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[00:00:00] **Josh:** What right does any person on earth have to say you're not allowed to have data about your body? I can tell you my blood sugar to within like five to ten points, just right off how I feel. 52 percent of people, American adults, have pre diabetes or diabetes. Your average glucose the next day, if you sleep seven hours instead of eight, would be 9 percent higher.

They just made up the

[00:00:17] **Dave:** 10, 000 steps and they started advertising it. Simple Movement is wildly more capable of controlling blood sugar than I would have thought. 50 year old recommendations from a government agency who actually hates me. Those guys think my blood sugar levels should look like this.

You're listening to The Human Upgrade with Dave Asprey.

Today we're going to talk about something that is remarkably fun and interesting. It is blood sugar. And you're like, wow, you know, Dave, you've written books on this. There's a lot kinds of people talking about it. I don't care about your religion around blood sugar. I care about data. And. The one thing that I committed to myself when I started the biohacking movement was I'm just going to do what works, which means as a computer hacker, you have something you don't quite know what's going on in there.

You poke and you prod and you measure what happens until you can get in and control the system, even if you never know how it works. And over time, science helps us figure it out. Well, I had a big problem with my energy levels because I had chronic fatigue and I weighed 300 pounds and had a bunch of other stuff on.

So I got into mitochondria and that means I also got into regulating my blood sugar. About 12 years ago, one of my followers who was a type 1 diabetic sent a package and she said, Dave, your work has really helped me as a type 1 because now that I understand ketosis, I have a backup fuel supply, so if my blood sugar crashes, I don't go unconscious and die.

Thank you. So she sent me her blood sugar 24 hour tracking thing, a continuous glucose monitor. And it was a very old one, and it was big, and you had to put it on your stomach. And she said, I think you'll like the data. And that was my first exposure to continuous glucose monitoring. And no, I didn't have a prescription, because you don't need a prescription to measure anything in your body.

So I used it for a little while. It was clunky. And then years ago, I started tracking from the back of my arm, which is just game changing for you. I remember I went on Dr. Oz and I had my aura ring on and I had my levels. CGM monitor on, and he goes, What's that weird white thing on the back of your arm?

And I'm like, Oh, that's just my robotic arm because I'm getting all my data from that arm and he just said, Well, it looks weird on camera, but okay, whatever. What I do though, and what I've done for several years, is I look at track my blood sugar. That means, How do I sleep? What did I eat? What did it do?

Because ultimately, if you have blood sugar spikes, you're gonna get old. So I have the founder and I'm going to say founder and head of engineering if nothing else for levels And you've heard me talk about levels multiple times because they are they're actually standing up for your right to know what's going on in your body and making it really easy for you to do this and It's a profoundly good app, but Josh is here because they have a new sensor that I'm gonna try for the first time And this one is super cool.

And I've literally never put one of these on before. Do I need alcohol for this one? You should swab. Yeah. I should swab, Ari. It's probably in the box. This is a sensor that is better than the old Levels sensor that we had. Actually, it would have been in the Levels box. Oh, in the other box? Shoot. What if I just lick my arm and stick it on?

Will that work? That, uh, typically doesn't, yeah. Guys, don't lick your arms. If I do it without, will something bad happen? I've done it. Yeah, they, I mean, they don't even put them in the box these days because they don't think they can. I'm just gonna do it. I've never used one of these. I twist it? Mm hmm.

Twist it left? Mm hmm. And a lot of times people are saying, you're going to wear like a wire. It's not a wire. It's like a little hair that goes into your arm. It's completely painless. And now this is an excuse to show off my gun. So see, when you put it on, you have to like really flex. Okay. You don't just goes about right there.

Maybe a little higher. There you go. I can even up there. Boom. Okay. And then I push the button on the side of this. Yep. Boom. Literally. You don't feel anything. It just feels like a rubber stamp hit my arm. And now I am getting data from a new upgraded sensor from levels. And because, well, I am an investor in the company and an advisor, I put my levels patch on to help keep it on my arm.

Although I find they don't fall off even if I don't put the cover on. Yeah. It varies person to person, which is interesting, the duration that they'll stay. It also has to probably do with how hydrated your skin is and things like that. And I did hydrate my skin this morning. In other words, that's the biohacker way of saying I used lotion.

All right. So I'm going to put this on and. I think I've got it about coverage. Yep. And I'm not going to think about this. It'll just show up on my phone like my sleep score and everything in this way. I can see what's going on. And one of the things I'm curious about, cause I haven't tracked in about three or four months, I'm 4.

8 percent body fat. It would be nice to add some body fat. So I've been eating like four plus cups of rice now for a while, and I'm not gaining any weight from doing that, which throughout my entire life I've been the guy who puts weight on without looking at anything. And so I finally fixed my metabolism and it's, it's actually ridiculous, but I want to know how much am I raising my blood sugar when I do that.

Because excessive blood glucose, even for two hours after a meal, it's not really good for you. It should go up, but it should go back down. If I eat stuff and it doesn't go back down, it means I'm doing something wrong in my biohacking and I gotta fix it. So, I wanna talk with you about everything continuous glucose monitoring.

Let's do it. Okay. One of the things I appreciate about you is you're a real nerd. Now there's health nerds, and then there's, I worked at SpaceX nerds. And you're both, which makes it a lot of fun. I'm a computer science nerd from Silicon Valley as well. So when I talk with you about what you're doing with data, what you've learned because you're talking to someone who's really gone deep on the data and on the science.

First thing though, why did you decide to not make spaceships and to make continuous glucose monitors?

[00:06:15] **Josh:** Well, I gotta say it was a hard decision. I really like making spaceships and, you know, that was something that I never thought I'd have the opportunity to do and it was a pretty surreal experience to be at a place like SpaceX.

I had no idea what was gonna happen in the journey. That was a small, it was a very small, unknown company in the world of aerospace when I started there and in 2010 I got to work on the first Dragon capsule that went to orbit and all the way through the first landing of Falcon 9 and then on to the most exciting project, which was the Developing.

I was one of the first people on the life support program. So taking the cargo version of a spacecraft and turning it into an astronaut carrying version of a spacecraft. And, and that's actually really where I was first confronted with metabolism and human performance. I'd always been somebody who cared a lot about sports and physical fitness, but I had not thought deeply about nutrition, mitochondria, the way the body functions on a, you know, on a biological and and sort of biochemical level.

And that's where I got exposed to it. And it just started to pull me in that direction because the depth of knowledge that we have, to me, relative to what we understand about our machines, is not cutting it. We have to do better at explaining the human health state and improving it and optimizing it.

[00:07:26] **Dave:** I've always believed that we're not going to get to Mars. Without biohacking and I got a chance to ask the president of SpaceX, like you've hardened all of your electronics for space. What have you done to harden astronauts for space? And she looked at me and she said in 17 years, no one's ever asked that question.

I'm like, well, maybe. That's cheaper than trying to just leave us in our squishy bodies with no knowledge and just hope that we get there and put, you know, astronaut potato chips in air. It's one of those things where the definition change the environment around you. Oh, in a spaceship, you own everything in that environment.

So you have control of your own biology. So you have to know biohacking to be able to go to other planets.

[00:08:06] **Josh:** Totally agree. And I, you know, I think, although that's ultra aspirational to think about Mars as the forcing function. I just like the idea of. We are we are on a spaceship. You know, this rock is float is flying through space.

We should be having this sort of optimization aspirational concept around our health around our daily actions anyway, right? And I love that we, you know, it's actually how I started thinking about this is that I'm, you know, working on the space program and I'm thinking a lot about the systems I'm designing, which include like the breathing system that delivers oxygen to the suits and that maintains a cabin pressure that's Going to maintain life and scrubs out toxins and puts out fires and all these things.

And we have all these sensors were able to measure in real time with redundancy every parameter about that spacecraft and we can deliver a perfect optimal environment. But when something goes wrong and you have to sort of cycle through some failure mode and get the vehicle back to operational and there's a human in there, how do you confirm this is this is a thought that went through my mind?

How do we know that there? Okay, that they're healthy that they weren't damaged in some way. That's going to progress. In fact, how do we know that they weren't already carrying some chronic illness onto the spacecraft in the first place? That's going to affect them. And then we're in some emergent situation in orbit or God forbid on the way to to Mars.

And so, and there's questions that had no satisfying answers. So that's what led me to start thinking about, well, what, what sensors do we have available? What can we measure about the human physiology, human biology today? Okay. And let me go experiment with some of those. And I came away like very frustrated.

There weren't any. Not only were there not any, but the only one there was, was a very early version of a continuous glucose sensor. And I was told that it was not available to me because I wasn't already

[00:09:49] **Dave:** carrying a disease drives me insane Yeah, like what right does any person or agency on earth have to say you're not allowed to have data about your body?

It's not in the Constitution. I didn't sign away that right. It's mine And if you try to take it away, you are an enemy of mankind.

[00:10:04] **Josh:** It's a property rights issue I completely agree. And in fact, I had that argument with that specific physician that day I said, you know, I was pretty, by the way, pricking my finger with a blood sugar glucometer.

[00:10:14] **Dave:** Me too. In my 20s, I did it 20 times a day. I was always bruised because they told me I had high blood sugar. I'm like, no, I don't.

[00:10:20] **Josh:** So exactly. So I'm doing the same thing. Black and blue fingers exposing, you know, I've got a bunch of punctures in my finger that are exposed to infection risk and all this stuff.

And I go in and I say that to the doctor, look, I bought this thing on Amazon. I'm tracking my blood sugar and I have this Excel spreadsheet and all this stuff. I want to get one of these CGMs, which is going to be much easier for me and it'll give me the same data. Yeah. No, you're not, you're not sick enough for that.

I was like, sick, sick enough? What does that have to do with anything? And I started to make the argument that, you know, first off, that's not how we design any system that we have control over. Wait till it breaks? I mean, imagine if Airbus allowed their A350 to fall out of the sky and then went and did the forensics to figure out why.

Well, you're not allowed to have a black box until it falls out of the sky. Right. Yeah. Now we'll, now we'll equip it. Now we'll go pick up the pieces and try to figure out why it failed. No, instead Airbus collects two and a half terabytes of data per flight day. And they do that across every functional system on that machine because it's failure critical.

Human lives are at stake. Why do we not take the same approach with human health? Equipping ourselves with enough information to know when something is starting to trend off course and intervening then and so my argument to the physician at the time was not as well thought out, but I was simply saying, like, that's not right.

I do engineering work. I have failure critical systems. You need to I need to be measuring this now, so I don't end up in that situation. And the second argument was that property rights thing, which is that this is my body. This is what you should be asking me for access to this information, not the other way around.

[00:11:43] **Dave:** Yeah, the failure state thing is, is unusual because a lot of people don't like to think about this, but being alive is a life threatening condition. You're, you're going to die and people will say, well, I'm going to live forever. The universe will probably collapse in on itself unless we don't understand something about quantum whatevers.

So it may take a long time, and I hope it takes a very long time for you and for all of us. But given that, we might want to have some data because even if you don't extend your life, you'll probably just have a better one. So the fact that anyone has the arrogance and the audacity to just say. I will limit your access with the stroke of my pen.

The appropriate answer for, for physicians like that is, I am going to not pay you. Because I'm paying you for what is legally required now, which is a permission slip to have access to my data. And I'm working really hard, and so are you, to just liberate, Our data so that I can say, you know, 50 year old recommendations from a government agency who actually hates me and wants me to die early so I won't have to collect social security.

Those guys think my blood sugar level should look like this, but I don't care. And the government thinks my diet should look like this. I don't care. What I care about is does my diet support metabolic function so that I can feel really good all the time? And since those guys aren't a part of my universe anymore, it's all about the data.

And then track my behaviors and looking at the data and it's so liberating because the first thing that frees up is your brain. Right? And you can think. Yeah. How many engineers who you've worked with at SpaceX or at other places are into this tracking their own numbers and doing something about it?

[00:13:25] **Josh:** There's a very high overlap between, you know, people who do jobs where you have to measure the state of something and those that reflect on their own health state and wonder. You know, how can I get get more confidence? And so I think that's how it goes is you start to learn a trade and you start to understand how important measurement and single variable measurement like accurate measurement is to being able to know anything.

And then you look at health and you say, like, I am flying blind. You know, the average person is getting blood work done, so they get their average blood panel. Every three to five years, so everyone, not everyone is getting an annual and it changes

[00:14:02] **Dave:** every four months or more frequently, right?

[00:14:04] **Josh:** So many numbers on that sheet change hourly, right?

I mean, they tell you to do it in a fasted state because if you weren't fasted, the numbers would be different. That's all the information you need to know that we do not measure sufficiently high resolution to understand human health. And so any person, today we treat it like an absolute lottery win when someone lives to a hundred.

We're just like blue zones centenarians. It's unbelievable. How did they do it? Well, it is unbelievable because they did it completely through luck. It's it's threading the needle in 1000 ways. And that doesn't have to be that way. There's no we can predict the failure modes again of our incredibly complex jet engines to within a number of hours.

We know how they break down and when that's going to happen. And we take them out of service or we maintain them. We could I know biology is complex. I'm not saying we'll ever have the same degree of confidence, but we can certainly get better than plus or minus 20 decades or I'm sorry, 20 years, right? I mean, that's where we currently are.

A lot of engineers, a lot of data. People inherently get this because they do it every day. What I think is important is making that more accessible to the folks who maybe don't have that sort of like brain chemistry that they don't think that way necessarily about life. And how do we make the devices as useful and accessible to every person such that it.

Each little tiny decision we make, because we make many decisions every day that are consequential, is compounding in a positive direction instead of a negative direction. And, you know, I like to say, our sensor system that the human body is equipped with Was developed in a different era it was developed in an era where all of our threats came from around us And so we have great vision and we can like touch and feel and smell and hear and that's all about observing You know what where the lion is gonna eat us what's gonna eat us?

What can we eat but you can't tell when you have a six ounce tumor on your liver? That is a real lack of internal awareness. We don't have the sensors for it So I think just, you know, luckily we got past the, the sort of tiger being the main, the main threat, but now we have like our incredibly capable agricultural system is the main threat and we can't observe the impacts that it has on us yet.

[00:16:06] **Dave:** I would argue that we actually do have onboard sensors for most of that. They're just unlabeled and our brains learned it didn't make any sense to, to pay attention to it. And they're called entero and interoception. And when you have any sort of signal. From the body that your conscious brain understands it will over time map it to a felt state So it's very hard to feel high blood sugar you can feel low blood sugar usually once you know what it feels like but if you learn how to How to look at your heart rate variability in real time or using the stuff that I do at 40 years of Zen the neuroscience You can feel a certain state and you realize oh all these people sitting in monasteries are trying to tell you Here's how to feel a state inside your body You And the whole world of somatic therapy.

And what's exciting about levels is that when you look at your blood sugar levels, thousands of times, which you'll just do, cause I just ate, I wonder what it's doing now. It just with curiosity, after a while, you'll turn on your interoception and interoception, which allows you to go, you know what, I can tell that thing raised my, my blood sugar.

It's, it's part because, you know, it should have done it. But you'll know if it did or didn't because there's this subtle change in your awareness of your felt state. Do you get that?

[00:17:20] **Josh:** Could not agree more. I think this is a beautiful, beautiful benefit of the technology. And something, by the way, that we, we have a, we have a good cohort to look at for this, which are type, people with type 1 diabetes.

They would know. People with type 1 diabetes, they have an acute life or death concern. If, you know, if they over or under. Medicaid with with insulin. It is a it's a life or life threatening concern. You can lose consciousness if you have too much insulin on board, blood sugar goes too low. And likewise, you know, you're causing significant damage if blood sugar stays too high.

And they have through, you know, unfortunately, having that acute life or death situation, pay very close attention. And they understand better than any other person that I've run into in my life. People with type one have an acute awareness of how Certain exercise will affect them. How sleep, a red eye flight, they know exactly how their carbohydrates have to be adjusted for the same amount of insulin after flying on a red eye instead of sleeping a full night.

And that is exactly the point you're making, which is that we have neuroplasticity. It's an incredible capability that we don't use enough, but when you start to give yourself close feedback between body and mind over and over again, You don't even have to do it consciously. You will start to learn and associate subtle things.

And for me, I know when my heart rate, in fact, I can essentially after six years using a CGM daily, I can tell you my blood sugar to within like five to ten points, just right off how I feel. So, you know, it's just the subtleties of, you know, when blood sugar is high. This is all measurable. Your body temperature goes up.

Your pulse rate goes up. Blood pressure goes up a little bit. When it's low, you have a sympathetic nervous system activation. You start to get some of those same stress feelings that you might get when going into a, into a meeting or something that's stressful. And so if you're cute enough, if you know what to look for, yeah, you can start to close loop.

And so I do think there's a way that we can hand off by having these devices. We can hand off some of that observation to the brain and get a better sense for it. But there's nothing really like having them. The quantitative view. I think people really love that too,

[00:19:18] **Dave:** but you, you want the quantitative view because there's no other way you're ever going to train your, your senses to do that.

I have something similar. I've had low blood pressure my whole life and two times it's led to life threatening situations. Like, you know, you, you pass out and that can be bad if you do it the wrong time. And I learned how to manage it a long time ago, but I can tell, Oh, my blood pressure is getting a little low because, well, one of those times, you know, involved a seizure and, peeing in the back of an Uber when I was unconscious.

Morning Uber. Right. So like, you don't want to that. Thankfully had an ER doctor in the, uh, in the thing with me and I'm no longer susceptible for that kind of a thing because I know the feeling now, right? And I know all the ways to manage it. And it's just built in, but most people wouldn't track it.

So what I find the levels does is it helps me to label a dial or a level that's in my body that I don't know how to pay attention to. So it's actually driving consciousness and awareness of my state in a new way. And that's entirely unrelated to diagnosing a medical condition. It's actually a consciousness tool if nothing else.

Let's talk about the difference between science and engineering and hackers. So I've been interested in this because I'm a computer hacker and a former networking engineer in Silicon Valley and a data center engineer and all kinds of stuff like that. So the first real. Engineer slash hackers came about in the early 1930s.

Can you guess who they were? Engineer hackers, that's an interesting

[00:20:52] **Josh:** I mean, there was a ton going on in the 30s, pre war.

[00:20:56] **Dave:** Yeah, that's true. It was driven by Rockefeller, unknowingly. So Rockefeller banned fermentation to make sure we would have cars that didn't burn ethanol. So there was prohibition for eight years, just long enough to get all the infrastructure for petroleum in place.

And during that time, we had our bootleggers, so they would take apart their cars. These were not scientists, and they would make their cars faster than the cop cars. So they had a pressing need to be able to do this. And after that, it was actually the guys who made lowriders. And these were the best hydraulic engineers on the planet.

So the, like, Cholo's from Española, where my family is from in New Mexico. got hired by the army to build the hydraulics for tanks because they can make their cars do things that engineers didn't know how to do. And from there, we started getting into hacking the phone system, the Freakers, P H R E A K.

And they're saying there's this complex thing, let's figure out how to get free phone calls though, using quarters. I might have had a device to do that. Sorry, AT& T, not sorry. In fact, that was where Apple got started. Steve Jobs was selling what was called a blue box. The very, very early days of it.

Did not know that. Oh yeah. Then, of course, we had computer hackers, which is kind of where I came into things in the 90s, cyberpunk and all that. And then we had phone hackers. So there was a time I'd take apart my Nokia 9600 or whatever it was called and I'd, you know, re solder different color electrodes and then we installed software and we'd do all the things to our phones and a lot of that's locked down now.

Thanks, Apple. And after that, what's left? It's actually hacking our biology. So we have this drive as humans to change things and to improve them and to make them better, to make them different. And of course it was inevitable that it would turn in on ourselves so that we could do this. So you don't need to have a car to jack it up because you can have a body and you can jack it up along the way.

Someone figures out how to do it and they might not know why. And the engineers are the ones who figure out how to do it and how to do it in a better way. And then scientists oftentimes come back and go, well, let's figure out all the principles behind that. And that informs the next generation of engineers.

But a lot of people who come on the show are scientists and they're at universities doing correlative stuff. And it's not problem solving stuff so much as it is understanding. And so when you take engineers and you put them at the human body, I think you get different results. It's not what doctors do either.

Doctors are rarely engineers unless they're functional and they're trained. When you look for a doctor to work with you on your health now, knowing what you know, what do you look for?

[00:23:28] **Josh:** That's a great question. And I think the framework that you're laying out there is a, is a nice partition, right? Scientists.

The scientific method is excellent at taking an incredibly complicated scenario and exploring it and and starting to tease out single variables and observing causation and and that is important to describe the state of the world. We need it. We need it. It's a, you know, understanding our place and what's happening around us is super important, but that is explicitly not engineering.

Engineering is solve a problem, take science and solve a problem. And so engineers are are the people who build bridges and they build, you know, cars. And so it's transportation. It's efficiency. It's understand problem state more than anything and certainly don't overdescribe it. And don't another way very much pay close attention to the requirements and trimming those down is as important as as like having a set of solutions.

Right? So like the simpler the problem you can you can Yeah. Sim or something down to the larger the number of potential solutions. And so that's that's I think what an engineer typically does. And then the hackers. I think the hacker concept comes from taking systems as they are and and finding the the Being able to, you know, strip and flip and reverse and change how the system was designed to function to solve other problems that maybe were never even thought of by the engineers, and they have a completely different sort of, I think, strategy.

And for me, I think the engineers mindset is the one that I understand the most. And for a doctor, you know, Peter Atiyah is a prime example, I think, right? Surgeon and engineer. And I think you see that in his approach to describing His understanding of science, medicine, and in his

[00:25:11] **Dave:** practice, and a lot of people get that.

Doesn't he though say in his book that you can't extend human life, and that aging clocks are unscientific? That always made me question whether he was like a 1970s longevity doctor, because the guys I see believe you can extend human life.

[00:25:26] **Josh:** Well, I think, you know, although he says those things, he, he also, for example, has been taking rapamycin, I think, uh, experimentally for a long time with the intention.

Oh, he's biohacking. Oh my gosh. Yeah. It

[00:25:34] **Dave:** must be embarrassing for

[00:25:34] **Josh:** him. I, I think there, there's some, there's some, there's some like needle threading he's doing there in terms of like what he's writing down versus what he's doing. And so there is some hacking there. Yeah. But, but I think my starting point is really to look more for the engineer, the person who understands the problem and can take, you know, like, take it down to the fundamentals and talk about solutions.

And understands that like when you're dealing with a complex system, you have, you have measurement and operational requirements and you need feedback to like, yes, to close those loops. And, and so they're, they're not the types who would push back on me asking to get a full body MRI because they understand that a full body MRI.

I'm not going to go after some incidental Loma, right? I'm going to use it as a starting point and then I'm going to get another full body MRI and I'm going to look for progressions. So people, I think people get a little concerned. When you have too scientific a mind about the approach a lay person is taking, right?

And so you can say, well, if you, if you take an MRI scan of someone's body, you're going to find something that can't be explained. And because you can't explain it because we haven't done the science yet. You may risk cutting someone open for no reason. And so therefore nobody should get full body MRIs.

An engineer says, well, if you're getting a full body MRI, does it harm you? No. So why don't you just take Get another scan and see if anything changed and now you've solved the problem because you're not going to cut anyone open for a reason that doesn't exist and you can now create a movie of how the body is developing and so that's, that's just the, the, the thing I, and maybe a hacker would think of that at first, but to me, I like to think of the science, the scientist and engineer and you know, there's a really nice, I think

[00:27:12] **Dave:** there's symbiotic.

And they are scientists enable the next generation of engineers to understand what's much more likely to work than not 100%. And engineers are ultimately responsible for did it work or not. And when science lies, say, you know, the big food industry engineers are going to be the ones that go I did the inputs you said worked in your whatever stuff you paid for and it doesn't work.

It doesn't solve the problem. Data goes in the wrong direction. And the, the idea of statistical process control. is something that unless you're in, in the field, you probably wouldn't know about. And what this means is, I have something that's working pretty well, a process, like blood sugar regulation or like a jet engine that continues working.

And you say, well, I want it to look exactly like this. But I noticed it's still within the okay thing, but it's starting to trend towards the edge of being okay. It's like when you go to the doctor and go, your thyroid's pretty good, Like, well, hold on. Is it in the middle of pretty good or is it the edge of pretty good?

And doctors are trained, unless they're functional, to go, well, you're within the range, so you're fine. But the reality is, if every year it's getting a little bit worse, your testosterone's dropping, your thyroid's dropping, you're actually trending towards death. And an engineer is going to look at that and say, well, from a statistical process control, don't I want a flat curve so I don't age?

And that my hormones stay where I want them because it's not about avoiding illness, it's about not pointing in the direction of illness.

[00:28:37] **Josh:** And I would go so far as to say, we shouldn't be thinking about protecting against disease. We should be thinking about improving our health. Yes. It should be, we need an aspirational concept around health again, because right now it's just like 52 percent of people, American adults, have prediabetes or diabetes.

One in two people are expected to have cancer. The numbers are so crazy high that everyone's just sort of like, when's it going to happen to me and has it happened yet? And it needs to flip. We've got to change our approach and it has to be, it has to be very much around, is that trend line, is the process trending?

In a favorable or unfavorable direction, and if it's trending, I don't care where the absolute value is, because the first derivative is heading in a dangerous direction. I love that you're talking about

[00:29:21] **Dave:** derivatives. That means angle of the curve, guys.

[00:29:24] **Josh:** Yeah, the rate of change. And so if the rate of change, even if, you know, if you're A1c, to use glucose terms, if you're A1c still hasn't exceeded 5.

9, so you're not pre diabetic yet, was it 5. 9? Six last year was a 5. 6 a year before that. If not, if it was five last year and 4. 8 the year before that, then your trend, even though it hasn't exceeded the pre diabetes threshold is pre diabetes is just around the corner. Like you're going to be this trend if it continues is going to lead to disease.

And we don't do any of that right now. I don't understand why. You know, it's really just like if it fits in the box, it's okay. Not only do we not do that, we don't even try to describe, you know, we give people normal ranges, right? That's what that's what doctors report against. Mhm. We don't even try to describe optimal.

We give it no thought. Optimal is the thing we should be comparing against.

[00:30:10] **Dave:** One of the, the reasons that I, I started the biohacking movement is that I wanted data from millions of people. We were talking beforehand years ago, I was a co founder of the first company to get heart rate from the wrist. So we got a 24 hour heart rate from millions of people.

Intel ended up buying the company and shutting it down because Intel isn't that interested in, in wearables as they probably shouldn't be. But what was fascinating to me was, I just want data for millions of people all the time because that's going to define optimal and now that we have all these devices out here and the kind of newest entrance for devices is the levels monitoring where yes, I can track my heart rate variability in my readiness score from aura or whoop and I can track my sleep.

Doing it for 17 years now, it's a lot easier than it used to be with a big headband and it's just changed my metabolism. It's changed my life. And I will say having my levels monitor especially when I started doing this quite a while ago. I mean, just when you guys were first getting started, I, I really did find that oatmeal problem that we all talk about.

And I was able to tune what I eat, but most importantly, I want to go deep with you on this. Thanks. I travel a lot like circadian disruptions a thing and the effect of travel and quality, but not length of sleep on my blood glucose management was insane, but you guys have crazy amounts of data. So I know my own story, but you have the data that I've been fantasizing about.

What do you know about sleep duration, sleep quality and blood sugar?

[00:31:42] **Josh:** Yeah, I mean, you're, you're singing my tune here. The, the beauty of the. Era we're in with computing and many miniature electronics is that we can develop devices like a CGM that can generate real time data over long time periods. And you can wear that on the back of your arm and it is, it is constantly collecting that data and surfacing it for you and that's going to be the future.

You know, I just want to make a comment here that right now to talk about science, like the gold standard in science today. Because studying nutrition, studying biology is so hard, is you take a lot of people, so this is called N in scientific studies, so N of thousands, but very few data points, because it's hard to measure people.

So you have N of thousands with very few data points per person, and we sort of average them in these, you know, quite simple ways, honestly, and look for the trend and say, like, did, did this intervention change anything across lots of very different people with very few measurements? The future, for sure, is N.

N of 1 with lots of data points. So you will be doing the same gold standard science. But on your body over the duration of your life, and so you won't have to because there's so much Confounding relationship here, you know, whether it's genetics or body composition or you know a disease that's progressing quietly that we don't know about You take that in the goal here is to have a large enough sample size that we sort of average all that out And that's how science sort of controls that now, but really what you care about is you it's not a selfish statement It's the fact is we are all genetically unique And therefore, we cannot do science in its most optimal way without measuring on a higher sort of time resolution and over longer durations.

And so that's just one thing that I think, like, science is going to be profoundly favorably impacted, biological sciences, by the advent of microelectronics and sensors like this. And we have started, so when we started Levels, it was just such an uphill battle because not only was, not only was the industry just not open to it, but also, there was no And this blew my mind.

There was no ground truth. There was no datum. We didn't know we didn't know so people, you know you can find tremendous studies on people with diabetes and what their blood sugar levels look like and Interestingly physicians are trying to help people with diabetes Manage their blood sugar levels back to a normal level that does not exist.

It hasn't ever been described

[00:34:06] **Dave:** There's a few university things on healthy young white dudes from the 70s That's probably about it. And even then the measurements weren't very accurate

[00:34:12] **Josh:** and they were discreet finger sticks or blood Vein draw so they didn't have so we're taking high resolution continuous data from a person with diabetes and trying to help them medicate to low resolution single data points from people who are fasting when they have their blood drawn and do not have the condition and Assuming that 88 okay 88.

Maybe that's the average fast and glucose level. What does that mean for somebody with a dawn effect? What does that mean after you drink alcohol? What does it mean after an intense exercise? Should I be injecting insulin because I'm person with diabetes in order to try to hit 88 at all times? Of course not.

It turns out I've spoken to physicians who who have had this experience They would look at the CGM trace of somebody, you know, with type 2 diabetes, for example, and they would say, you had a huge blood sugar spike at 530 yesterday. We really have to, you know, you must be eating something with a lot of fast acting carbohydrates.

And the person would say, no, I was exercising. And it was like, yeah, sure you are. Or got in the infrared sauna. Right. Right. And sure you were you need to increase the bolus in the afternoon to, you know, take on more insulin to keep that down and try to drop those carbs. And they were, They were actively disbelieving of their patient.

Then they, this physician, put on a CGM, went to her CrossFit class and said, My blood sugar hit 220 from a CrossFit class. And I now understand my patients were telling me the truth. And I was, I was probably intervening in a totally natural process of favorable gluconeogenesis and glucose release and glycogen release that happens during intense exercise for this person.

And my point is just that, This is the problem. We, we are, we do not yet describe normal, let alone optimal. And so Levels, one of the missions that we are on, and we're taking action on this. So we, today we have a 50, 000 person IRB approved study. It's been running for multiple years. It's a big N. Right.

Large N and large data points. So, we've been running this for over two years. We've had people can, people are able to come in and out of it. And some people have been just continuously measuring for that entire duration. And the objective of the study is, it is the general population descriptive glucose test.

Okay. Or a study. And so what will what will come out of this is we will be able to slice off cohorts based on what we know of their metabolic health, and we'll be able to describe and publish on what is, you know, average CGM data actually look like and what is optimal, something that's more aligned with, you know, the trends that we were talking about in a favorable direction.

And what does it look like? During this study, because there are certainly people inside of the study who have improved their metabolic health and who have, who have you know, gone in the other direction. And so our goal here is to get data eventually from millions of people and to feed that back into society as a, you know, a useful understanding of like, this is what the human body does when it is in all of these various health states.

[00:36:54] **Dave:** The URL for this, if you're really interested in knowing, say, what your exercise is doing to your blood sugar or your sauna or your cold plunge and things like that. Levels dot link slash Dave Asprey and you'll get two months of free membership. If you ever heard that song, this is put together before AI and researchers looked at music around the world and looked at everyone's preferences and they made an average song that everyone should like.

I've heard of this. I may have actually heard the song, but I know exactly what you're

[00:37:22] **Josh:** talking about.

[00:37:22] **Dave:** All right. And earlier you said, well, you care about what it does for you. And what I've found is that different people have different goals and my upgrade labs company, a lot of our members, this is a franchise, we got 30 locations now that are opening around the country and we're helping people train their metabolisms and their brains and bodies and all that, but a lot of our members do use levels and they're using levels because they care about getting data off their body.

And it's remarkable what happens when you combine all of that data, because when they come in to upgrade labs, we just opened an awesome, by the way, I'll, I'll take it. I saw that. Yeah. Excited. So we do a survey, like, what do you care about? And some people, I just want to lose the weight or I want to put on muscle or I want my brain to work or I want longevity and they're different goals.

It's all of a sudden now with this rich data set that you're making it levels. It's like, oh, if my goal is to look like that group, maybe I can make my blood sugar look more like that group. So you now are tuning your metabolism for the results that are most important. So people losing a lot of weight quickly, what does it look like?

Right. Versus people who are at a steady state or people are putting on muscle. And so this is the future of understanding the hardware that we're running that no one understands because we are not born with a manual.

[00:38:39] **Josh:** Right. Yeah. It's a fundamentally new modality of measuring the human body. And it's really funny to me because the continuous glucose monitor was developed for one purpose.

To adjust the medication amount for people with diabetes who are using insulin. It wasn't designed to be a breakthrough in like the first of its kind in a measurement modality that can help describe the human health state, whether diabetic or not. It was, it was really to measure a symptom of a disease so that medication can be, can, can be prescribed and, and adjusted.

And it's a super powerful tool and an important tool for, for that purpose. And I'm, you know, I don't wanna take away from that at all, but I think we missed the forest for the trees. We, you know, we, there's really an amazing development that was a, a leap. The first CGM and what's fascinating, it sort of closes the loop back to the introception conversation we were having, but in our dataset, in this research dataset, and this is preliminary, you know, findings that, that we will ultimately have an independent group you know, analyze and publish on.

But in, in that dataset among people with a BMI, the starting body mass index of 25 of above 25, which would be people who 25 I think is the overweight cutoff and 30 is, is considered obese. Just using CGM is dose dependent correlated with weight loss. So just using a CGM, duration of CGM use directly correlates with weight loss.

And the average person who starts with a BMI over 25 in this research data set, again, with no intervention, we aren't prescribing any diet, we aren't prescribing any medication, we aren't prescribing any medication. They, the average person loses 10 and there are people who have lost 10 BMI points, which can be up to 120 in the data set and from what we understand, this is driven by, you know, begins with and continues through the duration of their CGM use and how it really there's, there's one other element to it, which is how engaged are they with the data, right?

So are you logging your food in, in the product and then seeing because the food logging concept, it's not just about logging how much protein and how many calories you had. It's, it's a data point. So you, when you look at your blood sugar data and you say, I just ate this thing. And then the, the product now knows that something happened here and it can look at how your body responds to it.

And we provide scores on that. And so then, then we can prompt you to come back in and see, you know, how did that specific meal, how did that four cups of Actually affect you. And like you were saying earlier, was that a tight, you know, quick return to baseline spike or was that a prolonged duration spike?

And we can help close that loop for people. And so we've seen in our data set that when people actually engage with the product and pay attention to those loop closures, they lose

[00:41:12] **Dave:** weight faster and more. It makes a ton of sense. As someone who for years struggled with losing a hundred pounds of fat and you lose 20 gain 30 lose 30 gain 40 and all the yo yos it's maddening and what you'll typically do is you'll say, okay, I'm going to eat less and you start using your willpower and then your metabolism slows down your mitochondria like we're in charge of your energy.

And we know willpower just doesn't work over time. One of the few remaining. Calories in, calories out, kind of angry dudes Spencer Nodolsky just posted. He goes, you know, I've had people who've been able to maintain weight loss on my program for five years, and they just went on Ozempic to manage the cravings.

If you have a levels monitor, you can replace a food that raises your blood sugar and makes you fat with another food that satisfies you and doesn't raise your blood sugar, like steak. So all of a sudden now you're never hungry, you just know what to eat and the results are you don't have any willpower required.

This is why I think levels makes you lose money. Oh, I won't eat the potatoes because those are a problem for me, but maybe I can eat the cake if for some reason cake doesn't raise your blood sugar, but it just helps at least help me make better food swaps. And also a shout out to Rob Wolfe, who is one of the first nutritional influencers.

Who just said, look, different carbs affect different people differently. And he was sticking his finger back in the day when you and I were doing it, too, and ended up writing a book a long time ago about it.

[00:42:42] **Josh:** That book is where I learned about CGM. So it was Wired to Eat. I was doing, uh, during that SpaceX era, I was doing the glucose related diet.

I was doing his sort of calibration with finger sticks, and that's why my fingers were so trashed. And, and in the back of the book, he's like, there's a CGM. This exists. This was 2017. So, yeah, exactly. I mean, your point is, Perfectly made we we have the ability again. We can start to think of ourselves as a little science experiment, right?

And you can see you don't have to be hungry You don't have to go on ozempic to control cravings if you can see that there's a way to get satiety with a very clean sort of biological response and The thing that the Spencer Nadolsky's of the world haven't yet embraced Is that because of what I think is a bit of dogma around calories are the only thing that matters.

It's so easy to disproach. It's just, you gotta go one layer up. Okay, I agree with you. A calorie is a calorie. That's a thermodynamic unit. It's essentially irrelevant. It's like saying heat is heat. Fine. Is every macronutrient a macronutrient or are all macronutrients equal? That's the question that we need to ask.

And what people are seeing with the levels approach and really with this closed feedback loop is that. Exactly, like you said, if you're eating the potato, different macronutrient, still has calories, and then you eat the steak, different macronutrient, still has calories, you can see how those affect you, both in terms of the quantitative, how does your blood sugar respond, and the qualitative, am I full, and you can connect those dots, and it becomes effortless, and this is, this is the effect that we're seeing in the research data set, because we aren't saying everybody eats steak, We're letting people do their own thing.

And we have people who are vegan, we have people who are carnivore, and they can all find a mode that helps them manage blood sugar, increase peace of mind, understand their metabolic state, and feel full and lose

[00:44:28] **Dave:** weight. That's the thing, too. It's not the same for everyone. Right. And the reason I like this idea of biohacking is we'll test it.

And just do what works and if I, I've done a carnivore before we called it that and I was stress testing the edges of the bulletproof diet and I've been, you know, a radical raw vegan, like I've tried all the different things to see what's going to work and sometimes you see it in blood sugar. Sometimes you don't.

And if you take all of the CGM data, uh, And then you take a bunch of other data sets around inflammation, all that, I think there's a good case for sometimes having an empty stomach, no matter what your diet is. And how often? Well, it depends on your age, your gender, and your stress levels, right? You know, and, and Jack Dorsey's been a huge fan of biohacking for a long time, but I think he might have overfasted for a period.

There were his, like, I just don't eat on the weekends, I eat one meal Monday through Friday. There's a window, and if you look at blood sugar, and you look at a bunch of other things, I think some people do well in carnivore because plants are so toxic for their biology. It's just better. But if you were to take them and just give them like a spoon of pure sugar, just pure glucose every now and then, they'd probably do better because they're glial cells.

Well, you could measure how much that's going to raise their blood sugar if they do it, right? So I could be wrong about all this stuff and what works for me might not work for you. Um, but I look at blood sugar as a really good indicator of, is your metabolism working? And if your metabolism works, your chances of cancer, diabetes, heart disease, and Alzheimer's go down through the floor.

So if people just learn how to do that, and if you give us the data, I can't wait to see your 50, 000 person study, because I'm well aware that when I eat carbs, my blood sugar goes up. It's supposed to do that. And it's how rapidly does the body clear it, right? And then from a longevity perspective, you have people say, well, it should never go up because, of glycation of proteins, which is what happens when sugar in the blood sticks to proteins and causes a reactive oxygen species that aren't beneficial.

Well, maybe I don't care that much about that. I take carnosine and other things that block glycation as part of my longevity practice. But if my postprandial blood sugar spike, in other words, if I eat and my blood sugar goes up, how much does it go up and how long does it stay up? Those are really important variables.

I don't know what the right number should be. I don't think it should be zero because throughout all of human history we've never done that. But I'm open to it being zero if there's data. And you're the only person in the world that I'm aware of. Who is working on solving that problem. I think it's the coolest thing.

And you're making me feel really happy that I invested in you guys when you first started. So I just I'm genuinely grateful that you're so curious about this and you have an engineering mind and a scientific mind.

[00:47:08] **Josh:** Yeah, I mean, it's, it's been an awesome opportunity. And I should just say, like, it's very selfish.

This project for me is I want to understand my own health much better than the current state of health technology allows me to. I want to understand my parents health and I want to help them extend healthspan and live a longer time. And I don't want to throw caution to the wind and just hope for the best the way our current system is set up.

I don't believe that a blood panel that has rigid cutoffs is the appropriate way to think about this because we all know that this is a gradient. And the, in fact, the point at which damage starts to happen is different person to person. This is another thing that's interesting is we use these universal you know, A1C values.

Yeah, we know that people with different genetic backgrounds have a higher risk of heart disease heart attack and diabetes onset at different thresholds of, of glucose irregularity. Look, I mean, public health is not a dirty word to me, but at the same time, when we try to just remove all of the individuality and try to come up with one size fits all solutions, whether it's nutrition, Or medical guidelines.

We fail.

[00:48:14] **Dave:** All we do is we get that song that no one

[00:48:16] **Josh:** likes. It's a song no one likes. And, and so we, you know, we should just embrace the opportunity here. I think it's a little bit when, when you're a physician who has a lot of patients and very little time with them already and you're faced with the idea of having to look through reams of ECG data from an Apple, Apple Watch and reams of CGM data and reams of food log data.

It can be overwhelming and I understand people are thinking like how am I possibly going to be able to keep up with this with all my patients and the answer is your doctor is not the one who's responsible for keeping you healthy. We have to change the paradigm.

[00:48:45] **Dave:** Oh, it's your employer.

[00:48:46] **Josh:** It's the individual themselves.

[00:48:47] **Dave:** It's your government. It's your daddy. Oh, oh my gosh, you're responsible for your own health and that means that from a health perspective, your doctor works for you. Your health insurance company. Well, they just don't work at all. So we can ignore them. Ideally, you don't need the health insurance. I mean,

[00:49:00] **Josh:** that should

[00:49:01] **Dave:** be Unless a truck hits you.

You shouldn't ever need one.

[00:49:03] **Josh:** That's, that's how I think of the future is one where the individual has the tools and is empowered to understand their own health state, the cause and effect of changes in their health. And then the physicians off the hook. They don't have to worry about going through reams of Apple health data.

We are in an era now where AI models are going to massively improve the opportunity for this to become a reality like now, instead of say, you know, decades in the future, because an LLM is going to be able to give you insights that your physician would never have been exposed to. So I'm super optimistic about it.

I mean, the way this is going to impact our quality of life, and I realize I Did not answer your question about sleep because I got excited about research stuff. So did I. But this is where it's gonna, it's gonna manifest in, in ways that, you know, so another early finding from our study, sleep and, Blood sugar control are fascinating.

There is a strong correlation on average, but if you remove certain cohorts, the correlation gets super strong. So some people do not have the same dependency on consistent sleep that as most people do. 5

[00:50:03] **Dave:** 10 percent of people. Completely do you find, I just interviewed John Demartini. He's got four hours of sleep for 30 years straight and he's 70 and he does not look 70.

[00:50:12] **Josh:** Well, right. Yeah, this is, and I, I suspect it may be even a little more common than that. Although there could be, it could be that there's that five to 10 percent who biologically don't need it. And then there may be a situation where you have maybe like another 10 to 15 or 20 percent who just sleep really, really well and have good body composition in our athletic.

And so they are in a state of, of. Extremely quality rest and recovery. And so when they sleep a short night or take a red eye flight, the impact on their biology, their physiology is not as pronounced. But if you look at the average person the trend is a single hour less sleep. So one hour costs you about 9 percent of your average glucose control.

So your, your average glucose the next day, if you sleep 7 hours instead of 8, We'll be 9 percent higher. That's the average.

[00:50:58] **Dave:** Why is 8 the set point? Or did you not make 8 the set point to start measuring Tom?

[00:51:03] **Josh:** We, that's, that's if you sleep 7 instead of 8. I don't know if I misspoke there.

[00:51:06] **Dave:** Okay. I'm just sort of thinking, you know, 9 percent less than 8 hours because I, I found two different studies, one of 3 million people and one, I believe of 2 million people over multiple years.

And they found the lowest all cause mortality at 6. 5 hours. Hmm. And. My belief there is that people who are healthy metabolically require less sleep and like the thousands of people have reached out to Dave and went on the Bulletproof diet and I wake up in an hour less sleep and I feel really good and I'm losing weight.

Yeah, me too.

[00:51:34] **Josh:** Wouldn't it be great if we, if we understood what we're approximating when we say something like six and a half hours is the right amount where eight hours is the right amount. There's some health state that we're trying to achieve each night when we go to sleep. And there is a way it's the information is there.

We haven't captured it yet to be able to say that is a sufficient sleep for that that individual. And that's the thing I look forward to is right now we're using these really rough approximations. Did you get your 10, 000 steps? You know, is your A1C below six? Did you get eight hours of sleep? You know where the 10, 000 steps came from, right?

Just it was randomly pulled out of in air from a Japanese company.

[00:52:07] **Dave:** It was even from data. It was a 1950s Japanese company. I'm forgetting their name because I did all this research because I had the first fitness tracker wrist space heart thing. I'm like, where's this number from? It turns out this Japanese company made a mechanical pedometer that clipped on your belt.

They just made up the 10, 000 steps and they started advertising it and it just became part of our belief about reality with zero science behind it whatsoever. The real data we've seen now is probably closer to 8, 000 steps depending on the person. And so for me, the, the two most important daily tracking things are What's my blood sugar doing in my CGM from levels and then it's what is my heart rate variability on average last night?

And if I had to add a third one, it's how many minutes of deep and REM sleep did I get and on a good night? If I wear my my true dark glasses I can do 90 minutes of REM and 90 minutes of deep sleep in five and a half hours Wow, and six and a half hours very very likely Right. And like you said, there's some people who can just do that.

I was a five minutes of deep and five minutes of REM when I started tracking 17 years ago. And I'm like, what are all the variables in my life? They're going to let me get good sleep and I can fly to Europe with no jet lag, because I'm tracking all this stuff, right? And I share it as much as I can. But again, I'm just one person and I know the reasons and the scientists have done good work.

A 50, 000 person data set, you'll be able to say you think you got enough sleep and maybe your heart rate variability, which measures recovery is pretty good. But your blood sugar is still dysregulated. So since you didn't get enough sleep because you were on an airplane last night, take some chromium and your blood sugar will be regulated.

[00:53:47] **Josh:** Yeah, that's, that, you know, this, this first descriptive study is going to be really helpful to, to sort of paint the picture of where we are today. You know, what, where is the, Average person inside of the whole population inside of these sub cohorts and we'll be able to describe, you know What these numbers look like but yeah I'm really excited for the future where we can start to do targeted interventions and There is a world where we over rotate on just glucose control.

Yes, and It's super important that we again, as I was, as I was saying, like this device was developed for symptom measurement and levels is bringing that to sort of upstream of the disease that drives the symptom because we want to correct course and avoid the next 100 million cases of diabetes. It's not a, it's not a disease prevention tool.

It's a health optimization tool. And if you optimize health, you are moving away from disease, but we have to extend this into additional measures, right? We need to start to synthesize all the information we're currently collecting, our sleep quality, our heart rate, heart rate variability. For me, HR, HRV, and heart rate in the morning, I look at both of those.

If my minimum heart rate dropped below a threshold which is around 43 for me, and my HRV was above a certain threshold, I know that I was well rested last night. And if, and if those values, they tend to work, they tend to move. From the same things. So if I ate late or I had a particularly you know, stressful evening, like I won't sleep super well.

So anyway, I'm looking at those and what we, and so we have like a good number of metrics, but the potential is essentially limitless to truly be able to define health state in a, in a high resolution way with additional metrics. And it doesn't have to be that we 100 sensors. It's just, you know, I'm looking forward to the next generation technologies, taking this concept, recognizing the opportunity and bringing more metrics.

Thanks.

[00:55:33] **Dave:** If

[00:55:33] **Josh:** this

[00:55:33] **Dave:** is sounding interesting, that's because it is go to levels dot link slash Dave Asprey and Josh will give you two extra months of membership when you sign up for it, even if you don't do this for the rest of your life, I go through phases where I do levels a lot and then I think, you know, I'm just not going to do it for a little while.

That's okay, but what I want you to do is just wear it for a few months, maybe a year, and you'll have so much Like downloaded information about what it feels like to be in a regulated state with your blood sugar and you may decide it's worth it to wear it forever. I've been doing this for what, 7 years now?

How long have you guys been around? Yeah, about 6 years, okay. I know that I had it right before you guys got started and so for me it's been 7 years and I would say probably 70 percent of the time. I've been doing it, and it works. So, track your sleep, track your blood sugar, totally a good decision. I have this fantasy that one day, ten years from now, we're able to take all of our levels data, all of our other tracking data, and all of the video that's recorded from the surveillance state that people built on the original internet that they weren't supposed to do that to, and even your webcam.

And the accelerometers and audio sensors and put all that data together and correlate it with blood sugar so that you can just have a camera looking at you and tell you your blood sugar levels. I think we'll be able to get enough data to do that.

[00:57:07] **Josh:** I've been wrong about what large models are capable of doing too many times to say no.

So I think the answer is, I don't really know. And I'm really excited to find out because what what comes first. It's having the ground truth data. We have to start there. We can't approximate through camera vision what your glucose is. We need that ground truth to train models to be able to eventually do that.

And yeah, I think in the future, we do have synthesized models that are looking out for us. You know, instead of the devices being reactive to your inputs, they're going to be proactive to, like you said, you get off an airplane and yeah, take chromium or rearranging the menu on the takeout. Restaurant to just have foods at the top that are going to taste good that you like and that support blood sugar control or reduce inflammation or whatever it is that is most pressing for your individual biochemistry at that moment.

That's where we're heading. It will be effortless. We don't have to think of this as like a really painful math problem you're solving in your mind at all times.

[00:58:04] **Dave:** A lot of people say I want to be healthier. I want to lose weight. I want my brain to work better. I want to manage stress all that stuff.

That's where we're headed. But it's just too complex. And I'm like, Oh, just listen to 1200 episodes of this show and read all eight books and buy a bunch of trackers and you'll be good. Of course, I don't say that. So the thing is we're engineers and nerds and biohackers and all that kind of stuff. And we do this for a living and it's fun and interesting.

And we're wired for that. And if you're listening to this going, this seems like a lot. I want you to have hope because you don't have to do everything. You just need to get a signal and just, what did I do last night? Why is my blood sugar jacked up today? And just be a little bit curious. Oh, look, I ate my favorite meal and now I look like I'm diabetic for a little while.

What was the one thing in that meal? Without having to understand the hows and the whys and statistical analysis and all that kind of stuff, just understand this is coming and it's coming really quickly. And, you know, right now, just like you can wake up and most listeners have a sleep track or some sort, you know, how'd I do?

Well, what if after every meal, you're like, how'd I do? And then the cool thing is, Oh, look, my blood sugar is trending higher than I wanted. Maybe I can do 20 air squats. What does that going to do to your blood sugar?

[00:59:19] **Josh:** Yeah. So in, in the research data set, the impact of movement, simple movement is wildly more capable of controlling blood sugar than, than I would have thought most people, you know, I'll use, I'll use steps actually to refer back to the, to 10, 000.

But there's, there's just a, you know, a 40 percent negative correlation between number of steps and total glucose. And and so you're like average glucose. So you can actually reduce blood sugar and the slope is 40%, meaning like 4 in 10. I don't know how to describe that more effectively, but you can imagine like as your steps increase, your average glucose is decreasing and the correlation is 40%.

And so that is profound because people typically think that you have to get like a ton of exercise in, um, Go to the gym, run on the treadmill for 90 minutes to have some improvement to your health. But the reality is, if you take 15 minutes after a meal, and like I said, if you don't have space to move around and walk, do air squats, activate the largest muscles in our bodies, our muscles can pull in glucose without insulin.

So it's doing this without increasing, you know, insulin production and potentially driving up insulin resistance. You can do this completely without insulin. You can absorb that glucose directly out of the bloodstream. And walking does this, air squats does do this. It's really activate the large muscles.

We did a, we did a trial, you know, so our, our, you know, the early research shows that this is across the population. This is the case. And you know, we've also done, Little, like, case studies. For example, we did a Coke experiment where we had for science, we had everybody who wanted to would drink a full sugar Coke and just be sedentary.

You're at your desk, drink a Coke, and then observe the blood sugar response, right? And so this is just pure sugar, it hits the bloodstream instantly and that's the worst case scenario, right? Most, most foods, they have fiber, they have protein, they, they break down over a longer time period, and so the blood sugar response won't, won't be as aggressive.

But we went with Coke deliberately because we want that, that response. And then the next day, drink another Coke and walk for 20 minutes. And the area under the curve reductions on average was 28 percent lower peak. I'm sorry, lower entire area under the curve. So the integral of all that time that it was elevated was reduced by almost 30%, but some people had like a 75 percent reduction in that blood sugar elevation.

So everybody gets benefit. Some people get like, they just erase the curve altogether and it's all they're doing is strolling. They're not running, they're not panting. They're not, you know, they're not at the gym. And, and so like this is, I think some of the powerful stuff here is just having that, you know, you sit down, you eat lunch, 30 minutes later, you get, you start to see the feedback and you can start to put together these subtle tweaks where maybe it's just a walk when I eat a certain type of food or a certain portion size.

Maybe you introduce a walk after every meal, you know, the air squats, maybe they work the same for, for some people.

[01:02:01] **Dave:** I've gotten to the point where I have more biohacking technology than I do hours of the day. And I have more best practices too. And they're powerful. And so my challenge over the last nine or so years at Upgrade Labs has been to use science and data to say what are the practices that take the least amount of time with the least amount of suffering, because some things don't feel that great, that will most dramatically get the results I'm looking for.

So VO2max, 12 percent shift in 15 minutes a week, which is six times better than an hour a day. And sure, going for a walk is great, but if you live in Canada, it's dark after you eat, and it's raining anyway, at least on Vancouver Island, so you're like, I'm not gonna go for a walk, what can I do in five minutes?

So it's air squats, or whole body vibration is another tech that we use. Right? You can stand on the same thing they use to help astronauts recover bone density and it vibrates the whole body, which causes all the little micro muscles to start taking up glucose. So, just like you can say, what do I eat that causes my blood sugar to rise?

And Lovell will tell you. Then, what can I do afterwards that's effective for me that'll drop it? Maybe a cold plunge after you eat. That's going to definitely work because you're going to start taking up all of that sugar in order to create body heat. But it might be much better for one person, and not so good for another, and for another person it'll raise their cortisol too much, and then it'll dysregulate blood sugar, because cortisol raises blood sugar.

Yep. So it's this fascinating game, where even if you don't understand all the stuff that I just said, you can say, well, I'm gonna have a signal. Was my meal okay? And is what I'm doing now helping or making it worse? And once you know that, you don't know anything. That's the hacker thing. I don't know what's going on in there.

I just know if I do this, I get this. Therefore, I control the system. And that's the very base of everything.

[01:03:48] **Josh:** Exactly. And you touch on a concept controllability, right? We're trying to control health and an observation like observability of a system is necessary in order to be able to control it. So, so that is, it's a duality.

You must have one in order to have the other. You know, the last thing I think just on the complexity of all this, because I do, I do agree that some people here. All of the gadgetry and all of the attention paying to these curves and numbers and can get overwhelming. And the other thing we're doing with the research data set is we are building models that can show you the blood sugar response for the average person like you, whether you have a sensor on or not.

And also the food swaps and alternative actions. That help control a situation like the one that you just saw in your body or may have just seen had you had a CGM on so our goal is to make this much more approachable for people that don't necessarily want to use a sensor when you have we have 1. 8 billion data points in our data set right now when you have that Quality of data and our logging which we have AI logging now you take a picture and it can break out all the macronutrients and does an amazing job with portion control.

We, we're making it such that the barrier is low to be able to log a certain thing. This is something I just did. And then to get feedback from the data set whether it's, unique to you because you have a CGM on, or it's the best estimate the model can provide for other people who have done the same action.

The delta is just whether or not you want to wear a CGM and whether you want that specific absolute value number, or whether you want the guidance from the dataset.

[01:05:17] **Dave:** So levels can help you learn from other people's suffering, even if you don't wear a cgm. That's a succinct way to put it. I mean, that's basically my whole life.

Everything I've learned from someone much older than me is, is learn some stuff and pass it on. I was talking with my son recently, who's a teenager. And just a great human being and how do you know all this stuff? And I said, suffering,

[01:05:46] **Josh:** there you go. A lot of effort, at least. Yeah, yeah. I mean, I don't want to make it seem like it's suffering to use the tools, but it's just the effort of people in the process,

[01:05:55] **Dave:** mistakes and spent thousands of hours trying to manage their blood sugar and people who have eaten meals that made me feel like crap.

You could just eat a bunch of meals that make you feel like crap and dysregulate you and figure it out. Or you could say, well, everyone else already ate those meals. Why don't you just tell me what's probably going to work for me and then measure whether it does. And that's what I mean by, by saving you with other people's suffering.

Because every mistake someone else has made where you capture the data and we call it a mistake. Well, they just made a decision. Maybe they liked their, you know, their dessert or whatever it was, but we just know what it did. Yep. So now we have predictability so that instead of having to experiment to know what's going to happen to me, someone else already ran the experiment.

I just get to know what's likely to happen and maybe you say, okay, that didn't work because I have my levels on. So then you're slightly different than the average person there. And then it just creates a starting point.

[01:06:42] **Josh:** It's clarity, you know, a place to start. And I think everybody learns from pulling on a thread and, you know, seeing what happens.

So,

[01:06:48] **Dave:** yeah, I'm just thinking I really started trying to lose weight around 16 or I'm like, I don't like having a triple ripple. And I got up to 300 pounds by the time I was 23. And I mean, I was trying everything. So I worked from 16 till about 36. So that's 20 years to try and figure out my metabolism. And if I'd have had levels back then and a little bit of biohacking knowledge, It would have saved me an enormous amount of money and time, enormous, and in fact, that's what's motivated me to write all the blog posts and books and to do the show is if I could only have told myself this like at 19, it would have been so liberating.

So I just have to say, if you're a young person and you're going, why is my body doing this, A, try biohacking, but B, get the data. So you have to guess about why. And then you're going to say, uh, maybe that Red Bull, even though you think it has no sugar maybe it wasn't working for you. And in fact, uh, Damon John was just on stage at the biohacking conference from the shark tank and he was doing exactly that.

He was drinking Red Bulls for energy and then he got his glucose levels just a one C and he said, Oh, I'm actually pre diabetic and like, I didn't realize it was going on. So he actually went on a longevity and health kick and it's been cool because we've been chatting about it. And how would anyone know without the data?

And so just real time data versus once a year data, life changing. So I, I'm, I'm super stoked. And I have some specific questions for you that I know listeners are going to want to know about. HIT training versus endurance for cardio, which one is better for blood sugar?

[01:08:26] **Josh:** Well, when you have the high resolution data, you find that there's an, an interesting counterintuitive element here.

So long term, I think both matter. Short term, I would say that the most. Powerful tool in the tool chest for controlling blood sugar is lean mass lean muscle mass hit is more associated with Maintaining and building muscle mass than endurance training In fact, it's possible and I've actually done this to lose muscle mass through a lot of endurance training If you're not compensating with more intake but if you Put a device on it.

I think basically I think zone two mitochondrial training is super powerful. Oh,

[01:09:04] **Dave:** it's long term

[01:09:05] **Josh:** super powerful. If you want to spend three or four hours a week. Yes, which I don't short term if you put a device on and you put a CGM on and you observe what happens to your blood sugar when you do an intense workout versus doing his own to run.

So I myself have a very reactive blood sugar response to exercise. I don't really understand why yet, but if I'm just doing his own to run for an hour. At about, basically my blood sugar just monotonically decreases through that time frame. It just lowers and lowers and lowers, and I will actually bonk.

So I'll hit, I'll hit 60s blood sugar, 60mg per deciliter. And I can feel it coming on, and it's terrible. But bonking sucks. Bonking's the

[01:09:41] **Dave:** worst. I used to be a chronic cardio guy, even when I was a teenager trying to lose weight. Bonking's like, the worst brain fog ever.

[01:09:47] **Josh:** It is awful. It's a, it's a physical, you lose all of your, your energy.

Feel sick, hungry, shaky. So that happens to me like clockwork. I have to eat a very specific diet in order to avoid that. But my, basically the, my body's in a completely different physical state. And so blood sugar will be, my, my point I guess is that blood sugar will be acutely lowered by zone 2. So it will seem like it's more powerful long term for blood sugar control.

If you were to do that and just observe like, Oh, it, zone 2 lowers blood sugar. Hit, like zone 5, your body is going to activate a sort of fight or flight mode. Cortisol and adrenaline. Yep. Cortisol is going to get released. Cortisol is a glucocorticoid hormone. It releases, it drives blood sugar release into the, into the, into the bloodstream to distribute to the muscles.

And that is a, when you're watching on a CGM, that is going to cause a blood sugar spike. And so I've easily exceeded 200 milligrams per deciliter doing, you know, HIIT workouts. And it, and that can also, it can feed this idea that, oh, this is, so zone two lowers blood sugar, HIIT increases blood sugar.

Thus, HIIT must be. Not good, and Zone 2 must be good. Not the right takeaway, and we really, you know, we have a lot of educational materials in the app to show that, that, Hit, muscle building, intensity building, capacity building, VO2 max building exercise long term is associated with better reduction in blood sugar levels long term.

And zone 2, although again, I do think mitochondrial training is really important. There are lots of endurance athletes who have pre diabetic blood sugar control. Tons. And I think there's a, there's something that really has to be looked into there because I think there, it may be an overtraining element where the body's in a chronically, uh, sort of overtrained state.

Yeah. So that's, that's kind of my spiel on it. I do a bit of both, but I definitely, I will say that over the long duration, you have to, you have to sort of recognize that that spike is a completely different physiologic circumstance than eating Skittles. Totally different.

[01:11:39] **Dave:** Yeah, unrelated. Have you, by any chance, read my last book, Smarter, Not Harder?

I have it on my desk. I've, page three, I have not yet finished it. Got it. Thank you, by the way. I know you probably get as many books sent to you as I do, and it's hard to read them all. There's a stack, yeah. There's a principle in there that's just emerged over a lot of time on how do I drive change in less time.

A lot of it driven from upgrade labs data, and I call it slope of the curve biology. It says that what's driving change in biology, the most quickly at least, is the slope of the curve up on a stressor and the slope of the curve down on a stressor. So it's how rapidly did you stimulate something and how rapidly did you resolve it and return to a calm baseline.

And that if you show the body this state may happen again, but now it's safe and it has enough energy and enough micronutrients. Oh, I might as well become more stress adapted to that state. And what that means is that the derivative for engineering speak, you know, the slope of the curve is much more important than area under the curve.

So it could even be that when you're doing this high intensity training, the fact that your heart rate goes up, your stress hormones go up, and your blood sugar goes up as a response to the stress hormones, but then if you do that high intensity interval, even a reduced exertion one, where the data I think is strongest, And, but you return to baseline quickly that the body says, Oh, I'm good, right?

And then it's able to change. And so I've been looking less and less at amount of work done and at rate at which I have to do it and rate at which I can recover. And I think recovery drives better blood sugar stability and especially in chronic endurance athletes.

[01:13:16] **Josh:** Yeah, I, I certainly agree with the, the recovery you know, the ability to recover the sort of resilience of the system is what we're trying to improve.

You know, if you can, if you can do. high power, like, you know, lots of work in a short amount of time and recover quickly. That's a really resilient physiology. That's what we all, I think, want and to be able to adapt to that. So I, I, I like that concept. I think it also maps to like what you see with CGM.

Again, like if you, if you have a rapid blood sugar change and your body can't recover for hours, that shows a low resilience to the load state, the conditions that your body's being exposed to, especially if it's something that you do every day, if you're having that frappuccino every morning, and that's how your body's responding.

That's a huge red flag. If you can take on, you know, 400 grams of rice or whatever, sweet potato, whatever it is. How do you do that in one meal? I do it in two meals. Some people, I'm sure, you know, given their state of training and their resilience, could and would return rapidly to baseline and not have like an overcorrection and a reactive hypoglycemic event where your blood sugar goes low and then your body has to produce, actually, re release glucose into the bloodstream and you sort of like, spike all over.

That's the sort of thing that you're looking for that that would tell you that you're, you're not, not managing that. That glucose very well. So I think that, yeah, I do like the idea of focusing on on slope of the change and on really, I think variation, you know, those are the two things if you're able to, you know, take, I call them load conditions.

It's an engineering thing. But, but like, you know, we're such a nerd. I love

[01:14:42] **Dave:** it.

[01:14:43] **Josh:** I mean, we another problem with our current health care system is we measure in the best possible circumstances. We measure the human body. Yeah. You know, we do a fasting blood draw again, fasting in the morning, nothing's happened yet.

We basically set the conditions to be optimal and then we measure and we wait for that to be a marker of things have gone too far. Like when you're in your best possible healthiest moment, that's not what we need to worry about. It's when you are being tested, when the loads are high on the body, that's the first indication that something's going to fail.

That's where the failure actually starts. You know, the jet engine doesn't fail when it's idling on the tarmac. It fails when you're flying, you know, and having to like gain elevation in a strange condition. And so that's what I think we have to be looking for is like how resilient are we to The outlier situation, like when you go and you get drinks and you have, you know, pizza and tacos or whatever, how's your body responding to that?

How well did you sleep that night and how you recover? So

[01:15:35] **Dave:** talk to me about blood sugar and cognitive function. What do we know? Not

[01:15:39] **Josh:** enough, frankly, this is, this is where the research really, we really do have to get into the sort of interventional stuff I think in the near the next few years, but there are observational studies that show like a really profound effect on Memory, like short term memory kids who, there were some studies that show that fact recall and again, short term memory under the sort of sugary beverage influence versus drinking water, totally different.

So, kids who are on, on the sugary beverages had, I'm not going to be able to remember the numbers directly, but something like a 30 percent memory loss. Lower capacity to recall recall facts when they were in a high stress sessions when they were in a high when they had basically drank. I think it was fruit juice versus having just water.

So there's there's some effect on, you know, the brain chemistry there. And then the rates of depression, suicidal ideation are just it's like 47 percent higher for people with diabetes. And there are some confounders there. But the point is, is that the mental health state You know, our brains are made up of cells that have mitochondria, just like every other cell in the body.

We, we really have to consider that, you know, we have this physical fitness idea, and then we think of mental health as this sort of metaphysical concept. And ultimately, you know, metabolic health affects every cell in the body. The way that we are challenging and responding, the resilience concept, affects all of the organs in our bodies, and our brains are one of them.

And so I think we see this, we, we see strong sort of indications that a lot of the mental health and cognitive function is impacted by blood sugar control. In fact, my wife's a nurse. She sent me a, a PowerPoint when she was going through school at, at Drexel. And it, the title was Alzheimer's colon type three diabetes.

Yes. And, and so we're, we're getting to the point where we understand, and the reason that that's said is that the brain becomes insulin resistant in, in the state of Alzheimer's. We don't yet understand the causality, but the point is that blood sugar irregularity is So what's driving? I don't yet know.

And all I know is that lots of stuff goes, goes bad when blood sugar controls lost

[01:17:54] **Dave:** Dr. Dale Bredesen, who wrote the book, the end of Alzheimer's, I came on the show and I think he had seven different causes of it. And one of them was the type three diabetes cause. And strangely, a lot of mitochondrial toxins, hydrogen sulfide oxalate, let's see, carbon monoxide, mycotoxins, lead, mercury, toxic metals, all of those directly inhibit mitochondrial function.

And when mitochondria are inhibited, they do a worse job of taking blood sugar in. And so you can say, I have insulin resistance because I can't take in insulin. You can also have dysfunction where even though you could take it in, you can't burn it because something has damaged the function of the cell.

And so a lot of my. Practices for cognitive function are around. Let's limit toxins that inhibit mitochondria and let's ensure adequate blood sugar because hypoglycemia or low blood sugar is worse on cognitive function than high blood sugar. So regulated blood sugar is good. And I advise, you know, students who are saying, Dave, you know, how do I ace my next exam?

And like, well, that morning you should have a high protein animal protein breakfast. And as long as it was, you know, within a brief time afterwards, have some carbs might maybe even some sugar, but not too much and have, you know, a shot of danger coffee because you want some caffeine in there because there's, there's good evidence for that and take some cognitive enhancers.

There's a bunch of stuff. Oh, and also take a ketone like MCT or something else. So now you have lots of fuel in the brain, but not super high blood sugar because the protein controlled it and you have endurance of your blood sugar. So it's. Elevated, but unhealthy elevated. And then when your brain, which can use 20 percent of your energy is really focused on this, when the mitochondria and your neurons are calling on it, they've got everything they need and you tend to have much better function.

And a lot of that came out of headstrong, my book there, where it's like mitochondrial function plus BDNF and neuroplasticity equals. A brain that can do what you want. So I consider blood sugar regulation to be a part of hacking neurological function. And we're kind of get the data from levels, of course.

[01:20:00] **Josh:** Yeah, I mean, that totally resonates and I've done, you know, anyone who's done a long fast has probably experienced the sort of breakout clarity that can happen when, you know, when you've been deep in the fast and there's likely lots of factors there. I don't want to say it's all blood sugar, but I'll tell you this.

My blood sugar becomes a. Indescribably flat line. Yeah. After a certain amount and everyone's does, where the system is just perfectly balanced. The, the amount of output gluconeogenesis is dialed to the amount that you need. And so the, so clearly there's something that happens there cognitively that it's probably could be ketones.

Yeah. You know, I think, but, but I, I think that the, the lack of variation in blood sugar. 'cause like, like you said, you know, when, when blood sugar goes low. There, there is no worse brain fog state, you know, talk to someone with type one who, who has had a hypo event, like you just really lose presence of mind, memory, ability to think clearly.

And, uh, and so I, I do believe that that stability is, is really you know, a profound element of, of that cognitive function.

[01:20:59] **Dave:** Well, there you go, guys. If you want to get a data point that's as important as your sleep or probably more important than your number of steps per day you should get a Levels Cjam.

And go to levels. link slash Dave Asprey. And what does that get him, like, puts him at the front of the line or gives him a discount or something? I think it

[01:21:18] **Josh:** adds two months free free membership for you. There you go.

[01:21:20] **Dave:** So free membership, levels. link slash Dave Asprey. I talk about a lot of cool stuff on the show, and I literally have a room full of crap people have sent me.

I have devices, I've used it three times, like, this doesn't work, it isn't very good. And people say, you know, Dave, you talk about all kinds of stuff. Yeah, the world is so exciting, and there's all this fun and cool stuff. And what I want you to understand is you don't have to do everything. I want you to know, oh, if I'm interested in this, then this would be relevant for me, and maybe it's right, maybe it's not.

I also want you to know the most foundational things you can do and tracking your sleep and tracking your blood sugar are the two most foundational things you can possibly do before you do anything else, except maybe put some salt in your water and get some sunlight in the morning. All the free stuff that I've been talking about for a dozen years.

Do those. But if you're going to invest a little bit in your health, I think this data is so precious because it'll inform everything you do from how you eat to how you move and even how you sleep. So if you have just those two signals and you never got a lab test or anything else, you can manage your health and extend your health span, which is a wimpy goal anyway.

You can probably extend your lifespan and let's face it, that's what we all really want. We want to live longer and feel good the entire time. And at least in my case, I talk about at least 180. I just want 50 percent better than our current best. As an engineer, you know, that's a pretty small goal, right?

Seems achievable. But the real goal is I want to die at a time and by a method of my choice. So I don't want to die because I failed to pay attention to my blood sugar. So pay attention to yours. And if you say, I just don't want to wear a cool looking button on the back of my arm then don't and look at the app and just benefit from people like me who are willing to wear it.

Again, levels. link slash Dave Asprey. Josh, I'm so happy to be an advisor, investor, and enthusiastic supporter for the good work you're doing in the world. Awesome to come on the show. And thanks for having me, Dave. See you next time on the human upgrade podcast.