Life-Changing Artificial Pancreas Helps Manage Type 1 Diabetes

University of Virginia

Photo courtesy of Tandem Diabetes Care

Living with Type 1 diabetes (T1D) requires constant management. Due to a deficient pancreas, food and exercise must be manually balanced against blood sugar and regular insulin injections. Even for patients with insulin pumps and compact monitors, managing T1D creates daily medical decisions that burden basic activities with the disease's life-threatening nature.

The concept of an artificial pancreas, based on a complex algorithmic combination of pumps and monitors into one closed-loop system, has been around for as long as pumps and monitors themselves. And yet, it has for decades remained unsolvable, a far-flung hope flying the face of the reality that emulating organic pancreatic function presents impossibly complex problems.

> *The impossible became a reality after decades of effort from a collaborative team of mathematicians, engineers, physiologists, clinicians, alumni, and a software startup company from the University of Virginia (UVA).*

Among the group of interdisciplinary researchers from the UVA Schools of Medicine and Engineering in Charlottesville, VA were Boris Kovatchev, Ph.D., who was inducted into the National Academy of Inventors in 2020, Stephen Patek, Ph.D., Patrick Keith-Hynes, Ph.D., Marc Breton, Ph.D., and Stacey Anderson, M.D.

The research team attracted early funding in 2006 from the National Institutes of Health, the Juvenile Diabetes Research Foundation (JDRF) and UVA's LaunchPad supported by the Manning Family Foundation. This support enabled the development of a simulator that digitally replicated the human metabolic system in order to connect Continuous Glucose Monitoring (CGM) systems to insulin pumps. Pre-clinical trials of automated insulin delivery using the simulator began at UVA in 2008 and expanded to include 10 other centers across seven countries.

By 2011, ongoing research and development led to new iterations of the device that had shrunk from a bulky computer system into a wireless smartphone device, leading to staggering success in further clinical trials. Recognizing the strength of the team's research and intellectual property portfolio, the UVA Licensing & Ventures Group (LVG) tapped UVA alumnus Chad Rogers to launch TypeZero Technologies, Inc., in 2013, with a license for the artificial pancreas technology. When TypeZero launched, it held the single largest patent portfolio ever licensed from LVG, which leveraged more than 30 clinical trials with more than 500 patients at 12 sites, including one at UVA. Several members of the research team, including Stephen Patek and Patrick Keith-Hynes, joined the company to further develop and productize the "artificial pancreas."

In 2015, TypeZero received the first investment from the newly established $10 million LVG Seed Fund, enabling the company to further develop the platform and attracted Dexcom Inc., and Tandem Diabetes Care as partners for a large-scale, multi-site NIH-funded clinical trial.

"This story is representative of what is possible when we harness the full capacity of this institution to support innovation," said Michael Straightiff, LVG Executive Director. "Our interdisciplinary team of researchers leveraged federal funds, the financial generosity of our alumni, and our sophisticated translational research infrastructure to engineer technologies to relieve the heavy decision-making burden from patients living with diabetes. Then, in partnership with our research team, LVG once again leveraged the time and talent of our alumni to build, invest in, and sell a company that productized these early technologies. The story, though not yet over, has culminated in local economic development, return on investment, and, most importantly, lives enriched and improved by the University of Virginia."

In August 2018, Dexcom, Inc. acquired TypeZero Technologies, Inc., uniting the groundbreaking artificial pancreas technology with an industry giant capable of bringing TypeZero's innovative solutions to the commercial market. The acquisition marked the first exit for the LVG Seed Fund, and the artificial pancreas reached a coveted commercialization status rarely achieved by university technologies.

The technology made its commercial debut with Tandem Diabetes Care in January 2020 as Control-IQ™, and has since improved the lives of more than 155,000 patients with Type 1 diabetes. The system is the first of its kind to secure FDA approval and integrates with the Dexcom G6 CGM system. The increasing potential of Control-IQ™ motivated a five-year sponsored research agreement with Dexcom that LVG helped secure to continue advancing the Type 1 and Type 2 diabetes research at UVA.

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