State University Partnership Research Brief
Longitudinal Analysis of Type 2 Diabetes in Medicaid Beneficiaries

Partner University: University of Louisville
College/School: School of Public Health and Information Sciences
Principal Investigator: Bert Little, PhD

What is Known on This Topic?
Diabetes mellitus is a serious public health concern in Kentucky, and is particularly prevalent amongst adults enrolled in Medicaid. Diabetes is debilitating for individuals and expensive for insurers when it progresses to severe complications, such as End Stage Renal Disease.

What Did this Project Do?
This project used several years of Medicaid claims to build a predictive model, with the aim of early-identification of a clinical profile of patients likely to progress to one of five severe diabetic complications. These five complications were: (1) Diabetic nephropathy; (2) Diabetic cardiovascular disease; (3) Peripheral artery disease; (4) Diabetic neuropathy; (5) Diabetic retinopathy.

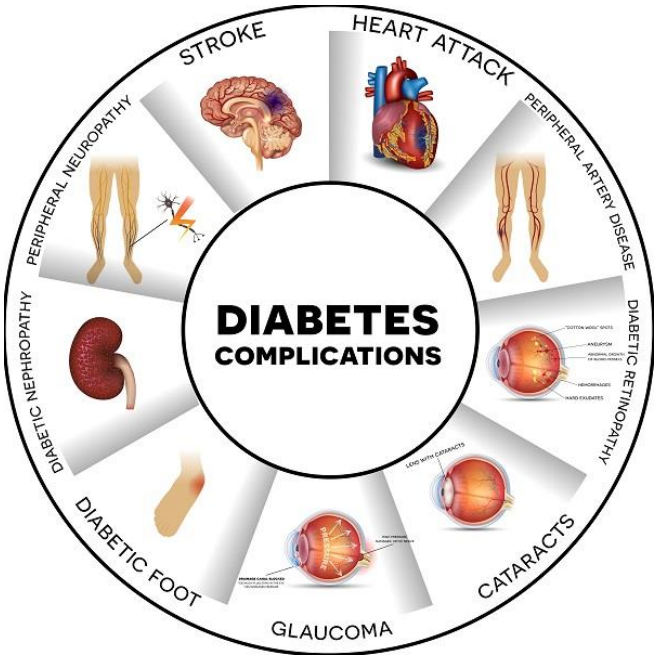
What Could Medicaid Do with These Conclusions?
It was possible to predict these end stage events with 72%-83% accuracy at 420-270 days before the condition was diagnosed. These results suggest a means of effective early intervention to prevent some of the most severe complications of diabetes. Study authors propose the use of their new predictive model to inform the case management activities of Medicaid Managed Care Organizations in Kentucky.

Introduction

Diabetes Mellitus is a serious disease; one that often progresses to severe organ damage if it is poorly controlled. Table 1 illustrates the most common of these complications of Diabetes. At 13.4%, Kentucky has the fourth highest prevalence of Type 2 Diabetes in the U.S. (roughly 458,000 people in 2015). Among Kentucky's Medicaid population, the prevalence of Type 2 Diabetes is even higher at 18% – nearly 1 out of every 5 beneficiaries. In 2015, there were 94,050 Medicaid beneficiaries that made at least one healthcare claim – approximately 20.5% of people in with Diabetes in Kentucky. The American Diabetes Association estimates that the total direct healthcare costs associated with providing treatment for Type 2 Diabetes in Kentucky was $2.66 billion (2015 dollars). Five of the most clinically significant and costly complications of Diabetes are: (1) Diabetic nephropathy; (2) Diabetic cardiovascular disease; (3) Peripheral artery disease; (4) Diabetic neuropathy, and; (5) Diabetic retinopathy.

In the clinical setting, it can be difficult to predict which patients will progress to one of these severe Diabetic complications. While there are many established treatment protocols and patient education tools to help people manage their Diabetes, these often have mixed results – frequently as a function of the social determinants of health. For example, patients who struggle to access healthy foods (i.e., those who live in "food desserts") have limited capacity to adhere to nutritional recommendations to manage their Diabetes. Tools to assist healthcare providers in the early identification of serious complications – before the most debilitating symptoms ever develop – would confer a significant advantage in preventing morbidity and mortality.

Figure 1: *Common Complications of Diabetes*



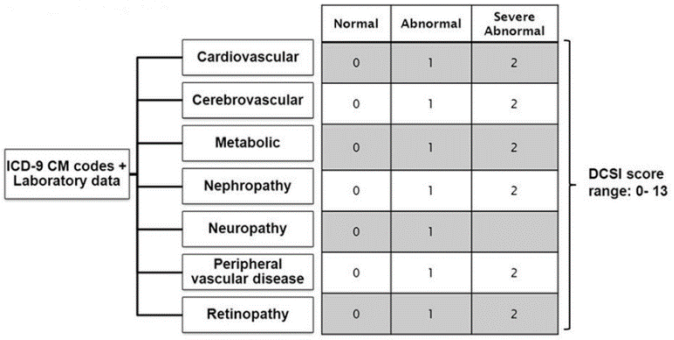
University of Massachusetts Medical School (accessed at https://www.umassmed.edu/dcoe/diabetes-education/complications/)

Project Methods and Results

This project was designed to develop just such a tool. Predictive analytics are becoming increasingly common in healthcare settings, and can be utilized to assist providers in their selection of the most appropriate treatment option, as well as how they should target their interventions towards patients that are most at risk of adverse outcomes. In this case, study authors aimed to use Medicaid claims to create a statistical tool that could enable healthcare organizations to predict which of their patients was at highest risk of developing each of the aforementioned five serious diabetic complications.

To facilitate this project, de-identified Medicaid claims data was shared by the Kentucky Cabinet for Health and Family Services to the research team at the University of Louisville School of Public Health and Information Sciences. Medicaid claims data from January 1, 2010 to December 31, 2018 were utilized to build the predictive model. Data from the claims was used to compute: (1) the Diabetes Complications Severity Index (DCSI) modified for CMS claims data, and; (2) the Charlson Index. The number of days until the unique diagnosis types were possible because dates of service were included with each claim line. The sample analyzed included Medicaid beneficiaries with Type 2 Diabetes who had 9 years of follow-up, and included only individuals aged 30 – 89 years old.

Figure 2: *The Diabetes Complications Severity Index*



Once the research team prepared this data for analysis, a series of statistical models were fit to predict which risk factors were most significant in terms of early identification of each of the aforementioned significant complications of Diabetes. Specifically, the study authors analyzed the transformed claims codes data over time using Cox regression with time-varying covariates. The outcomes were associated with the number of days to the event (e.g, diagnosis of End Stage Renal Disease). In this model, a larger number of days to achieve an event would be considered protective (i.e., a clinical phenomenon that decreased the likelihood of the adverse event), and covariates that were protective had this effect. Conversely, covariates that decreased days to event were a positive hazard and considered an increased risk (i.e., a clinical phenomenon that increased the likelihood of the adverse event).

Figure 2: *Survival Function Describing End Stage Renal Disease*

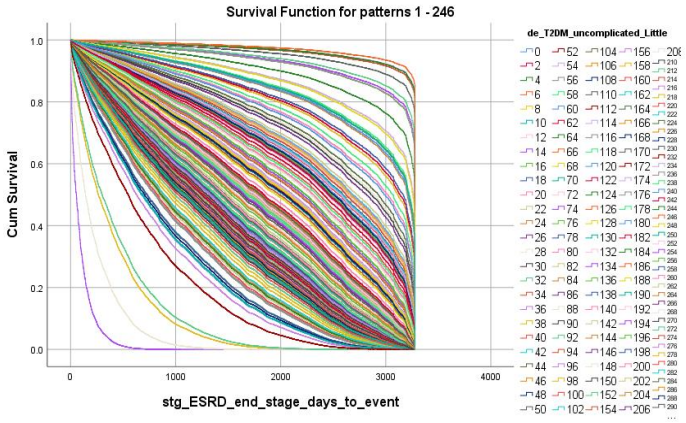


Figure 2 describes the results of the survival analysis predicting the occurrence of End Stage Renal Disease. This model correctly classified 83% of those who developed End Stage Renal Disease during the study period.

Conclusions & Health Policy Implications for Medicaid

The capacity to reliably estimate which patients are significantly at risk for developing severe complications ultimately allows providers to intervene earlier – possibly preventing such cases for many patients. The study authors specifically mention how this predictive model could be paired with recent clinical insights related to the use of sodium-glucose co-transporter 2 (SGLT2) inhibitor drugs to prevent these Diabetic complications – especially Diabetic nephropathy.[1-3] This could potentially allow for new interventions to significantly reduce disease burden and systemwide healthcare costs. These results have utility for Medicaid providers, researchers, and Managed Care Organizations.

References

[1]Zelniker, T. A., Wiviott, S. D., Raz, I., Im, K., Goodrich, E. L., Bonaca, M. P., ... & Bhatt, D. L. (2019). SGLT2 inhibitors for primary and secondary prevention of cardiovascular and renal outcomes in type 2 diabetes: a systematic review and meta-analysis of cardiovascular outcome trials. *The Lancet*, *393*(10166), 31-39.

[2]Dorsey-Treviño, E. G., González-González, J. G., Alvarez-Villalobos, N., González-Nava, V., Contreras-Garza, B. M., González-Colmenero, A. D., ... & Rodriguez-Gutierrez, R. (2020). Sodium-glucose cotransporter 2 (SGLT-2) inhibitors and microvascular outcomes in patients with type 2 diabetes: systematic review and meta-analysis. *Journal of Endocrinological Investigation*, *43*(3), 289-304.

[3]Heerspink, H. J., Karasik, A., Thuresson, M., Melzer-Cohen, C., Chodick, G., Khunti, K., ... & Nicolucci, A. (2020). Kidney outcomes associated with use of SGLT2 inhibitors in real-world clinical practice (CVD-REAL 3): a multinational observational cohort study. *The Lancet Diabetes & Endocrinology*, *8*(1), 27-35.