Special Issue 5
2022

The GH-Method

Viscoelastic Medicine Theory (VMT #341): Comparison of Both Prediction Accuracy and Waveform Similarity between Collected Quarterly PPG Data from 1/1/2016 to 10/3/2023 versus Three Sets of Predicted PPG Data Using Both LEGT and Two VMT Models of GH-Method: Math-Physical Medicine (No. 941)

Gerald C. Hsu*

eclaireMD Foundation, USA

Abstract

Sir Isaac Newton formulated his law of gravity, also known as universal gravitation, in 1687. This law was published in his seminal work, "Philosophiæ Naturalis Principia Mathematica" (Mathematical Principles of Natural Philosophy). Regarding viscous fluids, Newton published his groundbreaking work on fluid mechanics, "Mathematical Principles of Natural Philosophy," in 1687 as well. The theory of stress-strain and the concept of Young's modulus were proposed by the British scientist Thomas Young. Young introduced the concept of modulus of elasticity, which is now known as Young's modulus, in his lectures published in 1807. Young's modulus (E) is a measure of the stiffness or rigidity of a material and quantifies the relationship between stress (force per unit area) and strain (deformation) in a linear elastic material. The understanding and utilization of fluid viscosity in the field of solid engineering can be credited to the French physicist and engineer Claude-Louis Navier. In 1822, Navier introduced the concept of viscosity and Navier's equation into the field of solid engineering. In October 1967, a British Professor Norman Jones at Brown University published a paper titled "Finite Deflections of a Rigid Viscoplastic Strain-Hardening Annular Plate Loaded Impulsively." In 2018, the author of this paper, Gerald C. Hsu, applied the principles of stress-strain and Young's modulus from solid engineering to develop his Linear Elastic Glucose Theory (LEGT)-based postprandial plasma glucose (PPG) prediction equation: Predicted LEGT-based PPG = {FPG} * 0.87 + {Avg carbs + sugar} * 2.7 - 4 * {Avg exercise - post meal} / 1000. Upon the recommendation of his academic advisor at MIT, Professor Norman Jones (the same Professor mentioned above), the author of this paper began integrating the space-domain viscoplastic energy model (SD-VMT) into his biomedical research efforts in January 2021. The following is his developed VMT-based PPG prediction equation: Predicted VMT-based PPG = (({FPG} / 100) * 0.42 + ({Avg carbs + sugar} / 14)* 0.35 + ({Avg exercise - post meal} / 4000) * 0.23) / 1.065 * 116. Subsequently, after applying these two prediction equations, the author further employed the energy ratios related to inputs from the SD-VMT energy model to create his third set of predicted PPG values. In summary, this quarterly data study presents four observations: 1. Regarding prediction accuracies, LEGT-PPG has 99.2%, VMT-has 98.4% and the third VMT model has 99.8%. 2. Regarding waveform similarities (correlations), LEGT-PPG has 80%, VMT-has 71% and the third VMT model has 75%. 3. Regarding SD-VMT energy ratios, LEGT-PPG contributes 49.8% while VMT-PPG input contributes 50.2%. 4. Regarding SD-VMT time-zone energy distributions, period of Y16-Y19 contributes 53% while period of Y20-Y23 contributes 47%. All three prediction models provide highly accurate predictions (above 98.4%). Overall, the LEGT model yields better results than the VMT model.

Keywords: Viscoelastic; Viscoplastic; Diabetes; Exercise; Postprandial plasma glucose; Fasting plasma glucose

Abbreviations: MI: metabolism index; CVD: cardiovascular diseases; CKD: chronic kidney diseases; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose

Available online: 12 January 2024

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

1. INTRODUCTION

Sir Isaac Newton formulated his law of gravity, also known as universal gravitation, in 1687. This law was published in his seminal work, "Philosophiæ Naturalis Principia Mathematica" (Mathematical Principles of Natural Philosophy). Regarding viscous fluids, Newton published his groundbreaking work on fluid mechanics, "Mathematical Principles of Natural Philosophy," in 1687 as well.

The theory of stress-strain and the concept of Young's modulus were proposed by the British scientist Thomas Young. Young introduced the concept of modulus of elasticity, which is now known as Young's modulus, in his lectures published in 1807. Young's modulus (E) is a measure of the stiffness or rigidity of a material and quantifies the relationship between stress (force per unit area) and strain (deformation) in a linear elastic material.

The understanding and utilization of fluid viscosity in the field of solid engineering can be credited to the French physicist and engineer Claude-Louis Navier. In 1822, Navier introduced the concept of viscosity and Navier's equation into the field of solid engineering.

In October 1967, a British Professor Norman Jones at Brown University published a paper titled "Finite Deflections of a Rigid Viscoplastic Strain-Hardening Annular Plate Loaded Impulsively."

In 2018, the author of this paper, Gerald C. Hsu, applied the principles of stress-strain and Young's modulus from solid engineering to develop his Linear Elastic Glucose Theory (LEGT)-based postprandial plasma glucose (PPG) prediction equation:

Predicted LEGT-based PPG
= {FPG} * 0.87 + {Avg carbs + sugar} * 2.7 - 4 * {Avg exercise - post meal} / 1000

Upon the recommendation of his academic advisor at MIT, Professor Norman Jones (the same Professor mentioned above), the author of this paper began integrating the space-domain viscoplastic energy model (SD-VMT) into his biomedical research efforts in January 2021. The following is his developed VMT-based PPG prediction equation:

Predicted VMT-based PPG
= (({FPG} / 100) * 0.42 + ({Avg carbs + sugar} / 14)* 0.35 + ({Avg exercise - post meal} / 4000) * 0.23) / 1.065 * 116

Subsequently, after applying these two prediction equations, the author further employed the energy ratios related to inputs from the SD-VMT energy model to create his third set of predicted PPG values.

1.1 Biomedical information

The following sections contain excerpts and concise information drawn from multiple medical articles, which have been meticulously reviewed by the author of this paper. The author has adopted this approach as an alternative to including a conventional reference list at the end of this document, with the intention of optimizing his valuable research time. It is essential to clarify that these sections do not constitute part of the author's original contribution but have been included to aid the author in his future reviews and offer valuable insights to other readers with an interest in these subjects.

Notes from the author of this paper:

Upon reviewing the upcoming excerpts from other published articles, it becomes evident that these findings are predominantly conveyed using qualitative statements. On occasion, these statements include a limited number of numerical values, typically sourced from statistical data within epidemiological studies. However, a recurring deficiency among them is the lack of robust quantitative findings to underpin their qualitative conclusions. Consequently, the author of this paper has deliberately opted to leverage his familiar methodologies from mathematics, physics, and engineering fields in his medical research pursuits. This strategic choice is intended to yield substantial conclusions supported by sound proofs via quantitative data, effectively bridging the current gap in the realm of biomedical research.

Pathophysiological explanation of FPG in early morning and health status of pancreatic beta cells:

The explanation for fasting plasma glucose (FPG) levels being higher in the early morning and the health status of pancreatic beta cells can be understood through the concept of the dawn phenomenon and the role of beta cells in insulin production.

The dawn phenomenon refers to the natural rise in blood sugar levels that occurs in the early morning, typically between 3 am and 8 am, in individuals without diabetes. This phenomenon is primarily influenced by the body's hormone release patterns, particularly the release of growth hormone, cortisol, and catecholamines, which can lead to increased glucose production by the liver. Additionally, insulin sensitivity tends to be lower in the early morning, further contributing to elevated FPG levels.

Pancreatic beta cells play a crucial role in maintaining blood glucose levels by producing and releasing insulin. Insulin is responsible for facilitating the uptake of glucose from the bloodstream into cells, thereby lowering blood sugar levels. In individuals with diabetes or impaired beta-cell function, the ability of the beta cells to produce sufficient amounts of insulin may be compromised.

The health status of pancreatic beta cells can vary depending on various factors. In type 1 diabetes, an autoimmune condition, the beta cells are destroyed by the immune system, leading to a severe deficiency of insulin production. Individuals with type 1 diabetes require exogenous insulin therapy to manage their blood sugar levels.

In type 2 diabetes, the most common form of diabetes, beta-cell function may initially be normal or even increased. However, over time, due to factors such as insulin resistance and chronic hyperglycemia, beta-cell function progressively deteriorates. This reduction in beta-cell function leads to inadequate insulin secretion, contributing to elevated FPG levels and impaired glucose control.

Furthermore, other health conditions such as pancreatitis, pancreatic cancer, or genetic disorders can also impact the health and function of pancreatic beta cells.

In summary, the higher FPG levels in the early morning are primarily attributed to the dawn phenomenon, influenced by hormone release patterns and reduced insulin sensitivity. The health status of pancreatic beta cells is essential for proper insulin production, and any impairment or dysfunction of these cells can contribute to elevated FPG levels and the development of diabetes.

Pathophysiological explanation of relationship between FPG in early morning and PPG after meals:

The relationship between fasting plasma glucose (FPG) in the early morning and postprandial plasma glucose (PPG) after meals can be understood through the dynamics of glucose regulation and insulin secretion in individuals with impaired glucose metabolism.

In a healthy individual, FPG levels are typically maintained within a narrow range due to a balance between hepatic glucose production and glucose uptake by peripheral tissues. However, in individuals with impaired glucose metabolism, such as those with prediabetes or diabetes, this balance is disrupted, leading to higher FPG levels.

The mechanisms underlying this relationship involve the interplay between insulin secretion, insulin resistance, and the body's ability to regulate glucose. In the early morning, there is increased secretion of counter-regulatory hormones like growth hormone, cortisol, and catecholamines, which can induce hepatic glucose production and contribute to higher FPG levels. Additionally, insulin sensitivity tends to be lower in the early morning, further exacerbating the impact of hepatic glucose production on FPG levels.

The elevated FPG levels in the morning can also influence PPG levels after meals. When glucose is consumed during a meal, it is absorbed into the bloodstream, resulting in an increase in blood glucose levels. In response, the pancreas secretes insulin to help facilitate the uptake of glucose into cells, thereby lowering blood sugar levels. However, in individuals with impaired glucose metabolism, the ability of the beta cells in the pancreas to produce and secrete insulin may be compromised.

If beta cell function is impaired, insulin secretion may be inadequate, resulting in reduced insulin levels or delayed insulin release. As a consequence, after-meal glucose levels may remain elevated for longer periods, leading to higher PPG levels. The impaired ability of insulin to efficiently transport glucose into cells, known as insulin resistance, further contributes to the persistence of elevated PPG levels.

It is important to note that the relationship between FPG and PPG can be influenced by various factors, including diet, physical activity, and medication use. The management of FPG and PPG levels in individuals with impaired glucose metabolism typically involves strategies such as diet modification, exercise, medication, and insulin therapy to optimize blood glucose control.

In summary, the relationship between FPG in the early morning and PPG after meals involves impaired glucose regulation, reduced insulin secretion from beta cells, and insulin resistance. Addressing both FPG and PPG levels is crucial for the management of glucose metabolism disorders such as prediabetes and diabetes.

Pathophysiological explanation of relationship between carbohydrates and sugar intake amount with post-meal exercise level and PPG after meals:

The relationship between carbohydrate and sugar intake amount, post-meal exercise levels, and postprandial plasma glucose (PPG) after meals can be explained through the dynamics of glucose metabolism and the body's response to these factors.

Carbohydrates are the primary source of glucose in the diet, and their consumption directly affects blood sugar levels. When carbohydrates are digested and absorbed, they are broken down into glucose, increasing blood glucose levels. The amount and type of carbohydrates consumed can influence the magnitude and duration of the rise in PPG.

A higher carbohydrate intake, especially if it includes a higher glycemic index or glycemic load (referring to the rate and amount of glucose released into the bloodstream), is more likely to result in a rapid and significant increase in PPG levels. On the other hand, a lower carbohydrate intake or choosing carbohydrates with a lower glycemic index may lead to a slower and more controlled rise in PPG.

Sugar intake, which includes simple sugars like glucose, fructose, and sucrose, can also have an impact on PPG levels. Consuming excessive amounts of sugar can cause a rapid spike in blood glucose levels, resulting in higher PPG levels. The body's response to high sugar intake involves the release of more insulin to normalize blood glucose levels. However, in individuals with impaired glucose metabolism or insulin resistance, this response may be suboptimal, leading to prolonged PPG elevation.

Post-meal exercise levels can also influence PPG levels. Exercise causes muscles to increase glucose uptake, which can result in a reduction in blood glucose levels. Engaging in physical activity after a meal, especially aerobic exercise, can enhance glucose uptake and utilization by muscles, potentially leading to lower PPG levels. This effect can be attributed to increased insulin sensitivity, improved insulin action, and increased glucose transport into cells during and after exercise.

However, the timing and intensity of post-meal exercise can play a role. Intense exercise immediately following a meal may temporarily increase blood glucose levels due to the counter-regulatory response, which releases more glucose into the bloodstream. In contrast, moderate-intensity exercise performed 1-2 hours after a meal is more likely to have a positive effect on PPG levels.

It is important to note that individual responses to carbohydrate and sugar intake, as well as post-meal exercise, can vary based on factors such as overall health, physical fitness, insulin sensitivity, and medication use. Therefore, personalized approaches to diet, exercise, and glucose management are often recommended for individuals with impaired glucose metabolism.

In summary, the relationship between carbohydrate and sugar intake amount, post-meal exercise levels, and PPG after meals involves the impact of these factors on blood glucose regulation. Consuming excessive carbohydrates and high-sugar foods can lead to higher PPG levels, while lower carbohydrate intake or selecting carbohydrates with a lower glycemic index can help manage PPG. Engaging in moderate-intensity exercise after meals can enhance glucose uptake and utilization, potentially leading to improved PPG control. Individualized approaches are crucial to effectively manage postprandial glucose levels based on an individual's specific needs and metabolic response.

What is the recommended levels for carbohydrates and sugar intake grams and post-meal exercises for a type 2 diabetes over 20 years history?

It is important to note that specific dietary and exercise recommendations for individuals with type 2 diabetes can vary based on factors such as overall health, individual goals, medications, and medical advice. Consulting with a healthcare professional or registered dietitian is highly recommended for personalized recommendations.

Carbohydrate intake

For individuals with type 2 diabetes, the American Diabetes Association (ADA) recommends individualized carbohydrate intake based on factors like weight, age, activity level, and glucose control. The general range is typically 45-60 grams of carbohydrates per meal for women and 60-75 grams for men. However, individual quantities may vary depending on specific needs and goals.

It is also important to focus on the quality of carbohydrates consumed. Whole grains, legumes, vegetables, and fruits are preferred over highly processed carbohydrates, as they have a lower glycemic index and provide more fiber, which can help with glycemic control.

Sugar intake

The ADA does not have a specific recommended daily intake limit for sugar for individuals with diabetes. However, it is generally recommended to limit added sugars in the diet and choose naturally occurring sugars found in fruits, vegetables, and dairy products. The American Heart Association suggests that women limit their added sugar intake to no more than 6 teaspoons (25 grams) per day and men no more than 9 teaspoons (38 grams) per day. It is advisable to check nutrition labels for added sugars when making food choices.

Post-meal exercise

The ADA recommends individuals with type 2 diabetes engage in at least 150 minutes of moderate-intensity aerobic activity per week, spread across at least 3 days. Additionally, including resistance training exercises twice a week is encouraged. Exercise can have numerous benefits for individuals with diabetes, including improved insulin sensitivity, better glucose control, weight management, and cardiovascular health. However, the timing and intensity of exercise after meals may require individual adjustments based on personal preferences and glucose response. It is advisable to monitor blood glucose levels and consult with a healthcare professional or certified diabetes educator to determine the appropriate exercise plan.

Again, it's essential to consult with a healthcare professional, registered dietitian, or certified diabetes educator who can provide personalized recommendations based on an individual's specific needs, health status, and goals.

2. METHODS

2.1 MPM background

To learn more about his developed GH-Method: math-physical medicine (MPM) methodology, readers can read the following three papers selected from his published 760+ papers.

The first paper, No. 386 describes his MPM methodology in a general conceptual format. The second paper, No. 387 outlines the history of his personalized diabetes research, various application tools, and the differences between biochemical medicine (BCM) approach versus the MPM approach. The third paper, No. 397 depicts a general flow diagram containing ~10 key MPM research methods and different tools.

2.2 The author's diabetes history

The author was a severe T2D patient since 1995. He weighed 220 lb. (100 kg) at that time. By 2010, he still weighed 198 lb. with an average daily glucose of 250 mg/dL (HbA1C at 10%). During that year, his triglycerides reached 1161 (high risk for CVD and stroke) and his albumin-creatinine ratio (ACR) at 116 (high risk for chronic kidney disease). He also suffered from five cardiac episodes within a decade. In 2010, three independent physicians warned him regarding the need for kidney dialysis treatment and the future high risk of dying from his severe diabetic complications.

In 2010, he decided to self-study endocrinology with an emphasis on diabetes and food nutrition. He spent the entire year of 2014 to develop a metabolism index (MI) mathematical model. During 2015 and 2016, he developed four mathematical prediction models related to diabetes conditions: weight, PPG, fasting plasma glucose (FPG), and HbA1C (A1C). Through using his developed mathematical metabolism index (MI) model and the other four glucose prediction tools, by the end of 2016, his weight was reduced from 220 lbs. (100 kg) to 176 lbs. (89 kg), waistline from 44 inches (112 cm) to 33 inches (84 cm), average finger-piercing glucose from 250 mg/dL to 120 mg/dL, and A1C from 10% to ~6.5%. One of his major accomplishments is that he no longer takes any diabetes-related medications since 12/8/2015.

In 2017, he achieved excellent results on all fronts, especially his glucose control. However, during the pre-COVID period, including both 2018 and 2019, he traveled to ~50 international cities to attend 65+ medical conferences and made ~120 oral presentations. This hectic schedule inflicted damage to his diabetes control caused by stress, dining out frequently, post-meal exercise disruption, and jet lag, along with the overall negative metabolic impact from the irregular life patterns; therefore, his glucose control was somewhat affected during the two-year traveling period of 2018-2019.

He started his COVID-19 self-quarantined life on 1/19/2020. By 10/16/2022, his weight was further reduced to ~164 lbs. (BMI 24.22) and his A1C was at 6.0% without any medication intervention or insulin injection. In fact, with the special COVID-19 quarantine lifestyle since early 2020, not only has he written and published ~500 new research articles in various medical and engineering journals, but he has also achieved his best health conditions for the past 27 years. These achievements have resulted from his non-traveling, low-stress, and regular daily life routines. Of course, his in-depth knowledge of chronic diseases, sufficient practical lifestyle management experiences, and his own developed high-tech tools have also contributed to his excellent health improvements.

On 5/5/2018, he applied a continuous glucose monitoring (CGM) sensor device on his upper arm and checks his glucose measurements every 5 minutes for a total of 288 times each day. Furthermore, he extracted the 5-minute intervals from every 15-minute interval for a total of 96 glucose data each day stored in his computer software.

Through the author's medical research work over 40,000 hours and read over 4,000 published medical papers online in the past 13 years, he discovered and became convinced that good life habits of not smoking, moderate or no alcohol intake, avoiding illicit drugs; along with eating the right food with well-balanced nutrition, persistent exercise, having a sufficient and good quality of sleep, reducing all kinds of unnecessary stress, maintaining a regular daily life routine contribute to the risk reduction of having many diseases, including CVD, stroke, kidney problems, micro blood vessels issues, peripheral nervous system problems, and even cancers and dementia. In addition, a long-term healthy lifestyle can even "repair" some damaged internal organs, with different required time-length depending on the particular organ's cell lifespan. For example, he has "self-repaired" about 35% of his damaged pancreatic beta cells during the past 10 years.

2.3 Energy theory

The human body and organs have around 37 trillion live cells which are composed of different organic cells that require energy infusion from glucose carried by red blood cells; and energy consumption from labor-work or exercise. When the residual energy (resulting from the plastic glucose scenario) is stored inside our bodies, it will cause different degrees of damage or influence to many of our internal organs.

According to physics, energies associated with the glucose waves are proportional to the square of the glucose amplitude. The residual energies from elevated glucoses are circulating inside the body via blood vessels which then impact all of the internal organs to cause different degrees of damage or influence, e.g. diabetic complications. Elevated glucose (hyperglycemia) causes damage to the structural integrity of blood vessels. When it combines with both hypertension (rupture of arteries) and hyperlipidemia (blockage of arteries), CVD or Stroke happens. Similarly, many other deadly diseases could result from these excessive energies which would finally shorten our lifespan. For an example, the combination of hyperglycemia and hypertension would cause micro-blood vessel's leakage in kidney systems which is one of the major cause of CKD.

The author then applied Fast Fourier Transform (FFT) operations to convert the input wave from a time domain into a frequency domain. The y-axis amplitude values in the frequency domain indicate the proportional energy levels associated with each different frequency component of input occurrence. Both output symptom value (i.e. strain amplitude in the time domain) and output symptom fluctuation rate (i.e. the strain rate and strain frequency) are influencing the energy level (i.e. the Y-amplitude in the frequency domain).

Currently, many people live a sedentary lifestyle and lack sufficient exercise to burn off the energy influx which causes them to become overweight or obese. Being overweight and having obesity leads to a variety of chronic diseases, particularly diabetes. In addition, many types of processed food add unnecessary ingredients and harmful chemicals that are toxic to the bodies, which lead to the development of many other deadly diseases, such as cancers. For example, ~85% of worldwide diabetes patients are overweight, and ~75% of patients with cardiac illnesses or surgeries have diabetes conditions.

In engineering analysis, when the load is applied to the structure, it bends or twists, i.e. deform; however, when the load is removed, it will either be restored to its original shape (i.e, elastic case) or remain in a deformed shape (i.e. plastic case). In a biomedical system, the glucose level will increase after eating carbohydrates or sugar from food; therefore, the carbohydrates and sugar function as the energy supply. After having labor work or exercise, the glucose level will decrease. As a result, the exercise burns off the energy, which is similar to load removal in the engineering case. In the biomedical case, both processes of energy influx and energy dissipation take some time which is not as simple and quick as the structural load removal in the engineering case. Therefore, the age difference and 3 input behaviors are "dynamic" in nature, i.e. time-dependent. This time-dependent nature leads to a "viscoelastic or viscoplastic" situation. For the author's case, it is "viscoplastic" since most of his biomarkers are continuously improved during the past 13-year time window.

2.4 Time-dependent output strain and stress of (viscous input*output rate)

Hooke's law of linear elasticity is expressed as:

Strain (ε: epsilon)
= Stress (σ: sigma) / Young's modulus (E)

For biomedical glucose application, his developed linear elastic glucose theory (LEGT) is expressed as:

PPG (strain)
= carbs/sugar (stress) * GH.p-Modulus (a positive number) + post-meal walking k-steps * GH.w-Modulus (a negative number)

Where GH.p-Modulus is reciprocal of Young's modulus E.

However, in viscoelasticity or viscoplasticity theory, the stress is expressed as:

Stress
= viscosity factor (η: eta) * strain rate (dε/dt)

Where strain is expressed as Greek epsilon or ε.

In this article, in order to construct an "ellipse-like" diagram in a stress-strain space domain (e.g. "hysteresis loop") covering both the positive side and negative side of space, he has modified the definition of strain as follows:

Strain
= (body weight at certain specific time instant)

He also calculates his strain rate using the following formula:

Strain rate
= (body weight at next time instant) - (body weight at present time instant)

The risk probability % of developing into CVD, CKD, Cancer is calculated based on his developed metabolism index model (MI) in 2014. His MI value is calculated using inputs of 4 chronic conditions, i.e. weight, glucose, blood pressure, and lipids; and 6 lifestyle details, i.e. diet, drinking water, exercise, sleep, stress, and daily routines. These 10 metabolism categories further contain ~500 elements with millions of input data collected and processed since 2010. For individual deadly disease risk probability %, his mathematical model contains certain specific weighting factors for simulating certain risk percentages associated with different deadly diseases, such as metabolic disorder-induced CVD, stroke, kidney failure, cancers, dementia; artery damage in heart and brain, micro-vessel damage in kidney, and immunity-related infectious diseases, such as COVID death.

Some of explored deadly diseases and longevity characteristics using the viscoplastic medicine theory (VMT) include stress relaxation, creep, hysteresis loop, and material stiffness, damping effect based on time-dependent stress and strain which are different from his previous research findings using linear elastic glucose theory (LEGT) and nonlinear plastic glucose theory (NPGT).

Note: For a more detailed description, please refer to the "consolidated method" section which is given at the beginning of the special issue.

3. RESULTS

Figure 1 shows comparison of three quarterly PPG prediction model results.

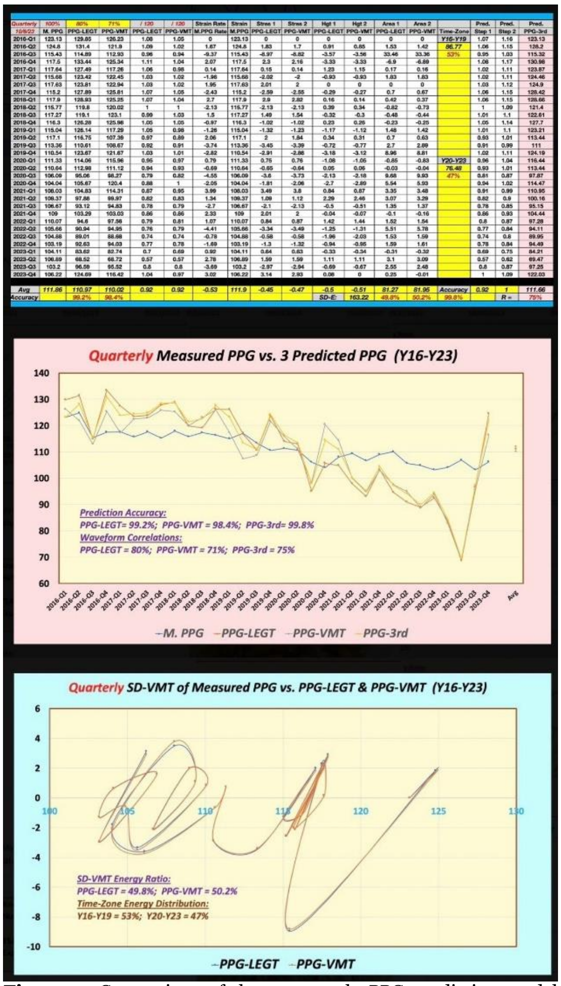


Figure 1: Comparison of three quarterly PPG prediction model results.

4. CONCLUSION

In summary, this quarterly data study presents four observations:

1. Regarding prediction accuracies, LEGT-PPG has 99.2%, VMT-has 98.4% and the third VMT model has 99.8%.

2. Regarding waveform similarities (correlations), LEGT-PPG has 80%, VMT-has 71% and the third VMT model has 75%.

3. Regarding SD-VMT energy ratios, LEGT-PPG contributes 49.8% while VMT-PPG input contributes 50.2%.

4. Regarding SD-VMT time-zone energy distributions, period of Y16-Y19 contributes 53% while period of Y20-Y23 contributes 47%.

All three prediction models provide highly accurate predictions (above 98.4%). Overall, the LEGT model yields better results than the VMT model.

5. REFERENCES

For editing purposes, majority of the references in this paper, which are self-references, have been removed for this article. Only references from other authors' published sources remain. The bibliography of the author's original self-references can be viewed at www.eclairemd.com.

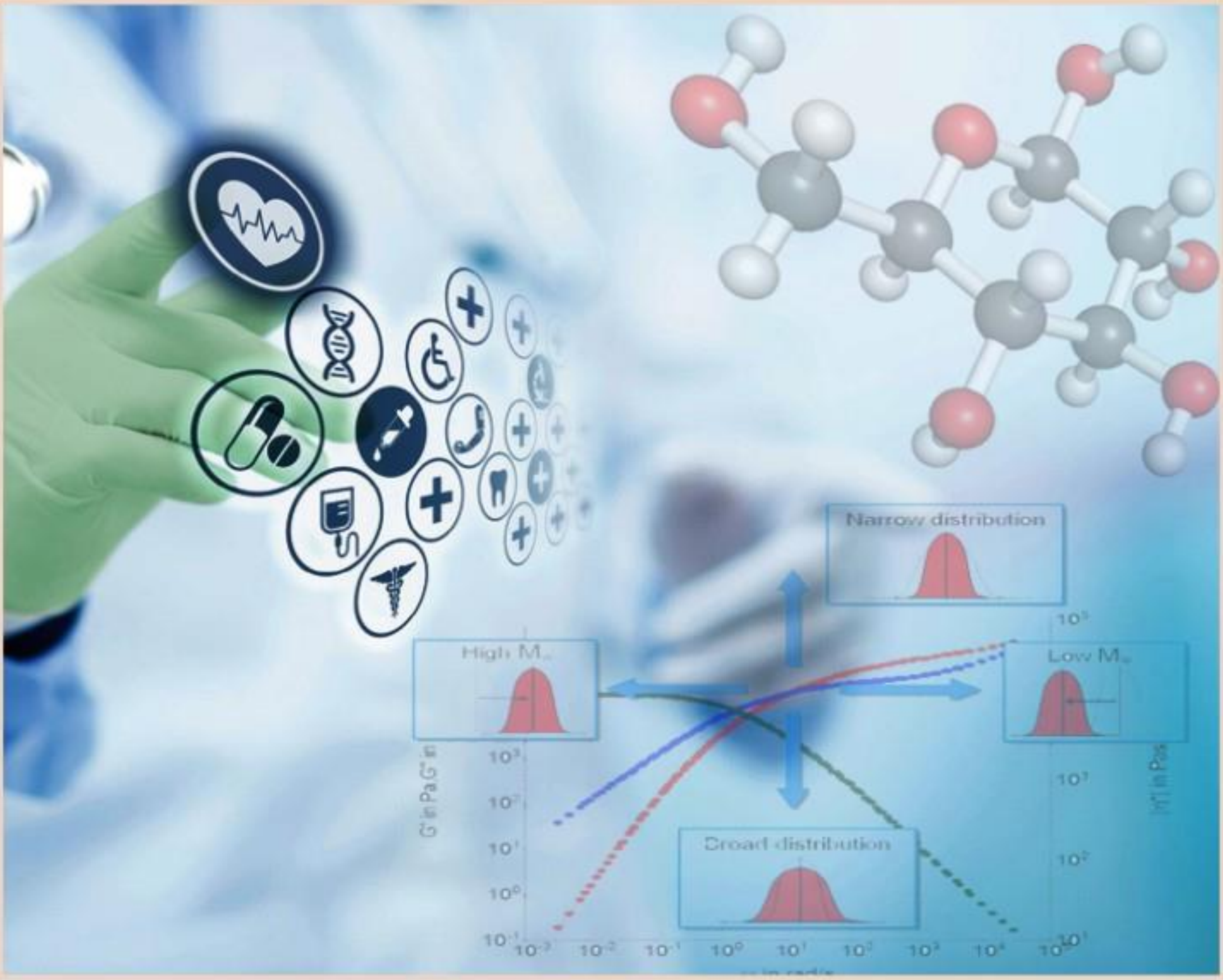
For reading more of the author's published VGT or FD analysis results on medical applications, please locate them through platforms for scientific research publications, such as ResearchGate, Google Scholar, etc.

Special Issue | Issue No. 5

The GH-Method

Viscoelastic and Viscoplastic Glucose Theory Application in Medicine

Gerald C. Hsu



https://theghmethod.com

2022