Artificial intelligence: The next frontier in diabetes therapy

Medtronic

For decades, Medtronic has focused on improving glycemic outcomes and reducing the management burden of people with diabetes through innovative cutting-edge technology. Medtronic pioneered many of the 'firsts' that have transformed diabetes care since the 1990s (**Fig. 1**). The company's interest in the field started with its first-to-market wearable pump, which was followed by real-time continuous glucose monitoring. By the mid-2000s, the technology evolved to continuous glucose monitor-directed predictive insulin suspension to prevent hypoglycaemia, which demonstrated an 83% reduction in severe hypoglycaemic events[1]. In 2016, the introduction of the hybrid closed-loop algorithm (MiniMed™ 670G) automated basal insulin delivery every five minutes. The 670G study reduced HbA1c, increased time-in-range (70-180 mg/dL,) and reduced time below range (70 and 50 mg/dL) in a clinical study[2]. An advanced hybrid closed-loop system, the MiniMed™ 780G*, demonstrated even greater glycaemic control by providing a lower glucose target and auto-correction boluses delivered every five minutes, which mitigated post-prandial hyperglycaemia resulting from missed, late or incorrectly calculated meal boluses[3,4].

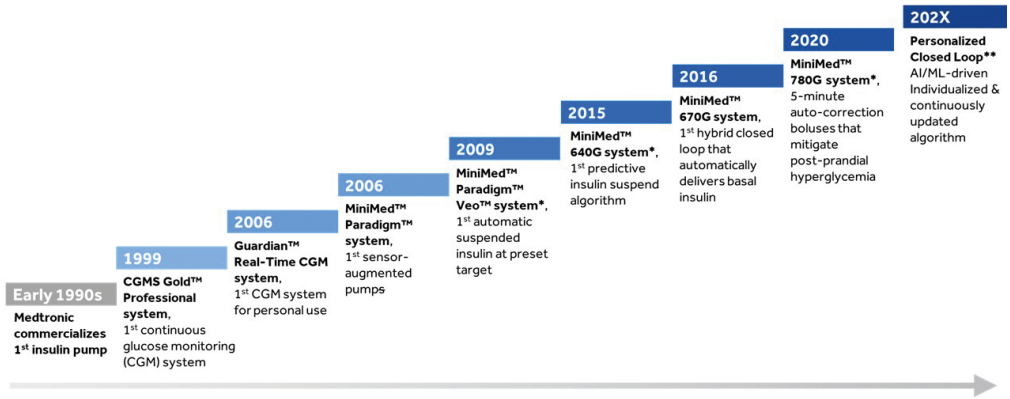

Figure 1. The evolution of glycemic control pioneered by Medtronic.

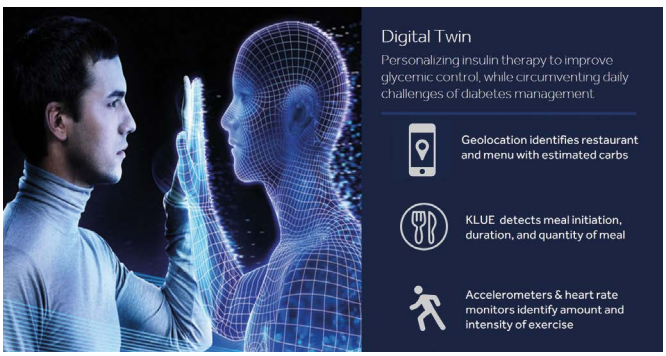

Figure 2. The "internet of things" applied to persons with diabetes includes using physiologic or activity sensors incorporated into smartphones or wearables that associate with a "digital twin" to provide important behavioral data that can be used to improve glycemia, personalize therapy, and minimize the burden of diabetes management.

Artificial intelligence (AI) will be critical to achieve the ultimate dual goals of near-normal glycaemia and reduced burden. Reducing mental burden in diabetes management cannot be over-emphasized. The multitude of decisions throughout the day can overwhelm patients, which can lead to abandonment of even the best technologies. Current systems continue to require multiple dosing decisions surrounding meals, exercise and other activities. Incorporating AI through a frequently updated 'digital twin' can circumvent daily challenges by promoting pharmaco-adherence and providing personalized management. **Fig. 2** describes how machine learning can use physiologic and/or activity sensors incorporated into smartphones or wearables to communicate with the digital twin and deliver personalized therapy that improves glycaemia while minimizing burden. For example, geolocation on a smartphone can predict the contents of an upcoming meal based on past behaviour and deliver the appropriate insulin dose before the meal. Also, hand gesture-sensing can determine when the meal starts or ends and the quantity of food consumed. Fitness monitors can identify the quantity, intensity and glycaemic response to exercise so insulin delivery adjusts accordingly.

Iteratively updating algorithms maximizes glycaemic control by personalizing therapy in a way that puts us on the cusp of developing a true artificial pancreas. Successfully incorporating AI into future products will fulfil Medtronic's mission of using biomedical engineering to restore health and reduce the management burden for people with diabetes.

*Approved for use only outside the United States
**In development. Not approved by the FDA for any use and not available for research or commercial use in the United States.

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