

# Division of Diabetes Treatment and Prevention

## Advancements in Diabetes Seminar What the Diabetes Team Needs to Know About ESRD

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Andrew Narva:

Well, thank you. I'm really delighted to have this opportunity to speak. I am a nephrologist. I worked for Indian Health Service for 25 years and then about 10 years ago was recruited to work at a job here at the NIH. But my identity is, as an IHS doc and always will be and everything I know is what I learned from my patients and from my colleagues in Indian Health. So I actually still see patients by telemedicine at Indian Health. I have a clinic at Zuni and we just actually published yesterday our experience with about 2,000 patient visits and if you're interested to see that, just send me an email and I'll be glad to send you a copy of that article.

So what we're going to talk about today is end-stage renal disease and this is a little different from the talks that I've given in the past for Advancements. Before I proceed though, I need to tell you that I am a member of the American Board of Internal Medicine, Sub-Specialty Board in Nephrology and in the event that any of you listening are planning on taking the qualifying exam, I have to tell you that I am not going to reveal any of the questions or the answers on that exam.

So we are really going to talk about kidney failure today and although the first objective talked about -- stated that I was going to talk about the lab tests to evaluate and follow up people with kidney disease, I'm really not going to do that very much. We talked about that quite a bit in the last Advancements talk and that's still I think available. We're talking about kidney failure which occurs when the kidney function is less than about 15% or the estimated GFR is less than 15 milliliters per minute. And at that point, the kidneys really can't maintain the internal environment very well, that's known as homeostasis and often times, kidney failure is associated with fluid, electrolyte and hormonal imbalances, as well as metabolic abnormalities like hyperkalemia and acidosis. Kidney failure is not the same as end-stage renal disease. End-stage renal disease is actually an administrative term that was developed by Medicare to describe people on dialysis or with a kidney transplant. So you can have kidney failure and not be on dialysis and many of our patients can do okay with very little kidney function. Every end-stage renal disease patient has kidney failure.

But before we move into that, you know what Indian Health Service is mostly about and what all of you are committed to, is keeping people from reaching the point where they have kidney failure and where they need dialysis. That's the focus of everything that we do. And as Jan mentioned, last month CDC published a Vital Signs issue that really detailed the work that you have all done, the results of that which is a decrease in the rates of kidney failure due to diabetes among American Indians. And if you look at this black line here, which 20 years ago was the highest; the rate of ESRD due to diabetes among American Indians was the highest of any group. And over the past 20 years, it is decreased, so that it's quite close to the rate for Caucasians. And I think this reflects the efforts of Indian Health Service mostly as implemented by the Diabetes Program to implement excellent care or best care in a systematic coherent way, which has had a significant effect over time. So this is the work you're all focused on, and this is the mission, and you seem to be accomplishing it. So congratulations.

However, people do reach the point where they have kidney failure. And coping with that and adjusting to it is quite challenging. There are a number of problems that confront diabetes professionals, and the first one is that most patients have no signs or symptoms until kidney disease is very advanced. And what that means is, is that you may be in the position of trying to explain to a patient that they have kidney failure or they have kidney disease or that they need to start preparing for dialysis at a time where they don't actually feel bad. And because this is scary news and because understanding dialysis and transplant is complicated, they may not take the news well. And

they may not be happy with you. But I think it's still very important to do that and especially it's true because these issues need to be brought up well in advance of the time that people need to make decisions about their treatment.

Other issues, it's like any other chronic state, it's very hard. It takes a long time to accept it and as well, the fear associated with kidney failure and dialysis really is a barrier to helping people with kidney disease and diabetes understand what their status is and what their choices are. And it's also complicated by the fear that many healthcare providers, dietitians, pharmacists, physicians, everybody has about kidney disease. Many patients actually almost have to go through a grieving process, grieving for their kidneys which are now, despite their best efforts, not surviving. So in the United States, most people are not well-prepared for kidney failure. And as a result, most people don't meet a nephrologist until very late in the course of their disease, and most healthcare professionals in the primary care setting are not comfortable talking about kidney failure.

So it's been shown that if people have some information earlier in the course of their disease and they have a chance to learn about it, they do much, much better. Early depends not only on just the level of kidney function, but also how quickly it's dropping. We have older people who maybe had eGFR of 30 four years ago and now it's 25. And for someone like that, it maybe more likely that they'll die from something else before they reach the point where they'll need dialysis. But for middle-aged people who are losing 5% or 10% of their kidney function per year, it's likely that they will reach that point. And early can be -- whenever it occurs to you, you can mention it to people I think. Certainly people who don't have any information end up not having much choice at all, and the worst case is for someone to start dialysis as an emergency with a catheter stuck in their neck and without any chance to sort of prepare themselves. Unfortunately in the United States, 80% of people starting dialysis, start with a catheter in their neck. That's in the total U.S. population, but that includes the majority of people who are actually followed by a nephrologist, which may convey some of the problems that nephrologists actually have in communicating with patients as well.

When you approach patients with kidney disease that you're managing over a long period of time, there are key goals which are listed there, but the two bottom ones are absolutely critical and we often ignore those. One is to educate the patient about their kidney disease, and then the other one is to begin the preparation for kidney failure.

So if you're following someone who is 50 years old and looks like they're going to survive for several more years and who's losing kidney function and is certainly likely to survive long enough to reach the point where they'll reach dialysis. I think it's certainly okay to say to somebody, "Look, you're doing great. You're doing everything we've asked. But kidney disease and diabetes tends to get worse. It's getting worse much more slowly because you're doing all these things we've asked you. But I want you to know that your kidneys don't get better. That's not the way this works. And it's likely that at some point in the future, you will reach the point where you may need dialysis or a transplant. And I'm not mentioning that to you now to scare you or because you need to do anything right this minute. But you've heard you had kidney disease and you're probably thinking about this anyway. And this is something that we should be talking about little by little as time goes along because it's complicated. It's kind of scary and if you have time and there's no rush and there's no emergency, it will be easier for you and you'll do much better."

So in addition to me saying this, the AADE also endorses this as part of a way of promoting self management in patients. And at least not necessarily doing comprehensive education about dialysis. The dialysis nurse and other folks who may be working with a nephrologist can do that. But at least to begin to talk about this, certainly warning people that they're approaching dialysis as not any -- shouldn't be any more threatening than warning someone that their foot is compromised by poor circulation or that their cardiac status is such that they need to be -- they have some risk to have a cardiac event.

And beyond that, kidney disease education, is a Medicare benefit and unfortunately, what Medicare pays healthcare facilities to provide this, is pretty small and it's not widely done. And the other thing they limited it to physicians, PAs, nurse practitioners and clinical nurse specialists. They did not include dietitians. They did not include social workers and they did not include many of the people who actually end up doing the most effective education. They will cover six sessions and our program has in collaboration with IHS, has developed sort of a toolbox for populating six sessions to help people understand what their options are.

So what we're going to talk about today is just some background information, so that when you talk about this with patients, you'll have some idea of what it is that they need to know. It's not as if any of you are necessarily going to become dialysis providers, dialysis nurses, nephrologists. But just as at least for physicians, the example I would give is, even if you're not working in an ICU. If you're working doing primary care, you still need to have had some

knowledge of what happens in an ICU so that if one of your patients goes there or if you're talking to people about how they would be cared for if they have a heart attack, that you'll be able to speak with some confidence.

So the information that I am going to cover in this talk is really just about giving you the background so that you'll be able to explain some of these options to patients or at least begin the conversation. I don't think you need to take the place of the nephrologist, but many of our patients have limited access to a nephrologist. And even when they see the nephrologist, that person may or may not have good communication skills. And if you were a patient and you had some scary and complicated information to learn, would you rather hear it from the diabetes educator nurse or primary care provider that's been following you for the last 10 years and in whom you have a lot confidence, and who you feel comfortable. Or, would you rather hear it for the first time from perhaps a very busy nephrologist who is not going to be able to spend as much time with you perhaps as you might like. I'm really encouraging all of you to at least feel comfortable bringing this up, not as a threat for patients. Not, "If you don't do this, you're going to end up on dialysis." I don't think that's a good approach. But at least to say, "Look, this is what's involved and I can give you some information and later on, you'll get more elsewhere."

So the three choices for treating kidney failure are kidney transplant and you can either get your organ from a living donor like a family member or even someone who's unrelated or from a deceased donor which is someone who has died but immediately after death or very soon after death, the organs are removed, someone who is killed in a car accident or some other trauma is often how that happens.

The second choice is dialysis and there are two general ways to do that. Peritoneal dialysis is a process that uses the belly and I'm going to describe that in detail and you can do that in a couple of different ways and I'm going to describe that, or hemodialysis which is what people mostly think of when they think of dialysis and you can either have that done at a dialysis unit or do it at home.

And then the third choice and we're learning more and more that this is something we can talk about with some data that may help people is no transplant, no dialysis and we provide people with supportive care. And we can address many of the medical problems, but you can't address the uremia. In other words, the waste products that build up in the blood have to be removed by filtration either by your own kidneys or by dialysis. And that can't be fixed with medical treatment, and so someone who chooses not to have transplant and no dialysis will eventually die from the build up of waste products in their blood.

The best treatment you can get is a kidney transplant and this figure shows the survival of transplant versus peritoneal and versus hemodialysis. The transplant, living donor and deceased donor is the blue and the red, the green is peritoneal dialysis and the purple is hemodialysis. And you can see over time the differences are significant. Now, it's sometimes a little bit tricky to compare the people being treated different ways because not everybody who's on hemodialysis would even be a candidate for a transplant but we try to make adjustments and clearly a transplanted kidney is the only treatment that actually takes the place and does all the functions that an actual kidney does.

Who is a candidate for transplant? And you know, if you actually talk to patients who have progressive kidney disease and say, "You know I'm afraid you're going to require dialysis or a transplant in the future." Many people say, "Oh you know, I'm not doing dialysis. I've seen what that's like but I might get a transplant." So who can get a transplant? Well someone who can tolerate a big surgery and you need a donor or an organ. And if you have a relative or a friend who can give you a kidney, that makes it much faster. But that person has to be in perfect health because you wouldn't want to take a kidney from someone who might need it in the future. If you go on the waiting list and wait for a deceased donor, the waiting time is generally for several years. Like in New Mexico, I think it's five to six years at this point. And then the third issue is having a kidney transplant is a treatment, it's not a cure and you actually have to take anti-rejection medicines for the rest of your life and you have to have periodic visits with a physician. You may feel perfectly normal, but you still have kidney failure. It's just treated with a transplant.

And for peritoneal dialysis, don't worry, I'm going to come back and give you more details. Peritoneal dialysis is a choice for somebody who has nothing going on in their belly that would prevent this like a lot of scar tissue or some kind of infection, who wants to do their own treatments at home, is willing to do them everyday because you have to do this everyday, and has room at home to store the supplies which is a real challenge for many of our patients.

In-center hemodialysis is for someone who can travel to a dialysis center three times a week and for many of our patients on reservations, that can be a real challenge, as you all know. Even if sometimes distance, sometimes weather, sometimes both. Someone who prefers to have the staff do their treatment, doesn't mind needle fix and

is willing to follow a diet. Home hemodialysis and I don't know if any of you are aware or have experience with that, but there are machines now that make it pretty easy to do it at home. It can be a little intimidating, but people are treated, are trained and usually with a family member, you can do it three times a week, but you can do it more often for a shorter period of time. You need storage space and you need to be willing to stick yourself or your partner needs to be able to stick them -- stick you.

And then finally, no treatment, no dialysis is a choice for somebody who really understands what their options are, but feels the treatment won't improve their health and may feel that they have done what they wanted to do in life. Although a lot of times, people are a high enough risk so in fact there's no real benefit from dialysis. And hopefully they've talked with their family and the family can support that. Although this is clearly like every other choice, it's the patient's choice.

Transplant, well, many people are little confused about where the new kidney goes. The old kidney generally is not removed. In most cases, when you reach kidney failure, the kidney disease is generally a scarring process and over time, the kidney gets small and contracted and it's kind of a ball of scar tissue. And there's no real reason to remove it unless it's infected or causing problems with blood pressure and that is not common. The new kidney is put in the groin here. This is the groin. This is the iliac vessels and the artery is attached to artery -- the vein is attached to the vein and the ureter is popped into the bladder and attached right there. And so, it's generally put in the right or left groin and it's tolerated quite well. Although people who have kidney transplants are usually encouraged not to engage in contact sports.

What are the pros and cons of a kidney transplant? The pros are, you have a functioning kidney and it does all the things that a kidney is supposed to do. And dialysis, although it works fairly well doesn't do all the things that a kidney does. Kidneys have a complicated job. It's not just a simple filter. People with kidney transplants have fewer dietary restrictions. They still need to watch their salt to avoid hypertension. A successful kidney transplant is usually associated with better and higher quality survival.

The downside is if you're on the waiting list for a deceased donor, it might be a long time. Rejection is a possibility. It's much less than it used to be and if medications are taken on a daily basis, rejection, sudden loss of the kidney does not often occur. However the kidney, the transplanted kidney doesn't last forever and over time, from various causes, they tend to have decreased function as well. The medications suppress the immune system and may make patients more likely to have infections or to mask serious infections like -- you could have cholecystitis and if you're on prednisone and other immune anti-rejection medicines, it may not become apparent that anything is going on until you have sort of a life-threatening infection.

The medications and the weight gain associated with some of the medications may make it harder to control diabetes. And new-onset diabetes does occur after transplant in association with some of the medicines. It's important to take the medications everyday as directed and many of you are familiar with people on prednisone for other reasons. There are lots of side effects. Imuran is not used a lot anymore, that's an Azathioprine. Cellcept or Mycophenolate is commonly used for transplant and other reasons, and I'm not going to go through all these complications. You can see them here. Cyclosporine is less used now. It does cause hair growth and gum growth and that's very distressing to many patients. Tacrolimus and Sirolimus are newer agents and they both are associated with or at least the Tacrolimus especially may cause the onset of diabetes in people who are at higher risk.

Risk factors for diabetes, new diabetes after a kidney transplant, this isn't within people who don't previously have diabetes is older age, Hispanic or African-American heritage, family history of diabetes, weight gain, hepatitis C and the medicines that I mentioned.

So peritoneal dialysis, I assume many people are familiar with peritoneal dialysis because it's a very good option for people living in rural settings, who are not living near a dialysis unit. In peritoneal dialysis, the peritoneum is the lining of the abdominal cavity, is the substitute kidney or filter. And when I explain it to patients, I say, "Many of our patients have hunt or have slaughtered animals." And I say, "You know, when you open the abdominal, the belly of an animal and you take all the organs out, the lining of that space, which kinds of looks like the inside of your mouth, is called the peritoneum and that lining is very thin and has a lot of blood vessels. And if we put clean liquid in there, the waste products in the blood, in the blood vessels that line that, will pass from the blood vessels, right through the very thin wall, into that water. And then if we drain that water out, we can clean the waste products out of your body." It works for me and it may work for you too.

So what is a peritoneal dialysis exchange? How is this done? How does peritoneal dialysis work? Well, dialysis solution with some dextrose and it flows into the abdominal cavity. The solution remains there for a period of time, which is called the dwell time. It's generally from one and a half to three or four hours. And while it's in there, substances and fluid pass from the capillaries in the peritoneum, into the solution and dextrose, the sugar that's in the solution will pull some of the extra fluid out. But while it's in there, some of the fluid is absorbed and that can make the sugar go up. And then at the end of the dwell, which as I told you, maybe from two to four hours, the solution is drained and new solution is put in.

And this shows schematically what happens. The blue fluid -- let me get the little finger here. Let's see here. Oh, there it is. Okay, this is clean, that new dialysis fluid. It passes down through the catheter into the peritoneal cavity. Now, you know, approximately two liters and then it sits there in the dwell, during the dwell time. And during the dwell time, waste products pass and fluid pass into the abdominal cavity and that's what's turned it green. And then it's drained out into a bag and removed.

There are two ways of doing this, continuous ambulatory peritoneal dialysis, called CAPD is when you do it by hand and you have the bags and you have a rack and four to five exchanges a day is what you do and each one takes about 30 minutes. And if you have no electricity, this is your choice. This is your only choice. But I've had patients who lived way down the muddy road with no electricity and no running water who are able to do this successfully.

But what most people do, because most people do have electricity, is something called CCPD, which is continuous cycling peritoneal dialysis. And in this kind of treatment, there it is. Okay, you have this little box, a pump. It's about the size of a VCR, although nobody has a VCRs anymore. You know it's about that size and basically, it pumps fluid out which drains and then pumps new fluid into the patients. So it does the exchanges during the night and it can be quite efficient because the exchanges can be done at a little higher frequency. And many patients can receive all of their treatment while they're sleeping. And they learn to live with having this little pump and with a noise, but they hook up in the evening and they unhook it at bedtime, in the morning, rather. And virtually anybody who has electricity is likely to do this because is so much more convenient. Some patients will still need to do a couple of extra exchanges manually during the day and I've had patients for example who did this cyclers at night and then they go to work and at lunch time, they do an extra exchange and that gave them enough what we call clearance, enough treatment so that they could get adequate dialysis so that they could feel well.

One thing its' important to remember is the dextrose in the solutions is a source of carbohydrate. And some of that may be absorbed and one of the most important reasons for patients to be careful about how much fluid they gain is that the more fluid that needs to be removed, the higher the concentration of dextrose and the more sugar they may absorb. And so if people are careful about their fluid and they don't have to remove as much, they can use the 1.25% solution. Using 4.25% to remove a lot of fluid is -- it's very hard to control your sugar that way. And with CCPD, less sugar is absorbed, than in CAPD because the dwell time is shorter.

Now, the one thing that you can do to treat hyperglycemia in these patients or treat their diabetes is to give them insulin through the peritoneal dialysis solution. So you add insulin to the solution and it goes in and it's absorbed through the peritoneum. Now, a lot of the insulin will stick to the bag and it's not predictable how much will actually get to the patient. And I've given huge amounts of insulin to patients and just because of their biology, I'm sure most of it didn't get to them. Most of it just stuck to the inside of the plastic dialysis solution bag. But it did control their diabetes and in a way, this may be more physiologic, because remember the actual insulin from a functioning pancreas is produced by the pancreas and it goes into the portal vein which then drains to the liver, so before it goes into the rest of the circulation. So the liver, which as you know has a big role in controlling glucose by storing glucose and releasing it, but the liver, because the insulin goes directly from the pancreas to the liver through the portal vein sees much higher concentrations of insulin than the rest of the body. And if you give patients insulin in their peritoneal dialysis solution, the peritoneum, the venous drainage also goes to the liver and in that way duplicates the sort of high levels in the same way and much better than -- if you inject sub queue peripherally, that insulin has the same level everywhere. So it can be tricky and it is an opportunity to contaminate the process but I've certainly have had good experience with that, with patients.

So the pros and cons of peritoneal dialysis, one of the pros is that it preserves what we call residual renal function better. In other words, when most people start dialysis, they don't have zero kidney function. They may have 5% or 6% or 7% or 10% and that 5% or 6% or 7% or 10% really makes a difference. It's not enough to keep you healthy by itself, but it can make a big difference to someone who's on dialysis. And in peritoneal dialysis, that sticks around longer. It declines much more slowly than in hemodialysis. The pros, patients do it on their own, and so they have autonomy and independence. They choose the time and the place. If you have to do an exchange and someone

invites you to dinner tonight and you're normally doing an exchange around that time, you can just delay it. But if you're on hemodialysis and you have to be in the dialysis unit at that time, you can't go. You don't have to go to the dialysis unit except maybe once a month. And the waste products are removed every day, so that means your body is more steady over time. In other words in hemodialysis, if you're getting treated three times a week, the waste products build up and the fluid builds up, then you get dialysis and it comes down quickly over a couple of hours. And then it slowly builds up and then comes down at the next treatment. Under peritoneal dialysis, things are a sort of much more, much less up and down.

The disadvantages are you've got to plan your treatments around your activities, but that's true regardless of what kind of chronic illness you're dealing with. You need to adhere to the prescription and do it the way it's instructed. You got to follow the instructions and doing this is not any harder than changing a diaper, but you've got to be the kind of person that really follows the rules. And when I talked to patients about this, I tell them, "You know if you're the kind of person that brushes their teeth every night and if you forget for some reason, you'll get into bed without brushing your teeth, you'll still get out and brush your teeth. You'll do well on peritoneal dialysis." If you're the kind of person who says, "You know, just skip it tonight." You'll end up getting an infection and an infection is the biggest risk. Diabetes may be harder to control and weight gain maybe more difficult. Travelling, you have to make arrangements to have supplies but they can actually be delivered wherever it is you're going. Diet may be a little bit less strict than hemodialysis. And people on peritoneal dialysis are never really fasting because they always have some dialysis solution with glucose in their belly.

I'm going to skip this a little bit because time is passing quickly. Now hemodialysis, hemodialysis requires a vascular access. So in other words when hemodialysis is done, blood is drawn out of the body at 300 to 400 ccs per minute. And even if you have great veins that really stick out. If you stick a needle into one of those veins, you try to draw blood out that quickly, it will just collapse like a straw that you're sucking on too quickly. So in order to do dialysis efficiently and safely, you have to have a way of getting blood out at a high, high rate and returning it, and that's called a vascular access.

And in the early days, we had what we called shunts and those were tubes that went into the vessel and came out through the skin and those tubes got infected very, very rapidly. So the big advance was to develop what we call these vascular accesses which are under the skin, they are subcutaneous and they can be accessed with a needle. And in between, they're not exposed to infection. And in general, the vascular accesses is put in the non-dominant arm and this is something you should tell patients with kidney disease who may progress and that's basically everybody with diabetes, is that those veins in their arm need to be protected. And they need to be protected for years before you reach dialysis because every venipuncture causes a little bit of a scar. And every IV catheter and every pick line for sure causes real damage. So in general, it's a great idea if you have patients with kidney disease even relatively early kidney disease to encourage them, encourage your lab and the phlebotomists to draw blood from their hands, below their wrist, in their hands if possible. They can use a small needle and draw it from their hands. In that way, the veins are protected because when those veins get damaged and can't be used, you aren't going to develop any new ones.

So unfortunately, most people start hemodialysis with a temporary vascular access because it's an emergency or urgent and in those cases, needles aren't used, the catheter is long so blood flows are slow and it's only a temporary solution. The preferred way of doing dialysis is through a fistula and a fistula is a direct connection between your own artery and your own vein. And those last longer, are less likely to get infected, and less likely to clot. And those are generally done in the wrist or in the elbow, in the antecubital fossa.

This is such a much better way of getting treated that it's actually an objective in Healthy People to try to have these placed in people ahead of time so that they're usable to decrease the number of catheters. And this all requires good care in people who haven't reached kidney failure yet, but who had been educated and understand that they need to do to get this done. And it is a big leap for someone to have an operation done on their arm in anticipation of dialysis because it means you really have kidney failure and you know, I see lots of patients and I talk to them and when they go out, if they find this too scary, they can kind of pretend, "Well, you know maybe I don't really have kidney failure." Maybe he doesn't really know what he's talking about." But once you've had something, an operation done to your arm, you can't pretend that you don't have it and so it's a big step and that's one of the reasons that a large portion of patients, even followed by a nephrologist, still don't get catheters, don't get fistulas placed.

An AV graft is what is used when you can't place a fistula either because the blood vessels are too small or they're in just poor health. An AV graft is a synthetic tube. It's actually made of Teflon and it connects the artery and the

vein and that's this yellow piece here and that is then the needle is put into the graft itself. However, it's more likely to become infected and more likely to clot. And this may all seem a little bit obscure to all of you, but as tough as dialysis is, what really causes a lot of problems for patients is what is called access grief. So in other words, they show up at dialysis and they can't be dialyzed because their graft is clotted or it's become too narrow to allow good blood flow. And so on top of showing up at the dialysis units three times a week, you've got travel some place to have some surgery or have a procedure done and it can become extremely discouraging.

Okay. So how does dialysis work? A lot of folks think that somehow the blood goes into the dialysis machine and it does something and then the blood comes out. Well, that's not the way it works. This is a schematic of the artificial kidney, the dialyzer. It's a tube, it's about the size of a toothpaste tube and blood is pumped from the patient into the top of the dialyzer and then it's forced into many, many, very fine tubes that run the length of the dialyzer and they're hollow but they're each the size of a hair. And so they come down, they pass through the middle of the dialyzer, inside tubes and then they come out.

As they pass through these thin tubes, on the outside of the tubes, dialysis solution is passing in an opposite direction. And during the one second it takes to go from here to here, the waste products will diffuse outside through these tubes, into this dialysis solution and be carried away. And some substances that we try to get into the blood like bicarb will go in. And so in the one second, the blood goes from this end to this end through these very fine tubes, there's a diffusion of the bad stuff out and the good stuff in. And depending on how much pressure is put at this end will determine how much water is also forced out. So you can remove lots and lots of fluid if you need to as well.

The blood actually does not go into the machine. The blood stays in this -- it comes out through this needle and passes through this line. This is just a pressure gauge. It's moved by a roller pump which is just sort of like a rolling pin almost that pushes the blood. It comes up here, it gets a little bit of heparin. It goes into the dialyzer as I showed you. It passes through the dialyzer and then comes back to the patient. That's it. The blood does not go into the dialysis machine. The dialysis machine is just all the machinery and the electronics to pump the blood and to monitor their pressure and the temperature and keep everybody safe.

So if you want to do it at home, it does require training and every dialysis provider is obligated to make this available. And in the community where you're at -- it's not very popular but it's something, all of these treatments have to be made available in one way or another for patients. If you do it at home, you can do it for shorter, more frequent at shorter periods of time or at night. And in both those cases, those patients actually do much better.

So the pros and cons, one of the pros actually is that facilities are everywhere and the staff does the work. If you want somebody who just wants to go to the dialysis unit, stick out your arm and get treated. That's what will happen. The other thing is especially for older people, even large dialysis units don't have that many patients and people tend to go at the same time, be dialyzed with the same patients, sit in the same chair, with the same nurses, and it becomes a social experience. And if you're an older person and you're isolated, I know it sounds weird or may sound not what you expect, but you know, going to the dialysis unit gives you an exposure for three to four hours, three times a week with a group that you're familiar with and cares about you and are friends. So actually in some places, older people especially may show up early to the dialysis unit because they have time to sit in the waiting room first. That's just something to think about.

The diet can be somewhat strict. People have to follow a schedule. They have to travel to the dialysis unit and because of this up and down phenomenon, they may feel quite fatigued and a lot of the feeling that people have at the end of dialysis of exhaustion is due to the big change in their body. It's a good change in that fluid is removed and waste products are removed, but anytime your body undergoes a huge change like that, it can make you feel not great.

Home hemo, is better for some people because if it's more frequent. They have less dietary restrictions. They can decide the time that they get treated. They don't have to travel and fewer up and downs if they are dialyzed more often. You do need a partner and the partner burnout is a real issue. You need space for all the equipment. You need to insert the needles and you need to get some time off for training and you may not be able to get training locally.

Now one thing to remember, hemoglobin A1c in dialysis patients can be very tricky because hemoglobin A1c is -- the way we look at it, it's based on the average life expectancy of red cells. And in dialysis patients, there can be increased turnover of red cells. They don't live as long and so because they don't live as long, they don't have as

long to get glycosylated and as a result, you may get lower A1cs even though the sugars are not as low as you might expect. On the other hand, uremia can attach protein to your hemoglobin and that can result in a false elevation in A1c. So take a look at them, but you need to look at them with some skepticism at times.

So what about no transplant and no dialysis? It's usually described as supportive care. The complications of kidney failure can be treated. Medications are continued, but you can't take the place of dialysis or the kidneys in terms of removing waste products. The goal is to maintain quality of life and when you make these decisions, obviously it's the patient's decision. And it's important to include the family which is -- in general our patient's families are usually involved. I think the approach that I take in talking to patients, virtually everyone when they first hear that they might need dialysis, they go, "I'm not doing that." And I say, "Look, you know, that's your choice. It's your body and it's your life. Our job, my job is not to get you to do anything. My job is to make sure you understand what your choices are, what the pros and cons are of each treatment." And you know, if you come back and say, "Look Narva, you know I understand what all this means. I've learned about the different treatment options. I visited the dialysis unit. No way do I want that. And I've talked to my family and they support me." I go, "Okay. Thank you for having the courage to learn about that. I can write in your chart that this patient has an understanding and understands that without dialysis, they may die from their kidney failure. You know if they show up and are acutely ill, they should not be considered for dialysis."

And it's a way of people having control. But if someone -- you know, just as well, my brother was on dialysis. I don't want to do it. You got to push a little farther because everyone is different and you know and patients are autonomous. They certainly need to make their own decisions. But it needs to be an informed decision because this is a life and death decision.

So in summary, I think it's important to discuss choices early to allow time for a patient to adjust, to make a decision and that may mean that in the primary care, in diabetes clinic, to start mentioning this and to give people information. It is not an area that you should hesitate to go.

So remember that transplant required is a treatment, not a cure. That if people are going to do peritoneal dialysis, their glucose requirements may increase. And hemodialysis has a more restrictive diet and that may be an issue for many patients. So I have 1 minute left and about 37 questions. So I'll try to -- I'll look at some of the questions and try to answer the ones that seem most common.

If you have questions and I don't answer you, I would encourage you to look at some in the materials at our website here and I'm always happy to answer questions if you write me a question because that's how I learn, from answering or trying to answer questions. And I can do my current job better and serve patients better as well.