Digital Diabetes Technology

Kudos

I owe a debt of gratitude to Keith Runyan. His book has been helpful, though more on diet and exercise than pumps or CGMs.

I've also found Ian Lake's website and Zero Five 100 to be helpful.

Finally, Matt Vande Vegte has incredible content and led me to much of the advice and conclusions that I mention here.

Room for improvement

Digital diabetes is a complex ecosystem owing to the integration of sensors and mobile devices via bluetooth plus mobile devices and cloud systems via the 4G LTE and the internet. The devices are complex even without wireless connectivity but those things have only magnified the complexity and point to the need for human-centered design, and a non-existent last mile geek squad of technical support that is overwhelming doctors, diabetes educators, and patients.

Design problems show up despite manufacturer's best efforts to solve them and I believe this is a result of the aforementioned complexity. I have the benefit of having worked in medical devices and digital health and so I can generally intuit what's wrong when the system fails but there are at least a few cases that were difficult to debug even for someone with a shared mental model, technical depth and experience.

There are several incidents that are worth mentioning that demonstrate the challenge that these companies face in overcoming the ecosystem complexity. First, Dexcom and Tandem are not operating at NASA levels of technology delivery maturity. They are doing well enough to survive and perhaps thrive in the market, but there are cracks in the safety armor.

Almost a year ago, not long after I got the Dexcom G6, the blood glucose readouts and notifications that would typically show up on my watch or phone suddenly stopped and didn't start working for several days. This was widely reported on the internet and reached major news sites such as the Wall Street Journal.

This situation raises the need for vigilance on the part of patients, caregivers, and everyone in the technology support system to be aware that the publish-subscribe system employed by Dexcom to publish bluetooth data originating from the sensor to it's subscribers (which may be everything from the patient's watch to a parent's smart phone or other app) was dependent on a single point of failure in the cloud.

I believe Dexcom learned its lesson with crisis PR, as the company now has better status mechanisms in place, but there were a tense few days, not so much for people like me - I can live without my watch displaying blood glucose - but for parents with diabetic children or the like. Second, Tandem's software quality problems have played out slightly differently. The company was slow to market with a mobile app that interfaced with the t:slim X2, but once delivered, the app seemed polished and professional.

Unfortunately, that polish was a facade. The app worked well most of the time but as I spent more time with it, I realized that there were serious latency and queuing problems plaguing the app. This latency and queuing plague is so serious that I've considered uninstalling the Tandem app from my phone. In short, what happens is that notifications from the pump are queued and not displayed on the phone until hours after the events that triggered them. This may seem like a minor annoyance until you consider that those events are important, like insulin delivery stopped and inherently timely, like receiving the insulin delivery stopped notification when insulin delivery is not actually stopped hours later or vice versa.

The implication of this is that the state machine that has to be managed by the mobile app is out-of-synch with the insulin pump itself. The worse implication would be that there is no state machine in the design. This is a huge safety hole, one that I hope doesn't wind up causing injury or harm because it could be easily misread and lead to bad dosing decisions on the part of the patient or caregivers.

At a minimum, the app designers need to consider the cognitive dissonance that occurs when the patient receives a notification that they know is out of synch with the pump.This kind of latency may be fine in text messaging, but the design consideration in medical devices should be a serious safety concern. Third, the challenge of producing a system that is a collaborative venture between two companies such as Dexcom and Tandem, and the G6 and t:slim X2, respectively, is that the customer experience should not be concerned with crossing the chasm between Dexcom and Tandem, either legally, technically, or in terms of supply chain and support.

The past year has been challenging for everyone providing remote technical support, as many systems were not up to the

challenge of scaling to support so many simultaneous connections, both human and machine.

However, where this shows up with Dexcom and Tandem is when a device or a disposable component malfunctions, it can be confusing to navigate help lines, web sites, and email addresses without a single, unified entry point into such systems. Patients deserve better. I believe Tandem and Dexcom are working hard to improve the disconnects, but it has been challenging when support needs to transit a complex ecosystem of email, web, and phone. That said, I've had a positive experience with both Tandem and Dexcom support and they've always followed through when the products and services malfunctioned. Most commonly, this has been with Dexcom's G6 transmitter batteries. They frequently failed before their 90 day expiry and this has been resolved every time with a warranty replacement, and a sensor to account for the wasted sensor owing to the transmitter change.