Metabolic Health

Cardiovascular and Wider Impacts

Dr. Tro Kalayjian, D.O.

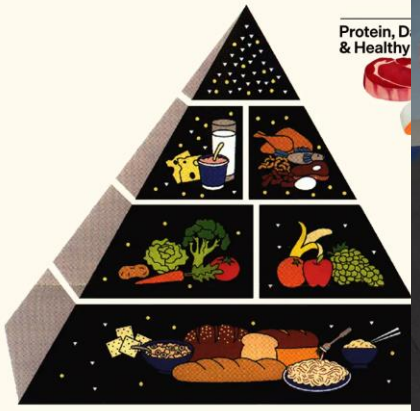
April 2026

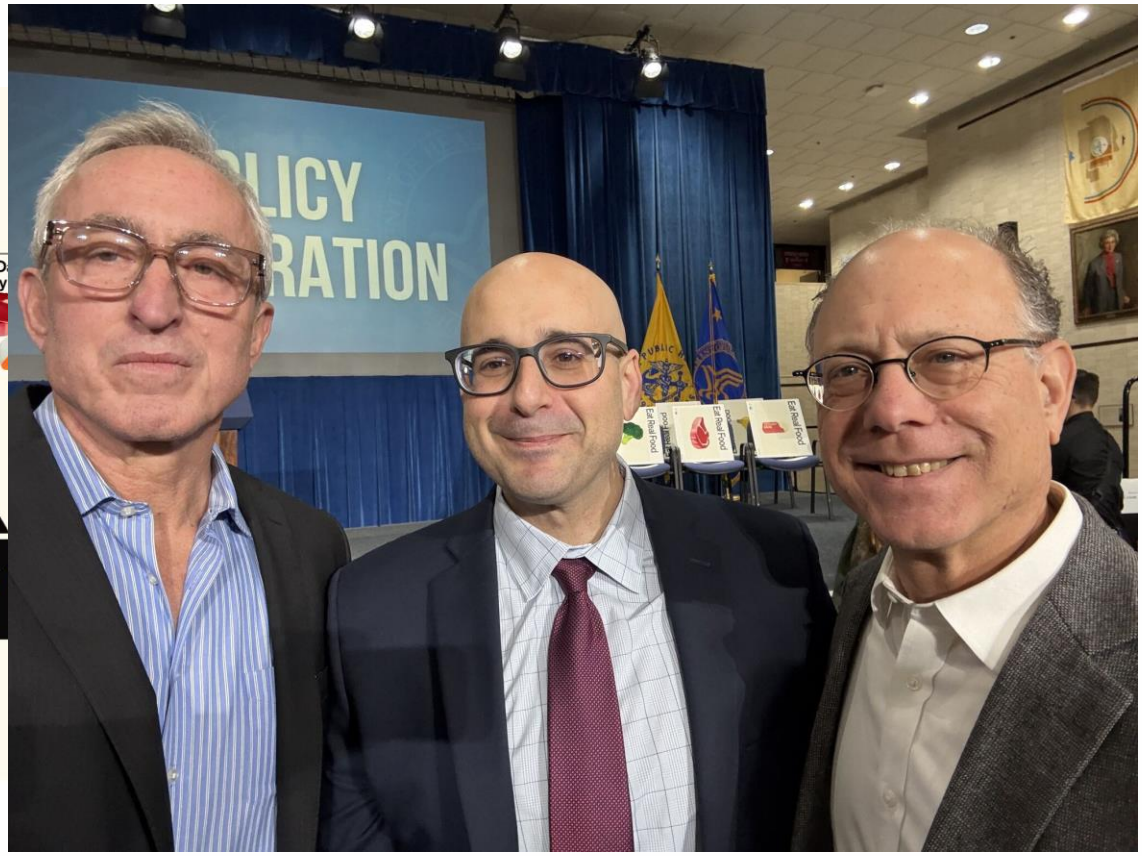
Swiss Re

Who am I?

- Board certified Internal Medicine Doctor
- Board certified Obesity Medicine Doctor
- Certified Personal Trainer, Health Coach
- Nationwide Virtual Obesity & Primary Care Practice
- Board Member of SMHP
- Scientific Publication on Metabolic Health & Regulatory Capture (NLA, APA, AAP, ADA, AHA)
- Personally lost 150lbs
- 2,000 patients, helped lose over 100,000lbs
- Smartphone app with 17k members
- Podcast with 12 million downloads
- 3 ongoing IRB projects with Stanford, Yale New Haven and Wake Forest
- Baszucki Grant Recipient (project to be announced)
- Father of 3 amazing children

Thanks to the Swiss Re, SMHP, Metabolic Coalition, Nina Teicholz, Ben Bikman, and so many others…





Controversy with the American Heart Association…

THE WALL STREET JOURNAL.

Business U.S. Politics Economy Tech Markets & Finance Opinion Free Expression Arts

HEALTH | WELLNESS

Heart Association Clashes With RFK Jr. Over Red Meat, Dairy and Beef Tallow

The American Heart Association recommends getting protein from plants—rather than meat—and avoiding full-fat dairy

By Andrea Petersen Follow and Betsy McKay Follow

Updated March 31, 2026 6:53 am ET

Share Resize 647 Listen (2 min)

The American Heart Association report cites research showing that diets higher in beans, peas and lentils—and lower in red and processed meat—are associated with a lower risk of heart disease. GETTY IMAGES

the basis for an updated scientific statement reflecting the latest nutrition guidance published today in **Circulation**, the peer-reviewed, flagship journal of the American Heart Association, a global force changing the future of health for all.

The *2026 Dietary Guidance to Improve Cardiovascular Health: A Scientific Statement From the American Heart Association* updates the Association's 2021 guidance with the latest in evidence-based science aligned with reducing cardiovascular disease risk, improving quality of life and saving lives. The statement outlines nine key features of a heart-healthy dietary pattern:

1. ***Adjust energy intake and expenditure to achieve and maintain a healthy body weight:*** Try to balance how much you eat with how active you are, to reach and maintain a healthy body weight.
2. ***Eat plenty of vegetables and fruits and choose a wide variety:*** Include different colors, textures and types of produce, and remember, even canned and frozen can be nutritious and affordable.
3. ***Choose foods made mostly with whole grains rather than refined grains:*** Foods such as whole-wheat bread, brown rice and oatmeal are better choices than refined grains including white bread or white rice.
4. ***Choose healthy sources of protein:*** Shift from meat to plant-based sources such as legumes, including beans, peas and lentils, along with nuts and seeds; regularly consume fish and seafood; select low-fat or fat-free dairy products; and if red meat is desired, choose lean cuts, avoid processed forms and limit portion size.
5. ***Choose sources of unsaturated fats in place of sources of saturated fat:*** Replace saturated fats with healthy unsaturated fats, including those from nuts, seeds, avocados and nontropical plant oils.
6. ***Choose minimally processed foods instead of ultraprocessed foods:*** Go with foods close to their natural state, with minimal added commercial ingredients, rather than those that are highly processed with additives.
7. ***Minimize intake of added sugars in beverages and foods:*** Limit the sugar-sweetened beverages you drink and the foods with added sugar you eat.
8. ***Choose foods low in sodium and prepare foods with minimal or no salt:*** Be aware of hidden sources of sodium in commercially prepared and packaged foods and season your food with healthier options such as herbs, spices or lemon instead of salt.
9. ***If alcohol is not consumed, do not start; if alcohol is consumed, limit intake:*** Alcohol can increase your risk for high blood pressure and other health conditions, so if you don't drink, don't start.

Related Video

Dr. Khera on main updates in new dietary guidance

Amit Khera, M.D., FAHA, volunteer vice-chair of the dietary guidance writing committee and director of preventive cardiology and clinical chief of cardiology at the University of Texas (UT) Southwestern Medical Center.

News release

copyright American Heart Association

Download (73.6 MB)

Failed Food Pyramid vs. New Food Pyramid vs. AHA nutritional guidelines

My meals look like this... what should I do?

A Proven Model for Metabolic Health

The TOWARD approach prioritizes **personalized, real-time metabolic care** that empowers patients to take control of their health. This model is built on six core principles:

T **Text-Based Communications** – Regular touchpoints and support via messaging keep patients engaged and accountable.

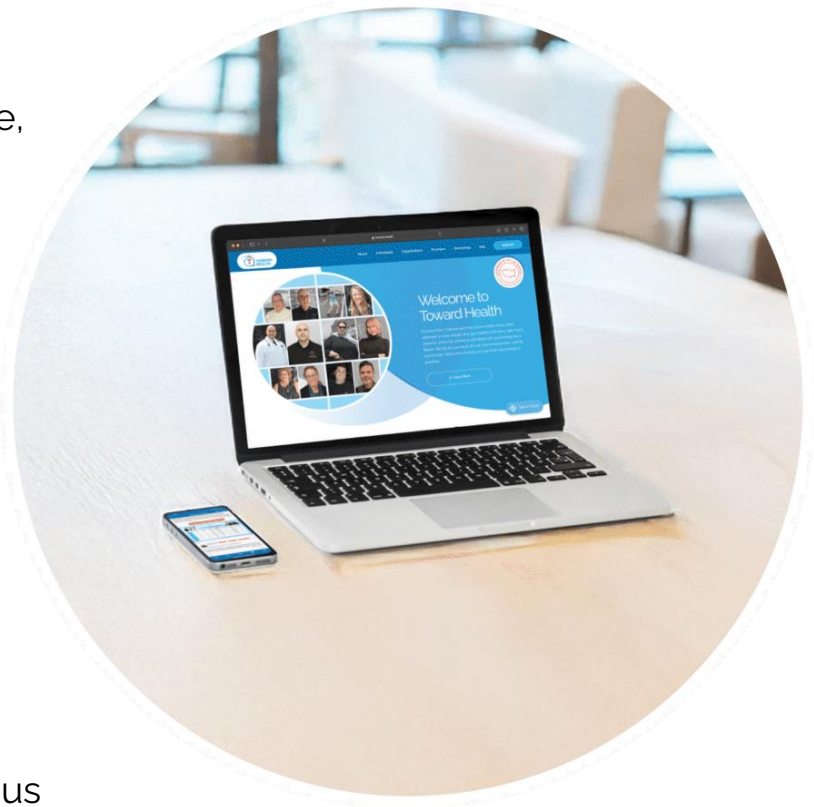
O **Online Interactions** – Virtual visits provide accessible, convenient care without the need for in-person appointments.

W **Wellness Coaching** – Expert health coaches guide patients through sustainable lifestyle changes.

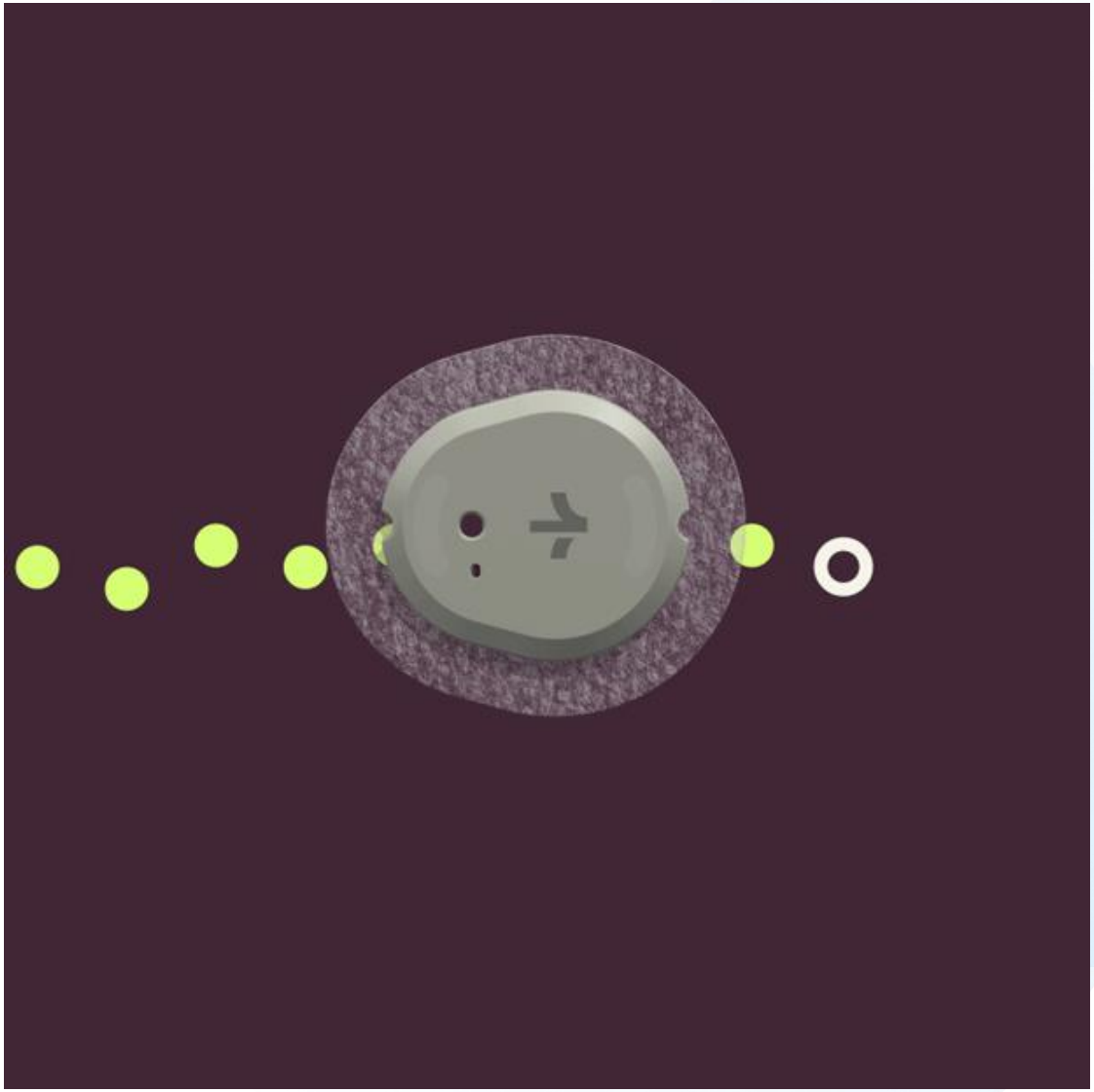
A **Asynchronous Education & Community Support** – Self-paced learning and peer support foster long-term success.

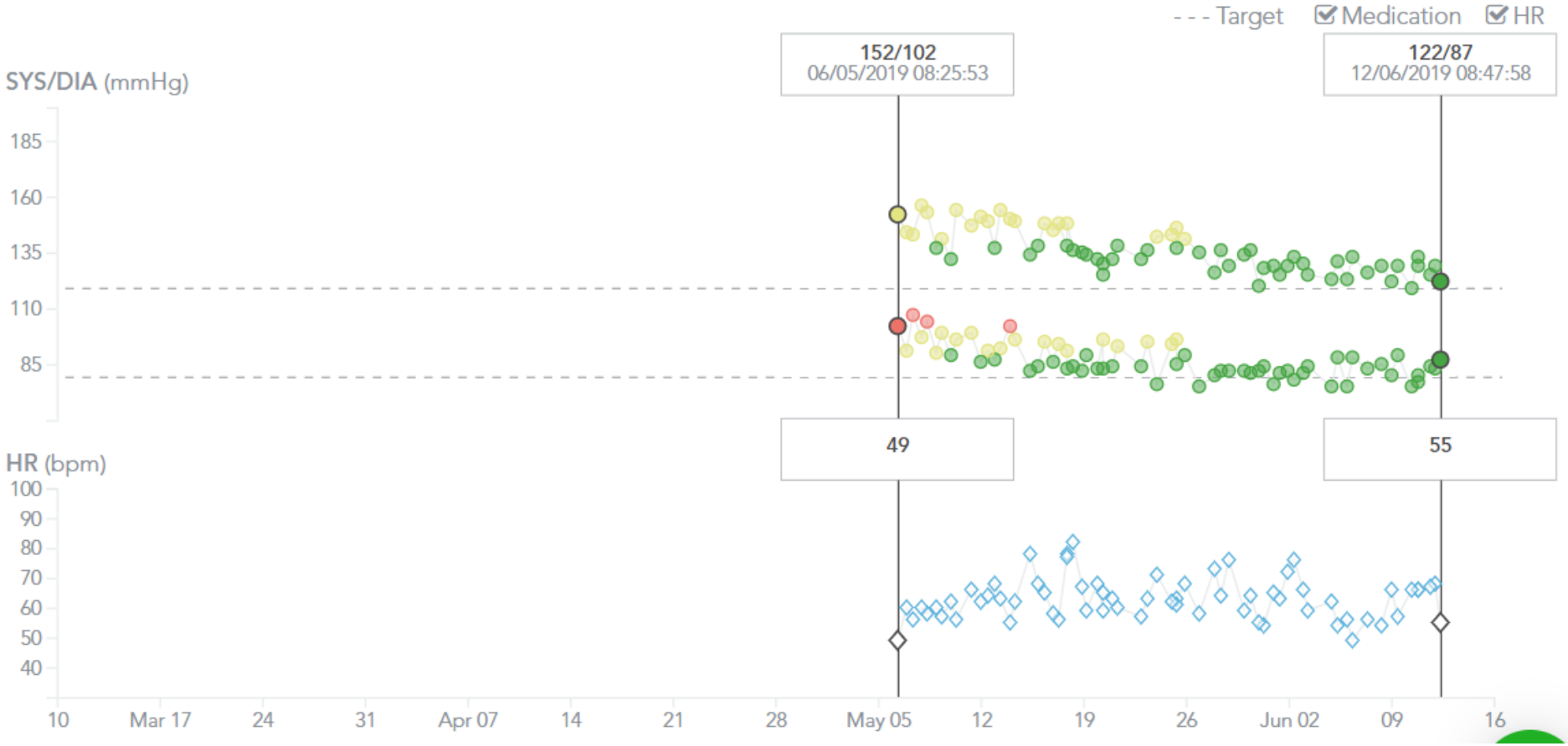
R **Real-Time Biofeedback & Remote Monitoring** – Continuous tracking of metabolic health metrics enables timely adjustments.

D **Dietary Modifications Emphasizing TCR & IF** – A focus on **Therapeutic Carbohydrate Reduction (TCR)** and **Intermittent Fasting (IF)** supports metabolic flexibility and sustainable weight loss.



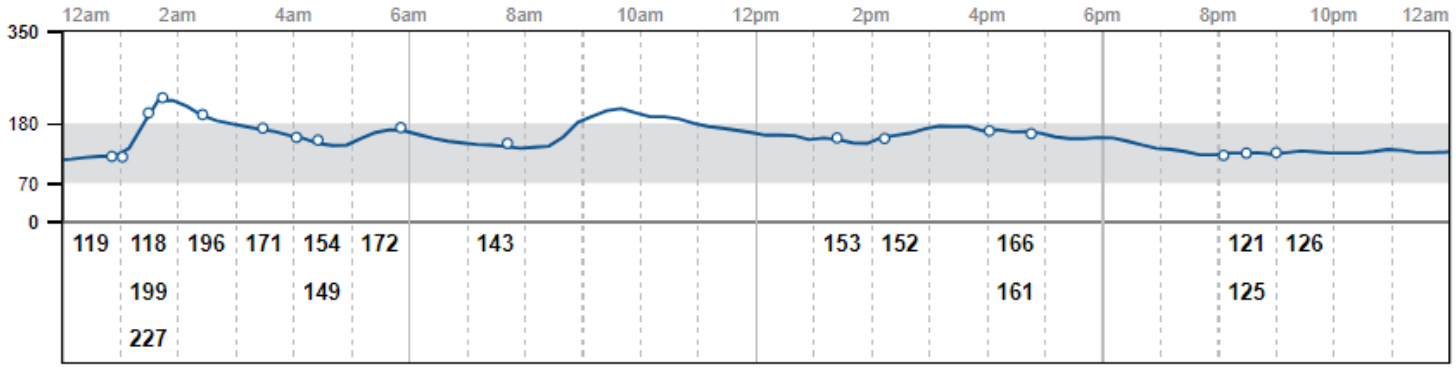
Leveraging technology to improve medical outcomes





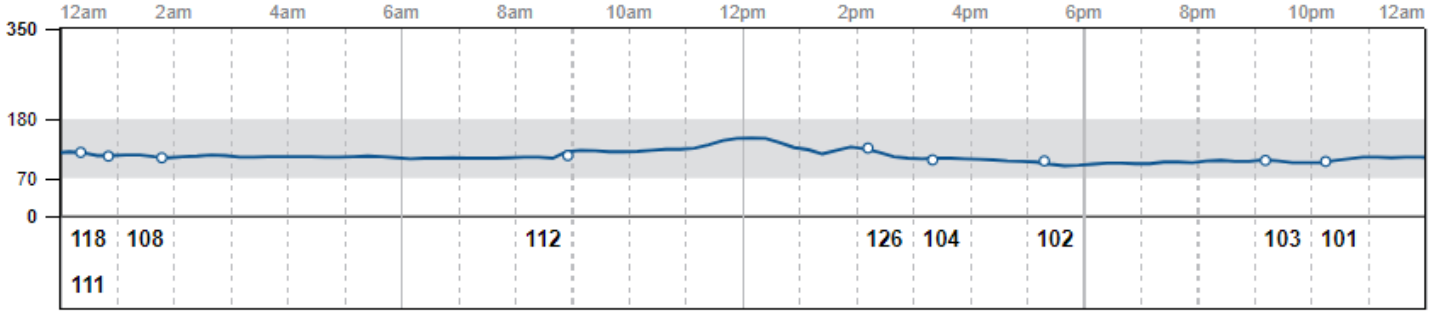
SUN **May 26**

Glucose mg/dL

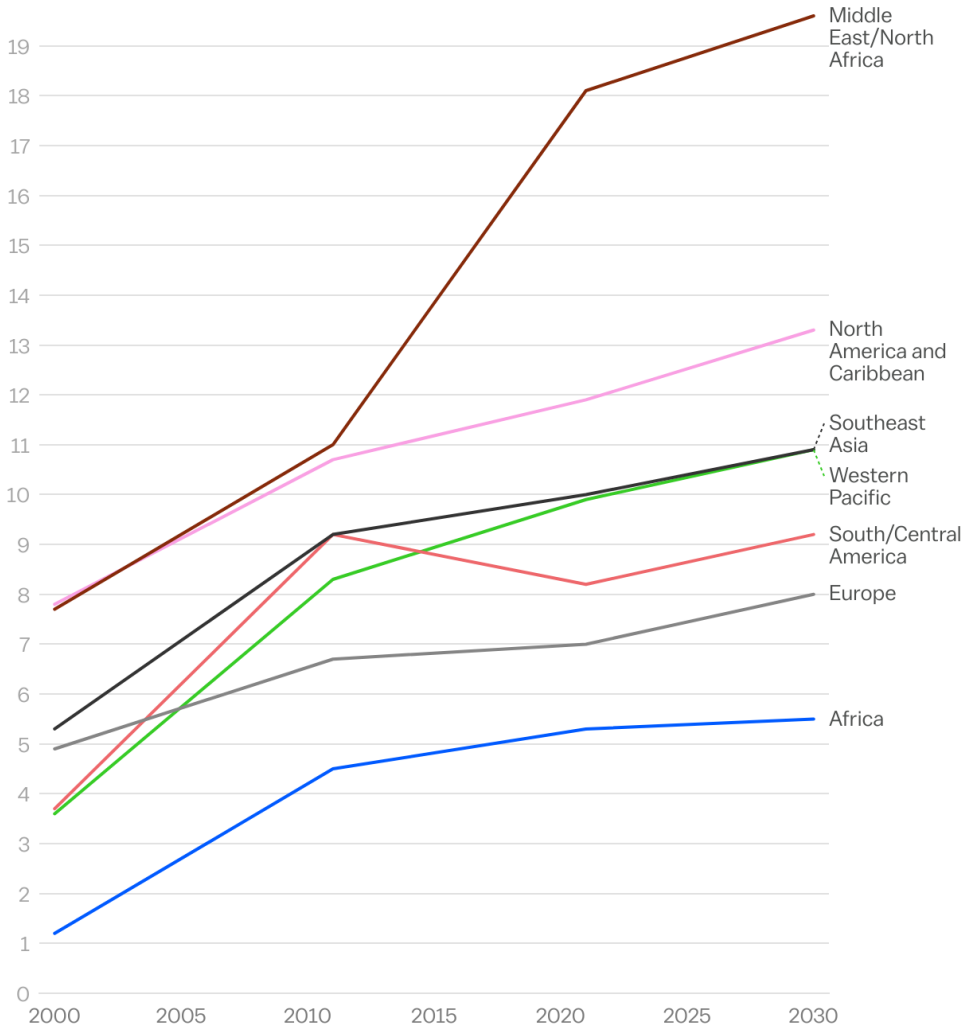


SUN **Jun 2**

Glucose mg/dL



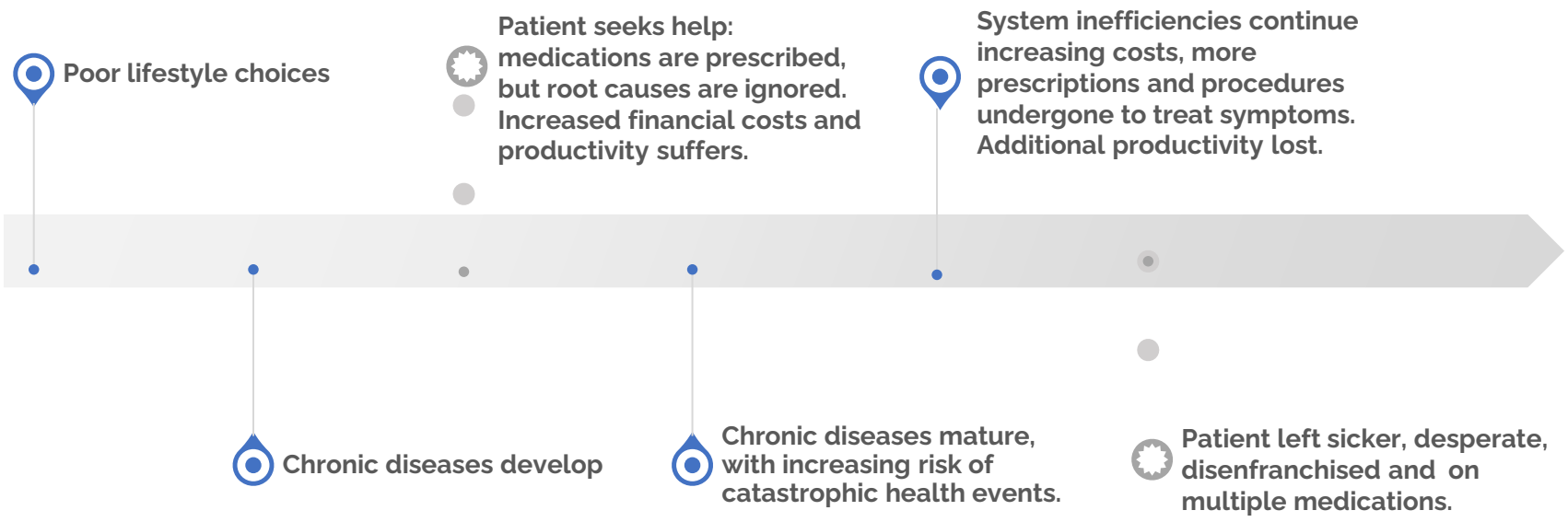
Ignoring root causes leads to metabolic disease…



Showing the percentage of adults with diabetes

The Status Quo

The current healthcare model is **expensive** & **does not prevent or reverse chronic disease**



The Problem

My own **case study** to demonstrate the problem:

Poor lifestyle choices

Chronic diseases develop

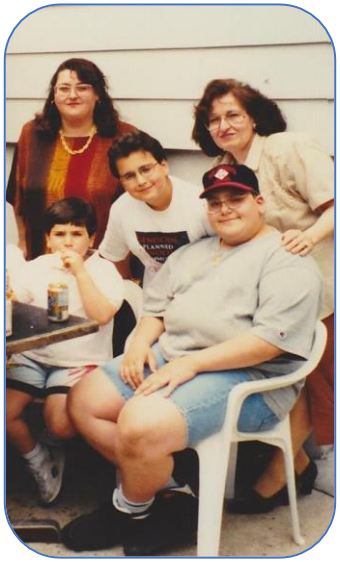
Patient seeks help: medications are prescribed, but root causes are ignored. Increa… prod…

Chronic diseases mature, with increasing risk of catastrophic health events.

System inefficiencies continue increasing costs, more prescriptions and p… undergone to trea… Additional produc…

Patient left sicker, desperate, disenfranchised and on multiple medications.

Case #1



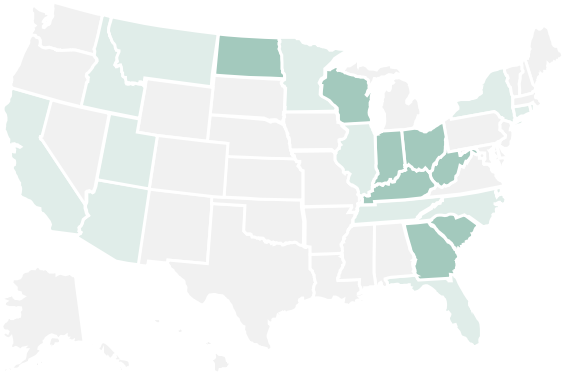
Genetics, the obesogenic environment and thermodynamics didn't change…

What changed?

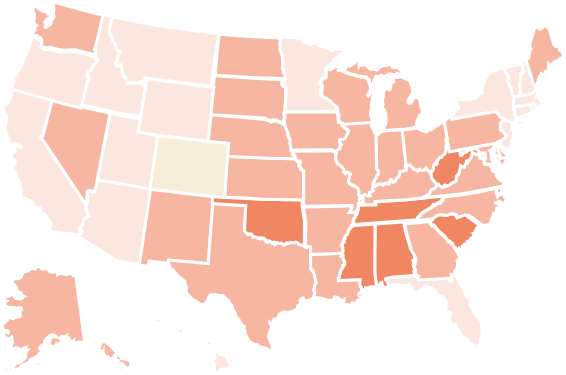
Let's be detectives together…

What changed?

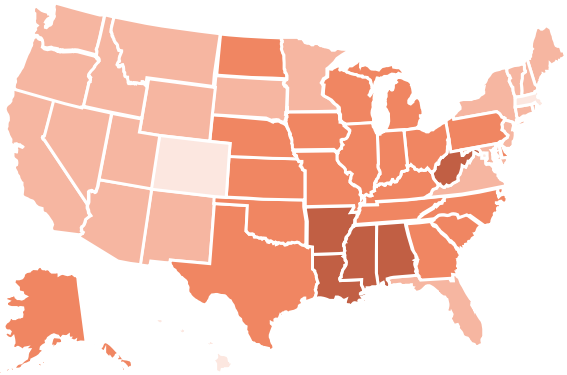
1985

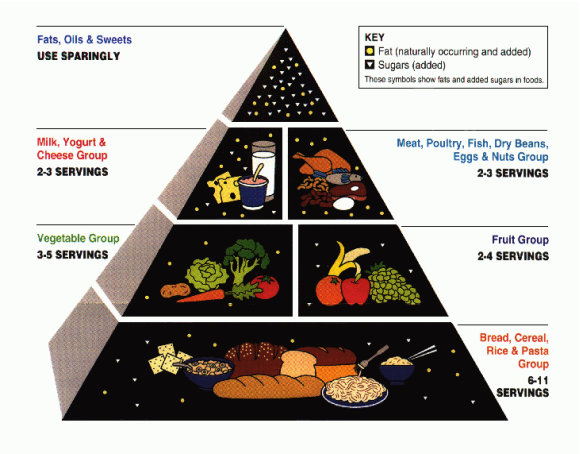


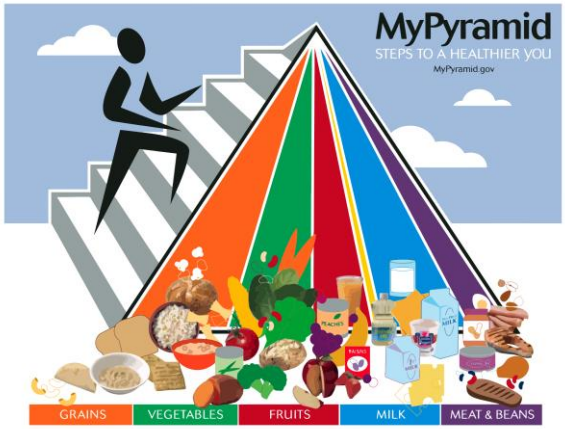
2008

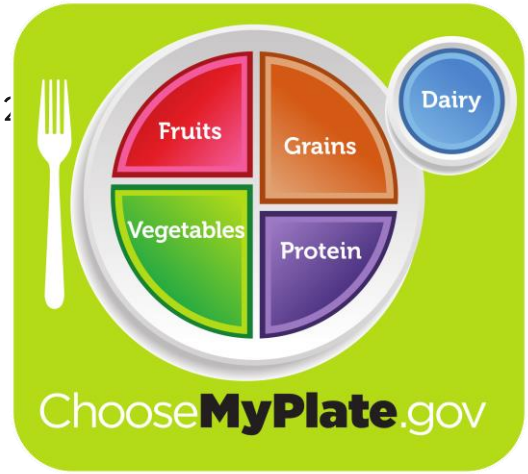


2016









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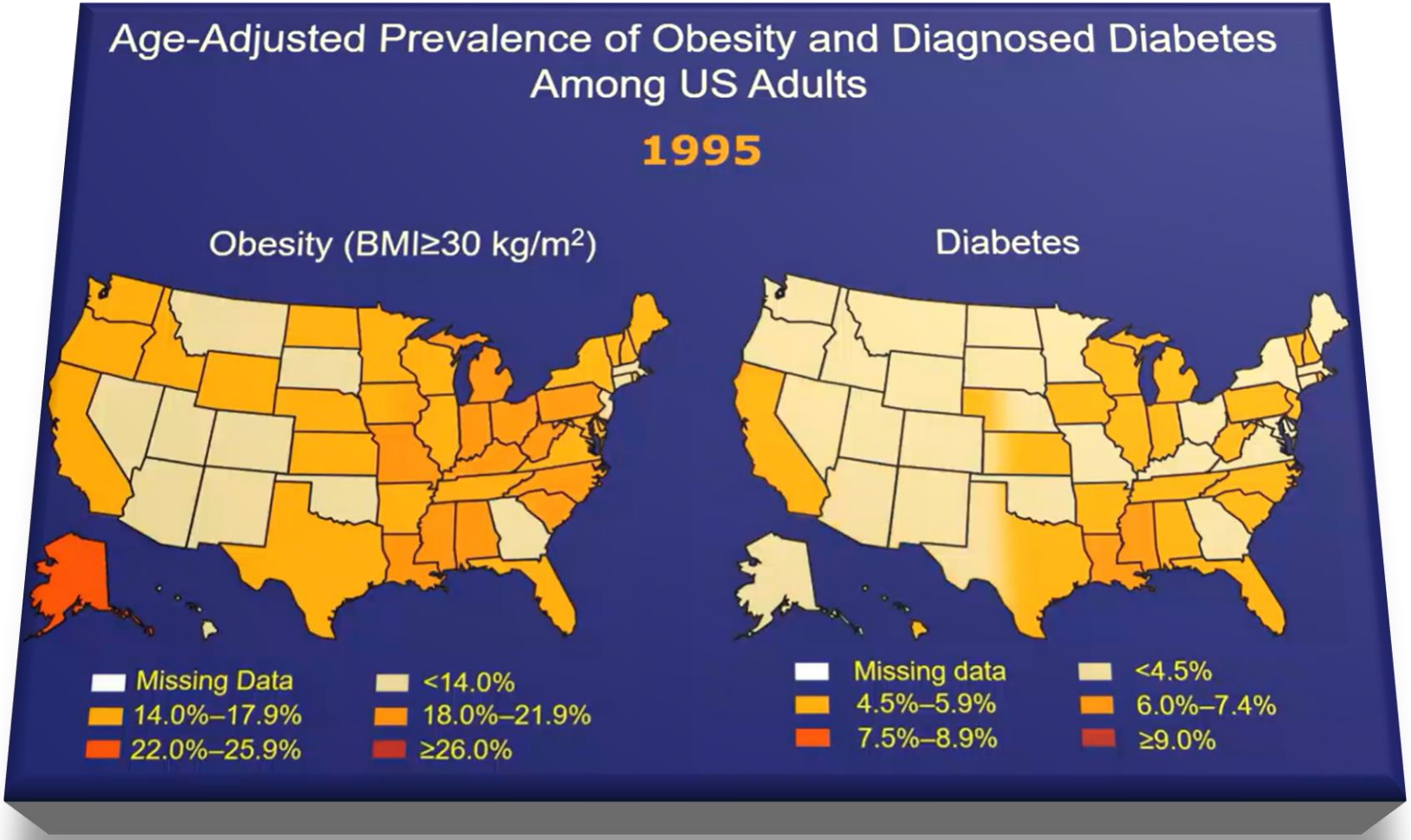

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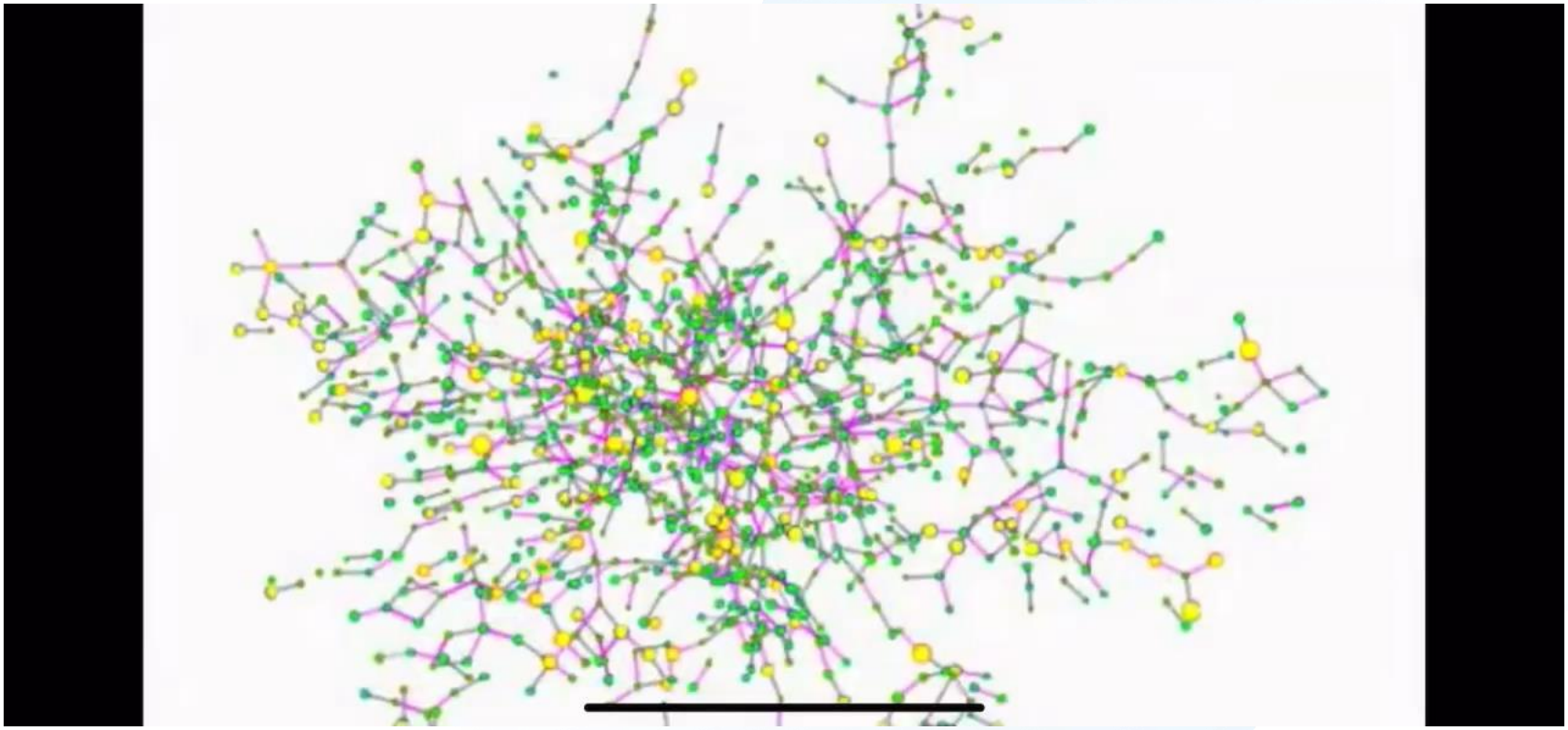

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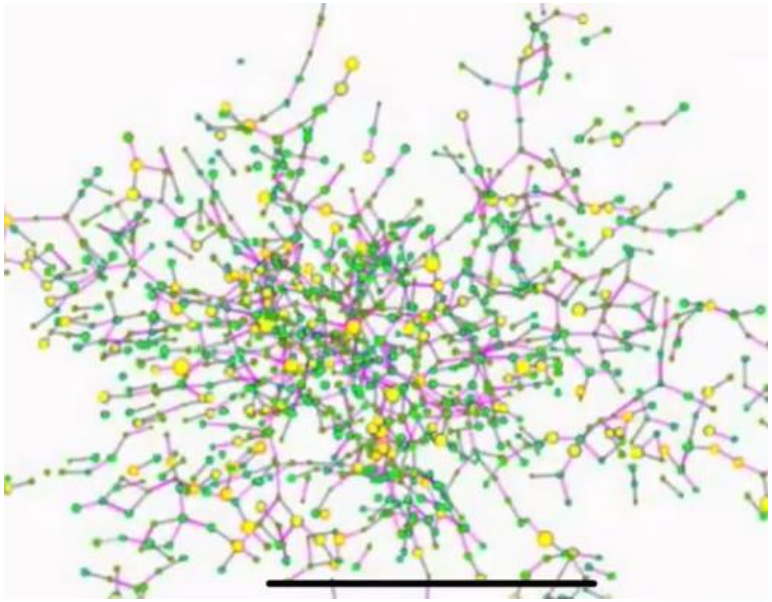

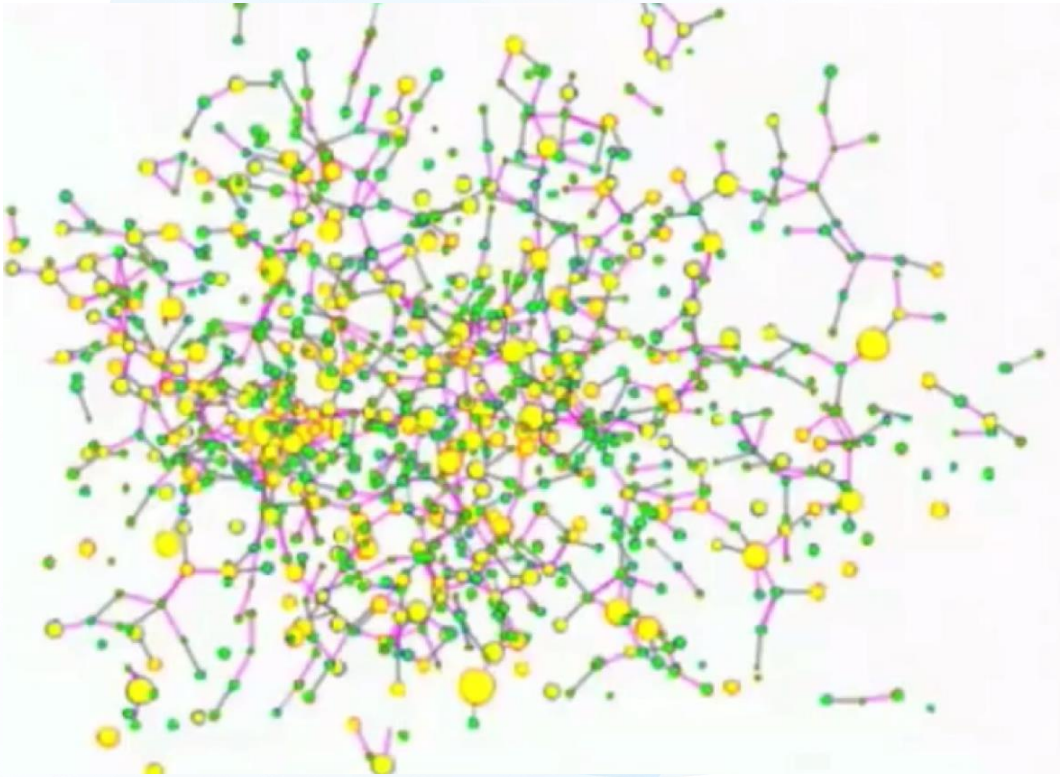

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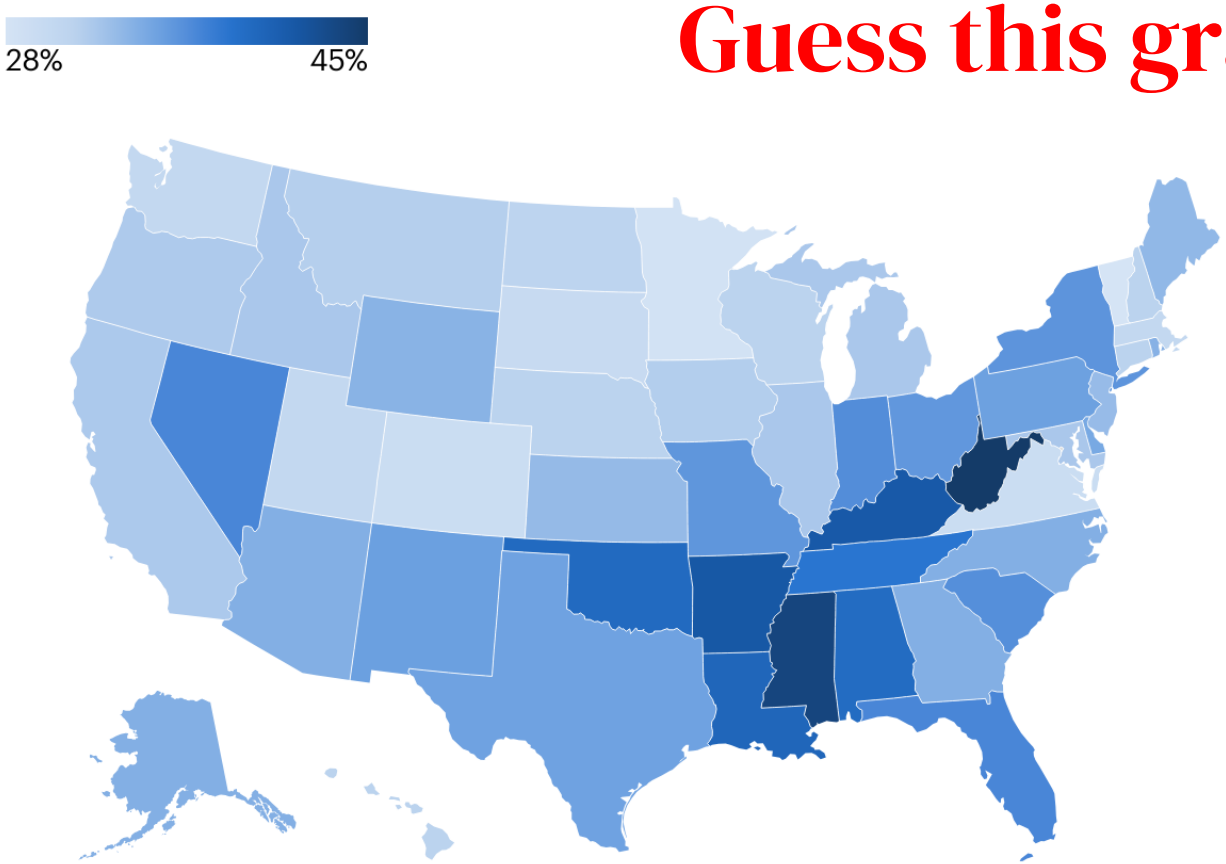
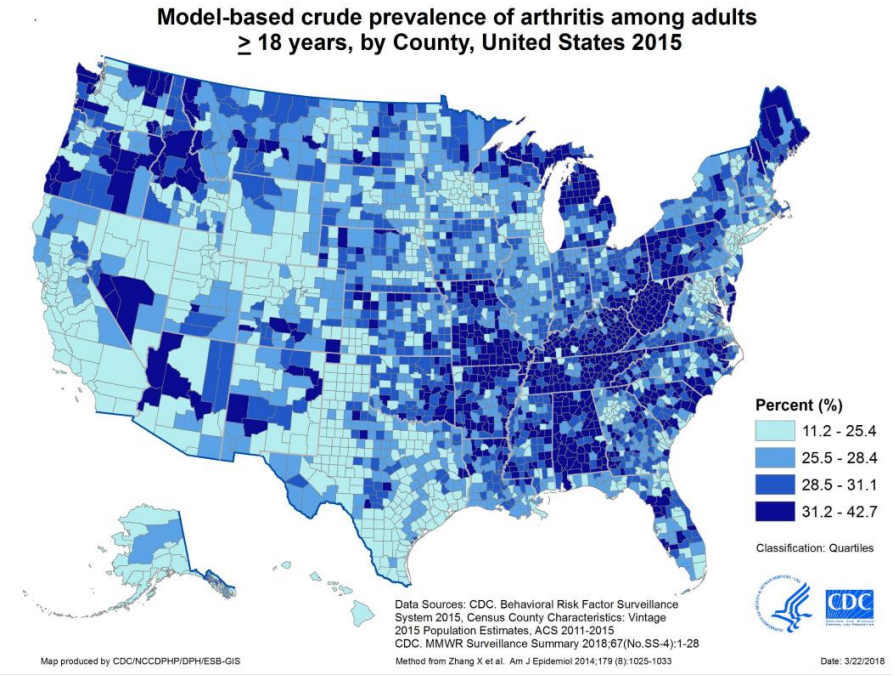


Guess this graph?

Source: Centers for Disease Control and Prevention

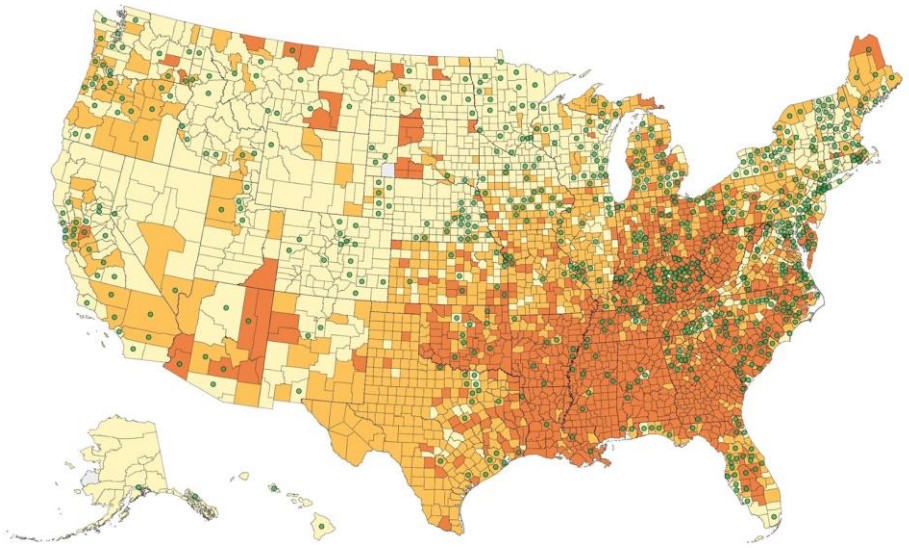
These maps looks eerily similar…

Arthritis



Diabetes

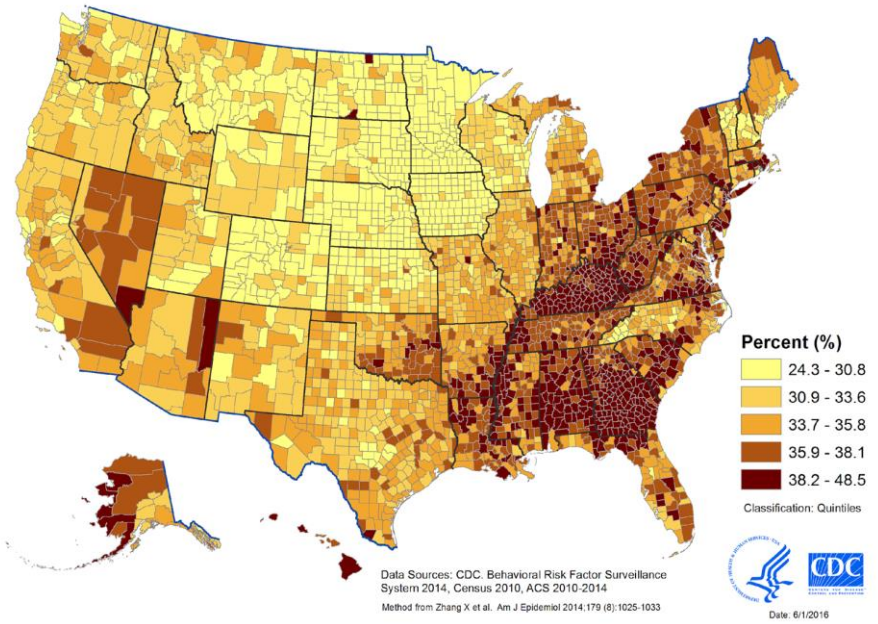
Prevalence by County - 2023



Source: CDC

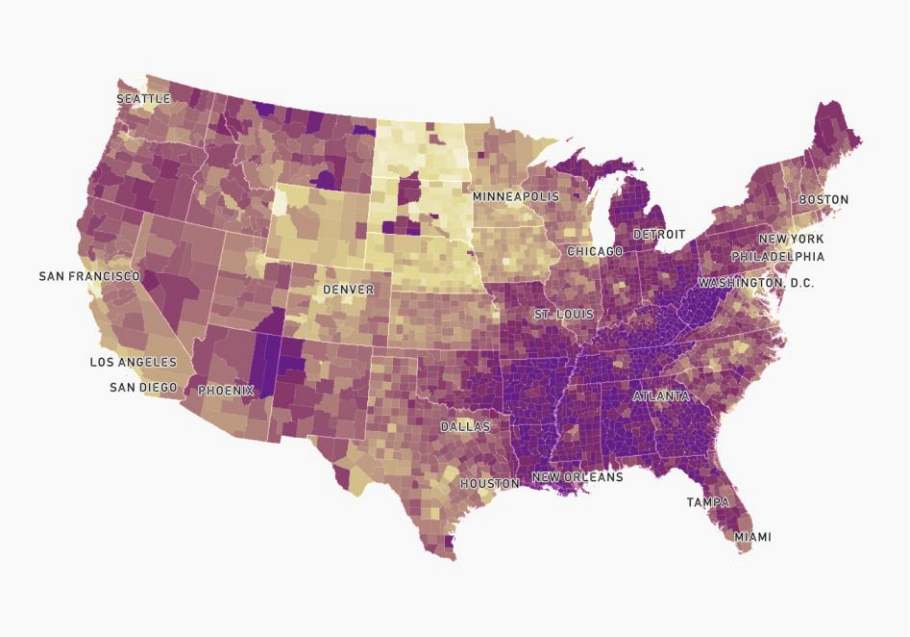
These maps looks eerily similar…

Short Sleep Duration 2017



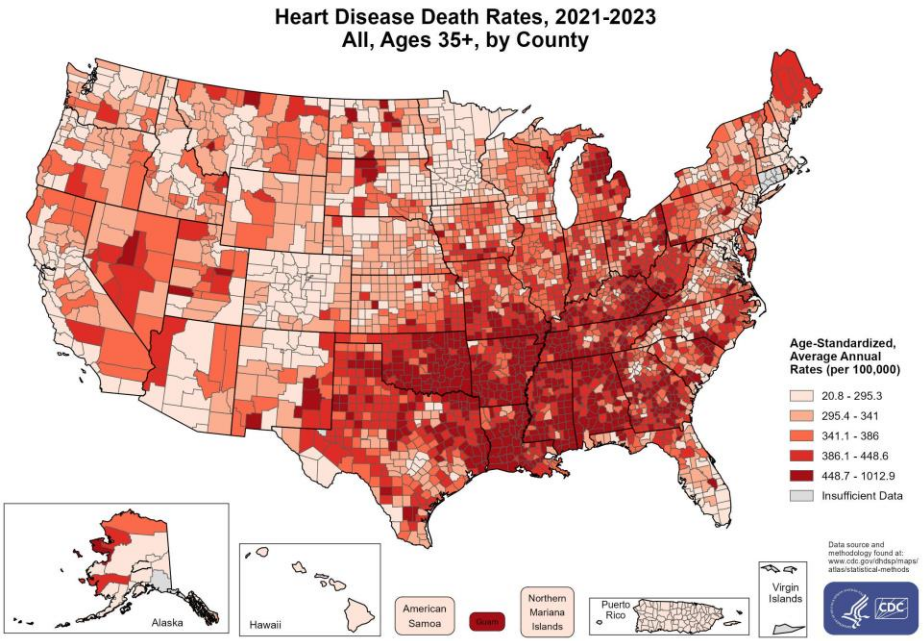
Mental Distress

Average number of poor mental health days (2019)

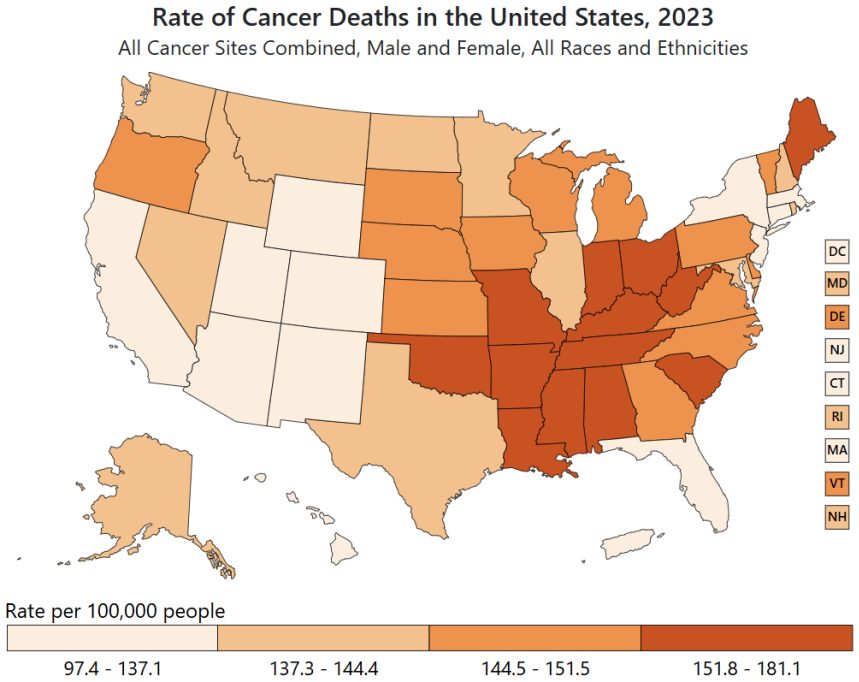


What is going on here?

Heart Disease Death Rates



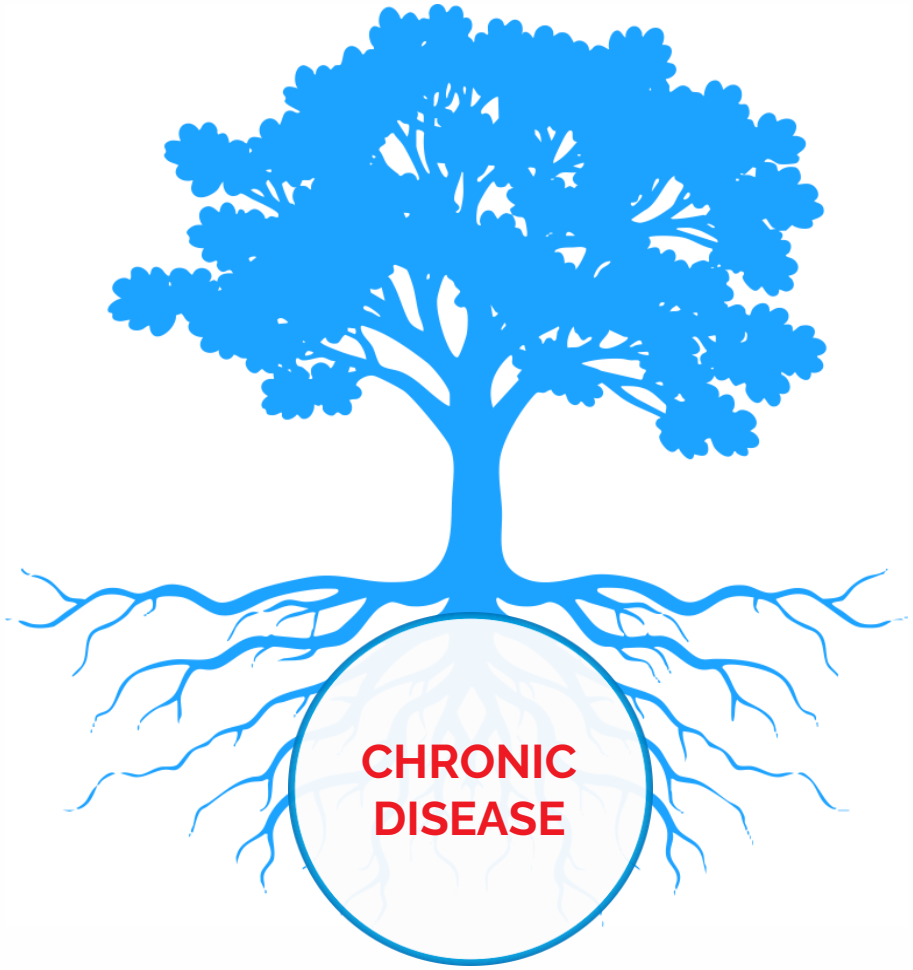
Cancer Deaths



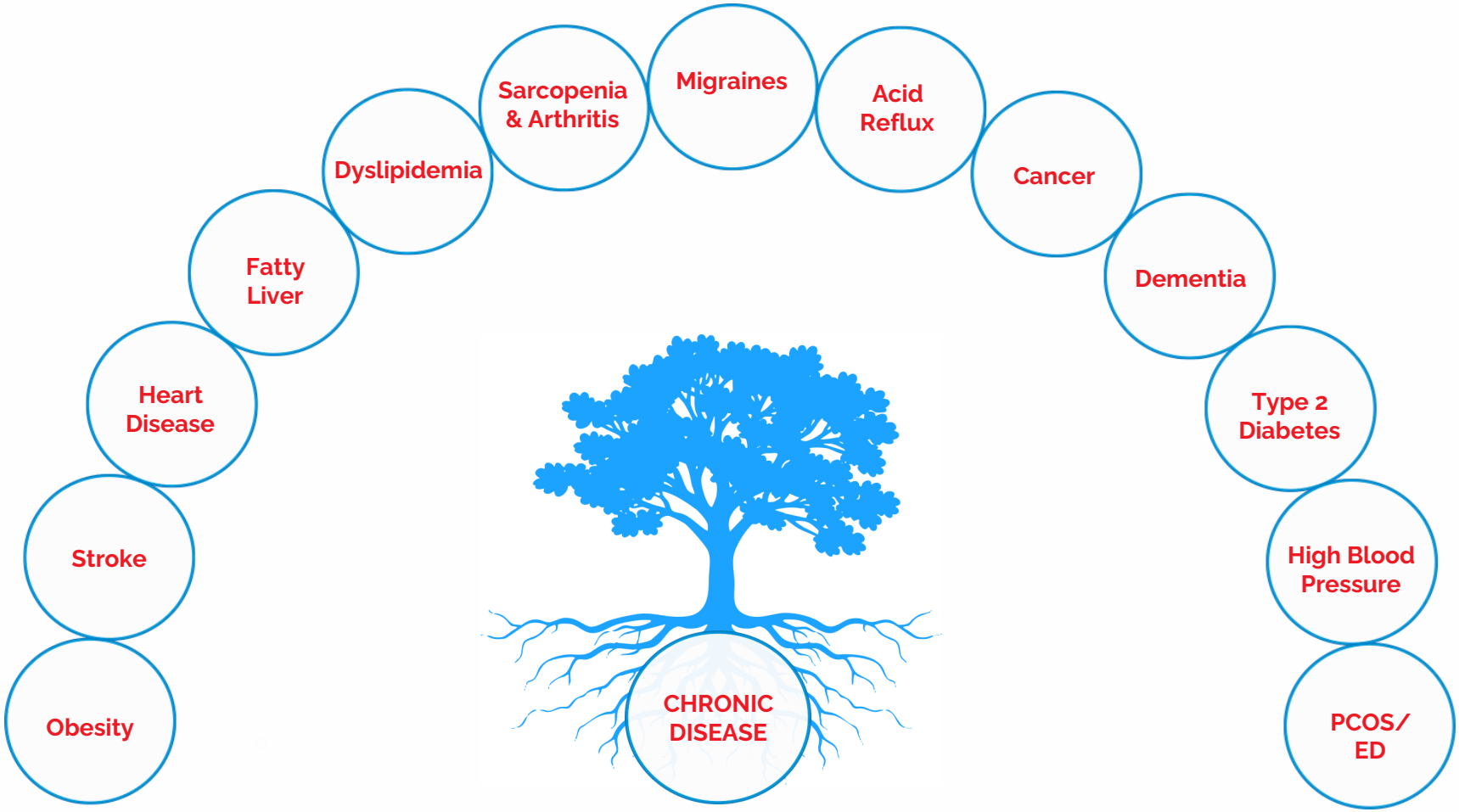
The Problem

Is it possible to explain **modern chronic disease** very simply?

Ignoring root causes leads to chronic disease...

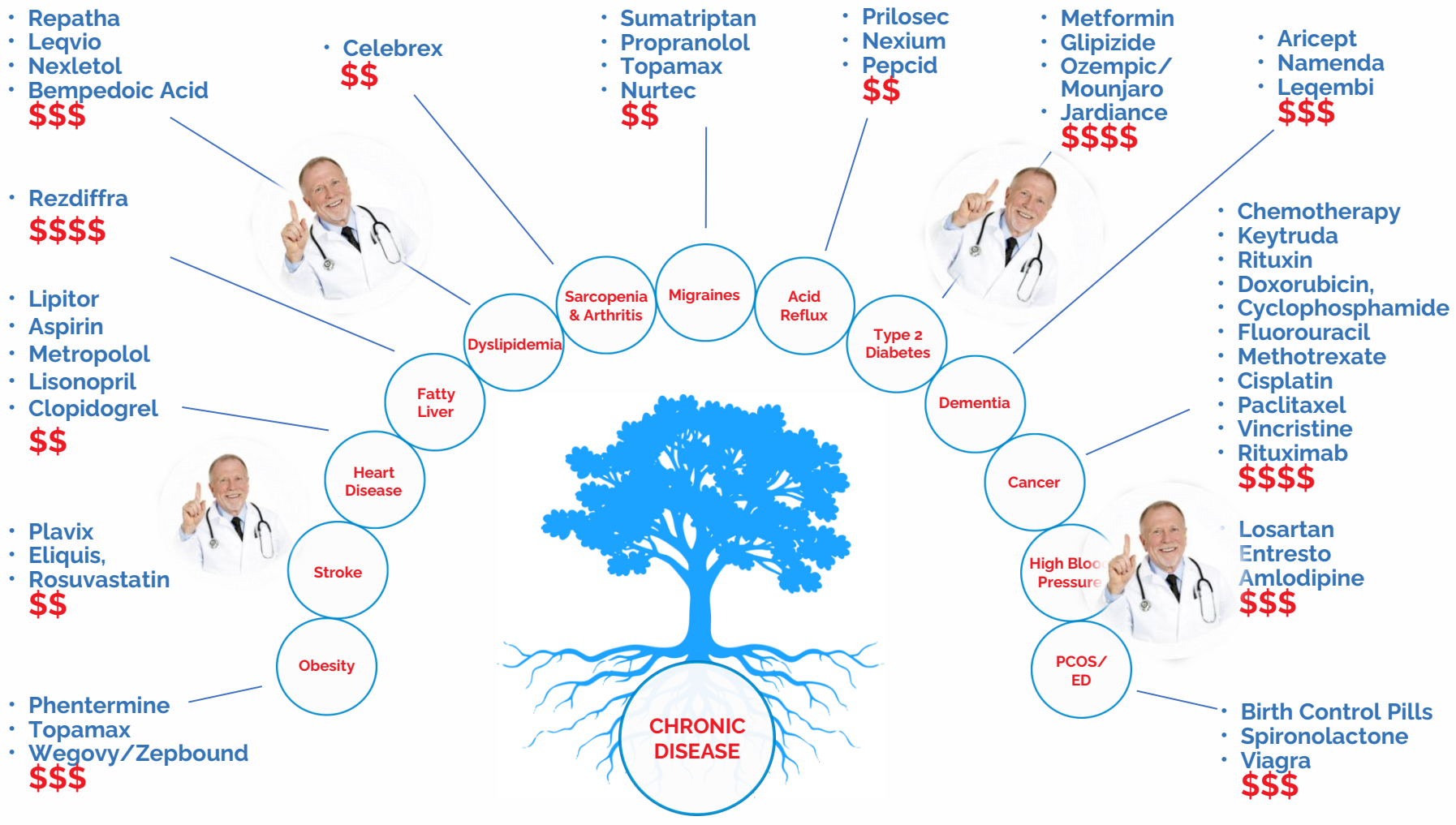


Ignoring root causes leads to multiple secondary diseases...

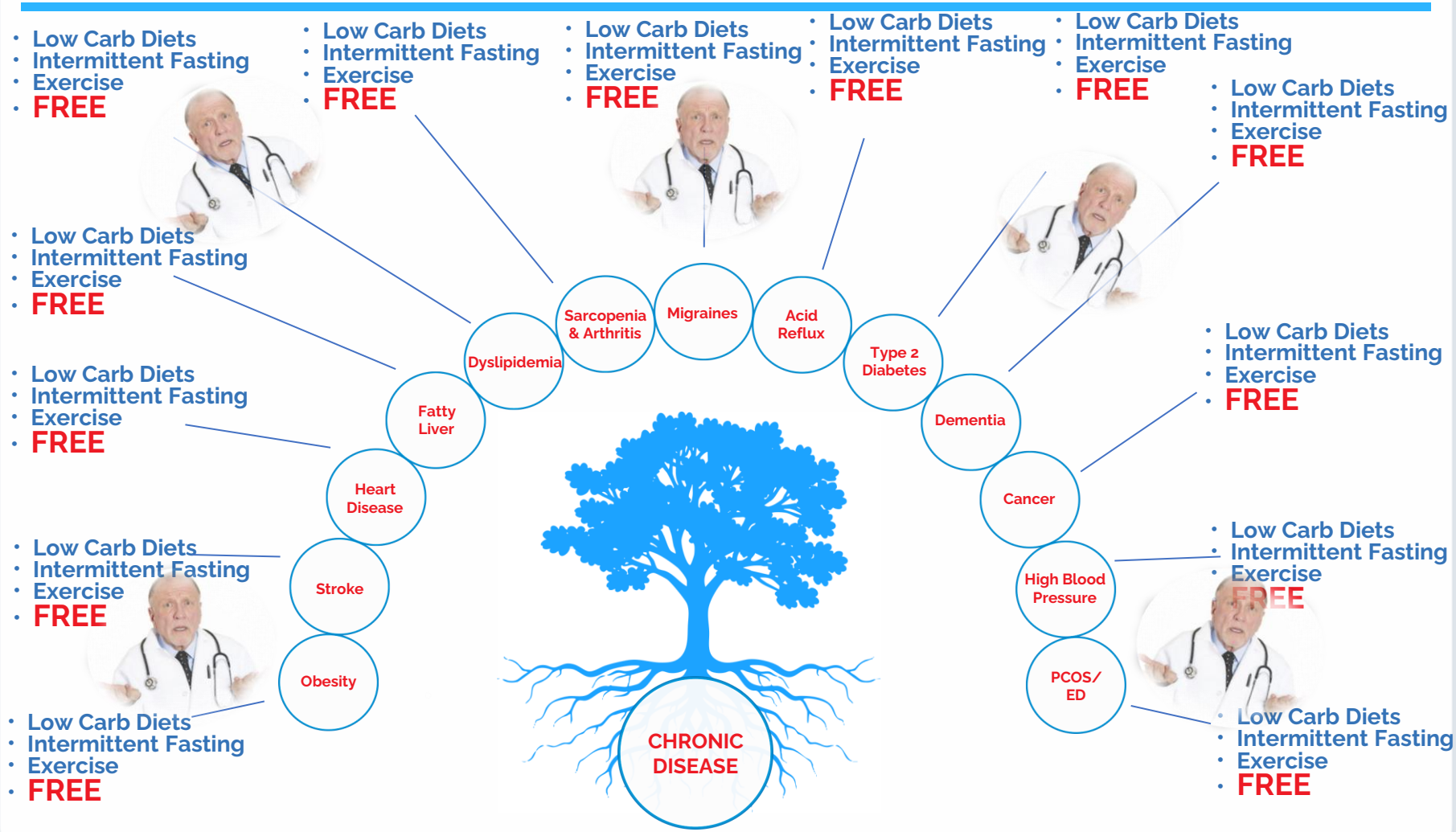


...addressing symptoms is lucrative with widespread medical consensus

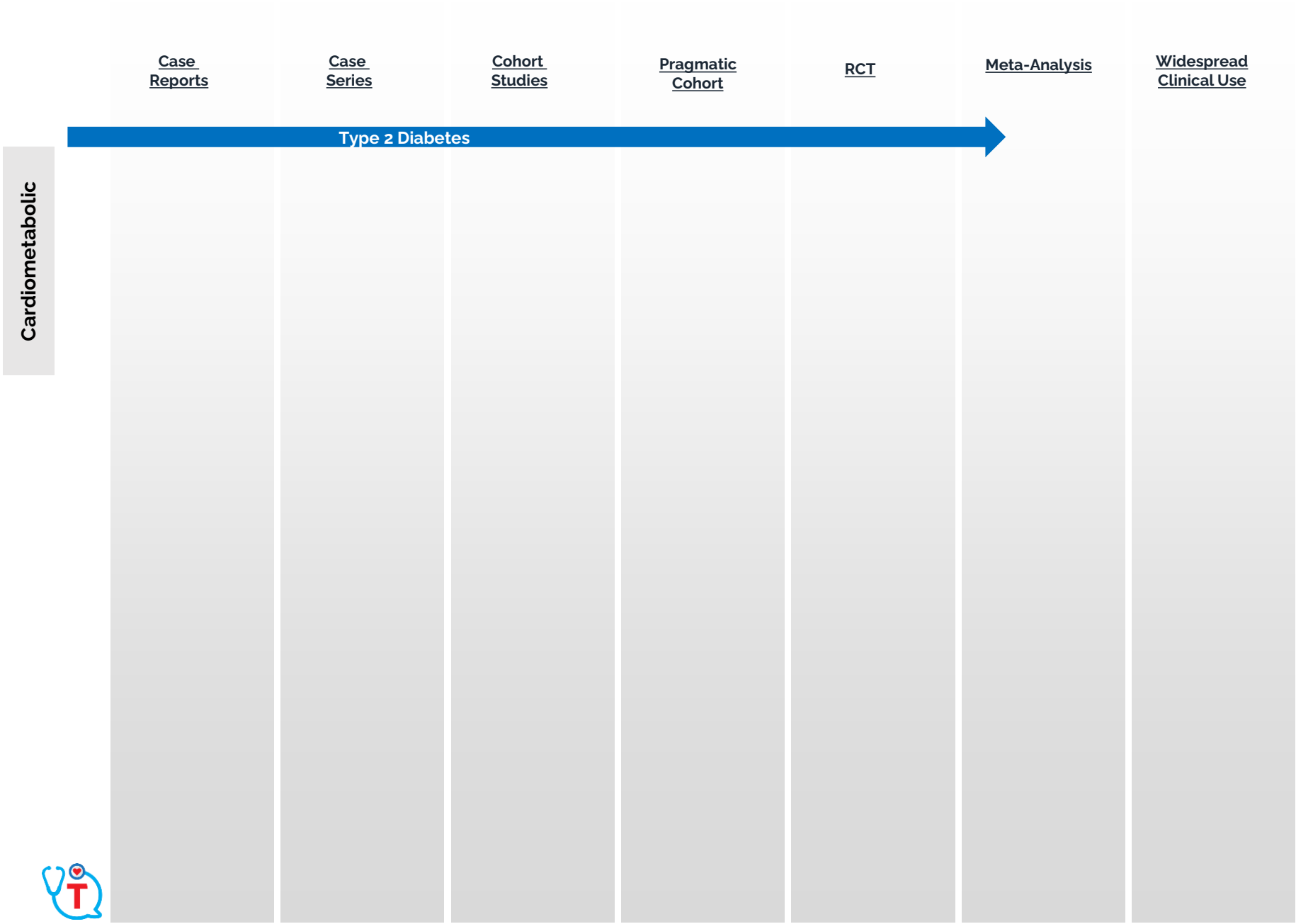
KEY:
$ - less than $500 per year
$$ - $500–$2,000 per year
$$$ - $2,000–$15,000 per year
$$$$ - $15,000+ per year



Does the data actually support metabolic interventions?



OPINION



Case Reports | Case Series | Cohort Studies | Pragmatic Cohort | RCT | Meta-Analysis | Widespread Clinical Use

Type 2 Diabetes

Cureus

Open Access Review Article

DOI: 10.7759/cureus.25528

Open Access Original research

BMJ Open Diabetes Research & Care

Systematic review and meta-analysis of dietary carboh in patients with t

Ole Snorgaard,[1] Grith M Poulsen,[2]

To cite: Snorgaard O, Poulsen GM, Andersen HK, *et al*. Systematic review and meta-analysis of dietary carbohydrate restriction in patients with type 2 diabetes. *BMJ Open Diabetes Research and Care* 2017;**5**: e000354. doi:10.1136/bmjdrc-2016-000354

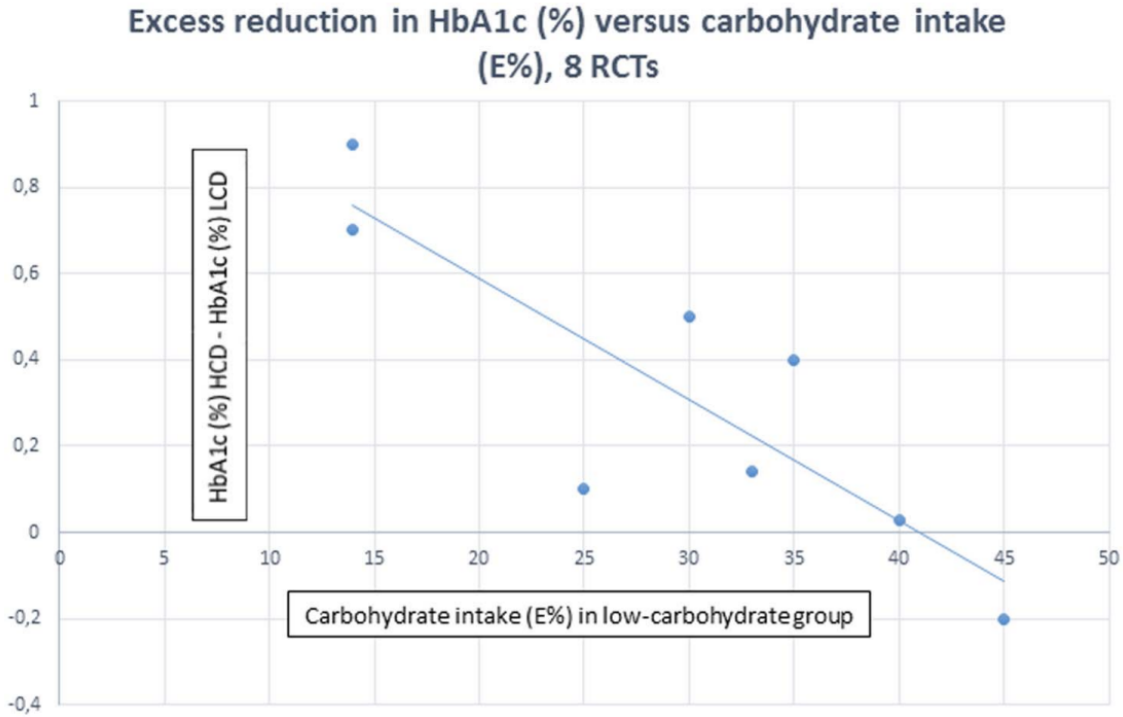
Received 31 October 2016
Revised 2 February 2017
Accepted 5 February 2017

ABSTRACT

Objective: Nutrition therapy is an integral part management education in patients with type 2 diabetes. Carbohydrates with a low glycemic inc recommended, but the ideal amount of carbohy the diet is unclear. We performed a meta-analys comparing diets containing low to moderate am of carbohydrate (LCD) (energy percentage belov to diets containing high amounts of carbohydra (HCD) in subjects with type 2 diabetes.

Research design and methods: We systema reviewed Cochrane library databases, EMBASE, MEDLINE in the period 2004–2014 for guidelin meta-analyses, and randomized trials assessing outcomes HbA1c, BMI, weight, LDL cholesterol of life (QoL), and attrition.

Results: We identified 10 randomized trials comprising 1376 participants in total. In the firs of intervention, LCD was followed by a 0.34% l HbA1c (3.7 mmol/mol) compared with HCD (95 0.06 (0.7 mmol/mol), 0.63 (6.9 mmol/mol)). Th greater the carbohydrate restriction, the greater glucose-lowering effect (R=−0.85, p<0.01). At or later, however, HbA1c was similar in the 2 di groups. The effect of the 2 types of diet on BM weight, LDL cholesterol, QoL, and attrition rate similar throughout interventions.

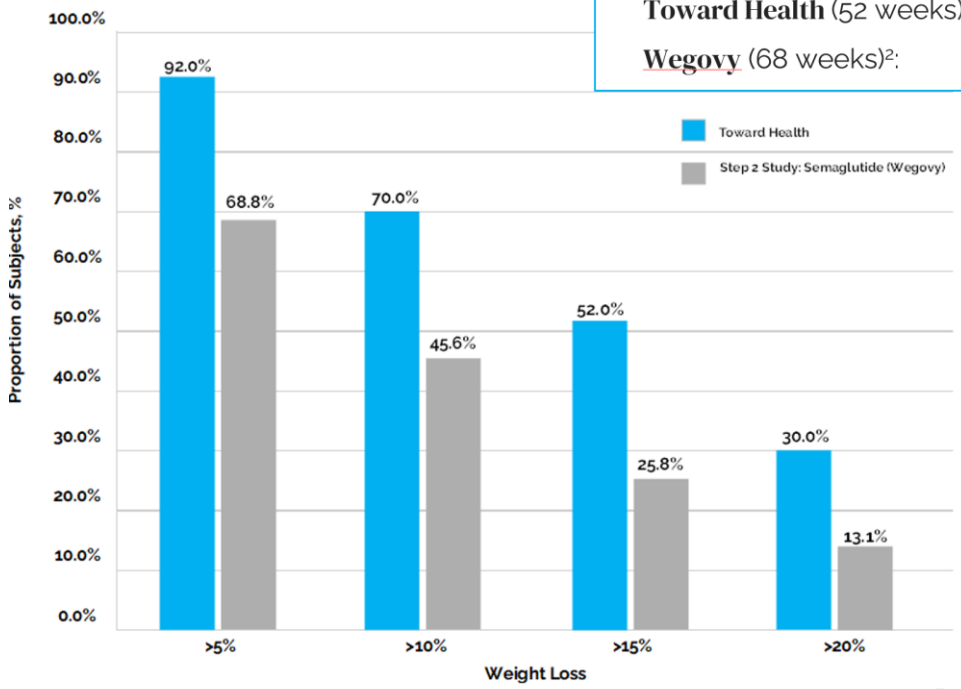


BMJ Open Diabetes Research and Care 2017;**5**:e000354. doi:10.1136/bmjdrc-2016-000354

Case Reports | Case Series | Cohort Studies | Pragmatic Cohort

Published Medical Weight Loss Program Results: Low-Risk Population

Comparison of Weight Loss

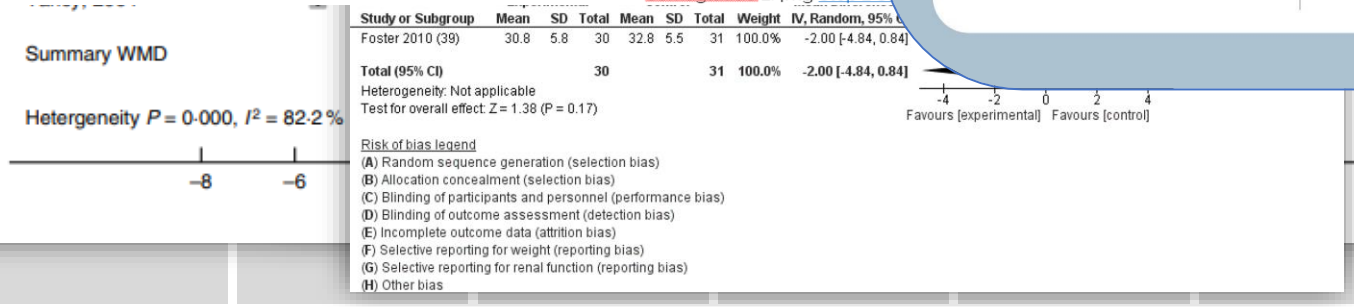


Change in Body Weight %: Comparis

Toward Health (52 weeks)[1]:	15.5
Wegovy (68 weeks)[2]:	14.9

[1] Frontiers in Nut

[2] Semaglutide 2.4mg Step 2 S



12-Month Weight Loss & Deprescription Savings with the TOWARD Approach

ORGANIZATIONAL

50
EMPLOYEES

INDIVIDUAL

43 lbs
AVG. WEIGHT LOSS PER PERSON

96 total DEPRESCRIBED MEDICATIONS

1.92 DEPRESCRIBED MEDICATIONS PER PERSON

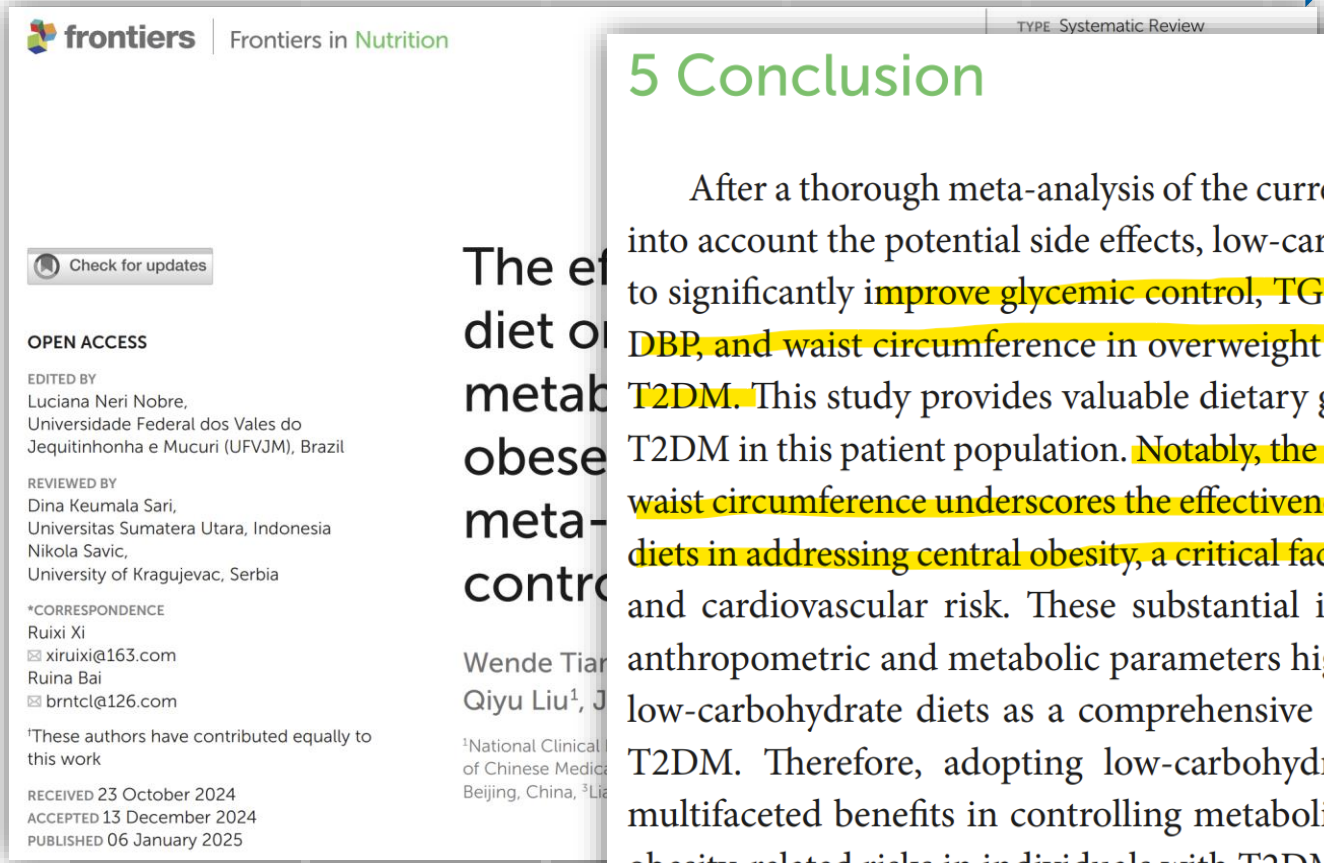
TOTAL ANNUALIZED COST SAVINGS
$83,285

$1665
ANNUALIZED SAVINGS PER PERSON

Cardiometabolic

Case Reports	Case Series	Cohort Studies	Pragmatic Cohort	RCT	Meta-Analysis	Widespread Clinical Use

- Type 2 Diabetes
- Obesity
- Metabolic Syndrome



frontiers | Frontiers in Nutrition

TYPE Systematic Review

Check for updates

OPEN ACCESS

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5 Conclusion

After a thorough meta-analysis of the current evidence and taking into account the potential side effects, low-carbohydrate diets appear to significantly improve glycemic control, TG, HDL-C, weight, BMI, DBP, and waist circumference in overweight or obese patients with T2DM. This study provides valuable dietary guidance for managing T2DM in this patient population. Notably, the significant reduction in waist circumference underscores the effectiveness of low-carbohydrate diets in addressing central obesity, a critical factor in metabolic health and cardiovascular risk. These substantial improvements in both anthropometric and metabolic parameters highlight the potential of low-carbohydrate diets as a comprehensive strategy for managing T2DM. Therefore, adopting low-carbohydrate diets could offer multifaceted benefits in controlling metabolic health and reducing obesity-related risks in individuals with T2DM.

Case Reports | Case Series | Cohort Studies | Pragmatic Cohort | RCT | Meta-Analysis | Widespread Clinical Use

Cardiometabolic

- Type 2 Diabetes
- Obesity
- Metabolic Syndrome
- Hypertension

Comparing Very Low-Carbohydrate vs DASH Diets for Overweight or Obese Adults With Hypertension and Prediabetes or Type 2 Diabetes: A Randomized Trial

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[4]Department of International Health, Johns Hopkins Bloomberg School of Public Health,

ABSTRACT

PURPOSE Adults with a triple multimorbidity (hypertension, prediabetes or type 2 diabetes,
tions, but
recomme

METHOD
bidity usi
(VLC) die
results wi
regulatio

RESULTS
to greate
mm Hg;
$P = .034$)
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Table 2. Estimated Mean (SE) of Outcomes Across Diet and Time From Linear Mixed Model

	VLC Diet				DASH Diet					
Outcome	Baseline	Post	Change	Within-Group *P* Value	Baseline	Post	Change	Within-Group *P* Value	Difference in Change (VLC Lower)	Between-Group *P* Value
SBP, mm Hg	133.72 (1.73)	123.95 (1.88)	−9.77 (1.66)	<.001	132.84 (1.69)	127.66 (1.80)	−5.18 (1.59)	.002	−4.59	.046
HbA_{1c}, %	6.09 (0.07)	5.74 (0.08)	−0.35 (0.07)	<.001	6.10 (0.07)	5.97 (0.07)	−0.14 (0.07)	.06	−0.21	.034
Weight, lb	219.24 (5.39)	200.10 (5.41)	−19.14 (1.73)	<.001	236.43 (5.1)	226.1 (5.2)	−10.34 (1.73)	<.001	−8.81	.0003

DASH = Dietary Approaches to Stop Hypertension; HbA_{1c} = glycated hemoglobin; SBP = systolic blood pressure; VLC = very low-carbohydrate.

Note: Outcomes were analyzed using a linear mixed model including all possible interactions between diet, support, and time and adjusted for age and sex. Results are presented collapsed over all other factors: support allocation, sex, and at the mean value of age. The between-group *P* value is calculated from a Z-test based on the estimated mean changes and the associated SE values reported in the table.

Case Reports | Case Series | Cohort Studies | Pragmatic Cohort | RCT | Meta-Analysis | Widespread Clinical Use

Cardiometabolic

- Type 2 Diabetes
- Obesity
- Metabolic Syndrome

Effect of a ketogenic diet on hepatic steatosis and hepatic mitochondrial metabolism in nonalcoholic fatty liver disease

Panu K. Luukkonen[a,b,c], Sylvie Dufour[a,d], Kun Lyu[e], Xian-Man Zhang[a,d], Antti Hakkarainen[f,g], Tiina E. Lehtimäki[f], Gary W. Cline[a,d], Kitt Falk Petersen[a,d], Gerald I. Shulman[a,d,e,1,2], and Hannele Yki-Järvinen[b,c,1,2]

[a]Department of Internal Medicine, Yale School of Medicine, New Haven, CT 06520; [b]Minerva Foundation Institute for Medical Research, Helsinki 00290, Finland; [c]Department of Medicine, University of Helsinki and Helsinki University Hospital, Helsinki 00290, Finland; [d]Yale Diabetes Research Center, Yale School of Medicine, New Haven, CT 06520; [e]Department of Cellular & Molecular Physiology, Yale School of Medicine, New Haven, CT 06520; [f]Department of Radiology, HUS Medical Imaging Center, University of Helsinki and Helsinki University Hospital, Helsinki 00290, Finland; and [g]Department of Neuroscience and Biomedical Engineering, Aalto University School of Science, 00076 Espoo, Finland

Contributed by Gerald I. Shulman, January 31, 2020 (sent for review December 26, 2019; reviewed by Fredrik Karpe and Roy Taylor)

Weight loss by ketogenic diet (KD) has gained popularity in management of nonalcoholic fatty liver disease (NAFLD). KD rapidly reverses NAFLD and insulin resistance despite increasing circulating nonesterified fatty acids (NEFA), the main substrate for synthesis of intrahepatic triglycerides (IHTG). To explore the underlying mechanism, we quantified hepatic mitochondrial fluxes and their regulators in humans by using positional isotopomer NMR tracer analysis. Ten overweight/obese subjects received stable isotope infusions of: [D_7]glucose, [$^{13}C_4$]β-hydroxybutyrate and [3-^{13}C]lactate before and after a 6-d KD. IHTG was determined by proton magnetic resonance spectroscopy (^{1}H-MRS). The KD diet decreased IHTG by 31% in the face of a 3% decrease in body weight and decreased hepatic insulin resistance (−58%) despite an increase in NEFA concentrations (+35%). These changes were attributed to increased net hydrolysis of IHTG and partitioning of the resulting fatty acids toward ketogenesis (+232%) due to reductions in serum insulin concentrations (−53%) and hepatic citrate synthase flux (−38%), respectively. The former was attributed to decreased hepatic insulin resistance and the latter to increased hepatic mitochondrial redox state (+167%) and decreased plasma leptin (−45%) and triiodothyronine (−21%) concentrations. These data demonstrate heretofore undescribed adaptations underlying the reversal of NAFLD by KD: That is, markedly altered hepatic mitochondrial fluxes and redox state to promote ketogenesis rather than synthesis of IHTG.

after 48 h of caloric restriction (26). We previously showed that a hypocaloric, KD induces an ~30% reduction in IHTG content in 6 d despite increasing circulating NEFA (27).

While the antisteatotic effect of KD is well-established, the underlying mechanisms by which it does so remain unclear. KD increases plasma NEFA concentrations, the main substrate of IHTG (11). In the liver, NEFA can either be re-esterified into complex lipids, such as TGs, or be transported to the mitochondria to be metabolized by β-oxidation into acetyl-CoA, which in turn can either be irreversibly condensed with oxaloacetate by citrate synthase to form citrate and enter the TCA cycle for terminal oxidation to CO_2 (28, 29) or it can enter the ketogenic pathway, where it is converted into acetoacetate (AcAc) and β-hydroxybutyrate (β-OHB) (28). These mitochondrial fluxes are tightly regulated by substrate availability and product inhibition (29), mitochondrial redox state (30), and hormones, such as leptin (31) and triiodothyronine (T3) (32).

Significance

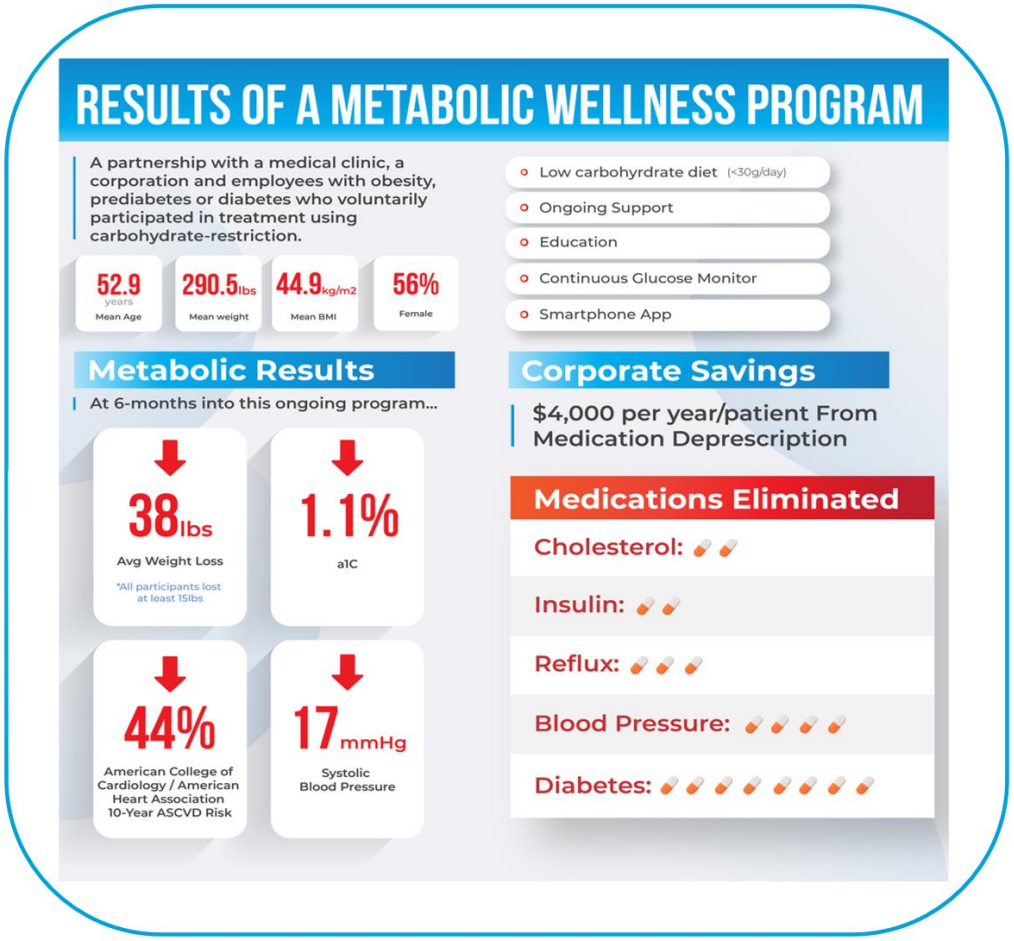
Ketogenic diet is an effective treatment for nonalcoholic fatty liver disease (NAFLD). Here, we present evidence that hepatic mitochondrial fluxes and redox state are markedly altered during ketogenic diet-induced reversal of NAFLD in humans.

Cardiometabolic

Case Reports	Case Series	Cohort Studies	Pragmatic Cohort	RCT	Meta-Analysis	Widespread Clinical Use

Type 2 Diabetes

Obesity



This high-risk cohort (nearly 2/3 of patients had diabetes) had an average starting HbA1c of 7.1%:

Deprescription cost savings: $4,000 per patient, per year

Metabolites: A Company Is Only as Healthy as Its Workers: A 6-Month Metabolic Health Management Pilot Program Improves Employee Health and Contributes to Cost Savings

Demonstrated cardiometabolic risk reduction

Study	A1c	Weight	BP (mmHg)	Deprescriptions
Toward Health*	↓ 7.1% to 6.0% (-1.1%)	↓ 288 lbs to 251 lbs (-38 lbs)	↓ 141/83 to 124/78 (-17/6)	Saved $4,000 per patient, per year in medication deprescriptions
Toward Health**	↓ 6.34% to 5.5% (-.79%)	↓ 271 lbs to 228 lbs (-43 lbs)	↓ 144/87 to 126/80 (-14/7)	Saved $1,665 per patient, per year in medication deprescriptions

Can we be more conclusive?

The TOWARD Approach provided **a 44% reduction in the employees' 10-year risk of heart attack and stroke in an initial pilot**

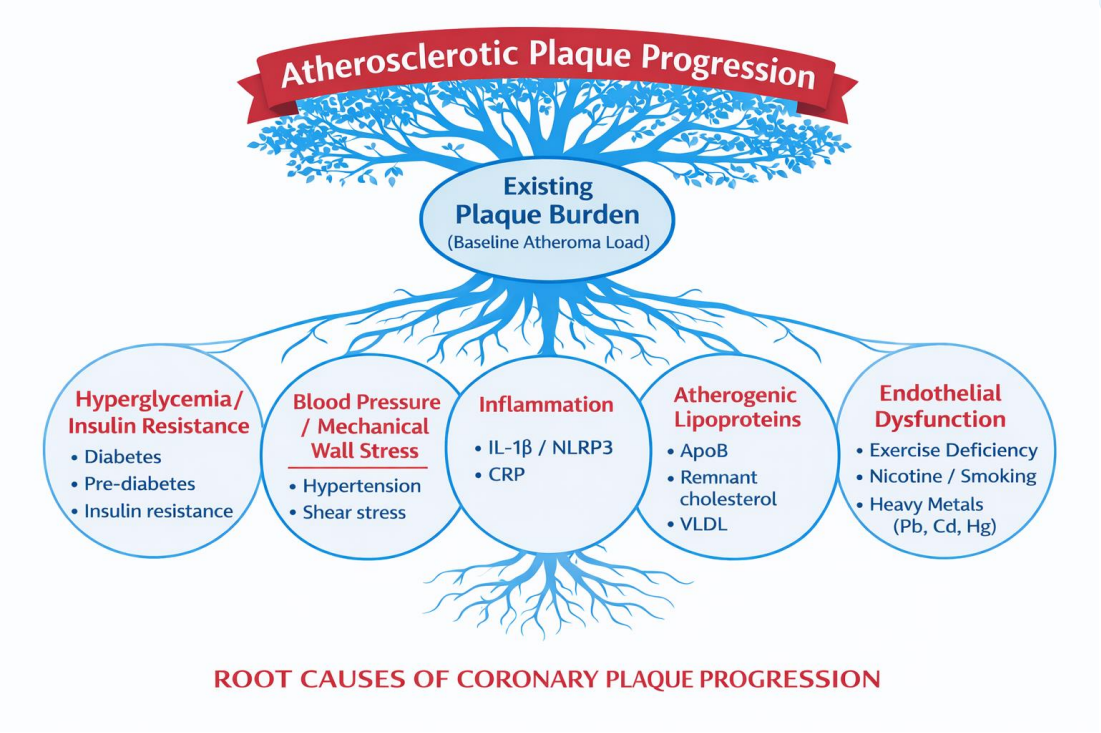
* High-risk cohort (*6-months*): 2/3 with diabetes
**Lower-risk cohort (*12-months*): 1/3 with diabetes

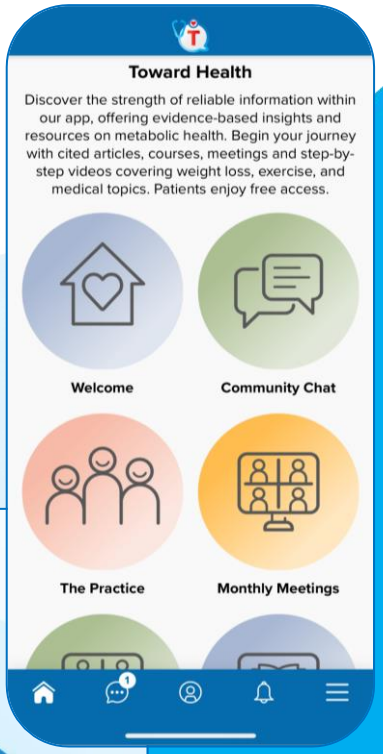
One-Year PREVENT Data – 120 patients

(in submission, please do not share)

Reversing Coronary Plaque

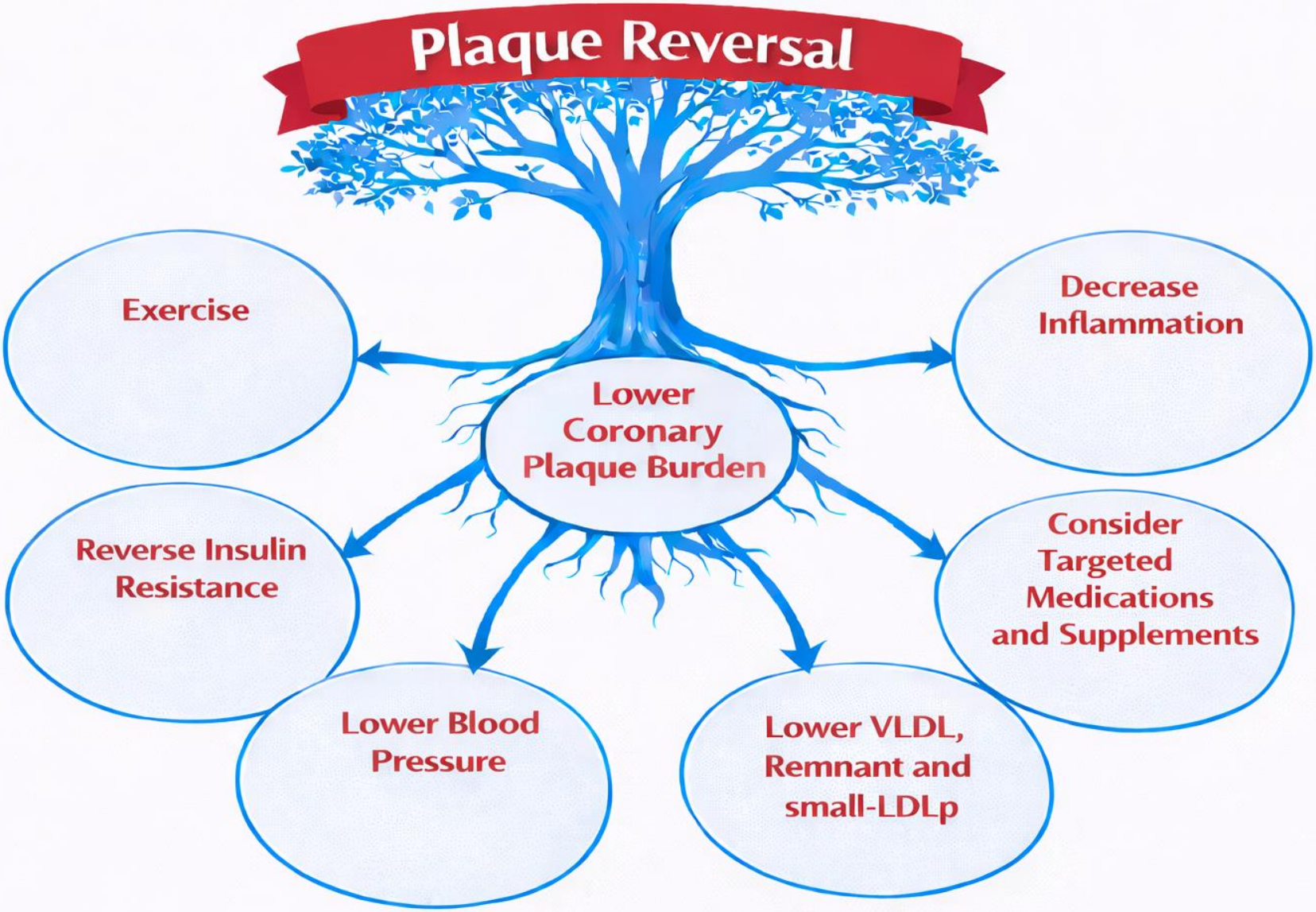
Human Clinical Trial Evidence





A metabolic health clinic in your pocket

The Toward Health program includes the Toward Health app which has a fully interactive Cardiovascular Disease Reversal and CAC course for all patients.



PLAQUE REVERSAL STRATEGIES

Three Diseases, One Risk Calculator

Cardiovascular disease
Heart attacks, strokes, and heart failure

Atherosclerotic cardiovascular disease
Heart attacks, and stroke

American Heart Association®

Heart failure
Decreased functioning/forward flow of the heart. Can cause leg swelling, shortness of breath, and poor quality of life

PREVENT Calculator

Newest risk calculator from the American Heart Association that aims to predict 10-year and 30-year risk of these diseases from metabolic markers

Three Diseases, One Risk Calculator

CVD | ASCVD | Heart Failure

Sex*
(•) Male ( ) Female

Current Smoking
Any cigarette use within the last 30 days
(•) No ( ) Yes

Lipid-lowering medication
Current use of statin medication to lower cholesterol
(•) No ( ) Yes

Age (years)*
30-79

HDL Cholesterol (mg/dL)*
20-100

BMI (kg/m^2)*
18.5-39.9

Total Cholesterol (mg/dL)*
130-320

SBP (mmHg)*
90-200

eGFR (mL/min/1.73m^2)*
15-140

Diabetes
Any history of diabetes.
(•) No ( ) Yes

Anti-hypertensive medication
Current use of any medication for hypertension
(•) No ( ) Yes

The following three predictors are optional for further personalization of risk assessment. When they are clinically indicated or available,

If avaliable or indicated, select "Yes" and enter the value.

UACR (mg/g)
UACR is clinically indicated for individuals with chronic kidney disease, diabetes, or hypertension
(•) No ( ) Yes

HbA1C
HbA1c is clinically indicated for individuals with diabetes, prediabetes, overweight, or obesity, or those with history of gestational diabetes
(•) No ( ) Yes

Zip Code
valid 5-digit zip code is needed to estimate social deprivation index [SDI]
(•) No ( ) Yes

Cardiovascular Disease Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	7.3%			
30-year risk	29.3%			

Cardiovascular Disease = Heart attacks, strokes, heart failure

Cardiovascular Disease Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	7.3%	3.8%		
30-year risk	29.3%	20.3%		

Cardiovascular Disease = Heart attacks, strokes, heart failure

Cardiovascular Disease Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	7.3%	3.8%	↓ 3.5%	↓ 48%
30-year risk	29.3%	20.3%	↓ 9.0%	↓ 31%

Cardiovascular Disease = Heart attacks, strokes, heart failure

Atherosclerotic Cardiovascular Disease Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	4.4%			
30-year risk	17.9%			

Atherosclerotic cardiovascular disease = Heart attacks

Atherosclerotic Cardiovascular Disease Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	4.4%	2.3%		
30-year risk	17.9%	12.0%		

Atherosclerotic cardiovascular disease = Heart attacks

Atherosclerotic Cardiovascular Disease Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	4.4%	2.3%	↓ **2.1%**	↓ **48%**
30-year risk	17.9%	12.0%	↓ **5.9%**	↓ **33%**

Atherosclerotic cardiovascular disease = Heart attacks and stroke

Heart Failure Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	6.2%			
30-year risk	26.1%			

Heart failure = Decreased functioning/forward flow of the heart. Can cause leg swelling, shortness of breath, and poor quality of life

Heart Failure Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	6.2%	2.3%		
30-year risk	26.1%	14.2%		

Heart failure = Decreased functioning/forward flow of the heart. Can cause leg swelling, shortness of breath, and poor quality of life

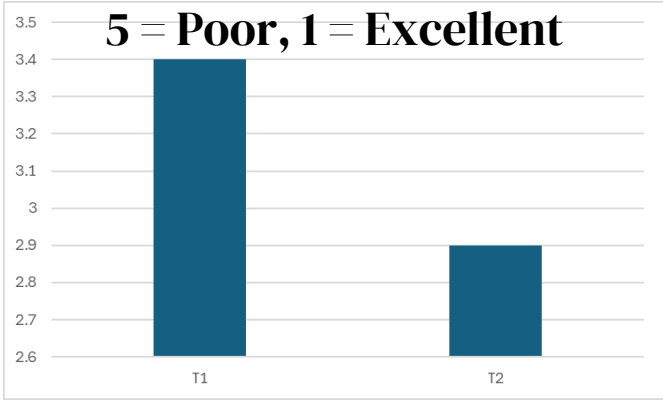
Heart Failure Risk

	Risk before Intervention	Risk After Intervention	Absolute Risk Reduction	Relative Risk Reduction
10-year risk	6.2%	2.3%	↓ **3.9%**	↓ **63%**
30-year risk	26.1%	14.2%	↓ **11.9%**	↓ **46%**

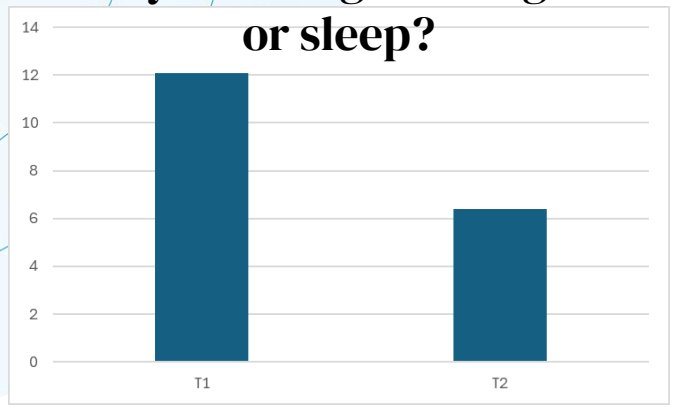
Heart failure = Decreased functioning/forward flow of the heart. Can cause leg swelling, shortness of breath, and poor quality of life

Quality of Life Improvement Surveys

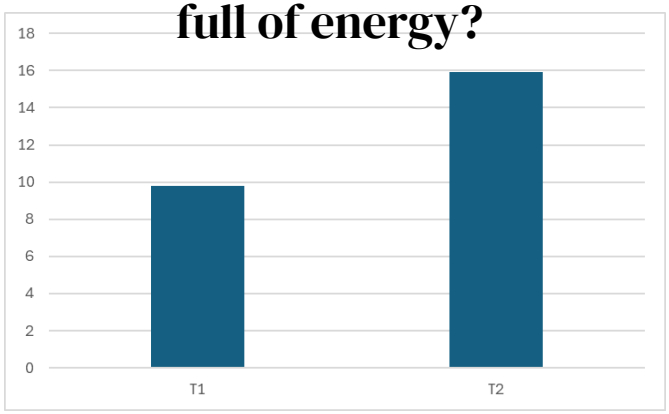
How Would You Rate Your General Health?
5 = Poor, 1 = Excellent



How many days during the past 30 did you NOT get enough rest or sleep?



How many days during the past 30 have you felt very healthy and full of energy?



In Review – Please DO NOT share

British Journal of Nutrition

Effects of the very low-carbohydrate ketogenic diet in women with polycystic ovary syndrome: a systematic review with meta-analysis of clinical trials

Published online by Cambridge University Press: **18 November 2025**

Jéssica Abdo Gonçalves Tosatti, Fernanda Medeiros Vale Magalhães and Karina Braga Gomes

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Article contents

Abstract

Polycystic ovary syndrome is a disorder characterised by insulin resistance, low-grade inflammation and increased adipose tissue. The very low-carbohydrate ketogenic diet has been suggested to reduce obesity risks in polycystic ovary syndrome. This study aimed to update the evidence on the effects of the very low-carbohydrate ketogenic diet in women with polycystic ovary syndrome. Searches were conducted in electronic databases for randomised clinical trials addressing the research question. The values for the meta-analysis were presented as weighted mean difference (WMD). Twelve studies were included in the qualitative analysis and eleven in the quantitative analysis. Significant reductions were observed in anthropometric outcomes: weight (WMD: −9·57 kg; $P < 0·0001$), waist circumference (WMD: −7·75 cm; $P < 0·0009$), fat body mass (WMD: −7·44 kg; $P = 0·0008$), BMI (WMD: −3·45 kg/m^2; $P < 0·0001$) and waist-to-hip ratio (WMD: −0·02; $P < 0·0034$). Hormonal improvements included free testosterone (WMD: −0·31 ng/dl; $P < 0·0001$), total testosterone (WMD: −7·21 ng/dl; $P < 0·0001$), sex hormone-binding globulin (WMD: 15·22 nmol/l; $P = 0·0035$), luteinising hormone (WMD: −3·97 U/L; $P = 0·0008$) and luteinising hormone:follicle-stimulating hormone ratio (WMD: −1·04; $P = 0·0053$), but not for follicle-stimulating hormone levels (WMD: 1·23 mUI/ml; $P = 0·12$). Significant changes in metabolic markers were seen in blood glucose (WMD: −9·65 mg/dl; $P = 0·0031$), insulin (WMD: −2·41 mg/dl; $P = 0·0387$), homeostatic model assessment for insulin resistance (WMD: −2·46; $P = 0·0123$) and TAG (WMD: −29·95 mg/dl; $P = 0·0188$). The very low-carbohydrate ketogenic diet shows significant benefits in managing body composition, reducing hyperandrogenism, balancing sex hormones and improving glucose metabolism in polycystic ovary syndrome.

Cardiometabolic

Hormonal

Effects of dietary fat and fiber on plasma and urine androgens and estrogens in men: a controlled feeding study[1,2]

Joanne F Dorgan, Joseph T Judd, Christopher Longcope, Charles Brown, Arthur Schatzkin, Beverly A Clevidence, William S Campbell, Padmanabhan P Nair, Charlene Franz, Lisa Kahle, and Philip R Taylor

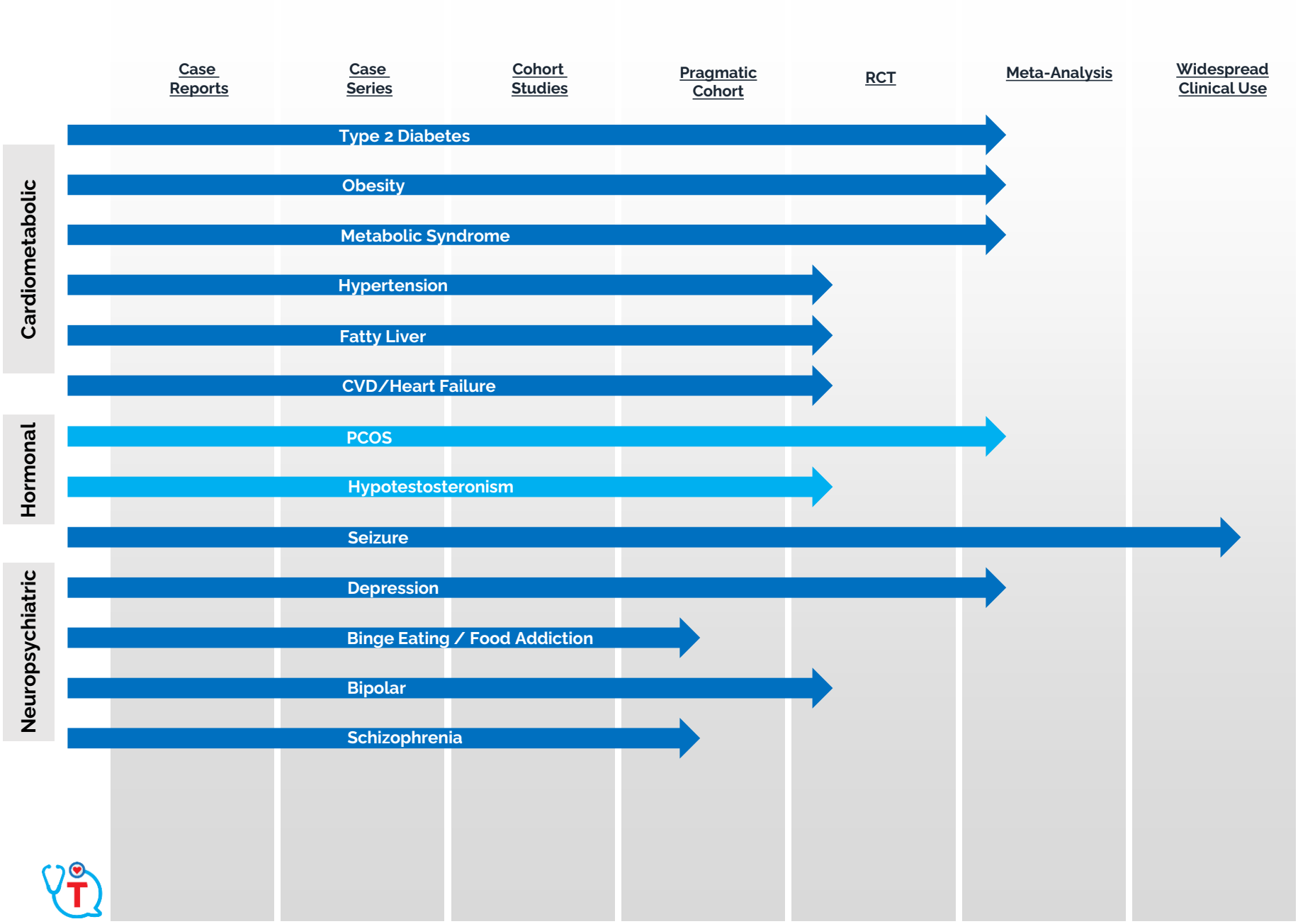
ABSTRACT We conducted a controlled feeding study to evaluate the effects of fat and fiber consumption on plasma and urine sex hormones in men. The study had a crossover design and included 43 healthy men aged 19–56 y. Men were initially randomly assigned to either a low-fat, high-fiber or high-fat, low-fiber diet for 10 wk and after a 2-wk washout period crossed over to the other diet. The energy content of diets was varied to maintain constant body weight but averaged ≈13.3 MJ (3170 kcal)/d on both diets. The low-fat diet provided 18.8% of energy from fat with a ratio of polyunsaturated to saturated fat (P:S) of 1.3, whereas the high-fat diet provided 41.0% of energy from fat with a P:S of 0.6. Total dietary fiber consumption from the low- and high-fat diets averaged 4.6 and 2.0 $g \cdot MJ^{-1} \cdot d^{-1}$, respectively. Mean plasma concentrations of total and sex-hormone-binding-globulin (SHBG)-bound testosterone were 13% and 15% higher, respectively, on the high-fat, low-fiber diet and the difference from the low-fat, high-fiber diet was significant for the SHBG-bound fraction ($P = 0.04$). Men's daily urinary excretion of testosterone also was 13% higher with the high-fat, low-fiber diet than with the low-fat, high-fiber diet ($P = 0.01$). Conversely, their urinary excretion of estradiol and estrone and their 2-hydroxy metabolites were 12–28% lower with the high-fat, low-fiber diet ($P \leq 0.01$). Results of this study suggest that diet may alter endogenous sex hormone metabolism in men. *Am J Clin Nutr* 1996;64: 850–5.

KEY WORDS Diet, dietary fats, dietary fiber, estrogen, androgens

intake, and the association was primarily due to animal fat consumption (8).

Prostate cancer is a hormone-dependent cancer and a current hypothesis is that diet modifies prostate cancer risk through an effect on the sex hormones (10, 11). Male vegetarians have been reported to have lower plasma testosterone and estradiol concentrations than omnivores (12), and dietary fat and fiber have been correlated with sex hormone concentrations in several studies (12–14). Specific diet-hormone relations reported in men include positive correlations of testosterone with polyunsaturated fat (13) and dihydrotestosterone with vegetable fat consumption (14) and inverse correlations of testosterone and estradiol with fiber intake (12). However, comparisons between vegetarians and omnivores and correlations of specific dietary components with hormones from different studies have been inconsistent (12–17). Moreover, in three diet intervention studies (18–20), serum or urine testosterone levels were depressed with the low-fat, high-fiber or vegetarian diet, but findings for other hormones were inconsistent.

In 1986 the National Cancer Institute and Beltsville Human Nutrition Research Center, Agriculture Research Service, conducted a controlled feeding study in men to evaluate the effect of modifying dietary fat and fiber intakes on several indexes potentially related to cancer or atherosclerosis, including plasma lipoproteins (21), prostaglandins (22), fecal mutagens, and hormones. As part of this study, we evaluated the effect of these dietary components on plasma and urine androgens and estrogens.



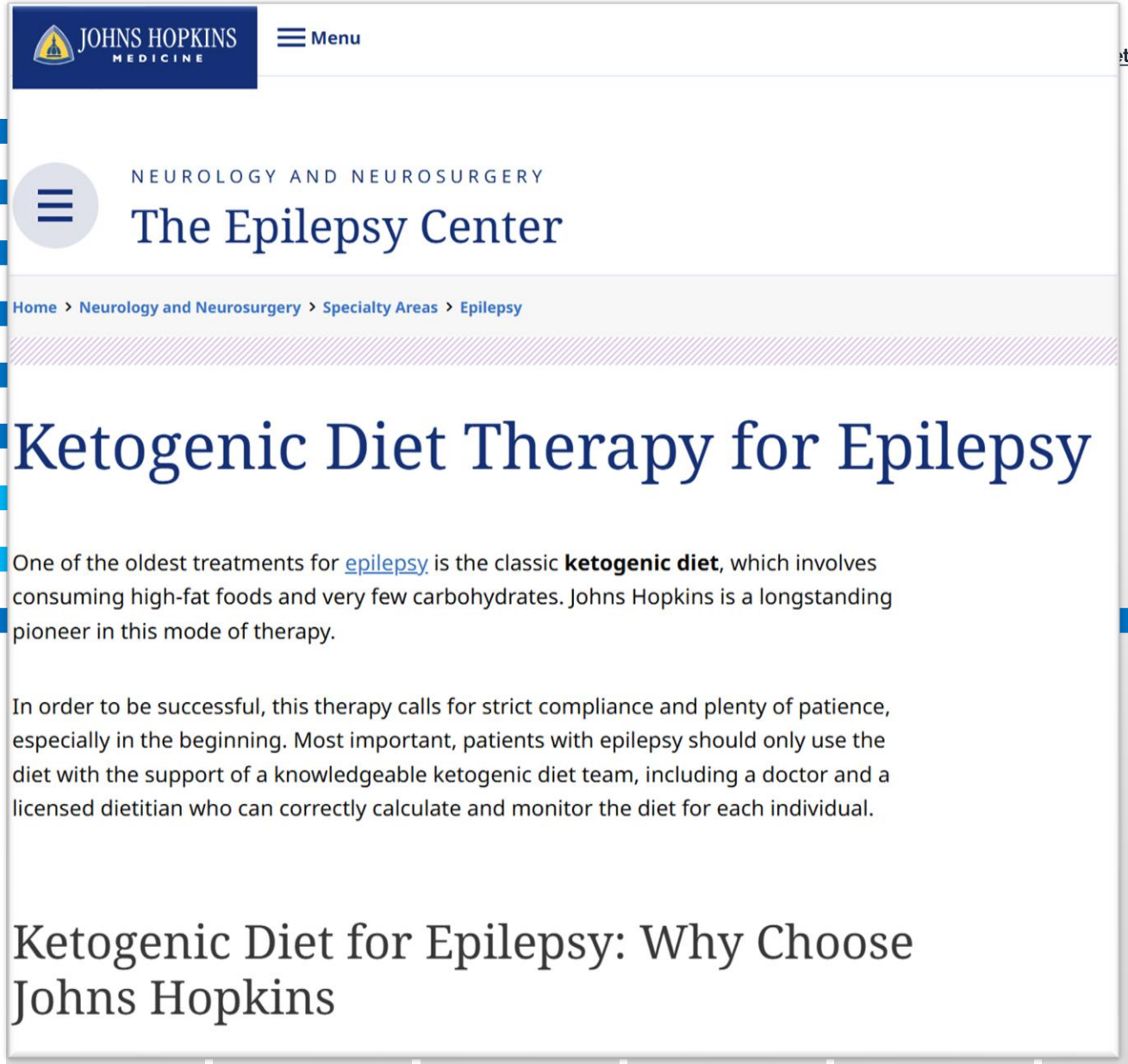
Cardiometabolic

Hormonal

Neuropsychiatric

eta-Analysis

Widespread Clinical Use



Cardiometabolic

Hormonal

Neuropsychiatric

Case Reports

JAMA P

RCT: A Ketoge

POPULATION

26 Men, 61 Wome
1 Nonbinary

Adults with treatment-r
depression with a Patie
Questionnaire-9 (PHQ-
Mean age, 42.1 y

SETTINGS / LOCA

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across t

Gao M, Kirk M, Knight H, et
Published online February

JAMA Psychiatry

Original Investigation

Ketogenic Diets and Depression and Anxiety
A Systematic Review and Meta-Analysis

Reinhard Janssen-Aguilar, MD[1,2]; Tulassi Vije, BHSc[1]; Malika Peera, BHSc[1]; et al

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RELATED ARTICLES

Key Points

Question What are the associations between ketogenic diets (KDs) and mental health outcomes in adults, particularly depressive and anxiety symptoms?

Findings In this systematic review and meta-analysis of 50 studies, KDs were associated with small to moderate improvements in depressive symptoms in randomized clinical trials and with larger improvements in quasi-experimental studies. No significant associations were found for anxiety in randomized clinical trials.

Meaning KDs show potential associations with reduced depressive symptoms, but evidence for anxiety is inconclusive; larger, high-quality trials are needed to clarify effectiveness and generalizability.

frontiers | Frontiers in Psychiatry

TYPE Brief Research Report

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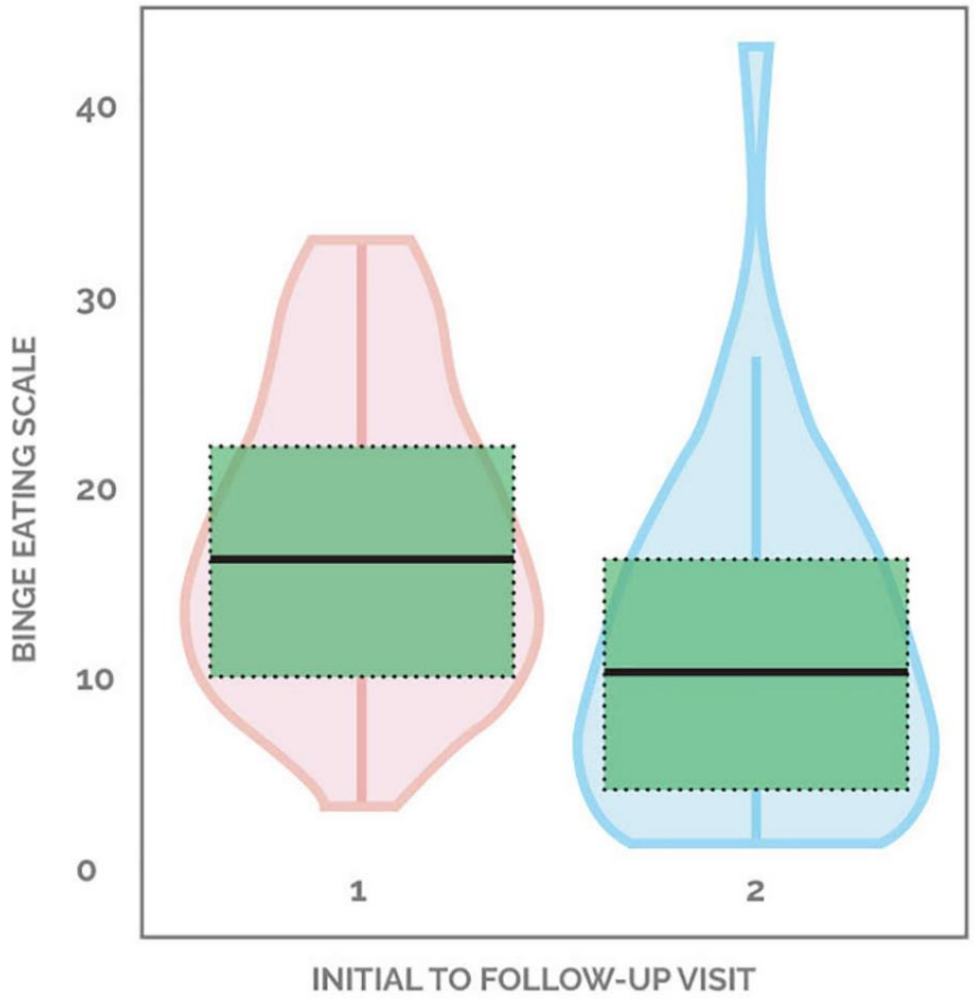


FIGURE 2
Violin plot of change in BES scores pre- and post-intervention.

Widespread Clinical Use

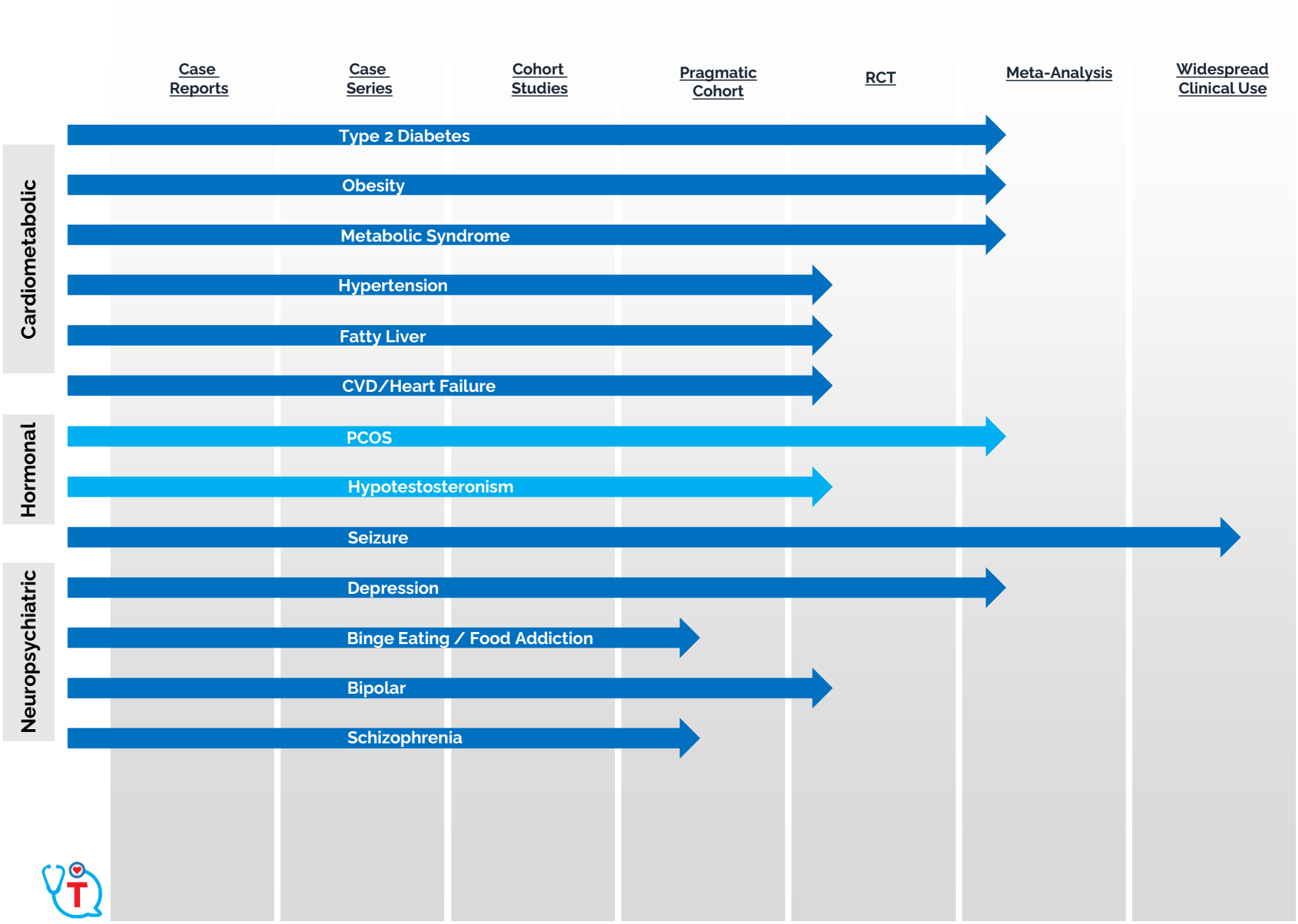
health
oves
ns

46%
F PATIENTS IMPROVED
FOOD ADDICTION
SYMPTOMS

ARD

REAL-TIME BIOFEEDBACK

DIET SUPPORTING KETO + IF



Cardiometabolic

Hormonal

Neuropsychiatric

Meta-Analysis

Widespread Clinical Use

ORIGINAL ARTICLE

A randomized phase II trial of gemcitabine, nab-paclitaxel, cisplatin with or without a medically supervised ketogenic diet for patients with metastatic pancreatic cancer

Gayle S. Jameson MSN, ACNP-BC, AOCN[1] | Denise J. Roe PhD[2] | Erkut Borazanci MD[1,3] | Diana L. Hanna MD[4] | Caroline G. P. Roberts MD[5] | Meredith S. Pelster MD[6] | Richard C. Frank MD[7] | Angela T. Alistar MD[8] | Alan M. Miller MD, PhD[9] | J. Erin Wied | Sandra D. Algaze MD[4] | Alison R. Zolle | Betsy C. Wertheim MS[2] | Keehoon Lee | Joshua D. Rabinowitz MD, PhD[13] | Step | Sunil Sharma MD[1] | Daniel D. Von Hof

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Funding information
Ludwig Institute for Cancer Research; John E Sabga Foundation; Purple Pansies; TGen's National Pancreatic Cancer Advisory Committee

ABSTRACT

Background: A and cisplatin w (non-MSKD) w ductal adenoca

Methods: Patie or non-MSKD and 8 of a 21- daily ketone (be 3.0 mM. The pr alpha level of quality of life (

Findings: Over patients achiev 39.4%. The me MSKD patients median OS was 13.7 months with MSKD and 10.2 months in the non-MSKD arm:

Virta Health's Nutrition Therapy Extends Survival by 34% in Stage IV Pancreatic Cancer Patients, New Clinical Trial Shows

Published on March 12, 2026

Virta Health's Nutrition Therapy Extends Survival by 34% in Stage IV Pancreatic Cancer Patients, New Clinical Trial Shows

Virta's nutritional intervention shown to improve survival outcomes in randomized, controlled Phase II clinical trial on patients with one of the deadliest cancers

Percent Offered Metabolic Nutrition Therapy

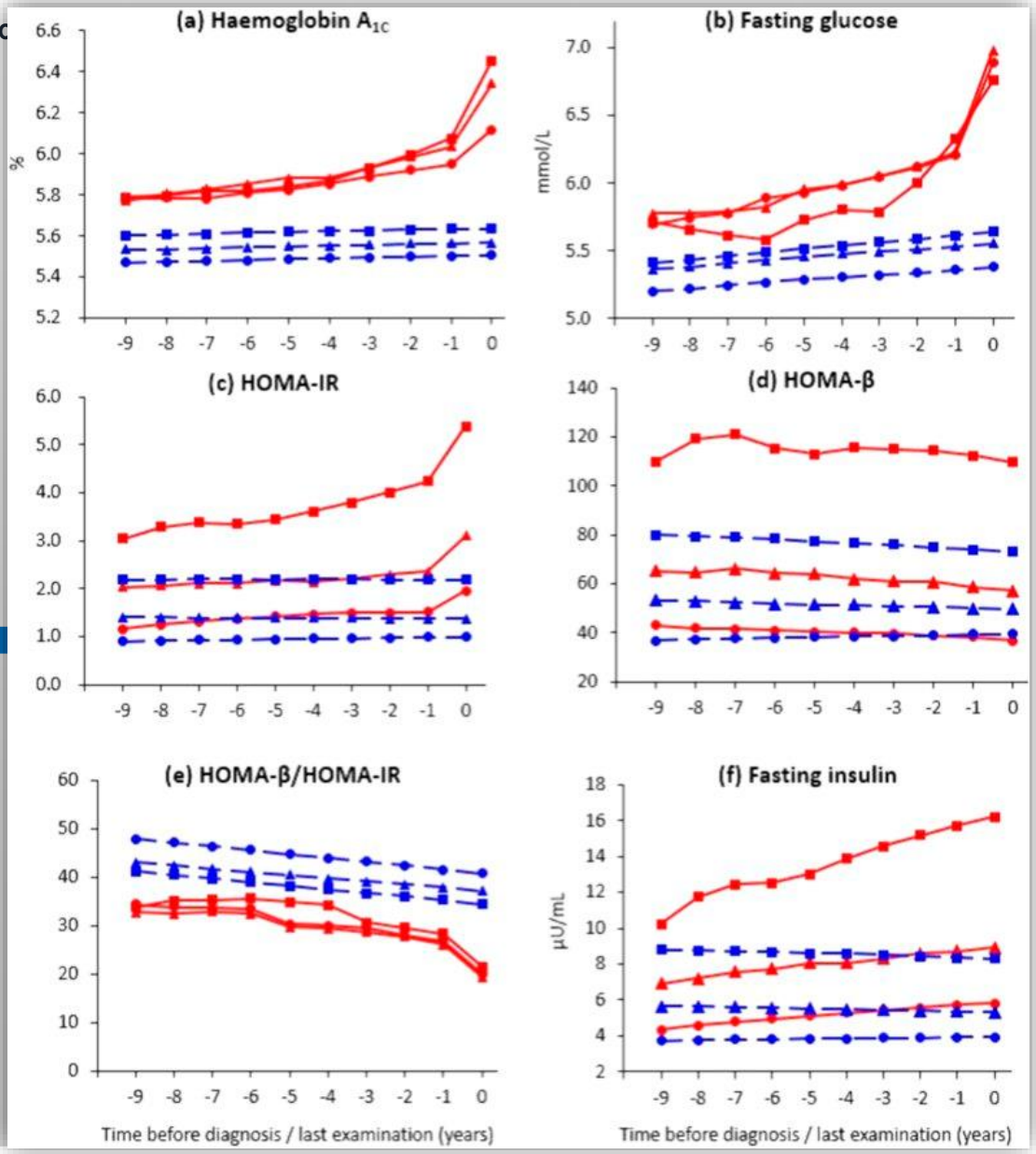
0% <20% 40

Cardiometabolic
- Type 2 Diabetes
- Obesity
- Metabolic Syndrome
- Hypertension
- Fatty Liver
- CVD/Heart Failure

Hormonal
- PCOS
- Hypotestosteronism

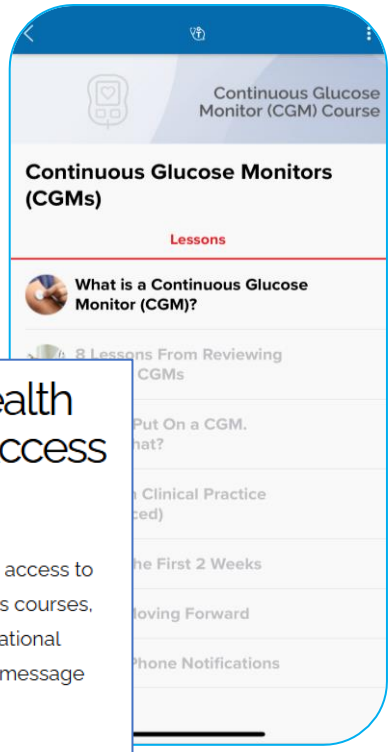
Neuropsychiatric
- Seizure disorder
- Depression
- Food Addiction
- Bipolar
- Schizophrenia

Cancer



Getting Started

Scan QR code to receive premium access to the Toward Health app with a self-guided CGM course



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