

Ruth Adewuya, MD (host):

Hello, you are listening to Stanford Med Cast, Stanford CME podcast where we bring you insights from the world's leading physicians and scientists. This podcast is available on Apple Podcast, Amazon Music, Spotify, Google Podcast, and Stitcher. I am your host, Dr. Ruth Adewuya. Welcome to season four of Stanford Medcast. This episode is part of our hot topics miniseries. In this episode, I am talking with Dr. David Maahs. Dr. David Maahs is the Lucille Salter Packard professor of pediatrics at Stanford University and the Lucille Packard Children's Hospital, and is an accomplished physician who specializes in pediatric endocrinology. He earned his MD at the University of New Mexico, completed a pediatric endocrinology fellowship, and a concurrent PhD in epidemiology at the University of Colorado and was a faculty member at both universities before joining Stanford. Prior to his medical career, Dr. Maahs earned a BA and MA in English from the University of Kansas and served in the Peace Corps with assignments in Tunisia and the Central African Republic.

His scholarly interest is improving care and preventing complications in people with type 1 diabetes. He is also the co-author of the 12th and 13 editions of Understanding Diabetes or Pink Panther, which are the most widely used educational books for children newly diagnosed with type 1 diabetes. Thank you so much, Dr. Maahs for chatting with me today.

David Maahs, MD (guest speaker):

Thank you, Dr. Adewuya. It's wonderful to be here and thanks for your interest in pediatric diabetes.

Ruth Adewuya, MD (host):

I want to start our conversation just talking about your journey to medicine. You served in the Peace Corps. Can you share a little bit about your background and your journey into the field of pediatric endocrinology and diabetes?

David Maahs, MD (guest speaker):

Yeah, so I had done my pre-med courses before I went to Peace Corps and actually have a master's degree in English, which is an unusual course before going to medical school. But then having been, first in Tunisia until the Gulf War started and then the Central African Republic realized that I really did want to go into medicine. And so then applied and started after I returned. And then I think, particularly going into pediatric diabetes, I quickly learned that I loved pediatrics. And then during my pediatric fellowship, diabetes then specifically really appealed to me. My grandparents had diabetes, so I'd grown up knowing about that. I remember back in the day, seeing my grandfather sharpened his needles to give insulin doses. And so that made an impact on my young mind.

And then the first continuity clinic that I got to do as a medical student was at the Indian Health Services in Albuquerque, New Mexico, there was the diabetes clinic there. So I had the opportunity to work with some great doctors there, great team members, and also to learn more about diabetes and the potential to really help people in that area. And then I think there was some personal connection as well with my family experience.

Ruth Adewuya, MD (host):

Thank you so much for sharing that. I always find it fascinating to hear about how physicians end up where they are, how they choose the specialties that they continue to practice in. I think this is a great segue to say what diabetes is and if you could explain the differences between type 1 diabetes and type 2, particularly in the context of pediatric patients.

David Maahs, MD (guest speaker):

Yeah, that's a great question. And of course people could give you a 10 hour lecture on this, but-

Ruth Adewuya, MD (host):

I'm sure.

David Maahs, MD (guest speaker):

... maybe going back to how we might explain this to a family who's newly been diagnosed and might ask that question. So I think the way we would explain type 1 diabetes is that it's an autoimmune condition. So the immune system in type 1 diabetes has gotten confused, and it's now attacking a part of the body, the pancreas, and specifically the beta cells in the pancreas and destroying those. And so the symptoms that you see at the onset of type one diabetes typically are the result of not having enough insulin in your body. So what does insulin do? Well, we eat our food, it gets broken down, and then absorbed as sugar, and then we need insulin to work like a bridge to get the sugar from the blood into the cells of the body. And if you don't have insulin, it's like that bridge is out and the sugar can't get across into the cells of the body. So a couple of things happen. Glucose blood sugar levels get higher and higher, the kidneys do their job and pee out that extra sugar.

So now you're getting dehydrated, so you're drinking more water, but you're still peeing out because you don't have the insulin that you need. Okay, so that's one thing, so you have polyuria, polydipsia. Second thing that does happen then is without insulin getting into ... the cells are hungry. They send out a signal, breakdown fat to use it as energy, so you lose weight, but that breakdown of fat also releases ketones. Ketones are an acid, and so they are chemically similar to acetone or nail polish remover, so you might smell that fruity smell on someone's breath. Also, in extreme cases you get what we call kussmaul respirations or these very deep and rapid respirations. Sometimes they can be confused in children that they're having an asthma exacerbation, but it is a different breathing pattern. It also something that can be picked up with a finger poke, glucose meter, and with a urine test to look for ketones in the urine. So those are a couple of quick tests you can do if in doubt.

So the key to type 1 diabetes then for treatment, is to replace insulin in the way the body should be making it but isn't able to make it. So conceptually that sounds quite simple. In practice, it's very challenging, and so we can talk more about that. Type 2 diabetes is slightly different, but it ends up at the same place, in that your glucose levels are high and you can have some of those same symptoms. The pathway to getting there can be a little bit different, and we'll say to families that your body's making insulin just not enough. And so it's frequently related to a higher weight. It also has a strong family component as well. Type 1 also can have a strong family component, but not quite as strong as in type 2 diabetes. And so it's a combination in type 2 diabetes of insulin resistance, often related to increased weight, and then your body not being able to make quite enough insulin and your body not being able to use it quite as efficiently. So sometimes in type 2 diabetes, diet and exercise, if you can catch it early, can prevent progression.

And sometimes you can take pills, metformin, and now we've got many other treatments as well in addition to insulin. Sometimes people with type 2 diabetes need insulin as well, but we do have more options in type 2 diabetes. And those really transformed care and I think if started in adults, like many medications, you start using them in adults and then they filter down into pediatrics. And so we're just starting to use some medications that adult providers have been using for a long time. You've probably given many prescriptions for GLP 1, SGLT 2s, et cetera. And so those really have transformed the care we can provide. And I think we have the opportunity to do better in pediatric type 2 diabetes. The

outcomes for pediatric type two diabetes have been very sobering. There's a couple of big studies, the one called the Today Study that was a randomized controlled trial to test different treatments. And that study then completed, but then they've continued to follow those participants.

And I think one of the very concerning, scary outcomes is a New England Journal paper a couple of years ago where they described that about 2/3rds, if I recall correctly, of those participants in the study who are now in their 20s and 30s were diagnosed as teens have some sort of vascular complication. There were some cases of heart attacks, there were some fatalities, there were some renal failure. And to think that's happening already in somebody in their 20s and 30s is when they should be in the prime of their life, that they're having those complications, that previously may have been associated with people older 50s, 60s, 70s who've had diabetes for a longer time is a real concern. So we've got a lot of work to do in both type 1 and type 2 diabetes as well.

Ruth Adewuya, MD (host):

The last portion of what you said really underscores the importance of early diagnosis because there are potential consequences. Can you speak more about the importance of early diagnosis in managing pediatric diabetes?

David Maahs, MD (guest speaker):

Yeah, it's a great point. And with type 1 diabetes, we now just in the last year have the first approved immunomodulatory therapy. It's called Teplizumab or the trade names Tzield, and that is immunomodulatory agent that has been shown to delay the onset, the clinical onset of type 1 diabetes by about two and a half years. And so that's the first treatment that we've had. There was another study out in the last year called the Clever Study, and it was a factorial design looking at starting newly diagnosed pediatric patients with type 1 on automated insulin delivery, yes or no. And then yes or no starting with verapamil. And the endpoint was then preservation of C-peptide or beta cell function. So the automated insulin delivery achieved more time and range or a lower A1C, but it didn't have an effect on C-peptide or beta cell preservation. So people were disappointed about that. However, the verapamil did show a benefit, I think to the surprise of many, it has a effect on calcium channel and glucotoxicity. And so that's thought to be the mechanism.

And there's papers written on that, that we could pull and look at those if we wanted to, but that's encouraging as well. And you think about a medicine like verapamil, which has been around for decades and is not very expensive. Now, some people point at that paper, which was in JAMA in the last year and say, but it was a small group of, I think it was 80 people or so in the whole study. So there are other versions of that study being repeated now in slightly larger groups. But finally we've got a couple of treatments that we can offer people at the beginning, in addition to intensive management right away. Back to that study that the intensive management didn't preserve beta cell function was a disappointment. However, it's very encouraging that you can start intensive management early and get such good outcomes. And that also goes back to the study we're doing where we're getting about 65% of our patients have an A1C below 7% at one year. And historically that might've been 25% or so who had A1C below 7%.

So we still have work to do, but we're moving in the right direction. For type 2 diabetes, the prevention can start even earlier. Healthy diet and exercise, whether you're an adult doctor, a pediatric doctor, eat healthy, exercise, don't smoke, these are pillars of health. And it can be a real challenge though for some of these children and adolescents. They're not doing the grocery shopping. There can be some very difficult socioeconomic situations. You may not have access to food. You may not be in a neighborhood where it's safe to exercise outside. There may not be these opportunities. And also it's hard, so it's not

such a simple thing as saying, go eat healthy and exercise. You need support, you need programs, but the importance of prevention of type 2 diabetes is really important. There was an interesting paper out from one of our colleagues, Dr. Anisha Patel, looking at just the effect of having drinking water available in schools as opposed to sodas.

Ruth Adewuya, MD (host):

Yes.

David Maahs, MD (guest speaker):

Okay. That sounds-

Ruth Adewuya, MD (host):

It sounds like a no-brainer.

David Maahs, MD (guest speaker):

It sounds like a no-brainer, exactly, and guess what, it worked. It had positive benefits. So we need to be creative in how we do this. And by the time they get into the doctor's office with type 2 diabetes, there's many things we wish would've happened before to help prevent that. I think some of those interventions that can be policy, community. Again, back to the equity and disparities is we need to have a healthy environment for children and adolescents.

Ruth Adewuya, MD (host):

There's tremendous work being done in the space if we do the job to try and diagnose this early. There's a lot of work being done to hopefully stop it in its tracks. And with the immunomodulators that you talked about, there's a higher chance that we can actually do something about it. Because again, as we started the conversation, the consequences can be quite dire. You talked about how children are typically not the ones who grocery shop. You need to look at socioeconomic factors. What are other unique challenges and considerations when you're dealing with diabetes in children and adolescents that you might not think about when you're dealing with diabetes in adults?

David Maahs, MD (guest speaker):

No one chooses to have diabetes, and I think if you're an adolescent, it's really important to have your friend group, your peer group, and you don't want to be different. Historically, there's been a stigma associated with having diabetes. I think that's improving, but it's still something that we need to be very aware of, the distress that diabetes can cause people, and I think that can be even more pronounced with adolescents. Now, again, I think it's getting a little bit better. One thing I have noticed on a very specific point is, for example, continuous glucose monitors. Five years ago, people didn't really know what that was when they would walk into our office with a child newly diagnosed with diabetes, but now for the most part, people say, "Oh, is that the one that grandpa wears?" Or, "Is that the one that Nick Jonas did that had for ..." something like that? And they say, "Exactly, let me tell you about that and why it's so much better to wear this little thing.

Now, I know you don't want to wear a little thing, but the other option is to poke your fingers 6 to 10 times a day." And as a parent, if you wear a continuous glucose monitor, we can get that data up to the cloud and down to your phone. And if your child's in kindergarten, you can look and see what's going on and that peace of mind that comes with it. So that's one improvement that's been made. Now, no one

wears diabetes technology by choice. It's not a fashion statement. Having said that, I think we're in a different place now than we might've been 10 years ago with that. But I think the challenge in pediatrics is it can be just that peer group and making sure that the children and adolescents are able to work through that. And we're very fortunate here at Stanford that we've got multiple diabetes psychologists on our team. And so to have that type of support for diabetes distress and other things related to diabetes is really important. It's not all about what's your glucose, it's what's your quality of life.

And so with one thing in type 1 diabetes, that's been a huge advance is the diabetes technology that they've been talking about. And so you have a continuous glucose monitor, it's going to read the glucose every five minutes. It can beam that information to an insulin pump that then delivers insulin and it can modulate the insulin to give a little bit more or a little bit less depending on what your glucose value is. And if it's predictive, it's going down, going up. Now, you still have to give a bolus, or push a button to give a dose with your meals and snacks to get the best results. But those systems work really well compared to the past. They're A level evidence from American Diabetes Association, ISPAD, which is International Society Pediatric Adolescent Diabetes. Having said that, not everyone necessarily wants to wear something like that. However, it's getting better and better.

I think we're now at the point where continuous glucose monitors, I think in our clinic we're 70, 80% of our patients with type 1 diabetes are wearing those, and hopefully that continues to go up. And then I think these automated insulin delivery systems, and there's now about five that are approved and available, five different companies and systems, as well as some do it yourself or open access type systems.

Ruth Adewuya, MD (host):

Obviously this is a chronic issue. This is something that's ongoing, will likely be part of an individual's life for the rest of their life. And so, in terms of primary goals of diabetes management in pediatric patients, it sounds like the goal is to prevent complications, and does the goal of management change depending on their age or other factors?

David Maahs, MD (guest speaker):

What I used to say to my patients is the three goals for diabetes care have your A1C as low as possible. A1C being a measure of your average glucose over the last three months. I think now we also use continuous glucose monitoring metrics. So to have an average glucose or time in range between 71-80 to optimize those. But then the second part is not have too much hypoglycemia, sugar's below 70, we want to be less than 4% of the time or less than 54, less than 1% of the time. And think, 4% of the day is one hour, so that's one hour in that 70 to 54 range. So those are the first two goals and they battle against each other. You got to balance them, it's a little bit, I don't want to say easier, but it's a little bit more achievable now with continuous glucose monitors to get those targets. But then the third goal is a little bit of a trick question, have fun and be a kid. It's really quality of life.

We got to do those first two things, but we want you spending your time doing whatever other kid is doing, playing soccer, or whatever it is that you like, doing your homework, whatever. So we got to take care of those first two things, but then we want you to have a full life doing what you want to do. Complications, the acute ones are hypoglycemia that I talked about. That's still very much a concern, but it's gotten much better with continuous glucose monitors and the automated insulin delivery. And then the other side is the diabetic ketoacidosis where you're not getting insulin. That's also improved with continuous glucose monitors to give you a warning that you're high and should be, for the most part, avoided once you know that you've got diabetes. Sometimes it may be unavoidable with illnesses or

other things, but we should be able to manage that. And then the longer term complications, as you talked about, are damage to the eyes, the nerves, kidneys and heart.

Those general are longer term from having elevated glucose values and something that we should be able to reduce with those lower A1Cs that we're now seeing. And in kids, a 14 year old doesn't think about 10 years from now, they may not be thinking about 15 minutes from now. So it's often something more that medical team or the families are worried about. And it doesn't do any good in my experience to threaten kids with, "Oh, you better do this, or that is going to happen down the road." It doesn't make me feel very good as a doctor either. I think it's more focusing on the positive benefit, how do we help you with your diabetes? Because they're in seeing us a handful of times a year, right, and this is a 24 hour a day condition that they have to manage. And that's one of the really hard things, you don't get to say, "Oh, I'm taking today off."

Ruth Adewuya, MD (host):

Exactly. You don't want to play the bad cop when you're talking to a child or adolescent about their care, but they have to be bought into their care at the appropriate age level for them. How do you do that? Because as you just mentioned, that can be quite difficult to do because that's not what they're thinking about. As a clinician, how do you navigate those conversations with pediatric patients?

David Maahs, MD (guest speaker):

We're very fortunate, we've got a multidisciplinary team, so we've got certified diabetes care and education specialists. We've got dietitians. We've got social workers. We've got psychologists, and then we've got the doctors, the pediatric endocrinologists as well. So we've got a big team of people, and it's really the diabetes educators who are doing the bulk of the work with the education, teaching the families what they need to do. For the most part, children do wonderfully on families that do very well. It's a lot of work. I think it has gotten a little bit better with the diabetes technology. I think you could relate not having to poke your finger 6 to 10 times a day where a CGM on your arm or elsewhere, that's a step up and also the amount of data that you'd get. But it's still hard. It's very hard. And so I think that's also why we need to follow the children with diabetes and with their families closely. And we typically have appointments every three months.

We've now got this system where we can periodically take a look at glucose values in between visits and getting a flag or a warning if something has happened. And then we also have the diabetes psychology team if it gets really difficult. And sometimes those barriers can be helped by a visit with a diabetes psychologist. And I think talking to the child and family and finding out what's going on, sometimes it's something we can work together and help. And I referenced the study that we've had going for about the last five years, and when we looked at one year data and what percent of people were above 9% on their A1C, which is one marker of opportunity for improvement in your glucose values, and we only had 3 people out of this last cohort of 135 or so who are above 9% at one year. So I think we've not only lowered the average across this population, but fewer outliers, so that I think everyone's benefiting from the improved care model that we've introduced. Still work to do. We would like to get everyone below 7%, but we'll keep working at it.

Ruth Adewuya, MD (host):

I think your response really speaks to the importance of bringing in a multidisciplinary team, to not only care for the patient clinically, but also there are psychosocial impacts of chronic conditions, and bringing in experts to work alongside of the patients and their families is really important. One of the things that also comes up in this space is this idea that at some point the pediatric patient transitions to becoming

an adult patient, and that can be a critical phase as well, because you get into that cycle of the three month visit, who your care providers are. What are some of the ways that clinicians can ensure this seamless transition that still promotes the patient's long-term wellbeing, understanding that it may be a completely different set of guidance and rules and providers that they're working with.

David Maahs, MD (guest speaker):

It's a challenge across many health conditions that transition from pediatrics to adult medicine. I think there's different approaches. I think there's a little bit more expectation in adult medical clinics that you missed your appointment, okay. Whereas in pediatrics, then we tend to say, "Oh my goodness, we got to go track them down and get them back in." So I think particularly for diabetes, and I'll talk just about our program here at Stanford, that we've got some outstanding colleagues in adult endocrinology. And we've got a program, Marina Bacina, Rehan Law, Mike Hughes, in particular, who have a program to do what they're calling a guided transfer, so that there's an introduction while they're still in pediatrics clinic and then a warm handoff into the adult diabetes clinic. So they've been working on that for a couple of years and I think had some promising early results. And so that's a really important program. Getting lost for a year or two in that 18 to 26 range, there's usually a lot going on in your life.

Maybe you're off to college, maybe you are out of the home for the first time and have your first job. There's a lot happening and a lot of learning about how to operate in the world. And healthcare system in the US does not make it easy. And then if you don't have the support of family and others, again, talk about a disparities issue, and who gets lost, and who might not have insurance. Maybe your insurance is gone, what happens then? How do you afford your insulin costs? And the cost for diabetes supplies has been a huge issue. It is heartbreaking that there are people in the US who have died because they didn't have access to insulin or they were rationing their insulin. So we've got a lot we have to do in this area of transition from pediatrics to adult, and I think we've got some programs here at Stanford. It's a national issue, I think even internationally, that we need to help that happen in a better way.

Ruth Adewuya, MD (host):

Yeah. I want to go back to where we started and how you enter the world of diabetes and pediatric endocrinology. As you've been here for a while now, what are some of the most rewarding aspects of working with pediatric patients with diabetes?

David Maahs, MD (guest speaker):

Yeah, I think it's always fun. I'm looking at a patient last week who brought me a little bracelet. They'd made this little bracelet that says Dr. Maahs.

Ruth Adewuya, MD (host):

Aww.

David Maahs, MD (guest speaker):

Things like that, and then they drew me a little picture. And I think one of the great things about pediatrics is you get to know the families. In diabetes, we generally see them every three months, and it's fun to see these kids. I think with these automated insulin delivery systems, often we don't have to spend as much time looking at glucose values and figuring out how to adjust insulin because these systems are already doing it for us. We still need to pay attention to that. But there's more time to talk about general health, your wellness, mental health, are you exercising, what are other things that we

can help with? I heard recently about the T. Swift concert from two patients. That was pretty ... it's what's going on in your life and let's talk about that. And then what can we do to help with your general health? What can we do to help with your diabetes?

So I think that's always one of the joys of pediatrics is seeing the children grow up. And again, with diabetes, you often enter their life when they're in crisis, and the overwhelming majority do very well. It's hard work, but to watch the children grow up and do better, it's really exciting. And I guess I've gotten old enough now, run into a few patients who are training in medicine and its-

Ruth Adewuya, MD (host):

Oh, wow.

David Maahs, MD (guest speaker):

[inaudible 00:26:09] that's great. I think it's a very rewarding area.

Ruth Adewuya, MD (host):

It's very helpful to have daily reminders of why you do the work that you do, and to see people grow and live their lives fully. I know that we're barely scratching the surface of the incredible work that you and your team are doing and the advancements that are happening in this space, but I think this gives us a great peak and awareness that there are things that are happening that are exciting. Thank you so much, and thank you for sharing your insights on this topic.

David Maahs, MD (guest speaker):

Thank you very much. It was my pleasure.

Ruth Adewuya, MD (host):

Thanks for tuning in. This episode was brought to you by Stanford CME. To claim CME for listening to this episode. Click on the claim CME link below, or visit medcast.stanford.edu. Check back for new episodes by subscribing to Stanford Medcast wherever you listen to podcast.