Review Article

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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)

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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

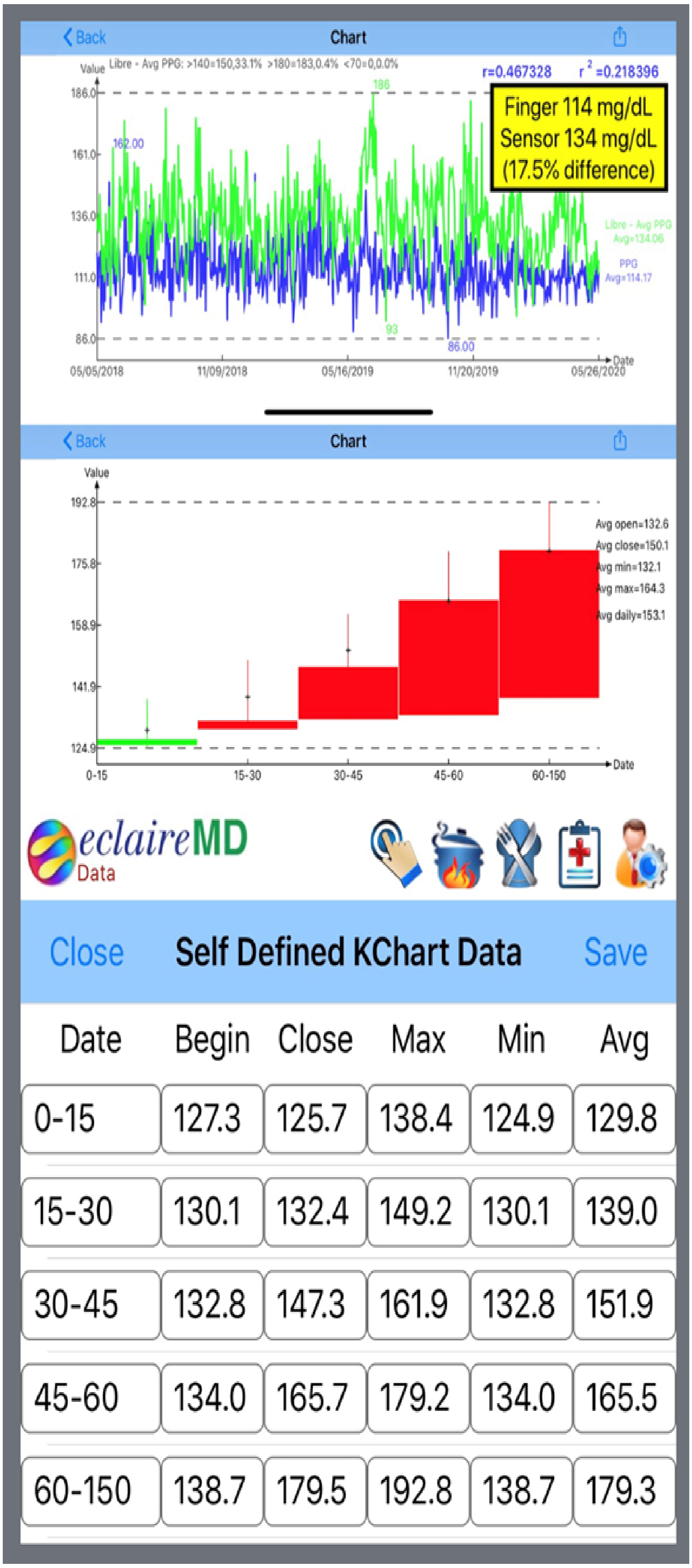
The author has spent ten years collecting approximately 2 million data of chronic diseases and their complications along with details of a lifestyle management program. By utilizing theories and techniques from mathematics, physics, engineering and computer science, he developed a sophisticated computer 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 glucoses 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.



Date	Begin	Close	Max	Min	Avg
0-15	127.3	125.7	138.4	124.9	129.8
15-30	130.1	132.4	149.2	130.1	139.0
30-45	132.8	147.3	161.9	132.8	151.9
45-60	134.0	165.7	179.2	134.0	165.5
60-150	138.7	179.5	192.8	138.7	179.3

Figure 1 Finger PPG, Sensor PPG, Candlestick PPG.

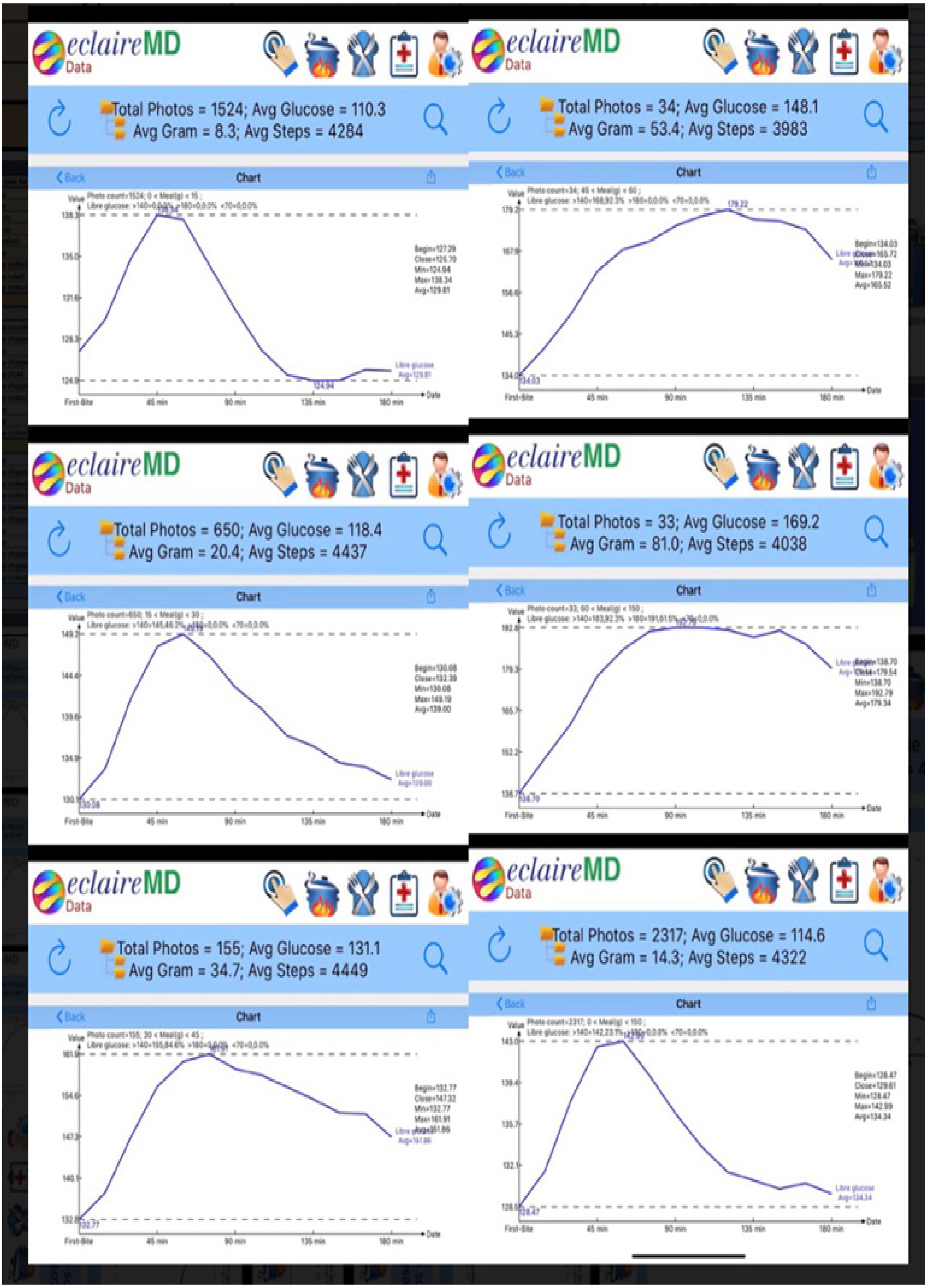


Figure 2 Sensor PPG waveforms, 5 carbs segments and total waveform.

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).

6/1/2015-5/21/2020					
Carbs/Sugar Range	Number of Meals	Averaged Carbs/Sugar grams	Averaged Post-Meal Walking	Finger PPG mg/dL	Avg Sensor PPG mg/dL
0-15 grams	3,933	8.1	4,354	112	N/A
15-30 grams	1,634	20.5	4,477	122	N/A
30-45 grams	400	35.0	4,351	139	N/A
45-60 grams	163	53.3	3,983	159	N/A
60-150 grams	96	77.9	3,780	178	N/A
0-150 grams	6,226	14.3	4,371	117	N/A
5/5/2018-5/26/2020					
Carbs/Sugar Range	Number of Meals	Averaged Carbs/Sugar grams	Averaged Post-Meal Walking	Finger PPG mg/dL	Avg Sensor PPG mg/dL
0-15 grams	1,524	8.3	4,284	110	130
15-30 grams	650	20.4	4,437	118	139
30-45 grams	155	34.7	4,449	131	152
45-60 grams	34	53.4	3,983	148	166
60-150 grams	33	81.0	4,038	169	179
0-150 grams	2,396	14.3	4,322	115	134

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

Food with Carbs	Size (one fist or one palm)	Carbs (grams)	Sugar (grams)	Carbs/Sugar (grams)	Fist or Palm
Cooked Rice	1 cup	44	0	44	
Cooked Egg Noodles	1 cup	40	1	41	
White Bread	2 slices	25	3	27	
Whole Grains Bread	2 slices	40	6	46	
Boiled Potato	1 medium	40	2	42	
Mashed Potatoes	1 cup	33	3	36	
Oatmeal	1 cup cooked	25	1	26	
yams	1 cup cubed	42	1	43	
Barley	1 cup cooked	44	0	45	
Starched Food		37	2	39	40%
Food with Carbs	Size	Carbs (grams)	Sugar (grams)	Carbs/Sugar (grams)	Fist or Palm
Lettuce	1 cup uncooked	2	1	3	
Cucumber	1 cup chopped	3	2	5	
Celery Sticks	1 cup	3	2	5	
Zucchni	1 cup chopped	4	2	6	
Yellow Squash	1 cup sliced	4	2	6	
Broccoli	1 cup chopped	6	2	8	
Spinach	1 cup cooked	7	1	8	
Cauliflower	1 cup	5	2	8	
Asparagus	1 cup	5	3	8	
Cabbage	1 cup cooked	5	3	8	
Low-carbs Vegetables		4	2	6	250%
Cherry Tomatoes	1 cup	6	4	10	
Green Bell Pepper	1 cup chopped	7	4	10	
Eggplant	1 cup cooked	8	3	11	
Mushrooms	1 cup cooked	8	3	12	
Squash	1 cup cooked	8	5	12	
Sweet Red Peppers	1 cup chopped	9	6	15	
Diced Red Tomato	1 cup	10	6	16	
Leeks	1 cup	13	3	16	
Carrots	1 cup chopped	12	6	18	
Onion	1 cup chopped	16	7	23	
Green Peas	1 cup cooked	22	7	29	
High-carbs Vegetables		11	5	16	100%
All Vegetables		8	4	11	140%

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

eclaireMD **Front Side of Glucose Control Card**

	0-15 grams	15-30 grams	30-45 grams	45-60 grams	60-150 grams
> 4K steps	112 or 110-138	122 or 118-139	139 or 131-152	159 or 148-166	177 or 169-179
3-4 K steps	117 or 115-143	127 or 123-144	144 or 136-157	164 or 153-171	182 or 174-184
2-3 K Steps	122 or 120-148	132 or 128-149	149 or 141-162	169 or 158-176	187 or 179-189
1-2 K Steps	127 or 125-153	137 or 133-154	154 or 146-167	174 or 163-181	192 or 184-194
0-1 K steps	132 or 130-158	142 or 138-159	159 or 151-172	179 or 168-186	197 or 189-199

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

eclaireMD **Back Side of Glucose Control Card**

Food with Carbs	Size (1 cup or 1 serving)	Carbs (grams)	Sugar (grams)	Carbs/Sugar (grams)	Fist or Palm
Starched Food		37.0	1.8	38.8	40%
Low-carbs Vegetables		4.4	2.0	6.4	250%
High-carbs Vegetables		10.8	4.9	15.7	100%
All Vegetables		7.7	3.5	11.3	140%
Starched Food	Cooked Rice, Cooked Egg Noodles, White Bread, Whole Grains Bread, Boiled Potato, Mashed Potatoes, Oatmeal, Yams, Barley				
Low-carbs Vegetables	Lettuce, Cucumber, Celery, Zucchni, Yellow Squash, Broccoli, Spinach, Cauliflower, Asparagus, Cabbage				
High-carbs Vegetables	Cherry Tomatoes, Green Bell Pepper, Eggplant, Mushrooms, Green Squash, Sweet Red Peppers, Diced Red Tomato, Leeks, Carrots, Onion, Green Peas				

Figure 6 Backside of glucose control card (plant-based food).

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:

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, orevery 360 walking steps would burn out ~1 gram of carbs/sugar intake***.**

Of course, someone could argue that every diabetes patient is different. The author also agrees that each patient's pancreatic beta cells insulin production quantity (insufficient insulin amount) and quality (degree of insulin resistance) are unique. The similar argument can also be applied to both diet and exercise. However, it is our research scientist's mission to figure out reasonable interpretations and then form logical conclusions from these chaotic situational analyses. One important goal is to possess a high accuracy percentage of prediction. For this case, the author has sufficient confidence that his simple glucose control card can provide a PPG prediction accuracy at a minimum of 90% level.

On the backside of the glucose control card (Figure 5) provides the guidance for carbs/sugar intake amount and sample plant-based diet. To visualize a 1-cup serving of your favorite food, look at your fist or palm, which both have similar volumes. One fist or a cupped hand is about one cup serving of food. Figure 4 offers a detailed table of carbs/sugar amount for some of sampling food we eat. It should be emphasized that, if you are a diabetes patient, you should always avoid consuming any kind of sweet food or drink, or any food containing high sugar amounts. Regarding the practical usage of this information, you want to keep your carbs/sugar intake within 15 grams per meal if possible, you must eat starchy food containing high carbs with 40% of a fist or palm size, or eat all kinds of vegetables with 140% of a fist or palm size. For example, if you want to eat 30 grams of carbs/sugar, you can then double the size mentioned above. When you visualize the size of vegetables, you should always remove the air and water space among vegetable parts, in other words, squeeze them together in your mind.

This cabs/sugar 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. 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, glucoses, 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*".

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.

References

1. Hsu Gerald C. eclaireMD Foundation, Community Medicine, Doctors without distance: Using AI tools and Internet to assist T_2D patients in remote rural areas (GH-Method: math-physical medicine approach)". USA, No. 226
2. The Johns hopkins university, Patients guide to diabetes.
3. A handy guide to portion size, The joint chiropractic – Shiloh.