

Using Artificial Intelligence Technology to Overcome Some Behavioral Psychological Resistance for Diabetes Patients on Controlling Their Glucose Level (GH-Method: Math-Physical Medicine & Mentality-Personality Modeling)

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Introduction

Medical professionals use a standard test to determine the severity of type 2 diabetes (T2D) in a patient based on Hemoglobin A1C (A1C), which has two different types of glucoses. First, postprandial plasma glucose (PPG) contributes about 70%-80% of A1C, which has two major influential factors such as quality of food (carbs/sugar intake amount, ~39%) and exercise (post-meal walking, ~41%). Second, fasting plasma glucose (FPG) contributes about 20%-30% of A1C, which weight is the major influential factor (quantity of food, ~85%).

T2D patients have constantly faced three major challenges:

1. Availability of accurate disease information with either physical evidence and/or quantitative proof, not just some general qualitative descriptions that may include false or commercial driven news over the internet (*knowledge* issue).
2. Awareness of disease status and overcome self-denial by moving to “psychological acceptance” in order to take effective action. The most difficult barrier to overcome is to have willpower, determination, and persistence on lifestyle change (*psychology* issues).
3. A non-invasive, effective, and ease of use technology-based tool to accurately predict glucose outcomes and also guide patients (*technology* issue).

Among these three challenges, psychological is the most difficult one and is also not easy to be quantified. Nevertheless, the author attempted to use technology as the “break-through point” of a patient’s psychological barrier.

Method

The author spent two years collecting ~8 million data on food, meals, and nutrition. For a period of 1,483 days from 6/1/2015 - 6/23/2019, he collected 4,449 meal photos with their associated PPG data. During a period from 5/5/2018 to 6/23/2019, he further generated 1,152 PPG waveforms containing 13,824 fluctuated PPG data over a three-hour timeframe for each meal. The author also included these two measured PPG datasets as a part of his “master food database”.

He then applied his acquired physics knowledge and engineering skills from the past 50-years, including optical physics, wave

theory, signal processing, energy theory, to develop an artificial intelligence (AI) based PPG prediction model. He also defined a natural intelligence (NI) model, i.e. using his eyes to look and estimate the carbs/sugar amount in his food and using his brain to process the relationship between food and glucose. This is based on his 9-years of study and research on these subjects. In summary, with each meal photo, he also keeps three associated PPG data, finger-piercing measured PPG, NI predicted PPG, and AI predicted PPG. During the past 384 days, he has further added an additional 13,824 sensor-based PPG data in order to understand PPG’s micro-fluctuations within the three-hour timeframe.

He has continuously improved his AI-based PPG prediction model over the past four years. Finally, he decided to convert this technology into a user-friendly APP software tool on both smart phone and personal computer for worldwide diabetes patients to use. He named the tool “AI Glucometer (AIG)”.

Results

The author has published several papers regarding the comparison of finger measured PPG and AI predicted PPG, including four clinical cases of severe T2D patients. All of these four clinical case results show a greater than 97% of PPG prediction accuracy except case C, which shows only a 90% accuracy due to some inaccurate exercise inputs. Case A (the author himself) has sufficient knowledge of diabetes and nutrition to push his NI accuracy to 99.99%, while his AI accuracy reached 99.66%, (of course, his NI created this AI).

The following three simple steps are aimed for T2D users of AIG:

1. You enter your morning body weight into AIG. Before you eat your meal, take a picture of your meal/food and store it in AIG.
2. AIG will then show your predicted FPG level in the morning. If your FPG level is high, control your three meal quantities and snacks during that day in order to reduce your body weight. Through this second step, 20-30% of your A1C will be under control.
3. If your PPG level is high, reduce or remove part of your meal containing high carbs/sugar. (Next phase of AIG enhancement will include suggestions made by AI regarding which part of your food and how much of your food should be reduced or

removed). Also, enter your planned post-meal walking steps or walking time (in minutes) into AIG in order to get an accurate PPG prediction. Through this third step, 70-80% of your A1C will be under control.



Figure 1: AI Glucometer with meal photos

Conclusion

Most diabetes patients have many excuses to avoid measuring their glucose values, which is the initial obstacle in controlling their disease. The possible excuses are:

“I am afraid of blood; it’s too much trouble; too much pain from finger-piercing; and/or it costs too much (~\$4 per day).”

Now, by using the free AIG tool and following the three simple steps mentioned above, it will be much easier for T2D patients to know their diabetes condition level instantly with high accuracy. It is also painless, trouble free, and available at no cost. The author hopes his invention based on his 24,000 hours of diabetes research can provide some help to T2D patients with their first step of fighting this disease [1-7].

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