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Sensor-based continuous glucose monitoring results and its impact on risk probability of cardiovascular disease and stroke using wave and energy theories (GH-Method: Math-Physical Medicine)

Introduction: This paper discusses glucose measurement results and their impact on health from two different methods, finger piercing and testing strip (Finger) and a continuous glucose monitoring system (Sensor).

Method: The author has been collecting a total of 9,490 glucose data by finger measurement, including both fasting plasma glucose (FPG) once a day since 1/1/2014 (1,825 days) and postprandial plasma glucose (PPG) three times a day since 1/1/2012 (2,555 days). Recently, he has further collected 17,046 glucose data by applying a sensor on his upper arm to collect his glucose values continuously. This sensor measurement is conducted in parallel with his routine finger-piercing measurements. During the period of 5/5/2018 to 12/13/2018 (241 days), he has collected and recorded his glucose values about 70 times per day. The measurement rate is approximately every 15 minutes during the day and every hour during the night. In summary, he has collected a total of 17,046 glucose data and 964 waveforms (241 FPG and 723 PPG). Other waveforms generated between meals or from eating snack/fruit are not included in this analysis.

Results: All glucose units are mg/dL. Finger's Average FPG/PPG: 110/116 mg/dL (as 100% baseline) Daily Average Sensor vs. Daily Average Finger: 130/115 (113%); Peak FPG Sensor vs. Average FPG Finger: 132/110 (120%); Average FPG Sensor vs. Average FPG Finger: 112/110 (102%); Peak PPG Sensor vs. Average PPG Finger: 159/116 (138% & +43); Average PPG Sensor vs. Average PPG Finger: 135/116 (117% & +19); Sensor's Time of Peak PPG Glucose: ~ 60 minutes after first-bite; PPG rising speed: 33 mg/dL per hour; PPG decaying speed: 20 mg/dL per hour (~ 60% of rising); PPG rising speed is 190% (takes ~60 minutes) of decaying speed (takes ~100 minutes); FPG (period - from 00:00 to 07:00): Overall FPG waveform: Average FPG: 112 mg/dL; Peak (crest): 121 mg/dL; Valley (trough): 106 mg/dL; Period of Trough (from 3am to 5am); PPG (period - from first-bite to 180 minutes later, total 3 hours) Overall PPG waveform: Average PPG: 135 mg/dL; Peak (crest): 144 mg/dL; Valley (trough): 127 mg/dL; Differential Energy (Sensor / 120 mg/dL): 117%; which provides 6.4% increase of cardiovascular disease (CVD) and stroke risk probability from 26.4% to 28.1% (based on 2017 data of medical conditions) ; Differential Energy (Finger / 120 mg/dL): 93%; which indicates this patient's type 2 diabetes condition is well controlled.

Conclusion: In average, PPG peak occurs around one hour after first-bite of meal, not two hours afterward as medical community said. PPG decaying speed is almost twice as slow than its rising speed; Average Sensor's PPG is 17% higher (+19 mg/dL) than the Average Finger's PPG. Peak Sensor's PPG is 38% higher (+43 mg/dL) than the Average Finger's PPG. FPG wave is similar to ocean wave which is much calmer than PPG wave that is similar to tsunami wave. FPG's lowest trough range happens during the deepest sleeping hours (3am to 5am). FPG starts to rise near wake-up time in the morning. Higher glucose values from sensor provide excessive (leftover) energy and increase moderate risk probability

of CVD and stroke.

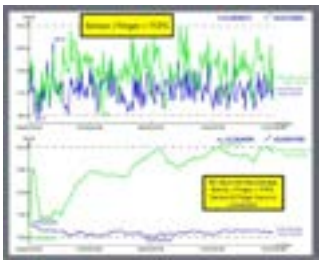

Figure 1: Daily glucose values comparison (Sensor vs. Finger)

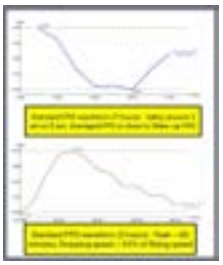

Figure 2: Two generalized Sensor waveforms of FPG & PPG from 964 individual Waveforms

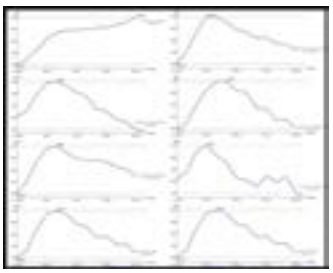

Figure 3: PPG waveforms (by 3 patterns and by 3 meals)

Biography

Gerald C Hsu has completed his PhD in Mathematics and majored in Engineering at MIT. He attended different universities over 17 years and studied seven academic disciplines. He has spent 20,000 hours in T2D research. His approach is quantitative medicine based on mathematics, physics, optical and electronics physics, engineering modeling, signal processing, computer science, big data analytics, statistics, machine learning and artificial intelligence. His main focus is on preventive medicine using prediction tools. He believes that the better the prediction, the more control you have.

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