Using a Predictive Model for People with Prediabetes: Disseminating Patient-Centered Estimates of Benefit

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Challenge Posed by Prediabetes

One in three U.S. adults has prediabetes—elevated blood sugar, but not high enough to indicate diabetes. People with prediabetes are at higher risk of developing type 2 diabetes over the next few years.

A landmark clinical trial (1996–2001), the Diabetes Prevention Program (DPP) Study, demonstrated that two interventions could reduce the risk of developing diabetes:

- An intensive lifestyle program, now available as the National DPP, and
- Taking metformin, although it benefits only people with prediabetes who are in the highest quartile of risk for developing diabetes.

In an earlier PCORI-funded study, the Predictive Analytics and Comparative Effectiveness (PACE) Center at Tufts Medical Center combined data from the DPP Study with EHR data from 2 million people with prediabetes, from OptumLabs. They developed a predictive model to estimate individual risk of developing diabetes within 3 years.

We know from the data that this model is a much better predictor than any individual clinical parameter, such as HbA1c, that providers might otherwise use to assess an individual's risk of developing diabetes.

This study focused on the use of this model by primary care providers, at the point of care, to inform shared decision-making for people with prediabetes.

Dissemination and Implementation

The PACE Center at Tufts collaborated with AMGA to implement the model in the EHRs of two AMGA member organizations:

- Premier Medical Associates, a 100-provider multi-specialty medical group in Pittsburgh, using the Allscripts TouchWorks EHR, and
- Mercy, a 3,000-provider integrated system based in St. Louis and serving patients across four states, using the Epic EHR.

In both EHRs, the 11-variable model was integrated into the clinical workflow, with automatic retrieval of model variables from the patient's record (the model is tolerant of missing data). Premier used a medical calculator application embedded in the EHR, Galen eCalcs. At Mercy, Interopion developed a cloud-hosted SMART app using FHIR standards, which was integrated into Epic's patient encounter workflow.

Results are presented here for Premier only. At Mercy, the SMART on FHIR app was successfully implemented in Epic during the initial phases of the COVID-19 pandemic, but the stress of subsequent COVID surges led leaders at Mercy to withdraw from this dissemination and implementation research.

Patient and Provider Focus Groups

Consistently, **people with prediabetes** said they wanted a personalized estimate of their risk of developing diabetes. Most focus group participants were able to quote the ages at which several family members developed type 2 diabetes. They were already thinking about their own personal risk in probabilistic terms, using the data they had available.

Providers want individualized risk estimates for their patients, both to inform shared decision-making and to gain some sense of prioritization within the seemingly over-whelming number of people with prediabetes.

The cloud-hosted SMART on FHIR app developed for Mercy is now available from Interopion for implementation in any leading EHR, with no license fee, only the cost of implementation and on-going hosting and support. Contact jcuddeback@amga.org.

Personalized Risk Estimates

The lower right-hand image is the user interface of the SMART app in Epic at Mercy. With usual care, this patient has a 17.1% chance of developing diabetes within 3 years, placing them in the high-risk group. But their risk drops to 7.2% if they complete the DPP or 13.2% if they take metformin. The app allows the provider to edit data retrieved from the EHR—patient race, smoking status, and having a diagnosis of hypertension, in this example. A separate "patient view" (the second of the three tabs at the top of this screenshot) displays the risk estimates graphically.

Only the tabular display (at the top of this screenshot) was available at Premier.

Use of the Model by Providers

About 2,500 people with prediabetes were seen in primary care at Premier from May 2018 through December 2019. In the first 9 months, the model was run for 52% of patients with prediabetes, increasing to 82% by 19 months.

Interventions by Risk Level

Before the model was implemented at Premier, no one with prediabetes had been referred to the DPP program at the local YMCA, and fewer than 5% of people with prediabetes had been prescribed metformin.

With the model, interventions were strongly risk-stratified:

Risk Level	Received an Intervention
High (top quartile)	74% (~ 2/3 referral to DPP, 1/3 metformin Rx)
Intermediate (middle half)	19%
Low (lower quartile)	8%

Over 19 months, 118 patients received a timely diagnosis of type 2 diabetes, partly as a result of increased screening that providers felt comfortable doing, knowing they could prioritize the additional people with prediabetes who are inevitably identified when screening for diabetes.

Outcome of DPP Referrals

Of 487 people with prediabetes who were referred to the DPP in the first few months after the model was implemented at Premier, 124 (25%) called the YMCA to inquire, and 64 (13%) enrolled in the YDPP. They achieved an average weight loss of 7.4% (the "design goal" of the DPP is 7%).

Discussion

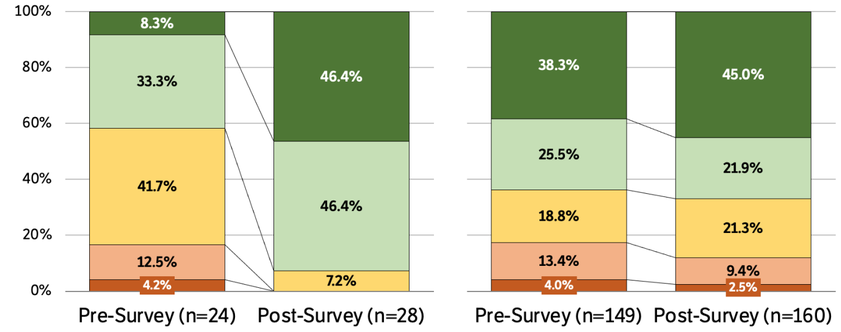
Pre/post surveys of providers and patients at Premier Medical Associates (upper right-hand figure) showed that providers felt far more confident *with the model* in their ability to estimate the risk of progression to diabetes for individual patients. Without the model, patients felt more confident than providers. But their increase in confidence with the model did not mirror the increase experienced by providers.

Nationally, very few people with prediabetes enroll in the DPP or receive metformin. This model provides a personalized estimate of risk and benefit. It can engage patients and empower providers, informing shared decision-making around treatment choices.

Providers and health systems need tools to help prioritize limited resources and increase patient treatment, referral, and adherence through more targeted and tailored treatment recommendations.

Survey Results: Providers and Patients

Providers: How confident do you feel about estimating the risk of progression to diabetes for your patients with prediabetes?



Patients: How confident are you that you understand your risk of getting diabetes?

User Interface of SMART on FHIR App Implemented in Epic EHR at Mercy