



# CHILDREN'S MERCY STUDIES IMPACT OF MACHINE LEARNING ON T1D OUTCOMES

## IMPROVING TYPE 1 DIABETES CARE IN REAL TIME USING PREDICTIVE MODELS

More than 18,000 new cases of type 1 diabetes (T1D) are diagnosed among young people under age 20 in the United States each year, according to the American Diabetes Association. Studies show that poor disease control at any age significantly raises lifetime risk of serious complications, such as heart disease and kidney disease.

**Can we predict which patients are at risk of poor outcomes so we can begin intervention sooner?**

In mid-2017, a project was launched to find out. Children's Mercy Kansas City and Joslin Diabetes Center in Boston teamed up with the machine learning-powered performance improvement company Cyft, Inc., to address this challenge. The effort was funded by the Leona M. and Harry B. Helmsley Charitable Trust. Working with Cyft, Children's Mercy and Joslin began to collect data and find opportunities to deploy machine learning to turn data into useful insights that could be provided to clinical staff at the point of treatment.

Leading the effort at Children's Mercy was endocrinologist and Medical Director for the Pediatric Clinical Research Unit Mark Clements, MD, PhD.

## THE BASICS OF MACHINE LEARNING

The foundation of the project was machine learning, a set of mathematical tools that make it possible to detect patterns in large collections of data. Machine learning, unlike traditional statistical models that rely on highly structured discrete data sets, can generate robust insights from a combination of discrete data, such as lab values, and unstructured data, such as free-text notes

found throughout electronic health records (EHRs). These models can be used to detect and alert caregivers to opportunities to intervene with patients at risk for near-term deterioration in their health.

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## METHODOLOGY: COLLECTING AND PROCESSING PATIENT DATA

Dr. Clements and his team developed a three-step process to create parameters for the project.

**STEP ONE:** Collect data from EHR, diabetes device data, and patient-reported outcomes data dating back to 2012.

- Clinical narratives from all care team members
- Patient-reported outcomes during clinic visits
- Continuous glucose monitor, insulin pump, and glucometer data
- Data from new electronic clinic intake forms that families complete on tablets
- Discrete data points, such as lab values, disease type and early outcomes

**STEP TWO:** Define all of the possible characteristics of patients at risk of poor outcomes.

**STEP THREE:** Sort through all the collected patient data using natural language processing to evaluate 17,500 features and variables that potentially contribute to a risk of deteriorating blood glucose control.

## OUTCOMES: DATA REVEALS OPPORTUNITIES TO IMPROVE CARE IN REAL TIME

Of the 17,500 variables, approximately 300 were deemed significant in predicting patients who would have the highest rise in HbA1c in the next 90 days. Based on these predictions, the team is able to implement quality improvement methods to clinical care, offering immediate alternate pathways of care for those at high risk of negative outcomes. The first intervention currently is being piloted at Children's Mercy, as described below.

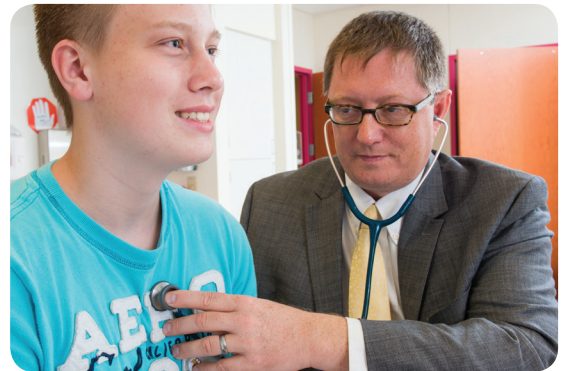
## ADDRESSING PREDICTED RISE IN HBA1C WITH TELEHEALTH VISITS

The standard of care is a clinic visit every 90 days. For patients who are predicted to have deteriorating blood sugar levels within the next 90 days, timely intervention is needed, before their next visit. The team reviewed research literature, looking for interventions most likely to prevent a significant rise in HbA1c with the least disruption to the current system of care. Telehealth rose to the top of the list.

Published literature suggests that more frequent contact with care providers, along with review of diabetes data, leads to better outcomes<sup>1,2</sup>. The team decided to combine telehealth with more frequent visits. They designed an intervention that offers two to four extra visits between clinic visits, using video technology.

The team collected data to build the predictive model that will generate weekly reports on predicted outcomes, so the team can review the list of patients and implement the intervention as needed. Providers in the Diabetes Clinic agreed to take on five additional patients predicted to have a rise in HbA1c in the next 90 days.

Once the intervention has been fully implemented and outcomes are understood, the ultimate goal is to automatically send output from the predictive model directly into the hospital's EHR to provide real-time alerts that pop up within the system.



*The team determined approximately 300 variables that were deemed significant in predicting patients who would have the highest rise in HbA1c.*

## SOURCES

<sup>1</sup> Association between diabetes control and visits to a multidisciplinary pediatric diabetes clinic. Kaufman FR, Halvorson M, Carpenter S. *Pediatrics*. May 1999; 103(5 Pt 1):948-951.

<sup>2</sup> Care utilization in a pediatric diabetes clinic: cancellations, parental attendance, and mental health appointments. Markowitz JT, Volkening LK, Laffel LM. *J Pediatric*. Jun 2014;164(6):1384-1389.



### LEARN MORE ABOUT THIS PROJECT OR DIABETES CARE.

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