

Podcast 46: Diabetes Technology: Insulin Pumps

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Today we are thrilled to welcome back Adena Goldstein, who will speak with us today about insulin pumps. Welcome back, Adena.

Adena Goldstein, RN, BSN, CDCES: Thank you.

RK: I thought that for today we could focus on insulin pump technologies. These have changed, haven't they? A lot over time, in terms of the capabilities and functionalities that insulin pump devices can offer.

I thought before we dive into what these technologies are, if we could briefly talk about who might need an insulin pump and when they might be recommended by the healthcare provider for a person with diabetes.

AG: An insulin pump is an alternative way to give insulin. As opposed to multiple daily injections where you have a shot of long-acting insulin and then short-acting insulin for your meals or for correction. In the insulin pump there is just fast acting insulin and it's just a different way to give insulin. Someone who is on multiple shots of insulin a day would be a candidate for an insulin pump.

The pumps, as you said, have changed a lot over the years. They've become very sophisticated. I tell my patients at every follow-up visit, "There's something new on the market" or "Some new feature's available."

Generally, people who are dependent on insulin to manage their diabetes might be a good candidate for an insulin pump.

RK: It is good to know about because these have changed a lot over time, and they can offer an option that may be an attractive option for patients who are used to injecting insulin multiple times a day — four or five times a day. This is an alternative that might facilitate diabetes care and, in some ways, make it easier for the patient as well. It's a personal choice; it may not be for everyone. As you mentioned it's often recommended for people who are on multiple daily injections, usually a long-acting insulin and mealtime or short-acting insulin or fast-acting insulin as well. It could be type 1 diabetes, where I think we often see this discussed as an option and type 2 diabetes for those later in the stage of their disease who are on multiple daily insulin injections as well. Do you see patients with both type 1 and type 2 diabetes in your clinical practice that use insulin pumps?

AG: The majority we see are type 1, but we do have some type 2 patients as well, who just prefer that method of giving insulin. Aside from a practical, different way of giving it, there are a lot of advantages to insulin pumps.

Some of the advantages [include that] they have been shown to lower A1C levels, especially the hybrid closed-loop pumps, which I'm sure we'll touch on later; less low blood sugar [levels]—more time in range; it helps with the dosing because it takes the insulin that they already have working in their body into consideration when they do give more insulin.

The tiny increments at which you can give the insulin are so helpful because in pens you can't go less than half a unit, and in pumps, you can be very precise. It also allows more flexibility for meals and dosing for snacks; instead of giving so many more shots, you're just able to program the pump and tell it how much to give. Pumps can be programmed to different rates at different times of the day.

They are integrated with sensors now, based on where it predicts your blood sugar is going to be, it is going to adjust the insulin based on that. This is very sophisticated and has really helped a lot with preventing the lows and the highs. Some of the pumps also can give automatic correction doses if you are running high. It really takes a lot of the mental burden actually off of patients.

RK: Wow. It's so amazing to hear about all the functionalities that insulin pumps can now offer. You are right, it is not just a different route of administration, but it has so many potential benefits, both clinical benefits and practical benefits.

As you mentioned—making the day-to-day management a little less burdensome for people with diabetes who take a preference to this modality of receiving insulin.

I thought the point that you mentioned was an important one to emphasize was that in an insulin pump, it is the fast-acting insulin. Only one type of insulin is given and that can be a little confusing for patients who are used to having a long-acting insulin and a fast-acting or mealtime insulin injection. At this time, primarily insulin aspart (Novolog) and insulin lispro (Humalog) are given through the pump.

You mentioned so many different types of functionalities of the pump. Can you describe for us, for someone who hasn't seen an insulin pump, what does it look like? What can people expect when we're talking about insulin pumps?

AG: There are different types of pumps. The basic idea is that there is a little catheter that is placed under the skin, and it's connected to the insulin pump. Some have tubes that connect to the actual pump, and some are tubeless, which are connected more to a pod. Insulin is fed through the catheter and then given to the patient that way, under the skin. It's given continuously; it drips little bits of fast acting insulin all the time, which mimics that shot of long-acting [insulin] and it also mimics what a normal pancreas would do—a little bit all the time.

Then when you go to eat or correct a blood sugar, you enter that into the pump and it gives what we call a bolus of insulin through that cannula under your skin. That cannula is changed out every few days. There are some that can be changed every seven days, but typically it's every few days. To give the area [a break], you need to move it around just so you have good absorption of insulin.

RK: In terms of the size of an insulin pump and the size of the catheter, could you give us a sense of how big we're talking about here or how small?

AG: There are different sizes of the catheters. They are as small as 6 millimeters. There are some that are angled, so those are longer, those can be 13 millimeters. There are steel cannulas that you leave in — you don't remove it. That is a different type, but those are about 6 millimeters as well. The pumps, vary in terms of sizes. They're about the size of a deck of cards, maybe a little smaller.

RK: That gives us a good sense to visualize what we're talking about. They're really not that big at all; 6 millimeters for the catheter, the size of a deck of cards — maybe even a thin deck of cards, if you will, for some of the newer pumps. I think it's important to recognize that these are not huge devices as they might have been when they first came out on the market, many decades ago.

But [these are] really portable devices that have a cartridge for the insulin that is infused continuously. An insulin pump usually infuses the catheter into the area right beneath the skin, the subcutaneous tissue. So it's pretty remarkable when we think about this technology, isn't it?

AG: If you see pictures of the first insulin pump, it's a big backpack, and now they're so small, they're very discreet. Some of them can be managed through a smartphone. A lot has changed over the years.

RK: I can't imagine the backpack pumps now that we know how small they've become. But technology evolves so rapidly over time. It's important to recognize how far we've come.

You mentioned different components of the pump. The actual pump, which could be the size of a deck of cards or thinner, the catheter through which the insulin can be infused. Then you also mentioned using a phone. Can you talk about when that might be used? Is that for the CGM part of it, the continuous glucose monitor part of it? Or can that actually control the insulin pump?

AG: There are a couple pumps on the market right now that you can actually control the pump from the phone — you can give your boluses from the phone. There are times, [when] you have to deal with the pump; when you refill it and to cancel alarms sometimes. But a lot of the day-to-day functionality you can do directly from the phone. There are some pumps that are only managed from a phone. That's a big component of that type of pump.

RK: Wow. That is just so amazing to have these different devices communicating with each other and that so much can be done even from the phone. This makes it, in some ways, less noticeable for someone who might be at work or in a professional setting who might need to give themselves a bolus before they eat or change their rates for any reason. That they could do that from the phone, is pretty remarkable to hear about. Where do people wear the insulin pumps? Where on the body do people wear those?

AG: The insulin pumps are generally in areas where you would give insulin — same spots. The tubed pumps are generally in the midsection of a patient's abdomen, lower back, upper part of the buttocks. Because that tube or the pump does need to clip onto something, in a pocket or, something like that. It can be worn [on] other places, but generally those are the more typical places we see. Then there's also tubeless pumps, which offer a little bit more in terms of flexibility of where you wear it because it doesn't have that tube or that clip that needs to be clipped on somewhere. People wear those on the back of the arm, on their legs, also their stomach. Again, any place where you give insulin.

RK: It sounds like there's really a lot of options in terms of where a pump can be worn and also in terms of the types of pumps. I wonder if we can now shift a little bit to talking about the different kinds of pumps that are available on the market and how an individual who's considering this technology might try and decide which pump is best for them.

Clearly what's covered by their insurance is an important factor. But assuming that there are options for coverage, how could they best decide what pump is best for them?

AG: Every pump has different features, and I always tell patients "It's like buying a car. Which feature is the most important to you when you're looking at a purchase like this?"

We can go through the different pumps and talk about some of the key differences between them. Again, for some people one factor is like number one priority and for other people it is not so important. It really is so individual.

We can start with the tandem pumps. There are currently two pumps on the market. The Tandem, t:slim X2 pump; it's a touchscreen rechargeable pump that is updateable. As new technology comes out, you can just plug it in and get the updates. That's pretty common nowadays, but years ago, as soon as you got the pump it was basically outdated because new technology was coming out so quickly. It's updateable, which is great for new algorithms, new sensor compatibility, different things like that.

This pump is currently compatible with the Dexcom G6 and Dexcom G7, as well as the Freestyle Libre 2 Plus. It adjusts the basal rates and gives auto corrections based on where the blood sugars are predicted to be with the sensor integration.

This pump does allow you to bolus from your phone. It doesn't allow you to manage the whole pump from your phone, but it does allow you to bolus from your phone. If you're at work and you're at a meeting, you don't want to take out your whole pump. You could just do it directly from your phone.

The other newer tandem pump that is available is called the Tandem Mobi. This pump is about one third of the size of the regular t:slim X2, and it is completely controlled from an iPhone. It can be worn with a traditional long tube, or it can be worn with a 5-inch tube and a little pocket that it can sit in. This pump holds 200 units as opposed to the traditional t:slim X2 that holds 300 units.

For some patients who go through a lot of insulin, that might be an important factor. For some people, they really like the idea of doing everything from the phone. Other people don't like to use their phone at all. It gives different options for different types of people and what they like. The Mobi has the same algorithm as the t:slim X2, it is just a different form factor.

RK: There are so many exciting developments, as you've mentioned with these newer models. I was wondering if you could talk a little bit more about how this automated insulin infusion works and how does the pump predict what's going to happen. I've heard about pumps automatically shutting off infusions at times too, if you could talk a little bit about that as well.

AG: The tandem pump, for example, will look 30 minutes ahead based on, the Dexcom or the Libre reading, the sensor reading and based on how much insulin is already working in your body. It makes a decision every five minutes how much insulin to give you. I described the basal rate, like a dimmer switch, it goes up and it goes down based on where those blood sugars are trending. It could also, like you said, shut off so that pump, the tandem specifically, tries to keep you between 112.5 and 160 mg/dL, but it's looking 30 minutes ahead. If it thinks you're going to be above 160 mg/dL in 30 minutes, it's going to dial that basal rate up. If it thinks you're going to be below 112.5 mg/dL, it's going to dial it down. If it thinks you're going to be above 180 mg/dL, it's actually going to give you an auto correction,

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if you haven't had a bolus in an hour, automatically about 60% of what a correction dose would be. If it thinks you're going to hit 70 mg/dL in 30 minutes, it's going to just shut it off.

But it's making that decision every five minutes. You might be shut off for 10 minutes and then it goes right back on — all automatically. We see these pumps really shine particularly overnight when people are sleeping because they need different amounts of insulin, night to night, and that's when they're sleeping and not paying attention to their diabetes. We really see a significant benefit, and one third of a patient's day is sleeping. We do see a lot of improvement in the A1C because of that. Patients really enjoy waking up in a good range every morning.

RK: The automated basal setting really does have so many advantages like you talked about, and I know we'll talk about other pumps that have a similar feature as well.

There are limitations though, aren't there, which is why patients still need to bolus their insulin before meals. Could you talk about times where the automated setting may not be able to keep up with changes in glucose?

AG: During times of illness sometimes we would put someone out of the automated system and back into manual mode, depending on the pump. Or maybe we would create another profile for them with more aggressive rates, if they needed more insulin during a time of illness. Or if they were on steroids for whatever reason, you have that option. Also, during pregnancy sometimes we will take patients out of automated; for some patients we keep them on; in some patients we do half and half. Again, it's very dependent on the patient.

RK: I agree. Especially when glucose levels are changing rapidly, for instance, after meals or those kinds of situations, that can take a while for the automated setting to catch up and for some patients who may need to be reminded that getting that mealtime insulin is just as important because the automated rate can't keep up with the changing glucose levels. It still does require some effort from the patient as well.

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AG: Yes, the, patients do need to input good information in order for the pump to work well. People hear automated and sometimes just stop — hands off. But really you do need to input all that. Your meal information, the blood sugars will pull in and give you appropriate doses based on that information.

RK: That's an important point to keep in mind for all of these pumps. We talked about the Tandem pumps. What other pumps are out there on the market?

AG: There is the Medtronic pump. Medtronic has been around for a long time. Their current pump on the market is the 780G. This pump does have adjustable targets down to 100 mg/d. It is updateable, just like the other Tandem pump I mentioned before. This pump does use real batteries.

It's integrated with their Guardian sensor. It does require one calibration to go into the automated smart guard — what they call it. This typically is done about once a week for most patients. This pump has a seven-day infusion set option, which is unique. The other infusion sets are supposed to be changed every two to three days, but this one can stay in for seven days.

This pump also has what they call meal detection technology where it detects the rising rate of change in the glucose after a meal, and then we will deliver more aggressive correction doses up to every five minutes to deal with that rise post-meal.

RK: That's really interesting. We haven't yet talked about the different pump settings that an individual with diabetes should be aware of. I wonder if we could just pause here to talk about the settings that a person with diabetes should be aware of. You mentioned correctional insulin, but I realized we hadn't talked about the different components. Can you just briefly talk about those Adena?

AG: Yes. So, there is a basal rate, which is a little bit that's given every few minutes, and that can be programmed for different times of the day. All of the settings really can be programmed for different times of day.

There is an insulin to carbohydrate ratio — how much one unit of insulin covers how many carbohydrates that will be programmed in.

As well as the correction factor where one unit will lower your blood sugar, a certain number, that is also programmed.

The target is also a number that we can program into the pump. For some pump there's a correct-above number as well.

Then there's active insulin time. Active insulin time is a setting that we can sometimes change a little bit. It's not necessarily what the actual scientific studies, in terms of how long insulin will last in a person's body, but it's how the algorithm uses that number and that will guide how often a correction dose can be given and how soon a full correction dose can be given.

RK: Usually, what is a number range for that?

AG: That's typically three to four hours for most people. Some pumps are programmed at five hours for that. It just depends on the patient, and depends on the pump.

RK: And how about the carbohydrate ratio you mentioned? What are some examples of a range that people might be in for that?

AG: That could be something like one unit for 10 grams. Again, very dependent on the patient, and their insulin sensitivity. One unit for 15 grams, someone who's very resistant might be on, one unit for five grams, or four grams.

RK: Yes, there's a broad range, but I think that does give a sense of what we're talking about here in terms of carbohydrate ratio.

Then you mentioned a correctional scale. What are some examples of a correctional scale that might be given to a person on a pump?

AG: A correction factor could be, let's say 50 units. One unit will bring down a patient's blood sugar by 50 or is expected to bring it down by 50. It uses that number as well as the target to figure out how much to give if a person's blood sugar's high.

The pumps also do all of the math for you. It's good to know how to do it, the manual way in case something happens. And everyone always needs to have a backup plan in case — it is a device, things happen. You always need to have your backup plan of how you're doing it currently, or back to injections.

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RK: You mentioned quite a few pump settings and also that now the pumps can do a lot of calculations for the individual, even though it doesn't replace the need to be educated about it

and to know about it. Once the basal rates are programmed and these other rates are programmed into the pump, with the newer technologies, what do the individuals with diabetes have to do? What do they have to input in the pump?

AG: They input their carbohydrates that they're eating. For some of the pumps they just announce when they are eating, which we'll talk about soon, but they still need to input their carbohydrate intake to let the pump know this is what I'm eating. The pumps will automatically pull in that blood sugar to add the correction dose along with their mealtime dose.

RK: Then once that's calculated, does a user have to do anything to actually give that, what we call, bolus dose?

AG: Yes, there's usually a couple confirmations because we want to make sure that they really want to give the right amount. I always tell people, especially once you get used to it, "You go really quick, really fast, and it's easy to press, an extra button, or skip the decimal point — always double check when it has that, you double check to make sure you're giving the right amount that you intend to be giving."

RK: It's pretty remarkable that now that we have the integration with many of these newer pumps and a continuous glucose monitor that feeds the glucose levels. As you mentioned [with] the older pumps, often patients had to input two things — the carbohydrates they're eating and the number before a meal. But now that second part has been largely relieved by the integration of pumps with CGMs. While patients still have to input the carbohydrates they're eating, much of that additional information is already fed into the pump, which is pretty amazing.

AG: Yes, it really is.

RK: We digressed a little bit to talk about the different types of pump settings that an individual should know about — just broad categories. But going back now to the Medtronic pump that you had talked about, were there any other features or any other models that you thought would be important to talk about?

AG: That was the Medtronic one. The next pump I'd like to introduce is the Omnipod 5. The Omnipod 5 is a tubeless pump. That is integrated with the [Dexcom] G6 and the G7 sensors. It takes the blood sugar readings and adjusts the basal rate only. This pump doesn't give auto corrections, but it does adjust that basal — like that dimmer switch, we talked about earlier.

Because it's tubeless, it has a controller, a separate controller. But it is also integrated with Android apps and recently the Apple app came out.

The algorithm on this pump is adaptive, so as your insulin needs change and your total daily dose changes, it will change the rates as well. With this pump, the user can't adjust basal rates during automation.

If you make an adjustment to the basal rate, it won't affect any changes in automation. This pump is also unique because it is a pharmacy benefit. So, I don't think I mentioned earlier, but [with] the traditional tube pumps, you're locked into your warranty for four years for commercial insurance and five years for Medicare (in the United States). Meaning the

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insurance will pay for a new one every four or five years. But if it's a pharmacy benefit, patients can go on that at any point regardless of their warranty status on a traditional pump.

RK: That's really interesting. How is that determined? Whether it's a pharmacy benefit or not? Does that vary by the type of pump or the type of insurer?

AG: The Omnipod 5 is marketed exclusively as a pharmacy benefit. This pump will only be available at the local pharmacy or mail order pharmacy. Occasionally some of the other pumps, or parts of it, the supplies, can be put through pharmacy, but the actual device is put through as medical typically.

RK: That is interesting, and it has implications when patients are looking at upgrades or looking at newer models and deciding what kind of benefit makes sense for them. I appreciate you pointing that out. You mentioned that it was tubeless. How does the insulin get infused if it's tubeless?

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AG: There's the small catheter that comes out of the little pod, and that's what goes under the skin. It sits directly on the skin. You can't give insulin from the pod. Again, it needs to be done either from the controller, which is like a remote — it looks like a phone or from an actual app on your phone.

RK: That is really interesting and a different type of pump route of administration. That's important to point out as well. What other pumps are there out there?

AG: The last pump I wanted to introduce is called the iLet. This is a different type of concept pump. This pump works with the Dexcom G6 and G7, and the Libre 3 Plus.

This pump is different because, you know all the settings we were talking about before — this pump does not have those settings. The only setting you program into the pump is the patient's weight.

For this pump, you don't need to enter the precise carbohydrates that we talked about before — you're just announcing your meals. You do need to be carbohydrate aware, so you need to be able to identify a carbohydrate and be aware of if you're eating more than your usual amount, less than your usual amount or your usual amount. That is what you tell the pump and it will figure out exactly how much to give you. It takes the numbers out of diabetes management, which is a novel approach.

This pump has no real backup plan. If you're not wearing the sensor, there's no manual mode like we talked about before, because there are no settings that were input initially. Patients need to be very conscientious to always have their sensor on with this pump.

This pump is good for people who may not necessarily want to micromanage their diabetes — just announce what they need to announce and let it be, you can't give corrections at other times.

This pump holds 180 units, so it's a little bit less, but they do have some prefilled cartridges that we will [or] can sometimes get authorized for people to put in there, so it's easier to bill and just replace the insulin. But it is the smallest amount of volume that's in a pump.

RK: That's so interesting that this model of pump doesn't require carbohydrate counting the way the other pumps do. I know for some patients it can be hard to count the carbohydrates.

Especially if meals are unpredictable or not being prepared at home, or even if they are being prepared at home, if there are ingredients that are not as familiar. So I can understand how this could be an option, particularly for people who may not be as well versed in exactly counting the amount of carbs or have challenges in doing that on a consistent basis. But it seems this is more qualitative, isn't it? If it's more than you usually eat, less than you usually eat or the usual amount. Given that it doesn't seem to be as quantitative (in terms of numbers), how effective is it at really keeping the blood sugars in check?

AG: The algorithm is very strong and works really well if you don't try to outsmart it. If you try to, give meals that don't exist or if you forget to announce your meal — those are things that could mess up the learning and the algorithm. But if you do what you're supposed to do with it and you're pretty consistent, then it is a very effective way at managing blood sugars.

RK: Thanks so much, Adena, for going through those different types of pumps. Particularly the newer models within each manufacturer that are currently available. Given that there are so many great options out there, how do people decide which pump is best for them?

AG: Some people, the tube versus tubeless is a factor. Some people, the size is a factor. Some people, the phone compatibility with the apps, like we talked about, is a big factor. For some people it's the algorithm, which algorithm is, more aggressive and will help them with their blood sugar. Particularly with their management habits and eating habits.

It really is so individualized. Your provider might have some suggestions and may guide you to one based on where they think you would do well. But ultimately it really is a patient preference as to which type of model they would like to move forward with.

RK: You mentioned not only the practical benefits of relieving some of that mental calculation and mental burden compared to being on the multiple daily insulin injections, but also some of the clinical benefits as well, not only in helping to manage the high blood sugars, but also the lows — I've definitely seen that as a benefit with some of the newer technology you're talking about, the infusion rates can stop automatically to prevent lows, especially overnight when people are sleeping.

However, we know that insulin pumps aren't for everyone. So, I wonder if you could just talk briefly about who might decide not to wear a pump and what other factors might contribute to that.

AG: There are some people who don't want to wear anything on them or have a physical sign of their diabetes that's visible. But again, a lot of them have become so much smaller and more discreet that I don't hear that as often. Generally, the clinical benefits are so profound that a lot of people can move past that, to at least to try it. A lot of the different pumps, they allow you, even the ones that get processed through your medical, they do have a return policy. If you really are not satisfied with it, they will take it back and refund your insurance. I really encourage patients to try it and, see if it's something that they can get used to.

Other patients who may not be a good candidate are patients who use a lot more insulin than, if they're using 300 or more units a day, they would be changing out the pump so frequently. They also might not be a great candidate for a pump.

RK: It's definitely an individual, personal decision regarding these pumps, but a discussion that's important to have at some stage of management regarding the options that are out there.

Are there any activities to avoid while wearing a pump? How does it impact daily life at all? For instance, showering or exercising. What do people do with their pump?

AG: The tubeless pump, the pod, is always on. You don't take that off. You swim with it, you shower with it, you exercise with it — it's always on.

The traditional tube pumps while they're water resistant and watertight; we typically don't recommend swimming with it, because you never know when there's a little crack in it and you know it'll break if you go in the water. I tell people “it's okay if you get wet outside in the rain or you get sprinkled by a hose, that's fine.” But we don't generally recommend wearing it in the water.

There is a little connector piece where you can disconnect it for showering and going in the pool, for short periods of time. Without the pumping connected you're not getting that fast acting insulin. You don't have any long acting insulin in the background. Your blood sugars can go very high without any insulin in the background. Your basal rate is stopped if you remove the pump for those activities. You have to be mindful, if you do swim all day to go back and forth with your pump to reconnect, give yourself some insulin and then go back out. But generally, it's something you sleep with, you figure out how to get it to work for your lifestyle.

RK: I think that's the key is that you figure out how to make it work for your lifestyle. But it's great to know that showering, water resistant technology, is not a problem. And then different kinds of activity, like you mentioned, swimming clearly is an exceptional example where you might have to take it off and appreciate you mentioning that.

It's important that if you're ever disconnected from your insulin pump or if there's a pump malfunction that a person with type 1 diabetes particularly and in person with type 2 diabetes, who was previously on multiple daily injections, may not or probably does not produce insulin on their own. They may need to take some insulin injections until the pump, or device is restored.

Then exercise in general. I think one of the great features about these pumps is you can have an exercise setting where you can maybe reduce your infusion rate by a set percentage, let's say 50%. I know I have some patients who do disconnect the pump during times of exercise because they know their sugars go lower during some kinds of exercise.

It is just important to have that discussion, as you mentioned with your healthcare provider to know if there's any other precautions that are needed, such as snacks, taking snacks, or injecting the insulin as well. But again, it's about adapting to it, as you mentioned, which I think is the key.

Given that technology is changing so rapidly, how do people with pumps keep up with updates? Do, how do they find out about them? Does the manufacturer tell them when there are updates? Do they have to update the software every now and then? How does that work?

AG: They will be notified by the manufacturer if there's any sort of update they need to do to keep their pump in good, healthy working order and as new technologies come out, so they can update their pump.

RK: We've talked about a lot of different types of functionalities of the pumps. We've talked about how far the technology has really come over the last few decades from backpacks to really now just a deck of cards, in size. What is on the horizon? What do people mean when they talk about closed loop systems and artificial pancreas? Could you just talk about that briefly? Where are we going?

AG: In the future the goal would be less patient integration or less patient interaction with the pumps. Right now, the insulin will bring the blood sugar down, but in the future if pumps could also have glucagon, for example, in the pump that would treat the low blood sugars.

The idea is, with iLet, having no carb number inputs takes more of that patient effort out of the insulin pump management. More announcements or like the Medtronic [system] can detect the meals; to have more sophisticated algorithms to manage.

Ideally if a patient could just wear a pump and not have to bolus, that would be, the best. It's exciting, the things on the horizon. Some parts move quickly, and some parts move slower. We'll see how the next few years play out.

RK: It certainly is an exciting time. And as you mentioned, a true closed loop system would require no effort from the patient. They wouldn't have to press a button to give themselves additional insulin and a bolus for meals. They wouldn't have to pay attention to the numbers, although we would hope that would still happen. But really it would be like having your own pancreas. You don't think about it on a day to day or minute to minute basis. Really that's where the technology is heading. It will be exciting to see as we get closer and closer to that the developments to come.

In parting Adena, I wonder for our listeners out there who might want to talk about the option of an insulin pump with their healthcare provider, or maybe they've had that conversation already with their healthcare provider and they're reluctant to proceed with trying the insulin pump. What would you say to them?

AG: I really recommend them to just try it. I know people are very comfortable with the way they've been doing things and it's always scary and nerve wracking to try something new and to shake things up. I always tell people if they are willing to try it, to do it at a good time in their life and not when they're moving or starting a new job, at a good time when they could, invest into it and invest in learning it. Because there is a learning curve. It's a different way of doing it, but after a while, like with injections, you do get used to it—it becomes second nature.

I think patients really do see a huge benefit, clinically. Their blood sugars just — when I see before and after pictures of patients, they go from injections to automated closed loop pumps, it gives me chills. You just see a lot less variability, a lot less lows, and smoother blood sugars. Very often patients just feel better with that smoother blood sugar range.

RK: That certainly is something to have chills about, to think about how much these technologies can impact the person with diabetes. Particularly the population that we talked about, who could really benefit from these — really having that conversation with the healthcare provider about whether it could be an option for you.

Thank you Adena so much for being here and educating us about all the different types of insulin pump devices out there. I'm sure there are going to be many more developments in the months to come, and we look forward to hearing about those too in coming episodes. Thank you so much.

AG: Thanks for having me.

RK: I'm Dr. Rita Kalyani, and you've been listening to Diabetes Deconstructed. We developed this podcast as a companion to our Patient Guide to Diabetes website. Our vision

is to provide a trusted and reliable resource based on the latest evidence that people affected by diabetes can use to live healthier lives.

For more information, visit hopkinsdiabetesinfo.org.

We love to hear from our listeners. The email address is hopkinsdiabetesinfo@jhmi.edu.

Thanks for listening. Be well and see you next time.

