



## Basal insulin with insulin pumps

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Welcome to the module on basal insulin specifically for those who use insulin pump therapy. My name is Emma Wilmot and I'm Chair of the Diabetes Technology Network and I'm also a consultant diabetologist in Derby. These are my disclosures.

So, the learning objectives for this module are to understand the desired effects of Basal insulin on glucose levels. Ultimately, we want you to feel more confident adjusting your insulin doses based on the Libre traces that you see. But to do this I guess you need to understand the factors that can influence the insulin requirements that you have day to day.

The role of your basal insulin is to keep your glucose steady across a day when you're not eating or bolusing. The advantage of a pump is that you can change the basal rate from hour to hour to match your needs throughout the day. Typically, people that we see in clinic tend to need a bit more insulin during the morning and less insulin during the afternoon. And you can see that here on the table here. Overnight, a slightly lower basal rate and in the early hours of the morning a higher basal rate to counteract the dawn phenomenon. And then typically, people need slightly less during the afternoon. But like everything with type 1 diabetes, it's very individual and you need to find the right settings for you. When you make a change in your basal rate it can typically take around 2 to 5 hours to have an effect. And we need to build that into the programming of new basal rates when a change is needed.

So, assessing basal insulin. How do we go about this? Well, the biggest advantage of the freestyle Libre is that you finally have access to your glucose data 24/7. You can see what's happening over night and work out whether your insulin settings are correct for you or not. Really, your best to do this on a normal day if such a thing exists for you. A day when you're not stressed, you've not had a hypo, you've not done more exercise than usual etc.

So, let's have a look this. Is the basal insulin, correct? If you're able to achieve a stable flat glucose overnight, then your basal insulin dose is correct. Ideally, you'd like to achieve this every night but this is a huge challenge in type 1 diabetes because there's so many factors that influence the amount of insulin that you need and we'll come on to this in a little while.

Here is an example where the basal insulin rate is too low. And you can see that there's a gradual rise in the insulin over night. So, your basal insulin needs to be increased during this time. So, let's think about how you would actually do this. So, in this example the glucose has risen between 3 am and 7 am and bearing in mind it takes a few hours for that change in basal rate to have effect this person would therefore want to go back 2 hours and increase their basal rate between 1 am and 5



am and then have a look to see whether that has a desired effect achieving a steady flat glucose overnight.

In this example the glucose is falling over night and if you notice a recurrent fall in the glucose overnight this is a sign that the basal insulin needs to be reduced. Again, we want to start the change in basal rate 2 hours before the start of the fall. So, here's an example. This person's glucose has dropped from 3 am through to 6 am. They therefore want to go back 2 hours and will need to reduce the basal rate between 1 am and 4 am and then see whether this has the desired effect on their glucose.

Another thing that is commonly encountered in type 1 diabetes is the dawn phenomenon. So, if you notice that your glucose levels take off before you wake up in the morning and you're waking with a higher glucose, the advantage of your insulin pump is that you can program your pump so that it delivers more insulin to counteract the dawn phenomenon. So again, in this example, the glucose is rising from 3 am through to 7 am and it is a recurrent pattern. This person will therefore need to increase the basal rate from 1 am through to 5 am to counteract this.

So, what if you wake up with a high glucose in the morning? Sometimes people presume it's the basal rate over night that is the problem but actually, if your glucose is flat and stable overnight, it is probably the night before. The advantage of the Freestyle Libre is that you can look back at what happened the previous day and work out was there extra carbohydrate intake or snacking that maybe wasn't covered with insulin. Because if the glucose was flat overnight the basal rate should be ok so try to tackle the snacking the previous evening. Aim for a pre bed glucose that's in target and see how you get on.

Of course, basal rates need to be set during the day as well and this can be more challenging with pump therapy but by either skipping or delaying a meal and monitoring of glucose you can see what the pattern is. And again, if you have a flat stable glucose during this time your basal rates are good.

In this example here somebody has skipped breakfast and you can see that the Freestyle Libre trace is nice and flat and steady, and it only starts to rise when they have their lunch when they stop their fast at 12 o'clock.

So, in an ideal world this is what we're looking for. That flat stable glucose when you do a basal rate test. However, do not be disheartened if this does not happen for you because it is extremely challenging to achieve and if you can achieve this on most days then you're doing really well.

What you want is a basal rate that keeps your glucose cruising at your desired glucose level. However, there are a range of factors that are going to increase and decrease the amount of insulin that your body needs. Things that increase the amount of insulin you need are things like stress, illness, sitting around, being premenstrual. Things that reduce the amount of insulin you might need like some exercise, standing, alcohol, relaxation.



But hopefully by using the freestyle Libre you will be able to develop a detailed understanding of the impact of these things on your glucose control. And you will be able to adjust your therapy settings for them.

So here is an example. This is an AGP or ambulatory glucose profile. Let's look at the glucose overnight to see what the basal insulin is like overnight. This person is waking up with a high glucose but if you look through, on average the glucose is fairly flat overnight. This would suggest that the basal insulin is probably ok. However, let's look in more detail. Let's have a look at the daily traces. Now this is where it gets a bit more complicated and everyone living with type 1 diabetes knows that there is no such thing as 2 days the same and this makes this point very well. There's a range of glucose responses overnight but this is where your expertise comes in. This person knew that they had consumed alcohol on some nights and that caused the fall in the early hours of the morning on some nights. And to try to unpick the detail here, scan through and find a night where you start the night with a glucose that is in target. And in this case, you can see that the glucose stays within range throughout the night. So, the basal rate doesn't actually need changed here. We just need to try and work out what's going on, when and understand the factors are influencing the glucose overnight.

Another word of warning. If you experience unexplained hypoglycaemia overnight, don't wait for it to become a pattern. Reduce your basal rate the next night and prevent it happening again. If you're worried about hypoglycaemia, I'd highly recommend that you watch Pratik Choudhary's module on hypoglycaemia for more information.

In conclusion, the freestyle Libre allows you to see your glucose trends overnight. You want to aim for a basal rate that keeps your glucose steady throughout this. However, there are lots of factors that influence your glucose control, so don't beat yourself up if you are unable to achieve this. Just keep trying and always reach out to your local diabetes team for help.

Thank you very much

