Community and Family Medicine via Doctors without distance: Using a simple glucose control card to assist T2D patients in remote rural areas (GH-Method: math-physical medicine)

Introduction

In this article, the author presents his concept of utilizing a simple glucose control card based on his big data analysis results to implement his vision of “Doctors without Distance” to provide community and family healthcare for type 2 diabetes (T2D) patients, especially for those living in remote rural areas or underdeveloped countries.

Methods

The author has spent ten years collecting approximately 2 million data of chronic diseases and their complications along with details of a lifestyle management program. By utilizing theories and techniques from mathematics, physics, engineering, and computer science, he developed a sophisticated computer software on the iPhone to predict his body weight, glucose, and HbA1C (A1C) with an accuracy greater than 95%, as well as his risk probability % of having cardiovascular disease (CVD), stroke, chronic kidney disease (CKD), diabetic retinopathy (DR), and pancreatic beta cells self-repair rate. He has used his developed MPM method and various tools to help himself and other T2D patients to keep their diabetes under control.

He wrote an article in 2019 to describe his concept of “Doctors without Distance” and related methodology to help T2D patients (reference 1). Those practical methods behind the concept can only be applied easily in nations with high percentage of literacy, availability of both Internet and smart phones. However, for the underdeveloped nations and certain remote rural areas in developed nations, it would encounter some difficulties. After realizing those restrictions, the author decided to change his implementation method and modified his developed tools to fit into those situations. The sophisticated academic theories and advanced technologies in the background remain the same; therefore, he will not discuss it in this article because this paper focuses on implementation. For readers who are interested in the background knowledge and complicated methodology, please refer to the author’s online written papers.

Depending on the age and prior medical conditions, the goal for diabetes patients is to be able to control their HbA1C values either below 6.0% or 7.0%. Fasting plasma glucose (FPG) contributes ~25% of A1C and its main influential factor is the body weight (~80% of FPG). Furthermore, weight is mainly dependent on meal’s portion. Postprandial plasma glucose (PPG) contributes ~75% of A1C and its two main influential factors are carbs/sugar intake amount (~39% of PPG) and post-meal walking steps (~41% of PPG). Based on the information mentioned above, diet plays an important role on A1C control. Besides, food, meal, and diet are much more complicated than the subject of exercise due to their scope of knowledge, variety of choices, and depth of food nutritional information. Based on his research knowledge and personal experience on glucose control, exercise is simpler than diet because it can be accomplished by selecting one type of exercise that is easy to do and have the most effective impact on glucose. For people of varying ages and residing in different nations, walking is a good option.

The author started to collect his lab-tested HbA1C values in 2000 and his finger-piercing tested glucose (one FPG and three PPG per day) in 2012 (Figure 1). Once he determined the quantitative relationship between glucose weight, diet, and exercise in 2014-2015, he started to collect his carb/sugar intake amount in grams and post-meal walking in one thousand step increments (K steps) on 6/1/2015. Starting on 5/5/2018, he began measuring and collecting his gluoses by using a continuous glucose monitoring (CGM) sensor device at ~80 time per day and 12 times per meal (Figure 1). With these collected CGM sensor glucose data, he could calculate and store five key characteristic values of glucose waveform’s candlestick for each meal group, i.e. beginning PPG, Maximum PPG, Minimum PPG, closing PPG, and average PPG (Figure 2).

Any scientific study always starts with a simple idea or concept. Once various theories, equations, tools, techniques are introduced into the research work, it becomes far more complicated. Only a small percentage of scientists who can further reduce these complicated scenarios into a simple form and shape to meet the requirements of real-life applications without losing its solid academic and strong theoretical background. The author’s medical research is no exception from this normal path. After applying topology, no linear algebra, finite element model, mechanical and structural deformation and fracture situations, elastic and plastic behaviors, big data analytics, artificial intelligence, machine learning, segmented pattern analysis, statistical tools, wave theory, energy theory, and quantum mechanics, his developed medical system became sophisticated and complex for most people to comprehend, let alone to use in real-life applications. This article indicates his first attempt to bring his complicated model to a real-life application of glucose control for the majority of T2D patients in the world.
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Figure 1 Finger PPG, Sensor PPG, Candlestick PPG.

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Figure 2 Sensor PPG waveforms, 5 carbs segments and total waveform.


Results

Instead of asking patients to understand and follow all of his developed rules, purchasing and utilizing an expensive iPhone device, seeking Internet access in rural areas, he decided to develop a plastic laminated card with two sides of printed information for controlling their PPG values of each meal. The front side shows a two-dimensional chart with a total of 25 sub-regions with a 5 by 5 table (Figures 3–5). Within each sub-region, it indicates either one glucose level (such as 110 mg/dL) or a range of glucoses (such as 110 mg/dL - 129 mg/dL). For different nations adopting different glucose units, their healthcare professionals can perform the unit conversion by themselves. On the back side of this simple glucose control card, it lists a summarized guidance for carbs/sugar intake amount with a focus on food product made from starchy food such as rice, grain, flour, noodle, potato, root carbohydrates, and lots of different vegetables (Figures 4–6).

Figure 3 Finger PPG, Sensor PPG and 5 carbs/sugar segments with walking steps.

Figure 4 Carbs/Sugar amount for starchy food, low-carbs vegetables, high-carbs vegetables.

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He utilized his own big data to develop the contents of this simple glucose control card. First, he separates his carbs/sugar intake amount into 5 segments on the x-axis. He uses two databases to build up this chart. First, he uses finger-piercing PPG data of 5,980 meals (including some snacks or fruits) within 1,815 days from 6/1/2015 through 5/21/2020 (Figures 1 and 4) to list a single PPG value in each sub-region. Second, he uses both of his finger-piercing PPG data (lower bound) and CGM sensor PPG data of 2,256 meals including some snacks or fruits (upper bound) within 752 days from 5/5/2018 through 5/26/2020 (Figure 1 & 4) to list a range of PPG values in each sub-region. Since his sensor PPG is 17.5% higher than his finger PPG (Figure 1), he has a range of predicted PPG values in the front side of the card (Figure 5) with the sensor value as the upper bound and the finger value as the lower bound.

First, listed below are 5 ranges of carbs/sugar intake amount which also includes number of meals and average carbs/sugar intake amount in each particular range:

**Figure 5** Frontside of glucose control card (for predicted PPG).

**Figure 6** Backside of glucose control card (plant-based food).
A. 0-15g, 3,933 meals, 8.1g  
B. 15-30g, 1,634 meals, 20.5 g  
C. 30-45g, 400 meals, 35.0 g  
D. 45-60g, 113 meals, 53.3 g  
E. 0-150g, 96 meals, 77.9 g  

Second, he separates his post-meal walking steps into the following 5 ranges on the y-axis:

1. 0-1K  
2. 1-2K  
3. 2-3K  
4. 3-4K  
5. >4K  

By cross-checking x-axis segment versus y-axis segment, the patient will end up in a specific sub-region of glucose value such as, A1, B4, or D3, and obtain a corresponding PPG value (based on 2015-2020 finger data) or a range of PPG values (based on 2018-2020 finger and sensor data).

All of his post-meal walking steps for both glucose periods (5-years of finger and 2-years of finger and sensor) are beyond 4,000 steps except the range of 60-150 grams of carbs/sugar has walking steps slightly less than 4,000 steps. This also indicates that diet is a far more complicated and difficult element to be understood and applied. From his previous research reports, he has already discovered, in general, every increase of 1,000 walking steps would decrease PPG by ~5 mg/dL, or every 360 walking steps would burn out ~1 gram of carbs/sugar intake.

Of course, someone could argue that everyone can eat this simple glucose control chart to establish what to eat and how much exercise activity can be performed to determine their PPG level after their meals. There are no advanced theory needed, no fancy technology required, no complicated knowledge of eating, and no difficult exercise necessary. Any person reading this part of the article should consult with their physicians about medications. In reference 2, the Johns Hopkins guide to diabetes mentions that Metformin is the commonly recommended initial medication for T2D patients. Its maximum dosage of 2,000 mg per day could clinically reduce a patient’s HbA1C up to 1.5%. Based on the author’s research with his own data of medications, glucose, and HbA1C, he has identified a conversion ratio of 17.1931 mg/dL of glucose equivalent to 1.0% of HbA1C. Therefore, 1.5% HbA1C is equivalent to 25.8 mg/dL of glucose. If we divided the maximum dosage of 2,000 mg of Metformin into 5 segments, each segment represents 400 mg of Metformin and would have about 5 mg/dL of glucose reduction per segment (400 mg of Metformin). Based on this type of explanation, we can then build up the third z-axis dimension of medications. He is providing some suggestions on how to further enhance this simple glucose control chart into a broader space including medications.

Conclusion

Most patients with diabetes can use this simple glucose control card to establish what to eat and how much exercise activity can be performed to determine their PPG level after their meals. There are no advanced theory needed, no fancy technology required, no complicated knowledge of eating, and no difficult exercise necessary. The PPG level is directly controlled by the food you eat and how much you move your body. Indeed, “you are what you eat and how you exercise”.

This table has summarized 30 different and common plant-based food with the following 3 distinctive categories with equivalent size of your fist or palm.

- **Starchy food with high carbs:** 40%
- **Low-carbs vegetables:** 250%
- **High-carbs vegetables:** 100%
- **Average of all vegetables:** 140%

This article only addresses carbs and sugar that affect diabetic conditions, and omit fat, proteins, sodium, and other nutritional elements which may impact other chronic disease conditions.

After discussing both diet and exercise, the author wants to discuss a little bit about the third dimension, z-axis, or medications. He took three different kinds of diabetes medications from 1998 through 2013. He started to reduce his medication dosages and then ceased taking one after another. It took him a full year to reduce his full dosage of Metformin gradually from 2,000 mg per day down to 1,500, 1,000, 500, and 250 mg (by cutting the 500 mg pill into half). Finally, by 12/8/2015, he finally completely stopped all of his diabetes medications and only depends on his stringent lifestyle management program. He successfully brought his averaged glucose of 280 mg/dL and A1C of 10% in 2010 down to glucose of 111 mg/dL and A1C of 6.3% in 2020.

He wants to declare that he is not a medical doctor nor a clinic healthcare professional, but rather a scientist with a background in mathematics, physics, engineering, computer science, and business. He only introduces this third dimension into his chart because most T2D patients are taking medications. He understands how difficult it is to rely solely on diet and exercise to control glucose. As a matter of fact, majority of patients want a “quick fix” by taking medications. Unfortunately, they cannot cure the diabetes, they just alter or control the symptoms. The description in this medication section is at the conceptual level, not to be served as any practical guidance.

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With this simple card, most of T2D patients can use its front side as a reference guide to quickly predict their PPG level which is absolutely dependent on their choices of both carbs/sugar intake amount and post-meal walking steps. The backside of the card would offer a simplified yet very practical guidance on what to eat and how much to eat regarding starchy food and vegetables. The author is highly recommending all diabetes patients to eat more plant-based food, i.e. vegetables, since it already contains sufficient carbs and sugar our body needs.1–3

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**Conflicts of interest**

The authors declare have no conflict of interest about the publication of this paper.

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