The GH-Method

A Case Study on the Prediction of A1C Variances over Seven Periods with Guidelines Using GH-Method: Math-Physical Medicine

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Keywords: Type 2 diabetes; Hemoglobin A1C; Math-physical medicine; Fasting plasma glucose; Postprandial plasma glucose

Abbreviations: T2D: type 2 diabetes; HbA1C: hemoglobin A1C; FPG: fasting plasma glucose; PPG: postprandial plasma glucose; MPM: math-physical medicine

1. INTRODUCTION

In this case study, the author analyzed, predicted, and interpreted a type 2 diabetes (T2D) patient's hemoglobin A1C variances based on seven periods of data utilizing the GH-Method: math-physical medicine approach.

2. METHODS

As shown in Figure 1, there are eight hemoglobin A1C checkup results:

6.7% on 4/9/2017
6.1% on 9/12/2017
6.9% on 1/26/2018
6.5% on 6/29/2018
6.6% on 10/22/2018
6.8% on 4/4/2019
6.6% on 9/25/2019
6.6% on 12/20/2019

The author selected seven periods of almost equal length with about five months each and then observed their measured A1C changes (variances) against the previous period as follows:

Period A (4/1/2017 - 8/31/2017): -0.6%
Period B (9/1/2017 - 1/31/2018): +0.8%
Period C (2/1/2018 - 6/30/2018): -0.4%
Period D (6/29/2018 - 10/22/2018): +0.1%
Period E (10/22/2018 - 4/4/2019): +0.2%
Period F (4/4/2019 - 9/25/2019): -0.2%
Period G (9/25/2019 - 12/20/2019): +0.0%

He applied his developed GH-Method: math-physical medicine (MPM approach) to analyze the following seven contribution factors of A1C:

(1) A1C variances contributed by FPG (between 15% to 35% contribution)

(2) FPG variance due to weight change (77% contribution)

(3) Colder weather impact on FPG (each degree of Fahrenheit decrease caused a 0.3 mg/dL decrease of FPG)

(4) A1C variances contributed by PPG (between 65% to 85% contribution)

(5) PPG variance due to carbs/sugar intake (~39% weighted contribution on PPG)

(6) PPG variance due to post-meal walking (~41% weighted contribution on PPG)

(7) Warm weather impact on PPG (each degree of Fahrenheit increase caused a 0.9 mg/dL increase in PPG)

It should be noted that his developed mathematical HbA1C prediction model is based on the different weighted ratios for the previous 4-month glucose data, instead of the

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standard "A1C as the three-month average glucose".

3. RESULTS

Based on the author's numerous publications of HbA1C contributions by FPG and PPG, along with the prediction models of these two glucoses and HbA1C, Figure 1 shows a summarized chart of these A1C values over 7 periods. Figures 2 and 3 depict weight, carbs intake, exercise, FPG, PPG, daily glucose, and A1C of Period G (9/25/2019-12/20/2019). Figure 4 shows the step-by-step calculation table of all periods on how to derive and interpret these A1C variances.

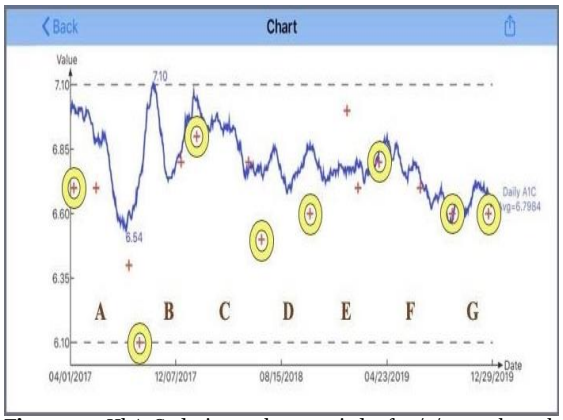

Figure 1: HbA1C during a long period of 4/1/2017 through 12/20/2019.

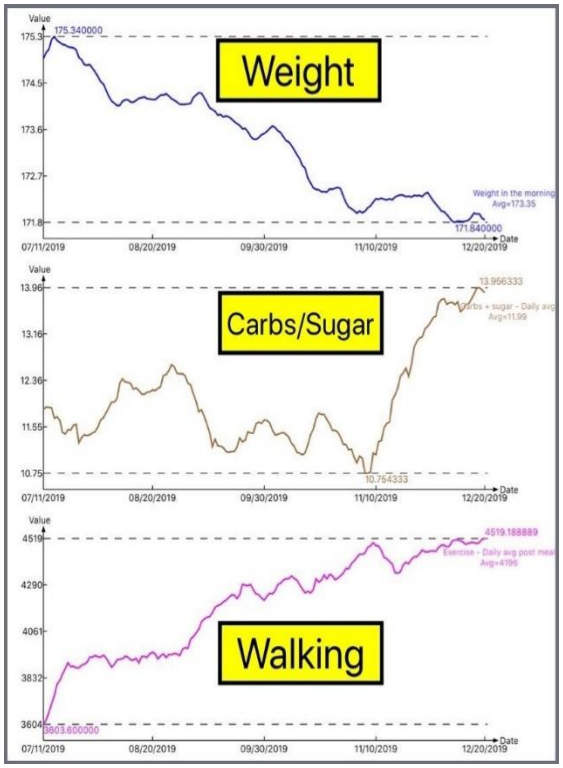

Figure 2: Weight, carbs intake, and post-meal walking (9/25/2019 - 12/20/2019).

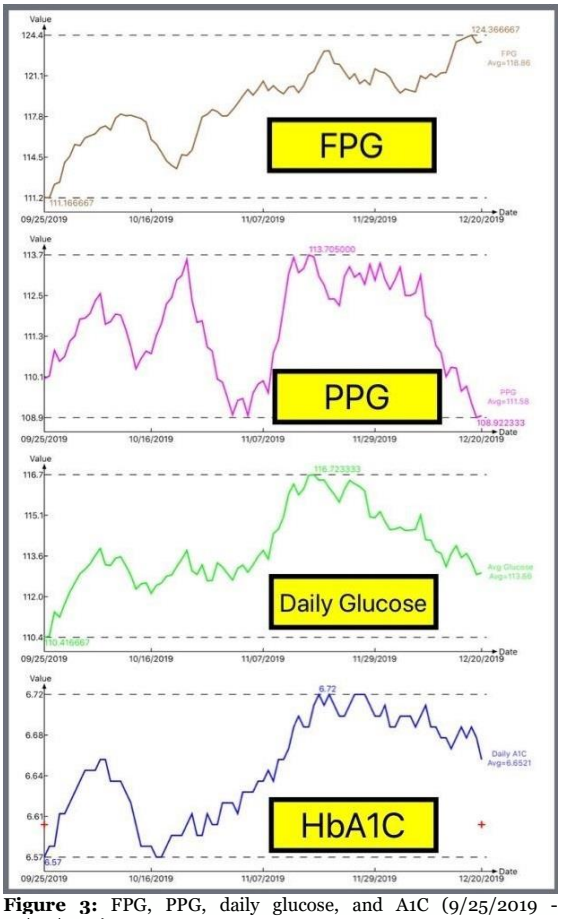

Figure 3: FPG, PPG, daily glucose, and A1C (9/25/2019 - 12/20/2019).

Period	Date: From	Date: To	Weight Change	FPG: From	FPG: To	FPG Change	Glucose ducto FPG (25%)	A1C from FPG) @ 12.5
A	4/1/17	8/31/17	9	131	107	-24	-6	-0.48
B	9/1/17	1/31/18	-5	109	125	16	4	0.32
C	2/1/18	6/30/18	4	124	113	-11	-3	-0.22
D	6/29/18	10/22/18	2	113	108	-5	-1	-0.10
E	10/23/18	4/4/19	0	107	119	12	3	0.24
F	4/4/19	9/25/19	2	116	111	-5	-1	-0.09
G	9/25/19	12/20/19	1	111	119	8	2	0.16

Period	Date: From	Date: To	Carbs & Walking	PPG: From	PPG: To	PPG Change	Glucose due to PPG (75%)	A1C (from PPG) @ 12.5
A	4/1/17	8/31/17	-1 / 400	121	119	-2	-1.5	-0.12
B	9/1/17	1/31/18	+3 / -300	112	120	8	6	0.48
C	2/1/18	6/30/18	-2 / +200	119	116	-3	-2	-0.18
D	6/29/18	10/22/18	+6 / -800	115	119	4	3	0.24
E	10/23/18	4/4/19	-1 / -540	118	117	-0.9	-0.7	-0.05
F	4/4/19	9/25/19	-4 / +500	116	113	-2.6	-2.0	-0.16
G	9/25/19	12/20/19	+4 / 300	110	109	-1.0	-0.8	-0.06

Period	Lab Dates	Lab Results	Lab (A1C Change)	A1C due to FPG	A1C due to PPG	Predicted A1C Variance	eclaireMD Predicted A1C %
	10/31/16	6.6%					
A	4/9/17	6.7%	0.1%	-0.48	-0.12	-0.60	6.1%
B	9/12/17	6.1%	-0.6%	0.32	0.48	0.80	6.9%
C	1/26/18	6.9%	0.8%	-0.22	-0.18	-0.40	6.5%
D	6/29/18	6.5%	-0.4%	-0.10	0.24	0.14	6.6%
E	10/22/18	6.6%	0.1%	0.24	-0.05	0.19	6.8%
F	4/4/19	6.8%	0.2%	-0.09	-0.16	-0.25	6.6%
G	9/25/19	6.6%	-0.2%	0.16	-0.06	0.10	6.7%
H	12/18/19	6.6%	0.0%				

Figure 4: HbA1C step-by-step calculation table during 7-periods (4/1/2017 - 12/20/2019).

As shown in Figure 4, his predicted A1C variances completely match the test results from the laboratory for Period A through Period F. The reason for the 100% match of the eclaireMD predicted A1C and Lab-tested A1C for periods A through F is that the Lab-tested A1C has a single decimal and eclaireMD predicted A1C has two decimals.

For Period G (from 9/25/2019 to 12/20/2019), the Lab A1C is 6.6% while the predicted A1C is 6.7% (actually 6.66%). The eclaireMD predicted A1C has achieved up to 99% accuracy. During Period G, the A1C

incremental amount of 0.06 mainly resulted from the FPG increase. As shown in Figure 5, the usual high correlation (77%) existing between weight and FPG (1/1/2014-12/20/2019) was not found for this particular Period G. In addition, Period G only has a duration of 3 months instead of 5-months and it was tested at a different hospital which may have different operating procedures. Therefore, the author will review this predicted A1C against the newly tested A1C around 2/25/2019. It definitely warrants a deeper investigation by the author for this period.

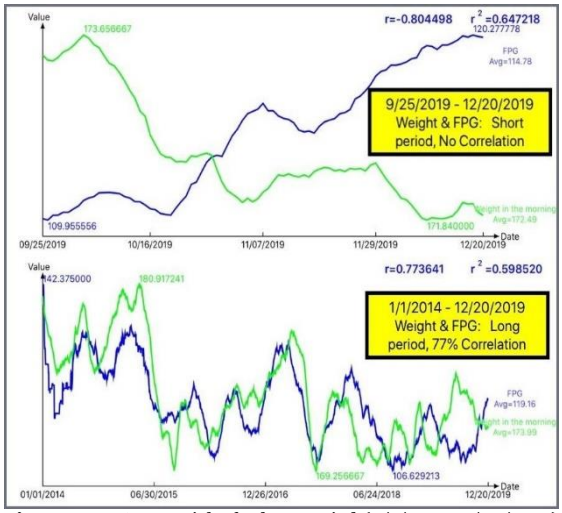

Figure 5: FPG vs. weight for long period (4/1/2017-12/20/2019) and Period G (9/25/2019-12/20/2019).

4. CONCLUSION

The A1C case study focused on seven periods within 994 days. It contains 2,982 meal data, including key contributing factors such as carbs/sugar intake, post-meal exercise, weather, and more. This study has demonstrated a high degree of accuracy for calculating and predicting the patient's future A1C value using the GH-Method: math-physical medicine (MPM) approach. Once the healthcare professionals and T2D patients understand and learn this skill for the HbA1C prediction method, the patient's overall T2D condition can then be more easily under control. The purpose of this research paper is to help them to prevent further damage to their internal organs caused by high HbA1C while waiting to take a laboratory test.

On a side note, if some of the healthcare professionals and diabetes patients have the interest to delve deeper into the formation of tested glucose and mathematical predicted HbA1C (hereafter, it is known as "A1C"), they should focus on the influential factors and their respective weighted contribution percentages listed in the method section.

Here is the summary:

(1) The most important month which contributes to the A1C is the closest month before the A1C test.

(2) PPG controls A1C (> 2/3).

(3) Body weight controls 77% or more of the FPG (keeping BMI < 25).

(4) Carbs/sugar amount contributes 39% of PPG (safer if below 15 grams).

(5) Post-meal walking steps contribute 41% of PPG (safer if walking 4,000 steps).

(6) A combined effort of diet and exercise controls 80% of PPG.