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The Analysis of the ADA Defined TIR, TAR, and TBR Based on 5-Minute Measurement Intervals of the CGM Sensor Glucose Data Using GH-Method: Math-Physical Medicine

Gerald C. Hsu

eclaireMD Foundation, USA.

**Corresponding Author: Gerald C. Hsu, eclaireMD Foundation, USA.*

Introduction

The author utilized the American Diabetes Association (ADA) 2020 Guidelines for time-in-range (TIR), time-above-range (TAR), and time-below-range (TBR) to analyze his collected CGM sensor glucose data for every 5-minute measurement interval (5-min).

Method

A continuous glucose monitor (CGM) device has been placed on his left upper arm to collect 54,720 glucose data over 724 days from 5/5/2018 - 4/28/2020, at a rate of 75.58 glucoses per day. These data were collected approximately every 15 minutes during the daytime and every hour during nighttime (15-min).

Furthermore, by using Bluetooth technology, on 2/19/2020, he installed an additional electronic device on top of the CGM sensor to collect and transmit the glucose data from the sensor directly to his developed iPhone APP at 5-minute intervals. For a period of 69 days (2/19/2020 - 4/28/2020), he has collected 17,871 glucose data at approximately 259 measurements per day.

Recently, the ADA published revised guidelines regarding CGM collected data (References 1 and 2) and included three new measurement terms: (1) TIR: time-in-range 70-180 mg/dL for "acceptable" diabetes glucose range; (2) TAR: time-above-range >180 mg/dL for severe diabetes concerns; and (3) TBR: time-below-range <70 mg/dL for insulin shock warning. The author has termed this as the "CGM Range Analysis".

Results

The 5-min dataset only covers 69 days with 259 measurement counts per day, while the 15-min dataset covers 724 days with ~76 measurements per day. Therefore, the author selected the same period of 69 days from 2/19/2020 through 4/28/2020 for a comparison study.

Figure 1 shows a comparison between 5-min vs. 15-min in terms of both percentages and averaged glucose values of the CGM range analysis. There is a minimum difference between the 5-min and 15-min in terms of both percentage and average glucose values. The TIR percentages represent around 97%-98% with an average glucoses of 124-121 mg/dL, which means that his diabetes conditions are very well under control. To date, he has not encountered the risk of insulin shock (TBR near 0%).

Conclusions

After conducting numerous diabetes research and development projects, the author can automatically transmit his 5-min sensor database into his 15-min sensor database. Next, he can transfer both of them into his iPhone APP software for further calculations and analyses, while generating his equivalent finger-piercing glucose database. Finally, he can then predict his HbA1C level in a totally automatic and continuous manner without any lab tests. It should be noted that he is still doing his regular A1C lab tests for the sole purpose of calibrating his HbA1C mathematical prediction model. This entire automatic data flow is now completed with a built-in device reliability adjustments (auto-checking and auto-correction) in order to achieve an extremely high prediction accuracy of all related biomedical data. His R&D work is ultimately aiming at providing practical and accurate high-tech system for worldwide diabetes patients.

The main reason he collects his 5-min glucose data is that he can then utilized them to conduct a wave theory and frequency domain analysis. In addition, he can apply the energy theory analysis to investigate the behavior of those higher-frequency with lower-amplitude glucose components and then investigate their impacts on our human internal organs (i.e. diabetes complications research).

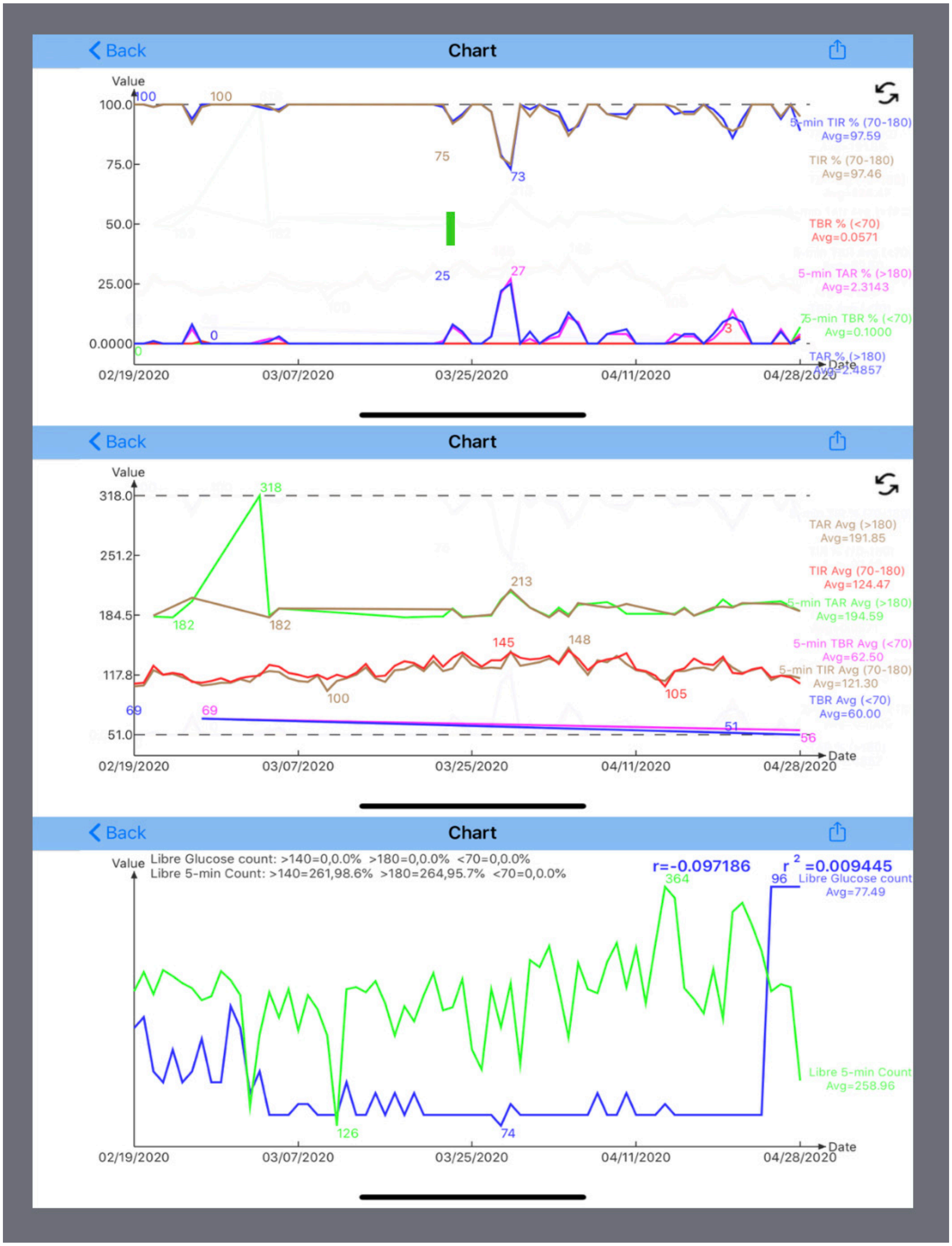

Figure1. *CGM Range Analysis with sensor 5-minutes TIR, TBR, TAR and measurement counts*

Percentage %	TIR (70-180)	TAR (>180)	TBR (<70)	Counts/ Day
15-min CGM Sensor	97%	2%	0%	77
5-min CGM Sensor	98%	2%	0%	259
Avgeraged mg/dL	TIR (70-180)	TAR (>180)	TBR (<70)	Counts/ Day
15-min CGM Sensor	124	192	60	77
5-min CGM Sensor	121	195	63	259

Figure2. *Table of percentage and average glucose of TIR, TAR, TBR (for both 15-min and 5-min)*

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