

A1C Variance Study and PPG Prediction Methodology over Six Periods Using GH-Method: Math-Physical Medicine

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Introduction

In this case study, the author analyzed, predicted, and interpreted a type 2 diabetes (T2D) patient's hemoglobin A1C variances based on six periods data utilizing the GH-Method: math-physical medicine approach by applying mathematics, physics, engineering modeling, and computer science (big data analytics and AI). He believes in "prediction" and has developed five models, including metabolism index, weight, fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and hemoglobin A1C. All prediction models have reached to 95% to 99% accuracy. His focus is on preventive medicine, especially on diabetes control via lifestyle management.

Method

As shown in Figure 1, there are six hemoglobin A1C checkup results at the same hospital:



Figure 1: Daily predicted A1C and Lab-tested A1C of 6 periods

Period	Date: From	Date: To	Weight Change	FPG: From	FPG: To	FPG Change	Glucose ducto FPG (25%)	A1C (due to 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
Period	Date: From	Date: To	Carbs/Sugar (gram) / Walking (steps)	PPG: From	PPG: To	PPG Change	Glucose due to PPG (75%)	A1C (due to 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
Period	Lab Dates	Lab Results	Lab (A1C Change)	A1C due to FPG	A1C due to PPG	Predicted A1C Variance	eclairMD 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%	
	9/25/19	6.5%	-0.3%					

Table 1: Calculation of A1C Variances (6 periods)

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

The author selected six periods of almost equal length with about five months each and then observed their measured A1C changes (variances) against 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%

He applied his developed GH-Method: math-physical medicine (MPM approach) to analyze the contribution of 7 A1C variances:

- (1) A1C variances contributed by FPG
- (2) FPG variance due to weight change
- (3) Colder weather impact on FPG
- (4) A1C variances contributed by PPG
- (5) PPG variance due to carbs/sugar intake
- (6) PPG variance due to post-meal walking
- (7) Warm weather impact on PPG

Results

Based on the author's numerous publications of HbA1C contributions by FPG and PPG, along with the prediction models of two gluces and A1C, Figure 2 shows his FPG and PPG during the most recent period F and Table 1 displays a step-by-step calculation on how to derive and interpret the causes of the these A1C variances [1-4].

As shown in Table 1, his mathematically predicted A1C variances completely match the test results from the laboratory.

Conclusion

The A1C case study focused on six periods within 908 days. It contains 2,724 meals data, including key contribution factors such as carbs/sugar intake, post-meal exercise, weather, etc. This study has demonstrated a high degree of accuracy on calculating and predicting the patient's forthcoming A1C value by 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 T2D patients to prevent further damage to their internal organs caused by high HbA1C, while waiting for the laboratory test results.

References

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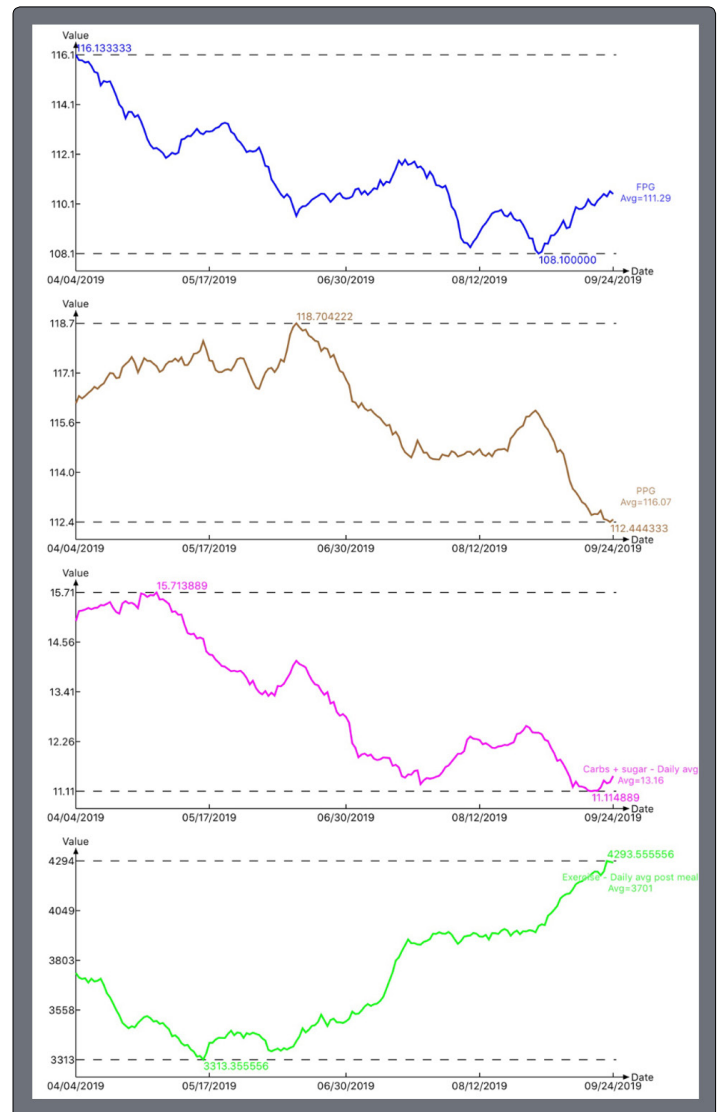


Figure 2: FPG, PPG, Carbs/sugar intake, and post-meal walking (4/4/2019 - 9/25/2019)

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