



Module 7

Understanding Kidney Lab Tests



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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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5.)	b
4.)	c
3.)	c
2.)	d
1.)	b

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

Module 7 – Kidney Quiz Answers





The story is told of a woman whose husband became ill. During their 25 years of marriage, he handled all of their finances. Since she didn't like working with numbers, she gladly let him manage their money.

But while her husband was recovering, dealing with the finances fell in her lap. She quickly had to learn about the bills and how to budget to pay them. She got help to make sense of it all, but in her words, those first few months were like, "getting a drink from a fire hydrant." Too much, too fast!

We tell you this story because some of you may feel like that woman as you step into this module on *Understanding Kidney Lab Tests*.

If you've ever looked at the results of your lab tests, they can quickly make your eyes glaze over if you don't know how to read them. At first

glance, most people see a list of words they don't understand, with numbers that make no sense.

Because it looks so complex, most people simply ask their nurse, doctor, or dietitian to tell them if everything is okay. Of course, that's one option you have: let your health care team read your lab results and just tell you the outcome. But we think there is a better way: one that empowers you more.

You see, it's *your* body. And lab tests tell you what's happening inside your body. By learning what each test measures and your target range, you can follow your health progress from one test to the next.

As you follow your progress, it becomes easier for you to care for your body by making needed changes. The more you take care of yourself, the better you will feel. And the better you feel, the more hopeful you will be about living with kidney disease.

Lab Tests We'll Cover Include:

- Complete Blood Count (CBC)
- Hemoglobin (Hgb or Hb)
- Hematocrit (Hct)
- Ferritin
- Transferrin Saturation (TSAT)
- Calcium
- Phosphorus
- Potassium
- Sodium
- Blood Urea Nitrogen (BUN)
- Creatinine
- Glomerular Filtration Rate (GFR)
- Urea Reduction Ratio (URR)
- Kt/V
- Parathyroid Hormone (PTH)
- Calcium-Phosphorus Product (Ca x P)
- Urine Blood or Urine Hemoglobin (Heme)
- Creatinine Clearance
- Urine Albumin
- Microalbuminuria
- Albumin-to-creatinine ratio
- Serum Albumin
- Total Cholesterol
- High Density Lipoprotein (HDL)
- Low Density Lipoprotein (LDL)
- Triglycerides
- Fasting Blood Glucose (FBG)
- Hemoglobin A1c (HbA1c)



Like the woman in our story who needed to manage her finances, you need to learn:

- Which tests you have regularly
- What each test measures
- Why these are important to you
- What happens to you when the results are out of range

This information is a tool to help you manage your overall health. Just as the woman in the story got help to make sense of her finances, we will help you through it—one step at a time.

Have you ever tried to read your lab results? If so, you know it can look pretty complicated. You might be surprised to learn that making sense of your lab results is easier than it might seem at first. We'll take each lab test and tell you just the basics, so we don't overwhelm you with too much information. By the end of this module, you'll be

able to read your next lab report with more confidence and know more about what it means for you.

So, let's get started!

Anemia Family

Anemia is a shortage of oxygen-carrying red blood cells. Anemia can make you feel cold, weak, and so tired that it is hard to carry out day-to-day activities. Testing your blood for anemia is the first step to getting treatment so you can have more energy and feel better.

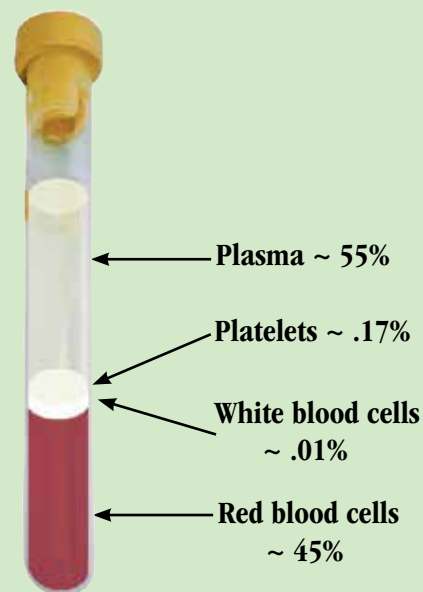
We'll start out with a very common test. The **complete blood count** (CBC) looks at your blood cells themselves.

The CBC measures your red and white blood cells, and many other cells. Although the CBC includes about 10 tests, we will only cover the two most important ones that relate to kidney disease.

What's in Blood, Anyway?

Because your blood has the vital job of carrying oxygen and other nutrients to every cell in your body, it has many parts. Here are just a few:

- **Red blood cells** – carry oxygen
- **White blood cells** – fight disease
- **Platelets** – help the blood to clot
- **Plasma** – straw-colored fluid that other blood cells float in
- **Serum** – fluid that remains after blood has clotted in a test tube
- **Whole blood** – all of the above





These are:

- Hemoglobin (Hgb or Hb)
- Hematocrit (Hct)

Let's look at how they are similar and different.

Hemoglobin

With each beat of your heart, your red blood cells carry vital oxygen to all your organs and tissues. **Hemoglobin** (Hgb or Hb) is the oxygen-carrying protein that gives your blood its red color. When hemoglobin levels are normal, your body is getting the oxygen it needs.

Hematocrit

Hematocrit (Hct) measures the percent of your blood that is made up of red blood cells. The higher the percent of healthy red blood cells, the more oxygen your body has to use.

Hemoglobin and hematocrit may both be checked, but Hgb is more often used for those on dialysis. Why? Because the Hct level can change based on how much water is in your blood, while the Hgb level will be stable. Since dialysis removes water from the blood, it's better to check a level that won't change.

Anemia is very common in people with kidney disease. It is very important to find anemia as soon as possible, so it can be treated.

Hemoglobin and hematocrit are also used to see how well anemia treatment is working and if anemia drug doses need to be changed.

But, you might wonder, "How do I know when my lab values are not normal?" This is a good question and one that applies to every test we talk about. We'll try to answer it in a way that will make it easy for you.

How Do I Know if I Have Anemia?

Anemia has many effects on the body, which can include:

- Fatigue/loss of energy
- Feeling cold all the time
- Shortness of breath/chest pain
- Pale skin, gums, and fingernail beds
- Trouble concentrating
- Dizziness/lightheadedness
- Headaches
- Changes in menstrual cycles (women)
- Difficulty with erections (men)
- Slower than usual growth (children)

If you have any of these symptoms, be sure to tell your doctor! Anemia may also reduce your ability to fight infections.

To learn more about anemia and what you can do about it, see Module 6—*Anemia and Kidney Disease*.

Each test has a target range. When your lab results come back with a number in the target range, it means your body is in balance in that area—not too much or too little. And that's just what you want.

Different tests have different measures. Some tests measure in grams per deciliter (g/dL), some in percents, and some use other standards. Let's use hemoglobin and hematocrit as examples.



The range for hemoglobin is:

- 14 to 18 g/dL for healthy men
- 12 to 16 g/dL for healthy women
- 10 to 12 g/dL for men and women on dialysis

The range for hematocrit is:

- 40% to 50% for healthy men
- 36% to 44% for healthy women
- 33% to 36% for men and women on dialysis

Since Medicare pays for most dialysis, they set the target levels of Hgb and Hct for people on dialysis. Studies continue to look at what levels of Hgb and Hct are healthiest for people on dialysis.

At the end of this module is a chart with all of the information you need—including target ranges. When you get your next lab test results, you can compare them to the chart. Each lab is a little different, though, so the target ranges for your tests might not quite match the chart. Ask your doctor or nurse if you have any questions.

We'll tell you about the tests in “families” to make them easier to remember. We'll think of this first set of tests as members of the anemia family.

Next, we move on to two other members of the anemia family—tests that begin to tell you if there is enough iron in your blood. If you read Module 6 on anemia, you already know the two tests that measure levels of iron in your blood are:

- Ferritin
- Transferrin saturation (TSAT)

If you didn't, don't worry, we'll explain them.



Why Are Ferritin and TSAT Levels Different in Dialysis Patients?

Iron deficiency is very common in people on dialysis. In fact, as many as half of people on dialysis may not have enough iron to make healthy red blood cells! Ferritin and TSAT are the best two tests of how much iron is in the body.

Clinical practice guidelines for the care of people with kidney disease—the *Kidney Disease Outcomes and Quality Initiative* (KDOQI™)

guidelines—say that people on dialysis should have a ferritin level of at least 100 ng/mL. The guideline for TSAT sets a level of greater than 20%.

Because people on dialysis have constant, small blood (iron) losses, there is very little chance that they could become overloaded with iron. For this reason, their levels of stored iron can safely be higher.





Ferritin and transferrin saturation

Iron is a key building block your body needs to make red blood cells. Hemoglobin contains iron. Your body absorbs some iron from foods you eat. But most of the iron used to make new red blood cells comes from...old, broken-down red blood cells.

If you have anemia, you have fewer red blood cells—and fewer building blocks to make more.

Ferritin measures how much iron is stored in your body. **Transferrin saturation (TSAT)** measures how much of your stored iron can be used to make new red blood cells. What does this all mean?

When your ferritin or TSAT levels are too low, your doctor may prescribe iron supplements. Extra iron will help you to have enough building blocks to make new red blood cells.

Some anemia drugs work by telling your body to make more red blood cells. These drugs are called *erythropoiesis stimulating agents*, or ESAs. They include EPOGEN® (Epoetin alfa), Aranesp® (darbepoetin alfa), and PROCRIIT® (Epoetin alfa). But they can't work properly if you don't have enough iron.

Electrolyte Family

Now we turn to another family: the electrolytes.

What's an electrolyte? To understand, it helps to think of your muscles as power tools and your nerves as electrical cords. Electrolytes are the electricity—minerals in your blood that carry an electrical charge. They allow your nerves to power up your muscles. Without the right amount of electrolytes, you could have a short circuit.

One job of healthy kidneys is to keep electrolytes in balance in your body. When the kidneys fail, it's vital to check the level of electrolytes in your blood. If they are out of balance, big problems can occur.

Four electrolyte tests are most important for people with kidney disease to know:

- Calcium
- Phosphorus
- Potassium
- Sodium



EPOGEN®? Aranesp®? PROCRIIT®? What Do They Do?

One of the jobs of healthy kidneys is to make a hormone called *erythropoietin* (EPO). EPO signals your bone marrow to make red blood cells. When kidneys fail, EPO levels fall—and anemia is the result. Before 1989, people with kidney failure needed blood transfusions to temporarily give them enough red blood cells so they could function.

In 1989, EPOGEN®, the first synthetic erythropoiesis stimulating agent or ESA, was made by Amgen Inc. (EPOGEN is also marketed as PROCRIIT® by Ortho Biotech and is used by people with kidney disease who are not on dialysis). Now, instead of needing blood transfusions, people get weekly injections and grow their own red blood cells, just as they used to.

In 2001, Amgen introduced Aranesp®, which also tells the body to make more red blood cells. It lasts three times longer, so fewer injections are needed. Other drugs to stimulate red blood cell production are being tested.



Hyper and Hypo

Some medical terms are hard to remember. Others are easier because they relate to things that you have probably heard of before. Luckily, hyper and hypo are some of the easy ones.

Hyper means *above, or more than the usual level*. You may have heard of hypertension (high blood pressure) or hyperactive (higher than the usual activity level).

Hypo means *below, or less than the usual level*. You may have heard of hypodermic (a needle that goes below the skin), or hypothermia (below normal body temperature).

Calcium

Calcium (Ca^{2+}) is a mineral you need for muscle action and healthy bones. You absorb it from dairy products, calcium supplements, and green, leafy vegetables.

Your bones and teeth are a storage locker for almost all the calcium in your body. Normally, just a little bit of calcium is taken out of storage and moved into your bloodstream at any one time.

Too much calcium in your blood, **hypercalcemia**, can make you feel sick to your stomach, confused, irritable—even send you into a coma! Too little calcium, **hypocalcemia**, can cause depression, numbness, seizures, confusion, or painful muscle spasms. In the long run, hypocalcemia can damage your bones. (See Module 16—*Long-term Effects of Dialysis* to learn more.)

Phosphorus

Phosphorus (P) is a mineral that is vital to energy use in your body. Fortunately, there is plenty of it around for your body to use—phosphorus is found in almost all foods. Phosphorus is measured in your blood as **phosphate** (PO_4^{3-}).

Like calcium, phosphorus is stored in your bones and teeth. Just a little bit is let out into your bloodstream. When the kidneys fail, phosphate levels usually go up, which can be bad news. (The good news is, medications and diet changes can help.)

Too much phosphate in your blood, **hyperphosphatemia**, can make you *itch all over*, and can damage your bones. Too little phosphate, **hypophosphatemia**, can cause muscle weakness and coma, but this is very rare.

Like magnets, calcium and phosphorus are attracted to each other. In fact, they join together into crystals that form a strong structure for your bones. **Phosphate binders** lock onto extra phosphorus and remove it safely in your stool. Binders are sometimes antacids, like Tums®, or can be special drugs just for this purpose, like Renagel®, Renvela®, PhosLo®, Fosrenol®, or many others.





Why is this important? The balance of calcium and phosphorus in your body starts to change early in kidney disease. Instead of neatly forming into bone, extra phosphorus and calcium float around in your bloodstream. Having too much phosphorus tells your body to pull calcium out of storage. This can weaken your bones and lead to fractures.

Even worse, if you have too much calcium and phosphorus in your blood, sharp crystals of calcium phosphate can form. These painful crystals damage blood vessels and other tissues. They can lead to loss of a limb—or even death. This very rare condition is called *extraskkeletal* or *metastatic calcification*. It is hard to treat, although sometimes special hyperbaric oxygen chambers are used.

Taking phosphate binders with food (lots of binders with a big meal, fewer binders with a small meal or snack) can help you keep your bones healthy.

Doing daily home hemodialysis (HD), 2.5 to 3 hours, 5 to 7 days per week, or nocturnal HD (8-hour treatments, 3 to 6 nights per week while you sleep) removes *much* more phosphorus than standard in-center HD does. In fact, most people who do nocturnal HD can stop taking phosphate binders—and may even have to *add* phosphate to their dialysate fluid. In the short term, getting more HD also means having a much more normal diet. In the long term, it can mean a better chance of avoiding renal bone disease.



Potassium

Potassium (K^+) is an electrolyte that allows your nerves and muscles to work—including your heart. It is the most plentiful ion *inside* your cells. Healthy kidneys control blood potassium levels. Having the right level is vital, because just a little too much or too little can cause sudden death.

Potassium is found in many fruits and vegetables, like oranges and bananas. When the kidneys fail, careful meal planning can help you keep safe potassium levels. You can learn more about meal planning in Module 9—*Nutrition and Fluids for People with Kidney Failure*.

Too much potassium in your blood, **hyperkalemia**, can make your muscles very weak and stop your heart. Too little potassium, **hypokalemia**, can cause fatigue, muscle weakness, paralysis, and abnormal heart rhythms.

Sodium

Our last member of the electrolyte family, **sodium** (Na^+), is important for your body's balance of fluid and water. It is the most plentiful ion *outside* your cells. Without the right balance, your muscles won't work properly. And without the right balance, your blood will be too thick or too thin, because it will have too much water, or not enough.

Salt is a form of sodium you've probably heard of. Healthy kidneys remove extra sodium in the urine. Most people with kidney disease need to limit their salt intake.



Too much sodium in your blood, **hypernatremia**, can make you very thirsty, raise your blood pressure, and give you headaches. Most often, if this happened you would retain water. It can also make your tissues swell up with fluid, a problem called *edema* (eh-dee'-ma). Too little sodium, **hyponatremia**, can cause bursting of red blood cells, low blood pressure and feeling faint, muscle cramps, headaches, nausea and vomiting, seizures, and even coma.

Electrolyte results outside your target range can usually be helped through food and fluid changes. Your dietitian can help you learn which foods to eat in moderation and which ones you can enjoy more often.

Kidney Function Family

The next three tests tell you how clean your blood is by measuring waste products that healthy kidneys remove. We'll call them the kidney function family. They are:

- Blood urea nitrogen (BUN)
- Creatinine
- Glomerular filtration rate (GFR)

Blood urea nitrogen

Let's start with BUN. To understand **blood urea nitrogen** (BUN), you need to know what urea is.

When your cells break down or you eat protein—meats, fish, eggs, etc.—your blood carries some of it to your cells. After the cells use the protein, what's left over is a waste called *urea* (which contains nitrogen). Healthy kidneys get rid of urea in the urine. When the kidneys fail, urea stays in the blood.

The BUN test measures the amount of urea in your blood. The results can be used to help your doctor know how well your kidneys are cleaning

How Often Are These Tests Done?

If you are on dialysis, your BUN and creatinine will be checked monthly. If you have chronic kidney disease, your doctor will decide how often your blood should be checked. Usually, blood tests are done more often as kidney function drops. Since creatinine is used to calculate GFR, GFR can be done any time this value is available.

your blood. In people on dialysis, the BUN is used to calculate how much dialysis you are getting.

Creatinine

Creatinine (cree-at'-uh-nin) is another waste product. It comes from the normal use of muscles during activity—so people with bigger muscles make more creatinine. Like BUN, creatinine is removed by healthy kidneys. When the kidneys don't work, creatinine builds up in the blood. Creatinine doesn't change with diet.

The creatinine test is a measure of how well the kidneys are working. It is a more sensitive measure of kidney disease than BUN—but it doesn't account for differences in weight, gender, or race.





Glomerular filtration rate

Strictly speaking, **glomerular filtration rate** (GFR) isn't really a lab test. It's an estimate of how well your kidneys work based on your gender, race, and serum creatinine. GFR is a measure of how well your kidneys are filtering.

KDOQI clinical practice guidelines for the care of people with chronic kidney disease say that GFR is the best measure of kidney function. To learn your GFR, visit www.kidneytrust.org/learn/calculate-kidney-function/. You can plug in your numbers and learn what your GFR is. To use the GFR calculator, enter your serum creatinine, age, race, and gender. Click "Calculate" to see the result.

Dialysis Adequacy Family

The last group of tests measured kidney function. If the kidneys fail, there are also tests to measure the dose of dialysis. The next two tests we'll talk about are only for people who are on dialysis. Here's a quick true/false statement for you:

Everyone on dialysis gets the same amount of treatment. True False

If you said false, you're right! Dialysis is prescribed by a doctor, just like medicine. The prescription depends on body weight, amount of wastes to be removed, and other factors. If you want to learn more about how to get enough dialysis to feel your best, read Module 10—*Getting Adequate Dialysis*.

Remember the blood urea nitrogen (BUN) test? It measures the amount of urea in your blood. In people on HD, the BUN is used to tell if the minimum dose of dialysis is being given. This is called **hemodialysis adequacy**.

Wait! What About Transplant Lab Tests?

Good question! In general, serum creatinine levels are very important to measure the function of the new, transplanted kidney. And tests to measure the levels of transplant medications in the blood are also done routinely. Ask your transplant team to explain your lab tests and how to interpret them—this is a key part of being involved in your care.

Urea reduction ratio

How? It's actually pretty simple. Once a month, BUN level is measured before an HD treatment. It's measured again after the treatment. Then the two levels are compared. This is called the **urea reduction ratio** (URR). This number tells you if you got the minimum dose of dialysis—for this one treatment only.

If you are on standard in-center HD and your clinic uses URR, your level should be *at least* 65% or higher. Higher is better, because more dialysis is better!

What's the Formula for URR?

In case you want to figure out your own URR, the formula is:

$$\frac{\text{Predialysis BUN} - \text{Postdialysis BUN}}{\text{Predialysis BUN}} \times 100$$

For example:

$$\frac{96 - 31}{96} \times 100 = 67.7\%$$



Kt/V

URR is easy to calculate. But it doesn't take body weight into account—or the time needed to remove fluid during HD. Another measure of HD adequacy called **Kt/V** (kay-tee-over-vee) does both:

K = dialyzer clearance in mL/min

t = length of the dialysis treatment in minutes (time)

V = volume of water in the body that contains urea

To figure out your Kt/V, a BUN level and weight are checked before and after a treatment. The results are put into a formula.

On standard in-center HD, your level should be at least 1.2 or higher. Your minimum prescribed dose should be at least 1.3. Again, higher is better, because more dialysis is better!

If you use peritoneal dialysis (PD), a form of Kt/V is used to measure your PD dose. Instead of looking at just one treatment, a *weekly* Kt/V is calculated, because PD is done continuously. Your PD should give you a weekly Kt/V of at least 2.0.

Bone Disease Family

Our next two tests measure the risk of developing renal bone disease.

Parathyroid hormone

The first is called parathyroid hormone (PTH). Your parathyroids are four tiny glands in your neck. Their job is to make PTH when your calcium levels fall. PTH helps you absorb calcium from what you eat and drink. High phosphate levels lead to high PTH.



Levels of intact PTH (iPTH) are measured, because high levels mean your glands may be getting bigger and making too much PTH. Your body tries to shut off the glands by pulling calcium out of your bones. If this goes on too long, your bones can become frail and may break easily.

Calcium-phosphorus product

Calcium-phosphorus product (Ca x P) is not really a test. It's a number that is calculated by multiplying your serum calcium level by your serum phosphorus level. For example, if your calcium is 9.0 and your phosphorus is 6.5, your calcium-phosphorus product would be 58.5. Doctors keep track of this number because it is a good way to measure your risk of developing calcium phosphate crystals. These sharp crystals can form in soft tissues and joints, causing tissue damage, loss of limbs, and even death. This problem is very rare, but more likely in people who have diabetes.

Urine Test Family

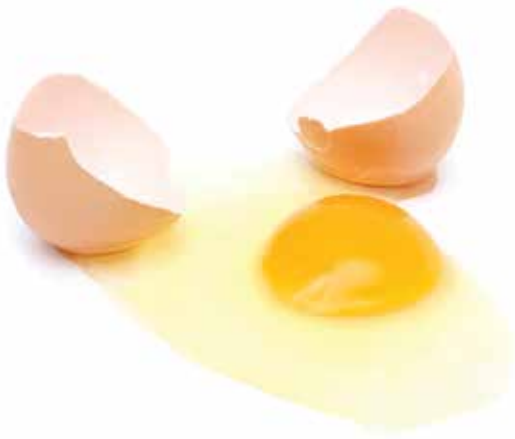
Our next five lab tests also measure wastes, but they do it using a urine sample instead of a blood sample. For this reason, they are more likely to be done in people whose failing kidneys have reached CKD stage 4 or early stage 5, but do not need dialysis yet. (People with kidney failure usually make little or no urine.)





We'll call these lab tests the urine test family. They are:

- Urine blood or urine hemoglobin (Heme)
- Creatinine clearance
- Urine albumin
- Microalbuminuria
- Albumin-to-creatinine ratio



Urine hemoglobin

Urine hemoglobin is a test to see if there is blood or hemoglobin in the urine. There should not be any blood in the urine, so finding blood can mean damage to the kidneys or urinary tract. Heavy smoking, jogging, bladder infections, and other causes can lead to blood in the urine, too.

Creatinine clearance

A **creatinine clearance** test shows how fast your kidneys remove creatinine from your blood.

To measure creatinine clearance you must collect urine for a 24-hour period. All of your urine is saved in a special container.

When you take the urine container to the lab, they will take a blood sample. Having both a urine and a blood sample lets your doctor compare how

What Is Creatinine Again?

Creatinine is a waste product in the blood. It comes from the normal breakdown of muscle during activity. Creatinine is created all the time and is removed in the urine by healthy kidneys.

much creatinine your body is making—and how much your kidneys are removing.

The creatinine clearance test gives your doctor a good measure of how well your kidneys are working.

Albumin

Albumin is a kind of protein that can be measured in the urine. (Egg whites are one type of albumin.) The test for albumin, or urine protein, measures how much protein passes through the kidneys and into the urine. Protein is a big molecule—too big to fit through the tiny blood vessels in healthy kidneys.

This means that finding protein in the urine is a sign that the kidneys are damaged. The tiny blood vessels are “leaky” and big protein molecules are slipping through.

Protein in the urine is a very important sign of kidney disease. A dipstick is usually used to measure protein.

Microalbuminuria

Studies of people with diabetes show that kidney disease starts slowly, even before protein can be found in the urine with a dipstick.

Microalbuminuria means very tiny amounts of protein. It is a very sensitive measure of protein in the urine.



The good news is, when microalbuminuria is found, it can be treated with any one of several classes of blood pressure drugs. Using these drugs can slow down the rate of kidney disease, sometimes for years. ***Each person with diabetes should have a microalbuminuria test at least once a year.*** This test can be done on a single urine sample or a 24-hour urine collection.

Albumin-to-creatinine ratio

There is another way to measure whether there is too much protein in your urine. You give one sample of urine in a cup, and it is tested for both protein and creatinine together. Looking at this ratio is more convenient than having you do a 24-hour urine collection. And it is accurate, even if you have had more or less fluid to drink.

General Health Test Family

We're down to our last few tests! Some of these may be familiar to you. We include them here because they are important for anyone who wants to maintain their health, especially those with kidney disease. We'll call them the general health test family. They are:

- Serum albumin
- Cholesterol
- Triglycerides
- Fasting blood glucose (FBG)
- Hemoglobin A1c (HbA1c)

Serum albumin

Remember protein (albumin) in the urine? That was a not-so-good thing. But the levels of albumin you have in your *blood* are very important.

Why? Because your **serum albumin**—the amount of protein in the fluid part of your blood—measures your overall nutrition. When your kidneys are failing, you may notice that you don't want to eat meat or other protein foods. Over time, this can lead to malnutrition.

Malnutrition is a risk factor for death in people who are on dialysis, so it's important to stay healthy and eat well! People who start dialysis with higher albumin levels do better down the road. Your level should be greater than 4.0 g/dL.



Cholesterol and triglycerides

Cholesterol and triglycerides are measures of fat in the blood.

Cholesterol is a soft, waxy fat in your blood that is used for many body processes. Cholesterol insulates your nerve cells, helps form the membrane around every cell in your body, and helps with hormone production.

A test for cholesterol measures the amount of these fats in your blood. Most labs measure total cholesterol and two types of cholesterol: high density lipoprotein (HDL) and low density lipoprotein (LDL).

HDL is “good” cholesterol, because high levels in your blood seem to protect against heart attack.





LDL is “bad” cholesterol, because high levels increase the risk of heart attack. And people with kidney disease are already at higher risk for heart disease.

Triglycerides make up about 95% of all the fat in our diets and in our bodies. This test measures the risk of heart disease and the body’s ability to use fat effectively. High levels of triglycerides can mean a higher risk of heart attacks. Some diseases, like diabetes, raise triglyceride levels.

Both cholesterol and triglycerides are measured after an overnight food and alcohol fast.



Fasting blood glucose and hemoglobin A1c

The final two tests are **fasting blood glucose** (FBG) and **hemoglobin A1c** (HbA1c). FBG is a measure of how much glucose (sugar) is in the blood. High levels of blood sugar after an overnight fast could mean that you have diabetes. Type 2 diabetes is the number one cause of kidney failure. For people with diabetes, the HbA1c test is a measure of average glucose levels over the past 2 to 3 months. The test should be done every 3 to 6 months. HbA1c levels should be below 7% to avoid long-term problems of diabetes.

But What About a Low Protein Diet?

If you have chronic kidney disease, your doctor may suggest a low protein diet. Some doctors believe that eating less protein may help the kidneys work a little longer.

But doctors do not all agree that a low protein diet will help the kidneys. There is good evidence that malnutrition is harmful and leads to early death. So eating less protein needs to be balanced with staying healthy. If your doctor suggests a low protein diet, ask for a referral to a renal dietitian, who can help you design a meal plan that will keep you healthy.

Once people begin dialysis, they may need *extra* protein. Dialysis—especially PD—removes some protein, so it is important to eat enough protein to avoid malnutrition.

Conclusion

You made it! We covered a lot of ground in this module. If you don’t remember many of the details, don’t worry. Our main goal was to expose you to these important tests. Let’s briefly cover how you can use this knowledge about lab results.

- 1 Your Personal Plan has charts that list all the tests we’ve covered, what each one measures, the target range, and room for you to write down your lab results for each test. Take the charts with you when you go over your lab results with a member from your health care team. Ask your doctor and dietitian to look over the Personal Plan to see if they would make any adjustments to the target range listed for each



test. Your doctor may have good reasons for giving you another target range.

- 2 Compare your lab scores with the target ranges for each test. Write your scores in the charts in your Personal Plan. This will allow you to see your progress over time.
- 3 Ask your doctor, nurse, or dietitian questions about any score that is outside the target range. For instance:
 - What might be causing my score to be out of the target range?
 - What can be done to bring it back into the target range?
 - How can I help improve this score?

This approach will help you to work closely with your health care team toward the goal of staying as healthy as you can. The more you watch your lab tests, the easier it will be to spot a problem. Never be afraid to ask your doctor, nurse, or dietitian any question that relates to your lab results. You have a right to know. It's your body and you are the main person responsible for your health.

It's time to wrap up this module on understanding kidney lab tests. 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 _____

Understanding Kidney Lab Tests

My goal:

To know the name of each lab test, what it measures, and why it's important to my health.

My incentive:

To manage my kidney disease so I can enjoy the highest possible quality of life and to be able to read my lab reports with more confidence.

I will use this Personal Plan lab test reference guide by:

- Asking my doctor, nurse, and dietitian to review the target range for each test to make sure that it is right for my needs.
- Asking someone from my health care team to review the results of each lab test with me.
- Writing down the results of each lab test so that I can see my progress over time.

- Asking questions I might have about any score outside my target range, such as:

- What might be causing my score to be out of the target range?
- What can be done to bring it back into the target range?
- Are there any specific things I can do to help improve this score?

By taking an active role in monitoring my lab results, I will be able to manage my kidney disease more effectively.

The following four pages show the lab test family charts from this module. I can write down my lab test results and take the charts with me when I meet with a member of my health care team.



Module 7 – Understanding Kidney Lab Tests

Anemia Family: Tells me if I have enough healthy red blood cells and iron to feel my best		
Name of Test	Target Range	Record Tests
Hemoglobin (Hgb or Hb)	<ul style="list-style-type: none"> • 14 to 18 g/dL: healthy men • 12 to 16 g/dL: healthy women • 10 to 12 g/dL: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Hematocrit (Hct)	<ul style="list-style-type: none"> • 40% to 50%: healthy men • 36% to 44%: healthy women • 33% to 36%: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Ferritin	<ul style="list-style-type: none"> • 12 to 300 ng/mL: healthy men • 12 to 150 ng/mL: healthy women • 100 to 500 ng/mL: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Transferrin saturation (TSAT)	<ul style="list-style-type: none"> • 20% to 50%: healthy people and those on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____

Electrolyte Family: Helps my muscles and nerves work properly Be aware of limits set at your center—they may be different!		
Name of Test	Target Range	Record Tests
Calcium (Ca²⁺)	<ul style="list-style-type: none"> • 8.6 to 10 mg/dL: healthy people • 8.4 to 10 mg/dL: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Phosphorus (P)	<ul style="list-style-type: none"> • 2.5 to 4.5 mg/dL: healthy people • 3.5 to 5.5 mg/dL: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Potassium (K⁺)	<ul style="list-style-type: none"> • 3.5 to 5.3 mEq/L: healthy adults • Less than 6.0 mEq/L: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Sodium (Na⁺)	<ul style="list-style-type: none"> • 135 to 145 mEq/L: healthy people and people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____





Kidney Function Family: Measures how well my kidneys are working		
Name of Test	Target Range	Record Tests
Blood urea nitrogen (BUN)	<ul style="list-style-type: none"> • 5 to 25 mg/dL: healthy adults • 60 to 80 mg/dL: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Creatinine	<ul style="list-style-type: none"> • 0.5 to 1.5 mg/dL: healthy men • 0.5 to 1.3 mg/dL: healthy women • 10 to 18 mg/dL: people on dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Glomerular filtration rate (GFR)	<ul style="list-style-type: none"> • Normal: 90+ • Kidney failure: Less than 15 KDOQI™ Clinical Practice Guidelines have listed five <i>Stages of Chronic Kidney Disease</i> according to GFR: Stage 1: ≥90 Stage 2: 60-89 Stage 3: 30-59 Stage 4: 15-29 Stage 5: <15 (dialysis or transplant) *GFR is reported in mL/min/1.73 m ²	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____

Dialysis Adequacy Family: Measures how well dialysis is working		
Name of Test	Target Range	Record Tests
Urea reduction ratio (URR)	<ul style="list-style-type: none"> • <i>At least</i> 65% or higher 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Kt/V	<ul style="list-style-type: none"> • <i>At least</i> 1.2 for hemodialysis • <i>At least</i> 2.0 for peritoneal dialysis 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____



Module 7 – Understanding Kidney Lab Tests

Bone Disease Family: Measures risk of renal bone disease		
Name of Test	Target Range	Record Tests
Intact parathyroid hormone (iPTH)	<ul style="list-style-type: none"> • 16 to 65 pg/mL: healthy people • 35 to 70 pg/mL: Stage 3 CKD • 70 to 110 pg/mL: Stage 4 CKD • 150 to 300 pg/mL: Stage 5 CKD 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Calcium-phosphorus product (Ca x P)	<ul style="list-style-type: none"> • Less than 55 in people with kidney disease over age 12; less than 65 in those 12 and under 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____

Urine Test Family: Measures the presence of protein and wastes in my urine		
Name of Test	Target Range	Record Tests
Urine hemoglobin (Heme)	None	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Creatinine clearance	<ul style="list-style-type: none"> • Men: 97 to 137 mL/min/1.73 m² • Women: 88 to 128 mL/min/1.73 m² 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Urine albumin	<ul style="list-style-type: none"> • 10 to 140 mg/L, or less than 30 mg/L in 24 hours 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Micro-albuminuria	<ul style="list-style-type: none"> • Less than 12mg/L 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Albumin-to-creatinine ratio	<ul style="list-style-type: none"> • Normal: <17 mg/g (men) <25 mg/g (women) • Microalbuminuria: 17 to 250 mg/g (men) 25 to 355 mg/g (women) • Albuminuria: >250 mg/g (men) >355 mg/g (women) 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____





General Health Test Family: Measures my risk of heart disease and diabetes		
Name of Test	Target Range	Record Tests
Serum albumin	Good: >4.0 g/dL	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Total cholesterol	Good: 150 to 199 mg/dL Borderline high: 200 to 239 mg/dL High: 240 mg/dL or more	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
High density lipoprotein (HDL)	Good: 60 mg/dL or more Higher risk of heart disease if: <40 mg/dL (men) <50 mg/dL (women)	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Low density lipoprotein (LDL)	Good: <139 mg/dL Borderline high: 140 to 159 mg/dL High: 160 mg/dL or more	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Triglycerides	<ul style="list-style-type: none"> • Female: 35 to 135 mg/dL • Male: 40 to 160 mg/dL 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Fasting blood glucose (FBG)	<ul style="list-style-type: none"> • Normal: <100 mg/dL • Prediabetes: 100 to 125 mg/dL • Diabetes: 126 mg/dL or more 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____
Hemoglobin A1c (HbA1c)	<ul style="list-style-type: none"> • <7% (American Diabetes Assoc.) • <6.5% (American College of Endocrinology) 	Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____ Date: _____ Level: _____



Take the Kidney Quiz!

You'll see how much you're learning if you take our quick kidney quiz. It's just 9 questions. How about it? (Answers are on page 7-2.)

- Hematocrit measures the _____ of red blood cells in the blood.**
 - Texture
 - Percent
 - Color
 - Length
- Ferritin measures the amount of _____ stored in the body.**
 - Tin
 - Calories
 - Phosphorus
 - Iron
- You can think of electrolytes as:**
 - Special light bulbs used to examine blood samples
 - "Glow-in-the dark" blood cells
 - Electrical signals
 - Vitamin supplements for people with kidney disease
- Which of the following is *not* an electrolyte?**
 - Calcium
 - Potassium
 - Creatinine
 - Phosphorus
- In medical terms, the word "hyper" means:**
 - On the left side of the body
 - Above or more than the usual level
 - A dark color
 - A test done weekly
- The waste product that results from normal use of muscle during activity is:**
 - Creatinine
 - Blood urea nitrogen (BUN)
 - Liver enzymes
 - Transferrin saturation (TSAT)
- According to medical guidelines for the care of people with kidney disease, the best test to measure kidney function is the:**
 - Renal ultrasound
 - Hemoglobin
 - Cholesterol
 - Glomerular filtration rate (GFR)
- The creatinine clearance test requires a urine sample to be collected over a _____ period.**
 - 5-minute
 - 3-week
 - 12-day
 - 24-hour
- Protein (albumin or microalbuminuria) in the urine can be a sign of:**
 - A diet with a lot of protein in it
 - Damage to the kidney's filtering units
 - Strong, healthy muscles
 - Not drinking enough water





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.

Books:

1 *The Patient's Guide to Medical Tests: Everything You Need to Know About the Tests Your Doctor Orders*, by Joseph C. Segen, MD and Josie Wade, RN

(Amazon Remainders Account, May 2002, ISBN-10: 0816046514)

This guide lists 1,000-plus commonly used medical tests in alphabetical order. Entries describe each test, preparation, procedures used, the range of values for those free of the disease, symptoms seen with abnormal values, costs, cautions to be used in reading the results, and possible risks.

2 *The Yale University School of Medicine Patient's Guide to Medical Tests*,

by Barry L. Zaret, MD (Editor), Peter Jatlow, MD (Editor), and Lee D. Katz, MD

(Houghton Mifflin, July 1997, ISBN-13: 978-0395765364)

A complete book on diagnostic tests that answers questions patients are often afraid to ask, such as: Will it hurt? How long will it take? Who will be in charge? Are there any risks? What do the results mean? What's the next step? Hundreds of tests are described in clear language and presented in easy-to-follow charts. You'll also learn what you should and should not do before the test and what factors may alter the results. This book covers tests you can do at home, as well as tests ordered by doctors.

Other material:

- 1** *Quick Facts: Medical Tests of Kidney Function*, 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 www.niddk.nih.gov.