Special Issue 5
2022

The GH-Method

Applying Linear Elastic Glucose Theory (LEGT) and Viscoelastic or Viscoplastic Glucose Theory (VGT) While Using Data Collected Over an ~7-Year Period, from 7/1/2015 to 3/30/2022, Organized into 8 Annual Data Points, 81 Monthly Data Points, and 2,463 Daily Data Points, Along with a Biomedical Explanation of 8 Sub-Cellular Pathology Pathways of Chronic Diseases to Study the Relationship Among Pancreatic Beta Cells Health State, Diet, Exercise, and Glucose Based on the GH-Method: Math-Physical Medicine (LEGT #40, VGT #51, & No. 638)

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Note: Readers who want to get a quick overview can read the abstract, results, and graphs.

Abstract

The author was a professional engineer working in the fields of the space shuttle, naval battleships, nuclear power plants, computer hardware and software, artificial intelligence, and semiconductor chips. After retiring from his work, he initiated self-study and research on internal medicine with an emphasis on biomarker relationship exploration and disease prevention. Since 2010, he has utilized these disciplines learned from 7 different universities along with various work experiences to formulate his current medical research work during the past 13 years. One thing he has learned is that in engineering or medicine, we are frequently seeking answers, illustrations, or explanations for the relationships between the input variable (force applied on a structure or cause of a disease) and output variable (deformation of a structure or symptom of a disease). However, the multiple relationships between input and output could be expressed with many different matrix formats of 1 x 1, 1 x n, m x 1, or m x n (m or n means different multiple variables). In addition to these described mathematical complications, the output resulting from one or more inputs can also become an input of another output, i.e. a symptom of certain causes can become a cause of another different symptom. This phenomenon is a complex scenario with "chain effects". Engineering and biomedical complications are fundamentally mathematical problems that correlate or conform with many inherent physical laws or principles. Over the past 13 years, in his medical research work, he has encountered more than 100 different sets of biomarkers with almost equal amounts of cause/input variables versus symptom/output variables. For example, food and exercise influence both body weight and glucose level, where persistent high glucose can result in diabetes. When diabetes combines with hypertension (high blood pressure) and hyperlipidemia (high blood lipids), it can cause cardiovascular diseases. Furthermore, obesity and diabetes are also linked with various kinds of cancers. These multiple sets of biomedical input versus output have been researched by the author using different tools he has learned from the fields of mathematics, physics, computer science, and engineering. Previously, he has applied signal processing techniques to separate 19 components from the combined postprandial plasma glucose (PPG) wave. He identified the carbs/sugar intake amount and post-meal exercise as the two most important contributing factors to PPG formation. Based on these findings, he then applied the theory of elasticity to develop a linear elastic glucose theory (LEGT) to predict PPG value with high prediction accuracy, using fasting plasma glucose (FPG), carbs/sugar grams, and post-meal walking k-steps as three major input components of predicted PPG formation. Furthermore, he took a specific PPG waveform in the time domain (TD) and applied Fourier transform technique to convert it into a waveform in the frequency domain (FD). The y-axis value in the frequency

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diagram indicates the magnitude of energy corresponding to a certain frequency component on the x-axis, while the total area underneath the frequency-energy curve is the total relative energy associated with the specific PPG wave. Recently, he has applied theories of viscoelasticity and viscoplasticity (VGT) to various biomedical problems and has written about 50 medical research papers. This VGT technique emphasizes the time-dependency characteristics of certain variables. In the medical field, most biomarkers are time-dependent since body organ cells are organic in nature and change all of the time. Incidentally, VGT can generate a stress-strain curve or cause-symptom curve (in physics, it is called the "hysteresis loop"), which can be used to estimate the relative energy created during the uploading (digesting carbs/sugar) and unloading (walking exercise) process over the timespan of a PPG wave. In this article, he initially selected a dataset containing 3 key biomarkers, finger-pierced PPG, carbs/sugar grams (carbs), and post-meal walking k-steps (steps) over the past ~8 years from Y2015 to Y2022. He then utilized the above-mentioned LEGT and VGT math-physical tools to calculate the contribution margin % from carbs and steps respectively, and the contribution ratio of carbs/sugar over walking k-steps. Through these data comparisons and existing biomedical sub-cellular pathology pathway explanation, he hopes that he can prove the carbs/sugar grams contribution is indeed higher (about 50% to 70%) than the post-meal exercise steps contribution to his predicted PPG formation. He has already discovered this observation from earlier research results using both LEGT and Fourier transformed frequency domain energy tools. Now, he tries to add in another validation result using the VGT tool to reinforce his earlier findings. He applies VGT specifically to construct a stress-strain diagram with two hysteresis loops corresponding to carbs/sugar and k-steps. The two-loop areas reflect the relative energies associated with input from carbs/sugar and k-steps respectively during the time-dependent process of uploading (digesting carbs/sugar) and downloading (walking). In this article, he has used both 8 annual data and 81 monthly data to demonstrate that they have achieved the same contribution ratio of diet over-exercise. Finally, he lists 8 biomedical sub-cellular pathology pathways of chronic diseases, specifically related to diabetes, from the book Metabolical written by Dr. Robert H. Lustig. The work behind this article allows him to connect his math-physical research with the physiopathological results. Here are some LEGT equations developed by the author previously: LEGT predicted PPG (finger-pierced) = pancreatic beta cells health state + diet contribution - post-meal exercise contribution = FPG*GH.f + carbs/sugar grams * GH.p - post-meal walking k-steps * GH.w, where 3 GH-modules are defined as: GH.f=0.92, GH.p= 2.4, GH.w=5.0. for his body health on metabolism during the period from 7/1/2015 to 3/30/2022. The following defined stress and strain equations are used to establish the VGT stress-strain diagram in a space domain (SD): VGT strain = ε (PPG) = individual PPG at the present time. VGT stress = σ (based on the change rate of strain, PPG, multiplying with a viscosity factor, carbs, or steps) = η * (dε/dt) = η * (d-strain/d-time) = (viscosity factor η using normalized carbs or normalized steps at present time) * (PPG at present time - PPG at a previous time). However, the measurement units for carbs/sugar (grams) and post-meal walking exercise (thousand steps or k-steps) were defined long ago without deep thought on their biomedical means in terms of their inherent biophysical inter-relationships. To place them on even ground with a sufficient biomedical sense, he has to normalize these two viscosity factors η of both carbs/sugar and k-steps respectively, using the following 2 formulas: Normalized Carbs/Sugar = Carbs&Sugar / 8.7; Normalized walking k-steps = Walking K-steps / 4.0. In other words, his daily practice targets are to maintain an extremely low carbs/sugar consumption (8.7 grams per meal). This is combined with high-quality proteins from fish, chickens, eggs, cheese, and tofu, along with vitamins, minerals, and other necessary ingredients from various fresh vegetables and fruits to complement the 4,000 walking steps after each meal. To control the word size of this article, he omits the repetitive background introduction regarding LEGT, VGT, Fourier transformation, frequency domain analysis, and energy theory. However, he will include a summary description of 8 biomedical sub-cellular pathology pathways in the method section. In summary, by using these four different validation methods, the author has obtained similar results regarding the contribution ratio of diet over exercise. In general, comparing these four validation results, the diet (carbs/sugar intake amount) contributions to PPG are definitely higher than the post-meal exercise (walking steps) with a contribution ratio of carbs over steps of approximately 1.6. (See the attached figures). (1) Using LEGT predicted PPG equation, we discover the following key data: measured PPG = 114.19 mg/dL; predicted PPG = 114.40 mg/dL; beta cell health via FPG = 101.44 mg/dL (87%); carbs = 34.17 mg/dL (30%); steps = -21.22 mg/dL (-19%). Therefore, the net contribution from carbs & steps = 12.95 mg/dL (11%), while the contribution ratio of carbs over steps = 34.17/21.22 = 1.61. They have demonstrated that the pancreatic beta cells health state is the fundamental strength of the body against developing diabetes, while diet is more important than exercise in terms of lifestyle influences on diabetic control. The LEGT results for the contribution ratio of diet over exercise is almost identical with the analysis results using VGT. (2) Using VGT analyses of 8 annual data, we discover the following key data: the stress ratio of carbs over steps = 2.03/1.25 = 1.62; the hysteresis loop area ratio of carbs over steps = 62/40 = 1.55. (3) Using VGT analyses of 81 monthly data, we

discover the following key data: the stress ratio of carbs over steps = 0.52/0.26 = 2.0; the hysteresis loop area ratio of carbs over steps = 1076/672 = 1.60. The 81 monthly data analysis result is almost identical to the 8 annual data analysis results (both around 1.6). (4) Using 8 physiopathological pathways for chronic diseases, particularly diabetes, diet is related to all of 8 pathways while exercise is only related to 5 of them. Therefore, using this simple form of mathematics view yet complex from a biochemistry view, the carbs/steps contribution ratio = 8/5 = 1.6 which is almost identical to the results from using both LEGT and VGT. In conclusion, regardless of the research methodology, either the math-physical approach or biomedical approach, all of the end results of the contribution ratio for diet over exercise are around 1.6. He would like to quote the comment statement from the book Metabolical by Dr. Robert H. Lustig as his concluding remark: "Physical activity is a useful adjunct, but you can't outrun a bad diet".

Keywords: Linear elastic glucose theory; Viscoelastic; Viscoplastic; Chronic diseases; Diet; Exercise; Glucose; Fasting plasma glucose; Postprandial plasma glucose

Abbreviations: FPG: fasting plasma glucose; PPG: postprandial plasma glucose; LEGT: linear elastic glucose theory; TD: time domain; SD: space domain; MPM: math-physical medicine

1. INTRODUCTION

The author was a professional engineer working in the fields of the space shuttle, naval battleships, nuclear power plants, computer hardware and software, artificial intelligence, and semiconductor chips. After retiring from his work, he initiated self-study and research on internal medicine with an emphasis on biomarker relationship exploration and disease prevention. Since 2010, he has utilized these disciplines learned from 7 different universities along with various work experiences to formulate his current medical research work during the past 13 years.

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Previously, he has applied signal processing techniques to separate 19 components from the combined postprandial plasma glucose (PPG) wave. He identified the carbs/sugar intake amount and post-meal exercise as the two most important contributing factors to PPG formation. Based on these findings, he then applied the theory of elasticity to develop a linear elastic glucose theory (LEGT) to predict PPG value with high prediction accuracy, using fasting plasma glucose (FPG), carbs/sugar grams, and post-meal walking k-steps as three major input components of predicted PPG formation.

Furthermore, he took a specific PPG waveform in the time domain (TD) and applied Fourier transform technique to convert it into a waveform in the frequency domain (FD). The y-axis value in the frequency diagram indicates the magnitude of energy corresponding to a certain frequency component on the x-axis, while the total area underneath the frequency-energy curve is the total relative energy associated with the specific PPG wave.

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In this article, he initially selected a dataset containing 3 key biomarkers, finger-pierced PPG, carbs/sugar grams (carbs), and post-meal walking k-steps (steps) over the past ~8 years from Y2015 to Y2022. He then utilized the above-mentioned LEGT and VGT math-physical tools to calculate the contribution

margin % from carbs and steps respectively, and the contribution ratio of carbs/sugar over walking k-steps. Through these data comparisons and existing biomedical sub-cellular pathology pathway explanation, he hopes that he can prove the carbs/sugar grams contribution is indeed higher (about 50% to 70%) than the post-meal exercise steps contribution to his predicted PPG formation.

He has already discovered this observation from earlier research results using both LEGT and Fourier transformed frequency domain energy tools. Now, he tries to add in another validation result using the VGT tool to reinforce his earlier findings.

He applies VGT specifically to construct a stress-strain diagram with two hysteresis loops corresponding to carbs/sugar and k-steps. The two-loop areas reflect the relative energies associated with input from carbs/sugar and k-steps respectively during the time-dependent process of uploading (digesting carbs/sugar) and downloading (walking). In this article, he has used both 8 annual data and 81 monthly data to demonstrate that they have achieved the same contribution ratio of diet over-exercise.

Finally, he lists 8 biomedical sub-cellular pathology pathways of chronic diseases, specifically related to diabetes, from the book Metabolical written by Dr. Robert H. Lustig. The work behind this article allows him to connect his math-physical research with the physiopathological results.

Here are some LEGT equations developed by the author previously:

LEGT predicted PPG (finger-pierced)
= pancreatic beta cells health state + diet contribution - post-meal exercise contribution
= FPG*GH.f + carbs/sugar grams * GH.p - post-meal walking k-steps * GH.w

Where 3 GH-modules are defined as: GH.f=0.92, GH.p= 2.4, GH.w=5.0. for his body health on metabolism during the period from 7/1/2015 to 3/30/2022.

The following defined stress and strain equations are used to establish the VGT stress-strain diagram in a space domain (SD):

VGT strain
= ε (PPG)
= individual PPG at the present time

VGT stress
= σ (based on the change rate of strain, PPG, multiplying with a viscosity factor, carbs, or steps)
= η * (dε/dt)
= η * (d-strain/d-time)
= (viscosity factor η using normalized carbs or normalized steps at present time) * (PPG at present time - PPG at a previous time)

However, the measurement units for carbs/sugar (grams) and post-meal walking exercise (thousand steps or k-steps) were defined long ago without deep thought on their biomedical means in terms of their inherent biophysical inter-relationships. To place them on even ground with a sufficient biomedical sense, he has to normalize these two viscosity factors η of both carbs/sugar and k-steps respectively, using the following 2 formulas:

Normalized Carbs/Sugar
= Carbs&Sugar / 8.7

Normalized walking k-steps
= Walking K-steps / 4.0

In other words, his daily practice targets are to maintain an extremely low carbs/sugar consumption (8.7 grams per meal). This is combined with high-quality proteins from fish, chickens, eggs, cheese, and tofu, along with vitamins, minerals, and other necessary ingredients from various fresh vegetables and fruits to complement the 4,000 walking steps after each meal.

To control the word size of this article, he omits the repetitive background introduction regarding LEGT, VGT, Fourier transformation, frequency domain analysis, and energy theory. However, he will include a summary description of 8 biomedical sub-cellular pathology pathways in the method section.

2. METHODS

2.1 Linear elastic glucose theory (LEGT) and viscoelasticity/plasticity glucose theory (VGT)

Here are some LEGT equations developed by the author previously:

LEGT predicted PPG (finger-pierced)
= pancreatic beta cells health state + diet contribution - post-meal exercise contribution
= FPG*GH.f + carbs/sugar grams * GH.p - post-meal walking k-steps * GH.w

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Normalized Carbs/Sugar
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Normalized walking k-steps
= Walking K-steps / 4.0

2.2 Sub-cellular pathology pathways

In chapter 10 of the referenced book "Metabolical" written by Dr. Robert H. Lustig, there are 8 sub-cellular pathologies that are related to chronic diseases, particularly diabetes.

1. Glycation
2. Oxidative stress
3. Mitochondrial dysfunction
4. Insulin resistance
5. Membrane integrity
6. Inflammation
7. Epigenetics
8. Autophagy

All of these 8 physiology-pathological pathways are related to chronic diseases, and also related to each other and food. But, only 5 of them are responsive to exercise.

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 a waveform comparison of measured PPG, carbs/sugar grams, and post-meal waling k-steps in both daily and 90-day moving average formats for predicted PPG using the LEGT equation.

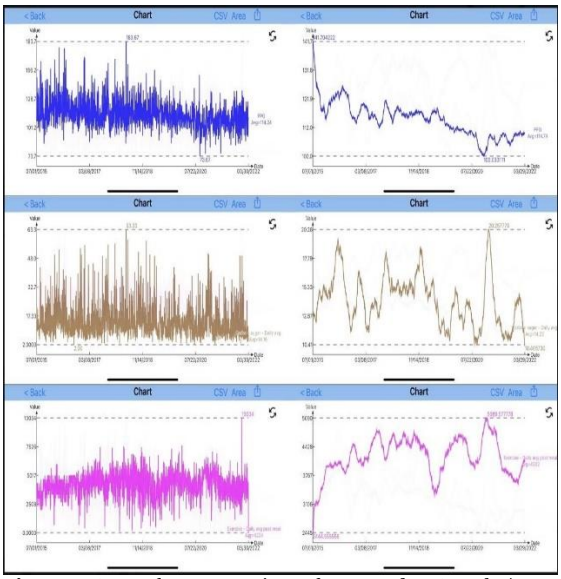
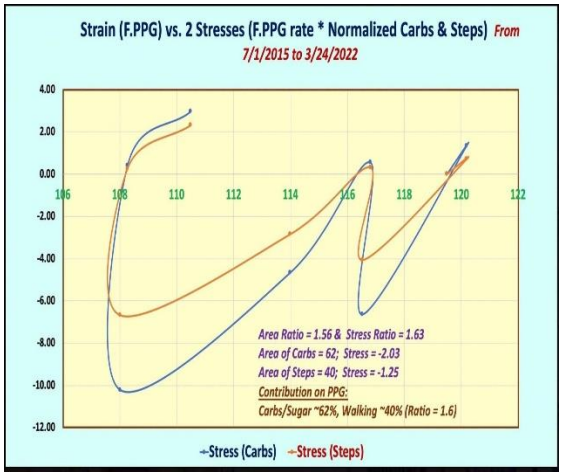


Figure 1: A waveform comparison of measured PPG, carbs/sugar grams, and post-meal walking k-steps in both daily and 90-day moving averaged formats for predicted PPG using LEGT equation.

Figure 2 depicts the stress-strain diagram in the space domain using 8 annual data of PPG vs. carbs/sugar and walking k-steps during a period from Y2015 to Y2022.

Figure 3 illustrates the stress-strain diagram in the space domain using 81 monthly data of PPG vs. carbs/sugar and walking k-steps during a period from 7/1/2015 to 3/30/2022.



3/25/22	Viscosity 1	Viscosity 2		8	4000		
Cancer Risk %	Carbs/Sugar	Walk Steps	Strain (F.PPG)	Stress (Carbs)	Stress (Steps)	Area (Carbs)	Area (Steps)
Y2015	14.6	3681	120	0.00	0.00	0	0
Y2016	15.6	4106	120	1.34	0.71	0	0
Y2017	14.5	4440	117	-6.64	-4.06	10	6
Y2018	15.8	4538	117	0.55	0.32	-1	-1
Y2019	13.2	4038	114	-4.67	-2.85	6	4
Y2020	13.7	4468	108	-10.23	-6.68	45	28
Y2021	12.8	4057	108	0.42	0.26	-1	-1
Y2022	10.7	4169	111	2.99	2.32	4	3
Average or Sum	13.9	4187	114	-2.03	-1.25	62	40
Correlation	72%	-26%	100%	(BW 2) / (BW)	163%	(BW 2) / (BW)	156%

Figure 2: Stress-strain diagram in space domain using 8 annual data of PPG vs. carbs/sugar and walking k-steps during a period from Y2015 to Y2022.

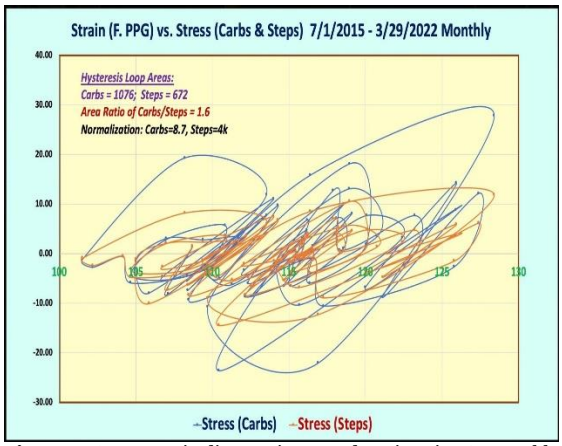


Figure 3: Stress-strain diagram in space domain using 81 monthly data of PPG vs. carbs/sugar and walking k-steps during a period from 7/1/2015 to 3/30/2022.

Figure 4 reflects the LEGT equation and input data using 2015-2022 daily data.

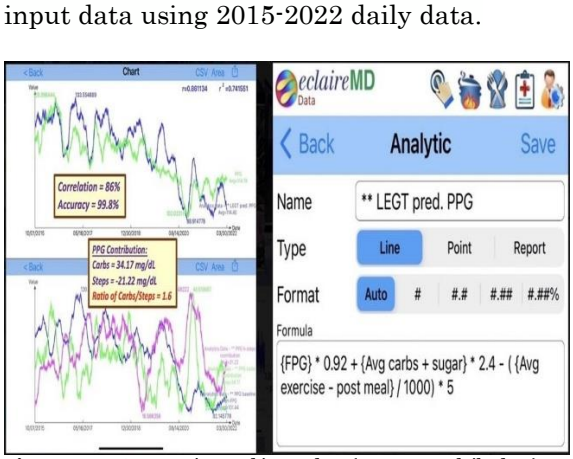


Figure 4: LEGT equation and input data (2015-2022 daily data).

Figure 5 displays the background data table of 81 monthly data and their calculation results.

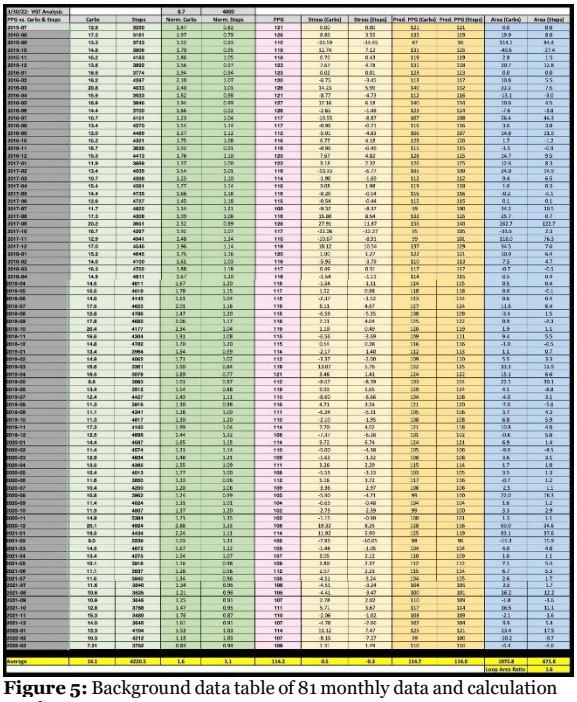


Figure 5: Background data table of 81 monthly data and calculation results.

4. CONCLUSION

In summary, by using these four different validation methods, the author has obtained similar results regarding the contribution ratio of diet over exercise.

In general, comparing these four validation results, the diet (carbs/sugar intake amount) contributions to PPG are definitely higher than the post-meal exercise (walking steps) with a contribution ratio of carbs over steps of approximately 1.6. (See the attached figures).

(1) Using LEGT predicted PPG equation, we discover the following key data: measured PPG = 114.19 mg/dL; predicted PPG = 114.40 mg/dL; beta cell health via FPG = 101.44 mg/dL (87%); carbs = 34.17 mg/dL (30%); steps = -21.22 mg/dL (-19%). Therefore, the net contribution from carbs & steps = 12.95 mg/dL (11%), while the contribution ratio of carbs over steps = 34.17/21.22 = 1.61. They have demonstrated that the pancreatic beta cells health state is the fundamental strength of the body against developing diabetes, while diet is more important than exercise in terms of lifestyle influences on diabetic control. The LEGT results for the

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5. REFERENCES

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

Special Issue | Issue No. 5 The GH-Method

Viscoelastic and Viscoplastic Glucose Theory Application in Medicine

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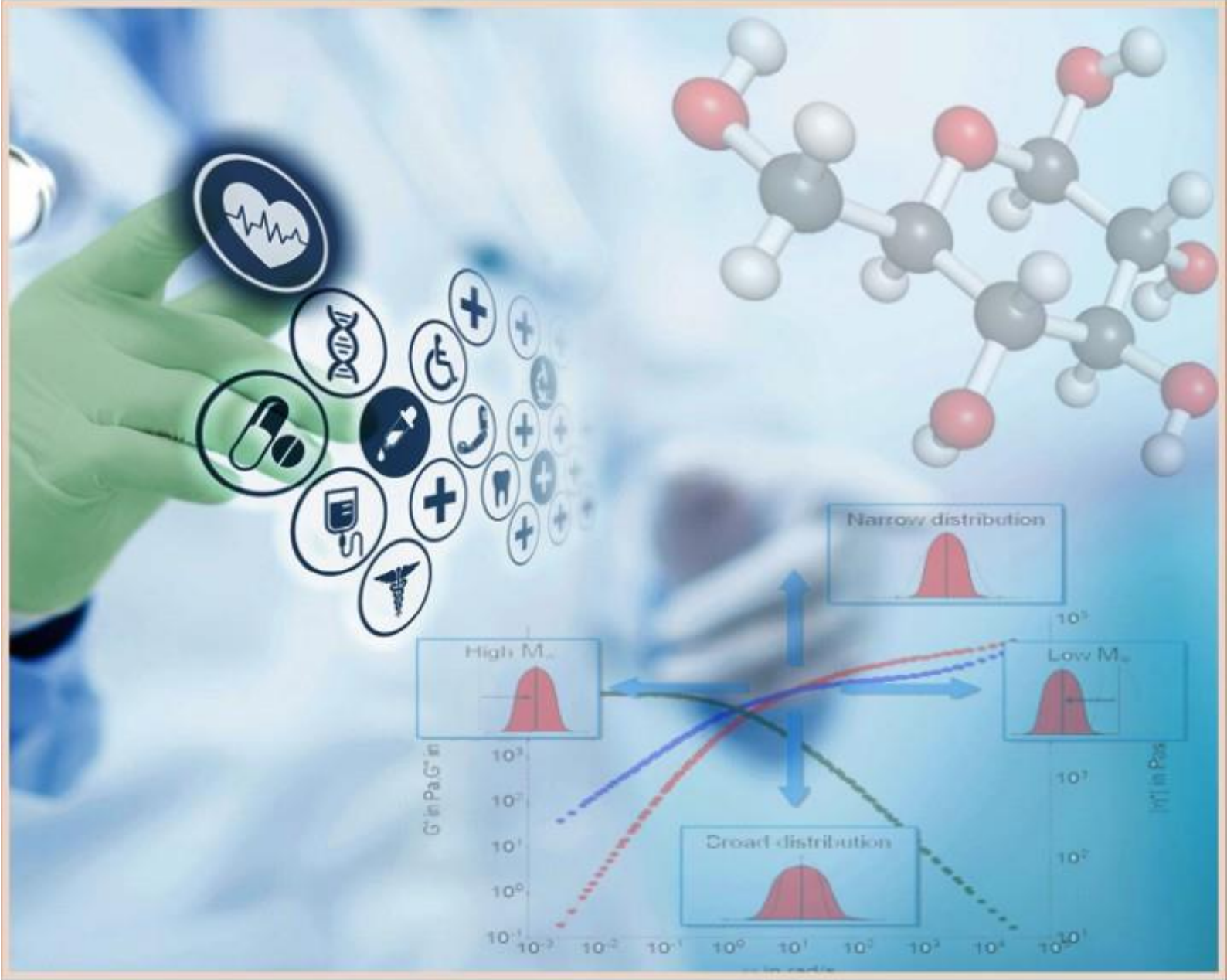

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