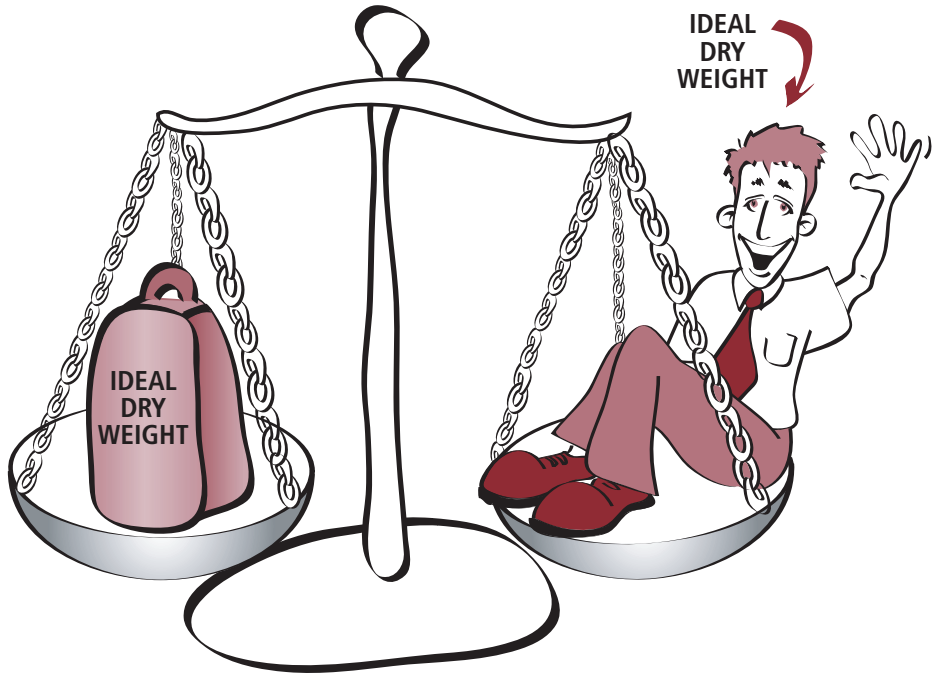

Using the *CRIT-LINE* Monitor to Manage Your Dry Weight for an Optimal Hemodialysis Treatment



HEMA
METRICS™

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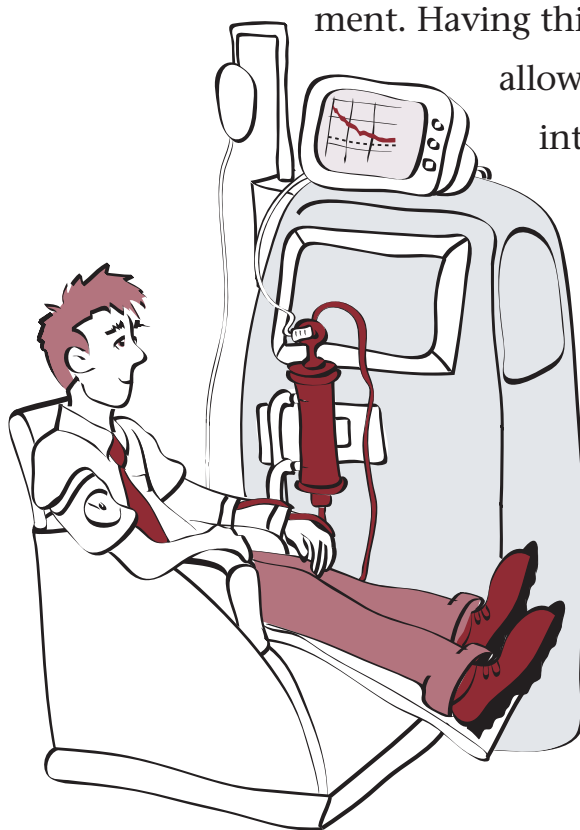
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Understanding Your Dry Weight in Hemodialysis

The CRIT-LINE as a window into your bloodstream.

Introduction

The *CRIT-LINE* is a tool that allows the health care team to safely dialyze patients with kidney failure to their *ideal dry weight*. It provides a window into the bloodstream by monitoring a patient's *blood volume change* in real time during treat-



ment. Having this information in real time

allows preventative or *proactive*

interventions based on the

amount of fluid the

patient's body is able to

shift or refill into the

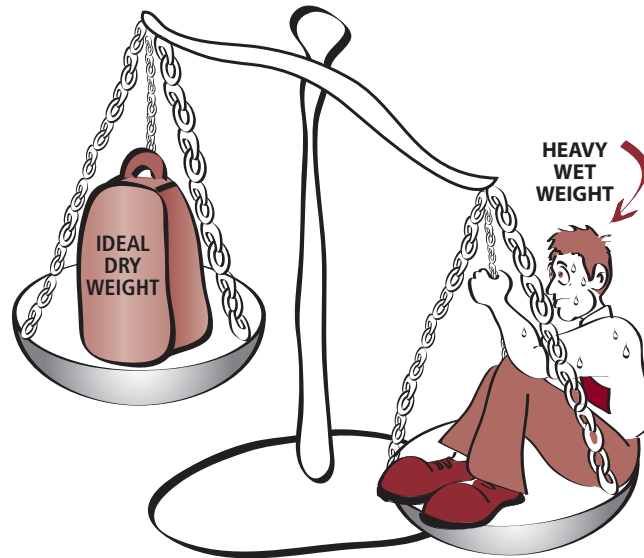
bloodstream from the

tissues during any given

treatment session.

Now, for the first time, the health care team can accurately determine how well a patient's *plasma refilling rate (PRR)* is keeping up with the *ultrafiltration rate (UFR)* of the dialysis machine. This is important to prevent feeling bad during dialysis and still ensure that all the extra fluid has been removed.

This will help you get to your true or *Ideal* dry weight instead of going home with a heavy or *Wet* weight.



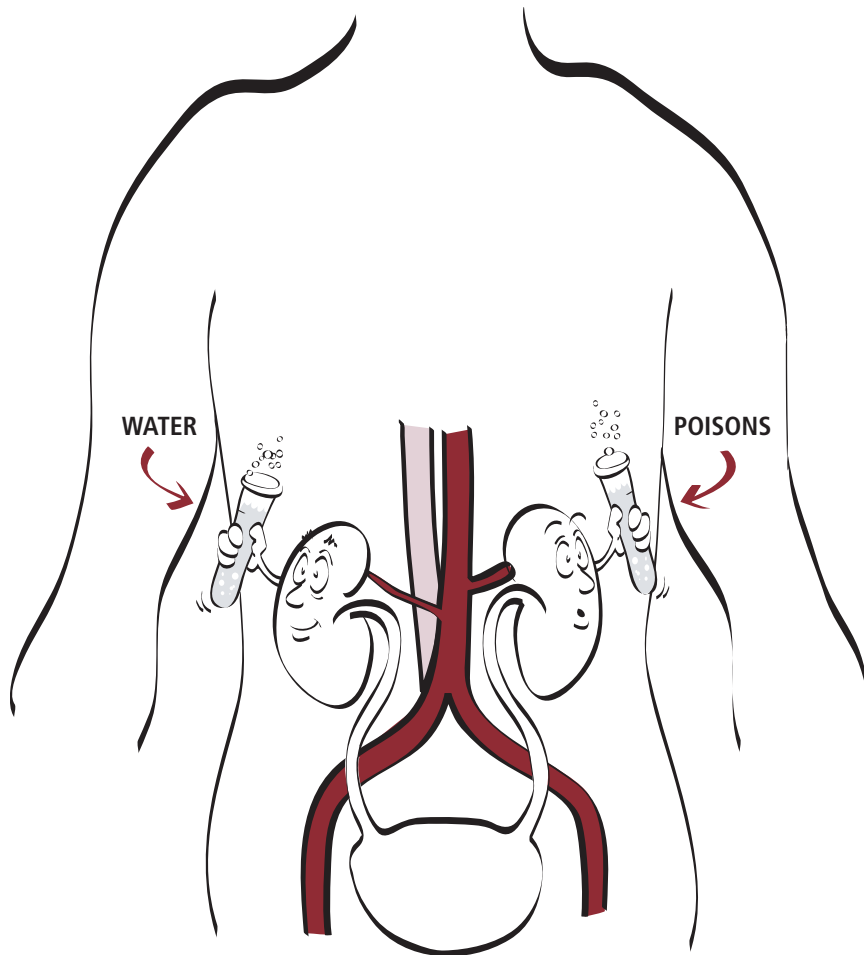
In addition to measuring your HCT and blood volume change, the *CRIT-LINE* measures oxygen saturation, access blood flow and recirculation. Oxygen saturation tells how well you are breathing and if your body is getting enough oxygen. Access blood flow and recirculation shows how well your dialysis access (graft/fistula) is functioning.

This book was written to help you understand what happens inside your body when you lose the ability to produce urine and the fluid must be removed by dialysis.

It is important to discuss any questions you may have with a member of your dialysis health care team.

What do kidneys regulate?

The *kidneys* are the master chemists of your body. They regulate *poisons, nutrients and fluid balance*. The poisons and fluids the kidneys take out of the blood become urine. Urine is stored in the *bladder* until it can be passed out of the body. Without adequate kidney function, a person will need dialysis or a kidney transplant to live.

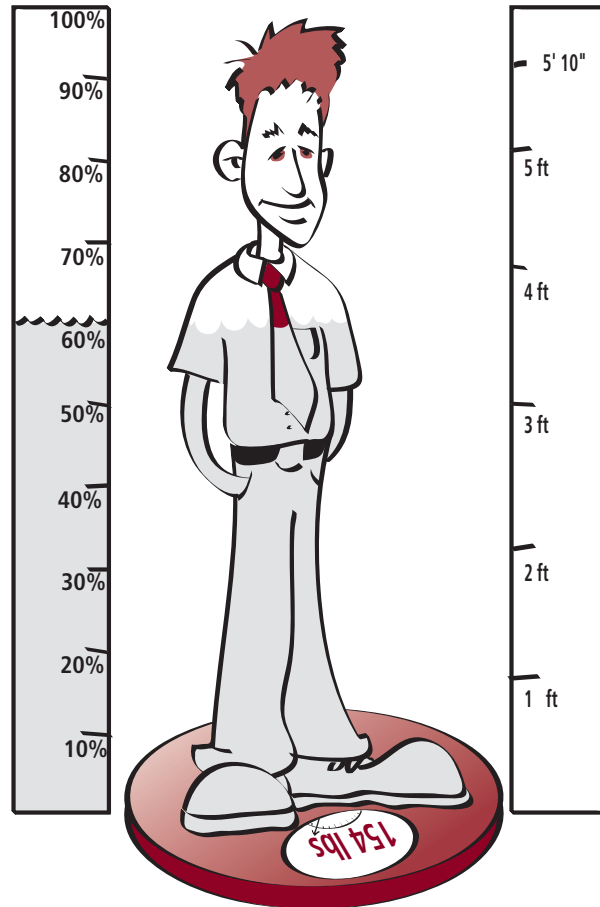


What is dry weight?

Dry weight is what you weigh when your kidneys are functioning and removing extra fluid. It is the weight resulting from normal renal function.

When your kidneys stop functioning and you drink fluid, the fluid stays in your body and is stored in your tissues. When you have extra fluid in your body, you no longer are at your dry weight.

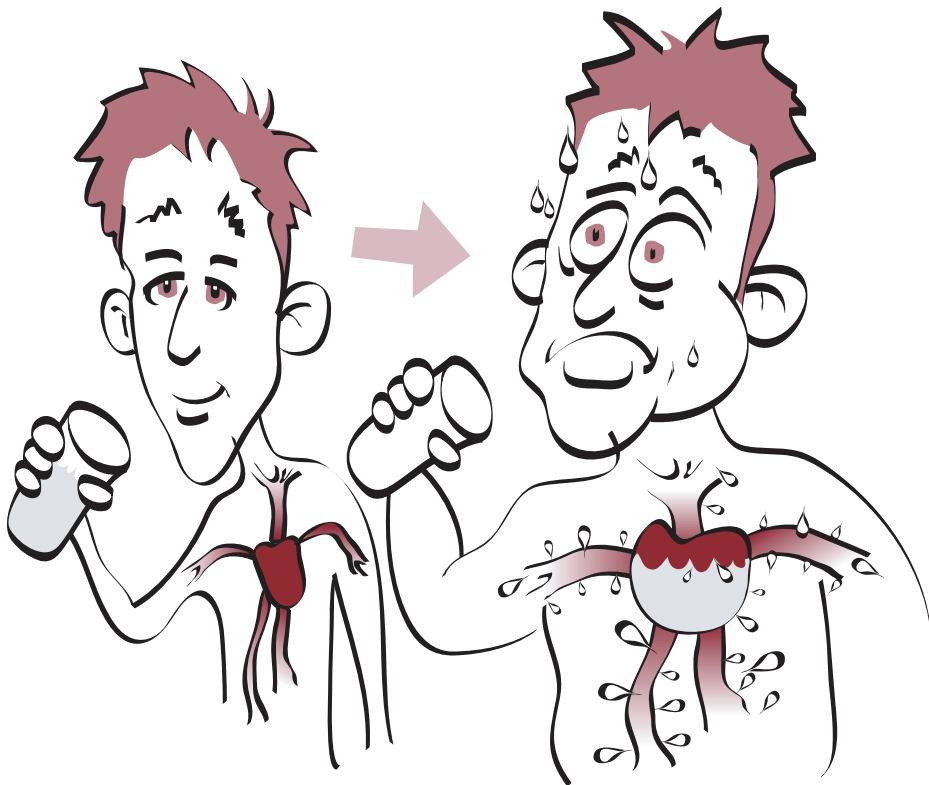
The “average man” is about 5 feet, 10 inches tall and weighs approximately 154 pounds. At dry weight, his body contains about 60% water by weight.



Where does the extra fluid go?

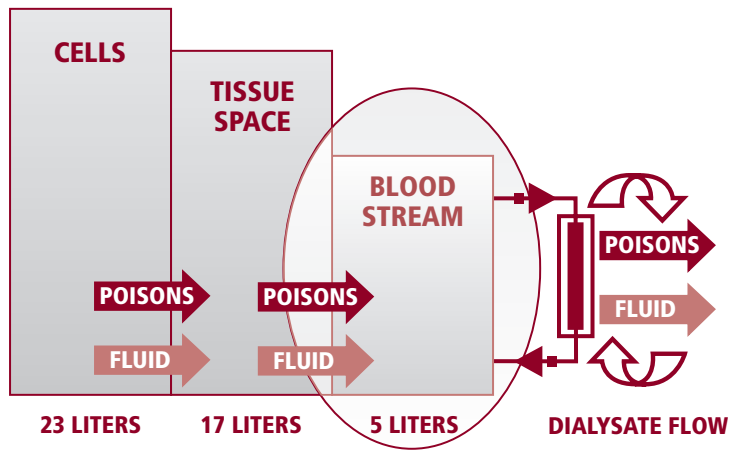
When you have little or no kidney function, every time you drink fluid it stays in your body.

When you drink, the fluid goes to the stomach and then is quickly absorbed into the *bloodstream*. Since the bloodstream can hold only so much fluid, the extra fluid will then shift into your tissues and cells. Your bloodstream is like a rubber band that can expand to hold more fluid – but only so much. When your bloodstream is full, all the additional fluid you drink will shift into your tissues and cells.



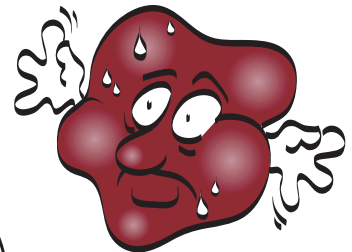
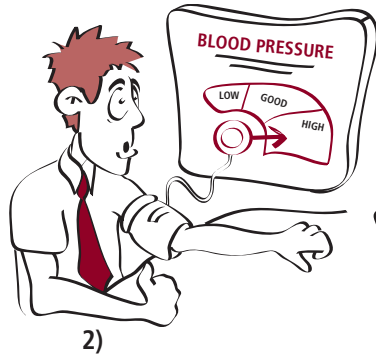
What is Plasma Refill?

During dialysis, the poisons and extra fluid move, or shift, from the cells and tissues into the bloodstream, then into the dialyzer where they are removed. The shift in fluid is called *plasma refill*. The speed the fluid moves, or shifts, is called *plasma refill rate (PRR)*.



Signs and symptoms of having too much fluid in your body.

- 1) Difficult breathing
- 2) High or Low Blood Pressure
- 3) Edema and/or puffiness
- 4) Swollen stomach (ascites)
- 5) Lower percent of red blood cells, or hematocrit (HCT), than usual.
- 6) Lack of energy
- 7) Heart problems.

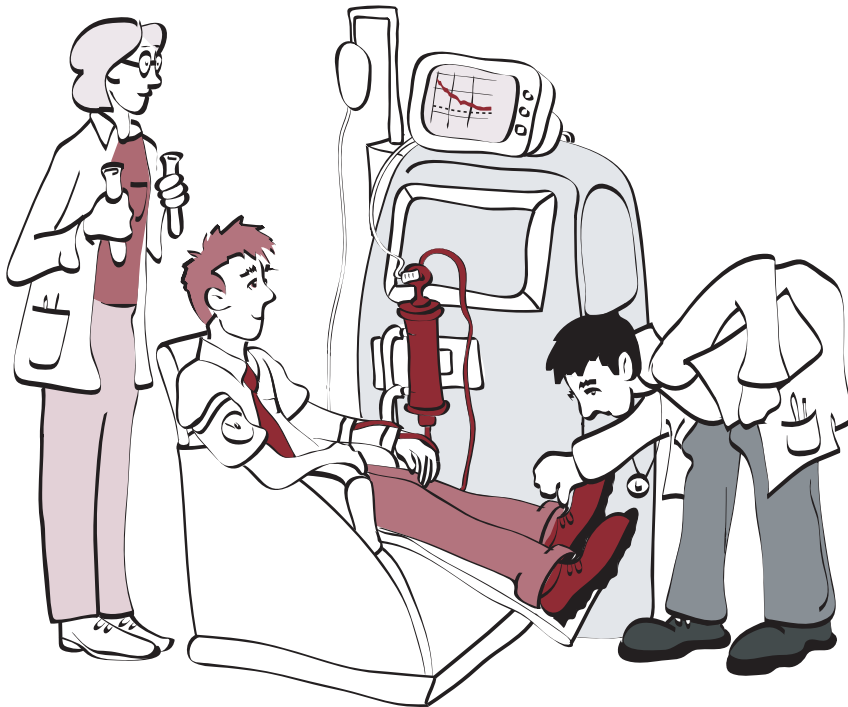


How is your dry weight determined?

Your health care team has many different ways to determine your dry weight. They do a number of things such as:

- 1) Look at your before (*pre*) and after (*post*) dialysis weight for fluid changes
- 2) Check you for swelling or edema in your tissues
- 3) Monitor your blood pressure
- 4) Check your lab values
- 5) Use the *CRIT-LINE*.

These factors all help you and the health care team determine your dry weight.

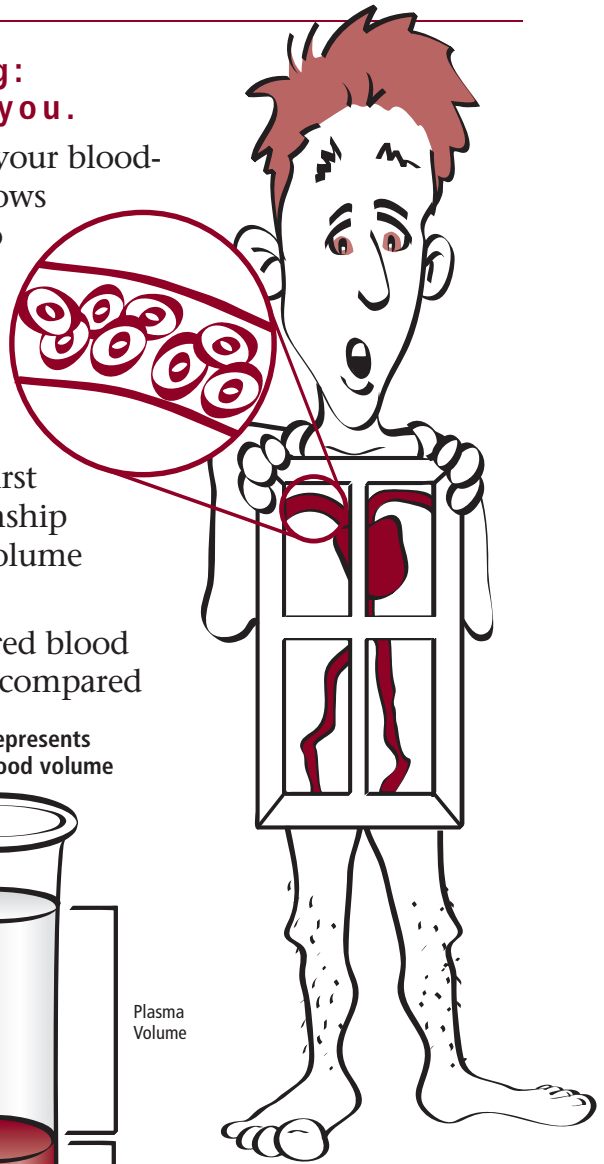
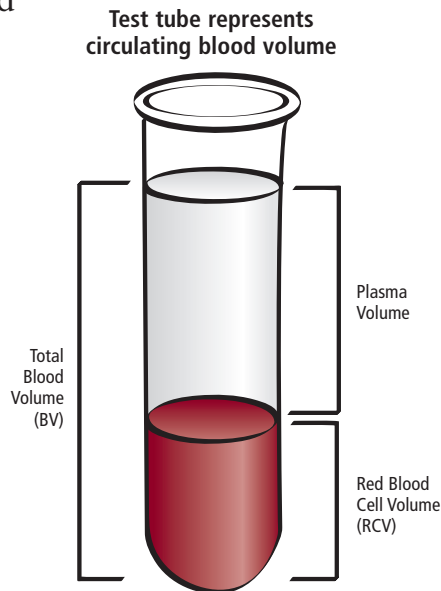


Blood Volume Monitoring: How CRIT-LINE can help you.

The *CRIT-LINE* is a window into your bloodstream that, for the first time, allows you and your health care team to determine if they are removing fluid from you too fast. This is called “*Blood Volume Monitoring*.”

To safely determine your ideal dry weight with the *CRIT-LINE*, first you must understand the relationship between hematocrit and blood volume change.

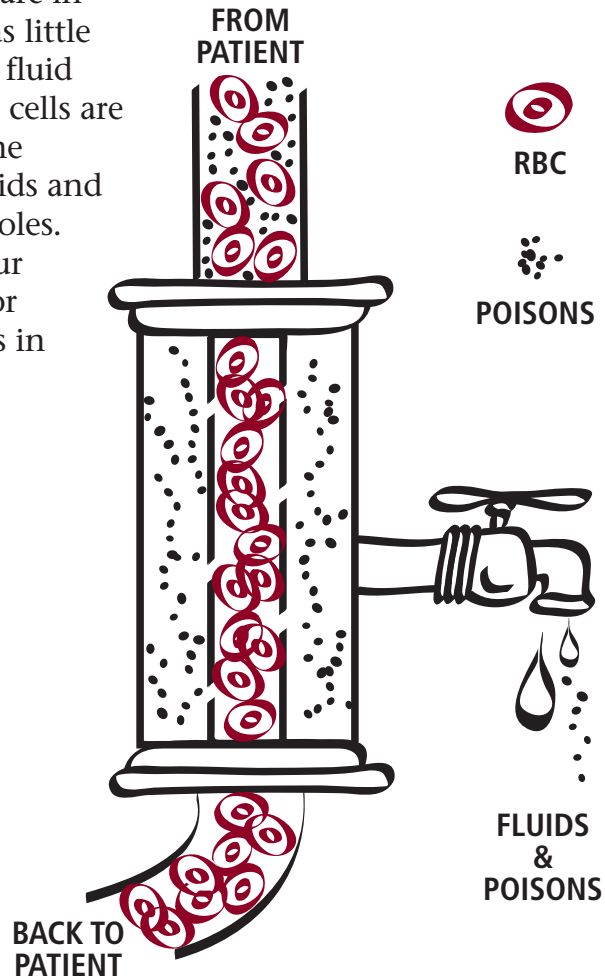
Hematocrit (HCT) is the ratio of red blood cells (RBCs) in your bloodstream compared to your total blood volume. It is reported as a percentage, i.e., your goal is 33-36%.



Red blood cells (RBCs) as a marker in your bloodstream.

Your RBCs remain the same during dialysis because they are too large to pass through the holes of the artificial kidney, or *dialyzer*.

In your bloodstream you have two main components – RBCs and plasma. Fluid and poisons are in the plasma. The dialyzer has little holes which filter out extra fluid and poisons. The red blood cells are too large to pass through the dialyzer holes. Only the fluids and poisons pass through the holes. As the fluid is removed, your percent of red blood cells, or hematocrit (HCT), increases in your bloodstream.



The opposite relationship of Hematocrit and Blood Volume (the Mirror Image).

By measuring your HCT with the *CRIT-LINE*, you are able to track or monitor the blood volume change in your bloodstream. As the extra fluid is removed and plasma blood volume decreases, your HCT will rise. (See example)

What is HCT Threshold?

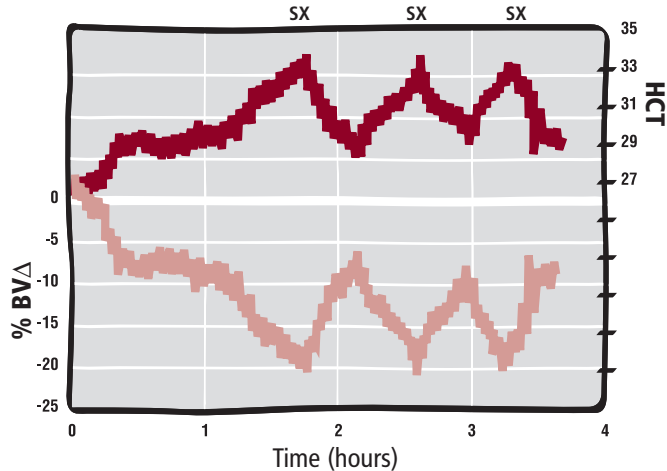
The dialysis machine pulls fluid from your bloodstream by ultrafiltration.

During ultrafiltration, your HCT becomes a marker to show you how your blood volume is changing during treatment. As your HCT rises, your blood volume decreases.

Every patient has a critical blood volume level, identified by a specific HCT, at which they may have a bad symptom or feel sick. This is called the *HCT Threshold* or *Crash Crit*.

In the example above, the patient “felt bad” each time the HCT was 34. This patient’s *HCT Threshold* is 34.

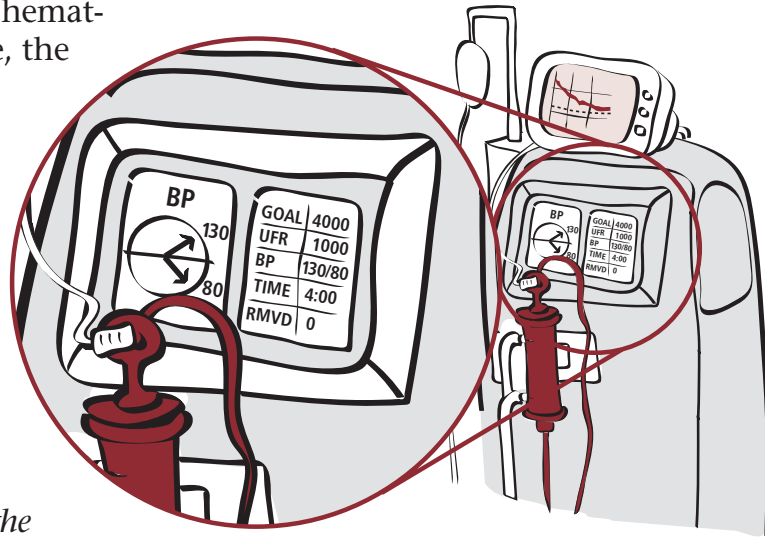
To prevent the patient from feeling bad, the dialysis team could treat the patient *proactively*, before the symptoms start when the HCT reaches an alarm line, or *HCT LIMIT* of 32-33.



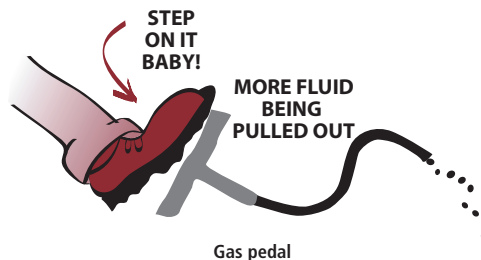
What is ultrafiltration rate?

Ultrafiltration rate (*UFR*) is the rate at which fluid is being pulled from your bloodstream. It is the fluid removal *goal* set as a number on your dialysis machine. During dialysis, you have a goal of fluid to remove over your treatment time. Let's say you're on dialysis for four hours with a goal of losing four liters. Your dialysis UFR goal may be set for one liter per hour. The dialysis machine will pull off one liter per hour from your bloodstream.

By reading your hematocrit in real time, the *CRIT-LINE* will show you how well your tissue is refilling (or keeping up with the fluid changes in your bloodstream.)



NOTE: Think of the UFR as a gas pedal. When you turn up the UFR, it is like stepping on the gas. The UFR will pull more fluid out of your bloodstream. On the contrary, if you turn down the UFR, you are putting on the brakes (slowing down the rate that fluid is being removed from your bloodstream.)



Gas pedal

Understanding Low Blood Pressure (hypotension).

When you don't have enough fluid in your bloodstream, your blood pressure will drop, or become low. This low blood pressure is called *hypotension*. Often, hypotension is treated after it happens (*reactive* treatment) with a saline bolus, which increases your bloodstream volume. The goal of dialysis is to remove fluid and get you down to your ideal dry weight. Receiving saline will not help you get to your ideal dry weight goal. The *CRIT-LINE* allows you and your health care team to be *proactive* in your treatment so you can prevent large drops in your blood volume, yet remove fluid safely to your ideal dry weight.



Using the *CRIT-LINE* Monitor

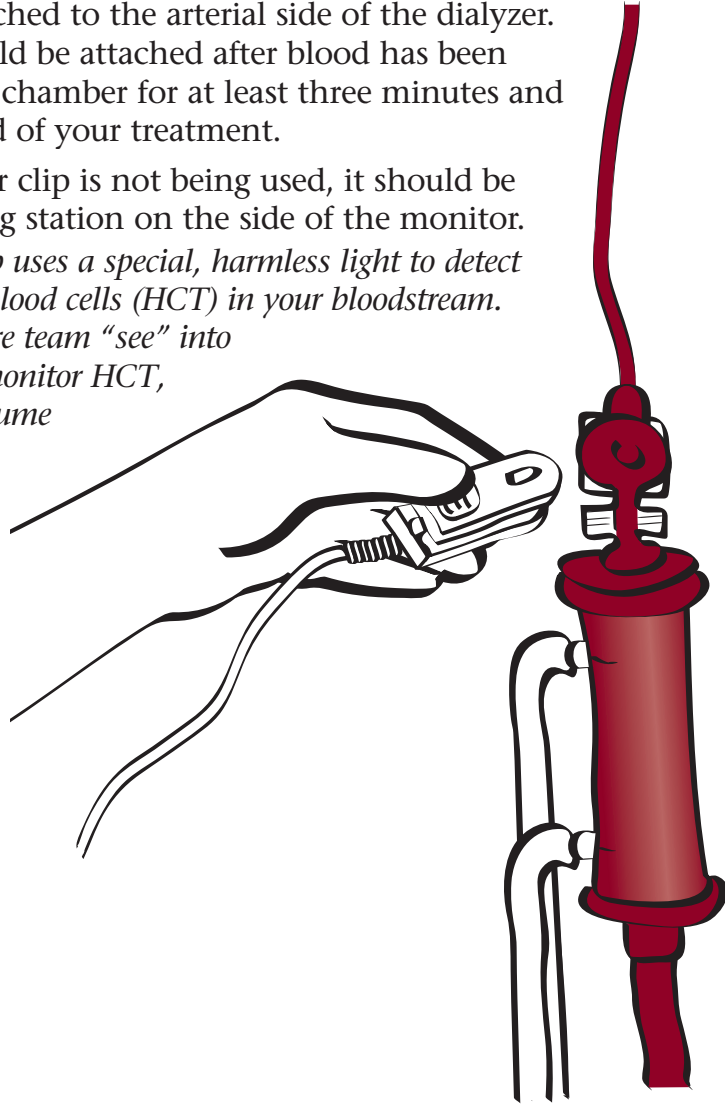
How to attach the sensor clip to the blood chamber.

The *CRIT-LINE* sensor clip locks into place around the blood chamber that is attached to the arterial side of the dialyzer. The sensor clip should be attached after blood has been passing through the chamber for at least three minutes and stay on until the end of your treatment.

Whenever the sensor clip is not being used, it should be placed in the docking station on the side of the monitor.

NOTE: The sensor clip uses a special, harmless light to detect the percentage of red blood cells (HCT) in your bloodstream.

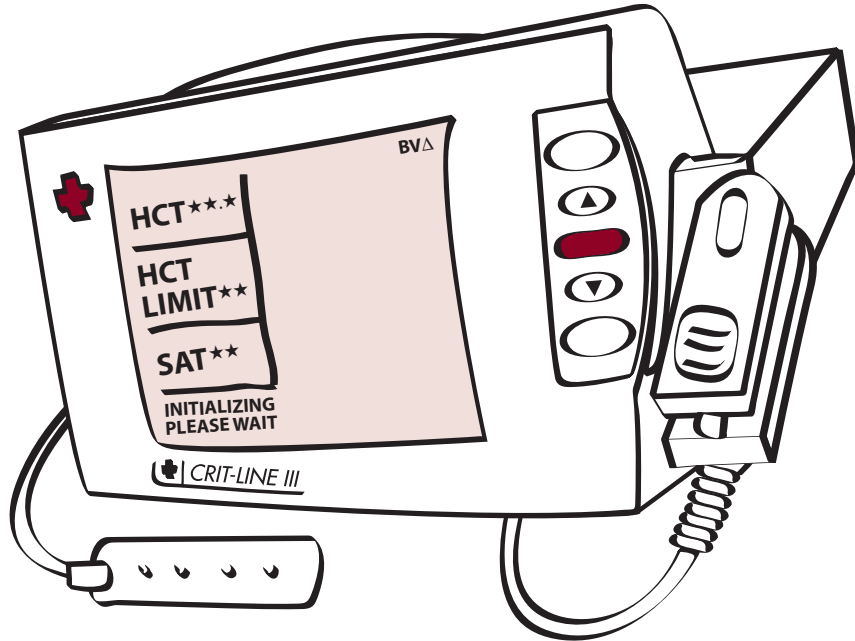
It helps your healthcare team “see” into your bloodstream to monitor HCT, oxygen, and blood volume changes.



Watching the CRIT-LINE during YOUR treatment.

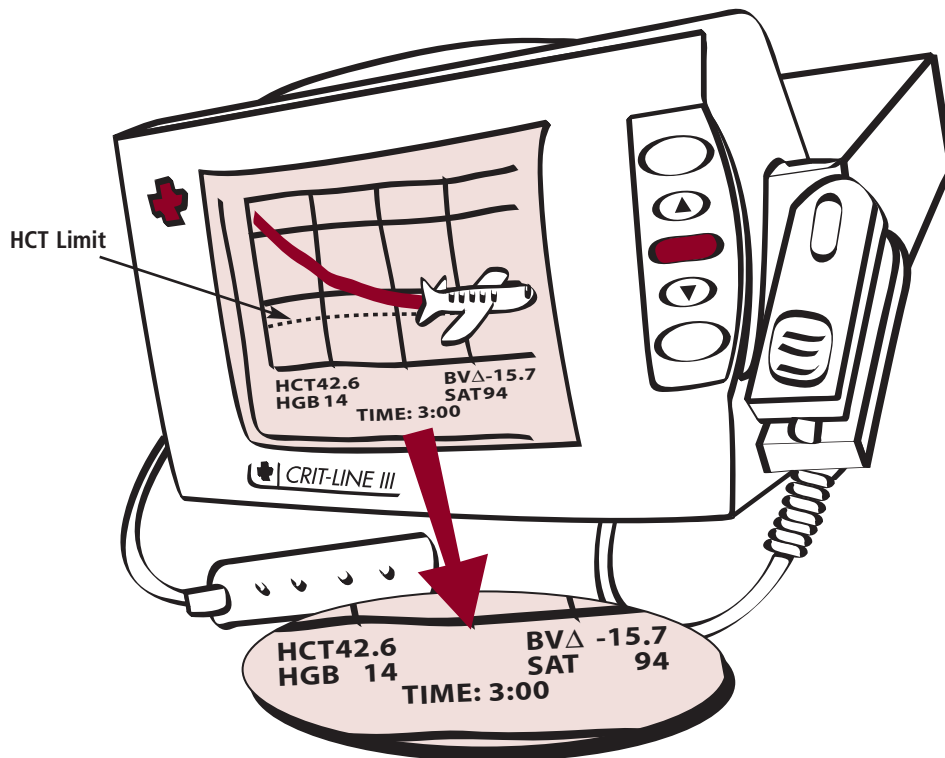
There are two main screens that appear on the *CRIT-LINE*. One of the screens shows your hematocrit and your oxygen saturation level in large boxes. Your health care team sets the HCT LIMIT (or alarm line) in the box between the two values.

If you know where your *HCT Threshold* is, the HCT Limit will be set one to two numbers below it (*i.e., if you have symptoms at a HCT of 40, it will be set at a limit of 38 or 39.*)



The other main screen shows how your blood volume is changing in real time. Often, you will want the screen to look like an airplane landing (a slow decline of blood volume change.) You should “land” right above your HCT Limit. The dotted line on the *CRIT-LINE* monitor is the alarm line, or HCT LIMIT.

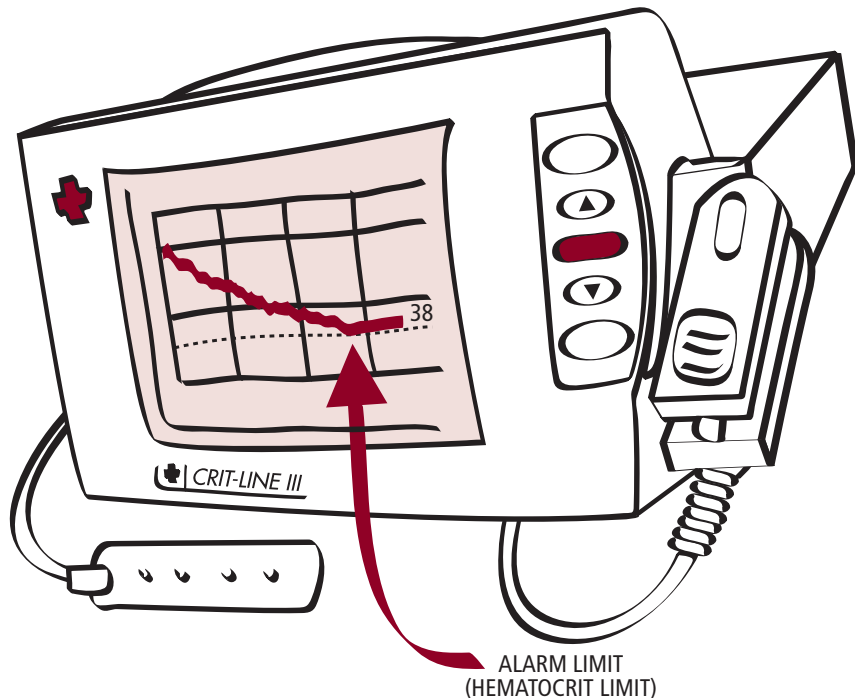
The bottom of the screen shows the current numbers for your HCT, hemoglobin, blood volume change, oxygen saturation level, and the time on the *CRIT-LINE* monitor.



How do I use the alarm on the CRIT-LINE?

If you have experienced symptoms, or “crashed,” at a hematocrit of 40, this may be your Hematocrit Threshold. Your alarm line, or HCT Limit, will be set at 38 – 39. The CRIT-LINE will alarm when you reach this HCT Limit. At this time, you and your health care team can try *preventative (proactive)* measures to avoid crashing. *NOTE: See commonly used interventions to treat or prevent crashing (page 19.)*

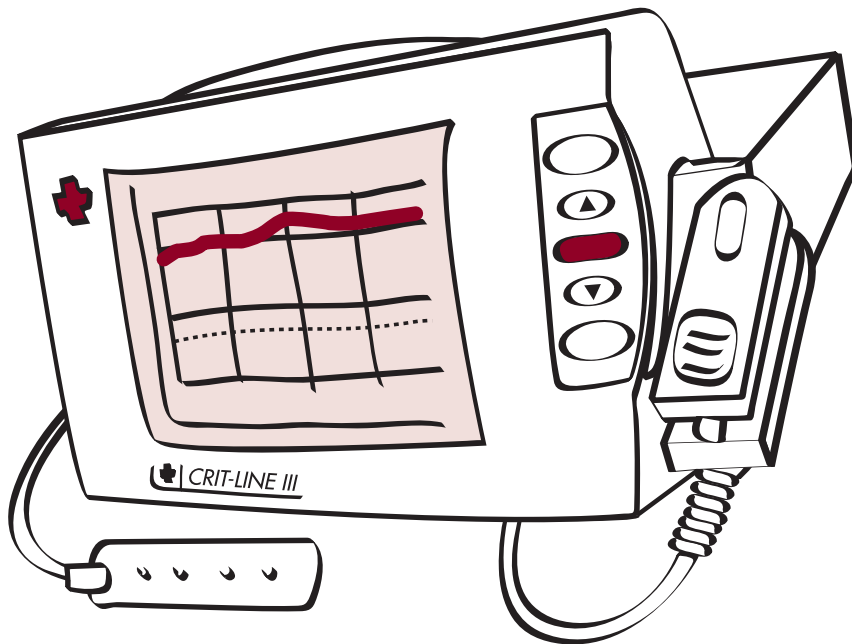
Example: When preventative measures were taken, the patient stayed above his/her HCT Limit and avoided a crash.



"A" Profile (a lot of fluid).

This is an example of the fluid in the tissues refilling into the bloodstream at the same or faster rate than the UFR is pulling fluid out. The hematocrit remains the same or becomes lower.

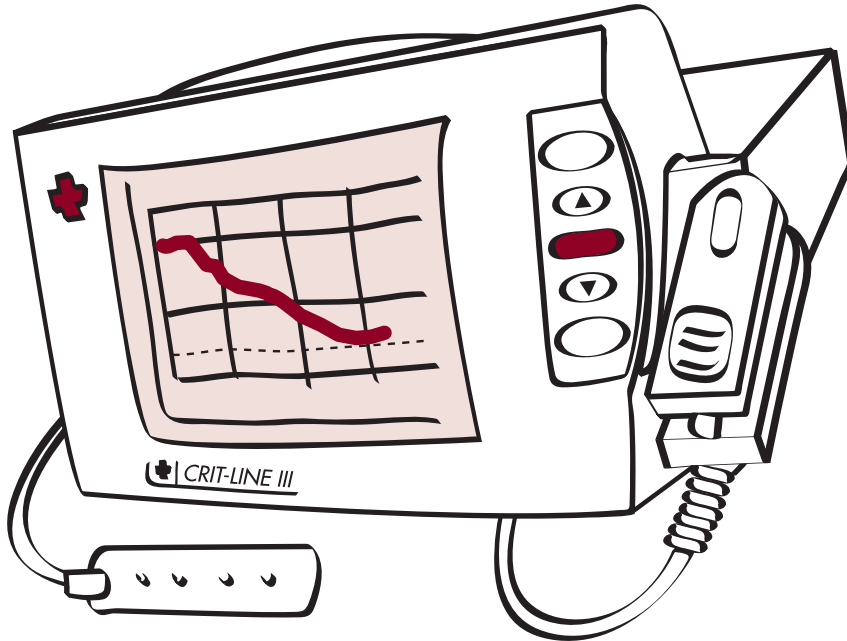
NOTE: If your hematocrit remains the same, or become lower, during dialysis and you need to lose fluid, this may be a chance to increase the UFR, taking advantage of the fluid that is refilling into your bloodstream from your tissues. Your plasma refill rate is equal to or faster than your UFR.



"B" Profile (better).

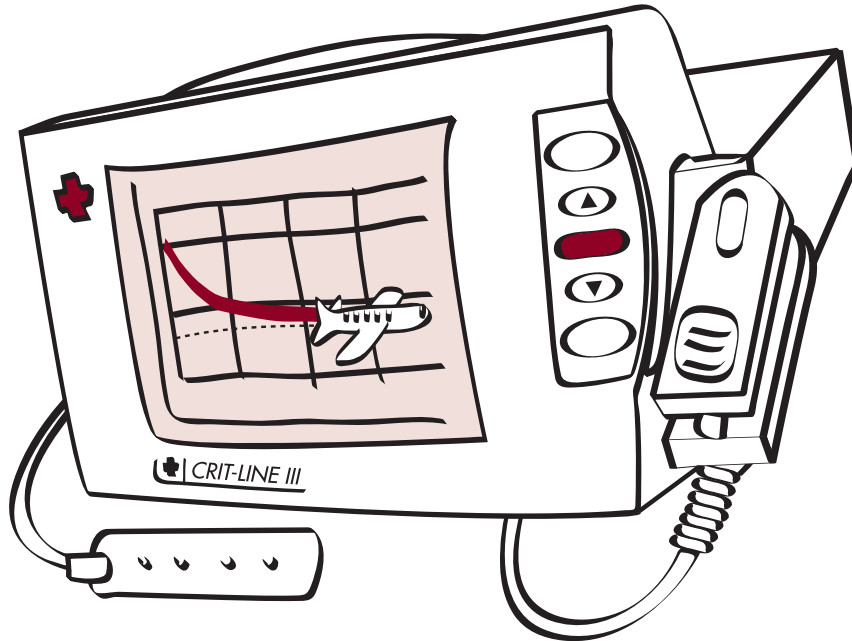
This is an example of where the UFR is pulling a little more fluid than your tissue is refilling into your bloodstream. If your bloodstream has stretched because of extra fluid (like a rubber band), it is important to get it back to normal. This will prevent problems as a result of having too much fluid in your body.

NOTE: If you have extra fluid in your body, this profile means you are removing fluid slowly, safely and effectively. A slow, gradual decrease (-3% to -8% per hour) in blood volume change is desirable until your HCT Threshold is known.



"Flying the Curve" profile.

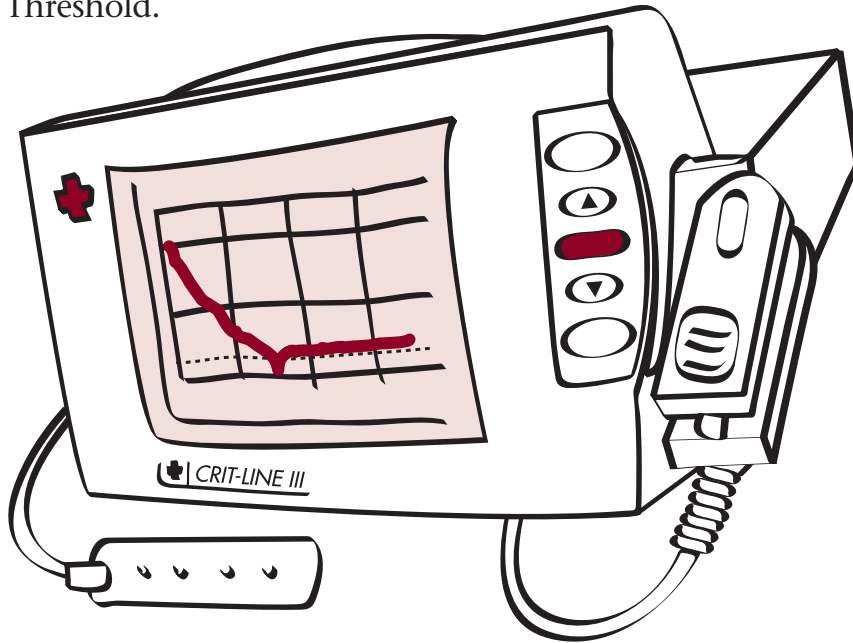
NOTE: In most treatments you want the CRIT-LINE screen to look like an airplane landing.



Bringing your blood volume down early to your HCT Limit, and keeping it there for the rest of your treatment, will help remove all the extra fluid without a "crash." This is called *Flying the Curve*.

"C" Profile (crash).

This is an example of the UFR pulling out the fluid too quickly from your bloodstream. The fluid in your tissue is not shifting very easily into your bloodstream. Therefore, your blood volume is dropping too fast. The hematocrit is rapidly rising past your HCT Limit to the HCT Threshold.

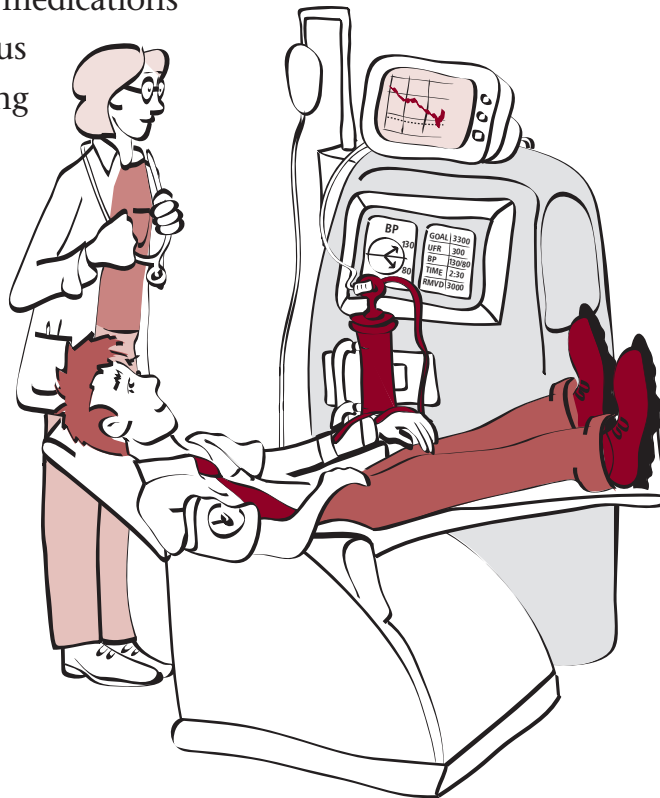


To prevent your blood volume from dropping too fast and to prevent "crashing," you want to be proactive. For example, lying back in your chair or lowering the UFR per hour. Your nurse may also give an injection of a hypertonic medication which will help you shift (or refill) the fluid into the bloodstream.

If your oxygen level is noted to have a low reading on the *CRIT-LINE* monitor, you may be given oxygen during the treatment. Don't be alarmed. This will help you refill and remove the fluid better. Many dialysis patients need extra oxygen during some of their treatments.

Commonly used interventions to Treat or Prevent crashing.

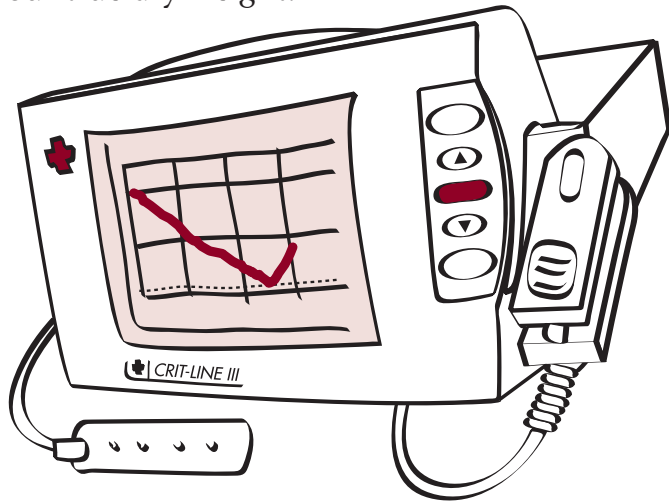
- Blood volume monitoring
- Oxygen administration
- Flat position with feet up (lying back)
- Slow down or stop ultrafiltration rate
- Longer dialysis treatment
- Sodium modeling
- Hypertonic medications
- Temperature control (cold dialysis)
- Adjusting medications
- Saline bolus
- UF profiling



Can the CRIT-LINE tell me if I have more fluid to lose?

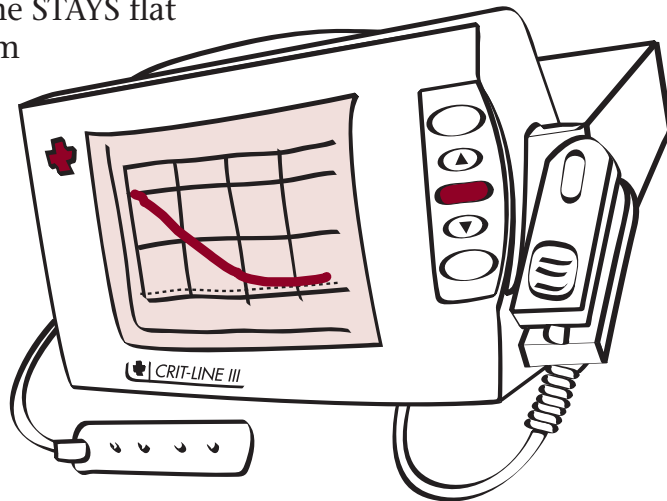
Yes. If the UFR is turned down to minimum and your blood volume refills, you are not at your true dry weight.

Refill shows there is more fluid to be removed.



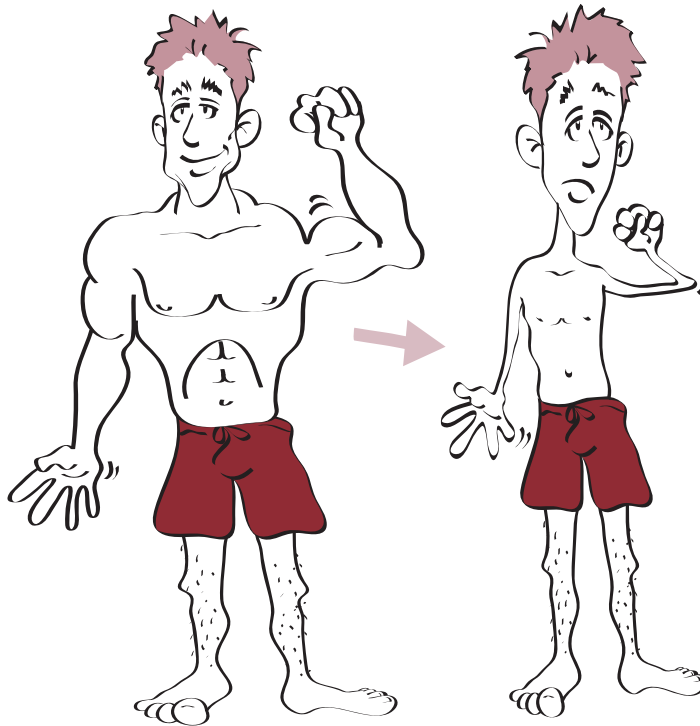
If the UFR is turned down to minimum, and no refill is seen (the line STAYS flat as shown in the bottom monitor), you are at your true ideal dry weight.

No refill is seen, *true ideal dry weight* has been reached without any bad symptoms.



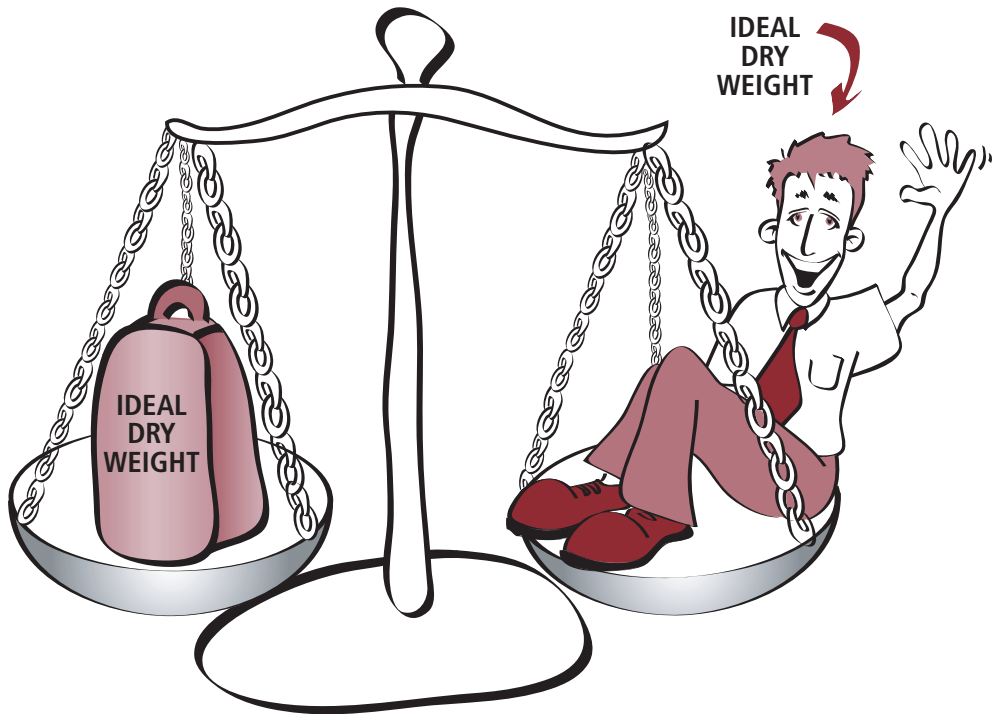
Can my dry weight change?

Yes, especially if you are new to dialysis. The change in your diet and adjusting to dialysis can affect your appetite. This will cause you to lose real body weight (muscle and/or fat.) It is important to know if you lose real body weight so those extra fluid pounds are detected. Once you have adjusted to dialysis, your appetite increases, and you may start to gain real body weight, not just fluid. Throughout your life, your weight can be a moving target. Your dry weight can also change with the seasons, during an illness and as you change your activity level. This is why it is important to partner with your health care team to manage your *ideal dry weight*.



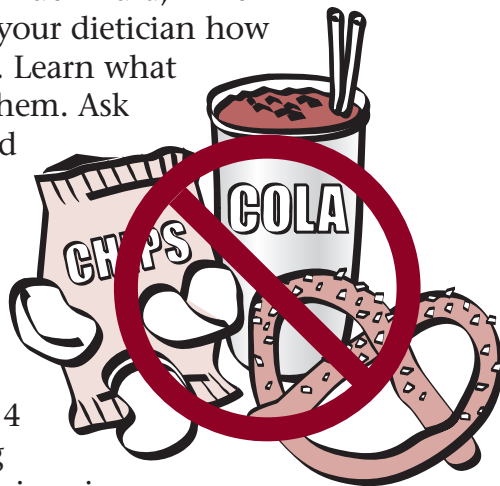
Why is it important to stay within MY fluid restrictions?

- To obtain and stay at your ideal dry weight
- To help control blood pressure
- To make it easier to breathe
- To reduce risk of heart disease
- To have a more comfortable dialysis treatment
- To feel better between treatments.

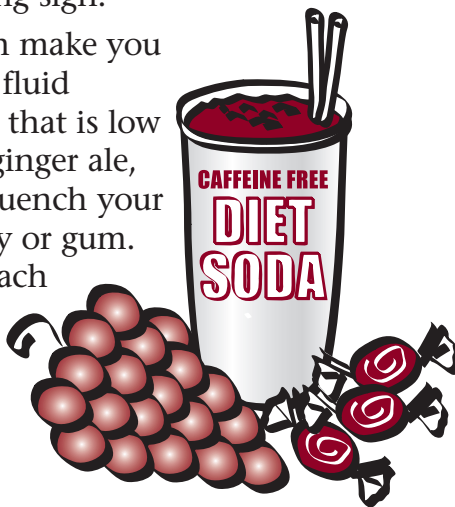


Controlling Your Thirst

One of the most difficult diet restrictions hemodialysis patients have is to limit fluids. When you are thirsty, it is difficult to think about anything else. Often, this results in drinking too much fluid. The key is to limit your sodium (salt) intake. The amount of sodium in a diet is what triggers a person to drink too much fluid, which then increases fluid weight gain. Ask your dietician how much sodium you can have each day. Learn what foods are high in sodium and avoid them. Ask your health care team how much fluid you can drink and gain each day. Weigh yourself daily, at about the same time. This can help you know when you are near or over your fluid limit. To feel your best, you need to limit your fluids so that you gain no more than 1 – 2 kilograms (about 2 – 4 pounds) between treatments. Gaining more than two pounds a day is a warning sign.



Beverages high in caffeine and sugar can make you extremely thirsty and lead to too much fluid intake as well. Instead, opt for soda pop that is low in calories and caffeine, like diet 7-Up, ginger ale, lemonade or caffeine-free tea. To help quench your thirst, carry sugar-free mints, hard candy or gum. Freeze a bunch of seedless grapes, and each one can become a mini frozen treat. Talk to your doctor and dietician about the many different mouth sprays and medications that may help you feel less thirsty.



More tips for controlling your thirst.

- Limit your salt intake
- Avoid salted snacks, canned soups
- Read food labels to avoid hidden sodium (avoid salt substitutes which are high in potassium)
- Choose sugar-free, caffeine-free drinks
- Chew sugarless gum
- In hot weather use a mist bottle with a fan
- Eat a spoon of chilled applesauce
- Eat a frozen piece of your favorite fruit (ask dietician for a list of low potassium fruits)
- Remember that anything that is liquid at room temperature **IS** a fluid. This includes soup, jello, pudding, ice cream, etc.
- Stay out of the sun, stick to shady areas if you can
- Suck on sugar-free hard candy, especially sour candy
- In hot weather wear clothes that breathe
- Suck on crushed ice or plastic decorative ice cubes
- Quench your thirst with lemon wedges
- Mute the television when they are advertising refreshing drink ads
- If you are diabetic, keep your blood sugar in control
- Measure and record the amount of fluids you drink daily
- Drink only the daily amount of fluid recommended by your healthcare team. Generally, this is one quart (one liter) plus the amount of urine you still put out daily.
- Sip, do not gulp
- Weigh yourself daily at about the same time
- Ask your health care team for more information.

Conclusion.

To have the best health possible, it is important to learn as much as you can about kidney disease and the care you need . Ask your dialysis nurse, technician, dietician or doctor to explain any procedure or concept you do not understand. Remember, you are a partner with the renal team to provide the best healthcare for you. Becoming knowledgeable about *YOUR* treatment will help you communicate your medical needs more effectively. And, since the well-informed patient also tends to be healthier, you may also live a longer, more productive life.



Frequently Asked Questions About Your Dialysis Treatments.

Q If I have Low Blood Pressure (BP) or cramping during dialysis, does that mean I am at my dry weight?

A Not always. If you have symptoms during dialysis, it may be that your tissues are refilling fluid into your bloodstream at a slower rate than the ultrafiltration is pulling fluid from them. This imbalance can cause cramping and/or hypotension. It is important to know that just feeling bad does *NOT* mean you are dry. Turning your UFR to minimum and checking for refill will help determine if you are really at your dry weight.

Q Does any fluid I drink during dialysis count in my daily allowance?

A Yes. The fluid goes into the stomach and has to be absorbed into the bloodstream to be removed by the dialyzer. This means that the fluid you drink during dialysis should be added into your daily allowance and the dialysis fluid removal goal.

Q Why is it important to take blood pressure medications at the time my doctor tells me?

A Taking your blood pressure medication at the wrong time can make your arteries and veins sluggish and they will not react as fast to the change in your bloodstream. Check with your doctor to find out the best time to take medication.

Q Why would I need to stay on the dialysis machine longer?

A It may be that you need more dialysis (longer sessions or more frequent treatments) to remove toxins (poisons) or extra fluids safely. Ultimately, more dialysis is better.

Q Will my blood pressure tell me if I am low on blood volume?

A Blood pressure is a late, reactive measurement. Often you will begin feeling badly before your blood pressure drops. The *CRIT-LINE* can help prevent blood pressure from dropping by showing your change in blood volume in real time before you feel badly.

Q What is the most common reason for high blood pressure?

A Studies have shown the number one reason for high blood pressure is extra fluid. Over time, patients who stay near their ideal dry weight may be able to have their blood pressure medications reduced.

Q Is it okay to eat while on the machine?

A When you eat, the blood volume and fluid go to the stomach to help digest food. This decreases your *plasma refilling rate (PRR)*, causing you to have symptoms (nausea, low blood pressure, dizziness, cramping, etc.) PRR is the rate the fluid shifts from your tissue into your bloodstream. Eating while undergoing dialysis should be avoided in most cases. Small meals before and after dialysis are also advised.

Q If I'm given a blood transfusion, will the *CRIT-LINE* reading change?

A Yes, the *CRIT-LINE* reads your red blood cell count during your treatment. Receiving a blood transfusion increases your red blood cell count and will cause a sharp change in blood volume during the transfusion.

Q Will it help if I lie back during treatment?

A Yes. Lying back with the feet up is often referred to as the Trendelenberg position. This position helps the refilling process, especially if you have a lot of fluid to remove.

Q Why is it bad for me to eat too much salt?

A Salt absorbs fluid. If you have a lot of salt or "sodium" in your tissues, your tissues act like a sponge. The spongy tissue likes to hold onto the fluid and will not allow the fluid to move into your bloodstream easily during dialysis. Also, eating too much salt will make you thirsty and you will want to drink more fluid. Drinking more fluid may cause you to become fluid overloaded, resulting in increased blood pressure.

Hema Metrics would like to give a special thanks to Lori Hartwell (kidney patient for over 30 years) of Hartwell Communications for her creative artwork and editorial guidance to make this difficult patient education topic easily understandable.



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