

The GH-Method

Viscoelastic Medicine theory (VMT #411): The Relationship Between Early Morning Body Weight and Sleep Conditions Using Viscoplastic Energy Model of GH-Method: Math-Physical Medicine (No. 1013)

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Abstract

On April 23, 2023, the author modified his body weight prediction equation as follows:

Predicted BW in the early morning = Yesterday's BW in the early morning + Yesterday's food quantity (m9a) + Yesterday's H2O drinking (m6) - Yesterday's bowel movement / 4 - Last night's sleeping hours / 6.

The author has implemented the above equation in his developed chronic software on his iPhone, replacing the previous version of his body weight prediction algorithm. Using data collected from 1/1/2014 to 12/31/2023, this updated equation has achieved a 99.9% prediction accuracy for his early morning body weight and a 98.6% correlation between measured and predicted body weight curves (see attached figure).

This article explores the relationship between the author's body weight in the early morning and his three sleep conditions at night, including overall sleep score, total hours spent in bed, and wake-up times during sleep (e.g., due to urination or sickness). The total sleep score consists of 23 contributing elements, with the most frequently changed elements being time spent in bed (i.e. sleep hours) and wake-up times at night. Additionally, the author chose 3 normalization factors: 0.5 (50%) for the sleep score, 7 hours for sleep hours, and 1.5 times for wake-up times at night. The analysis also applied the space-domain viscoplastic medicine theory (SD-VMT) energy method for its quantitative analysis.

In summary, three correlations existed between body weight curves and 3 sleep curves which are: Sleep score = +80%; Wake-up times = +87%; Sleep hours = -61% (The more hours of sleep, the lower the body weight).

The individual energy contribution ratios of three influential factors are Overall sleep score = 43%; Time-in-bed sleep hours = 31%; and Wake-up times at night = 26%.

The time-zone energy distribution ratios are: Y2014-Y2023 = 76%; Y2019-Y2023 = 24%.

Key message:

One out of five of the influential factors in the author's prediction equation of the early morning body weight, sleep makes a considerable impact on his morning weight. He carried out personal experiments between 7/1/2015 and 12/31/2023 and found that on average, his body weight decreased by 0.366 pounds per sleep hour or 1.1 pounds for every three hours of sleep.

In terms of energy contribution, the most impactful factor is the overall sleep score (43%), followed by the second strongest factor of sleep hours (31%), and the third factor of wake-up times at night (26%).

The majority of the energy (76%) is linked to the earlier period of 2014-2018 due to higher body weight, greater body weight change rate with year, and higher values for the three influential inputs. The recent period of 2019-2023 has much less associated energy (24%).

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

Abbreviations: CGM: continuous glucose monitoring; 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

On April 23, 2023, the author modified his body weight prediction equation as follows:

Predicted BW in the early morning
= Yesterday's BW in the early morning
+ Yesterday's food quantity (m9a)
+ Yesterday's H_2O drinking (m6)
- Yesterday's bowel movement / 4
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The author has implemented the above equation in his developed chronic software on his iPhone, replacing the previous version of his body weight prediction algorithm. Using data collected from 1/1/2014 to 12/31/2023, this updated equation has achieved a 99.9% prediction accuracy for his early morning body weight and a 98.6% correlation between measured and predicted body weight curves (see attached figure).

This article explores the relationship between the author's body weight in the early morning and his three sleep conditions at night, including overall sleep score, total hours spent in bed, and wake-up times during sleep (e.g., due to urination or sickness). The total sleep score consists of 23 contributing elements, with the most frequently changed elements being time spent in bed (i.e. sleep hours) and wake-up times at night. Additionally, the author chose 3 normalization factors: 0.5 (50%) for the sleep score, 7 hours for sleep hours, and 1.5 times for wake-up times at night. The analysis also applied the space-domain viscoplastic medicine theory (SD-VMT) energy method for its quantitative analysis.

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 explanations of morning body weight and overall sleep conditions, including sleep hours and wake-up times at night:

The relationship between sleep and body weight is complex and influenced by various pathophysiological factors. Here are some key considerations:

Hormonal Fluctuations:
Sleep affects the balance of hormones that control appetite. Ghrelin, the hormone that stimulates appetite, and leptin, which signals satiety, are influenced by sleep. Poor sleep can lead to increased ghrelin and decreased leptin, leading to increased hunger and appetite.

Metabolic Changes:
Lack of sleep can affect the body's ability to regulate glucose and can lead to insulin resistance, a risk factor for obesity and diabetes. The metabolic rate may also be altered by disrupted sleep patterns.

Energy Expenditure:
Sleep deprivation may lead to reduced physical activity due to fatigue, contributing to weight gain. Conversely, more energy might be expended if wakefulness is prolonged into the night.

Eating Patterns:
Disrupted sleep can lead to changes in eating habits, such as increased late-night snacking or preference for high-calorie foods, which can contribute to weight gain.

Cortisol Levels:
Stress and sleep deprivation can increase cortisol levels, a hormone associated with fat storage, particularly in the abdominal area.

Sleep Timing and Duration:
Both the amount and the timing of sleep can affect body weight. Irregular sleep patterns, like going to bed and waking up at different times, can disrupt the body's internal clock and affect eating patterns and metabolism.

Water Retention:
Fluctuations in body weight can also be due to variations in hydration status. The body may retain more water after a night of poor sleep.

Muscle Recovery and Growth:
Sleep is crucial for muscle recovery and growth. Reduced sleep can impair muscle recovery and growth, which can affect metabolism since muscle tissue burns more calories than fat tissue.

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In summary, the quality and quantity of sleep can significantly impact various physiological processes that influence body weight. Disruptions in sleep patterns can lead to hormonal imbalances, metabolic changes, altered eating patterns, and increased stress, all of which can contribute to weight gain.

Statistical data of morning body weight and overall sleep conditions, including sleep hours and wake-up times at night:

To collect statistical data on morning body weight and overall sleep conditions, including sleep hours and wake-up times at night, you would typically need to conduct a study involving a group of participants. The study would involve tracking and recording the following parameters for each participant over a defined period:

Morning Body Weight:
Participants would weigh themselves each morning upon waking, ideally at the same time each day and under similar conditions (e.g., before breakfast).

Sleep Hours:
Participants would record the time they go to bed and the time they wake up to calculate the total hours of sleep per night.

Wake-Up Times at Night:
Participants would note any instances of waking up during the night, along with the duration of these wakeful periods.

This data could then be analyzed to observe correlations and patterns, such as the relationship between sleep quality and body weight fluctuations. For accurate and reliable results, the study would need to control for variables like diet, physical activity, and stress levels, as these can also significantly impact both sleep quality and body weight.

Moreover, the study's design should consider the participant's privacy and consent, ensuring that data is collected and used ethically and responsibly.

Statistical data of morning body weight and overall sleep conditions, including sleep hours such as 6 to 8 hours and wake-up times at night such as 2 or 3 times per night due to urination or sickness:

The relationship between sleep quality, sleep duration, and body weight has been the subject of various studies. Here are some key findings:

Sleep Quality and Weight Loss:
A study published in PubMed explored the association between sleep characteristics and weight loss in overweight or obese women. It found that better subjective sleep quality and sleeping more than 7 hours per night increased the likelihood of weight loss success. Conversely, poor sleep quality was associated with a reduced chance of continued successful weight loss over time.

Consistency of Sleep Times and Body Fat:
Research conducted by an exercise science professor at Brigham Young University found that women who had consistent bedtimes and wake times had lower body fat. Specifically, those who had less than 60 minutes of variation in their sleep and wake times had lower body fat compared to those with more than 90 minutes of variation. The study emphasized the importance of a consistent wake time for body fat.

Effect of Wake-After Sleep Onset on Weight Loss:
A study from the International Journal of Obesity reported that lower sleep efficiency, higher wake after sleep onset (WASO), more awakenings during the night, and higher sleep onset latency were significantly associated with less weight loss. Additionally, these sleep disruptions were linked to lower odds of achieving recommended levels of physical activity, suggesting a broader impact of sleep disturbances on health and weight management.

These studies highlight the complex interplay between sleep patterns and body weight. Good sleep quality and consistency, as well as minimizing disturbances during the night, appear to be important factors for maintaining a healthier weight and enhancing the success of weight loss interventions.

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

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(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 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 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 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.

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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 circulate 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 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 have 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)

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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 sleep information, data table, inputs and SD-VMT energy output diagram.

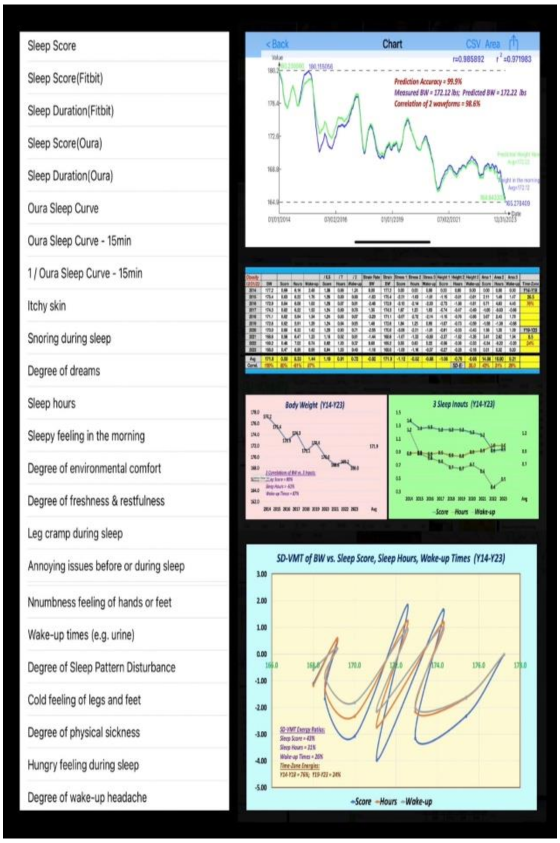

Figure 1: Sleep information, data table, inputs and SD-VMT energy output diagram

3. CONCLUSION

In summary, three correlations existed between body weight curves and 3 sleep curves which are:

Sleep score = +80%;
Wake-up times = +87%;
Sleep hours = -61% (The more hours of sleep, the lower the body weight.)

The individual energy contribution ratios of three influential factors are:

Overall sleep score = 43%
Time-in-bed sleep hours = 31%
Wake-up times at night = 26%

The time-zone energy distribution ratios are:

2014-Y2023 = 76%
Y2019-Y2023 = 24%.

Key message:

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7/1/2015 and 12/31/2023 and found that on average, his body weight decreased by 0.366 pounds per sleep hour or 1.1 pounds for every three hours of sleep.

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4. REFERENCES

For editing purposes, most 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.

Readers may use this article as long as the work is properly cited, 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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Viscoelastic and Viscoplastic Glucose Theory Application in Medicine

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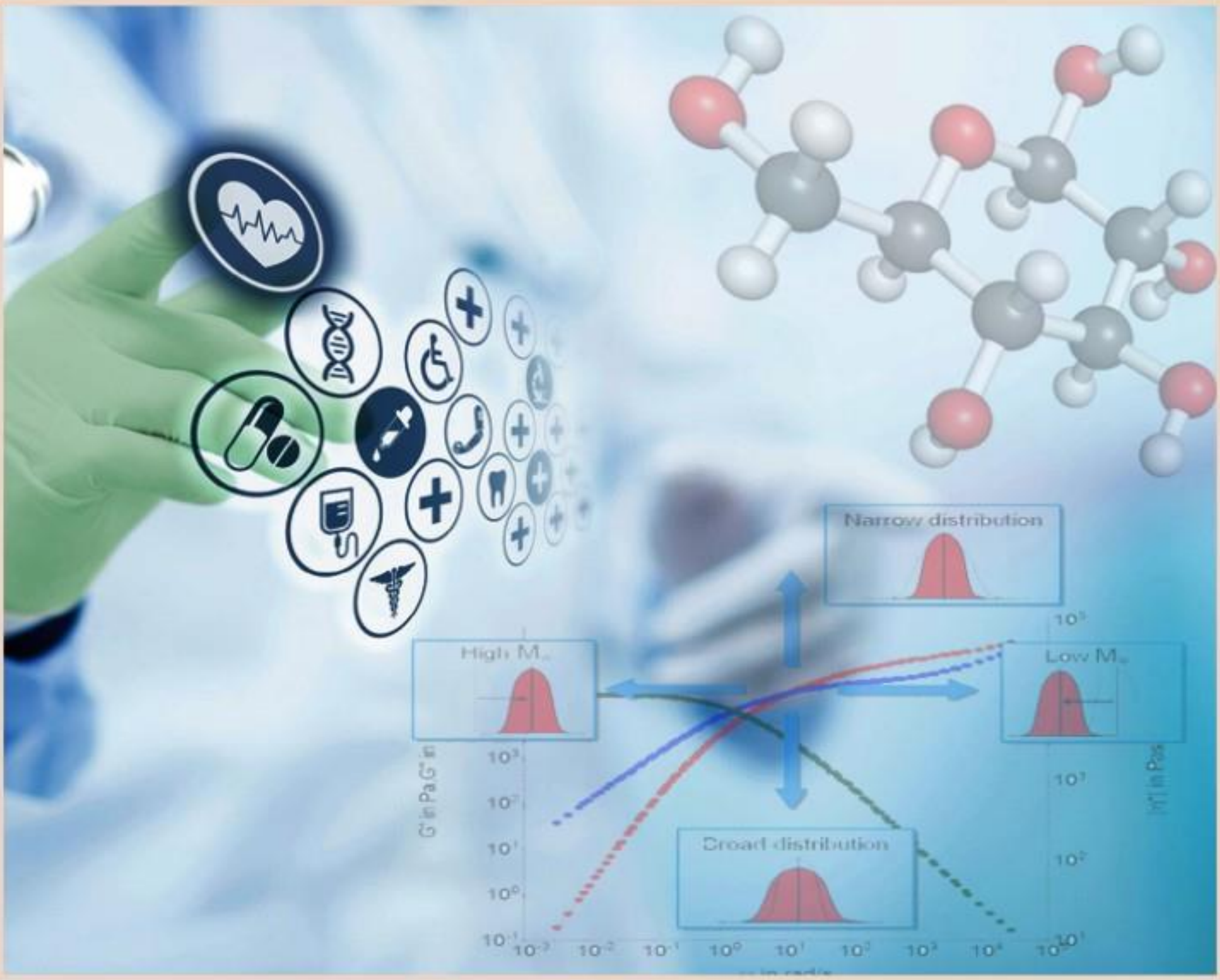

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