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The GH-Method

The relationship of postprandial plasma glucose versus fasting plasma glucose in the early morning, carbohydrates and sugar intake amount, and post-meal walking steps using both statistical correlation and viscoplastic energy model of GH-Method: math-physical medicine (No. 954)

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Abstract

This article explores the relationships and dynamics between postprandial plasma glucose (PPG, i.e., post-meal glucose) and fasting plasma glucose in the early morning (FPG), the amount of carbohydrates and sugar intake amount during meals (in grams), and the level of post-meal exercise (e.g., walking steps). The author initiated his data collection on important biomarkers and lifestyle details since 2012, focusing more on a 10-year period from 1/1/2014 to 11/14/2023, due to limited data available for 2012 and 2013. The correlations between PPG and both FPG and carbohydrate/sugar intake are notably high at +89%, and there is another significant negative correlation of -63% with post-meal walking steps. These statistical findings align closely with the author's understanding of glucose pathophysiology and biochemistry. Additional statistical analyses, conducted in three-year periods, reveal a consistent downward trend in averaged data for PPG, FPG, and carbs/sugar intake, resembling a skiing slope. Post-meal walking steps exhibit a mountain-like pattern with the mid-period at its peak. In summary, traditional statistical calculations yield the following correlations: - R of PPG vs. FPG: 89%; - R of PPG vs. Carbs: 89%; - R of PPG vs. Steps: -63%. Averaged data for three-year periods (Y14-17, Y18-20, Y21-23): - PPG mg/dL: 126, 113, 106; - FPG mg/dL: 121, 110, 91; - Carbs grams: 16, 14, 12; - Post-meal K-Steps: 3.0, 4.3, 3.6. In addition to statistical analysis methods, the author also applied the Spatial-Domain Viscoplastic Medicine Theiry (SD-VMT) method to the same dataset. This unique medical Viscoplastic energy analysis identified three energy contribution margins, with FPG contributing the most at 50%, followed by carbs/sugar amount at 31%, and post-meal walking steps at 19%. The energy ratio of carbs/sugar versus walking steps (1.6 = 31/19) mirrors the diabetes pathophysiological pathway ratio of 1.6 (=8/5) with diet (8 of 8 pathways) to exercise (5 of 8 pathways). Three Energy distribution: - Energy from FPG: 50%; - Energy from Carbs: 31%; - Energy from Steps: 19%. Key Message: The health state of pancreatic beta cells, as indicated by FPG, has the most significant impact on PPG formation. Furthermore, the dietary intake of carbs/sugar (approximately 60% of secondary factors) holds greater importance than post-meal exercise (roughly 40% of secondary factors) in influencing PPG formation.

Keywords: Viscoelastic; Viscoplastic; Diabetes; Glucose

Abbreviations: CGM: continuous glucose monitoring; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose

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1. INTRODUCTION

This article explores the relationships and dynamics between postprandial plasma glucose (PPG, i.e., post-meal glucose) and fasting plasma glucose in the early morning (FPG), the amount of carbohydrates and sugar intake amount during meals (in grams), and the level of post-meal exercise (e.g., walking steps). The author initiated his data collection on important biomarkers and lifestyle details since 2012, focusing more on a 10-year period from 1/1/2014 to 11/14/2023, due to limited data available for 2012 and 2013.

The correlations between PPG and both FPG and carbohydrate/sugar intake are notably high at +89%, and there is another significant negative correlation of -63% with post-meal walking steps. These statistical findings align closely with the author's understanding of glucose pathophysiology and biochemistry.

Additional statistical analyses, conducted in three-year periods, reveal a consistent downward trend in averaged data for PPG, FPG, and carbs/sugar intake, resembling a skiing slope. Post-meal walking steps exhibit a mountain-like pattern with the mid-period at its peak.

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.

Pathophysiological and biochemical explanations of PPG versus FPG in early morning, carbs and sugar food, and post-meal exercise level:

PPG (Postprandial Plasma Glucose) and FPG (Fasting Plasma Glucose) levels are indicators of blood glucose concentration at different times, providing insights into glucose metabolism.

Fasting Plasma Glucose (FPG):

Pathophysiological Explanation:
FPG measures blood glucose after an overnight fast. Elevated FPG indicates impaired fasting glucose or diabetes, suggesting inadequate insulin action or insulin resistance during fasting periods.

Biochemical Explanation:
In the absence of food intake, the liver releases glucose into the bloodstream through gluconeogenesis, contributing to FPG levels. Insulin typically inhibits this process, but insulin resistance can disrupt glucose regulation.

Postprandial Glucose (PPG):

Pathophysiological Explanation:
PPG reflects blood glucose levels after meals. Elevated PPG may signify impaired glucose tolerance or diabetes, highlighting issues with insulin secretion or action during the post-meal period.

Biochemical Explanation:
After consuming carbohydrates, the digestive process breaks them down into glucose, raising blood sugar levels. Insulin facilitates the uptake of glucose by cells for energy or storage, but dysfunction in this process can lead to elevated PPG.

Early Morning and Carbs/Sugar Intake:

Pathophysiological Explanation:
The dawn phenomenon can cause elevated FPG in the early morning due to increased secretion of counter-regulatory hormones like cortisol and growth hormone, leading to insulin resistance.

Biochemical Explanation:
Overnight, the body releases hormones that raise blood glucose to prepare for waking activities. In the presence of insulin resistance, this can result in higher FPG levels. Carbs/sugar intake before bed may exacerbate this effect.

Post-Meal Exercise:

Pathophysiological Explanation:
Exercise enhances insulin sensitivity, improving glucose uptake by cells and

lowering PPG levels. It also promotes muscle glucose utilization.

Biochemical Explanation:
During exercise, muscle contractions stimulate glucose uptake independent of insulin. This can help clear excess glucose from the bloodstream, reducing PPG levels.

Understanding these mechanisms aids in managing blood glucose levels through lifestyle interventions, such as adjusting meal timing, composition, and incorporating regular physical activity.

Can FPG in the early morning provide an useful indication of pancreatic beta cells insulin production and quality status?

Fasting Plasma Glucose (FPG) levels in the early morning can indeed provide useful indications of pancreatic beta cell function, insulin production, and overall insulin sensitivity:

1. Normal Functioning:

Low FPG: Typically, a normal functioning pancreas and healthy beta cells produce insulin effectively, helping to maintain lower fasting glucose levels.

2. Insulin Resistance:

Elevated FPG: Higher FPG levels in the morning may suggest insulin resistance or reduced sensitivity of cells to insulin. In this scenario, even though insulin is produced, the cells are less responsive to its effects.

3. Beta Cell Dysfunction:
Persistent High FPG:
If FPG remains consistently high, it might indicate beta cell dysfunction or a reduced capacity of the pancreas to produce sufficient insulin. This is often seen in conditions like type 2 diabetes.

4. Dawn Phenomenon:

Elevated Morning FPG:
In some cases, an increase in FPG in the early morning may be due to the dawn phenomenon, where the body releases hormones (like cortisol) that lead to increased glucose production, especially in individuals with diabetes.

5. Quality of Insulin:

FPG Fluctuations:
While FPG primarily reflects insulin sensitivity and production, persistent instability or fluctuations in FPG levels might also suggest issues with the quality or timing of insulin release.

Monitoring FPG levels, especially in the morning when the body is in a fasting state, provides valuable information about the status of glucose regulation, beta cell function, and overall metabolic health. It is important to carefully interpret FPG results in conjunction with other measures and consult medical research scientists or knowledgeable healthcare professionals for a comprehensive assessment.

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 (Reference 1) describes his MPM methodology in a general conceptual format. The second paper, No. 387 (Reference 2) 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 (Reference 3) 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).

3. RESULTS

Figure 1 shows data table, TD analysis results and SD-VMT analysis results.

4. CONCLUSION

In summary, traditional statistical calculations yield the following correlations:
- R of PPG vs. FPG: 89%
- R of PPG vs. Carbs: 89%
- R of PPG vs. Steps: -63%

Averaged data for three-year periods (Y14-17, Y18-20, Y21-23):
- PPG mg/dL: 126, 113, 106
- FPG mg/dL: 121, 110, 91
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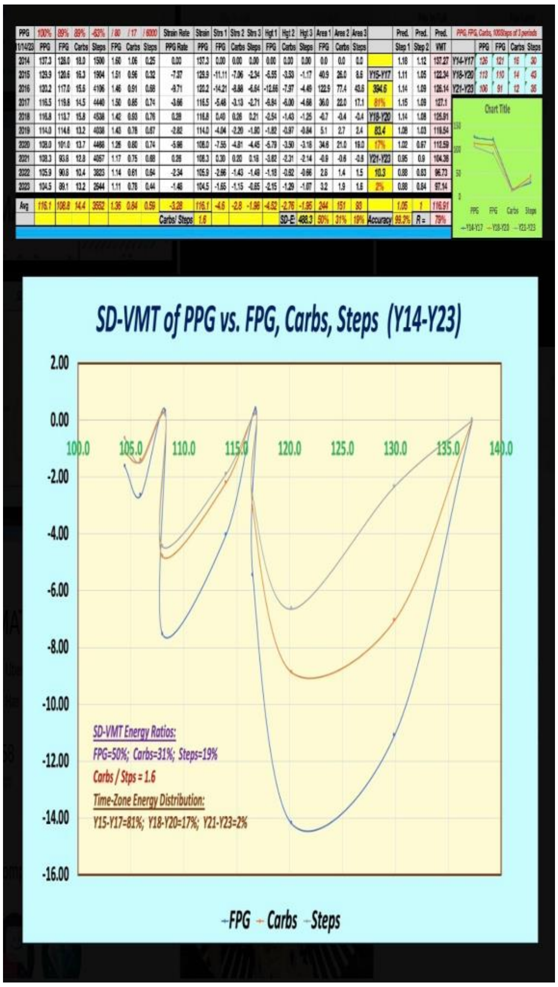

Figure 1: Data table, TD analysis results and SD-VMT analysis results.

Three Energy distribution:
- Energy from FPG: 50%
- Energy from Carbs: 31%
- Energy from Steps: 19%.

5. Key Message

The health state of pancreatic beta cells, as indicated by FPG, has the most significant impact on PPG formation. Furthermore, the dietary intake of carbs/sugar (approximately 60% of secondary factors) holds greater importance than post-meal exercise (roughly 40% of secondary factors) in influencing PPG formation

6. 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.

Readers may use this article as long as the work is properly cited, and their use is educational and not for profit, and the author's original work is not altered.

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.

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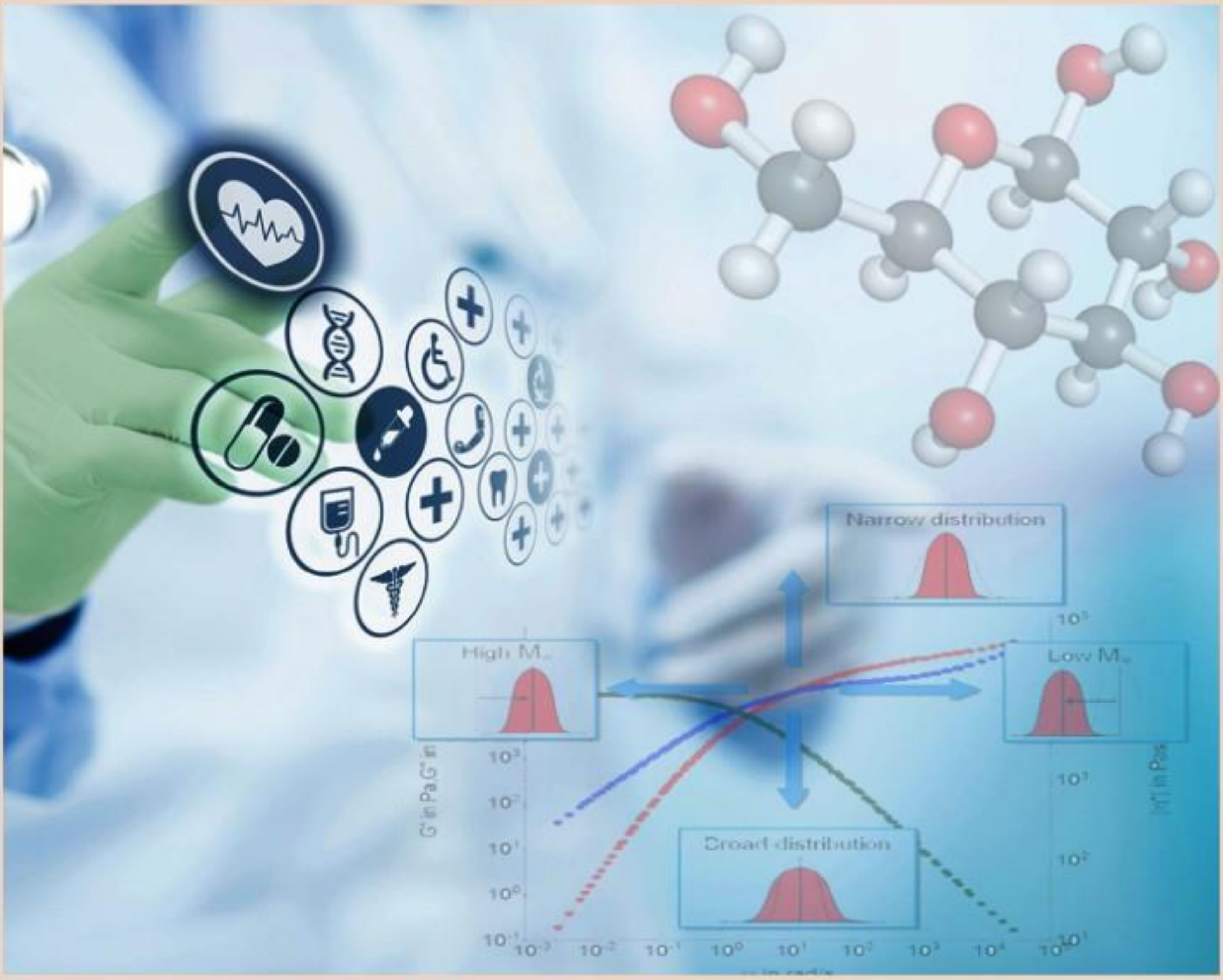

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