Digital Health through the Empowered Health Consumer

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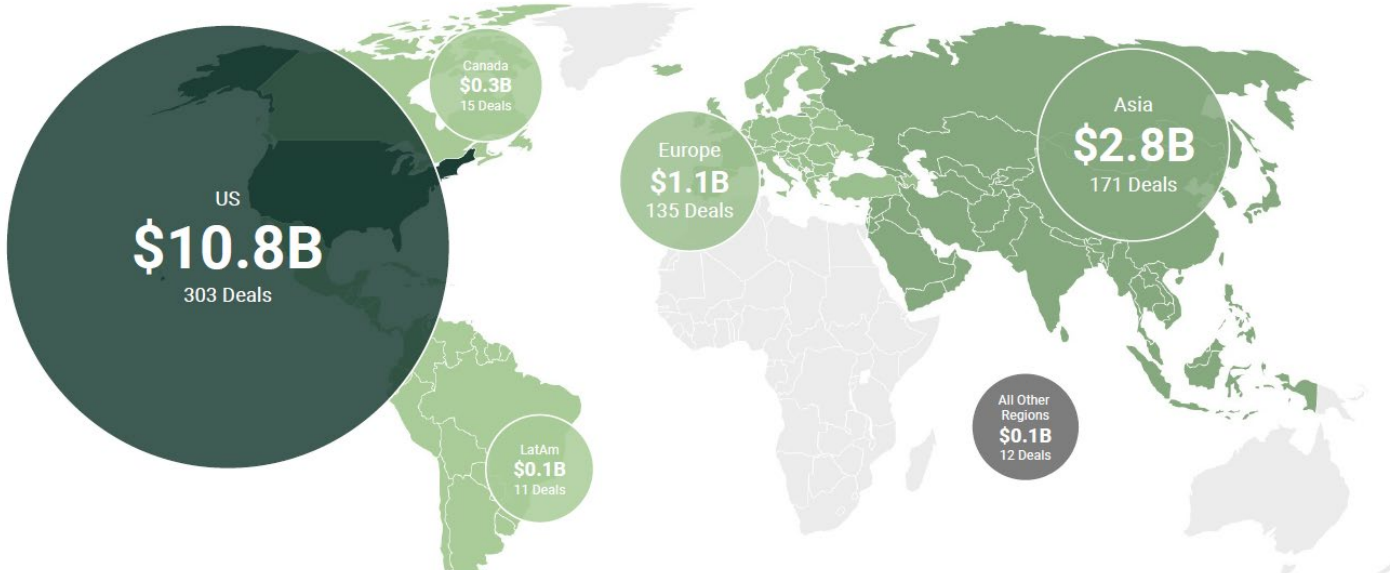
UC Irvine

Digital Health

Spaces

- Telehealth
- Digital Care
- Digital Therapeutics
- Clinical Trials Tech
- Health IT
- Mental Health
- Wellness Tech

Global regional comparison Q4'21



$57.2B

Global digital health funding. Record year.

Digital health startups pulled in a record-breaking $57.2B in funding in 2021, up 79% from 2020 totals. Funding in all geographies hit record levels in 2021, fueled by the growing need to provide digital solutions and delivery models to patients during the pandemic.

154

Mega-rounds ($100M+).

In 2021, the number of mega-rounds ($100M+) to digital health startups nearly doubled to 154. Mega-rounds accounted for the majority (57%) of total funding in Q4'21 – the second-highest quarter ever after Q1'21 (61%).

80% of the top 10 mega-rounds were to companies based in the US.

$37.9B

US funding. The highest on record.

The US digital health market continues to dominate, reaching a record $37.9B in 2021. US funding hit $10.8B in Q4'21 alone – more than the second-largest global market, Asia, recorded in all of 2021 ($10.7B).

US deal count dropped to 303 in Q4 – the lowest on record for 2021. This comes as smaller financings were overtaken by mega-rounds, which accounted for 63% of total US funding in Q4'21.

3X

Median late-stage deal valuation increases.

Late-stage digital health startups are closing much larger deals at much higher valuations.

The median late-stage deal size increased 87% from 2020 levels to $73M in 2021. At the same time, median late-stage deal valuation jumped to $1.5B, nearly 3x 2020 levels.

15 mos.

Median time between Series C and D raises shrinks.

Digital health startups are taking less time than ever to progress from mid- to late-stage financing. Moving from Series C to D, which took 22 months in 2017, has taken only 15 months (at the median) in 2021. Companies at later stages are progressing even more rapidly.

CDC's National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP)

CHRONIC DISEASES IN AMERICA

6 IN 10

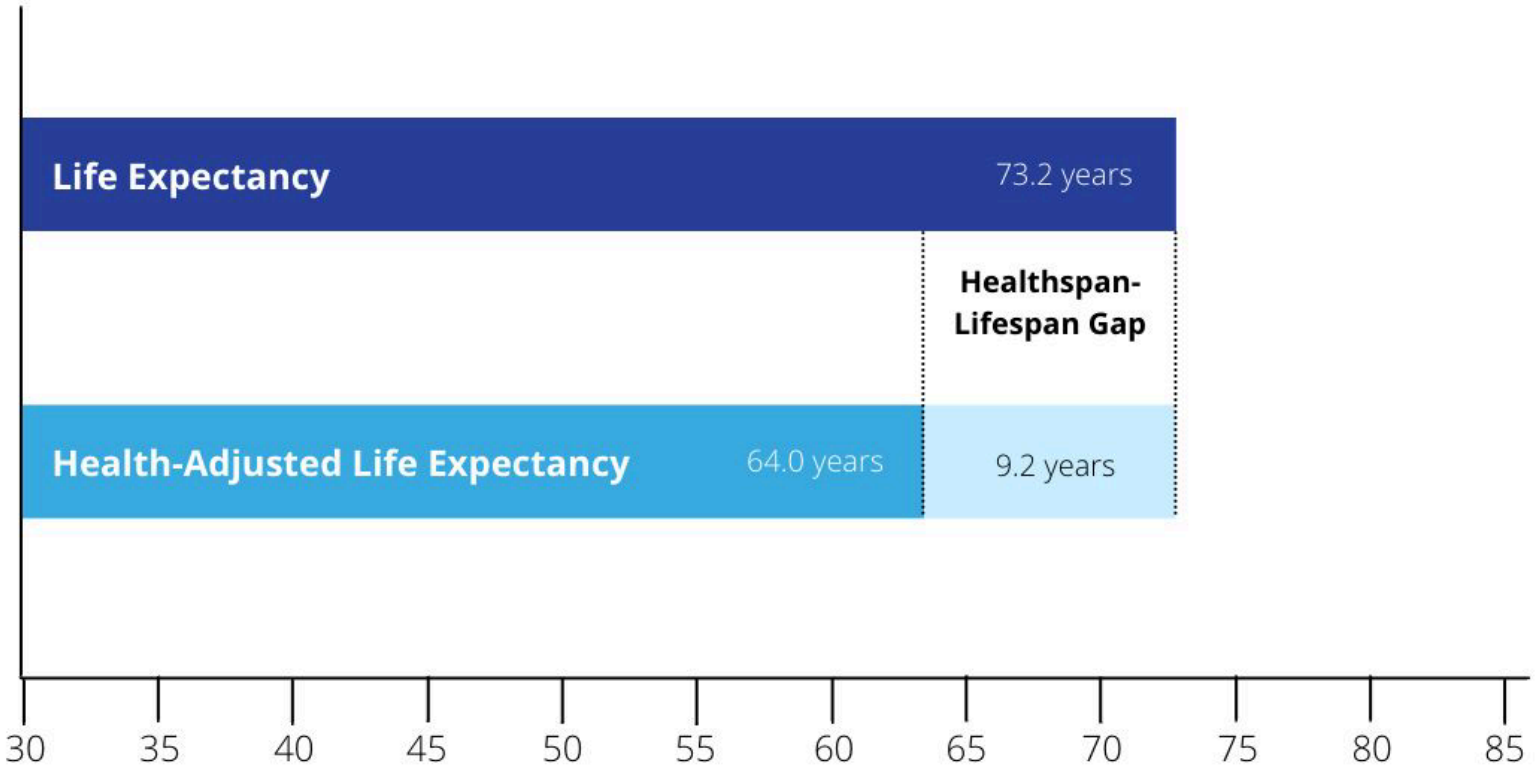
Adults in the US have a **chronic disease**

4 IN 10

Adults in the US have **two or more**

THE LEADING CAUSES OF DEATH AND DISABILITY
and Leading Drivers of the Nation's **$3.5 Trillion** in Annual Health Care Costs

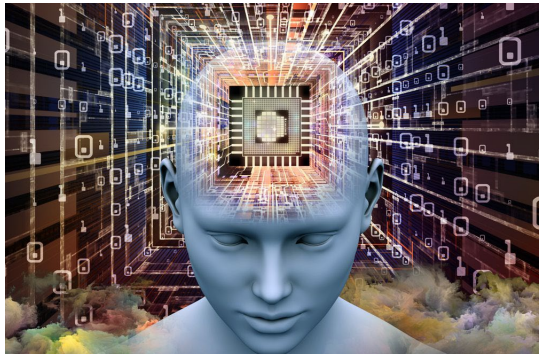
Lifespan vs. Healthspan



Garmany, A., Yamada, S. & Terzic, A. Longevity leap: mind the healthspan gap. *npj Regen Med* **6**, 57 (2021). https://doi.org/10.1038/s41536-021-00169-5

Consumer wants to be healthy

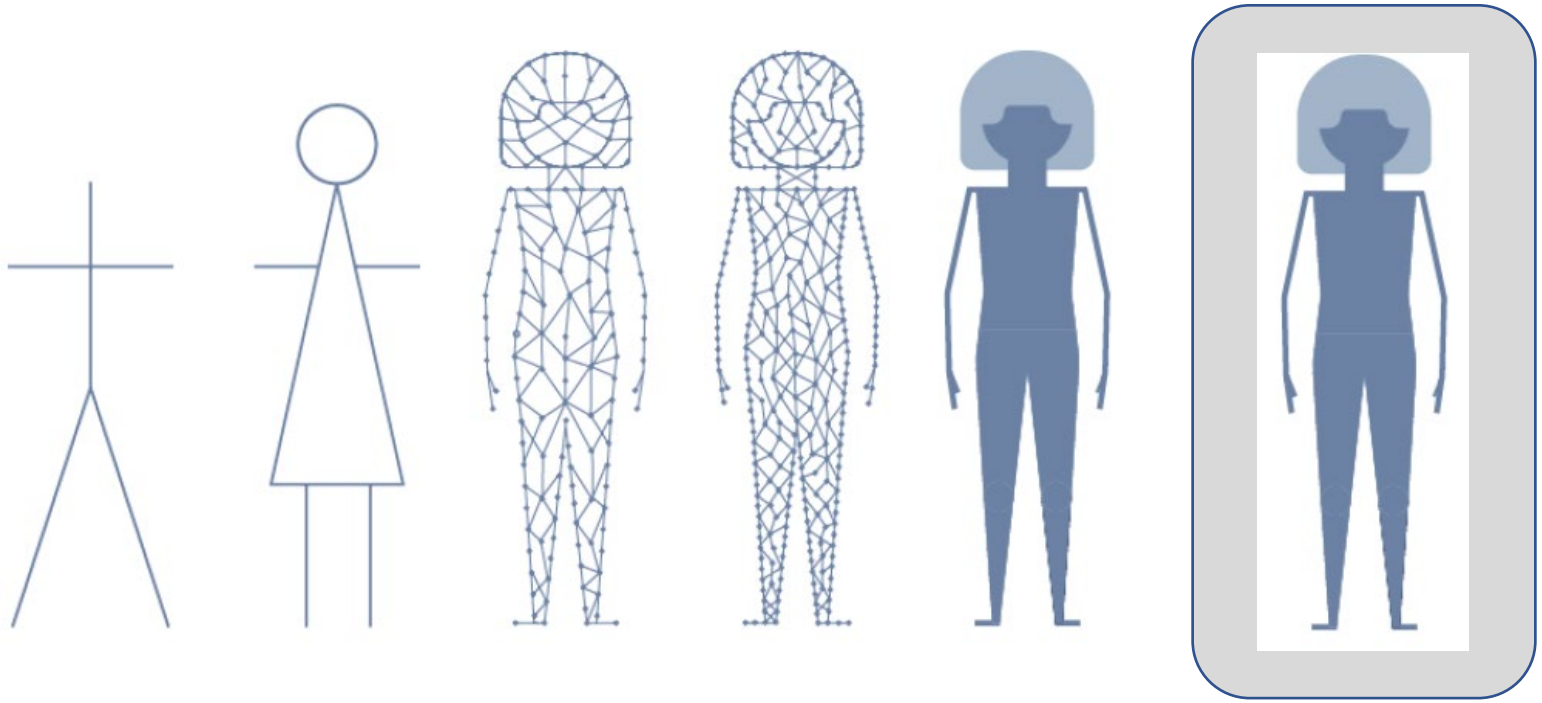
"Personalized"



We are hacking human existence

"Precision"

Hacking human existence & data explosion



Data deepens the phenotypic, genotypic, multi-omic, molecular, behavioral & environmental understanding

Medication Strategies for T2D Patients

Monotherapies:
- Metformin (Met)
- Insulin
- Sulfonylurea / Glinide (Su/Gln)
- DPP-4 Inhibitor (DPP-4)

Dual therapies:
- Met & Su/Gln
- Met & DPP-4
- Met & Insulin
- Su/Gln & Insulin
- Su/Gln & DPP-4
- DPP-4 & Insulin

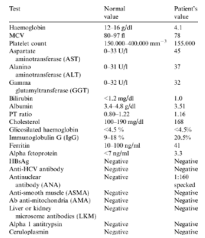
Triple therapies:
- Met, Su/Gln, & DPP-4
- Met, Su/Gln, & Insulin

- Other Less Frequent Combinations

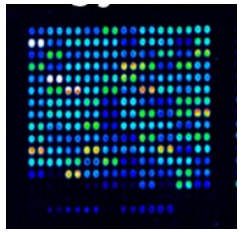
1,640 Unique Medication Trajectories for Treating T2D

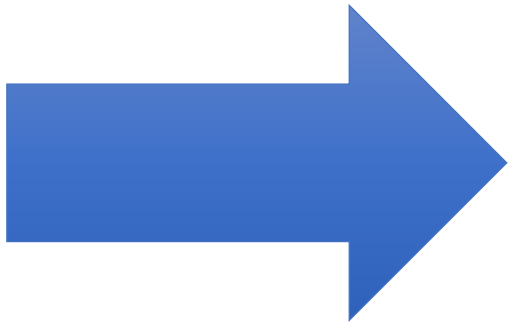
UCSF Butte Lab, Dr. Atul Butte & Tom Peterson (2018)

Type-2 Diabetes is not one disease

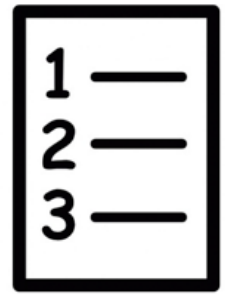


Test	Normal value	Patient's value
Haemoglobin	12–16 g/dl	4.1
MCV	80–97 fl	78
Platelet count	150,000–400,000 mm^{-3}	155,600
Aspartate aminotransferase (AST)	0–33 U/l	45
Alanine aminotransferase (ALT)	0–31 U/l	37
Gamma glutamyltransferase (GGT)	0–32 U/l	32
Bilirubin	<1.2 mg/dl	1.0
Albumin	3.4–4.8 g/dl	3.51
PT ratio	0.10–1.22	1.16
Cholesterol	100–190 mg/dl	168
Glycosilated haemoglobin	<4.5 %	<4.5%
Immunoglobulin G (IgG)	9–18 %	20.5%
Ferritin	10–100 ng/ml	41
Alpha fetoprotein	<7 ng/ml	3.3
HBsAg	Negative	Negative
Anti-HCV antibody	Negative	Negative
Antinuclear antibody (ANA)	Negative	1:160 speckled
Anti-smooth muscle (ASMA)	Negative	Negative
Ab anti-mitochondria (AMA)	Negative	Negative
Liver or kidney microsome antibodies (LKM)	Negative	Negative
Alpha 1 antitrypsin	Negative	Negative
Ceruloplasmin	Negative	Negative

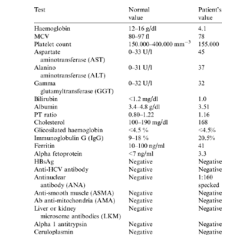


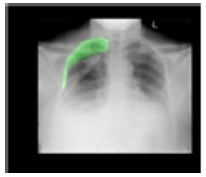


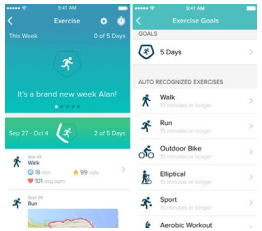
Ranked List of Medications & Doses Likely To Be Effective For This Patient

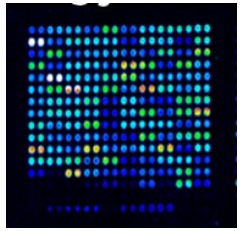


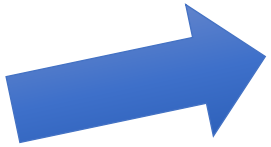
Type-2 Diabetes is not one disease











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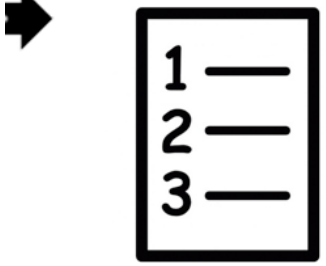
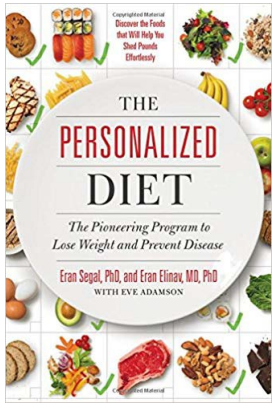




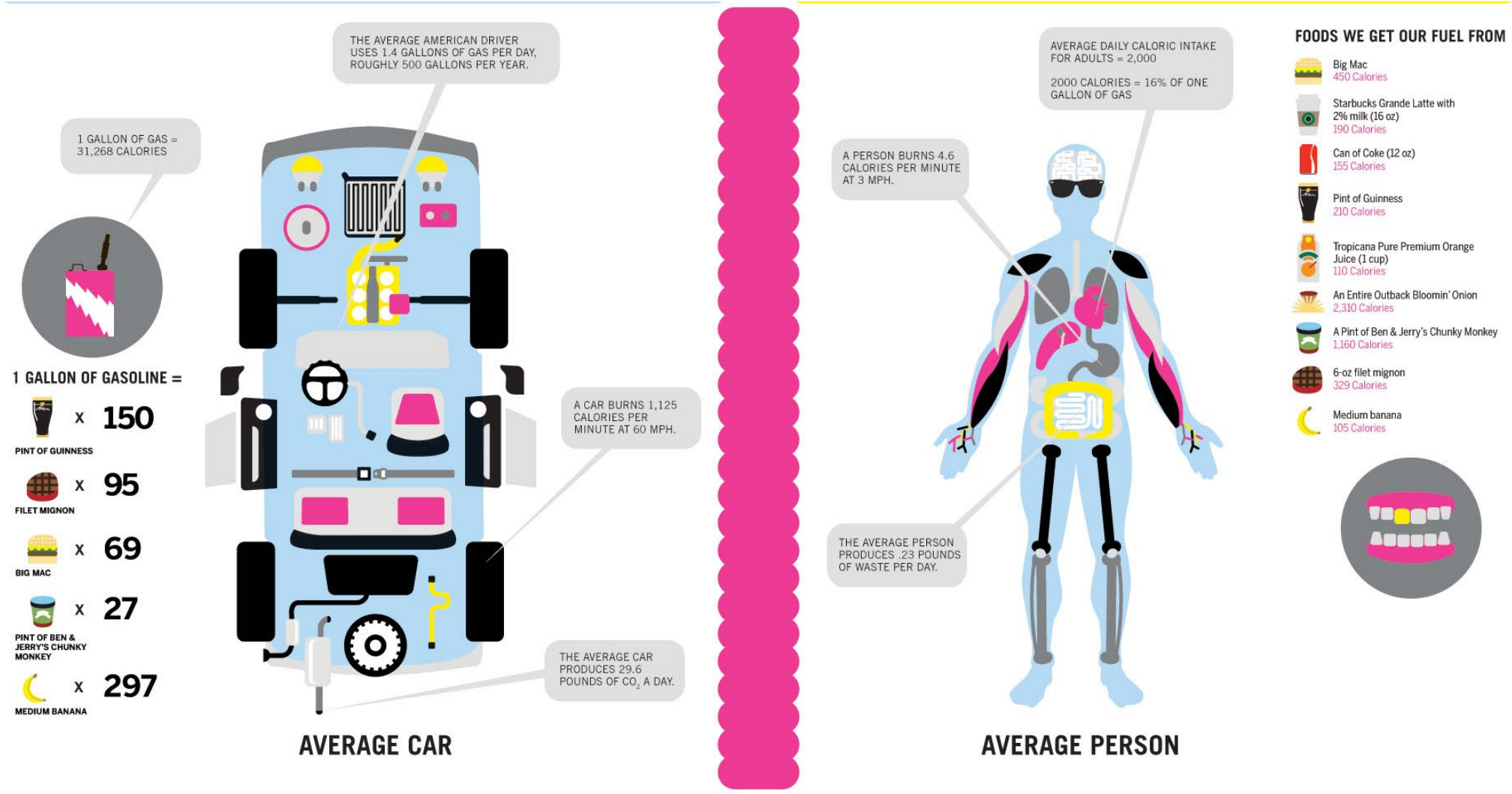
Can't we do better?

"Precision"

"Personalized"

"Can I be empowered"

Can't we do better?



SOURCES fightglobalwarming.org; NASA; The New York Times

Progression to Precision

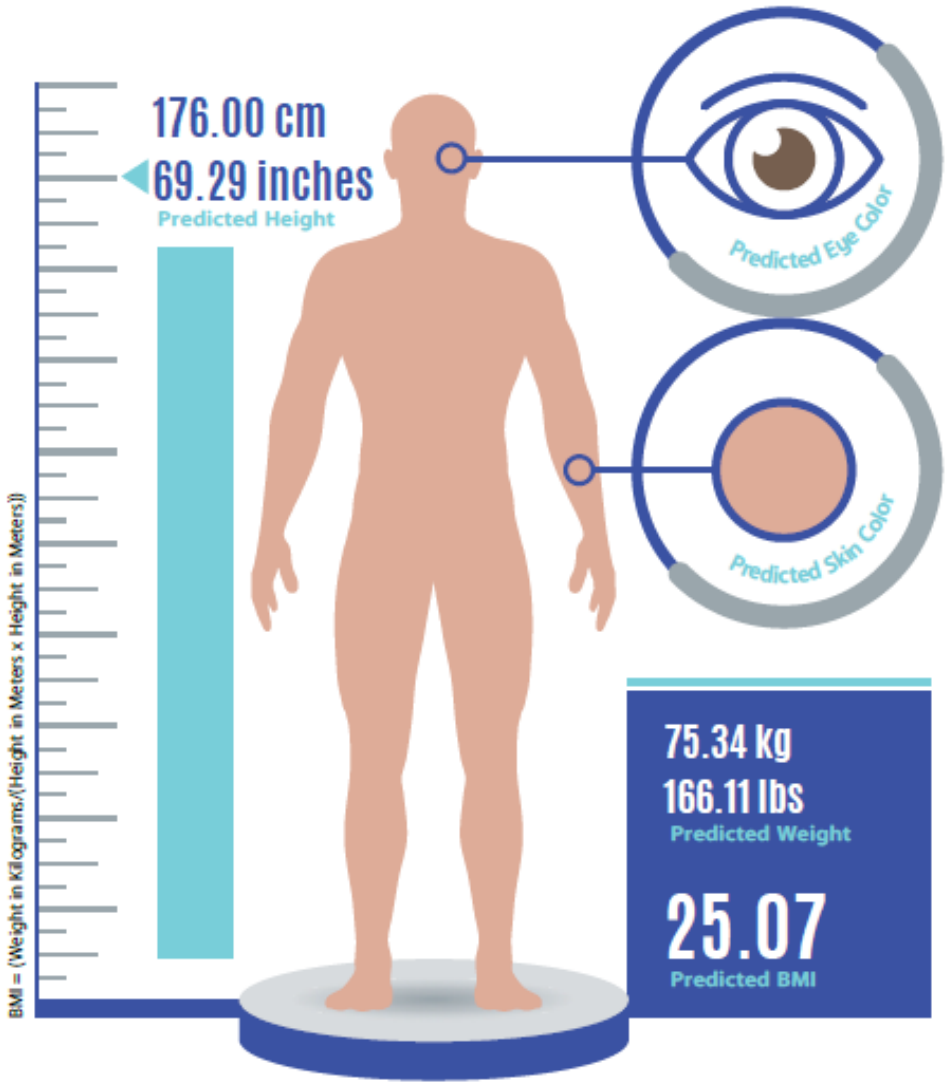
36.5% American adults are obesity

32.5 American adults are overweight

BMI Chart

WEIGHT lbs	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215
kgs	45.5	47.7	50.0	52.3	54.5	56.8	59.1	61.4	63.6	65.9	68.2	70.5	72.7	75.0	77.3	79.5	81.8	84.1	86.4	88.6	90.9	93.2	95.5	97.7
HEIGHT in/cm	Underweight						Healthy					Overweight				Obese				Extremely obese				
5'0" - 152.4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
5'1" - 154.9	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	36	37	38	39	40
5'2" - 157.4	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39
5'3" - 160.0	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	32	33	34	35	36	37	38
5'4" - 162.5	17	18	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	31	32	33	34	35	36	37
5'5" - 165.1	16	17	18	19	20	20	21	22	23	24	25	25	26	27	28	29	30	30	31	32	33	34	35	35
5'6" - 167.6	16	17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34
5'7" - 170.1	15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32	33	33
5'8" - 172.7	15	16	16	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	28	29	30	31	32	32
5'9" - 175.2	14	15	16	17	17	18	19	20	20	21	22	22	23	24	25	25	26	27	28	28	29	30	31	31
5'10" - 177.8	14	15	15	16	17	18	18	19	20	20	21	22	23	23	24	25	25	26	27	28	28	29	30	30
5'11" - 180.3	14	14	15	16	16	17	18	18	19	20	21	21	22	23	23	24	25	25	26	27	28	28	29	30
6'0" - 182.8	13	14	14	15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29
6'1" - 185.4	13	13	14	15	15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28
6'2" - 187.9	12	13	14	14	15	16	16	17	18	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27
6'3" - 190.5	12	13	13	14	15	15	16	16	17	18	18	19	20	20	21	21	22	23	23	24	25	25	26	26
6'4" - 193.0	12	12	13	14	14	15	15	16	17	17	18	18	19	20	20	21	22	22	23	23	24	25	25	26

Progression to Precision



Actual	Height: 176.28 cm 69.40 inches	Weight: 80.47 kg 177.40 lbs	BMI: 25.89

BMI Chart

WEIGHT lbs	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215
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5'4" - 162.5	17	18	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	31	32	33	34	35	36	37
5'5" - 165.1	16	17	18	19	20	20	21	22	23	24	25	25	26	27	28	29	30	30	31	32	33	34	35	35
5'6" - 167.6	16	17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34
5'7" - 170.1	15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32	33	33
5'8" - 172.7	15	16	16	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	28	29	30	31	32	32
5'9" - 175.2	14	15	16	17	17	18	19	20	20	21	22	22	23	24	25	25	26	27	28	28	29	30	31	31
5'10" - 177.8	14	15	15	16	17	18	18	19	20	20	21	22	23	23	24	25	25	26	27	28	28	29	30	30
5'11" - 180.3	14	14	15	16	16	17	18	18	19	20	21	21	22	23	23	24	25	25	26	27	28	28	29	30
6'0" - 182.8	13	14	14	15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29
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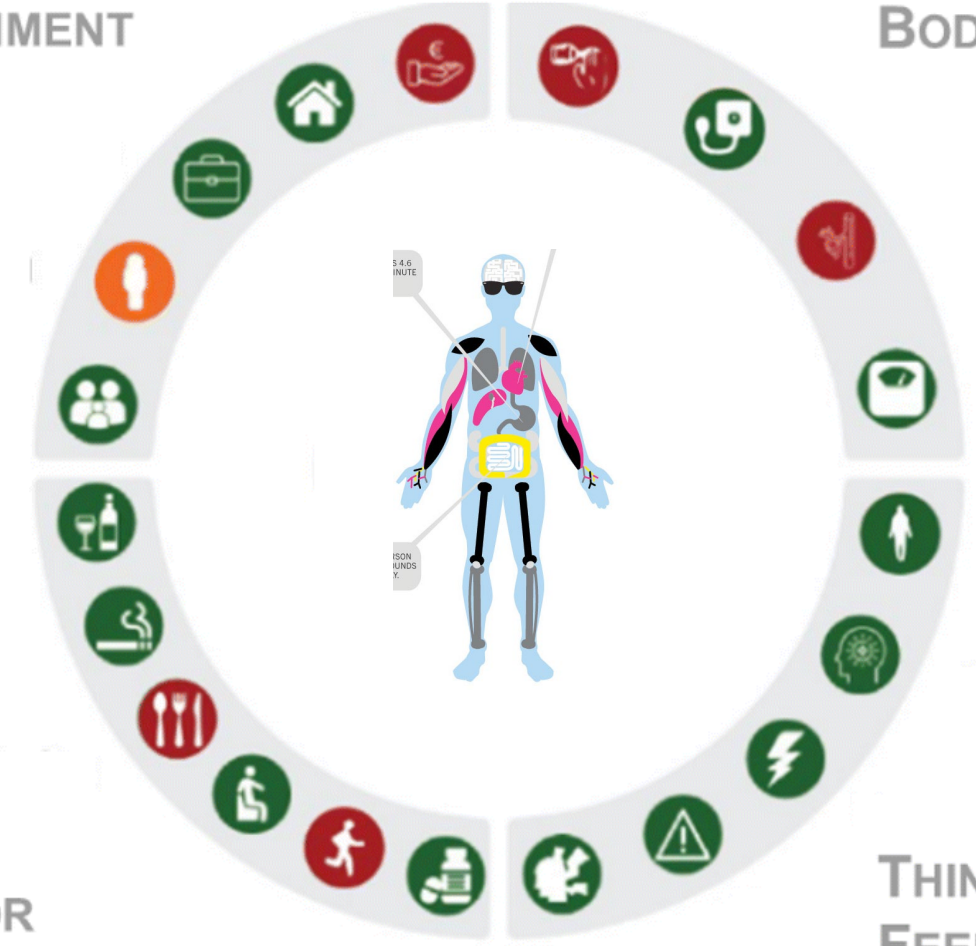
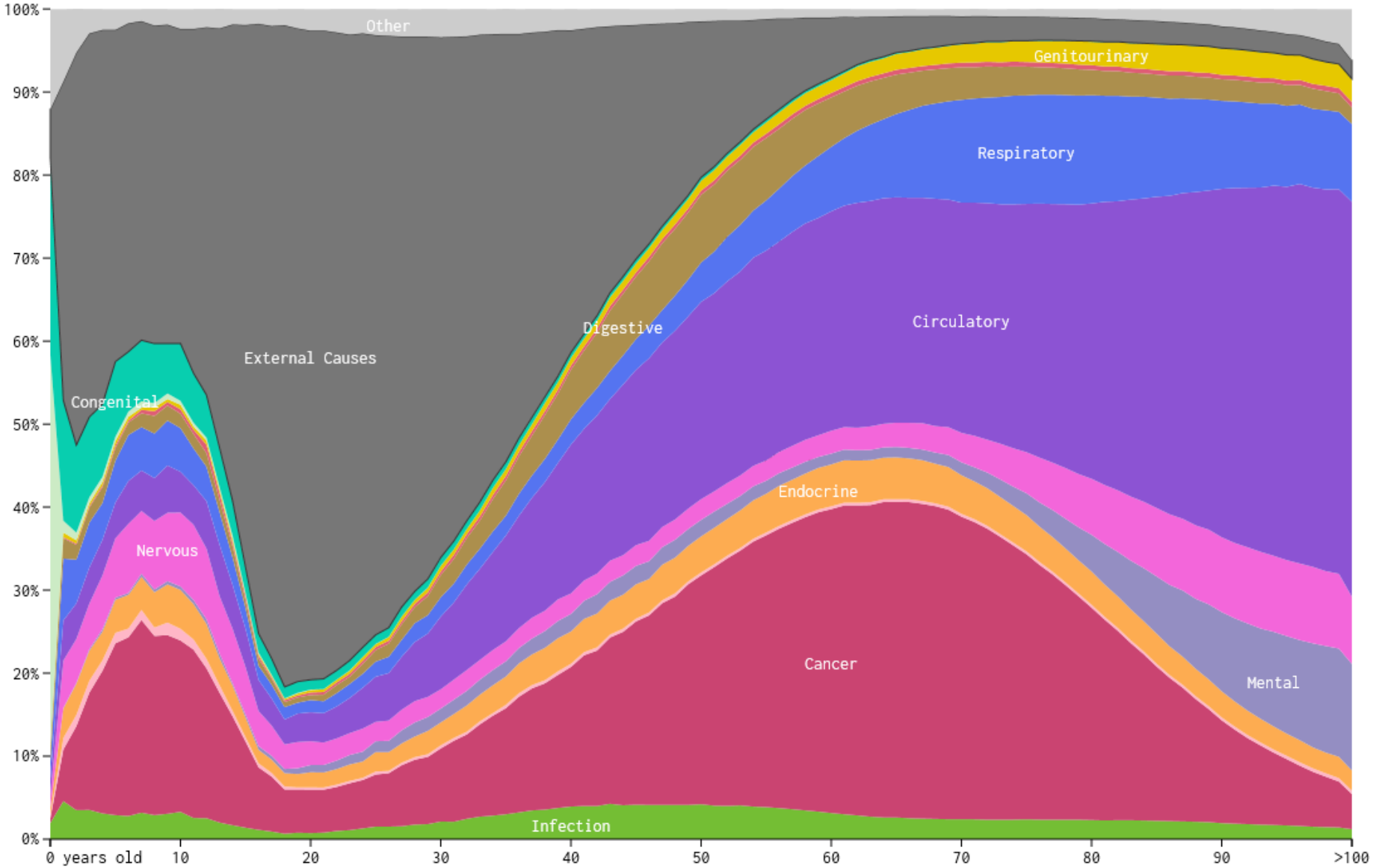
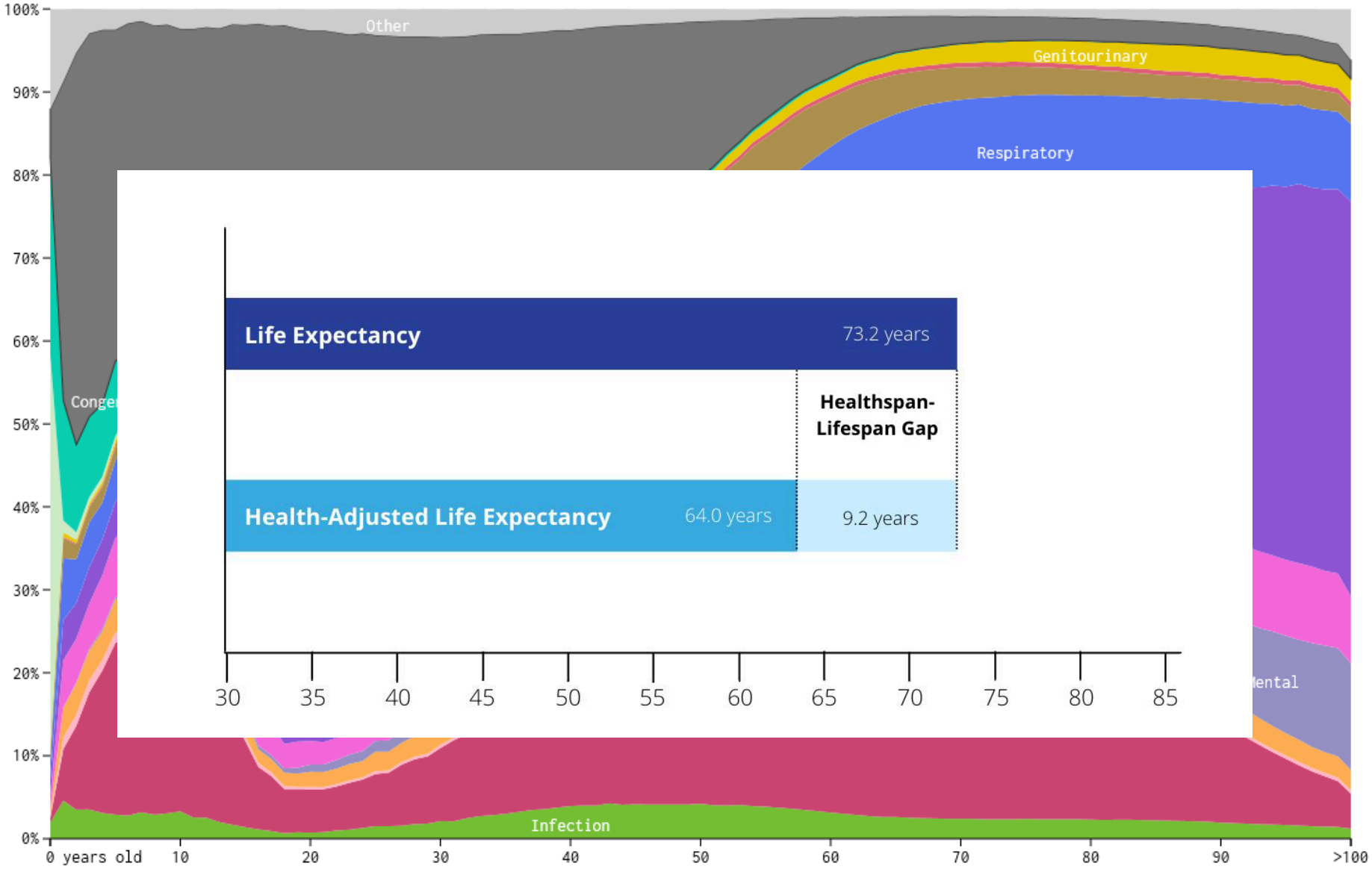
Digital Health through the Empowered Health Consumer



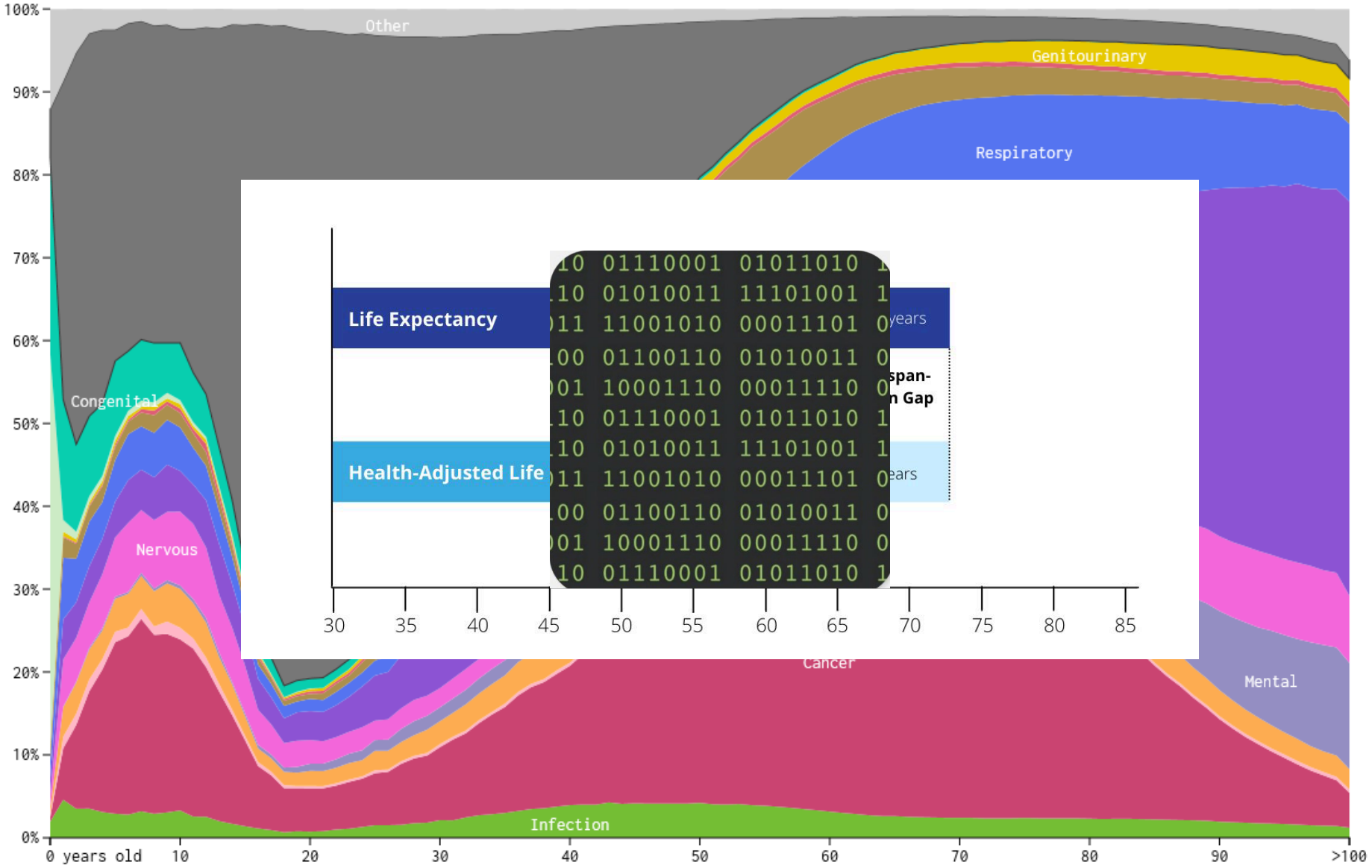
Q: What will I die from?

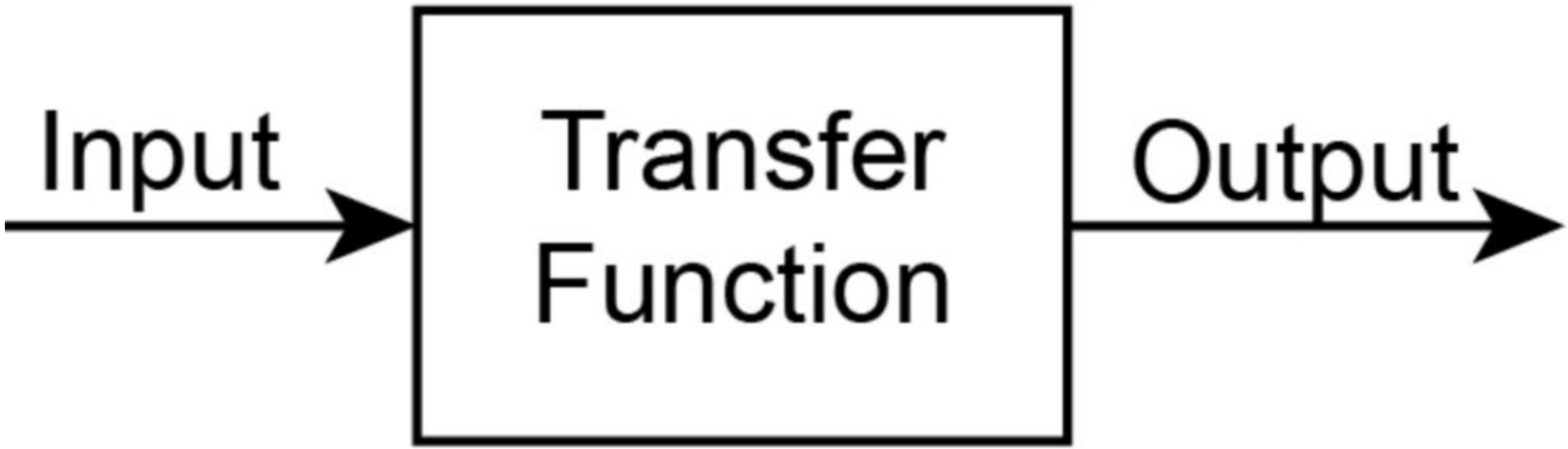


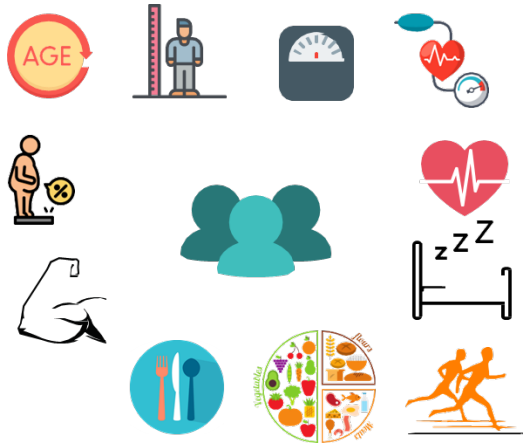
Q: How will I lose your healthspan?



Q: How can data be a game changer?




Input
Transfer
Function
Output

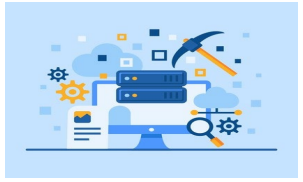


Goals
Targets
Advisors

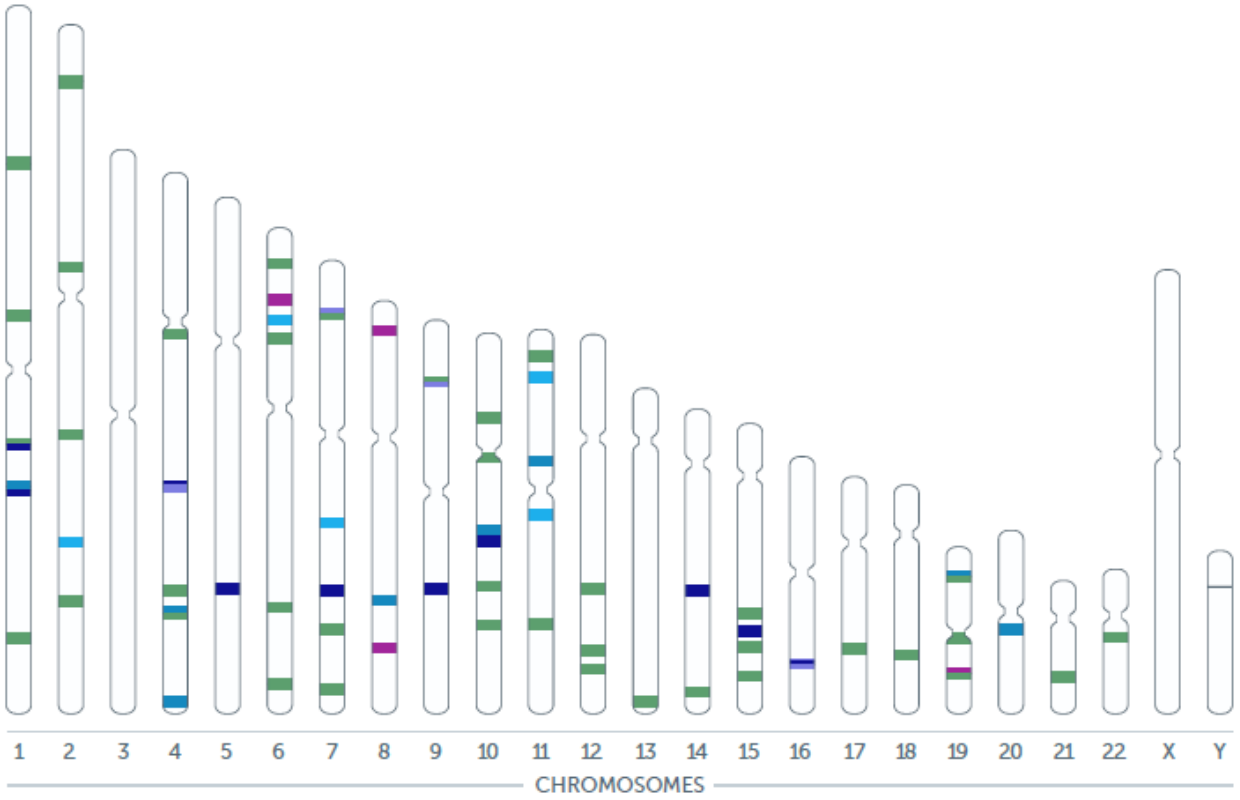
Input

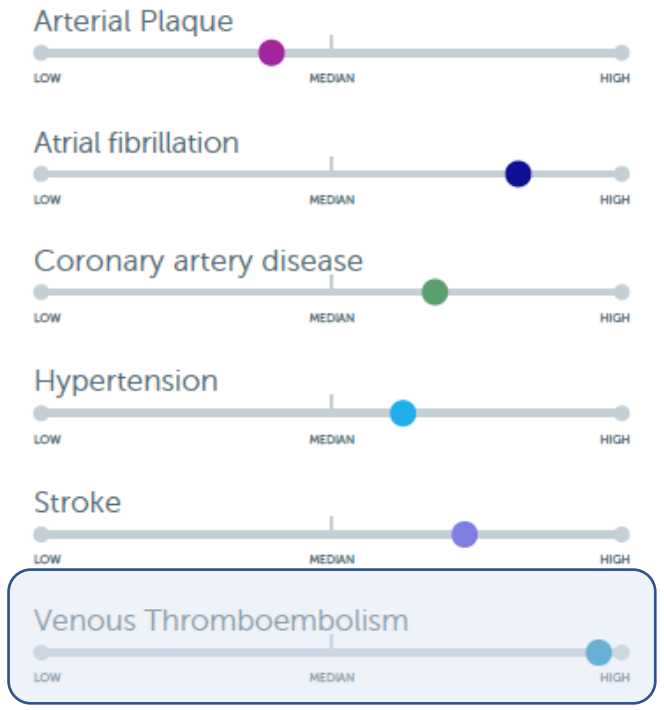
Transfer Function

Output



Phenotype & Genotype

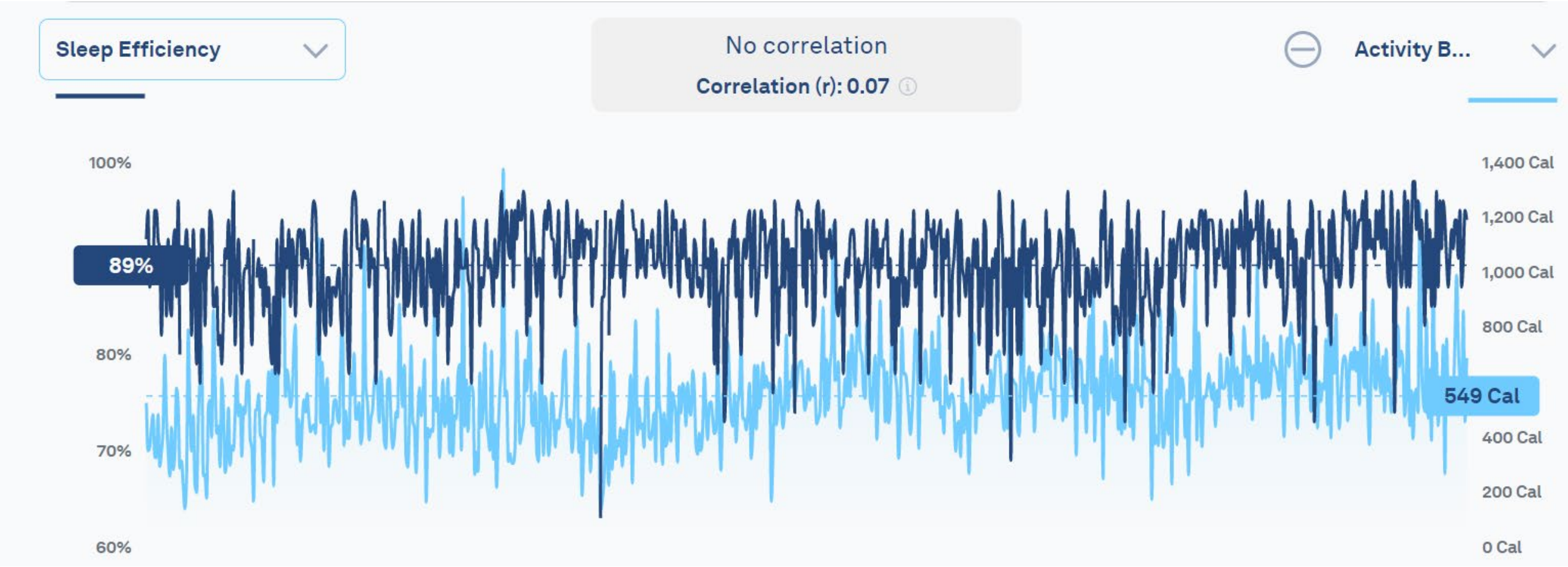




Family History

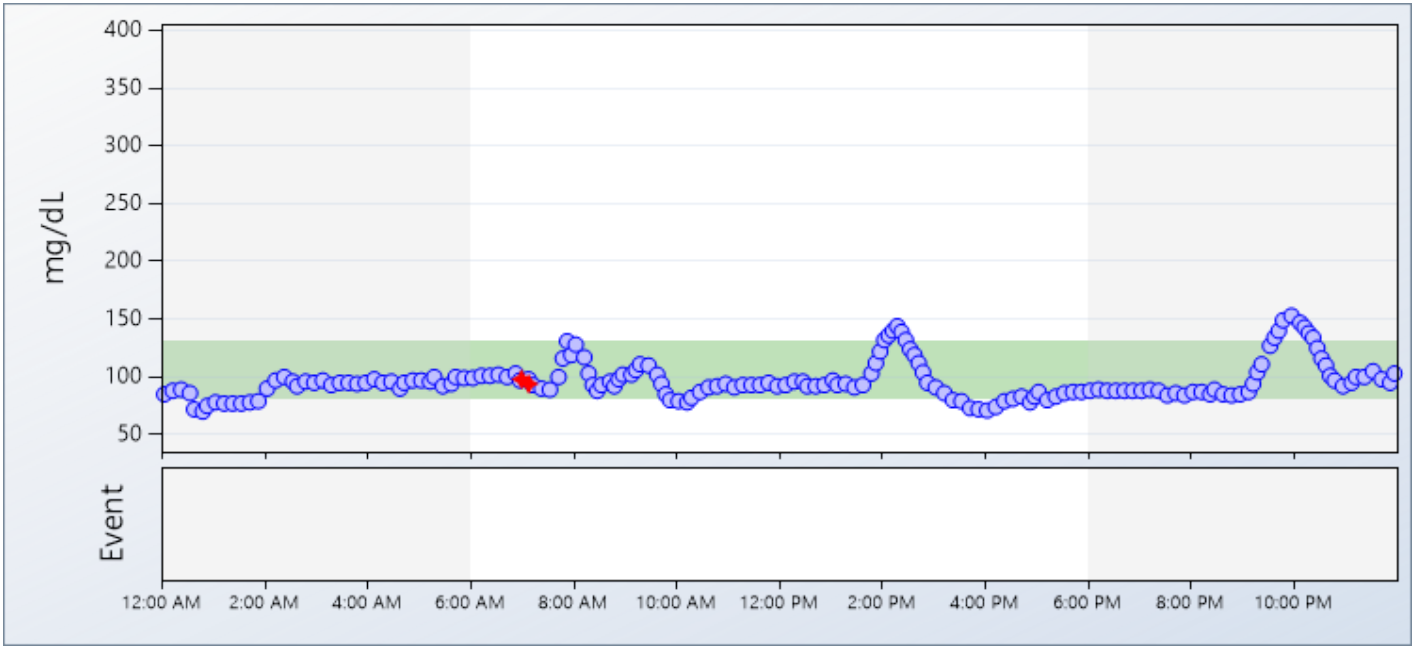
Vericose Veins

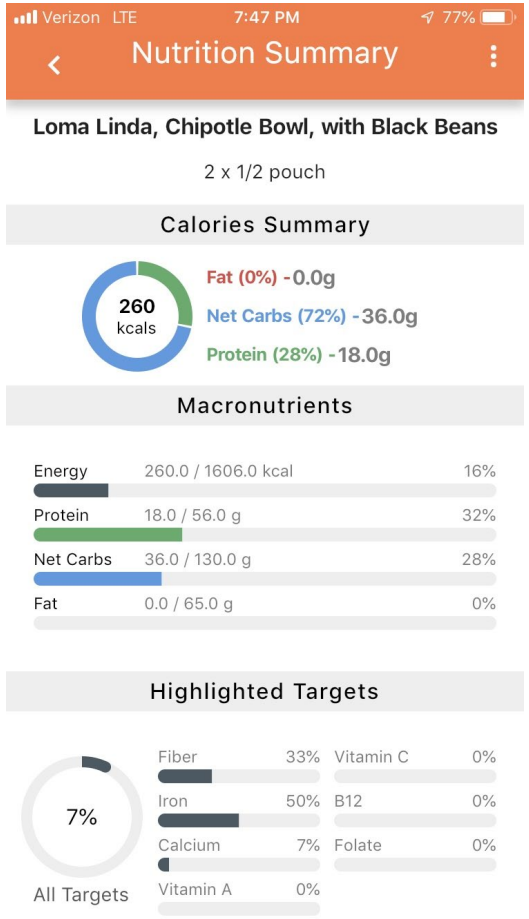
Sleep & Exercise

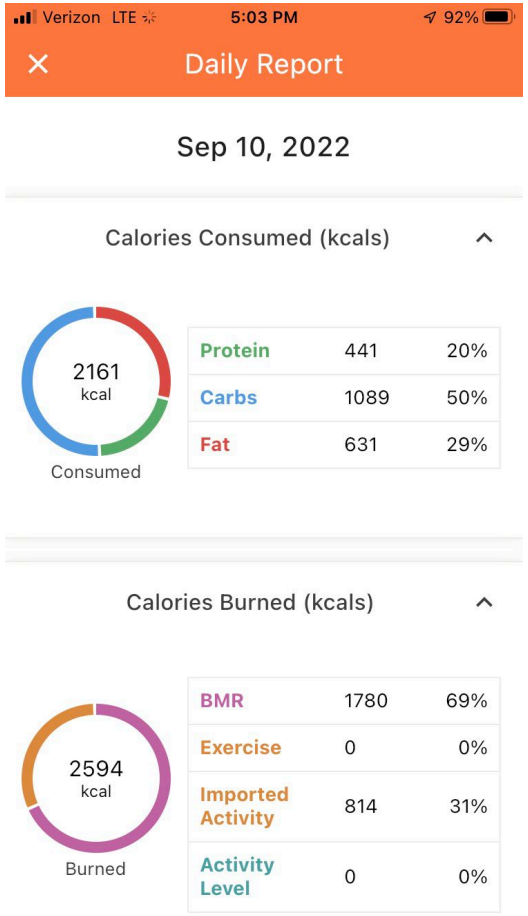


Food-Nutrition & Metabolic Health

Continuous Glucose Monitoring

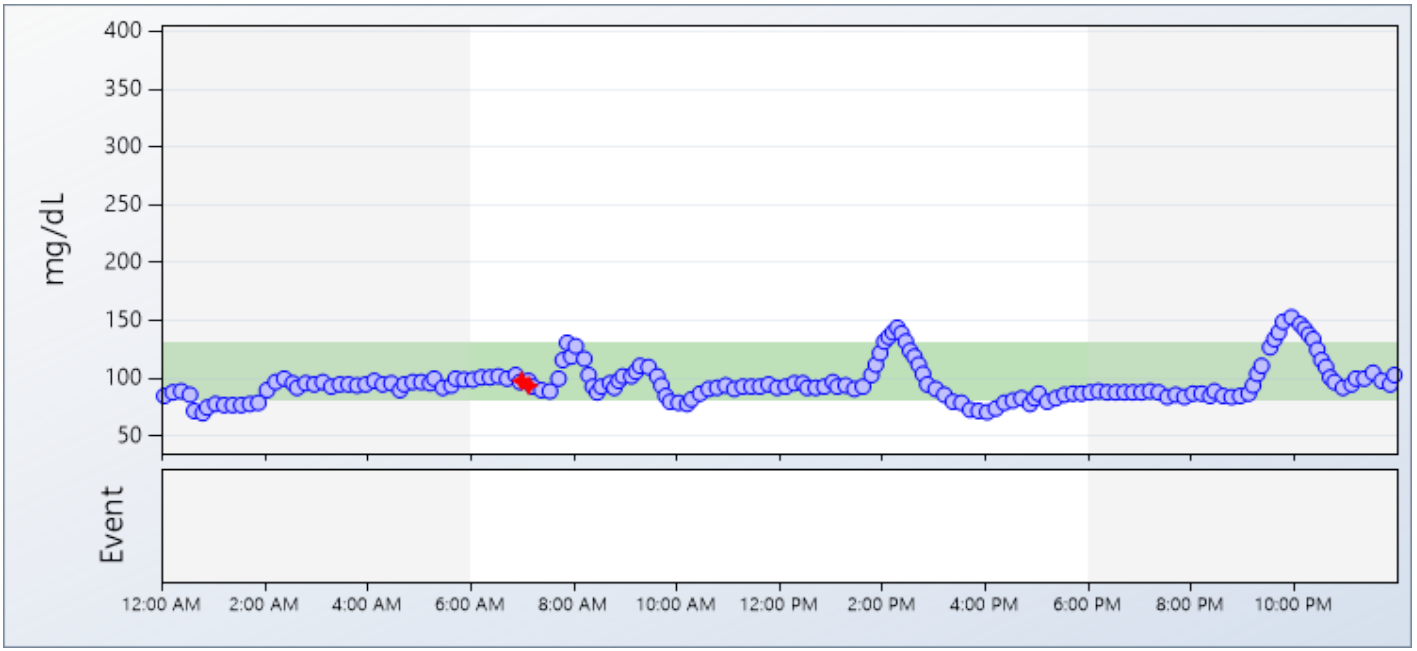


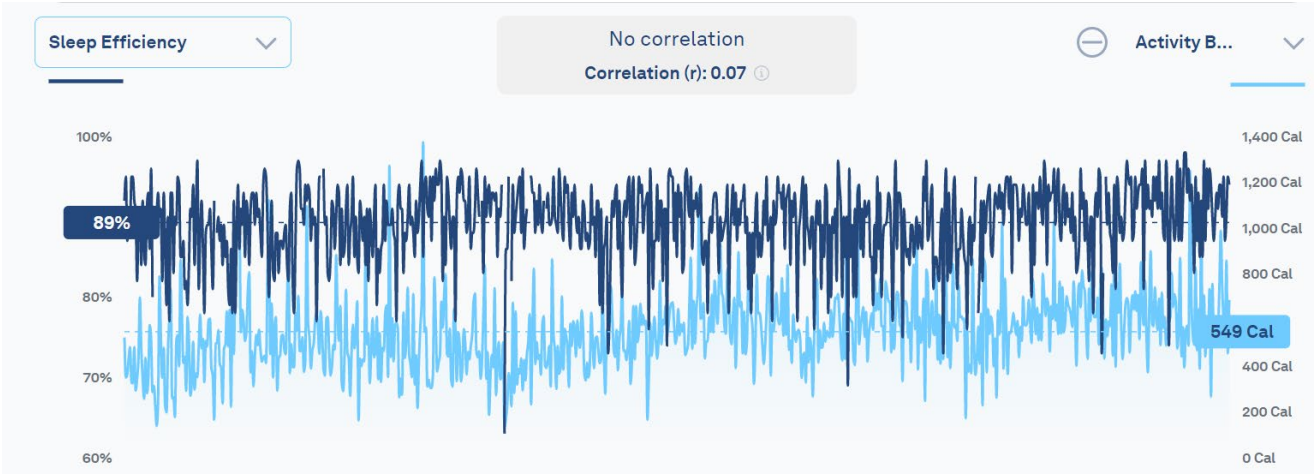


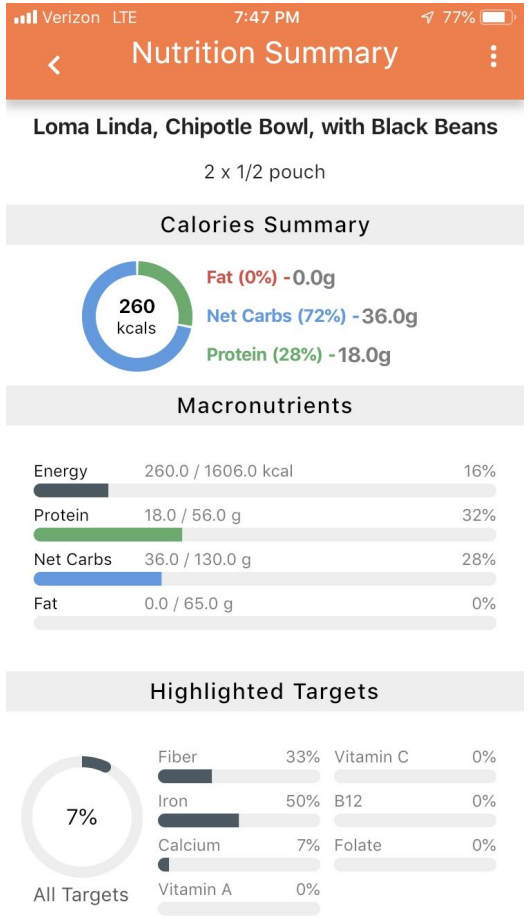


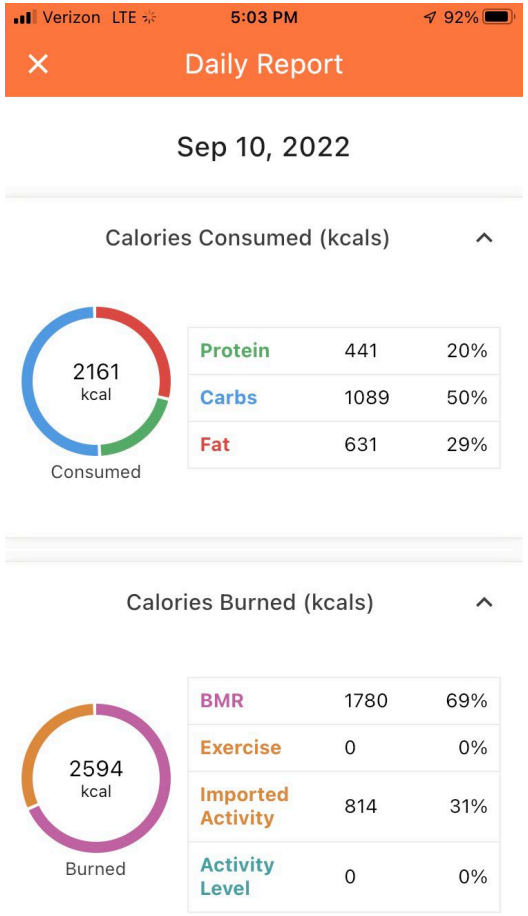
Food-Nutrition & Metabolic Health

Continuous Glucose Monitoring



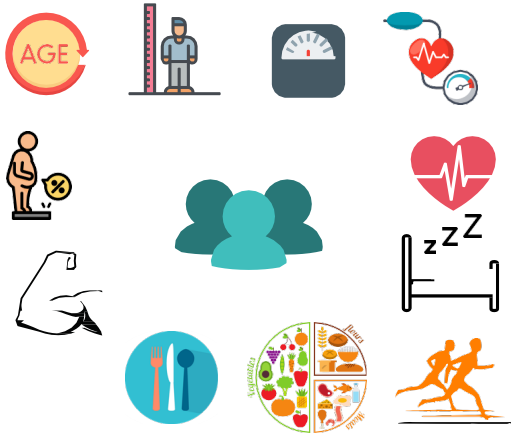






The Empowered Health Consumer

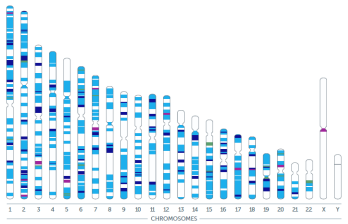
Data

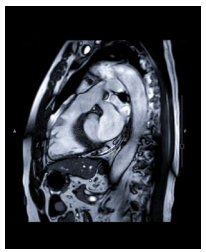


~100 daily data points (today)

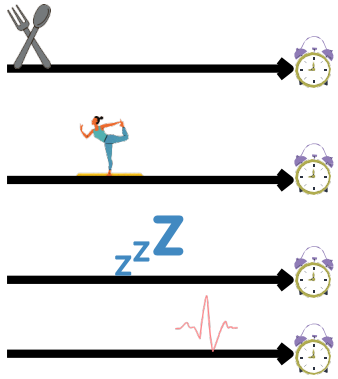
Baseline Data

Episodic Data





Event Streams



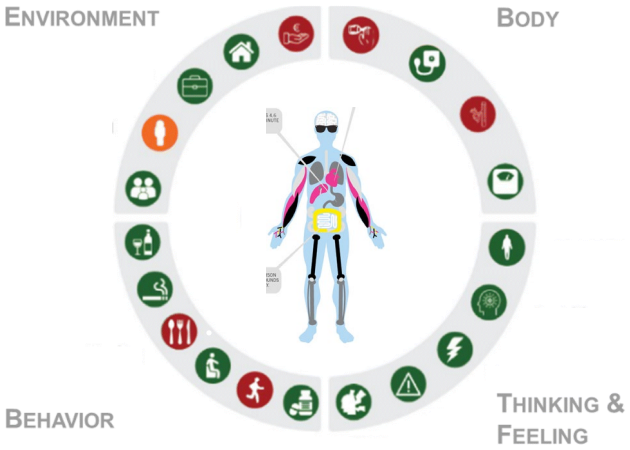
Visualization

Event Mining
Machine Learning

Analysis

Context

Personalized Models & Recommendations

Empowered Health Consumer

Empowered Health Consumer