.





In nature, diffusion goes on until fluids on both sides of a membrane have the same concentration. For example, until your tea is as strong as it can get. This takes time.

The process can be speeded up by creating a *gradient*—making the fluid on one side of the membrane stronger (more concentrated) than the other side.

Your blood has *high* levels of wastes. So, your doctor will prescribe a bath with *no* wastes. This gradient forces wastes from your blood to move across the membrane and into the bath—where they can be thrown away.

Now we know that wastes are removed mostly by diffusion. But how does dialysis remove extra water? Water removal in dialysis is called *ultrafiltration*.

In PD, ultrafiltration is done with a *gradient*. Sugar (glucose) in the dialysate pulls water out of the blood. A stronger glucose solution removes more water. A weaker glucose solution removes less water.

In HD, ultrafiltration is done with *pumps*. The blood pump is a horseshoe-shaped loop of blood tubing with a wheel in the center. The wheel squeezes blood through the tubing—squeezing out some water at the same time. Another pump is applied to the dialysate, to create a vacuum. The vacuum pulls water out of the blood. This pulling is called *negative pressure*.

When your kidneys fail, water can build up all over your body. Most people don't know that there are three places, or "compartments" in the body where water can go:

- 1 **Inside cells** (*intracellular compartment*)
- 2 **In between cells** (*interstitial compartment*)
- 3 **In your blood** (*vascular compartment*)

Dialysis and Medications

If dialysis removes wastes from the blood, does it remove medications, too? Well, it depends on the drug. Some drugs and vitamins are removed by dialysis. Others—like EPO to treat anemia—are not.

If you notice that one of your drugs isn't working as well as it did before you started dialysis, ask your doctor and your pharmacist. They may suggest that you change the time that you take the medication.

Dialysis can only remove water that is *in your blood*. Only about 15% of the water in your body is in your blood. Water moves from one compartment to another by diffusion—which takes time. This means if you gain a lot of water weight, dialysis may not be able to remove it all. The extra water can build up in your body and damage your heart. Water can also build up in your lungs and affect your breathing. *How well you feel after a dialysis treatment depends on how much—and how quickly—water is removed.*

Reading the Blood Pump

Just above the blood pump on some HD machines is a number for the blood pump speed. Dialysis centers often aim for a blood pump speed of between 300 and 400 for a standard HD treatment. Slower speeds make it harder to get adequate dialysis during a 3 or 4 hour treatment. (Slower speeds, which are much gentler and easier on the heart, are used for nocturnal HD, which is done for 8 hours at a time during sleep.) Faster speeds may damage a vascular access by forcing blood through with too much pressure. Your doctor will decide what speed is right for you





What Is Amyloidosis?

Amyloidosis is a build up of a waxy protein called amyloid. It can occur anywhere in the body, but often affects joints. Amyloidosis can cause pain and limited mobility. There is no treatment, but longer, slower dialysis—such as nocturnal HD—and use of high flux dialyzers remove more of the protein.

One study found that it may take as long as 6 hours or more to feel “normal” again after a standard in-center HD treatment. The less water weight you gain, the less you will need to take off. And if water can be taken off slowly, it is easier on your heart.

Now that you know more about how dialysis works, we can talk about your prescription. We’ll talk about the HD prescription here, and the PD prescription on pages 10-12 to 10-15.

Hemodialysis prescription

If you use hemodialysis (HD), your prescription has three parts:

- 1 **Clearance** of wastes removed by the dialyzer
- 2 **Time** for each dialysis treatment
- 3 **Volume** of water in your body

First, we’ll talk about clearance. Dialyzers are not all the same. Some have more surface area than others, so they remove more wastes during a treatment. Larger dialyzers have greater *clearance*. Larger people may need larger dialyzers.

- *Conventional dialyzers* remove small solutes (dissolved wastes) from the blood.
- *High efficiency dialyzers* remove slightly larger solutes.

- *High flux dialyzers* remove more small and middle weight solutes—including beta-2-microglobulin (B₂m), which can build up and cause a problem called *amyloidosis*.

High flux and high efficiency dialyzers are costly. For this reason, they are often *reused*—cleaned, sterilized, and returned to you for your next treatment.

With each treatment, the dialyzer can lose a little bit of clearance. The reuse process tests the dialyzer. When the clearance drops by 10%, the dialyzer should be thrown out and you should get a new one.

How you can help protect your own safety:

- When you get a new dialyzer, be sure it is rinsed well with saline (salt solution) to remove chemicals from manufacturing.
- Always read your dialyzer label to be sure you get your *own* dialyzer back.
- Pay attention to how you feel when you get a new dialyzer, and how you feel with each reuse. If your dialysis isn’t helping you feel better, you may want to ask your doctor about fewer reuses.
- Look at the test strip that measures chemical residues to be sure your dialyzer is residue-free.

Reusing a dialyzer can help you if you are very sensitive to the chemical used to sterilize new dialyzers (ethylene oxide).

Reusing dialyzers is also a way to reduce the high cost of HD. When your dialyzer is reused, this is what happens to it:

- 1 Your dialyzer is rinsed with pure water and a cleaning solution to remove blood cells and help kill bacteria. This cleaning solution may be bleach, hydrogen peroxide, or Renalin®.





- 2 The cleaning solution is rinsed out.
- 3 Testing is done to be sure the dialyzer does not leak, and to check the amount of fluid the hollow fibers can hold.
- 4 The dialyzer is filled up with a germ-killing solution and stored. Solutions used include formaldehyde, glutaraldehyde, and Renalin®.
- 5 Before the dialyzer is used again, a test is done to be sure that germ-killing solution is present.
- 6 The dialyzer is looked at to be sure it is clean and not leaking. If it looks okay, the germ-killing solution is rinsed out.
- 7 Tests are done to be sure the germ-killing solution is gone.
- 8 The dialyzer label is checked to be sure it's the right one for you.

To make sure this routine is followed each time, your dialysis team must record all of the steps taken for your dialyzer. If all of the steps are correctly followed, a reused dialyzer is safe. If the steps are not followed, this is what can happen:

- Bacteria can grow in the dialyzer, causing fever or other illness.
- Germ-killing solution left in the dialyzer can cause burning, sudden loss of vision or hearing, or other problems—including death.

Problems caused by reuse errors often happen within the first few minutes of dialysis. To ensure your own safety, know your body. Learn how you usually feel on dialysis. If something feels *wrong*, or *very different*—such as a sudden problem hearing or seeing—tell the staff **right away**.

Another possible risk of reuse is getting the wrong dialyzer. If this happens, you could be exposed to blood-borne diseases. To avoid this, two people

must check the first and last names on the dialyzer label. If possible, *you* should be one of these two people!

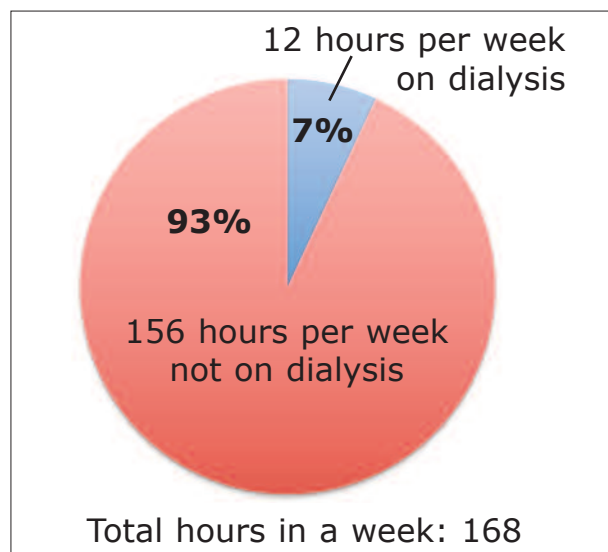
Taking part in checking your dialyzer can help give you peace of mind, and will help your care team. They want you to get the proper treatment. Your concern shows them that you want to be involved.

Now that you've learned a little more about dialyzer reuse, we'll talk about adequacy. The next part of your HD prescription is *time*.

Time for each dialysis treatment

Time is the part of HD that you have the most control over. Your doctor will prescribe a treatment time—and you can make sure that you get *every minute* of treatment that is coming to you.

Why does every minute count? Because there are 168 hours in a week and you may only have about 12 hours of dialysis—about 7% as much as healthy kidneys. If you miss just 2 minutes of each treatment, it adds up to more than 5 hours of dialysis missed per year.





How can you be sure to get all of your HD time? Here are some ways:

- Be on time for my treatments
- Avoid large water gains that can lead to painful cramping that makes me stop a treatment early
- Stay until the end of every treatment
- Ask for help if I get restless toward the end of treatment
- Be sure I get to make up minutes lost to machine alarms, broken machines, or bathroom trips
- Ask for longer treatments so my water removal can be more gentle, and more wastes will be removed.
- Change to daily or nocturnal home HD to get much more dialysis (see next section).
- Don't let my time be cut short if my treatment starts late, the staff wants to leave, or it's a holiday.

We'll include this list for your Personal Plan at the end of the module.

More time with home hemodialysis (HHD)

More dialysis time is one of the biggest pluses of home HD. Because you can schedule treatments at your own convenience, you can run longer if you need to.

Daily home HD and nocturnal home HD also offer many more hours of treatment in a week. Slower forms of dialysis, like nocturnal home HD, allow more time for wastes and water to move into the blood, where they can be removed. Nocturnal home HD is done for 8 hours at a time, three to six nights per week. This means getting 24 to 48 hours of dialysis instead of just 12—without taking time out of your day.

Patients who use these treatments say they feel much better than they did on standard in-center HD:

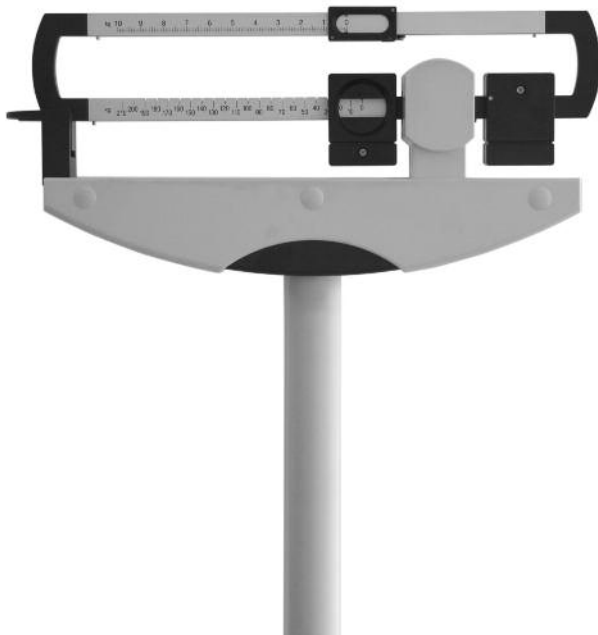
“I am on dialysis 6 nights a week at home. I have learned to put myself on and have a catheter. I dialyze every night except Saturday (date night, I guess). The sessions are 8 hours long. I used to be on 4 1/2 hours, 3 days a week. I used to dialyze at a blood flow rate of 400. I now dialyze at 250 to 270. My meds have been cut down considerably. I used to use 12 phosphate binders (PhosLo® and Renagel®) after every meal and my phosphorus was always high. My phosphorus is now 3.5 to 4.0 with NO BINDERS! I am even on a medication to raise my blood pressure. The advantage over in-center treatment is, in short: getting your life back. Not really any disadvantages. You feel in control of your treatment and yourself.” —Nocturnal home HD patient

“I'm tickled pink with daily HHD. My son [50 yrs. old] took the training with me. He learned how to put in my needles and we are working on me forming Buttonholes so I can cannulate myself. The set up and running the machine is a snap. All supplies are delivered to the house, so no traveling to the center. Our time is our own, so we can dialyze first thing in the morning and the rest of the day is ours. I have to say, right here and now, that I feel better now than I have since going on dialysis.” —Daily home HD patient

Volume of water in your body

How much water is in your body, anyway? There really is no easy way for your doctor to tell how much of your weight gain is water and how much is fat or muscle. In fact, this is one of the biggest reasons that dialysis adequacy is part science and part art. But you can watch your body for signs of excess water, called *edema* (uh-dee-muh).





Extra water may make your face, hands, or feet puffy. If extra water is in your lungs, it can make breathing harder. Always having extra water in your body can make your blood pressure impossible to control, even with many pills. High blood pressure is the main risk factor for heart damage called *left ventricular hypertrophy* (LVH), which is one of the leading causes of death for people on dialysis. If you can't limit your fluids enough to do standard in-center HD without high blood pressure, changing to a longer and/or more frequent type of home HD may help protect your heart.

Your goal weight without excess water is called *dry weight*. One way to find dry weight is to take off so much water that you get low blood pressure and cramps, and then back off from there. This is not recommended, but there is no practical, clinical way to assess dry weight. It is always trial and error.

As someone with kidney failure, it's up to you to tell your care team if you believe you have gained fat or muscle, so your dry weight can be adjusted:

“My blood pressure tends to run high, so I want to get as dry as possible. You, on the other hand, might feel better going back to your old way of calculating your goal and leaving a little fluid on. My dry weight is different every treatment. I ‘feel’ my way dry. I say to the nurse, ‘I feel like I need to take off X.X kilos today, please.’ If I hit dry before my time is up, I have them back my goal down a little. If I feel a little over when I leave, I will add more to my goal next time or try to add it on when I still have a half hour left. It’s a fine line and everybody needs to figure out for themselves what weight is most comfortable.”

It's also up to you to learn the signs of getting *too* dry at dialysis. There is no such thing as “overdialysis,” but it *is* possible to remove too much water at a treatment. When too much water is removed, your blood gets thicker and harder to pump. To make it easier on your heart, your blood pressure will drop. The next page lists symptoms people get when too much water is removed. Check off the ones you have felt yourself. If you learn what it feels like to get too dry, you can alert the staff at the *first moment you feel the symptom*—and feel better faster:

How Can My Low Pressure Be Helped—Fast?!

If you have lost too much water during dialysis, giving you back a little bit of fluid can help. Depending on how you feel, you may get some saline in your dialysis lines, or be able to drink some broth or other liquid. It also helps to recline the chair so your head is lower than your feet.



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- Dizzy, faint, lightheaded
- Ringing in my ears
- Racing pulse
- Feeling warm, sweating
- Nausea
- Vomiting
- Yawning
- Itching
- Severe muscle cramps (anywhere on my body)
- Other: _____

At each in-center HD treatment, you weigh in and your water removal goal is calculated. To know the most about your treatment, it's best if you learn to figure your water removal goal yourself. Ask your nurse, technician, or an expert patient how they do it—they can help you learn. The amount of water to be removed at each treatment includes:

- Water weight you gained between treatments
- Saline used to rinse your dialyzer (the *prime*)
- Saline used at the end of the treatment to rinse blood out of the dialyzer (the *rinseback*)
- Anything that you drink on dialysis—although, since the water will not yet be in your blood,



it won't all be removed during the treatment.

As two expert dialysis patients put it:

“Do people NOT on dialysis weigh the exact same amount every day at 1:00 p.m.? No! And neither do we! You should figure your own weight depending on how well you have eaten, how much you have exercised, and bowel regularity. Set your own weight up or down (each treatment if needed) depending on these factors. Always use the previous treatment end weight as a starting point to calculate current treatment end weight. Then tell them what you want your weight to be and what your goal is. If you feel like you have come off a little heavy, lower your weight .2 or .3 at the next treatment.”

“The dry weight is a balancing act. I always wear a uniform to dialysis so I'll weigh the same and I never fluid overload. I learned to calculate my goal myself and watch it go on the machine. I had to look at my symptoms. Had I gained or lost a little weight (my weight doesn't fluctuate much), were my bowels regular, were my blood pressures running low or high, how was my breathing, did I feel stuffy, ears popping, yawning, crampy hands or feet, soreness in legs, achy joints? I learned that all these symptoms meant something, and I learned the best thing I could do was to keep a comfortable amount of cushion above my dry weight or the symptoms would kick in. I manage to 'guesstimate' the proper target to shoot for at each treatment most of the time.”

How well HD is working is measured by the amount of wastes and water removed. One common waste is *urea*, which results from the breakdown of protein you eat. Urea is used as





a marker for other wastes in the blood that are harder or more costly to measure.

Once a month, your care team will draw blood before and after your treatment to measure the amount of urea in your blood. The staff must draw these blood tests correctly for them to be useful. These levels can be used in one of two ways to measure your dose of dialysis. These are:

- **Urea reduction ratio (URR)**
- **Kinetic modeling (Kt/V)**

The *URR* measures the level of urea in your blood before and after a treatment. The difference between the two levels is shown as a percent.

Symbol:	Stands for:	Means:
K	Clearance	The amount of wastes removed
t	Time	The length of time dialysis lasts
V	Volume	The volume of water in your body

Your Kt/V is figured by multiplying the amount of wastes removed by your treatment time. The result is divided by the estimated volume of water in your body.

Of the two methods, Kt/V is harder to figure, but it gives a better estimate of urea removed than URR, because it tries to account for body weight.

How do you know if you are getting enough dialysis? The National Kidney Foundation developed clinical practice guidelines called the *Kidney Disease Outcomes Quality Initiative*, or KDOQI, and they set minimum standards for HD:

- **URR: at least 65%**
- **Kt/V: at least 1.2**

These levels are a *minimum*—more dialysis is more like healthy kidneys. Kt/V measures a minimum amount of *urea*—but urea is just one waste, and not the most important one that dialysis removes. If your Kt/V is under 1.2, you are not getting adequate dialysis. But a Kt/V higher than 1.2 does not mean your dialysis is optimal. Sometimes patients are told “your numbers are good and you can cut back on your dialysis time.” ***Do not believe this!*** Removing enough phosphorus and B₂m (the protein that causes amyloidosis) takes time, so you need every minute of dialysis you can get. You can feel when you have too much—or too little—water removed, but it can take years to feel the ill effects of not having enough wastes removed.

If you fall below these levels, your doctor can make some changes. He or she might increase the amount of time (t) you are on HD or have you use a bigger dialyzer with more clearance (K).

You can help yourself by watching for signs of *uremia*—a build up of wastes in the blood—that might show you’re not getting enough treatment. Check off any of these symptoms you have:

- Weakness and fatigue
- Weight loss (from muscle loss)
- Poor appetite
- Yellow skin color
- Disturbed sleep
- Nausea or vomiting
- A bad taste in my mouth
- Itching
- Infections
- Prolonged bleeding
- Other: _____



If you do have symptoms, talk with your doctor right away to see if you are getting the dialysis you need. Take this list along to your next clinic appointment.

Before your next doctor visit, think through what you want to ask, and be honest about your treatments. Your doctor and care team need to know exactly what you're doing and not doing, so they can help make your treatments work the best for you.

On page 10-16, we will give you a Personal Plan. This plan will include an easy to use chart to record your Kt/V or URR. Writing it down helps you check your progress from month to month.

Another way to help yourself is to follow your fluid limits between treatments. Most people on HD make little or no urine. So fluid that is not used by the body adds up as extra weight that needs to be taken off at dialysis.

Do you know your fluid limit for each day? Talk with your dietitian about how much fluid you can have in a day. Once you know how much fluid you can safely take in, HD will be a lot more comfortable for you. Avoiding salt can make it much easier to follow your fluid limits. Fluid limits are one of the biggest challenges for many people on HD. If you need help with your fluids, read module 13—*Heart Health and Blood Pressure*.

As you can see, getting the dialysis you need is a team effort. Everyone needs to do their job—most of all,

you. No one on your health care team can do your job for you. If you work with them as an active partner in your care, you have much to look forward to.

Peritoneal dialysis prescription

If you use PD, your prescription has four parts:

- 1 Number of exchanges per day
- 2 Amount of fluid in each bag
- 3 Concentration of dialysate
- 4 Dwell time

Exchanges can be done by hand or by a machine called a *cycler*. By hand, usually 4 to 5 exchanges are done each day. With a cycler, many exchanges are done at night while you sleep. Sometimes an exchange is also needed during the day.

Number of exchanges

One of the best things about PD is that it's completely under your control. You decide where and when to do your exchanges. You can be a little flexible to fit in an errand or a special event.

Doing all of your exchanges

It can be tempting to skip an exchange if you're tired or busy—but if you do, you risk your long-term health. To feel your best, do *every* exchange. Below, one patient notes the key to getting enough PD:

“My PD nurse agreed that my missed exchanges were probably causing my fatigue. I just started back on PD, and while I know it is no excuse, I am getting used to fitting it in again, and misjudged how long I'd be away from home. Last time I dialyzed, I was not in school or working, and now I'm doing both

What's an Exchange?

In PD, an exchange is the process of draining used dialysate through a catheter placed in the abdomen, and then putting in fresh dialysate. To learn more about PD and HD, read Module 2—*Treatment Options for Kidney Failure*.





full time. Anyway, I'm very aware of what happens now, and am bringing extra bags with me. I also left a box of low- and medium-strength solution at my boyfriend's parents' house, and will probably leave a supply at my mom and dad's, so if I go there and get stuck, I'll be okay. Other places, I should be able to get to a dialysis center and borrow a bag if absolutely necessary."

Amount of fluid in each bag

Your doctor will prescribe a fill volume, or amount of fluid in each bag. The volume is chosen to give you the best chance of getting adequate dialysis. More dialysate per exchange means more wastes and water can be removed. Usually, dialysate bags hold 1.5, 2.0, or 2.5 liters.

Concentration of dialysate

Concentration of dialysate refers to the strength of the solution. There are three strengths of glucose-based dialysate used for PD in the U.S.:

- **1.5% glucose**
- **2.5% glucose**
- **4.25% glucose**

Most of the time, 1.5% solution is used. If you are retaining fluid—for example, if your hands and feet are swelling—you may use 2.5% solution. And if a lot of water must be removed, your nurse or doctor may recommend a 4.25% bag. The 4.25% solution is hardest on the peritoneal membrane. It's best to avoid this solution, if possible, by sticking to your fluid limits. Your PD nurse and doctor will help you learn when to use which solution. As one patient said:

"I had to do some experimenting for the first month on PD, but I found a mixture of solu-



tion strengths that works for me. Then I had to convince the clinic that this 'not by the book' approach was best for me. Fortunately, I kept good records so they could see the effects, and they okayed it. The doctors and nurses have guidelines and models that they use initially for everybody. When I demonstrated that I could understand and follow these guidelines, I was allowed some latitude, based on my knowledge of my own body." —Bob, began PD in 1999

Dwell time

During each exchange, dialysate dwells, or stays, in the abdomen. The dwell time allows water and wastes to move into the dialysate so they can be discarded. Some people are faster “transporters” (movers of water and wastes) than others. Your doctor will prescribe a dwell time for you, based on how well your peritoneum works.

PD adequacy

How well PD is working is measured by the





What if I *Have to Miss an Exchange?*

Sometimes missing an exchange just can't be avoided. Maybe you're on a long flight, or an appointment runs longer than you thought and you don't have a bag with you. You should always carry a bag. However, if you absolutely can't avoid missing an exchange, what should you do?

If you let used dialysate dwell (stay in the abdomen) for too long, your body can reabsorb the wastes and water in it. So, if you know you'll have to miss an exchange, drain out the used dialysate and stay dry until you can fill up again.

amount of wastes and water removed in a week. One common waste is *urea*, which results from the breakdown of protein you eat. Urea is used as a marker for other wastes in the blood that are harder or more costly to measure. To measure urea removal, you may be asked to come in to the clinic to do a supervised exchange. If so, plan to be there for a few hours until all the tests are done.

Your doctor looks at the results—and your notes about your exchanges—to see if you are getting adequate PD. The two most important lab tests to measure this are:

- **Kinetic modeling (Kt/V)**
- **Creatinine clearance**

We'll talk about Kt/V first. Your Kt/V is figured by multiplying the amount of wastes removed by your PD time. The result is divided by the estimated volume of water in your body.

Creatinine comes from normal breakdown of

muscle during activity. The creatinine clearance test measures how well PD is removing creatinine from your body.

To do the test, the amount of creatinine in your urine (if you still make urine) is compared to the amount of creatinine in your blood. Your doctor may test your urine using a sample you give at a clinic visit, or may ask you to collect your urine for 24 hours in a special container. If you don't make any urine, the test will be done using blood only.

The target levels for PD adequacy are a little different if you do the exchanges by hand (continuous ambulatory peritoneal dialysis, or CAPD) than if you use a cycler (automated peritoneal dialysis, or APD).

Your lab report will tell whether you are getting enough dialysis to remove enough waste and water from your blood. The target levels for someone on CAPD are:

- **Kt/V of *at least* 2.0 per week**
- **Creatinine clearance of 60**





The target levels for someone on APD are:

- **Kt/V of *at least* 2.1 per week**
- **Creatinine clearance of 63**

During the first 6 months of PD, you should have two or three blood tests to measure your Kt/V. After your dialysis is stable, you should have your Kt/V checked about once every 4 months. If your Kt/V value or creatinine clearance is below the target level, your prescription may need to change. Your doctor may ask you to try:

- **Using bigger bags**
- **Adding an exchange**
- **Using a different dialysate**

There are two other factors that play a big part in how well PD will work for you. One is how much kidney function you have left—called *residual kidney function*. The other is how well your peritoneal membrane works.

Studies show that PD helps you keep your residual kidney function longer than standard in-center HD. And, if you still make urine, you can drink more fluid because your kidneys do part of the work—so you don't need as much PD. But over time, your function may drop. It's important to measure your residual kidney function at least two or three times during your first 6 months of PD. If your function drops, you may need more PD to stay healthy and active.

Your peritoneum limits how much waste can be cleared from your blood, and how quickly. The *Peritoneal Equilibrium Test*, or PET, is used to see how well your membrane is working. You should have a PET in the first month of PD, and every few months after that.

To do a PET, you'll be asked to come into the clinic for about 4 hours. You'll drain out last

night's fluid, fill with 2 liters of 2.5% dextrose fluid, and turn from side to side. You'll let the fluid dwell for 2 hours and drain. Then your blood will be drawn. The PET will show how quickly your peritoneum can transport wastes. "High transporters" can use shorter dwell times—making cyclers use possible. "Low transporters" need longer dwell times, and may be better suited for CAPD—or may need to add a daytime exchange.

You can help yourself by watching for signs of *uremia*—a build up of wastes in the blood—that might show you're not getting enough PD. Check off any of these symptoms you have:

- Weakness and fatigue
- Weight loss (from muscle loss)
- Poor appetite
- Yellow skin color
- Disturbed sleep
- Nausea or vomiting
- A bad taste in my mouth
- Itching
- Infections
- Prolonged bleeding
- Other: _____

If you do have symptoms, talk with your doctor right away to see if you are getting the dialysis you need.

It's time to wrap up this module on getting adequate dialysis. But before we do, we want to give you a Personal Plan to help you get a start on some of the most important ideas in this module. We encourage you to put it where it will remind you of the goals toward which you're working.





Personal Plan for _____

Getting Adequate Hemodialysis

Dialysis removes waste and excess water from my blood. Adequate dialysis is important to me because it helps me feel better, live longer, and improves my overall health.

My HD prescription includes:

- 1 **Clearance** of wastes removed by the dialyzer
- 2 **Time** for each dialysis treatment
- 3 **Volume** of water in my body

Clearance

My dialyzer can lose a little bit of clearance each time it is reused. I can help protect my own safety by:

- Making sure a new dialyzer is rinsed well with saline (salt solution) to remove chemicals from manufacturing
- Always reading my dialyzer label to be sure I get my own dialyzer back
- Paying attention to how I feel when I get a new dialyzer, and how I feel with each reuse
- If my dialysis isn't helping me feel better, I may want to ask my doctor about fewer reuses

Time

Here are ways I can be sure to get all my HD time:

- Be on time for my treatments
- Avoid large water gains that can lead to painful cramping
- Ask for help if I'm restless toward the end of dialysis
- Be sure I get to make up minutes lost to machine alarms, broken machines, or bathroom trips
- Stay until the end of every treatment
- Don't let my time be cut short if my treatment starts late, the staff wants to leave, or it's a holiday

Volume

There is no sure way to tell how much of my weight gain is water and how much is fat or muscle. I can watch my body for signs of water build-up in my face, hands and feet, and lungs (trouble breathing).

Symptoms of inadequate dialysis

Having any of the symptoms below *may* mean I am getting inadequate dialysis:

- Weakness and fatigue
- Weight loss (from muscle loss)
- Poor appetite
- Yellow skin color
- Disturbed sleep
- Nausea and vomiting
- A bad taste in my mouth
- Itching
- Infections
- Prolonged bleeding

If I have any of these symptoms, I will contact my doctor very soon to discuss them.

I can use a chart like this to track my HD adequacy:

Date	Kt/V: Goal = at least 1.2/wk	URR: Goal = at least 65%





Personal Plan for _____

Getting Adequate Peritoneal Dialysis

Dialysis removes waste and excess water from my blood. Adequate dialysis is important to me because it helps me feel better, live longer, and improves my overall health.

My PD prescription includes:

- 1 Number of exchanges per day
- 2 Amount of fluid in each bag
- 3 Concentration of dialysate
- 4 Dwell time

If my Kt/V value or creatinine clearance is below the target level, my prescription may need to change. My doctor may ask me to try:

- Using bigger bags
- Adding an exchange
- Using a different dialysate

Residual kidney function

Over time, my residual kidney function may drop. It's important to measure my residual kidney function at least two or three times during my first 6 months of PD. If my function drops, I may need more PD to stay healthy and active.

Peritoneal Equilibrium Test

The peritoneal equilibrium test (PET) is used to see how well my membrane is working. I should have a PET in the first month of PD, and every few months after that.

Symptoms of inadequate dialysis

Having any of these symptoms *may* mean I am getting inadequate dialysis:

- Weakness and fatigue
- Weight loss (from muscle loss)
- Poor appetite
- Yellow skin color
- Disturbed sleep
- Nausea and vomiting
- A bad taste in my mouth
- Itching
- Infections
- Prolonged bleeding

If I have any of these symptoms, I will contact my doctor very soon to discuss them.

I can use a chart like this to track my CAPD adequacy:

Date	Kt/V: Goal = at least 2.0/wk	Creatinine clearance: Goal = at least 60%

I can use a chart like this to track my APD adequacy:

Date	Kt/V: Goal = at least 2.1/wk	Creatinine clearance: Goal = at least 63%



Take the Kidney Quiz!

You'll see how much you're learning if you take our quick kidney quiz. It's just 8 questions. How about it? *(Answers are on page 10-2.)*

- 1. Dialysis removes the same amount of wastes and water from everyone who needs it.**
 - a) True
 - b) False
- 2. Dialysis mainly removes wastes through a natural process called:**
 - a) Diversion: wastes are sent to another part of the body
 - b) Diffusion: wastes pass through a semi-permeable membrane
 - c) Effervescence: wastes bubble out of the body as gas
 - d) Magnetism: wastes are pulled out of the body by magnets
- 3. Hemodialysis removes water through:**
 - a) Evaporation: water is released into the air
 - b) Laxatives: water is removed in the stool
 - c) Ultrafiltration: water is pulled out of the blood with pumps
 - d) Effervescence: water bubbles out of the body as gas
- 4. Dialysate, or bath, is used in dialysis to:**
 - a) Scrub red blood cells clean
 - b) Clean the floors in the dialysis unit
 - c) Refresh thirst during dialysis
 - d) Carry away wastes and excess water
- 5. One measure of adequate PD is:**
 - a) Blood glucose
 - b) Cholesterol
 - c) Creatinine clearance
 - d) Protein rebound
- 6. Which of the following is not part of the Kt/V equation?**
 - a) Clearance
 - b) Time
 - c) Potassium
 - d) Volume
- 7. Symptoms of inadequate dialysis include all of the following except:**
 - a) Weakness/fatigue
 - b) Weight loss
 - c) Poor appetite
 - d) A raised, red rash
- 8. Fluids you drink pass into your bloodstream immediately, where they can be removed by dialysis.**
 - a) True
 - b) False





Additional Resources

In addition to the free Life Options materials you can find at www.lifeoptions.org, the resources below may help you learn more about the topics in this module of Kidney School.

PLEASE NOTE: Life Options does not endorse these materials. Rather, we believe you are the best person to choose what will meet your needs from these or other resources you find. Please check with your local library, bookstore, or the internet to find these items.

Materials:

- 1 *AAKP Advisory on Hemodialysis* by the American Association of Kidney Patients (AAKP). If you would like more information, please call (800) 749-2257, e-mail info@aakp.org, or visit their website at www.aakp.org/brochures/hemo-advisory/.
- 2 *AAKP Advisory on Peritoneal Dialysis*, by the American Association of Kidney Patients (AAKP). If you would like more information, please call (800) 749-2257, e-mail info@aakp.org, or visit their website at www.aakp.org/brochures/pd-advisory/.
- 3 *Fluid and Solute Removal: how and why—parts 1 and 2*, by John Agar, MD. These articles explain how dialysis cleans the blood and why more is better. The articles are available at www.homedialysis.org/resources/tom/200711/ and www.homedialysis.org/resources/tom/200712/.
- 4 *Hemodialysis Dose and Adequacy (fact sheet)*, by the National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC). If you would like more information, please call (800) 891-5390, e-mail nkudic@info.niddk.nih.gov, or visit their website at <http://kidney.niddk.nih.gov/kudiseases/pubs/hemodialysisdose/index.htm>.
- 5 *Peritoneal Dialysis Dose and Adequacy (fact sheet)*, by the National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC). If you would like more information, please call (800) 891-5390, e-mail nkudic@info.niddk.nih.gov, or visit their website at <http://kidney.niddk.nih.gov/kudiseases/pubs/peritonealdose/index.htm>.
- 6 *What You Should Know about Dialyzer Reuse: A Guide for Hemodialysis Patients and their Families*, by the National Kidney Foundation (NKF). If you would like more information, please call the NKF at (800) 622-9010 or visit their website at www.kidney.org/atoz/atozTopic_br.cfm/.

