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**Derya:** [00:00:00] It is right now unethical for doctors not to use AI. Even now, [00:00:05] AI is better than medical doctors. Eventually, robots will be better than most surgeons. [00:00:10] We have to cure the mother of all diseases, which is aging. It will depend on how fast we [00:00:15] can evolve AI and develop these digital twins, because the real bottleneck [00:00:20] is the clinical trials.

**Host:** Few scientists have pushed medicine further than Dr. [00:00:25] Derya Unutmaz. A world class immunologist at the Jackson Laboratory, he [00:00:30] stands on the front line of the emerging medical singularity, using AI to fuse [00:00:35] biology, immunity, and aging into a new blueprint for human [00:00:40] longevity.

**Derya:** Imagine having virtual cells.

virtual tissues and in fact digital [00:00:45] twins where AI can make predictions based on running [00:00:50] experiments literally digitally.

**Dave:** Are we already at longevity escape velocity? That [00:00:55] mythical date where we can make ourselves live for one additional day for every day that [00:01:00] happens on the calendar?

**Derya:** I don't think we are there yet, but I'm very [00:01:05] confident we'll get there in years.

**Dave:** You're listening to the Human [00:01:10] Upgrade with

**Host:** Dave Asprey.[00:01:15]

**Dave:** Hey guys, quick reminder. If you're listening to this on your [00:01:20] favorite audio podcast app, and you haven't been over to my YouTube channel, check it out. Just [00:01:25] search for the human upgrade or find me under Dave Asprey BPR. I post full video versions [00:01:30] of every episode and a bunch of other cool content outside the pod.

It's a great way to go deeper into the [00:01:35] content and connect with other biohackers like you. So leave a comment for me. Yeah, I'm actually going to [00:01:40] read them. And poke around while you're there, there is a lot of stuff specifically for you. It really [00:01:45] helps and it means a lot to me. You've seen incredible [00:01:50] change over your career in our technology capabilities.

And what's the most promising way [00:01:55] that AI is going to extend our lifespan?

**Derya:** There are several, but I think for me, [00:02:00] the most important thing is, uh, That AI will be able to [00:02:05] simulate biological systems. What I mean by that is, and we can go deeper [00:02:10] into that you know, imagine having virtual cells, virtual [00:02:15] tissues, and in fact, digital twins, where AI can make predictions [00:02:20] based on running experiments literally digitally.

I think that's, [00:02:25] really transformative because something that takes years [00:02:30] like clinical trials or, you know, developing new drugs can literally [00:02:35] take, uh, minutes or hours. So I think that will, that will change everything.

**Dave:** Are we going to have [00:02:40] to redesign our approval frameworks in order to take advantage of this?

Or is everyone [00:02:45] just going to go to Abu Dhabi and Costa Rica where they don't bother with stopping you from doing [00:02:50] things?

**Derya:** This will be established as sort of the, the, the baseline because [00:02:55] you know, we're living through the same thing through medical community. I mean, I have [00:03:00] a medical background. I don't see patients, but that's another area that You know, [00:03:05] takes, takes a while for people to accept that even now AI [00:03:10] is better than medical doctors.

Eventually robots will be better than most surgeons. [00:03:15] And so, you know, the society will demand that you know, and if AI can run [00:03:20] clinical trials better faster, and most importantly, uh, in a [00:03:25] personalized manner, I think this is the biggest problem in medicine. Uh, in fact, [00:03:30] 2, 000 years ago, Hippocrates said, you need to treat the patient, not the disease.

[00:03:35] But in medical school, they teach you to treat diseases. So if you can [00:03:40] personalize you know, if you have your digital twin and AI can run drugs for [00:03:45] you and if it's going to save, uh, millions and eventually billions of lives, I don't [00:03:50] think, uh, regulations can stand in front of that.

**Dave:** I love that the, the [00:03:55] demand will win over time, uh, and hopefully we'll vote out politicians who try to stop [00:04:00] us from living a long time.

**Derya:** And they will, they will benefit too, you know, if we can solve aging, um, [00:04:05] we wouldn't want to live longer.

**Dave:** It's true. It seems like a win win proposition to [00:04:10] me. You've written more than 150 papers. And you [00:04:15] know so much about immunity and what's going on in the systems biology [00:04:20] space, but I want you to put on your hat and say, let's assume that AGI rewrites the [00:04:25] rules of immunology.

What foundational assumption would it [00:04:30] throw away first?

**Derya:** That's a very interesting question. In fact, uh, you know, I was just asking, uh, [00:04:35] one of the models, uh, just the other day, you know, what are the most, you know, 10 [00:04:40] most important questions in immunology? Uh, and you know, so, so first of all, [00:04:45] let me say this this is something that I've been thinking for a very long time.

We, we tend to [00:04:50] think that, you know, our biological systems are just marvelous in a way they [00:04:55] are but they are highly legacy systems. So they're not. Sort of a [00:05:00] perfect engineering, uh, it builds on top of each other, you know, something that was [00:05:05] important, you know, 10, 000 years ago or a million years ago is not important anymore and [00:05:10] actually could be detrimental, but you can't just get rid of it.

You just have to build on top of it and [00:05:15] regulate it. So, you know, if you look at it from a very engineering perspective, uh, it's [00:05:20] not a very good system. In fact, immune system. probably kills more than [00:05:25] saves. You know, most of our problems, uh, uh, chronic inflammation that causes [00:05:30] heart disease, Alzheimer's and autoimmune diseases, uh, and not to [00:05:35] mention, you know, in many infections.

That overreactions of the immune system kills more [00:05:40] people. You know, we saw that during pandemic, you know, most people die because their immune system just [00:05:45] worked too much, too, too, too good. So it has to be very, very tightly regulated. [00:05:50] And if you regulate it too tightly, then you don't get responses to cancer.

So there, [00:05:55] the problem is just the opposite. So I would say, you know, to answer your question I would. [00:06:00] Sort of totally reengineer the immune system. I would call it as immune system 2. [00:06:05] 0. And, and I think, um, that will solve a lot of problem. And immune [00:06:10] system is also involved in aging process. You know, it actually accelerates aging.

And we [00:06:15] first saw that in HIV infection. I, I used to study [00:06:20] HIV, uh, immunopathogenesis. You know, what we notice is that, uh, as HIV infected people are living [00:06:25] longer they, their immune system was accelerated in, in aging, which in turn [00:06:30] resulted in them getting heart diseases a decade earlier than they would [00:06:35] normally because the virus was infecting sort of the genitals of the immune system.

And it was [00:06:40] really, kind of causing it to be exhausted and so on and so forth. So, [00:06:45] um, uh, there, there are many, many parts of the immune system that could be more [00:06:50] simplified re engineered that could regenerate better, that could regulate better. So, [00:06:55] uh, it's, it's sort of a wholesome situation which, which I think eventually we'll be able to do.

**Dave:** I [00:07:00] cannot wait. My immune system has been problematic. I've been, was diagnosed in [00:07:05] my early 20s with chronic fatigue syndrome and fibromyalgia. I've had [00:07:10] toxic mold exposures and I've been managing immunity and stress hormones [00:07:15] manually ever since. And I'm abundantly healthy but it's through a lot [00:07:20] of careful balance.

**Derya:** Speaking of which, I've been studying chronic fatigue syndrome for more [00:07:25] than a decade. Um, as you know, uh, it wasn't even considered a disease, [00:07:30] uh, but you know, 10, 15 years ago, uh, and I got, I got very [00:07:35] interested in it. It'd be exactly what you're saying. We, we, we saw that the immune [00:07:40] system was really the, maybe the cause in the disruption.

That was causing chronic [00:07:45] fatigue syndrome. And over the years, we've actually shown that again, again, actually we have a paper just [00:07:50] coming out that really links the microbiome, the immune system metabolism that [00:07:55] causes a chronic fatigue syndrome, and we'll, you know, we see similar thing in long, long COVID [00:08:00] as well.

So there, there's a very, very fine tuned balance. I mean, immune system is [00:08:05] sort of like, uh, the army, the police force, you know, the fire force [00:08:10] it could be very useful, but it could be. Very dangerous. So how do you keep the balance [00:08:15] is, uh, is not so easy.

**Dave:** Is chronic fatigue syndrome and long [00:08:20] COVID, is it really just mass cells misbehaving?

**Derya:** I think there are a number of different things. [00:08:25] The mass cells probably are mold, uh, we think. You know, I'm a T cell biologist, so a little [00:08:30] bit biased T cells are probably at the center of the things because, um, [00:08:35] you know, T cells, uh, sort of regulate or being regulated by the [00:08:40] microbiome the metabolites produced by these trillions of bacteria that live in your gut, [00:08:45] which by the way, really control a lot of our metabolism, our, our nervous [00:08:50] system, you know, even Depression could be caused by some bacteria that's [00:08:55] living in your intestines and they have a tremendous impact on the, uh, on the immune system.

So [00:09:00] obviously, you know, many immune parts are sort of dysregulated [00:09:05] and mast cells being one of the main, you know, one of the things about mast cells that they produce [00:09:10] huge numbers of cytokines, what we call these, these small molecules that actually [00:09:15] control and regulate other cells. So, this is a very networked [00:09:20] interaction and, you know, immune system is the most networked system in the body.[00:09:25]

There are dozens and dozens of different cell types. They all have to communicate just like in an [00:09:30] army. You know, you have so many different levels of of communication. And then you have, [00:09:35] you have to discriminate these trillions of bacteria. Bacteria from the real [00:09:40] pathogens, you know, most of them are beneficial for you.

So how do you keep that piece, you know, uh, and you [00:09:45] have to make sure that they don't cross the border. And so when that is disrupted, the whole [00:09:50] system starts to collapse and you know, everything eventually that leads to, to a [00:09:55] lot of the symptoms.

**Dave:** When I was diagnosed with chronic fatigue back then, [00:10:00] we didn't know a lot of the things we know today.

And I think if [00:10:05] we'd have known all this stuff, would I have started with getting a microbiome [00:10:10] analysis, an inflammatory cytokine analysis? Like, where would someone start saying, everything doesn't [00:10:15] work right, even today? What are the first tests you get to figure out what's going on?

**Derya:** Well, [00:10:20] that's, that's a great question.

In fact, um, that has been the, the key [00:10:25] issue where, you know, patients like you, they would, they would go see a physician and, you [00:10:30] know, the physician would do the regular test, which is like not even 0. 1 percent [00:10:35] of what's going on in the body and say, Oh, you know, everything looks normal or, you know, there's [00:10:40] nothing particularly specific to your condition.

But if you go deeper, you know, [00:10:45] this, uh, Paper that's going to come out in nature medicine soon, where we looked at [00:10:50] thousand different metabolites in, uh, over, uh, 200 patients. And [00:10:55] then we looked at it over three years period. We sequenced thousands of strains [00:11:00] of bacteria in the gut. And then we looked at hundreds of different cell types, the immune [00:11:05] cell types, and sort of, we did a massive network analysis.

Of course we used [00:11:10] AI. I mean, without the AI, there was no hope doing that because we had millions of. bits of [00:11:15] data. So unless you do something like that, it's very difficult to figure [00:11:20] out what's the problem. What, what was great about it is that we identified out of the thousand [00:11:25] metabolites, you know, several dozen lipids, uh, you know, certain amino acids and [00:11:30] small molecules.

That are being disrupted. One of the, uh, one of the major issues in a [00:11:35] chronic condition like this is that, again, we come back to the personalization issue, [00:11:40] that, um, not everybody has the same disruption. I mean, the, the, the end point is the same. You, you [00:11:45] know, you have the similar type of symptoms, but you have different disruptions.

You know, some [00:11:50] have disruptions in certain metabolites, some have disruptions in certain immune cells, [00:11:55] because the triggers can be different. Uh, you know, in long COVID. We see something very, very [00:12:00] different, even though symptoms are, you know, obviously that was caused by COVID, uh, infection. [00:12:05] So, this very large scale multi omic analysis [00:12:10] allows you to really personalize what's wrong with you.[00:12:15]

You know, you got, you know, these, these, these things wrong with you. But, but again, you know, without AI, [00:12:20] how are you going to analyze that? And I, I can see that in, you know, in near future. [00:12:25] Uh, you get your whole genome, analyze your metabolite, a metabolome, your microbiome, your immune [00:12:30] system, upload everything to AI in, in, in minutes or hours.[00:12:35]

You get a report, you know, well, you know, this is, this is your condition and this is, [00:12:40] and in fact, it also gives you actionable targets because you know, you can actually [00:12:45] change, even your diet could have an impact there are certain bacteria that produce [00:12:50] butyrates that go, that are lower in some patients and, and so on and so [00:12:55] forth.

So, um, yeah, I mean, we, we, we need a lot of [00:13:00] data, man. We, we need AI to analyze that.[00:13:05]

**Dave:** I'm an investor and advisor and a [00:13:10] company that has a million people's gut bacterial samples [00:13:15] now, and they just announced, uh, at my conference that they [00:13:20] can now detect pancreatic cancer at the first stage. Uh, with an [00:13:25] FDA approved, I think it's early approval, but FDA approved thing just from looking at that.

And it's, [00:13:30] it's so remarkable because that's, that's just blows my mind. [00:13:35] And that's from a preventing disease perspective, but I'm really into longevity. [00:13:40] So you're an immunologist. What is the single immune biomarker most [00:13:45] underrated for longevity?

**Derya:** Longevity is, very close to my heart as well. Um, because I think [00:13:50] ultimately we have to cure the mother of all diseases, which is aging.

You know, [00:13:55] people don't consider aging as a disease, but it really is the disruption of the whole [00:14:00] biological system that results in many other diseases. And I think the immune system is, [00:14:05] is sort of at the center of that. So, it, your question again is, is a great one. [00:14:10] We don't exactly know the answer, but we know some things.

Again, you know, [00:14:15] in the immune system, you have certain type of cells that [00:14:20] we call exhausted, but in reality, they're not really exhausted. [00:14:25] These are you know, I like, like to say. STEM two, like to [00:14:30] mercenaries, you know, they're, they're battle hardened cells that fight war after [00:14:35] war. For example, you have these cells that are specific to CME which is a [00:14:40] type of herpes virus that you can't get rid of outta your body, but you [00:14:45] need your immune system to constantly fight it or suppress it.

If you, if you're, if [00:14:50] you have immunodeficient, the CME will come out and will kill you, and eventually in. [00:14:55] Some elderly people, you know, almost a third of your immune cells, like T cells are [00:15:00] dedicated just to keep that CMV under check. And what we, what we [00:15:05] observed is that these cells are, have this sort of the exhausted phenotype, but in [00:15:10] reality, it shows that they have just felt a lot of worse.

And, [00:15:15] and they became very dangerous eventually. So they're being suppressed, but [00:15:20] not, not sufficiently. And actually because they're kind of like mercenaries, they will [00:15:25] cause with, with a slight of a trigger, they will release these cytokines that we call [00:15:30] inflammatory cytokines. And that will damage, you know, just normal tissue [00:15:35] and you know, that will cause chronic inflammation and then it will block your arteries and, [00:15:40] and, uh, so on and so forth.

So, I would say that that particular [00:15:45] cell type, which we can define phenotypically is probably the [00:15:50] most problematic. In fact, uh, we, we, uh, actually just wrote a grant application [00:15:55] to sort of eliminate those dangerous cells. [00:16:00] Because another problem is that as those cells accumulate, they occupy the [00:16:05] niches, you know, it's like, uh, imagine a city, you have these guys living there, but they're not.

The [00:16:10] new, what we call naive cells, the regenerative cells cannot come and [00:16:15] populate. And so we same thing happens in, you know, like skin, you know, uh, you [00:16:20] have these fibro, fibrotic cells that are senescent, they need to be [00:16:25] eliminated. so that new cells can come in. And then the extracellular matrix needs to be [00:16:30] cleaned.

You know, somebody has to collect the garbage. So yeah, that the, that's, [00:16:35] uh, I'm sorry, it was

**Dave:** a long answer. It makes sense to me. I also write longevity [00:16:40] books. I'm, I'm not an immunologist at your level, but I've gone pretty deep on it. And we talk about zombie [00:16:45] cells as the, the common thing for senescent cells.

And I think a lot of listeners understand [00:16:50] Some cells that they're exhausted. They're not doing their job anymore. They're kind of floating around, taking up [00:16:55] resources. So what do you do at your, you're an expert in the field. Do you [00:17:00] take senescent drugs? Do you do intermittent fasting? Or what's your personal strategy for dealing with this?

**Derya:** I [00:17:05] take some, some, uh, supplements, uh, and, uh, in terms of drugs, I use [00:17:10] metformin. Uh, even though I'm not diabetic, but, um, you know, the, [00:17:15] the, the energy metabolism is very, very critical. You really have to control [00:17:20] it. Um, I think, um, diabetes and, you know, high sugar levels is one of the [00:17:25] worst things you can do to your metabolism.

It really disrupts, uh, uh, pretty much everything. And it [00:17:30] causes inflammation because it's kind of like a fuel. You know, mitochondrial love it, you know, when the [00:17:35] cells are very, very active. But that, uh, results in, you know, lots of redox [00:17:40] potential and, and, and, uh, because, you know, that's their job actually, and that damages the [00:17:45] tissues and cells become more exhausted.

You know, there's an entropy, uh, happening there. [00:17:50] So if you could control energy meta meta metabolism, in fact, [00:17:55] you know, drugs like reptomycin That's what they do. So the insulin pathway, the [00:18:00] mTOR pathway. So, uh, metformin, I use it because, you know, it's, it's a [00:18:05] very safe drug. And there's the study after study that shows, in fact, I [00:18:10] think mortality from old Causes are reduced by about 10, 15%, [00:18:15] um, uh, for, for those who use metformin.

In fact, diabetics who use [00:18:20] metformin sort of lived longer than normal people, it was the first observation. [00:18:25] Other than that you know, I, I take omega three, um, fatty acids, uh, you [00:18:30] know, sort of fish oil, uh, which, which I think are important because you got to really balance [00:18:35] your Omega six versus Omega three.

Then I also take you [00:18:40] know, a nicotinamide, ribosite and R I won't give the name of the company because I don't want [00:18:45] any replacement. You probably know. And R is the precursor of NAD. [00:18:50] And so what happens is that as you age, especially after age 50, 55, [00:18:55] the NAD level starts to go down.

Um, And that, that you need to sort of replenish. Certain [00:19:00] things you need to make sure that, you know, you take them at certain ages, you know, the, you know, taking [00:19:05] NR at age 30 is not going to really help you very much, you know, uh, I think [00:19:10] you do urolithin A, um, which has been shown to have impact on immune [00:19:15] system.

yeah, I mean, I take, uh, sort of some extracts, uh, like broccoli [00:19:20] extracts because I, you know, I eat broccoli, you know, I don't eat it, but but it's [00:19:25] extremely useful for you. Garlic, for example. Uh, I, I like garlic, but I don't need [00:19:30] it very much. Uh, the other thing that I think you know, besides supplements, you know, obviously your diet is [00:19:35] extraordinarily important.

And one of the most important things for me is you know, olive oil [00:19:40] that has high, uh, uh, phenolic, the acid components. Um, uh, you [00:19:45] know, extra virgin, you know, I, I use when they, a Greek olive oil and. I make sure [00:19:50] that I, I take olive oil every day. I think about

**Dave:** 30 mils or what, what's [00:19:55]

**Derya:** something like that, you know, like, well, you know, one spoonful, um, either, you know, [00:20:00] mix it with with with food or you can just drink it.

And I actually like to. But, [00:20:05] but, but also really limit your carb intake. I think, you know, like again, um, [00:20:10] I, I wear a, a glucose monitor. Again, I'm not diabetic, but [00:20:15] it's extremely useful because. There are things that you don't notice that could really spike [00:20:20] your glucose. And you want to make sure that it comes down very quickly.

And it sort of [00:20:25] provides a auto, auto feedback. Um, so, I mean, there are other things, but I think [00:20:30] most things that you know and you talk about.

**Dave:** It's a, it's a great list. It, it's helpful to [00:20:35] know, you know, as an expert in the fields, you're doing the same thing that a lot of us biohackers are doing. You know, I.

[00:20:40] I have determined that baklava is actually a longevity substance. Is that true? [00:20:45] Um, uh, you know, without,

**Derya:** without the sugar. Yes. [00:20:50] You know, I, I'm from Turkey,

**Dave:** so, I know I was [00:20:55] eating Turkish baklava in Dubai last week with reckless abandon. Uh, so yeah, [00:21:00] I might've blocked this as much as I could. What do you think about Berberine [00:21:05] versus using Metformin?

**Derya:** I prefer Metformin. I think there's, there's definitely more [00:21:10] data. Bourbon has been, you know, might be useful for for diabetics. [00:21:15] Um, I mean, the other thing is, um, I've, I've started to take as small doses of the [00:21:20] GLP one receptor agonist. They're really miraculous drugs you know, [00:21:25] I I had a little bit of weight problem that it solved it, it was that, but, but [00:21:30] regardless, I, I, I will probably continue taking that, uh, you know, uh, small doses, [00:21:35] um, you know, rest of my life as long as I can, because it really, um, [00:21:40] has a sort of a anti aging effect and really quite a sort of normalizes the [00:21:45] metabolism.

And it's, it's, you know, it's a natural hormone that your body makes, but some people don't make it [00:21:50] enough. And so I think that's, that's very useful. And I'm, I'm looking forward [00:21:55] to drugs that will increase your muscle. Uh, you know, I think they're, they're, [00:22:00] they're coming. Soon I, I don't do too much you know, strain exercise, which I [00:22:05] should.

That's also very, very helpful.

**Dave:** Right. There's only so much time and effort in a day that you can [00:22:10] invest. Do you block your CD38 cells when you're increasing NAD?

**Derya:** [00:22:15] That's an interesting question. I, you know, so CD38 can be, [00:22:20] can be a good marker, a bad marker. So it's not, it's not necessarily bad in [00:22:25] the sense that if you if your cells are like immune cells are activated, [00:22:30] they will upregulate CD38 because they need to metabolize and [00:22:35] intake, uh, NAD.

I don't, The, I don't recall any study that [00:22:40] shows that the receptor cell is blocked. Actually I take it back because [00:22:45] we did, uh, we did try in vitro experiments where we added, you know, [00:22:50] NAD to T cells I don't think we saw any difference in their expression of [00:22:55] CD38 per se. But, but, you know, in, in some cases, you, you, you may want to [00:23:00] downregulate CD38 because, you know, the, the cells that I mentioned that are overly [00:23:05] active sort of the exhausted, but actually overactive cells.

Um, in that case, uh, [00:23:10] that may not be a good thing.

**Dave:** Got it. Cause we know that CD38 [00:23:15] loves NAD. So if NAD levels go up a lot, CD38 goes up, which can be inflammatory. And [00:23:20] some of these are kind of in the weeds for new listeners going, what is going on? But if you've listened [00:23:25] to a few of the episodes, there's an episode on each of these compounds.

There's actually four or five on urolithin [00:23:30] A and on NAD. And what's really interesting here is we have someone who spent his [00:23:35] career in the field, you know, 100 plus papers doing the things that are [00:23:40] most likely to extend longevity, even GLP ones. A lot of people are, are [00:23:45] judgy about those, because, oh, it's not fair to lose weight without suffering, but as [00:23:50] longevity drugs at low doses, they're magical.

**Derya:** They're magical. You know, uh, uh, [00:23:55] for example, I used to have, um, you know, apnea, um, Totally, totally [00:24:00] solved that problem. Wow. Just from, just from GLP ones. Yes. Just from GLP [00:24:05] one. It, it's, uh, it has so many different functions. It's really remarkable. But, but, [00:24:10] uh, you know, I think, um, your, your listeners should realize.

Um, you know, [00:24:15] biological systems are very finely tuned. And, uh, you know, [00:24:20] it can change from person to person. Uh, you know, some people really [00:24:25] need GLP one uh, agonists. Because they, their body's just not making enough of [00:24:30] it. You know, it's, it's a hormone that our gut cells are, are making. And so you're, you're [00:24:35] literally reconstituting that or that it's amount is dropping as [00:24:40] you age, for example.

Right. And so you need to reconstitute that doing too much of it [00:24:45] may not be a good thing. Right. So for, for any of these, uh, supplements, I mean, you [00:24:50] can't say, well, I'm going to take 10 grams of NR. So it's, it's all [00:24:55] good. Well, there's, there's a limit, as you just said, you know, it could, you know, everything is [00:25:00] like a double edged sword.

It could work for your and I think the, the, the other [00:25:05] thing is that we people should really analyze their metabolism. [00:25:10] Um, uh, there, there, there's some companies now that, that looks at hundreds of different [00:25:15] metabolites, um, you know, uh, uh, different small molecules, lipids, and so on. [00:25:20] That's extremely useful.

Or if you have deficiency in vitamin B12, you should take it. [00:25:25] definitely take vitamin B12, or if your vitamin D is very low, you definitely [00:25:30] need to take the vitamin D. But if it's, you know, normal ranges, do you really need to take high doses of [00:25:35] vitamin D? Probably not. So, it's, um, it's a very tightly [00:25:40] fine tuned, uh, system that, um, there's no all good or [00:25:45] all bad.

**Dave:** Thanks for saying that, and it is highly personalized, and the you I look at when [00:25:50] I started doing longevity stuff 25 years ago, just for myself, it [00:25:55] was very much, this is what everybody does. And over time you realize, well, that doesn't work for me, even [00:26:00] though it worked for the guy next to me. And it feels like even now where AI is, [00:26:05] mine's very well trained, but it's not a medical AI, man, [00:26:10] the, the wisdom that comes out of that, even with the kind of knowledge that I have, I'm like, wow, I hadn't [00:26:15] thought of that pathway.

It it's. It's so profound that the personalization is [00:26:20] happening. Um, and What I'm a little bit concerned about is [00:26:25] most lay people don't know what questions to ask around [00:26:30] longevity when they're working with an AI system and not a lot of physicians we can go [00:26:35] to are using AI at this level yet. Maybe they are themselves, but they're not [00:26:40] interacting with patients that way.

How do you talk to AI? Do you use GPT or grok or [00:26:45] something? Or do you have some sort of special university trained on pub med kind of thing?

**Derya:** No, I, I use, [00:26:50] um, touch GPT and actually have. Was probably one of the first users, uh, since chat [00:26:55] GPT three. I also, you know, test new, new models I'm testing one from [00:27:00] open AI.

I can't really talk about it, but, uh, you know, it's and they, they are just [00:27:05] unbelievably good. I mean, I, I, I can tell you, um, My mom [00:27:10] who asked me medical questions because, you know, if she gets sick says, [00:27:15] well, what should I do now? I tell her, don't ask me, ask Chachapiti because [00:27:20] Chachapiti knows better than I do.

Even in cases where. You know, I'm an [00:27:25] expert. You can't really compete with AI on these things, but, but the real power, I think going back to [00:27:30] your original question, um, because this is really, really important, the real power comes [00:27:35] from personalization again. You know, something like chat GPT has a memory now.

It [00:27:40] knows about you and, um, you know, the more data you feed it it [00:27:45] will sort of personalize suggestions to your age, your [00:27:50] conditions and, and so on. And, and not to mention if you, if you feed it [00:27:55] with data for example, you know, lab, lab data is very, very important. [00:28:00] People have this notion, including many doctors that, you know, if you're, you glucose or [00:28:05] cholesterol or whatever is in, within a certain range, it's normal.

If it's a little bit higher, it's [00:28:10] not normal. But again, it depends on, on you know, your set points. You know, [00:28:15] a cholesterol a little bit high for you could be normal actually [00:28:20] or a cholesterol that is within the normal range could be abnormal for someone, you know, [00:28:25] statistically. Uh, I think 70 percent of people who get heart attacks due to [00:28:30] atherosclerosis have normal cholesterol levels or only one out of 10 or one out of 20 [00:28:35] people who take statin actually benefit from it because we don't really know whom to give.

Obviously [00:28:40] we give to everyone who has high cholesterol, you know, some do benefit obviously, [00:28:45] but, but many don't. And so, I think, you know, to, to know your, uh, [00:28:50] set points, your ranges. If you, if you upload, uh, these [00:28:55] data, you know, every six months or every year, whatever. The AI will learn and say, [00:29:00] okay, well, you know, you're now outside of your normal [00:29:05] and, and we'll give you advice, uh, based on that.

And, uh, and they're, they're, they're [00:29:10] just getting so incredibly powerful. I think you can just use [00:29:15] ChatGPT or Gemini 2. 5, Grok, they're, they're all, they're all great. [00:29:20] And the next models are going to be even, even better.

**Dave:** Wow. So you're as excited as I am. Are we [00:29:25] already at longevity escape velocity, that mythical date where we can make [00:29:30] ourselves live for one additional day for every day that happens on the calendar?[00:29:35]

**Derya:** I don't think we are there yet, but I'm very confident we'll get there. [00:29:40] In 10 years, maximum 15 years. You know, that, that, that's the point [00:29:45] where, uh, we have to be, you know, I think like GLP one [00:29:50] agonist probably is beginning to cross that. Uh, you know, there, there's some [00:29:55] calculations that if everybody used GLP one agonist I think the average lifespan would [00:30:00] increase by about between five to 10 years.

Like you go from, you know, average [00:30:05] 80 years old to 90, you know, that's so, so one drug can make a huge [00:30:10] difference. You know, it will depend on how many of these type of [00:30:15] drugs that we'll have in the next decade. Especially, you know, the muscle [00:30:20] drugs are going to be really important because this is a huge problem during aging.

But, [00:30:25] but I think we're, we're, we're very close. In fact, I tell people. You know, try to stay alive [00:30:30] for the next 10 years, then you're good. Okay. We're, [00:30:35] we're, we're definitely getting, I mean, there, there's, there's I would be very surprised if it's, if it's [00:30:40] longer than that. And in fact, you know, uh, it will probably happen very quickly.

[00:30:45] You know, we'll see that in the next five, 10 years, there will be some advances, you know, [00:30:50] maybe a couple of more drugs that will add a few more years, but But suddenly we'll [00:30:55] see a massive jump, you know, uh, you know, average lifespan [00:31:00] 92 in one year, we'll jump to 95 next year, we'll jump to a hundred. [00:31:05] And especially once we start to reverse the aging process, then, uh, you know, [00:31:10] we, we, we already escaped the longevity escape velocity, uh, it'll probably be only [00:31:15] a few years and then after that, it will be, you know, into the space.

So, [00:31:20] uh, we're, we're, we're really getting there. And I think it will again, depend on how fast we [00:31:25] can evolve AI and develop these digital, uh, twins because the, [00:31:30] the, the real bottleneck is the clinical trials. You know, if, if you're testing for [00:31:35] something that will reverse aging, I mean, it's going to take years and years, right?

So we have [00:31:40] to be able to do that and iterate on it very, very quickly. So once we get [00:31:45] there and we just need to. The data we need a tremendous amount of data. We need a lot of [00:31:50] compute a lot of electricity. So that's why I think, you know, investing on data [00:31:55] centers and energies is, should be top priority.

Once we have that, then [00:32:00] in matter of, of months or sometimes weeks, we'll discover [00:32:05] hundreds of new, new molecules and, and, and, um, we're, we're, we're approaching [00:32:10] there. It's very exciting.

**Dave:** So, about five years is, is [00:32:15] maybe you're aggressive and ten years is you're conservative?

**Derya:** Yeah, I, you know, the, the [00:32:20] reason I'm, I'm, I'm saying ten years the, the AI will be capable [00:32:25] within, within five years.

There's no question about that. I think we'll get, we'll get to ASI, artificial super [00:32:30] intelligence, in three, four years. The problem is that, um, [00:32:35] You know, sort of the diffusion in the society, he [00:32:40] has a lag period. You know, uh, we, we see this in medical [00:32:45] medicine right now, right? So, so in my opinion right now, AI is better [00:32:50] than almost all doctors, including specialists, [00:32:55] um, but, but it's going to take probably another five years [00:33:00] before.

You know, people can say, well, okay, AI will be my doctor, [00:33:05] right? It will, that they will completely trust for that. Um, [00:33:10] uh, and, and I think that's the same thing will happen. You know, uh, when can we trust [00:33:15] AI to run clinical trials or, um, you know, that it will make [00:33:20] decisions that this drug will work on these type of people.

Even though it's going to be [00:33:25] capable in, in the next three, five years it probably will take another five years [00:33:30] before all the regulations, all the, you know, all the stuff that society has to [00:33:35] accept so, so I think that's the, that's the limiting factor.[00:33:40]

**Dave:** Do you think that AI [00:33:45] doctors should be allowed to write prescriptions?

**Derya:** Absolutely. Wow, I [00:33:50] would even blink on it. I mean, I, you know, because I, you know, I, I, I test [00:33:55] this all the time and actually we're, we're developing some benchmarks for various [00:34:00] specialities, dermatology and so on. Uh, it is the, the imaging part still needs a [00:34:05] little bit.

Uh, a little bit more uh, advanced, but, but it's actually almost getting there as [00:34:10] well. But otherwise, you know, something like O3 model from chat GPT or O3 [00:34:15] pro is, um, I, I can't, I cannot imagine [00:34:20] any, um, highly specialized oncologist or whatever can, can [00:34:25] compete with that because it thinks of every single, and it actually has an access to internet, so we'll [00:34:30] pull up the, all Uh, information that, you know, if that was a paper that's published [00:34:35] yesterday, you will actually incorporate that.

So, and this is, [00:34:40] this is really an important issue. Uh, in fact, I said in Twitter several times that [00:34:45] it is right now unethical for doctors not to use AI, [00:34:50] uh, very soon it's going to be, it's going to be malpractice. Yeah. [00:34:55] Because, uh, there are 12 million misdiagnoses in the U. S. alone. [00:35:00] About 700, 000 people die or, you know, severely harmed [00:35:05] because of mistreatment, misdiagnosis.

I mean, this is, this is massive. [00:35:10] So AI can reduce that to literally nothing. Because it will, it will not [00:35:15] make those mistakes. It's sort of like self driving cars. You know, if, if every car was self [00:35:20] driving, we would have almost zero accidents. Uh, we'll save about 40, 000 people. But in [00:35:25] healthcare, we can save hundreds of thousands of people.

Not to mention we can lower the [00:35:30] cost of healthcare by, by 10X at least. Because the [00:35:35] AI will also predict. What type of disease you will have or [00:35:40] whether a patient should be triaged, uh, whether it should be in hospital for five days or one [00:35:45] day or not in hospital at all. Most of this is, uh, you know, doctors just [00:35:50] do it.

Oh, well, let's be safe. Let's keep the. The patient, you know, three more days. [00:35:55] They don't really know if it's necessary or not. But you know, one of the, one of the [00:36:00] cool things about biology, even though it's extraordinarily complex, at the [00:36:05] same time, it's very, very predictive. People get surprised about that.

You [00:36:10] know, there's millions of billions of reactions happening in your body and trillions of cells. [00:36:15] But you can start from a single cell. And you can recreate the same [00:36:20] human being, you know, like in identical twins, right? Everything can start from a [00:36:25] single cell where there's trillions of things that happen and somehow nothing goes [00:36:30] wrong.

Uh, you know, or you can, you can just give an aspirin a, out of [00:36:35] thousands of metabolic interactions that one molecule, Can [00:36:40] actually heal you or, you know, fix you. So in a way biologists is, [00:36:45] is highly predictable. We just need to see that. And we can't [00:36:50] see that because there's billions of reactions that our brain cannot process.

AI can [00:36:55] do that. And so, the, the impact of AI in medicine is going to be [00:37:00] unbelievable, but unfortunately you know, there's a lot of resistance including from, from some of our [00:37:05] colleagues.

**Dave:** Are you worried that AI systems are trained on bad data. I mean, [00:37:10] PubMed can't be reproduced for the most part.

**Derya:** This is a very important [00:37:15] issue. In fact, uh, you know, I mentioned about digital twins, uh, digital virtual [00:37:20] cells, a number of times. I think one of the things that I'm worried about is that [00:37:25] we don't have high quality data to train AI to [00:37:30] understand fully the biological system or simulate the biological system.

Um, because [00:37:35] even even sort of, um, you know, date data in the databases, like for [00:37:40] example, you know, proteins and uh, RNA seq data and this and that, or [00:37:45] even microbiome data, um, not all of it is, is, is, [00:37:50] um, is high quality and so, we definitely need to have better [00:37:55] quality data sets. And I think, you know, some companies should definitely focus on [00:38:00] that.

But, but at the same time, um, I'm hopeful that. [00:38:05] AI can discriminate between the bad and the, you know, good [00:38:10] data. And again, you know, there, there's, there's a model that I'm testing right now uh, which is an agentic [00:38:15] model. So the, the very cool thing about AI agents is that They [00:38:20] don't take things for granted.

So if you, if you ask ChatGPT, you know, it will go and [00:38:25] find information and it will, you know, distill it and give it to you, but agents are [00:38:30] not like that. So you can have, um, an agent that will find some information. The [00:38:35] second agent will criticize it. Well, it will say, well, how do you know that's true? And the first [00:38:40] agent said, well, we made him your, your point as well taken.

Now let's go and find more, [00:38:45] more data and more truth. And so by, uh, sort of, uh, interacting with [00:38:50] each other, they can really sort of, Find what's, what's [00:38:55] closer to the truth. There's, there's never a absolute truth out there, but I [00:39:00] think, um, in fact, uh, you know, one of the things that, that I love about using AI is to [00:39:05] criticize papers, including my own, you know, I uploaded some of my papers [00:39:10] that I thought were, were great.

You know, they were published, they were reviewed by reviewers, [00:39:15] but AI found issues that, that I had missed. And I was like, Oh, oops. You know, I, you know, [00:39:20] fortunately it said that everything looks good, but if you had done this [00:39:25] experiment, it would have been a better supportive and things like that. So I think, you know, [00:39:30] eventually AI should be the reviewer of all papers.

**Dave:** Wow. Instead of peer [00:39:35] review, imagine what that would do. Yeah,

**Derya:** absolutely. Uh, I, I, [00:39:40] I trust, I trust AI much, much more than, uh, human reviewers, uh, because, you know, you, [00:39:45] as scientists your, your knowledge is very narrow you, you know, very restricted [00:39:50] set and, you know, we're also biased, right? Sometimes your papers get [00:39:55] rejected or accepted based on conflicts and other things.

AI doesn't have [00:40:00] those problems.

**Dave:** Unless its creators build them in, as we're starting to see, right? [00:40:05]

**Derya:** Yeah, well, you have to have some filters, right?

**Dave:** That's for [00:40:10] sure. I'm interested in your take on wearables. So I was a CTO and co [00:40:15] founder of the first company to get a heart rate from the wrist years ago, and an [00:40:20] advisor to one of the CGM companies to Levels, and really have gone in on [00:40:25] sleep tracking for almost 20 years now.

And all the normal lab [00:40:30] tests and all that aren't wearable. Put on your five year hat with everything you've seen. [00:40:35] What do you think we're going to be tracking with wearables?

**Derya:** Yeah, I love variables. First of all, I think [00:40:40] continuous monitoring of biological data gives you an [00:40:45] incredibly rich data set that you cannot achieve by doing, you know, like if you're, if you're measuring [00:40:50] your, your blood pressure once or twice a day.

That, that's [00:40:55] not, that's not really going to show you if something is wrong with your heart, um, most of the time. So, [00:41:00] so I think, uh, you know, heart rate and blood pressure and, uh, you know, with [00:41:05] Apple watch, you can do your, uh, ECG and, uh, you know, your oxygen [00:41:10] levels and all those things. But you know, I, I, I love these, uh, glucose monitors, [00:41:15] uh, and I, you know, my dream is that.

Uh, we should have such, um, sort [00:41:20] of the nano, uh, monitors that can monitor your, your lipid levels, your [00:41:25] glucose levels, and, you know, maybe a hundred different metabolites throughout throughout the [00:41:30] day. You know, then you can, you can decide, well, you know, um, I was supposed to go to [00:41:35] bed because, you know, you have circadian rhythms that completely will change your, [00:41:40] uh, your metabolism and So, so constant monitoring of, of [00:41:45] your, your biology through metabolic activity, and in some cases, some proteins as [00:41:50] well, you know, you might have in your case where you have chronic fatigue, um, [00:41:55] you know, there might be certain time of the day where, you know, there's [00:42:00] more inflammatory cytokines being screened, which we know could happen.

[00:42:05] Um, or, um, you know, uh, like. Chronic fatigue patients, um, [00:42:10] are not supposed to do a lot of exercise, you know, but maybe, maybe it's certain time of the [00:42:15] day you can do exercise. You just don't know that. So I, uh, you know, measuring [00:42:20] actually biological molecules for me is the ultimate variable.

[00:42:25] And especially if you link it to AI. Well, that's, that's the, that's the holy [00:42:30] grail of personalization.

**Dave:** Let's talk about teaching. You say a lot online about how AI is [00:42:35] going to change the world of teaching. I ran a program for the University of California [00:42:40] on web and internet engineering for five years. I spent a lot of time teaching working [00:42:45] professionals, and it's really hard work.

And even if you're a great [00:42:50] teacher, it seems like half the class is behind and half the class is a little bit bored. [00:42:55] How is AI going to change that?

**Derya:** Completely. I, I, I think, uh, the current [00:43:00] education system has to be totally scraped and I say that as a professor, you know, I've, [00:43:05] I've taught medical students and PhDs but as you said, you know, um, [00:43:10] the, you, you have to personalize education and also, uh, you know, [00:43:15] learning is different than, uh, than teaching, like you can teach, but [00:43:20] people you know, will not learn everything you teach.

So, [00:43:25] uh, in order for our brains to Keep something or learn [00:43:30] something. It has to be two things. Either has to be a threat. [00:43:35] Cause you know, the, the brains are evolved to look for threats. If it's something dangerous threat [00:43:40] threatening, you will remember that you will learn that, or. Or has to be fun. It [00:43:45] has to be like a game.

In fact you know, children learn everything [00:43:50] through, through games, right? So playing in a way, games are [00:43:55] simulations of what might happen. You know, it's also predicting the future [00:44:00] threats. You know, like, would you you know, you, uh, I play a lot of video [00:44:05] games, you know, um, um, Big fan of, uh, you know, some, some shooting games and, you [00:44:10] know, some parents don't like them, but, but actually those are kind of simulations [00:44:15] of how, you know, if there was a threat, how we would react to it.

[00:44:20] But, but you feel fun, you know, that's, that's how you [00:44:25] learn. And I think, you know, AI can do that. It will sort of [00:44:30] teach you the way you can learn and make it fun. And actually, you know, [00:44:35] I personally learned so much from AI. I mean, in the last. Two years, I probably learned more [00:44:40] about topics that I'm interested, but it's too boring to go and read [00:44:45] some textbooks or online, uh, whatever.

You know, I say, you know, like, [00:44:50] I don't know anything about this to chat GPT, you know, explain it to me. Like you would explain [00:44:55] it to a kid or, you know, about quantum mechanics, you know, it just, [00:45:00] uh, it's, it's really incredible. It really makes things very easy to understand [00:45:05] and through analogies to metaphors.

So I, I think it's, it's [00:45:10] no brainer that, uh, at least the higher education should be completely replaced [00:45:15] by with AI, you know, lower education. I think teachers still have a role [00:45:20] because there's, there's that power. Personal touch, um, that's important, um, but after [00:45:25] high school, um, I don't see a role for, for myself as a professor, actually.

**Dave:** Is [00:45:30] it still worth it for an 18 year old to spend 100, 000 plus on a [00:45:35] four year college degree when everything is available for free on AI?

**Derya:** [00:45:40] Absolutely not. Absolutely not. I mean, uh, it's, [00:45:45] it's, it's probably the worst investment of money and time you can do by [00:45:50] going, you know, going to, to a college for four or five years.

Uh, but you know, [00:45:55] actually, you know, everything you learn is already obsolete in, in, in matter of months. [00:46:00] Last year, about a year ago, I tweeted and as a [00:46:05] warning to medical students or people who want to go to medical school I tried to [00:46:10] discourage them and, you know, there was a lot of pushback. I said, well, you know, we need a lot of doctors and so on.[00:46:15]

Yeah, we need a lot of doctors, but, you know, by the time somebody goes to medical [00:46:20] school. School and becomes a resident. It's, it's about a decade of training. So it's a very, very [00:46:25] long process. Imagine how things will be in a decade. You know, we, we [00:46:30] have robots, which are going to do surgeries better than human surgeons.

So [00:46:35] there's, there's really not, um. And, and, you know, going to medical school is [00:46:40] extraordinarily energy, uh, tiring and, you know, the expense is [00:46:45] unbelievable. You're not going to get, get back your investment. So, so I think, [00:46:50] um, uh, my suggestion to, to, to young people is [00:46:55] that, uh, At the same time, this is a tremendous [00:47:00] opportunity, right?

So instead of wasting, uh, a hundred [00:47:05] thousand, 200, 000 in college or other schools use that time [00:47:10] to really learn how to use AI, uh, and, and have [00:47:15] agency and curiosity. Those are, I think those are two important features. [00:47:20] You have agency, you have curiosity. There's literally nothing you cannot do.[00:47:25]

I mean, uh, I, uh, I have, uh, a 10 year old son of my [00:47:30] cousin. It was a very high agency, really intelligent, uh, [00:47:35] kid. And we're actually working on starting up, uh, a robotics [00:47:40] company together. Because he uses ChatGPT better than I do, and you know, [00:47:45] he comes up with the name and how to build robots and and so if a [00:47:50] 10 year old kid can do, you know, anybody can.

**Dave:** I am very close to, uh, [00:47:55] for my 18 year old daughter, just saying, look do some deep learning with AI and let's take the [00:48:00] money that we were going to spend on college and let's buy a small company to learn how [00:48:05] to run it. Because it's a better investment. At least you get a return on it. And I do not believe that anyone [00:48:10] spending four years in college is going to get their money back right now.

It's just not how the world works anymore.

**Derya:** Absolutely [00:48:15] not. I mean, I, I think, um, people are either coping or [00:48:20] delusional or have no clue what's, what's happening. Uh, you know, anything that can [00:48:25] be done in computer. Is already be, will be gone in, in, in a matter of [00:48:30] years, uh, if not sooner. In fact, you know, even physical jobs are, are going to be very [00:48:35] hard to, to compete with robots.

That might last a little bit longer, uh, you know, maybe another five, 10 [00:48:40] years. But at the same time, you know, you know, someone like your daughter, if she buys a [00:48:45] company or starts a company. Just by herself, she can run a company, [00:48:50] you know, uh, you just hire AI agents. You can have an agent do your [00:48:55] website.

You can have an agent as a, your marketing personnel. And, you know, um, [00:49:00] it's, it's really remarkable how one person can do so many different [00:49:05] things. And, um, so I think we're going to see much more of that. [00:49:10] People will, will really find. Focus on, you know, personal, you know, [00:49:15] if, if you think about it throughout human civilization, jobs are a [00:49:20] recent invention, right?

We, we didn't have jobs until like.

**Dave:** [00:49:25] It's totally true and that, that advice is tough advice [00:49:30] for you know, people finishing high school thinking about going to college, but I think it's, it's real. [00:49:35] And I, I applaud you for being willing to say that it's controversial and you're [00:49:40] speaking as a person. If someone who's high up in the university education system, it's gonna have [00:49:45] to change rapidly and I, I really appreciate you being honest and truthful [00:49:50] about that and, and thank you for sharing all of your longevity knowledge and just your, your [00:49:55] perspective.

You've, you've developed incredible wisdom of going so deep on all the systems biology and [00:50:00] it's, it's refreshing to hear how you think about it. So I, I appreciate you and appreciate you being on the show.

**Derya:** Thank you [00:50:05] so much. This was, this was a lot of fun and great pleasure. Thank you

**Dave:** guys. If you would like to know [00:50:10] about more about Durya's work, go to jax.

org where most of his research [00:50:15] is and, uh, well stay on the longevity bandwagon. See you [00:50:20] next time on the human upgrade [00:50:25] podcast.