Editorial

David Kerr
Editor-in-Chief

Artificial pancreas – ready for "prime time"?

"With me, everything turns into mathematics."

Descartes

"In real life, I assure you, there is no such thing as algebra."

Frances Lebowitz

When it comes to holy grails of diabetes care, the most obvious ones are prevention or cure, especially for type 1 diabetes. There are, however, less lofty ambitions including making an insulin that does not have to be injected, creating a fail-safe hypoglycaemia alarm system and being able to have an accurate and reliable non-invasive glucose monitor. Here in sunny California, some very clever people have also spent a number of years seeking another holy grail – a fully automated closed-loop system, otherwise known as the artificial pancreas or AP.

The concept of the AP is really very simple: take an off-the-shelf insulin pump and a continuous glucose sensor and create feedback-controlled algorithms that automatically adjust the rate of insulin delivery by the insulin pump based on the real-time continuous glucose monitoring data. AP systems can be uni-hormonal (using insulin alone) or bi-hormonal (where glucagon is also infused to ameliorate hypoglycaemia [Peyser et al, 2014]). Other variations include whether or not the AP system needs to have meals or exercise "announced" (i.e. the user has to inform the system), whether the AP is only for overnight closed-loop control or for 24 hours, whether the aim is to control target glucose level or a range, or whether it is fully automated requiring almost no input from the user except having to wear the devices.

Until recently, most studies of the AP have been performed in controlled situations, but now AP research is being taken out of the laboratory and into more "normal" situations. Smartphone technology has also reached a point where these consumer devices can host the AP "brain", as well as allowing for remote monitoring by professionals and family members (Hvorka et al, 2014). At the present time, clinical trials of AP systems show that they are able to maintain glucose levels between 3.9 and 10 mmol/L for around 70% of the time (The Doyle Group, 2014).

Overall progress with AP research has been slow but steady, with incremental rather than large-scale changes. There are still a number of design and human factor obstacles still to be overcome, ranging from the need for multiple devices (pump, sensor and AP controller) to variations in insulin sensitivity that occur within individuals (Kudva et al, 2014). Some of the current roadblocks will be overcome as the algorithms improve and faster-acting insulin becomes more available. However, the elephant in the AP room is the question of affordability – will healthcare systems be willing to pay for this technology and can they afford it for everyone living with type 1 diabetes?

The fully automated 24-hour closed-loop AP system is a holy grail of diabetes care, and it might be achievable in the medium- to longer-term. However, as we have already learnt a huge amount about how to use insulin more appropriately and safely through AP research, perhaps now is the time to apply the algorithms outside of AP research and into daily life. There are many clinical situations where insulin therapy is especially problematic (maintaining control of glucose levels, but avoiding hypoglycaemia and reducing glucose variability): exercise, travel, shift work and many more. Locally, there is a growing belief that the time has come for algorithms that have, up until now, only been applied in the AP scenario, to be modified for use in routine clinical practice; as they say over here, to make personalised insulin therapy "prime time". The challenge is for industry, clinicians and people with diabetes to collaborate in unison as the algorithms are embedded within new technologies. ■

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David Kerr
Director of Research and Innovation at Sansum Diabetes Research Institute, Santa Barbara, California, USA and Founder of VoyageMD.com