

Design is Medicine

Life first. Health a distant second.

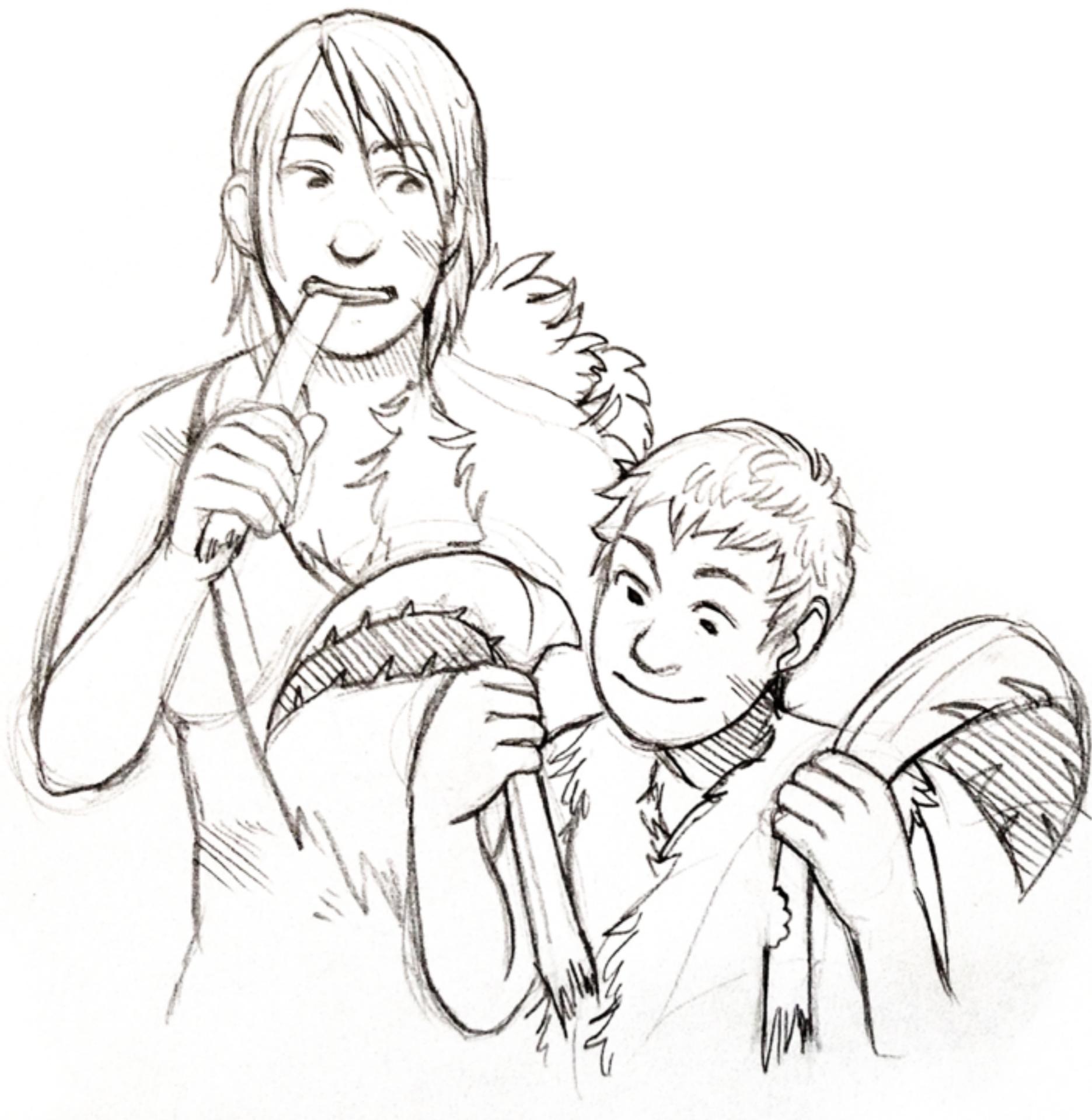
Juhan Sonin
juhan@goinvo.com
Sep 2013

From Bloodletting to Bloodless

Let's set the stage a bit.



Humans have treated their condition the same for millennia.
We roam around.



Eat mostly green stuff.



Drink water.



Have sex and procreate.



If we feel ok,
we think we're ok

And as long as we're feeling ok, we think we're ok.
Generally, that's true.



Then health happens.

Then health happens, usually when we least want or expect it.



1000 years ago

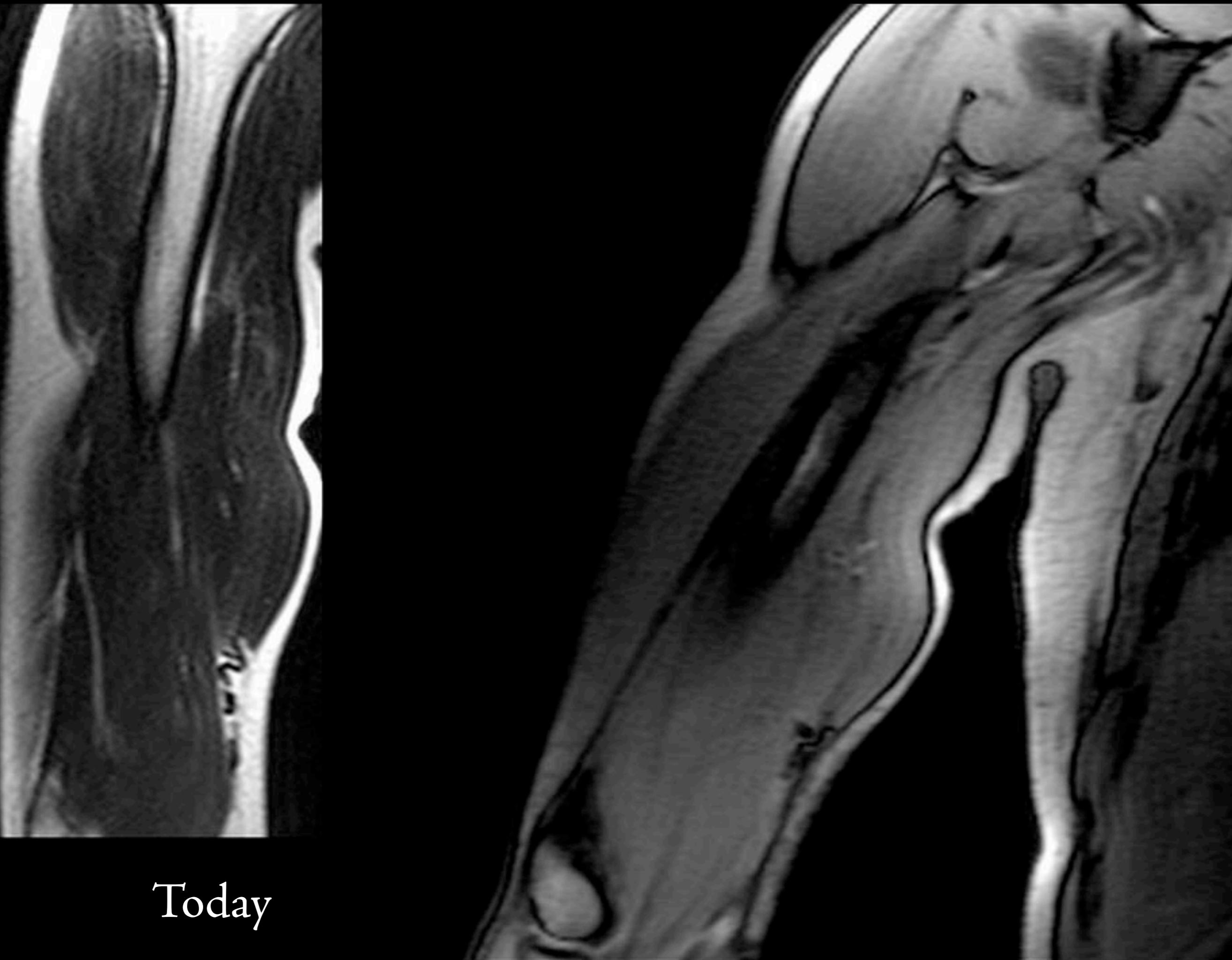
In the past...

You visit a tribal elder who has set broken bones before,



100 years ago

or seek out the town doc to diagnose and treat fever or malaria



Today

or get a MRI to reveal a bicep tendon rupture after catching your son flying off the living room couch.



Birth Broken Arm Back Pain Fever Death

Periodic Issues, Extreme Intervention

Episodic issues. Periodic exams.
Rare spikes in your health that require extreme intervention.
Management by exception.



1,000 years ago

Amazing Progress

Today

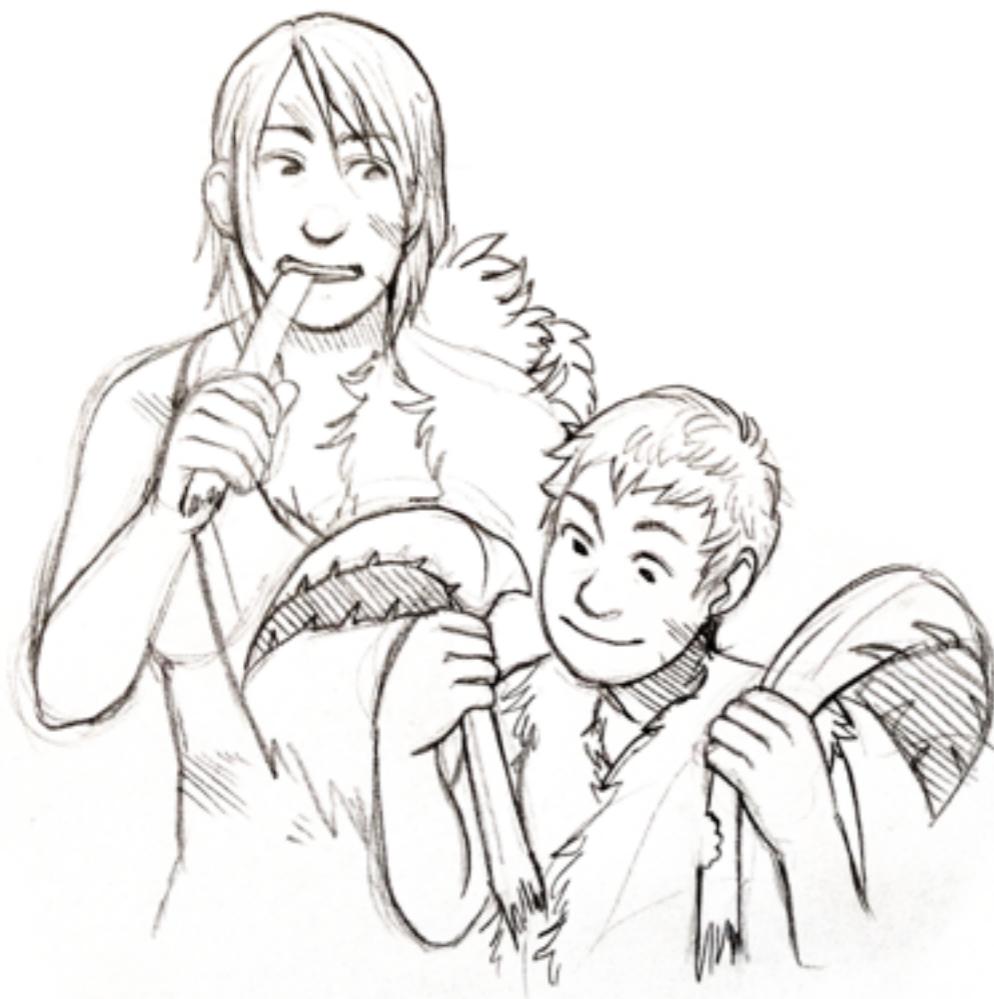


It's remarkable what's transpired over the past 100 years, the past 40, and the past 5,

from barely able to treat burn victims (by washing them daily for months on end),

to spray painting new skin (based on your cells) and being released from the hospital just days after a serious injury.

The jump in technology and our understanding of biology/the sciences is startling.



1,000 years ago



Same Feeling,
Similar Understanding

Today



Yet we're still stuck in the land of episodic treatment in thinking, engineering, and designing for health.

Humans don't want to think about health, same as 1000 years ago.

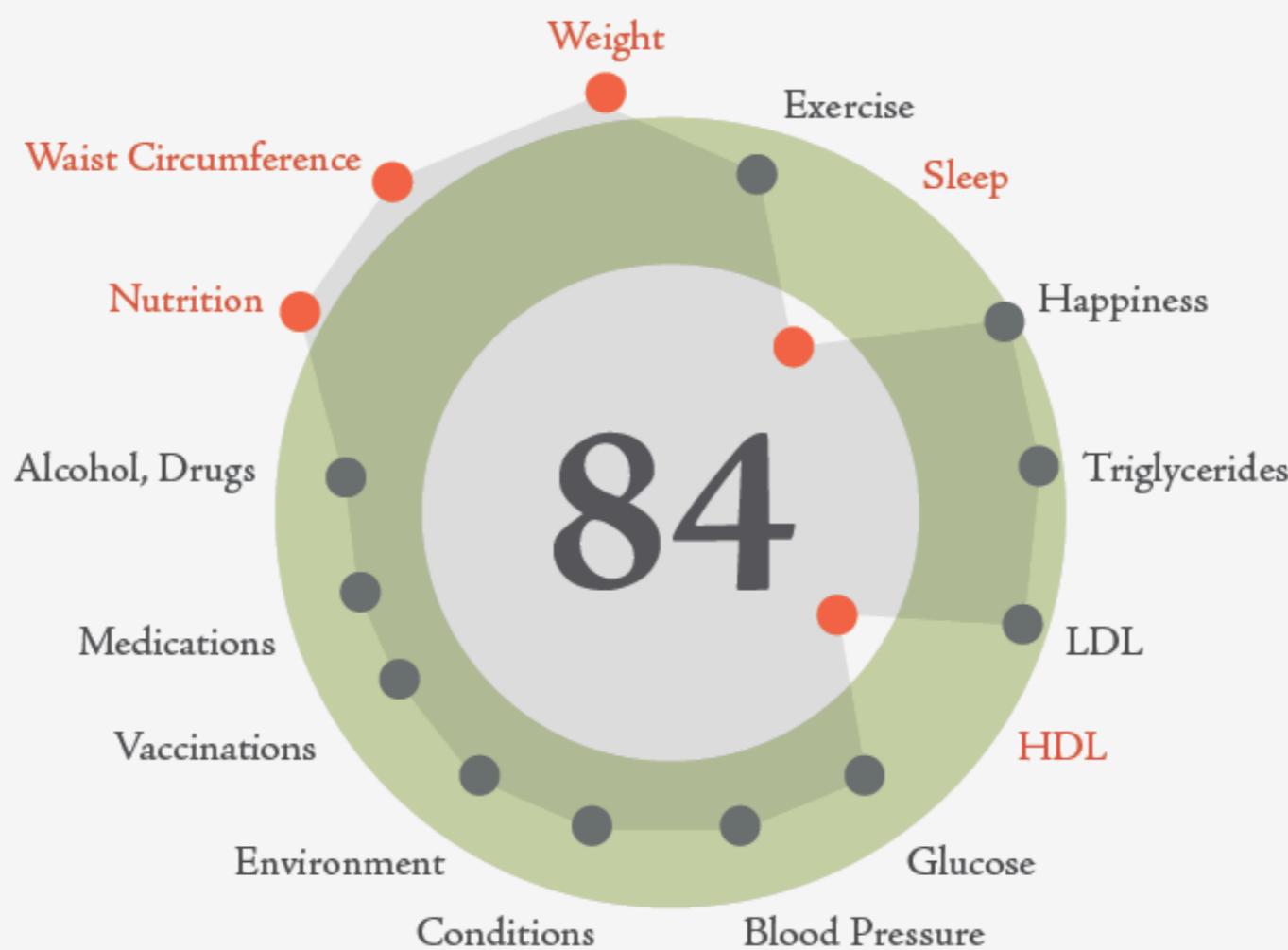
Let's do a quickie thought experiment.

Suppose your data is just collected – all of your data surrounding your existence from financial (which we're nearly doing today) to travel (again, done a bunch today) to habits to eating to exercise to examining your daily biome, etc. It's captured. It just happens.



Upcoming Appointment
Checkup on 13.Dec.2012 at 9:30am

Juhani Sonin
40yo Male



Kate Sonin



Udo Sonin



Viggo Sonin



Add Person

Here's me.

hGraph: Your health in one picture.

Compelling, standardized visual representations of a patient's health status...on the celltop

Designed to increase awareness of the individual's factors that can affect one's health

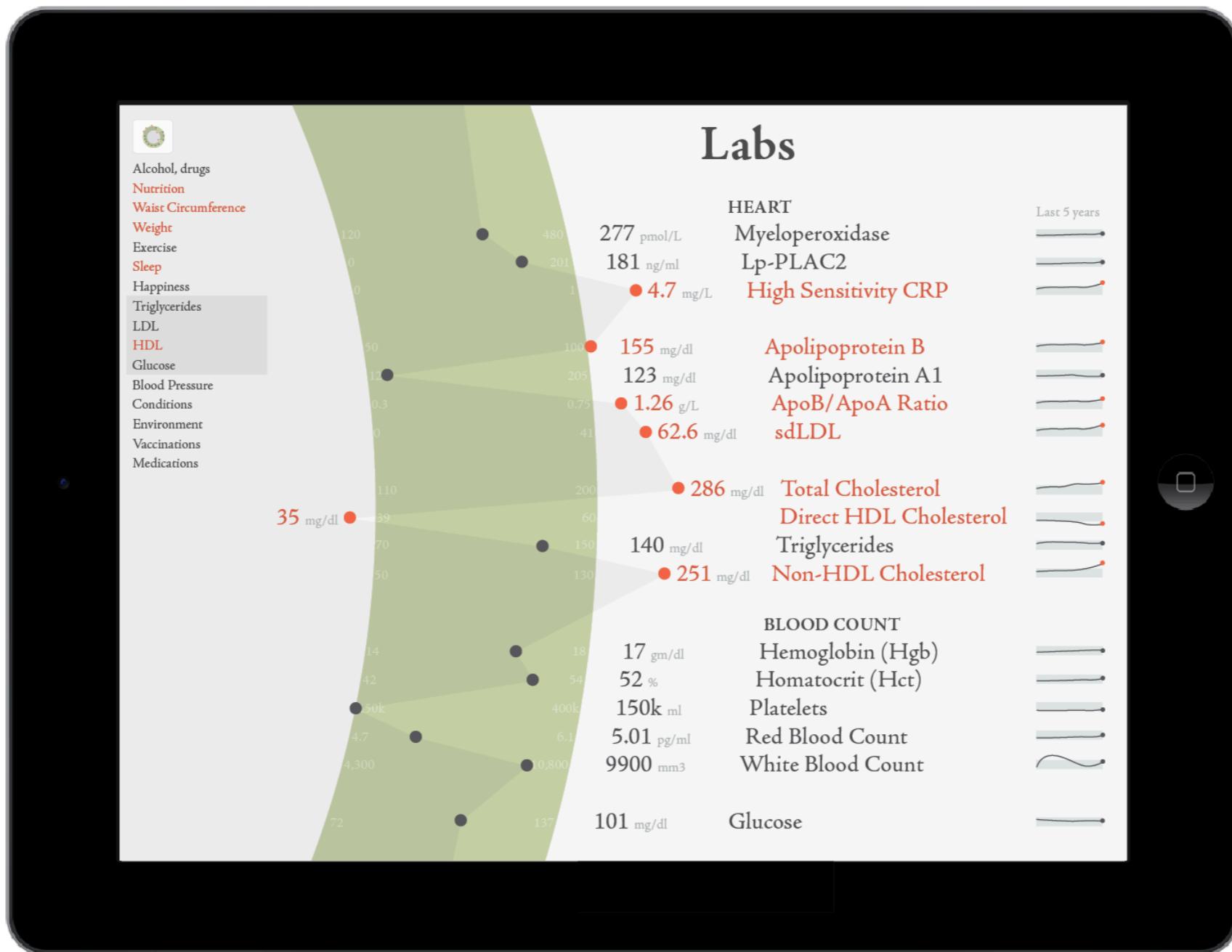
Users provide, view, share, and understand a holistic view of their health

Based on an individual's health data, identifies where an individual's health numbers are, and where they should be Patient focused, with professional clinical relevance

hScore

Single aggregated number ranging from 1-100 that represents best knowledge status of an individual's health

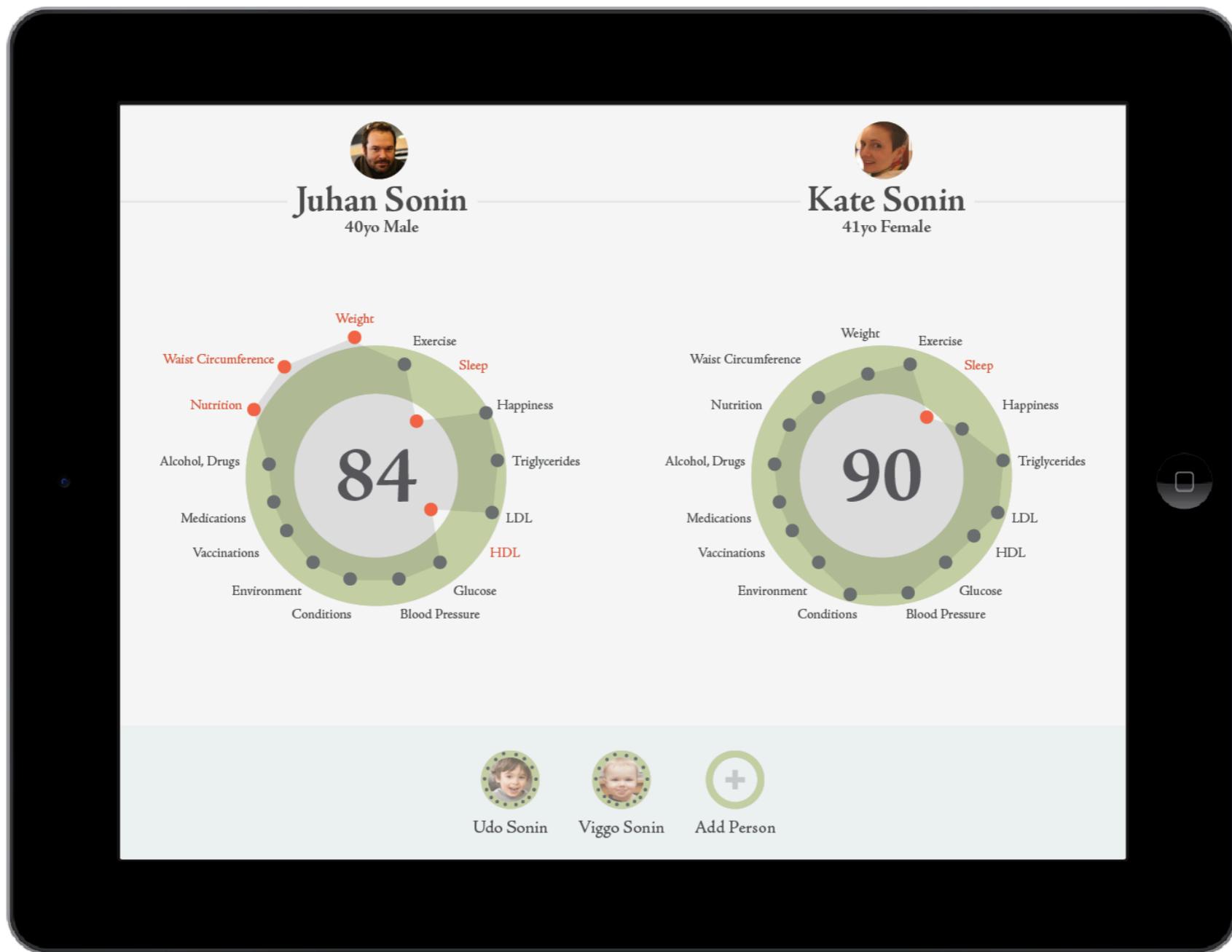
Experimental measure correlated with statistical data from open sources



Here's more of my data.

My Cleveland Heart Labs as of last year... which over the past 8 months have hopefully dramatically changed.

Note: All of my health data is open source. My entire genome is OS thru PGP.



Here's my family.

 Juhani Sonin	 Katie Sonin	 Udo Sonin	 Viggo Sonin	 Epp Sonin	 Aldo Sonin	 Agnes Morrison	 Ain Sonin
40 years old 1.Mar.1972 Male	40 years old 22.Jun.1971 Female	5 years old 17.Mar.2007 Male	1 year old 11.Aug.2010 Male	65 years old 9.Jun.1946 Female	33 years old 15.May.1979 Male	89 years old 31.Mar.1921 to 12.Nov.10 Female	73 years old 24.Dec.1937 to 21.Aug.10 Male
5', 10" 208 lbs 36" waist	5', 4" 110 lbs 25" waist	4', 1" 39 lbs 16" waist	2', 8" 26 lbs 12" waist	5', 0" 129 lbs 31" waist	6', 0" 205 lbs 34" waist	5', 0" 110 lbs 28" waist	5', 9" 142 lbs 32" waist
20/15 vision A+ blood type 117/79 BP 220 cholesterol	20/30 vision O+ blood type 120/85 BP 155 cholesterol	O+ blood type	O+ blood type	20/30 vision AB+ blood type 122/81 BP 200 cholesterol	20/20 vision AB+ blood type 115/70 BP 215 cholesterol	30/30 vision A+ blood type 135/86 BP 195 cholesterol	20/30 vision O+ blood type 140/90 BP 162 cholesterol
Repaired bicep tendon, right arm Surgery on 11.Dec.09	Appendectomy Surgery on 28.Feb.93	No history	No history	No history	No history	Dementia 3 more conditions	Dementia Alzheimers (stage 2)
No allergies	No allergies	No allergies	No allergies	No allergies	No allergies	No allergies	No allergies
Megavitamin, 1/day	Megavitamin, 1/wk	No medications	No medications	Megavitamin, 1/day Aspirin, 81mg/day Zocor, 10mg/day	No medications	Galantamine, 20mg/day 2 more meds...	Donepezil, 10mg/day 5 more medications
Fluent in English, Estonian	Fluent in English, Russian	22 Surry Rd Arlington, MA 02476	22 Surry Rd Arlington, MA 02476	Fluent in English, Estonian	1205 Embarro Dr San Mateo, CA 92005	Fluent in English, Estonian, French, German	Fluent in English, Estonian, Swedish
22 Surry Rd Arlington, MA 02476	Juhan Sonin (father), 40 Kate Sonin (mother), 40	Juhan Sonin (father), 40 Kate Sonin (mother), 40	Juhan Sonin (father), 40 Kate Sonin (mother), 40	104 Follen Rd Lexington, MA 02476	Single Juhan Sonin (brother) 40	820 Mass Ave, #410 Arlington MA	42 Mall Rd Atria LongMeadow Apt #110 Burlington MA
<i>Juhan Sonin</i>							

All of my family's health numbers, metrics are known.

You can see your data, see the trends, see your friends and family's data and help them on their journeys.

It's at our fingertips.

and the Problem is...

Increasingly complex systems

- ♦ Tool and Methodology gap

Decision makers are swamped with conflicting data

- ♦ Our work is increasingly multi-dimensional (not a flat decision space)

Artifacts driving decisions need to be coordinated, presented

Minimal transparency into key health metrics

This is in stark contrast to what happens now with the Design of your life, of your data, of your health. We have minimal transparency into key health metrics. For the data we do have, consider the enormous overhead required to collect it. People have a hard enough time putting on their underpants and figuring out mortgage refinancing. The systems we deal with are increasingly complex. And as decision-makers, we are swamped with conflicting data where rarely are the artifacts driving decisions coordinated and presented well.

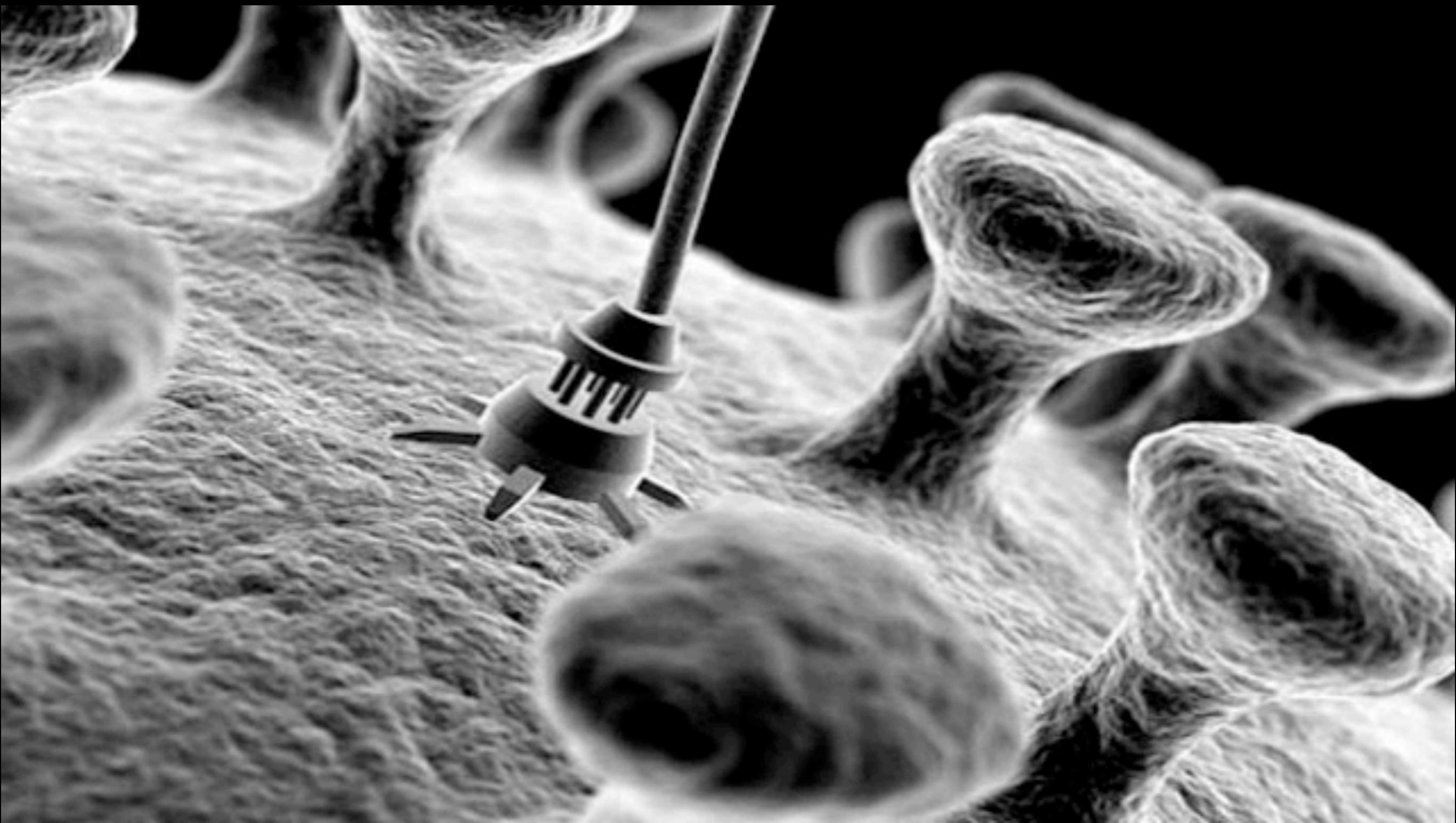
Our work is increasingly multi-dimensional (not a flat-decision space), and linear thinking human beings are not good at non-linear thinking.

Data isn't 'decision-grade' information

Linear thinking human beings are not good at non-linear thinking.

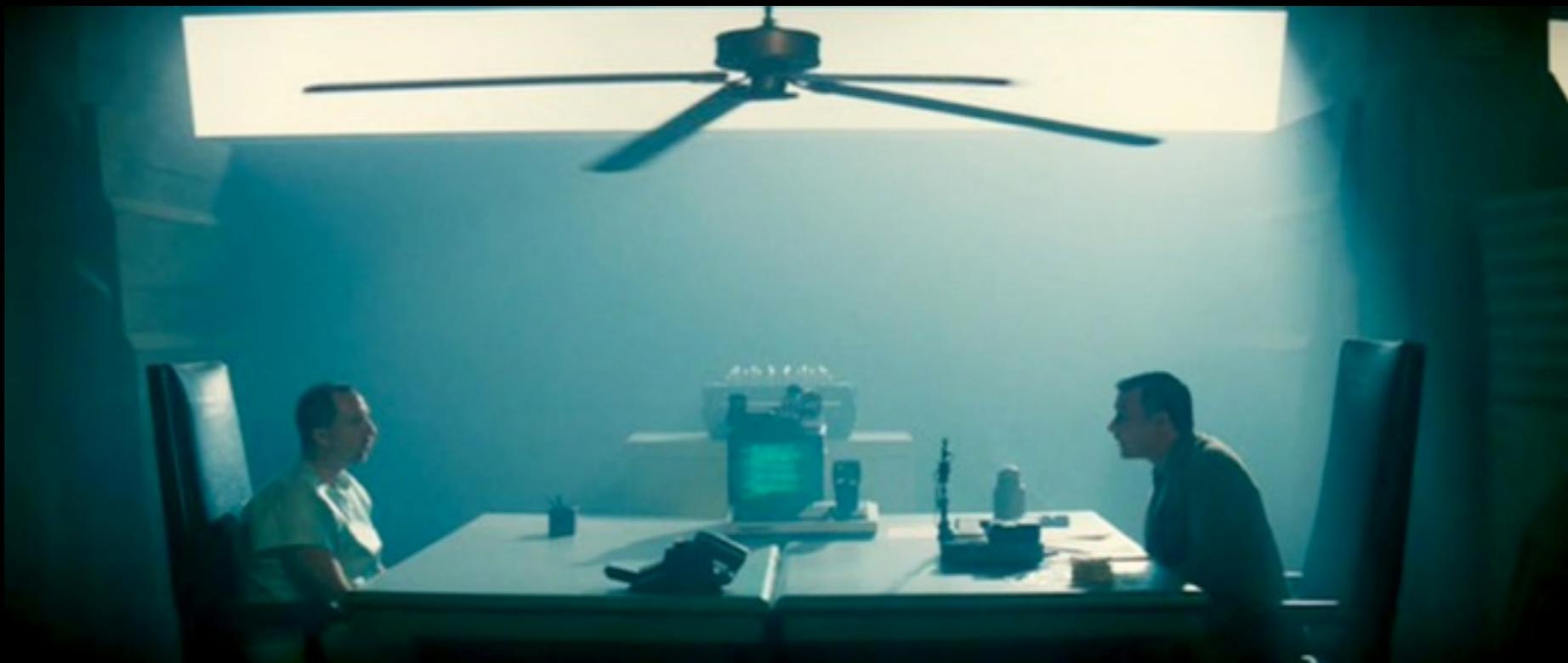
Lack of measurement to metrics conversion

Seeing every variable and doing the mental calculus to orchestrate better decision making ain't our species' forte. We fly by the seat of our pants.



So couple that idea of barely being able to conduct our current lives with the proliferation of smart sensors. They're blowing up... sensors are everywhere. The DARPA line from two decades ago is catching up: smart dust is all around us.

The Surveillance Invasion



I can't help to think about the Voight-Kampff interrogation machine in Blade Runner. The table-top apparatus with a mechanical eye to peer into a human's (or robot's) eye to non-invasively determine their "health" status.

There is a potential freakout moment when we imagine the future of health, surveillance, security, and the human condition. Like with this classic scene.



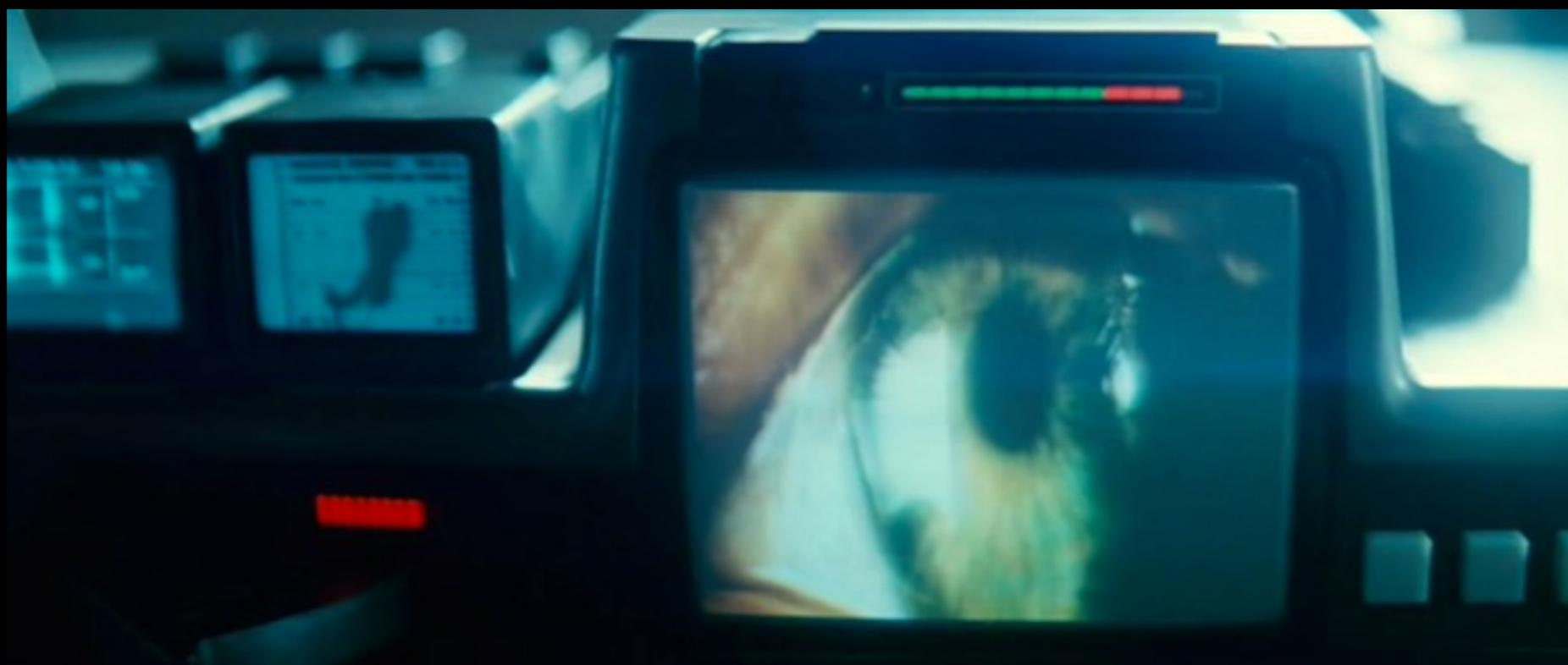
Not unlike our current doctor gods, this judge and jury carries out the assessment with a tech-heavy device.



It's not very human... by design ... for this flick.

And ultimately, it's not about fetishizing the hardware. Hardware is on the decline. It's a customer acquisition tool.

But there are a few spot-on health signals tracked by this particular example.



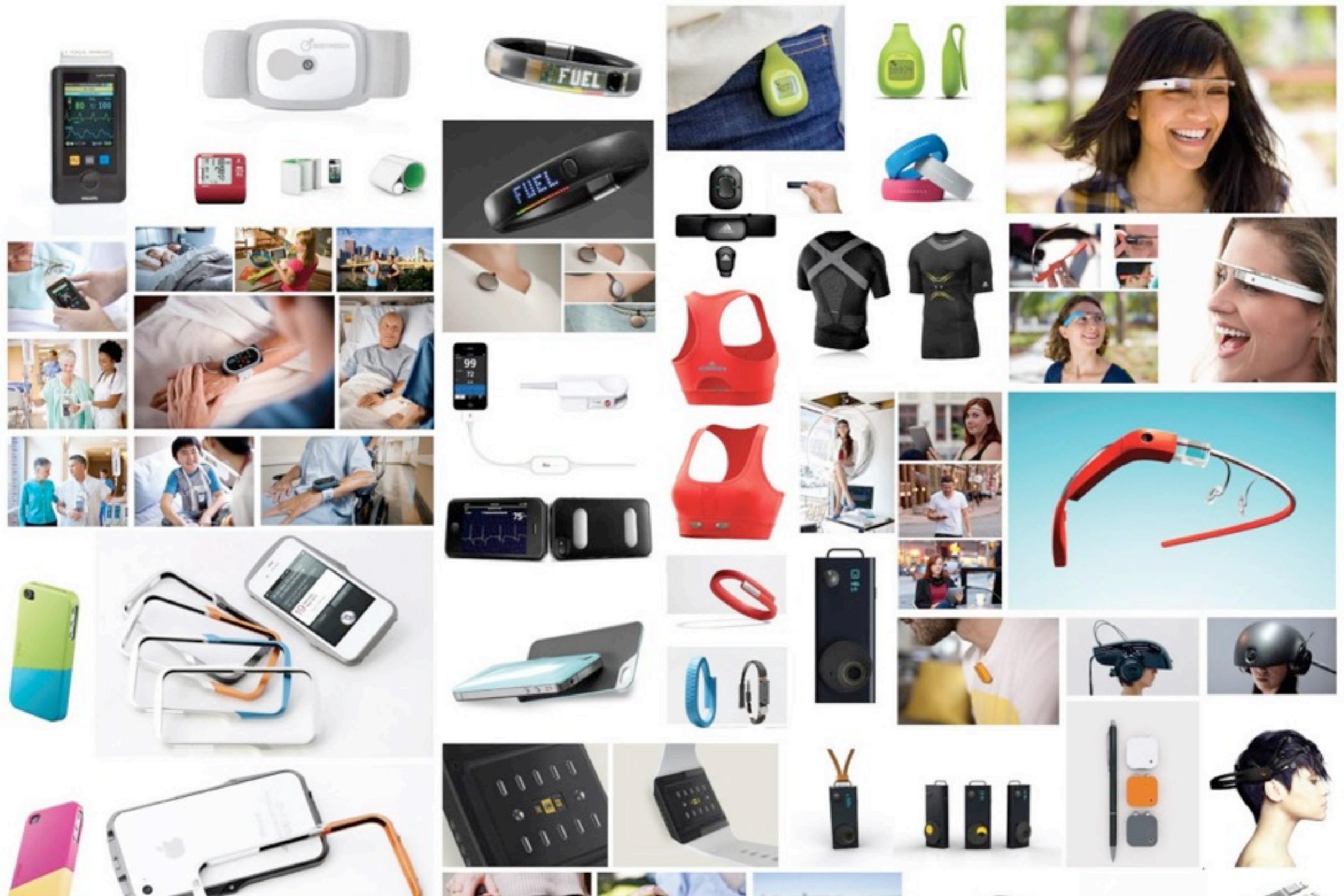
It measures bodily functions like respiration, BP, heart rate, eye movement in response to emotionally provocative questions, and retinal blood vessel structures (just to name a few).

And this is here.

We're in this confluence of sensor tech, data analytics maturity, hardware durability and industrial evolution, miniaturization which is an evolutionary forcing function for prediction modeling.

In a year, we'll have a good first cut at a human prediction model that is personally meaningful and changes behavior (and is only 5% wrong).

Smart Sensors



In the design studio, I count a half-dozen different wearable health devices staff are wearing from a basis watch to fitbit pedometer or bracelet to a bodymedia band to a jawbone up to a Philips pedometer. Digital scales, aliveCOR ekg iPhone cases, cameras to detect BP thru your face = we're surrounded by sensors.

One problem with the current batch of wearables is just that - they're wearable and require a ton of overhead to engage with.



Take the very cool Withings Pulse for example. It tracks steps, general activity, sleep, heart rate on demand. It has a touch screen, solid form factor, decent contrast UI/screen (especially compared to the mediocre Basis).



The biggest beef with all the micro wearables is that you're not wearing it 24-7. Sticking them in your pocket is easy, but it requires a pocket (when I'm at home, I'm often pantless), I don't wear it at night, and there are always switches to turn it to "night-time" mode which then requires a flip back to daytime usage.

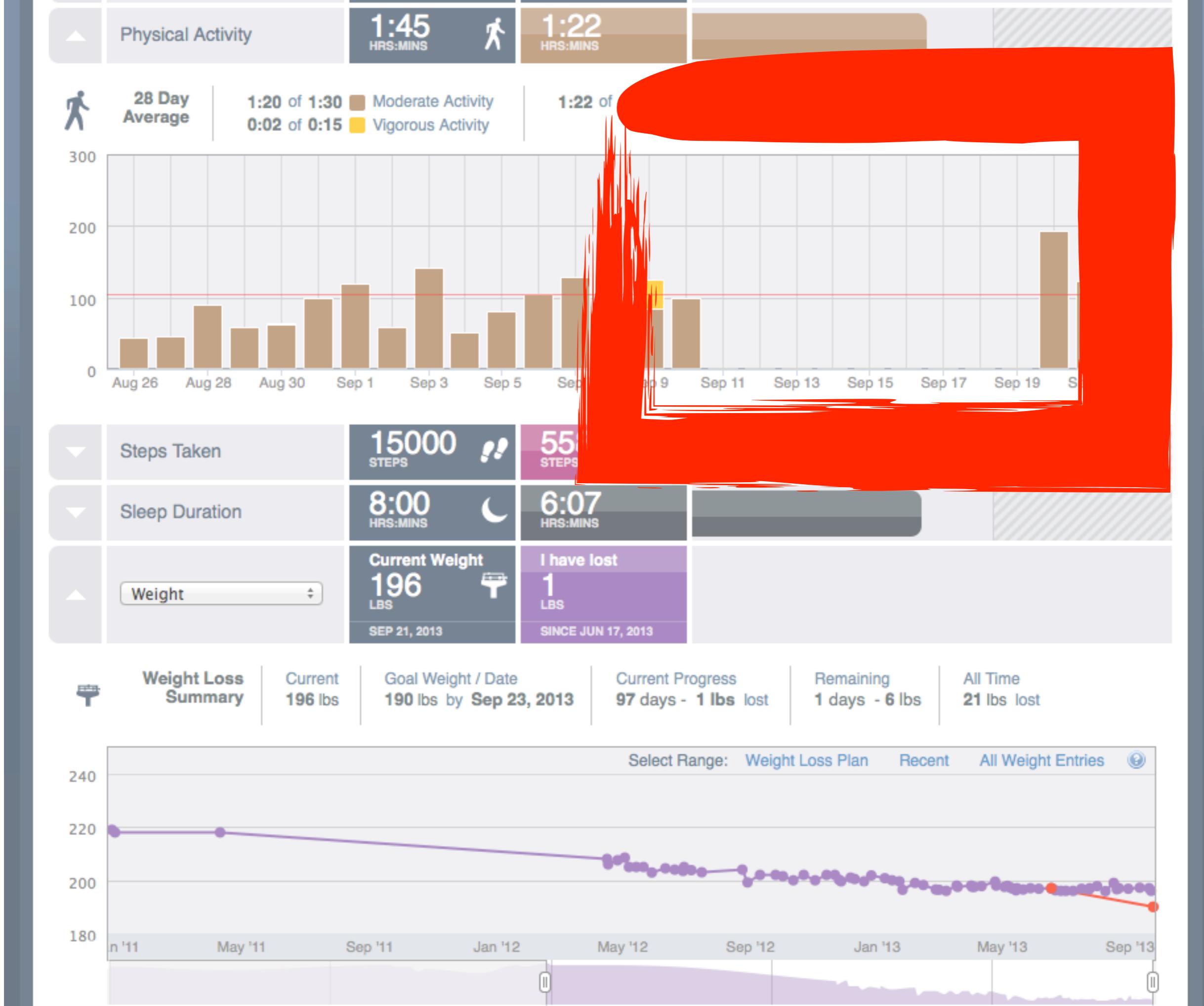
Even my bodymedia armband is not set it and forget it. I have to take it off to shower and to charge.



So even slick new devices like the Shine suffer from all the same "non-forgettables".

Form factor isn't really The Question – because no form factor really hits it on the head. Maybe it's the implant. Or the invisible.

Hardware is a gateway drug to services + data. If you're planning to get into health hardware, you're too late. Sorta. The current device line-up has little to do with the commodity of hardware and all about your information and decision-making.

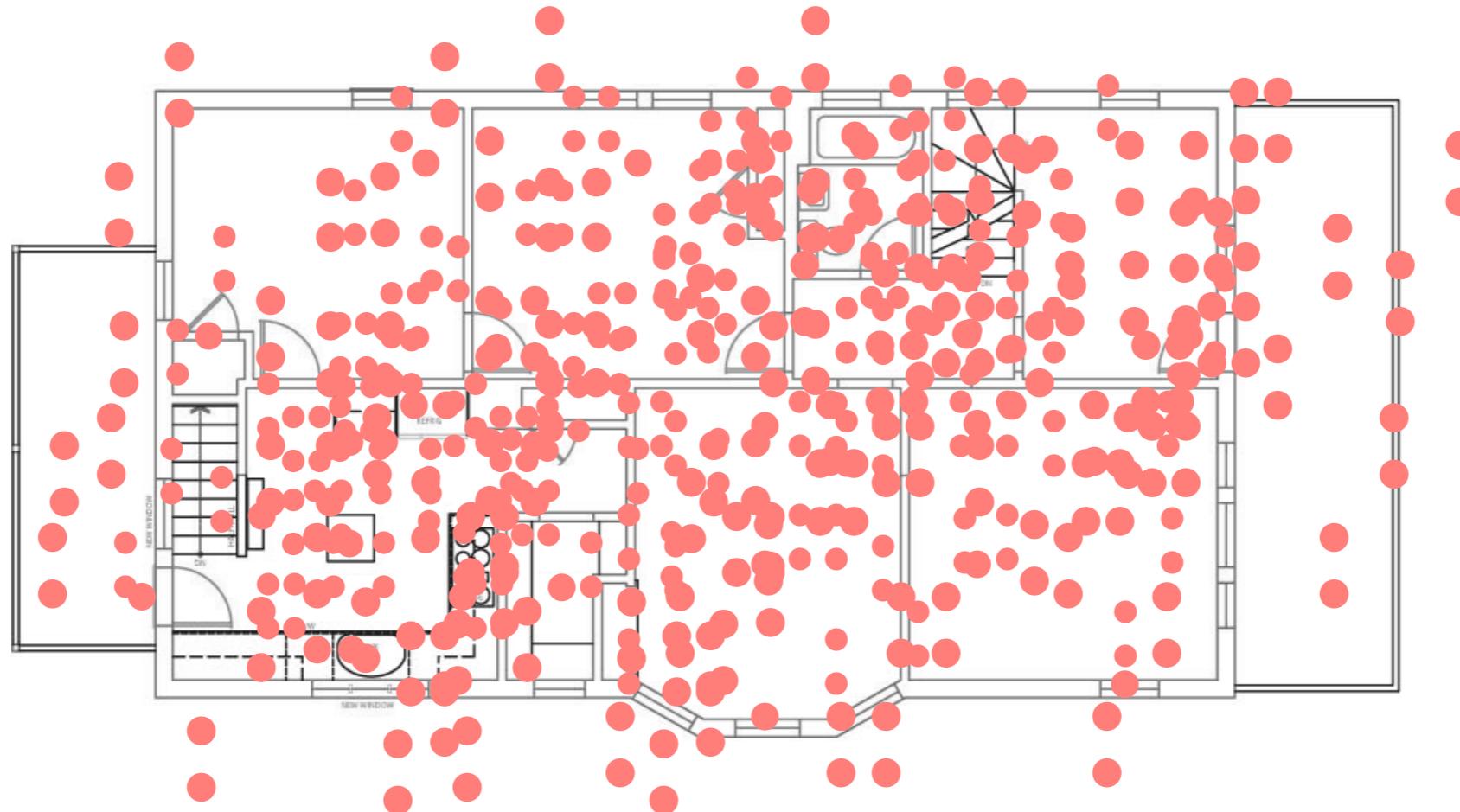


Now the flip argument, from a wellness POV, is that do "off times" really matter?

The little health plug straps on when sickness is coming on and then reduces symptoms and duration by 70%. Now that's a helpful micro device.

Life first.
Health a distant second.

Sensors throughout



We're going to design products to capture data beautifully... and usually that's going to mean invisibly. So I walk around my house, stand at my desk at work, go pee – and all of that physiological data is snagged to do DSP analysis on getting worse or better on a particular timeline (based on known prior results). This is where machine learning, big data, and design crash together.

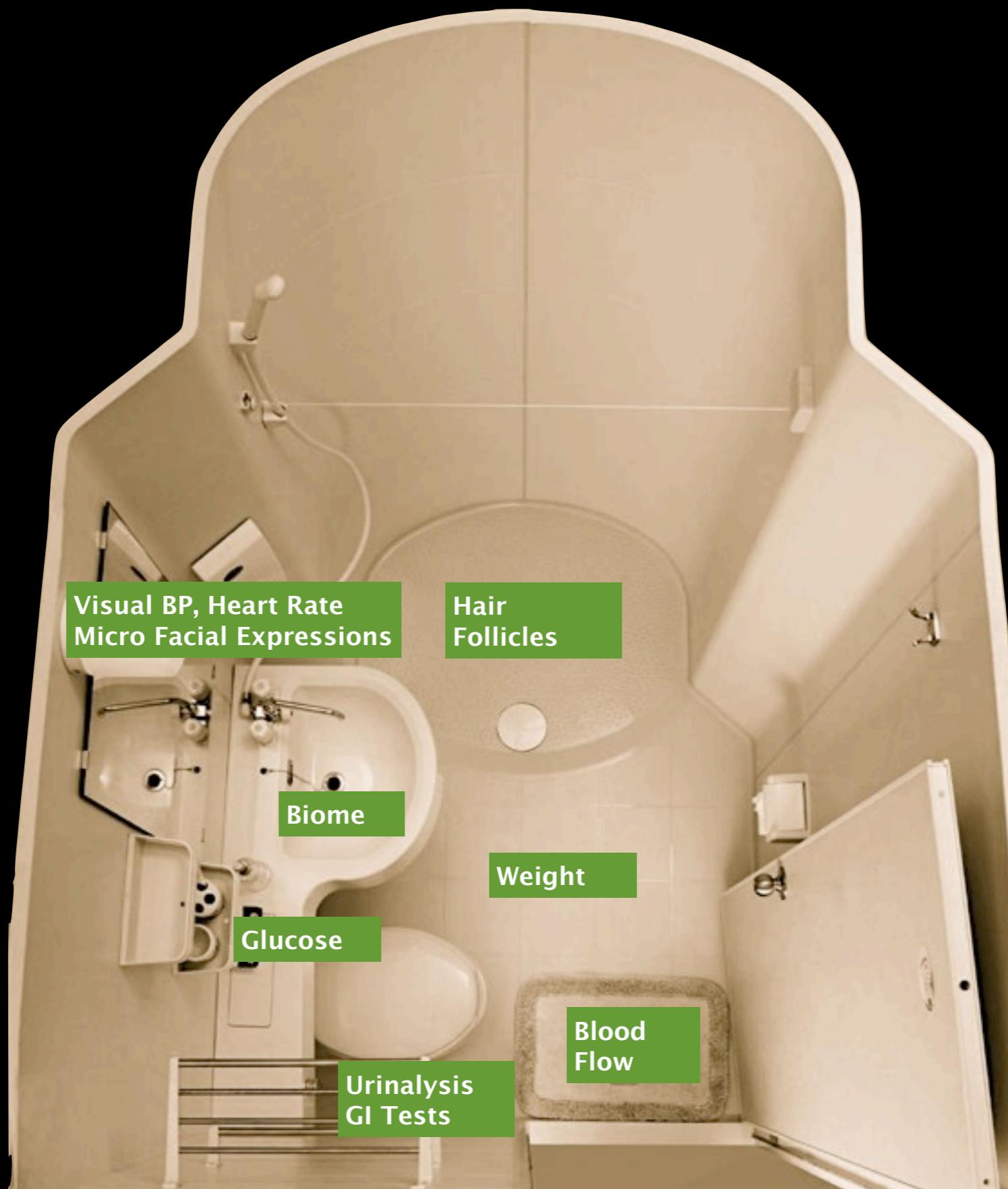
The Medical Home , Telemedicine

Sensors: Motion, Fire/Smoke/CO₂, Occupancy (Bed/Chair), Use (Door, Stove, Fridge, Tub), Location (Alzheimer's), Fall Alarms, Water flow...



Machines and humans are about to sync in a whole new way. Let's talk about the bathroom. Exciting!
Your bathroom will be an invisible sensor haven.
Shouldn't it tell you that dosage it fubar'ed? Consider what that room will collect, sooner rather than later.

The Medical Home - the bathroom turns into the healthroom



Hair follicles collected in the shower drain, GI and urinalysis from the toilet, your biome sloughing off into the sink, weight, heart rate, blood flow, facial expressions taken automagically. It just happens. No mental or physical overhead. Regular feedback loops.

It ain't the bathroom anymore, it's your health room.

[Gattaca reference on collecting urine and hair follicles]



Who gives a rat's ass about your patient portal? Electronic health records?

It's about teachable moments in data (usually micro behaviors shifts through baby steps) that show the future and what to do to get better.



Non-invasive hyper-surveillance will eventually produce a **majority of all personal “physiologic signs”**.

The majority of all your personal physiologic signs will be snagged non-invasively, through sensors that passively sniff you.

No blood draws.
Just whiffs and sniffs.

It just happens.

38

All the data is collected... automagically.

It must be designed to feel... *wonderful.*

Think more about LIFE.

Think less about "health" + "security"

40

How do we know more about health and healthy behaviors, but think much more about life and less about "health" and "security"?

Nobody wants to be called a "patient".

My health and my family's health is actively guarded.

41

Our digital health "guards",
the digital services that pound on those massive data sets and prior
patterns in order to keep us healthier, identify trends,
will reduce our sickness rates exponentially.

My health and family's health will be actively guarded. I subscribe
to a CitiBank "fraud security net" for \$10/month that monitors any
transaction that didn't come from me or my family, across the planet.

If there is any suspicious action, the bot notifies me immediately
and together, we deconflict the issue, in near-real time.

And my entire life data set is guarded... and available... not fragmented in 1000 disparate, non-chatty repos.

\$1, \$100, \$1000/month

42

Next up is LoveLife, a Netflix-type model where I pay \$1, \$100, or \$1000 per month for the service to look over and protect my data, know who is touching it, predict behaviors, tease me to change my behaviors. This cloud guard will auto-detect and alert me to the make-my-pill vending machine getting hacked = protecting all the trains of trust.

Yes, there is a small charge... but it's worth it... the protection, the monitoring, the hassle-less service.

Focus on your dreams.

43

That way, while sounding a bit cheesy and spine-chilling, we focus all of our energy on our dreams.



I always picture the Orgasmatron from Woody Allen's movie, Sleeper.
Walk in. Have a blast. Walk out 5 seconds later.

Scary? Sorta.

But it's coming.

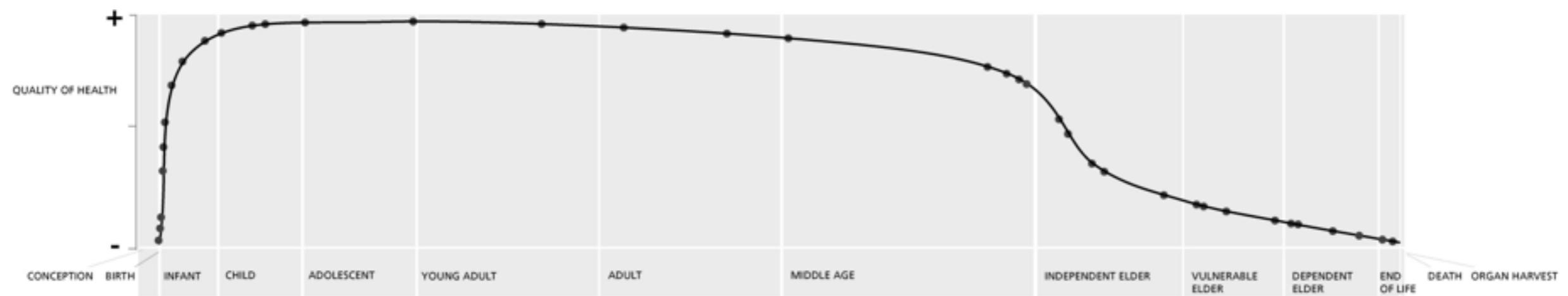
45

That's where engineering and design can really have impact.
Sign me up.

Stage Zero Detection

20th century

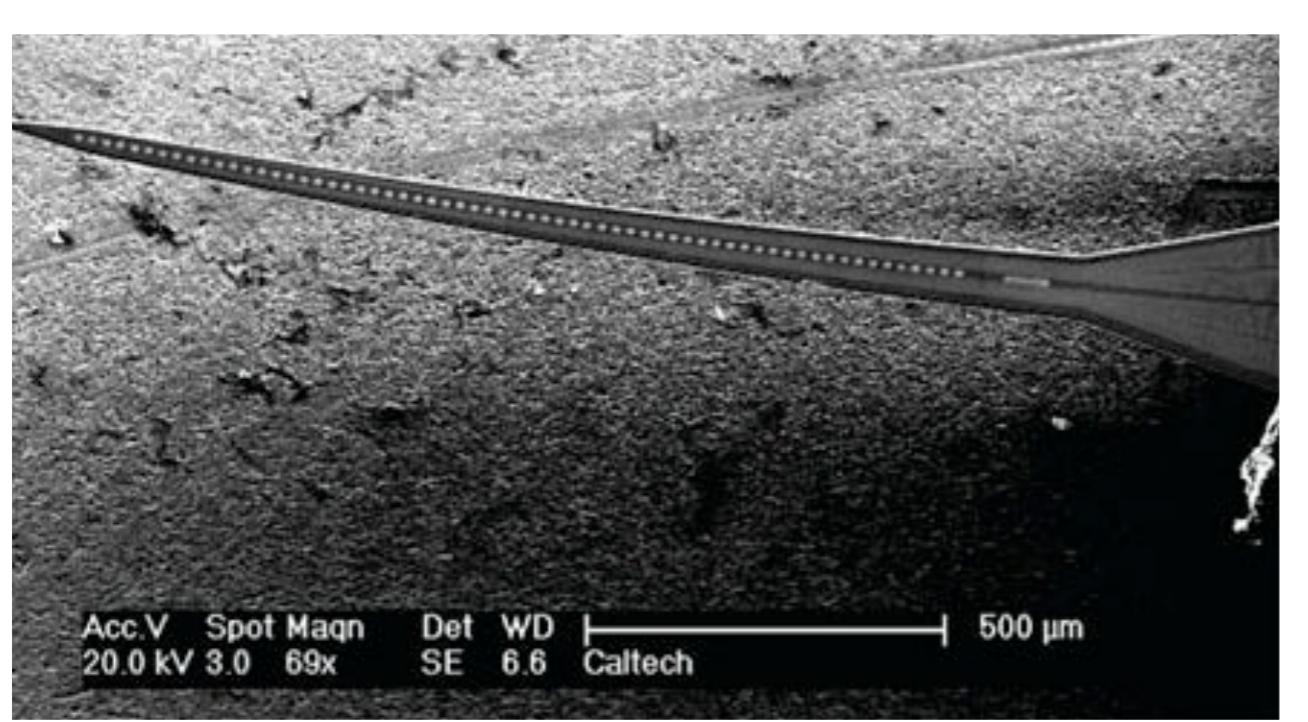
Aging Cycle



Diminishing Health, Gradual Deterioration

Here's our current aging cycle... how we as a species progress through life and the quality of health across time.

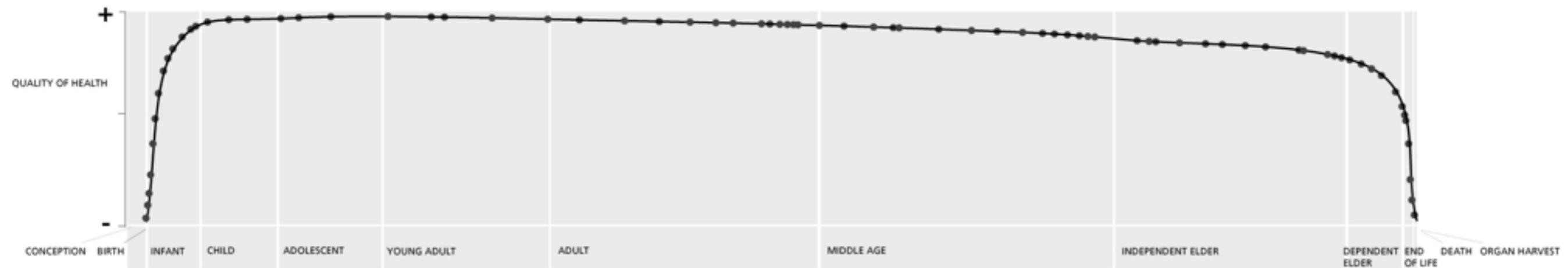
Once we hit 25, it's all downhill. A road to perdition. And it gets ugly, over the long now.



We're getting biome analysis, emotional analysis, breath evaluation, voice analysis, and bots are in our stomachs and blood streams and churning thru our bodies + molecules + gathering intel, and more... We are able to see disease + conditions erupt at the cellular level, not when they physically manifest so our eyes and bodies can "see" them. By that time, it's too goddamn late.

If health is beautifully integrated into our daily life, so that we're getting continuous assessments on how to adjust in near-real time

iGeneration Aging Cycle

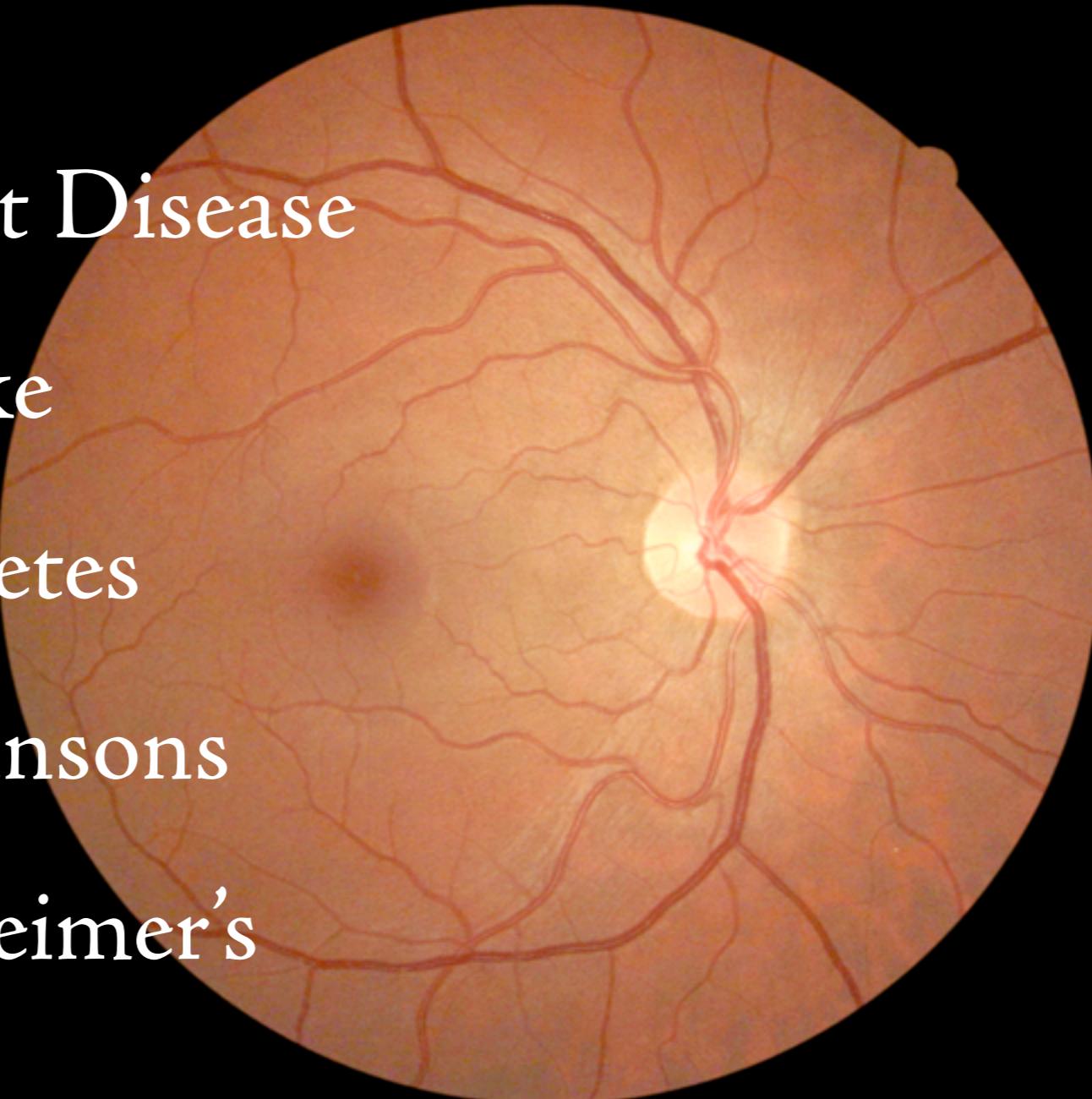


Sustained Good Health, Very Rapid Deterioration

Based on what's emerging from R&D, the next gen tools like breath evals, nanocapsules, synthetic data + population health data, voice analysis, and your biome, we as a species will be living longer, better. Longer alone ain't too great unless you're feeling good along the way.

inverse bathtub curve.

buying a washing machine... fails early or lasts a long time w/a quick, catastrophic failure at the end.



Heart Disease

Stroke

Diabetes

Parkinsons

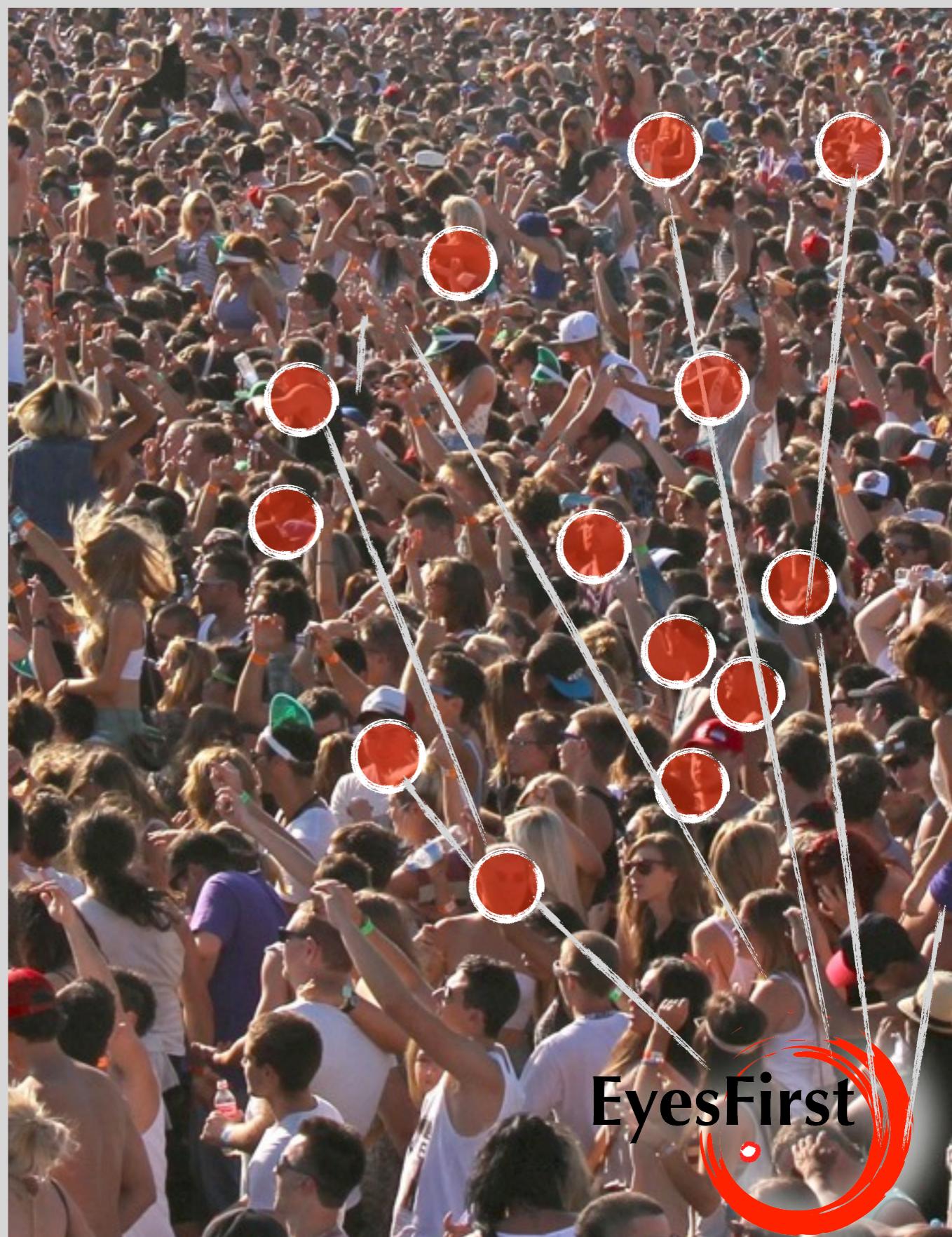
Alzheimer's

Compelling, upcoming services:

The eye is one of the few places to gain unadulterated access to blood vessels without slicing the skin...



NETRA



\$100k





Extracting accurate pulse, respiration, and blood-oxygen measurements from low-cost, low-res imaging (by Ming-Zher Poh in 2011). The system measures slight variations in brightness produced by the flow of blood through blood vessels in the face.

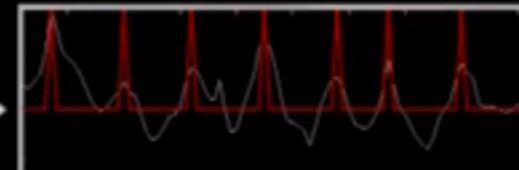
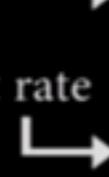


Source
(Courtesy of Winchester Hospital. Do not copy)



Hospital monitor

Bandpass signal +
peaks (pulse)



Estimated heart rate



156 bpm



Color-amplified (x150)

Amplifying variations in video frames helps humans see the invisible... to see someone's pulse, the breathing of an infant in a neonatal intensive care unit. (via MIT)

There are 100s more examples of non-invasive sensors and procedures like nano particle sniffers, breath tests, MRI, ultrasound, etc.



Scanadu (hockey-puck-sized, 10-major-metric, non-invasive data collector)



The nose

and breath

are windows
into our health

Breath sensor from Adamant (out of Penn State).

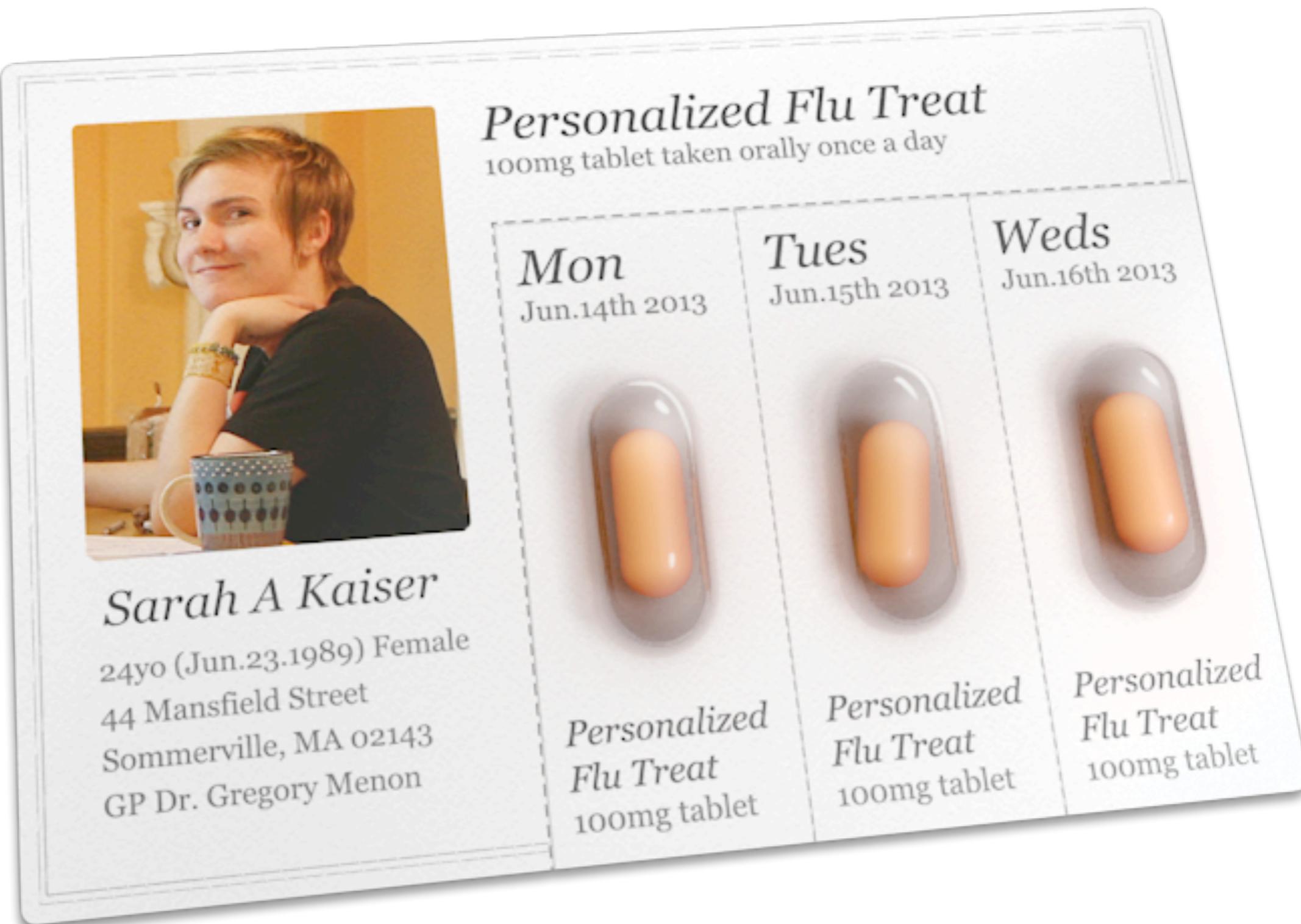
Seeing differing signatures in 25 variables of your breath... sensing your metabolism rates, diet, etc.

1 nanometer resolution spectrometers for \$10 cost for instant food analysis at the molecule level. Does this have ANY peanuts in it? Check it with my phone.



We'll eat our medicine and lookout bots.

They will monitor and command seek-and-destroy missions at the cellular level (in conjunction with external readings and decision-support tools). You won't feel or notice a thing.



I'll be notified that my biome composition has shifted and that a cold is coming on in a day. Your day-treat (concocted specifically for you based on your life data set from the molecular to intellectual) can be ready in 60 minutes at your local pharmacy. The skittle-sized gel tab, a living set of custom organisms ready to swim into your blood stream) is taken orally, melts away immediately, and within a several dozen minutes, your back to your original, diverse, healthy biome. No stuffy head, no aching muscles, no fever, no sign of "health".



Sound scary? It is... a little.

Now think about someone spoofing that transaction (to replicate your DNA and plant it on a crime scene). Fun!

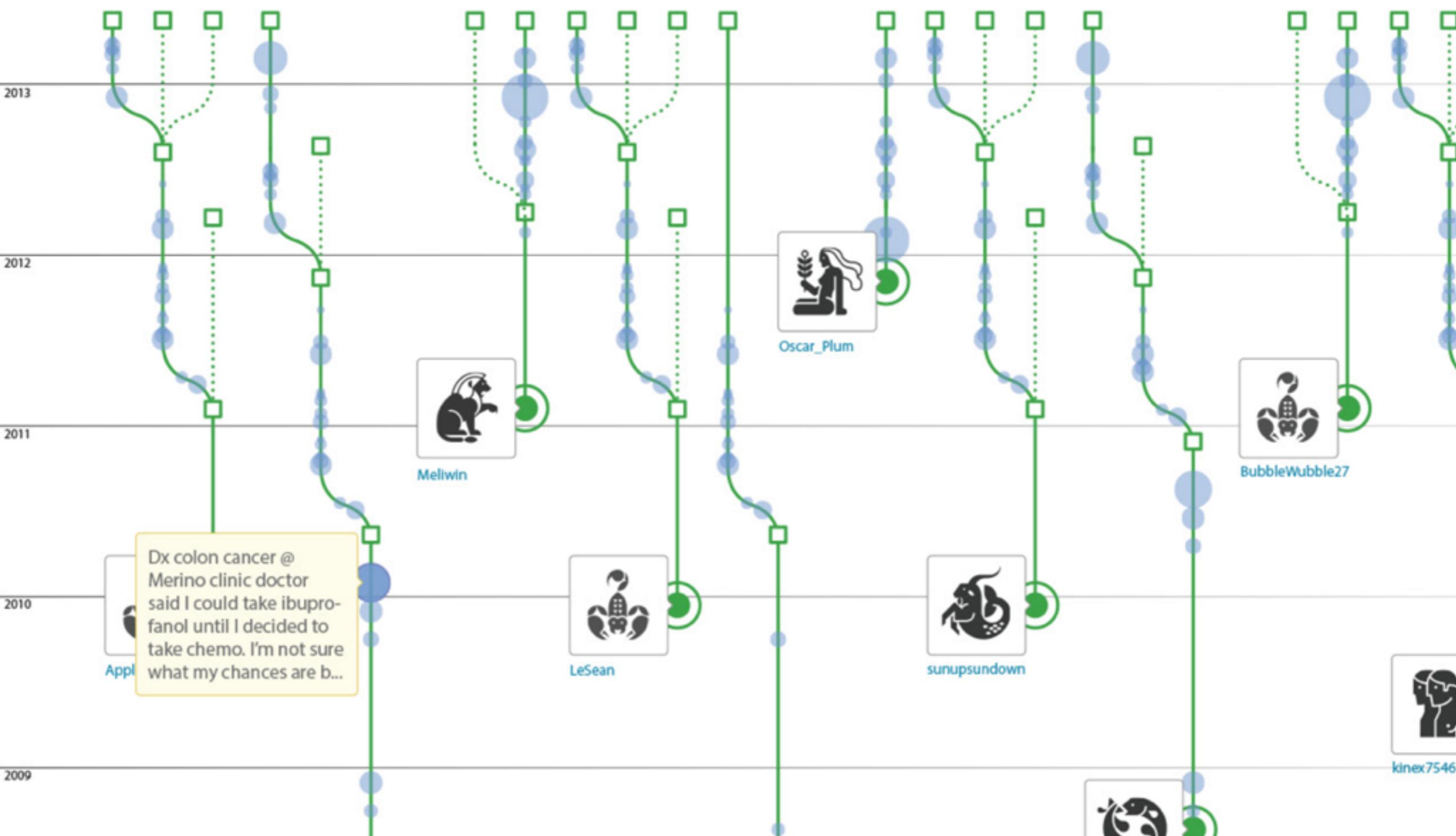
Hal is here. Whether we like it or not.

From Policy
to Pixel
to Protein

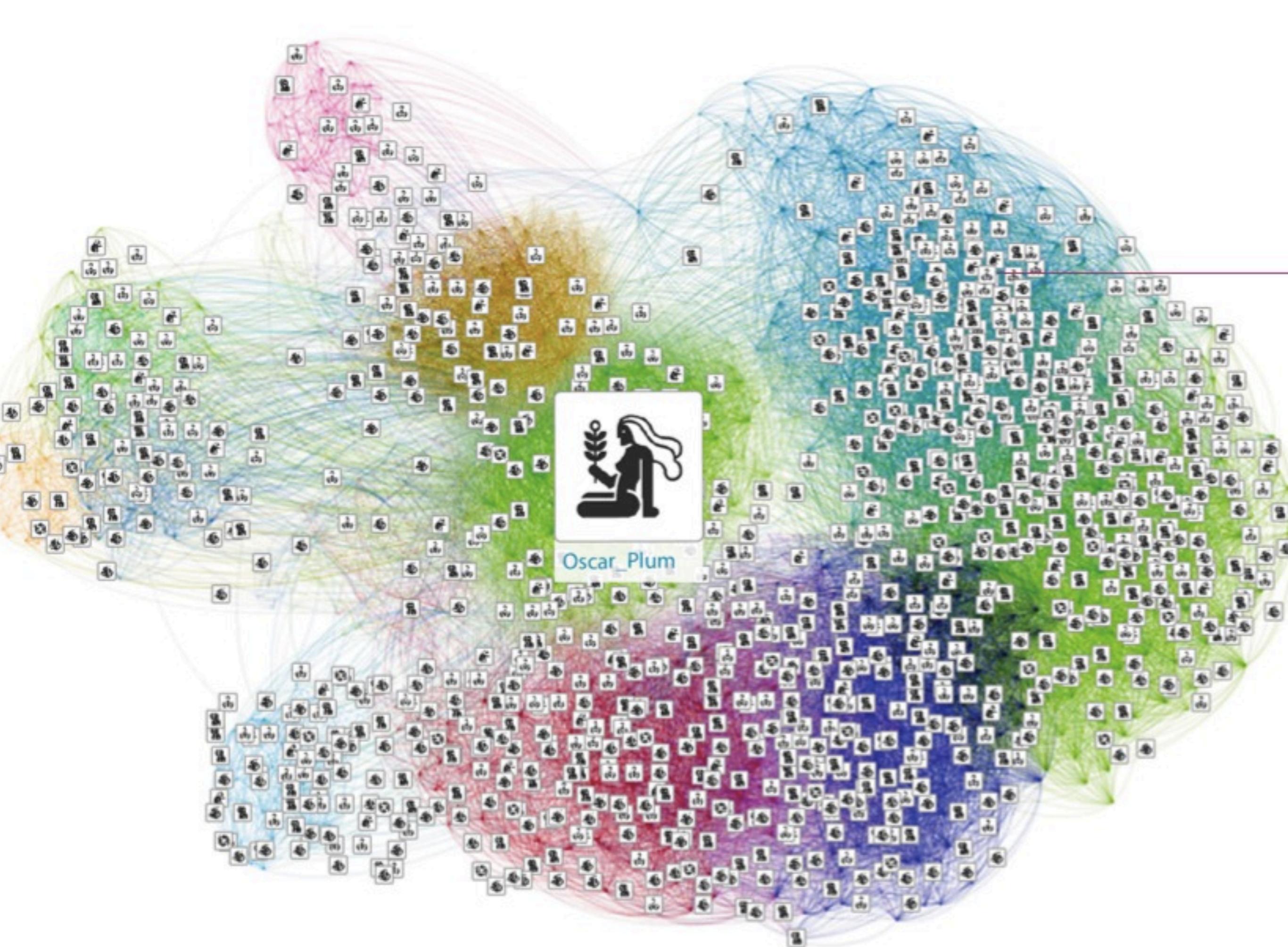


Another scary tidbit is that the planet has more people than jobs. And unless we have social policy to dictate the use of humans in labor, robots will be taking more jobs and making that ratio even more lopsided.

It's the power of Moore's law, mass personalized manufacturing, and self-service that are driving the trend. Instead of "Be Good" it's now "Be Good Robot." [robot = health machines/services]



Our medical records, our life records, will be available for computational use like we currently have with social data on Facebook and Google.



... Machine learning and prediction will vastly improve our ability to live life, to see conditions at their earliest manifestation, and give us fabulous, personalized, medical diagnostics + advice.

WTF?

This sensor cloud will monitor my online and physical activity, and suggest that if 90% of my bandwidth is porn, maybe that's why I suffer ED when faced with a live boyfriend (data is starting to trickle in on this, even though the researchers are having a hard time finding a control group).



We're doing what Orbitz did to travel agents,
that medical technology, design, and culture
shifts are doing to doctors.

Next up for designers and engineers:
Determine the Top 100 health signals.

66

#1

that automatically, hidden, in the fabric of life healthbots monitor invisibly, painlessly, silently, constantly, and friendly... all in protection of me and my family's health.

And then determine how to design the most lovely experience surrounding the collection and then bending, changing your behavior based on those metrics.

Get in the prediction game.

67

#2

work prediction models, based on life data, that incorporate w/
Δdecisions, Δbehaviors. Step 1 = validate models by lowering the rate
of disease progression. Step 2 = Those with the best risk models will
win.

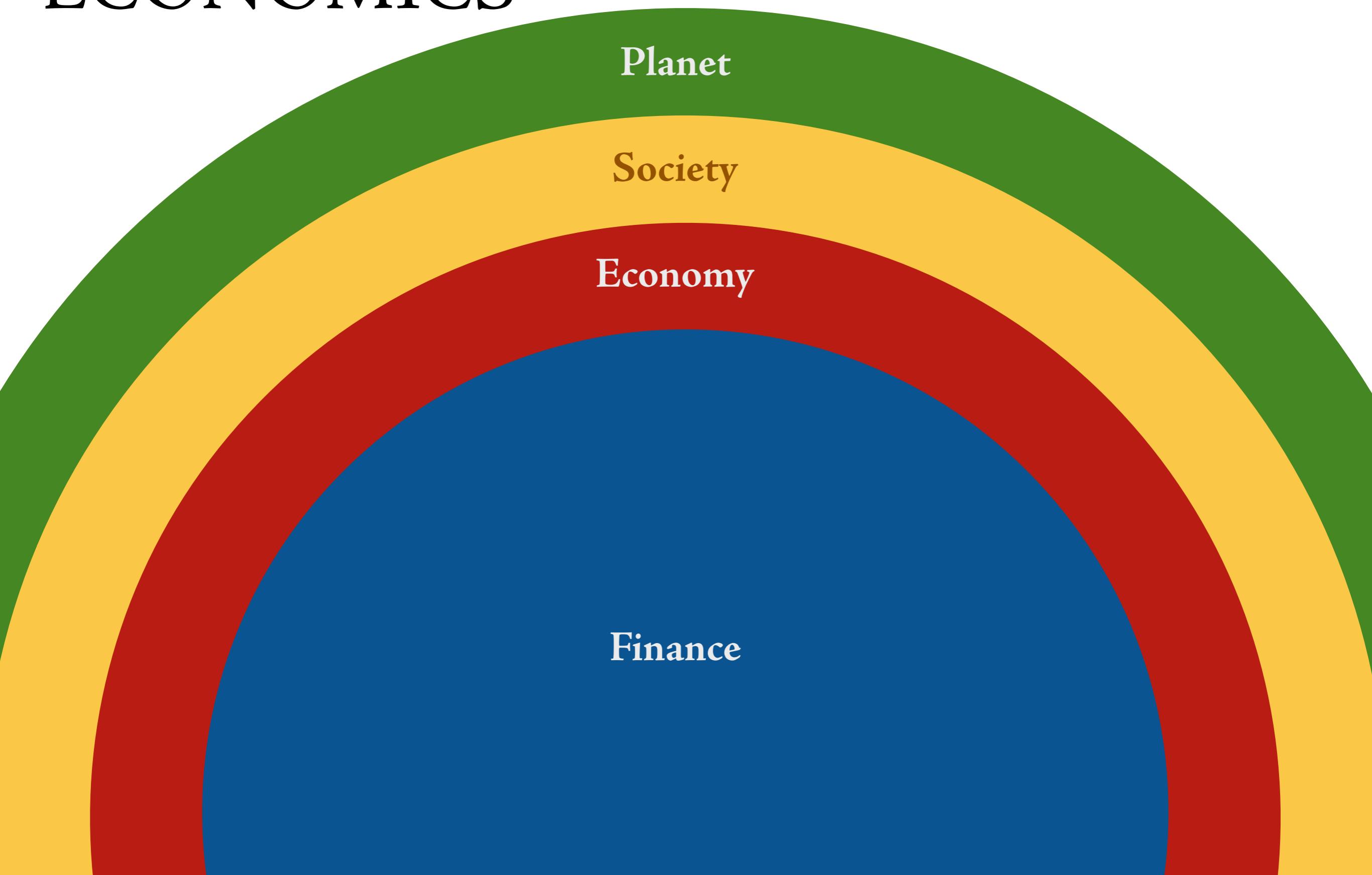
Get in the policy game.

68

#3

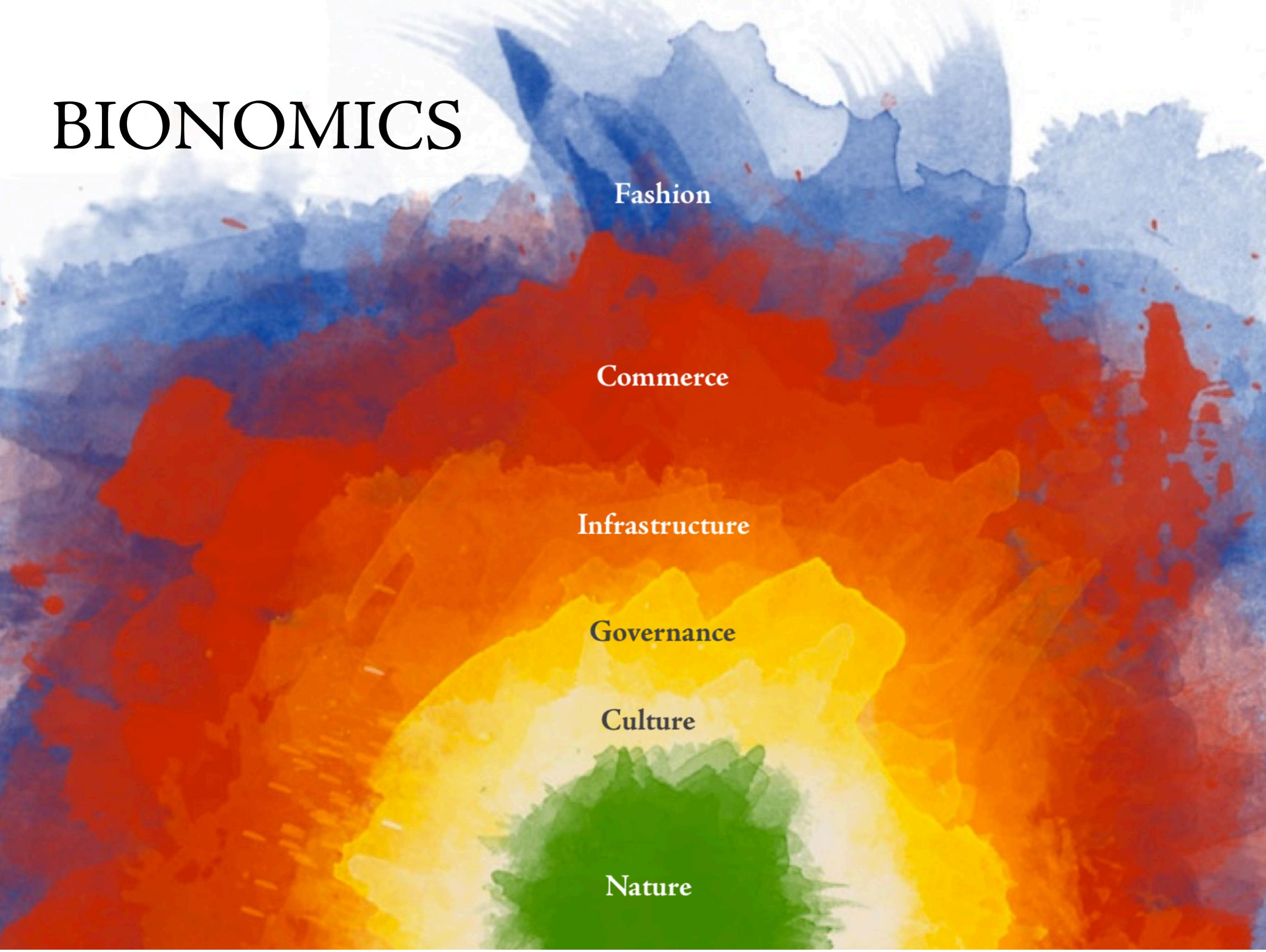
MORE HERE

ECONOMICS



As a United Statesian, this is how we're taught the world works... with money at the center.

BIONOMICS



And then there is the camp that sees nature as the core, the slowest moving force.

The point is that you need to attack several different fronts of design and engineering from fashion to infrastructure to governance to have the most impact.

This is pace layering... where the farther out you are on the circle, the faster you can go, but potentially the less impact you'll have. So move in. Diversify your design game.

From healthcard (FASHION) to Laika (Infrastructure) to hData, HL7, and HIMSS (Governance)

Start with the 30M uninsured.

#4

They're not threatening to The System. They need the attention. Devices have to be cheap (\$10). And you need to have individual buy-in + impact.

This is attacking at the fringe, from the outside in.

MORAL OF THE STORY

Invisible detection...

or when it is visible,
it's beautiful to engage with.

This is about less tech and more living.
It's all about the human experiences!

Integrated into our Daily Life

+

Increased Quality of Life

=

Culture Jamming our Denial of Health (for good)



BECAUSE what the data does, is lets us live *aware* of our health.

For example, being told ice cream is high in fat, high in sugar, high in cow milk = we can process "OK that's bad, but so what?"

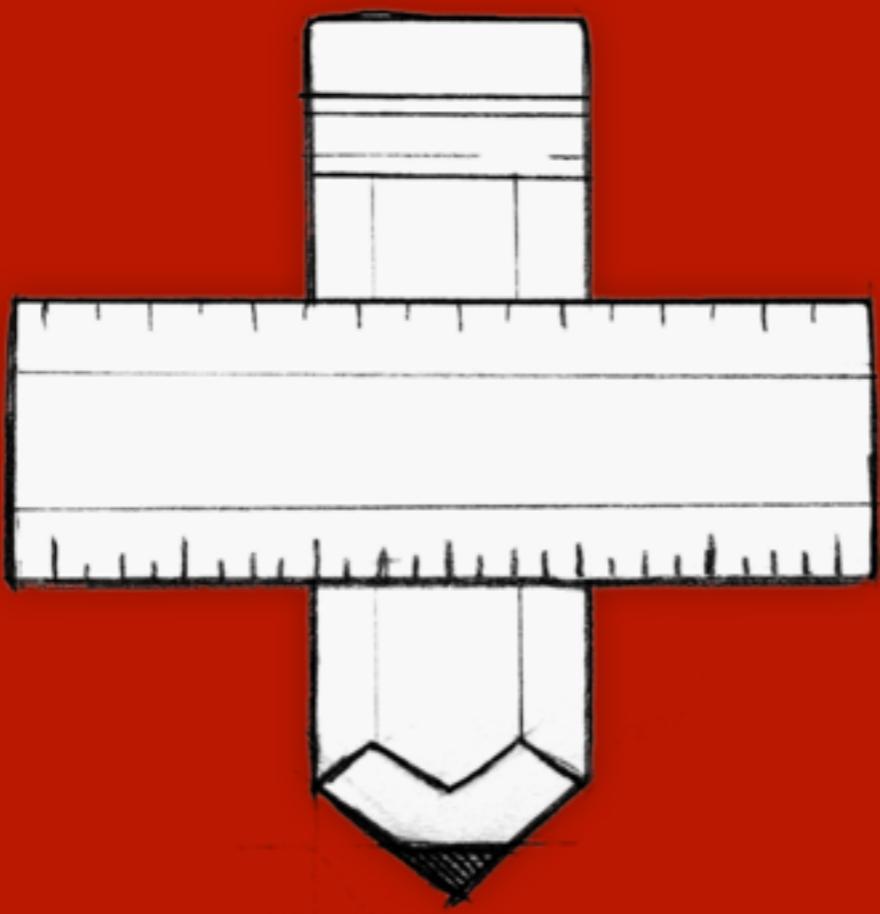
As soon as it becomes quantified, and not in an "I-have-to-keep-this-annoying-food-diary-and-look-everything-up" way



but in a "Here's my daily report and eating this way took two days off my life expectancy and – shit – my diet over the last year has taken 2.5 years off my life expectancy" –

THAT is when the entire world changes.

But not before.



Design is Medicine

Life first. Health a distant second.

Juhan Sonin
juhan@goinvo.com
Sep 2013

Special thanks to:

Harry Sleeper,
Sarah Kaiser,
Roger Zhu,
Eric Benoit,
Ben Salinas,
Jon Follett,
and
Dirk Knemeyer

HEALTH AXIOMS



On indiegogo today
igg.me/at/healthaxioms

Mantras for patients to change themselves, their clinicians, and the new digital healthcare system.

Grab a deck for \$15, including shipping.
Grab 10 for \$100.