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The GH-Method

Viscoelastic Medicine theory (VMT #363): Relationships of diabetic neuropathy risks and four biomarkers of type 2 diabetes disease, insulin resistance via FPG, glycemic control via HbA1c and eAG, hyperglycemia intensity using viscoplastic energy model of GH-Method: math-physical medicine (No. 964)

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Abstract

The interaction between diet quality and portion control significantly influences body weight, a crucial factor in the progression of type 2 diabetes (T2D). T2D is characterized by four key biomarkers: insulin resistance (measured via morning fasting glucose - FPG), daily glycemic control (averaged glucose - eAG), quarterly glycemic control (HbA1c levels), and hyperglycemia situation control (hyperglycemia intensity - HyGI). HbA1c and eAG are similar biomarkers. But, both of them lack representation of insulin resistance influences and damage caused by hyperglycemia. HyGI is calculated as averaged glucose above 180 mg/dL multiplied by the occurrence frequency of glucose above 180 mg/dL.

This study explores the author's diabetic neuropathy (DN) risks associated with these four T2D biomarkers, drawing from personal data collected over the past six years (5/1/2018 to 11/20/2023).

Traditional statistical analysis reveals strong correlations (61% to 94%) between the author's DN risk and the four T2D biomarkers. Additionally, the author employs the space-domain viscoplastic energy (SD-VMT) method to unveil hidden relationships and dynamics (i.e. energies) between these four T2D biomarkers and his annual DN risk output.

In summary, traditional statistical correlations uncovered significant associations between the author's DN risks and his four T2D biomarkers:
- DN vs. HbA1c: 92%; - DN vs. FPG: 90%; - DN vs. eAG: 94%; - DN vs. HyGI: 61%.

These differ from low positive correlations (14% to 41%) between his cancer risks and the same four T2D biomarkers, reflecting distinct characteristics in the risk waveforms of these two diseases.

Using SD-VMT energy results, four energy contribution margins on DN risks from T2D biomarkers were identified: - Energy from HbA1c: 22%; - Energy from FPG: 26%; - Energy from eAG: 22%; - Energy from HyGI: 29%.

Hyperglycemia Intensity is the strongest influential factor for his DN risks.

Key message:

The author's T2D conditions are indeed linked to his risks of developing DN. Hyperglycemia intensity HyGI contributes the highest energy to DN risks (29%), followed by 26% of insulin resistance via FPG, and 22% from HbA1c and eAG each. Despite representing only 2% occurrence of the total glucose dataset, hyperglycemia intensity contributes 29% of the total impact or energy on his overall DN risks..

Keywords: Viscoelastic; Viscoplastic; Diabetes; Glucose; Biomarkers; Insulin; Hyperglycemia; Neuropathy

Abbreviations: CGM: continuous glucose monitoring; eAG: estimated average glucose; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose; SD: space-domain; VMT: viscoelastic medicine theory; FFT: Fast Fourier Transform

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1. INTRODUCTION

The interaction between diet quality and portion control significantly influences body weight, a crucial factor in the progression of type 2 diabetes (T2D). T2D is characterized by four key biomarkers: insulin resistance (measured via morning fasting glucose - FPG), daily glycemic control (averaged glucose - eAG), quarterly glycemic control (HbA1c levels), and hyperglycemia situation control (hyperglycemia intensity - HyGI). HbA1c and eAG are similar biomarkers. But, both of them lack representation of insulin resistance influences and damage caused by hyperglycemia. HyGI is calculated as averaged glucose above 180 mg/dL multiplied by the occurrence frequency of glucose above 180 mg/dL.

This study explores the author's diabetic neuropathy (DN) risks associated with these four T2D biomarkers, drawing from personal data collected over the past six years (5/1/2018 to 11/20/2023).

Traditional statistical analysis reveals strong correlations (61% to 94%) between the author's DN risk and the four T2D biomarkers. Additionally, the author employs the space-domain viscoplastic energy (SD-VMT) method to unveil hidden relationships and dynamics (i.e. energies) between these four T2D biomarkers and his annual DN risk output.

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.

Diabetic neuropathy (nerve damage) from Diabetes UK:

What is diabetic neuropathy?

Diabetic neuropathy is when diabetes causes damage to your nerves. It can affect different types of nerves in your body, including in your feet, organs and muscles.

Nerves carry messages between the brain and every part of our bodies so that we can see, hear, feel and move. They also carry signals to parts of the body such as the heart, making it beat at different speeds, and the lungs, so we can breathe.

Damage to the nerves can therefore cause serious problems in various parts of the body for people with type 1, type 2 or other types of diabetes.

Types of diabetic neuropathy:

There are four main types of diabetic neuropathy:

- Diabetic peripheral neuropathy
- Diabetic sensory neuropathy
- Diabetic autonomic neuropathy
- Diabetic motor neuropathy

People with the condition could have just one or any combination of the types. Your healthcare team should tell you which areas are affected and give advice on what to do about any symptoms you are having. The type of treatment you need will depend on the type of neuropathy.

Causes of diabetic neuropathy:

Neuropathy is one of the long-term complications of diabetes. Over time, high blood glucose (sugar) levels can damage the small blood vessels that supply the nerves in your body. This stops essential nutrients reaching the nerves. As a result, the nerve fibres can become damaged, and they may disappear. This can cause problems in many different parts of your body, depending on the type of nerve affected.

Can diabetic neuropathy be reversed?

No, diabetic neuropathy can't be reversed (but the symptoms can be treated).

Once the nerves have been damaged, they cannot repair themselves.

But careful diabetes management including keeping your blood sugars as close to target as possible, and managing blood fat levels (blood lipids) and blood pressure can prevent the damage from happening or prevent further damage if you already have some of the symptoms.

Treatment for diabetic neuropathy

There are many treatments available to relieve the symptoms caused by neuropathy. This may include medication for nausea and vomiting, painkillers for sensory neuropathy or treatment to help with erectile dysfunction.

Keeping your blood sugar levels within your target range and also your blood fat levels (cholesterol) and blood pressure can also help to improve the symptoms of neuropathy and reduce the progression of the nerve damage.

Diabetic neuropathy pain

Why is diabetic neuropathy so painful?

The nerves carry chemical messages to and from the brain about what we can feel. When the nerves are damaged these messages cannot be sent properly which leads to a change in sensation or feeling. This can lead to feelings of numbness, tingling, burning, discomfort or shooting pains. Sometimes these sensations can be worse at night. We are not sure exactly why this is, but could be to do with cooler temperatures in the evening, stress at the end of a long day and fewer distractions in the evening meaning you notice the pain more.

Living with any type of long-term pain (whether you can always feel it or you regularly get periods of pain), can be very distressing and have a negative impact on your mental health and general wellbeing. If you are experiencing regular or frequent pain which you are struggling to cope with you should contact your GP for advice and support. You can also contact our helpline or reach out on our forum.

Steps you can take to prevent diabetic neuropathy

You can help avoid diabetic neuropathy by keeping your blood sugar levels within your target range, which will help protect the blood vessels that supply your nerves.

You should also check your feet every day and have your feet checked by a healthcare professional once a year. This is particularly important if you think you've lost the feeling in your feet. Speak to your diabetes healthcare team for advice if you think you're developing any signs of neuropathy.

Diabetic peripheral neuropathy

Peripheral neuropathy is the most common type of neuropathy and is damage to the nerves outside the brain and spinal cord. It affects the nerves particularly in the feet and hands and can be motor neuropathy, sensory neuropathy or both. Nerves in your feet should be checked during your routine annual diabetes check-up. For more information on peripheral neuropathy including treatment and symptoms, go to the NHS website.

Diabetic sensory neuropathy

Sensory neuropathy is damage to nerves that tell us how things feel, smell and look. It affects the nerves that carry messages of touch, temperature, pain and other sensations from the skin, bones and muscles to the brain. It mainly affects the nerves in the feet and the legs, but people can also develop this type of neuropathy in their arms and hands. The main danger of sensory neuropathy for someone with diabetes is loss of feeling in the feet, especially if you don't realize that this has happened.

Loss of feeling is dangerous because you may not notice minor injuries, for example if you step on something sharp while barefoot or get a blister from badly-fitting shoes. If ignored, minor injuries may develop into infections or ulcers. That's why it is important to look after your feet when you have diabetes.

Symptoms of sensory neuropathy in feet, legs, hands and arms:

- tingling and numbness
- loss of ability to feel pain
- loss of ability to feel changes in temperature

- loss of coordination – when you can't feel the position of your joints
- burning or shooting pains – these may be worse at night

People with diabetes are more likely to be admitted to hospital with a foot ulcer than with any other diabetes complication. We've got lots of information on taking care of your feet when you have diabetes.

If you have neuropathy, you're more at risk of developing Charcot foot. This is one of the serious foot complications caused by diabetes. We've got more information about what causes Charcot foot, as well as how to treat and prevent it.

Diabetic autonomic neuropathy

Autonomic neuropathy is damage to the nerves that carry information to your organs and glands. They help to control functions we don't even have to think about like your stomach emptying, how regularly your heart beats, and how your sexual organs work.

Examples of autonomic neuropathy:

- gastroparesis – when food can't move through the digestive system efficiently. Symptoms of this can include bloating, constipation or diarrhoea.
- loss of bladder control, leading to incontinence (not being able to control when you pee)
- irregular heartbeats
- problems with sweating - either not being able to sweat properly and intolerance to heat, or sweating related to eating food (gustatory)
- impotence (inability to keep an erection).

Motor neuropathy

Motor neuropathy affects the nerves that control movement. Damage to these nerves leads to weakness and wasting of the muscles that receive messages from the affected nerves.

Motor neuropathy symptoms

Nerve damage can lead to problems such as muscle weakness, which could cause falls or problems with doing tasks like fastening buttons, and muscles wasting where muscle tissues is lost because it's less active. It can also lead to muscle twitching and cramps.

Pathophysiological explanations of diabetic neuropathy and four biomarkers of type 2 diabetes, such as insulin resistance via FPG, diabetic control via HbA1C and eAG, and hyperglycemia intensity:

Diabetic neuropathy(DN) results from prolonged high blood sugar levels damaging nerves. Insulin resistance, a hallmark of type 2 diabetes, impedes glucose uptake by cells. Fasting Plasma Glucose (FPG) measures baseline blood glucose levels, reflecting insulin resistance. Haemoglobin A1C (HbA1C) gauges long-term diabetic control, indicating average blood sugar levels over several months. Estimated Average Glucose (eAG) offers a similar measure for glycemic control. The author uses eAG for his daily glucose levels. Hyperglycemia intensity, a key factor using averaged glucose value and frequency of those above 180 mg/dL which can be assessed through regular blood glucose monitoring.

Diabetic neuropathy is a type of nerve damage that can occur in people with diabetes. It is believed to result from a combination of factors including metabolic and microvascular changes, oxidative stress, and inflammation. The pathophysiological explanations involve the detrimental effects of sustained high blood sugar levels on nerve function.

There are several biomarkers used to assess various aspects of type 2 diabetes. Insulin resistance can be measured indirectly by fasting plasma glucose (FPG) levels in early morning. HbA1c, or glycated hemoglobin, reflects average blood glucose levels over a period of time (usually three months) and is used to monitor diabetic control. eAG (estimated average glucose) provides an estimated average of blood glucose levels derived from continuous glucose monitoring (CGM) device. It has the same meaning as HbA1c in terms of glucose monitoring. Hyperglycemia intensity represents the severity of high blood sugar levels, which can be measured through various means such as continuous glucose monitoring. These biomarkers play a crucial role in understanding and managing type 2 diabetes and its complications.

Diabetic neuropathy in type 2 diabetes is primarily attributed to prolonged hyperglycemia damaging nerves. Chronic high blood sugar levels lead to microvascular changes, inflammation, and oxidative stress, contributing to nerve damage. Peripheral neuropathy is a common manifestation, affecting extremities and causing pain, numbness, or tingling.

Statistically, diabetic neuropathy prevalence is significant among individuals with type 2 diabetes. Studies indicate that up to 50% of people with diabetes may experience neuropathic symptoms. The Diabetes Control and Complications Trial (DCCT) demonstrated a strong correlation between glycemic control and the risk of neuropathy, emphasizing the importance of managing blood sugar levels.

However, specific statistical data can vary based on populations, duration of diabetes, and other factors. Regular monitoring and early intervention remain crucial in mitigating the impact of diabetic neuropathy in type 2 diabetes.

1.2 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 the 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.

The author's diabetes history:

The author has been 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 developing 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 has no longer taken 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 travelled 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 travelling 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 checked 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 of over 40,000 hours and reading 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 lengths 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.

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 glucose 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 example, the combination of hyperglycemia and hypertension would cause micro-blood vessel leakage in kidney systems which is one of the major causes 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) influence 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., deforms; 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, carbohydrates and sugar function as the energy supply. After having labour 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.

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 the 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 a 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, and 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 the 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).

2. RESULTS

Figure 1 shows data table, Time-domain curves and SD-VMT energies.

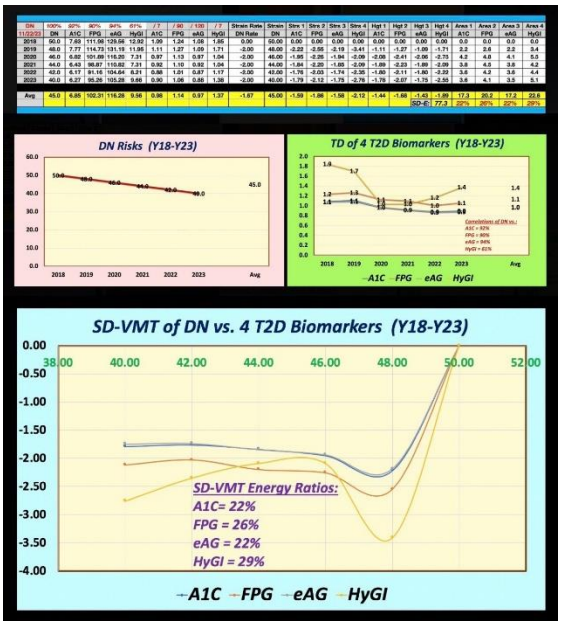

Figure 1: Data table, Time-domain curves and SD-VMT energies.

3. CONCLUSION

In summary, traditional statistical correlations uncovered significant associations between the author's DN risks and his four T2D biomarkers:

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These differ from low positive correlations (14% to 41%) between his cancer risks and the same four T2D biomarkers, reflecting distinct characteristics in the risk waveforms of these two diseases.

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Key message:

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4. REFERENCES

For editing purposes, the majority of the references in this paper, which are self-references, have been removed from 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.

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Viscoelastic and Viscoplastic Glucose Theory Application in Medicine

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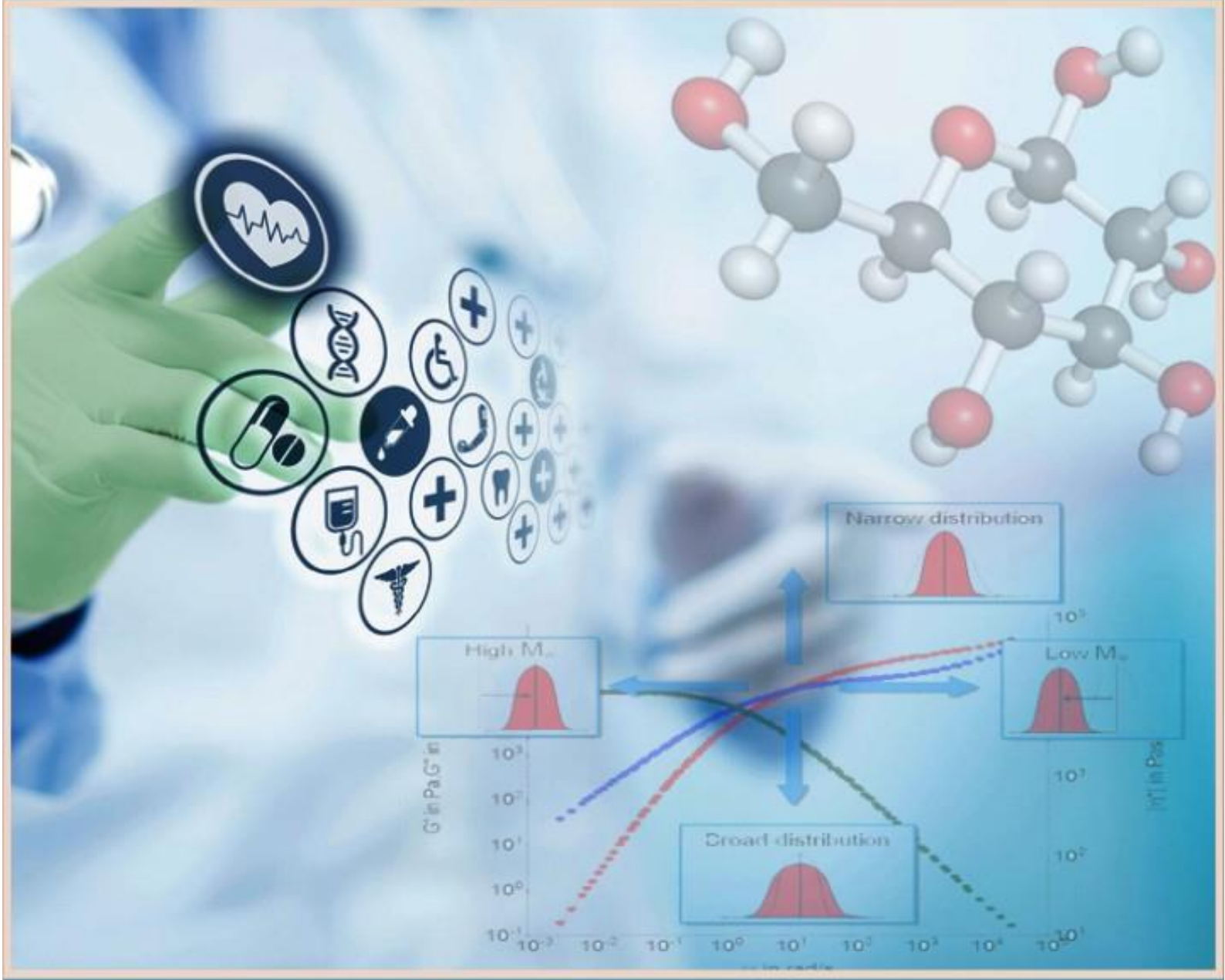

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