CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Kimberly A. Stahovich

Project Number

S0831

Project Title

Using Machine Learning to Predict Postprandial Blood Glucose in Type 1 Diabetics

Abstract

Objectives/Goals

People with Type 1 Diabetes (T1D) must compute an insulin bolus dose for every meal to cover the carbohydrates and return the blood glucose (BG) level to euglycemia (normal level). The goal of this project is to create an algorithm to accurately predict BG levels two hours after a meal, which will enable people with T1D to compute insulin doses more accurately. Typically, bolus doses are computed using a carb to insulin ratio (i.e., "carb counting") and the current BG level. This approach is inaccurate because it ignores many factors such as prior BG dysregulation, exercise, food composition, stress, hormones, and sleep. This project will examine several of these factors.

Methods/Materials

The following data was collected over a 30 day period: insulin infusion data from a Tandem t:slim pump, BG data from a Dexcom G5 continuous glucose monitor, heartrate data from an Apple Watch, and nutritional information from the MyFitnessPal app. Data was extracted from these sources and used to create variables to predict BG levels. The Weka machine learning toolkit was used to train models using these variables and to determine which of the variables have the most effect on blood glucose.

Results

Variables were created to characterize BG dysregulation, heartrate (exercise), and meal composition. These variables were used to train a machine learning algorithm to predict 2-hr postprandial BG levels. This approach is much more accurate than the standard method, carb counting, at predicting 2-hr postprandial BG levels. Carb counting achieved a correlation of $R = 0.35$, while the new approach achieved $R = 0.74$.

Conclusions/Discussion

I was able to build a model that accurately predicts 2-hr postprandial BG levels. This model will enable patients to optimize bolus doses to achieve their target postprandial BG level. The project has resulted in several findings. First, machine learning can be used to improve insulin dosing. Second, the project demonstrated that heartrate, prior BG levels, and food composition are all important for computing accurate insulin bolus doses. Third, measuring BG levels 1-hr postprandial can enable more accurate glycemic control. This work is a step toward creating a completely closed-loop insulin delivery system. However, more immediately, the project has resulted in a method (1-hr postprandial BG measurement) that can enable people with T1D to more accurately control their BG levels.

Summary Statement

Using machine learning techniques with data about heartrate (exercise), blood glucose dysregulation, and meal composition enables accurate prediction of two-hour postprandial blood glucose levels in Type 1 Diabetics.

Help Received

I came up with this project topic on my own. I also collected the data and constructed the machine learning models by myself. My father helped me in extracting raw data from the various devices and converting it to a useable format. He also assisted me by critiquing my writing and poster.