



## Principles of Hemodialysis

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### Basic principles of hemodialysis

Hemodialysis, which means “cleaning the blood,” is a treatment for people whose kidneys have failed. The hemodialysis process involves blood passing through a dialyzer (an artificial kidney) to remove wastes and excess water. The dialyzer uses tiny hollow filters that look like microscopic straws. The “semi-permeable” membrane surrounding these tubes is very thin and allows only some particles to pass through. As blood moves through these tubes it comes into contact with a solution called dialysate, a liquid made from water, an acid solution and a bicarbonate solution. The dialysate liquid is circulated around the outside of the hollow fibers.

The dialysis process causes molecules to move across the semi-permeable membrane of the dialyzer. As a result, some waste products and electrolytes in the blood will move from the blood side of the membrane into the dialysate solution and some molecules will move from the dialysate side of the membrane into the blood. This process is called diffusion.



**Just like making tea**

Making tea offers an everyday example of diffusion. Putting a tea bag into hot water causes the bag to act like a semi-permeable membrane. The tea leaves are too big to get out of the bag but the flavour and colour of the tea is able to pass through the membrane into the water, while water is also able to pass through the membrane into the tea bag.

During hemodialysis, large molecules such as blood cells and protein are kept inside the membrane but smaller molecules such as urea and creatinine (and other biological wastes) pass through the small holes of the dialyzer’s filters into the dialysate solution.

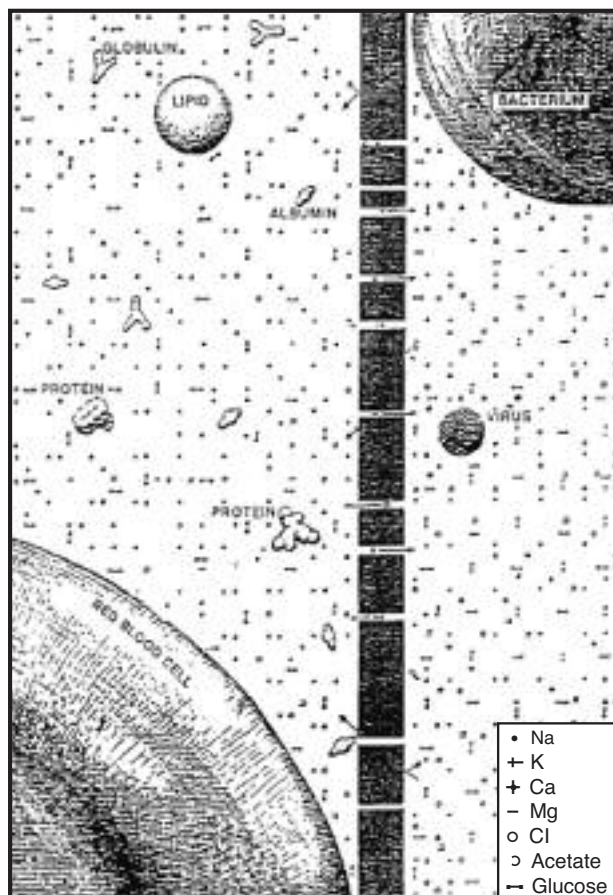


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**Did you know:** Two normally functioning kidneys filter about 180 litres of blood a day, extracting about two litres of waste and extra water. Your body produces hundreds of different waste molecules every second. Some of these molecules become waste products such as creatinine and urea, which are the result of the normal breakdown of muscle and food (known as metabolism). The by-product or waste products of metabolism are then turned into urine, which is contained in the bladder until it is expelled. People with kidney failure need the help of dialysis to get rid of these normal metabolic waste products.

### Note

1. **The counter current flow.** The flow on the dialysate side of the membrane is in the opposite direction of the blood. This enables fresh dialysate to constantly meet new blood.
2. **The different molecules travel in different directions.** Some of the molecules are moving from the blood side of the membrane to the dialysate side, while others are moving from the dialysate side to the blood side. Can you explain why this occurs? If you do not understand, ask your educator.





### What dialysis can and cannot do

**Dialysis can do some of the tasks of healthy kidneys — but not all tasks and not perfectly.**

#### Dialysis CAN

- Remove waste products (e.g. urea, creatinine, phosphorus, etc.)
- Remove excess water
- Correct *high* or *imbalanced* levels of potassium, chloride, sodium, etc. in the blood

#### Dialysis CAN'T

- Automatically regulate blood pressure
- Produce hormones like Erythropoetin (EPO)
- Regulate normal calcium levels

#### Removing excess water

Hemodialysis will get rid of extra fluid in the blood through a process called “ultrafiltration.” How much fluid needs to be removed during each treatment is very important and is covered in a separate part of this manual.

To remove excess water, the dialysis machine puts pressure on the blood side of the semi permeable membrane in the dialyzer. This pressure forces salt and water out of the blood and into the dialysate. The used dialysate with the blood wastes and excess fluid is taken away and drained.

#### Electrolyte balance

When you have kidney disease some of the molecules in your body are out of balance. For example, you will have too many of some molecules like potassium, and not enough of others like bicarbonate. These types of molecules are called electrolytes and are important to the function of the heart and the nervous system. Too many or too few of these molecules can be very bad for your heart, and other parts of your body.

During hemodialysis, the molecular imbalance in your body can be corrected by adding some electrolytes to your dialysate solution while excess electrolytes are removed as part of your treatment. The goal is to get the right amount of the right electrolytes. As you learn more about your blood work you will learn about the quantities of different electrolytes in your blood and how these numbers can rise and fall based on your dialysis treatments.



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### Dialysis adequacy

You have read how dialysis works to get rid of waste products and extra fluid from your system. You should also understand that the more dialysis treatment you get the better you will feel, as you will have a reduced amount of waste products and excess fluid in your body.

**A few signs (symptoms) of not getting enough dialysis are:**

- Weakness and tiredness
- Poor appetite
- Feeling sick to your stomach
- Trouble getting a good sleep
- Itchy skin
- Metallic taste in your mouth
- Difficulty in concentrating
- Reduced interest in sex
- Difficulty breathing, especially when exercising or laying down flat
- Swelling in your hands and feet
- Poor blood pressure control

Inadequate dialysis can be extremely serious. It is important to pay attention to these symptoms and to act on them quickly. Talk to your doctor or nurse as soon as possible before your symptoms become worse. Quick action can help you to feel your best. Getting the best dialysis possible will help prevent these symptoms.

**To ensure you get adequate dialysis you should:**

- Dialyze all the days you're supposed to
- Dialyze for your full treatment time
- Follow your diet and fluid restrictions
- Take your medications regularly
- Take care of your access and monitor your arterial and venous pressures.



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### **Understanding blood tests to determine adequate dialysis**

One of the ways your health team can measure if you are getting adequate dialysis is by your blood work. If you have had hemodialysis in a hospital or community setting you might have noticed a staff member taking some blood at the beginning and at the end of your treatment. By measuring these blood levels before and after hemodialysis we can calculate the quantity of waste products removed during your treatment in order to make adjustments to your dialysis prescription. You will learn more about specific blood values in the section titled Your Blood Work.