

Using Candlestick Charting Techniques to Investigate Glucose Behaviors via GH-Method: Math-Physical Medicine (No. 76)

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Introduction

This paper describes the investigation results of glucose behaviors based on both finger and sensor data using candlestick charting techniques.

Method

A Japanese merchant, who traded in the rice market in Osaka, Japan, started the candlestick charting around 1850. An American, Steve Nison brought the candlestick patterns to the Western world in 1991. These techniques are largely used in today's stock market to predict the price direction or action.

On 4/17/2018, the author had an idea to study glucose behavior by using the candlestick chart also known as the K-Line and subsequently developed a customized software to analyze his big glucose data. The analogies between fluctuations of stock price and glucose value are as follows:

1. Stock prices are closely related to the psychology of the buyer/seller, which is similar to the glucoses related to a patient's behavior psychology.
2. When there are more buyers than sellers, the price goes up, which is similar to the glucose value rising when carbs/sugar intake (buyer) increases.
3. When there are more sellers than buyers, price goes down, which is similar to the glucose value decreasing when exercise (seller) increases.

During the period of 5/5/2018 through 5/7/2019, the author collected 26,886 glucose data via a sensor placed on his upper left arm with 73.06 measurements/day (Figure 1). The OHLC is defined as the open value as his recorded glucose at 7:00, closed value at 23:30, lowest glucose within a day as the minimum value, highest as the maximum value, and average glucose as the daily average value of ~73 recorded data. Based on these 368 candlestick bars,

glucose patterns and moving trends can be observed and analyzed through further mathematical and statistical operations. Finally, he interpreted these operational results with his acquired knowledge of biomedical phenomena in order to discover some hidden medical truth and potential health dangers.

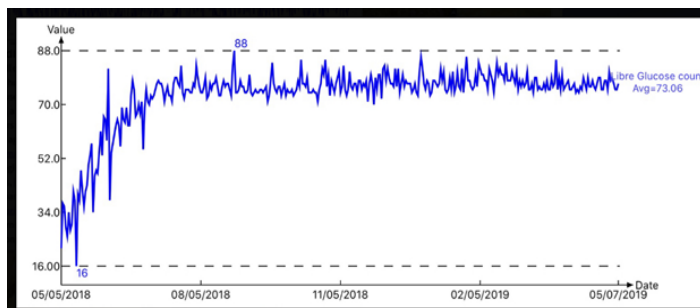


Figure 1: Sensor glucose measurements per day

Since the stock market is much more lucrative than the medical research field, it attracts more talented mathematicians and engineers to work in the financial industry. As a result, the author decided to import the candlestick techniques and apply them to his medical research activities in order to learn and gain from other intellectuals' knowledge and experiences.

Results

Here are some of his research findings:

1. (1) The sensor-monitor data fluctuate between a bands of 50 to 250 mg/dL, while the finger-piercing data fluctuate between a band of 96 to 136 mg/dL. The finger data covers a mere 20% range of sensor area with the bottom portion of 23% to 43% (Figure 2). This means that the existing finger-piercing glucose testing results cover only the lower half of the sensor collected data range, which will miss many of the glucose spikes.

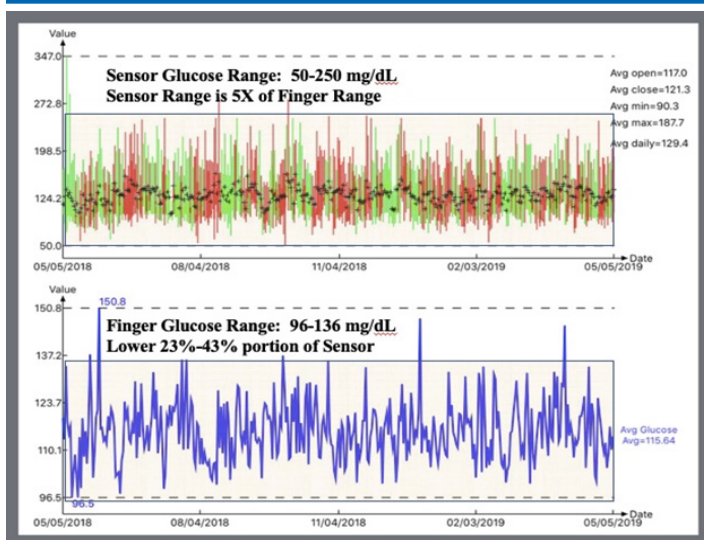


Figure 2: Finger-piercing glucose data are located at lower half of Sensor-based glucose data range

2. By using segmentation pattern analysis (Figures 3 and 4), further calculations have revealed that on the high glucose segment, 31.2% of the total glucose data are above 140 mg/dL (with an average glucose of 160 mg/dL, equal to A1C>7.2%, diabetes) and 4.5% of the total glucose data are above 180 mg/dL (with an average glucose of 199 mg/dL, equal to A1C>8.5% severe T2D). These high glucose values are the source for the diabetes-induced complications such as heart attack, stroke, thyroid and kidney issues, eye, and foot problems.

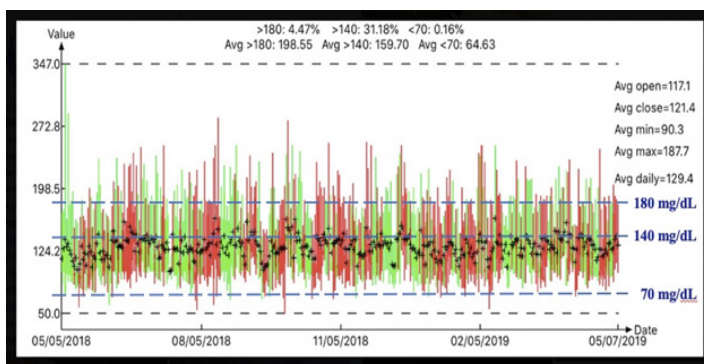


Figure 3: Candlestick chart of daily sensor-based glucose data

3. On the low glucose segment, there are 0.2% of the total data below 70 mg/dL with an average glucose of 65 mg/dL. These low glucose values could cause life-threatening conditions from insulin shock. Fortunately, the author has been careful in controlling his low glucose conditions, especially during

sleeping hours at night.

4. Average FPG (average value between open and close values) is lower than the daytime's average glucose (summation of 3 PPG periods and glucose data between meals).
5. This paper presents partial analysis results based on a candlestick chart over 368 days period. Future detailed glucose analysis of candlestick bars within a day, i.e., "intraday" analysis, would disclose more information regarding the glucose-moving trend and detailed patterns.

Conclusion

This paper has further demonstrated the power in observing the glucose phenomena, derivation of mathematical equations, application of various computational tools, and finally combined with biomedical interpretations to discover and predict more biomedical findings regarding the human body [1-5].

Acknowledgement

Foremost, I would like to express my deep appreciation to my former professors: professor James Andrews at the University of Iowa, who helped develop my foundation in basic engineering and computer science, and professor Norman Jones at the Massachusetts Institute of Technology, who taught me how to solve tough scientific problem through the right attitude and methodology.

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