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From weight management via diabetes control to cardiovascular risk reduction

Gerald C Hsu
EclaireMD Foundation, USA

Correspondence: Gerald C Hsu, 7 Oak Haven Way Woodside, CA 94062, EclaireMD Foundation, USA, Tel +1-510-331-5000, Email g.hsu@eclairemd.com

Abstract

Introduction: Since 1997, the author has been diagnosed with obesity, type 2 diabetes (T2D), hypertension, hyperlipidemia, and suffered five cardiac episodes. He spent 20,000 hours since 2010 to study and research his chronic diseases in order to save his own life. This abstract tells his story.

Method: He created a math-physical medicine approach, instead of using the traditional biochemical method, to conduct his research. Initially, he defined inter-relationships among 11 categories and 500 elements of a human metabolism system. He collected and processed 1.5million data of his lifestyle details and medical conditions. Furthermore, utilizing physics, mathematics, engineering modeling, and artificial intelligence (AI), he developed four prediction models with 99% accuracy, including weight, fasting plasma glucose, post prandial glucose, and hemoglobin A1C. Finally, he developed a risk probability calculation model of having heart attack or stroke.

Results: From the period of 2013-2018, he has reduced his weight from 220 lbs. to 167 lbs., waistline from 44" to 32", and BMI from 33.1 (obese) to 24.7 (normal). Based on his acquired knowledge, he developed AI-based prediction tools to reduce his average glucose value from 279mg/dL to 116mg/dL, A1C from 10% to 6.5%. Since 2016, his hypertension and hyperlipidemia are no longer health concerns along with dropping his cardiovascular risk from 74% to 31%.

Conclusion: Over eight years, the author was finally able to control his weight and T2D along with greatly reducing his cardiovascular risk. In addition to his willpower and persistence, his diligence in acquiring medical knowledge from reading hundreds of textbooks and medical papers has assisted him. More importantly, his knowledge from other disciplines in mathematics, physics, engineering, statistics, computer science, and technology have provided him the necessary tools.

Introduction

Since 1997, the author has been diagnosed with three chronic diseases such as type 2 diabetes (T2D), hypertension, and hyperlipidemia. As shown in Figure 1, his health reached to a "near collapsed" condition by 2010; therefore, he launched his type 2 diabetes (T2D) research in order to save his own life. From 2012 to 2018, he has collected and processed approximately 1.5M data regarding his own health and body conditions. During 2010–2013, he studied six chronic diseases and food nutrition in depth. In 2014, using mathematics and various engineering modeling, he developed a mathematical model of the human metabolism system, which contains 11 categories and ~500 elements. Currently, as shown in Figure 1, his chronic disease conditions are now under control. This paper described his effort for 8-years in terms of annualized segments with different working methods utilized at different stages. It specifically discusses the relationship and results from weight management via diabetes control to lowering his risk probabilities of having heart attack or stroke.

Health Exam Record	2010	2017
A1C (<6.4%)	10.0	6.1
90-days Average Glucose (<120 mg/dL)	279	113
ACR (<30)	116.4	12.3
Triglyceride (<150)	1161	67
HDL (>40)	24	48
LDL (<130)	174	74
Total Cholesterol (<200)	253	118
BMI (<25.0)	31.0	24.7
Weight (lbs.)	210	167
Waistline (inch)	44	34

Figure 1 Comparison of Medical Conditions (2010 vs. 2017).

Methods

The author, who is also the patient, checks his body weight twice a day in the morning and at bedtime. Using the finger-piercing method, he measures his fasting plasma glucose (FPG) in the early morning before starting his meals and activities. He also measures his postprandial plasma glucose (PPG) three times a day, approximately two hours after the first-bite of each meal. He checks his blood pressure (BP) at least once a day, preferably in the early morning, but sometimes multiple measurements as needed. Every three months, he goes to the same hospital to analyze his lipid conditions. Therefore, his lipid data amount is only around 1% of his other health conditions such as weight, glucose, and BP.

Using customized artificial intelligence (AI) software on his iPhone, he collected various detailed lifestyle data such as medication, salt intake, stress, sleep, illness, water, food and meal quantity, carbs/sugar intake, exercise, weather, etc. Finally, he has utilized these big data to conduct many useful correlation analyses among weight, chronic diseases, and lifestyle factors.

From 2015 to 2017, based on his metabolism model, he developed four prediction models, including weight, fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and hemoglobin A1C (A1C). All of these prediction models have reached to 95% to 99% data accuracy over a period of approximately four years (~1,500 days). Utilizing these prediction models, he could successfully reduce both of his weight and blood sugar. His BMI scores were classified as obese at first, then overweight, and finally to normal range. As a result, his diabetes is under control and both of his hypertension and hyperlipidemia conditions are no longer health issues. During the spring of 2018, he further extended his T2D research into the study of Risk probability of having heart attack and stroke due to chronic diseases.

During a period of 2,391 days (1/1/2012 - 7/20/2018) with ~30,000 collected raw data, which are directly related to this paper, the author further extracted other relevant information out from this big data pool in order to process them according to his designed process flow. He finally categorized them according to an annualized format for easier viewing of data trends from year to year (Figure 6).

Although the author suffered three separate cardiac episodes from 2001 to 2006, he did not link his health risks to his chronic diseases due to his ignorance. Therefore, he hardly kept any data during that decade except for keeping a few significant health records. In 2010, he got his wake-up call from the strong possibility of having dialysis when he received the following lab results: albumin/creatinine ratio 116.4mg/g, A1C 10% and triglycerides 1161 mg/dL. He then immediately ceased all of his ongoing technology business activities, moved into a stress-free retirement community away from Silicon Valley (one of his stressors), and also launched his own T2D research. However, to start this effort successfully, he dedicated his time to study six chronic diseases first in 2010 and throughout 2011. Therefore, after 2012, he started to collect his complete set of health data, including both medical conditions (~10%) and lifestyle details (~90%). Within this total set of approximately 1.5 million data, there are about 300,000 raw data collected by the computer and other 1 million+ data from information processing, which have been saved in a cloud server for other future studies. It should be noted that both A1C and lipid data were only available from his quarterly lab tests, not on a daily basis. However, the author has developed a predicted daily A1C that has reached to 95% accuracy since he added in an uplifted 3% to 8% of "safety margin" in order to provide an early warning to himself. Without this build-in safety margin, his predicted A1C data would reach to 99% accuracy.[1–4]

Unlike the incomplete data collected in 2010, the data integrity after 2012 is accurate, valid, and complete.

Results

During the period of 1/1/2012–7/20/2018, his medical condition changes and major lifestyle modifications are shown in Figures 2–6. The summarized highlights of results are listed:

Weight: -49/18lbs. (from 220lbs. in 2000, then 189lbs. in 2012 to 171lbs. in 2018). Period 2012–2014 (3 years) has the most reduction.

1. **BMI:** -7.1/2.6 (from 32.1 in 2000, then 27.6 in 2012 to 25.0 in 2018)

2. Waistline: -12/10 inches (from 44" in 2000, then 42" in 2012 to 32" in 2018)

   Period of 2014–2018 (5 years) has the most reduction.

3. **Food & Meal Quantity**: -28% (over 7 years) from his normal portion of food (from 112% in 2012 to 84% in 2018)

4. **Daily Walking:** +10,412 steps in 5 years (from 7,564 in 2013 to 17,976 in 2018)

   Period of 2016-2018 has the maximum exercise amount.

5. **Post-Meal Walking:** +2,599 steps in 4 years (from 1,900 in 2015 to 4,499 in 2018)

   Period of 2016–2018 has the maximum exercise amount.

6. **Daily Glucose:** -163/43mg/dL (from 280.0 in 2000, then 160.0 in 2010 to 117.0 in 2018). Period of 2016-2018 has the lowest glucose values.

7. **A1C:** -3.3% (from 10.0% in 2010 to 6.7% in 2018)

   Period of 2016–2018 has the lowest values (after discontinuing diabetes medication).

8. **BP (Metabolism Index 3):** - 26% (annual average SBP/DBP dropped from 127/85 to 96/64).

9. **Risk of heart attack or stroke:** - 43% (from 74% in 2000 to 31% in 2018, with 3 cardiac episodes during 2001-2006 and none afterwards)

Based on his research results published in the past (see references), a few key conclusions are described as follows:

a. Main causes of his weight loss are reduced by food quantity consumption and increased daily walking steps.

b. It took 3 years to reduce his weight and 5 years to reduce his waistline.

c. Based on his annualized data, he was obese (BMI>30) prior to 2010 and overweight (BMI between 25 and 30) during 2012-2017. His weight has been less than 170lbs. (BMI is normal, around 24.7) in 2018.

d. His reduced FPG below 120mg/dL is driven by his weight

reduction. The combination of his carbs/sugar intake around 14.3grams and post-meal walking around 4,000 steps has caused his PPG to go below 120mg/dL as well.

e. His lab-tested A1C value was reduced from 10% in 2010 (average daily glucose above 200 mg/dL) to 6.7% in 2018 (average daily glucose around 117mg/dL). It should be noted here that he has discontinued all of his diabetes medication for almost 3 years, since 12/8/2015.

f. His risk probability of having heart attack or stroke was 74% in 2000. During the period of 2001 through 2006, he suffered three cardiac episodes and none afterwards. By 2017, the same risk factor has reduced to 26.4% (comparable with Framingham Study of 26.7% risk in 2017).

g. He was diagnosed with hyperlipidemia in 1992, before his diagnosis of T2D in 1997. He noticed the effects of his hypertension condition in 2013 - 2015. However, after 2015, both of his hyperlipidemia and hypertension are no longer threats to his health.

h. He suffered complications from T2D such as renal dysfunction, infections from his bladder, foot ulcer, eye issues, and so forth. To date, all of these problems seem to be under control.
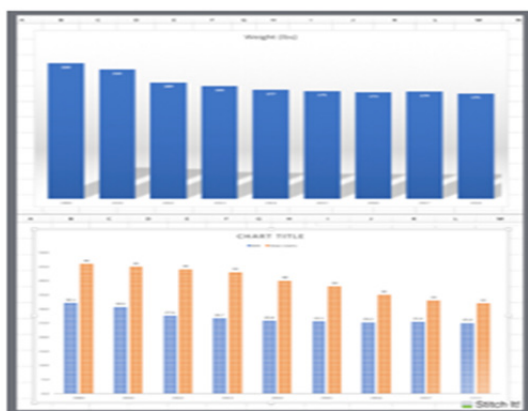
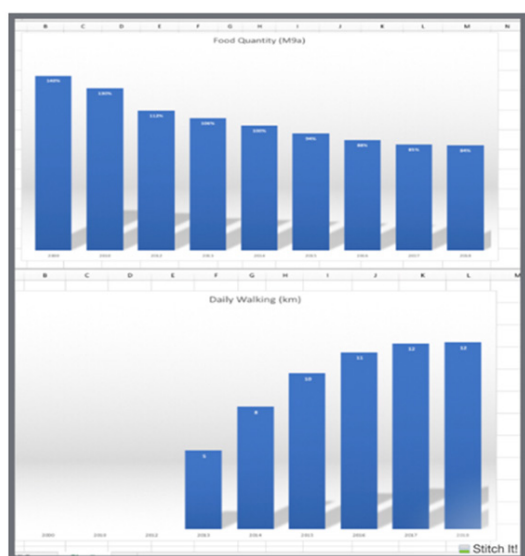**Figure 2** Weight, BMI, Waistline (2000, 2010, 2012-2018).
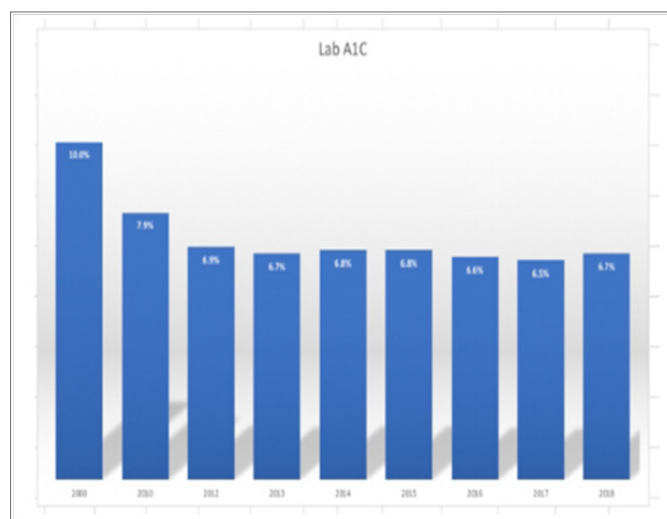
Figure 3 Comparison of Food Quantity & Walking.

Figure 4 Comparison of Lab-tested A1C Values (2010 - 2018).

Year	Probability MI	Probability Medical	Probability Lifestyle	Year Averaged
2000		74%	83%	79%
2012	74%	62%	70%	69%
2013	77%	38%	66%	60%
2014	59%	42%	54%	51%
2015	43%	39%	44%	42%
2016	36%	31%	38%	35%
2017	34%	26%	33%	31%
2018	33%	31%	33%	32%
7-Years	52%	34%	34%	40%
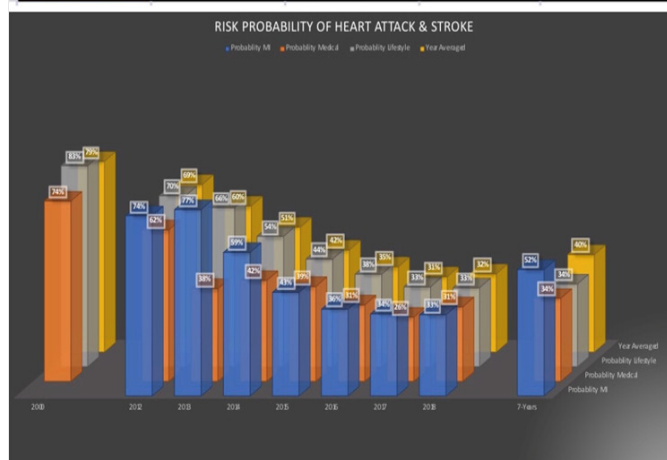
Figure 5 Risk Probability of Heart Attack & Stroke (2010, 2012-2018)

Year	Weight (lbs)	Weight (170 lbs as base)	Weight Loss (lbs)	Max Weight	Min Weight	Weight Delta	BMI	Waist Line (inch)	Waist Line Loss	FPG (mg/dL)	PPG (mg/dL)	Daily Glucose (DG)	DG Delta	FPG lbs	Predicted A1C	Lab A1C	Lab A1C (6.4% base)	Food Amount (M9a)	Food Quality (M9b)	Carbs & Sugar (gram)	Post Meal Walk (steps)	Daily Walk (steps)	Daily Walk (km)	Heart & Stroke Risk
2000	220	129%					32.1	46				280.0						0%	140%					74%
2010 *	194	114%					28.3	45	1			160.0	120		9.1%	10.0%		156%	130%					66%
2012	189	111%	5	194	183	11	27.6	44	1			127.7	32		7.2%	6.9%		108%	112%					62%
2013	183	108%	6	190	176	14	26.7	43	1	135.4	132.7	132.5	-5	1.5	7.5%	6.7%		105%	106%			7,564	5	38%
2014	177	104%	6	183	173	10	25.8	40	3	127.9	137.2	134.6	-2	1.8	7.6%	6.8%		106%	100%			11,767	8	42%
2015	175	103%	2	184	167	17	25.5	38	2	120.6	129.9	128.7	6	0.9	7.4%	6.8%	106%	94%	91%	14.2	1,900	14,997	10	39%
2016	173	102%	2	178	167	11	25.2	35	3	120.2	117.0	119.4	9	1.7	6.8%	6.6%	103%	88%	91%	15.5	4,110	17,017	11	31%
2017	174	102%	-1	180	167	13	25.4	33	2	119.8	116.5	117.4	2	1.0	6.7%	6.5%	102%	85%	97%	14.2	4,440	17,863	12	26%
2018	171	101%	3	176	167	9	25.0	32	1	116.9	116.5	117.0	0	1.7	6.7%	6.5%	102%	84%	99%	14.5	4,499	17,976	12	31%
Avg	184	108%	3	184	171	12	26.8	40	2	123.5	125.0	124.9	2	1.4	7.1%	7.1%	111%	88%	94%	14.6	3,737	14,531	10	34%
Change (13-18)	23						2.6	12				43				2.4%	3.5%	28%			2,599	6,967		35%

Figure 6 Annualized Data Comparison (2000, 2010, 2012-2018).

Conclusion

This report is about one patient (the author) over a 20-year period. He has collected and processed approximately 1.5 million data, particularly during the period of 2012-2018. He has spent 20,000 hours to conduct his research regarding chronic diseases and his own health. This dynamic big data analytics using tools, such as advanced mathematics, physics, signal processing, optical physics, engineering modeling, machine learning and AI, should be equally effective for analyzing other patient's conditions. Although some data may be slightly different, the results and conclusions should be applicable to other T2D cases. In this article, there are no new breakthrough findings about medicine, but the author is able to provide quantitative proof to support those existing knowledge in modern medical community.

Limitations of research

This article is based on data of metabolic conditions and lifestyle details collected from one T2D patient (himself). It does not cover genetic conditions and lifestyle details of other diabetes patients. However, the author's research approach is based on his solid inter-disciplinary academic background and successful multiple industrial experiences. His academic background and working experience have prepared him to conduct his diabetes research with the following thorough process and carefully chosen steps:

 Observing and identifying a system's basic characters like a pure physicist;

1) Developing related but rigorous mathematical equations like a mathematician;

2) Applying suitable engineering models and useful statistical models to address the real-world challenges;

3) Using modern computer science tools and sophisticated AI techniques to aid in problem solving.

Nevertheless, his conclusions and findings should be re-verified and proceed with caution when applying to other patients who are under different metabolic conditions or lifestyles.

Acknowledgements

First and foremost, the author wishes to express his sincere appreciation to a very important person in his life, Professor Norman Jones at MIT and University of Liverpool. Not only did he give him the opportunity to study for his PhD at MIT, but he also trained him extensively on how to solve difficult problems and conduct any basic scientific research with a big vision, pure heart, and integrity.

The author would also like to thank Professor James Andrews at the University of Iowa. He helped and supported him tremendously when he first came to the United States. His encouragement assisted him to build his solid engineering and computer science foundation. He is forever grateful to his mentor, who has a kind heart and guided him during his undergraduate and master's degree work.

Conflicts of interest

The author declares there are no conflicts of interest.

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