Discover The Power Of Blood Tests Transcript

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Introduction and the promise of blood-based Alzheimeru2019s testing

Everybody. And welcome back to the Reverse Alzheimer's Summit. Great to have everybody. I have a wonderful guest today, really honored and excited to have Professor Hans Frykman, M. D., Ph. D., who is from University of British Columbia.

And he is also the chief scientific officer of neural code. And this will get into neuro code is offering what I believe will be the most important test we will all get this year.

I'm going to get one myself. It's something that I think that all of us need to know, because in the past, we, you know, we had to go say, you know, is it possible I'm on the way to Alzheimer's.

I can get a PET scan several thousand dollars. I can get a I can get a spinal tap. Do we really want to get a spinal tap every year? I don't want to get a spinal tap every year.

Now, there are blood tests that are just revolutionizing the field, just becoming available. So great to have you. Hans, thanks so much for joining us.

Oh, thanks, Dale, for the invitation. And it's my pleasure to be here. So let's talk initially about, you know, why these tests we know why this is turning out to be such a good test.

So neuro code under, as I understand currently is offering pizza to 17. But also you are running neural filament light and also GFP glial fiber, Larry, acidic protein, is that correct?

This is correct, yes. So we also offer to the spinal tests, but. Right. Yeah, I think that the big change in 2024 is that we have now these blood tests, as you mentioned, and the blood tests are yes, they are revolutionary because we have gone from the first such test that was at all interesting in 2017 out of a group in Japan to now having something that is clinically useful.

And the last time this happened in clinical chemistry on a blood test is when we got troponin for heart attacks, right. Which is which is quite a few years ago.

And so so it's a very, very big happening in clinical chemistry world. Yeah, it's a great point. You know, when I was training way back in the 1970s and we would be getting a cpcb chance to see if someone had had a myocardial infarction.

And we've come a long way with troponin since then. And this is again, I think this is it's hard to overstate how important it really is because we're always trying to convince people, please don't wait.

We can reverse cognitive decline. We can prevent cognitive decline. But it is progressively more and more difficult as you wait and wait and wait. And unfortunately, of course, neurologists and other physicians have said for years, well, you know, there's not a lot we can do, so just wait.

It's probably going to be okay. And then of course, people march right through MCI, etc..

Why p-tau217 is replacing older Alzheimeru2019s biomarkers

We know from serial PET scans, of course, and spinal taps that you do have changes about 20 years before a diagnosis. That's pretty typical. So you can really see it coming.

There is a lot you can do about it, but people don't want to do this because for one thing, they don't want spinal

taps and for another thing they don't want to know.

Well, now everything has flipped around. We want to check earlier. We want to find out. And I just to give a recent example, there is one person out there who will remain anonymous.

Who who did happen to get this evaluated, did happen to find although this person was at risk and having minimal symptoms is a bogey for four had a very high pigtail and has just begun to do some of the appropriate things from a multi-modal sort of protocol.

And sure enough, the P is coming down. So I think that we will be using this. And of course, as you know, hands the ongoing trial that we have at six sites, we are working with the neuro code to do these very tests.

So we will be following the patients. Where do they start with their pito? Where do they end up? So let's start by talking about the comparison here. If you look at the two common ones are about a 42 to 40 ratio and Peto and Patel, there was a Patel and is a Patel 181 But it's turning out that Patel to 17 for a number of reasons is superior to Patel.

181 So let's go back to a base of 42 to 40 ratio. When you when you begin to have changes associated with your brain signaling that is going to lead ultimately to Alzheimer's, how much of a change do you see in the 42 to 40 ratio?

How much how robust of a test is this? Yes. So they beat out 40 to 40 ratio. Is is an excellent test to detect early early pathology because that's what you detect.

It's always important and to say that the tests that we do are detecting pathology rather than a disease right now, because it can lead to a disease and it's associated with the disease, but it's not.

The disease is called the biomarkers. Yeah, it's biomarkers that leads to pathology. And that's that's kind of an important distinction. They added a 40 to 40 ratio as a service and excellent test for spinal fluid.

And the reason for that is that there's the liquid that is inside the spinal system and in RA surrounding the brain, the what we call CSF is protected from the outside.

And so in that system, the A beta 42 gets used up. So we measure a lowering of a beta 42 and then we normalize the therapy to 40, which is a much more abundant protein.

And doing that we get a very robust signal for MCI and for mild and an even moderate to severe Alzheimer's. So but the most important is that we can detect MCI, we can detect a mild Alzheimer's with the CSF test, with the spinal fluid test, and that is FDA approved since about a year and a half or two years.

It's been FDA approved on two different platforms. And it's a test that's unfortunately not really covered either by the U. S. government or Medicare. But our not it to by the private insurance very much.

However, it's a very good test, but you have to get that spinal tap and that is something that is not a you know, that is not comfortable that you have to go in for the procedure or the procedure I think is covered by insurance.

But you have to go in for procedure. You risk to get headache or risk to have many other side effects. And the definitely, as you said, it's not something you want to do on a yearly basis.

And I, I did many, many of them as a neurologist, so I know they're not fun to have. Yeah. Pointed out people can get spinal headaches which can last for months, unfortunately.

So yeah. If you can get a blood test instead of a spinal fluid test, that's a huge advantage. Yeah. So now they're in that CSF test. You can also measure Peter 181 and you can measure total tau and the P to 181 gives a increased the validity of the signal of the AP at a 40 to 40 ratio.

So that makes that test more accurate. If you also add total tau, that can help you or can help a neurologist at least to differentiate Alzheimer's versus other pathology, especially tau pathologies, where where they are there.

It's not really Alzheimer's present, but there are other diseases present in another situation. So having those four biomarkers which by the way, we are the only lab that provides them and in North America all four, we actually provide five because we have also narrow filament light and the spinal fluid and data is happens to be the earliest of all the biomarkers and spinal fluid even before it beat up 40 to 40, you will have a rise of NFL their replacement light.

So so the focus. Is on the blood test for a moment here. So absolutely, as. You pointed out, these are excellent tests for the spinal fluid. But when you're getting a blood test, what are you getting if you're getting a rebate of 40 to 40 blood tests?

Excellent. So if you tried to do that in blood, maybe the 40 to 40 ratio that test does not work in blood.

How p-tau217 works and why it is highly specific

And the reason is that you have a beta 42 that is decreasing in the brain when you go into this pathologies. And if you're going to measure something that is decreasing, that is you get about a 40% decrease in spinal fluid but in blood.

The problem is that the body outside the brain produces a beta 42. So the blood test is very complicated to measure. It's actually not possible really to measure.

You have up only an 8 to 10% change, which is eight. To 10% is all you change when you have that pathology of. Exactly. So I. Will say. I'm sorry to say, but there is this test for that reason it's not suitable to perform.

And I know there are labs, I'm not going to mention any names, but there are a couple of famous lobster to perform that and even sell it directly to the public.

And this is very unfortunate because this test is useless. There's not a way to say it, but it's useless. So let's not discuss to. Spend too much time on there. Let's further right.

You you know, why have you chosen the ones you've chosen? Obviously because they're the best tests. And to me what what's exciting about the triad of detail 217 Neural filament Light and GFP is that they give you three complementary pieces of information, all of which are very helpful.

So let's start with Petal 217 multiple papers showing that it is highly predictive of the pathology of Alzheimer's disease. And but I think maybe the most important thing is how early do you see that change?

If we think of Presymptomatic phase, MCI, MCI and dementia, where do you start seeing the how 217 increase? Yes, that's a very good question. So we we don't exactly know that in detail.

There was a Daily Mail publication just a few days ago where it says, you know, our test, which they were writing about as we were in Time magazine and CNN and Fox.

And, you know, whichever side you are on the Atlantic or the Pacific Ocean, you were hearing about our test just last week. This test is probably not going to detect it 15 years ahead.

That's not there's no scientific proof of that. But certainly you could have indications even years before you have symptoms, exactly how many years that it is, we don't know at this time, but we can say is that it's probably going to be good enough to detect MCI in many cases, and it is certainly good enough to rule out MCI due to Alzheimer's pathology, which is also important because lots of people are worrying that they have MCI.

They start forgetting, you know, especially now after COVID. There is personally, I had COVID several times and I

experienced some light memory loss after that.

And I think many people have, you know, honestly different degrees of this. And and, you know, hopefully that reverses in most people and it likely will.

But nevertheless, the feeling of not memorizing as you used to is is terrifying and very, very sad. And and we can do a lot about it. If it's has Alzheimer's pathology, it's better to detect it early.

And this is the best blood based test there is available for that. And definitely, I said we can rule out MCI, we can probably rule in MCI, meaning if you do have that and certainly we can detect mild Alzheimer's, which is still a stage which can be reversed.

We we want to change the sad fact that 79% of all Americans who get diagnosed with Alzheimer's are diagnosed at the moderate to severe stage. Today, 79%.

So we are we are working with one of the big champions of this is a professor at Wake Forest who was previously at Mayo Clinic. Her name is Michelle Malkin.

She's a very, very dynamic young star in this field. And she is pushing for this to be used at the primary care level. And so we are entering into a very large clinical trial with her doing this at the primary care level.

So we are using the P tau to a 17 as a screening tool for MCI and for mild Alzheimer's just to get people diagnosed much earlier. And this is funded by NIH and and we're very excited to be part of that.

Yeah. All right. Fantastic. And so let's back up for one moment and just talk a little bit about it for itself. So we think of Tau as something that's almost like bolts on the microtubules.

It is something that stabilizes microtubules. So at least from the, you know, the biologicals side, it always made sense that if you are going to collapse your microtubules, if you are sending synaptic plastic signals and pulling back, you are going to phosphorylated your tail, which basically pops it off the microtubules and now you can collapse.

So it's a physiological process, but it also has implications for Alzheimer's disease. How how many amino acids? Entao 431 Okay. And how many phosphorylation sites.

Are all those are many. Many, many, many phosphorylation site. Yeah I don't know the exact number. 17 has turned out to be fairly specific for Alzheimer's.

So I guess that that's the next point here, which is when you see that increase in 217, it doesn't appear to be due to vascular damage. It doesn't appear to be due to other pathologies.

What does it does it how specific, I guess is the best question? How specific is that for Alzheimer's related pathology? Oh, that's a very good question.

It's 95% specific. So it's 95% accurate. It's it's a superb test. And that is very equal to the spinal fluid type, actually. No. And tastic. Then the other point is, you know, we've been telling people for years, if you find out you are APOE4 positive, please don't worry.

There's a tremendous amount you can do for prevention. And of course, there's a wonderful website set up by Julie G apoe4.info We're in the same situation here.

Please do not worry if you find out that your p tao 217 is high there is a lot you can do about it. And as Hannes indicated, this will come up fairly early so that you can actually do something about it.

This is going to change instead instead of your waiting. Now though, all the things we've been looking at hs-crp,

insulin resistance, so forth and so on, various pathogens and toxins, those tell you why you're at risk and why you're having problem.

This tells you if you're having me, this tells you that the signaling is going on. So they're extremely complex entry and again, will really give us the ability for many, many more people to get early diagnosis and therefore prevent pain and reversal, which is why I think this is such a game changer.

So okay, now this site to 17 out of the 431 that you mentioned, four.

Using p-tau217 to screen earlier and track treatment response

Or 4441 Sorry. 43 Okay. And this is a Syrian or threonine or which is this? Oh three And then I think you. So three innings. Okay. And is the major kinase that is phosphorylated is is this GSK three beta or is this other kinases as well?

That's a good question. But yeah, no, I think that there might might be multiple. Yeah. And have you seen of course, GSK three beta something that can be inhibited with lithium.

Have you seen reductions with people just using lithium or has anyone looked at that? Mm hmm. That's a good question. Also, I don't know the answer to that, actually, but.

So all right. So this is. Sorry, go ahead. Yeah. So that could be a just all right. So this is going to this test is going to tell you and I should mention, in terms of its robustness, as you've pointed out, talk a little bit about how much change you actually see, because it's got a huge dynamic range, which is a yeah.

Yeah, yeah. That's that's yeah, that's this is very comforting. So one of the reasons that this test is so good is that the difference between healthy controls that are age matched and there are healthy controls by we did PET scans of these healthy controls.

So we know that there are healthy because otherwise as you pointed out, we can't really know somebody can look very healthy and still not be so. So we know that and so compared to healthy controls where the wants to have disease particularly if they have both amyloid and tau pathology that the differences you know four and a half times at least I'm okay.

Wow. Four and a half times. So it's very, very large. So this this phosphorylation of this site is not huge in Alzheimer's, but it is enough to measure very, very sensitive instruments, but far from it.

There's no phosphorylation really going on at all in healthy controls. So your values should be very, very low. If you're healthy. And then if you have an elevation, the more elevation you have, the more pathology you have going on on a group level, at least.

So what I'm saying here is that the people that had on the amyloid pathology, they would have maybe two and a half to three times elevation, while the people that had both amyloid and tau pathology, they had more like four and a half, five times elevation.

So this ad, it rises through the continuum of the disease. So as you go, you have a personal value and that kind of rises as you progress. And then and the same way, if you're able to reverse Alzheimer's, you can see a decrease.

So we have seen that with your patients. We have seen that in clinical trials with even though I am not a huge fan, but we have seen that in the clinical trials with the kind of mob and donanemab and so forth.

So yeah, there is a good point. Yeah. There are, there are, there are many uses of these tests, not only as an initial screen diagnostic tool, but also as a follow up test.

And I think it's important to connect. Just I want to connect just to pathology because people wonder how come I

have amyloid pathology and you're measuring tau. Why?

Why is that? And the reason there is that once they block amyloid plaque attached to sort of forms at a nerve and the signal goes upstream to the towards the nucleus of this of the nerve cell and their the tau tangles gets phosphorylated and they happen to cause phosphorylated on many sites, as you indicated.

But 2 to 17 is most important site. Yeah so very, very interesting. So the the great news is not only can you see it relatively early on, at least not only does it reflect whether you have this sort of pathology, but you can also use it as a tool to follow over time.

Now, it's important to know, let's say we get at time zero and start treating people. Presumably we don't want to measure it the next week. What's the appropriate time to follow up to see is it going in the right direction, i.e.

back down? Yeah, that's that question we don't really have answers for. But I think at least three months and probably six months depends how much therapy you do.

And you know, as you know, there are some people that are very ambitious to follow your protocols and there are some people that, you know, take it more relaxed.

And so I think there if you have somebody who is very ambitious and really wants to see a reversal, I think three months even could be possible. But I think that the six months is probably more realistic in most cases.

All right, then let's for a minute talk about the other tests, because I think these are very complementary. So one of them is telling you, is this an Alzheimer related process?

And how how long has it been going on, etc.? The second one, neuro filament light is really telling you, is there neuronal damage? So if you have frontotemporal dementia, ALS, do you also see it with things like CTE?

If so, essentially any neuronal damage, is that fair to say? Now that's very fair. And then something more sinister, really. So unfortunately, if you have the NFL that you have rises, slows slowly in your life and for us that our man we can relate to that with PSA so PSA A. L. S.

but the same if you continue to measure your NFL for your life and then suddenly it takes off, meaning that you have longitudinal measurements of your A. L., then you will probably have the earliest biomarker there is presently available to detect.

Something sinister is starting to happen in your brain. And so NFL, I encourage people to measure. If it's normal, then fine. You probably don't have to measure it more than every second year or so.

Similar to what you would do if you were a male and a measuring PSA. And and in the case of PSA, you know, when it ticks off, bang up, you go for the scans and and, you know, you're probably go for biopsy and so forth.

Neurofilament light as a marker of neuronal injury

So in the same way here with NFL, if you measure it longitudinally and bang, it goes up, but you don't really feel anything, you should still probably be concerned because it's a very, very good biomarker.

It's very exact. The test that we have today is it's actually superb. It was developed quite a number of years ago by a group in northern Sweden. I think everybody used the same test, but you can use different platforms.

In our case we use it on a more professional platform, so we have moved it to the next level. I would say it's the second or third generation test. Working with the Japanese group called Foot, you re bio in this case and where the first lab setting up this more robust NFL test.

So we are very happy with measuring a well I don't think it's something that let's say you have a high p tal and your

NFL is normal. There's no reason for you to start re measuring NFL while you should follow utah to see that it normalizes.

Well, that's a good point. So for people that you've looked at who actually do have Alzheimer's disease and have high tells, how often do you see a normal NFL?

Most of the time. So so they are not that elevated and in Alzheimer's they are mostly quite normal. However, if you do have low if you do have an elevated NFL, then then honestly, that means, you know, just to be candid, that means that something more sinister is going on. So and I'm talking, you know, FDA, Dallas and all these things.

So I think there definitely a reason to measure nephrologists to check that that's normal, that nothing else is going on. As you know, there is overlap sometimes between different pathologies with Alzheimer's.

So you want to check for that. It just gives you more information and and a most cases is probably a test. You don't have to repeat that often. So for NFL, I think just one time, if you do have like traumatic brain injury, there is a reason to use NFL.

Also, it's a very good test for traumatic brain injury is very predictive of and there you can do it at a two day Sierra when you have the injury and then at day seven.

Gotcha. Okay. I mean, one of the reasons I'm enthused about it is so many people, they'll come in and, you know, I've had some twitches, I've had some for circulations is this ALS, which is very hard to treat and typically terminal within, you know, three, three and a half years.

That's the common or is this just benign for circulations? And if you have ALS, you're NFL should be typically high, correct? Correct. Well, this is a good way to reassure people.

Exactly. So it's kind of a rule out test in this case. Yes, I agree. So I think NFL is very good to use just to focus your attention on what's going on.

If it's after the NFL is high, for example, and, you know, your your treatment has to be a lot more aggressive. I don't know exactly your protocol, but I imagine it to be quite different.

And Alzheimer's and we don't have a lot of data yet on FTD. So, you know, the argument is the the approach we've used is tailored to the biochemistry of Alzheimer's.

We don't know about this. We've had some good results with Lewy body. We've had some good results with vascular dementia. We do not know about FTD yet, so there's a.

Lot to do from there. Yeah. So and with with Lewy Body Disease, since it's turning out, as you know, there's a lot of overlap between body and as John Trojan Wolski, the pathology professor at UPenn, has has shown most of the somewhere around 60% or so of the Alzheimer's autopsy cases have a better have Tao have TDP 43 and even have some even have some synuclein in there.

And so there is you know, there's Lewy body pathology in many of these. So I guess the first question is if you have a pure Lewy body case, is the phosphorous, how high and is the NFL's oh.

Oh. Oh will not be high in those cases. And what about the NFL. Peter? No. So NFL? I think not. It's a little bit elevated, but similar to Alzheimer's.

It's not not as much does have to do. Yeah it's it's a slower process then I think is really interesting is then the third test GFP is again complimentary.

This is really looking at the Astro glial response. Unfortunately, it's not telling you the Microglial response, but it's telling you the Astro glial response.

And as has been pointed out for years, that's one of the early if you're developing prion diseases like a Esvelt Jakob disease or if you're developing Alzheimer's, one of the earliest changes is this astro glial response.

So your g-sap is going to be not specific for Alzheimer's, but is going to be sensitive. And when you're looking at this, how commonly are you seeing increases in GFP in Alzheimer's cases?

Now, that's a that's most cases. So it's what's actually proposed as the marker for Alzheimer's by Dunbar and our group at Amsterdam that says that the pet out to one seven is much better now, but it still has great validity and I think it has value, particularly around inflammation.

Yes, part of of that. So so you can think about Alzheimer's as a small component, as you pointed out, and others. And so this is the inflammation part.

Exactly. So the you get a look then at, you know, what's the ongoing inflammatory component. And of course, again, you should be able to bring that down as you quell the inflammation, as you understand, you know, what's actually driving it.

I had a very interesting talk yesterday with Dr. Richard Horowitz, who is using Dapps zone and getting very exciting results, including improvements in cognition with people.

And you look at these plaques in the brain as Rudy Tanzi, of course, and Robert Moyer pointed out, years ago, inside these things, there are pathogens.

So these you know, this this amyloid is a sequestered in an anti-microbial peptide.

GFAP, inflammation, and the future of brain biomarker panels

And so if you can identify what's inside those, then you really have a leg up in terms of knocking down that pathology, which he's doing very successfully with his dapps on protocol.

That's very interesting. I didn't hear about that. So that's. I mean, it's an interesting drug because, of course, it was was used it has been used for years in leprosy.

But as he's pointing out, it is quite successful with Lyme disease, with tick borne illnesses and he uses these pulse protocols that have been working very nicely.

And of course, it has a nice anti-inflammatory effect. So it's it's it's got a real potential for many, many people who have these pathogens. And I don't know that they have the pathogens.

They just know that they have cognitive decline. So to more that and I guess let me before we move on are these all plasma tests? Serum tests are whole. Yeah, that's critical.

That's correct. They're all plasma tests. So that is the the non you know, if you take away the blood of the red blood cells, the white blood cells and the remain is plasma.

So the difference between serum a blood supply is not large, right, to just one product. So I think if there are plasma tests, it's very, very standard to separate plasma out of blood.

And and they're very robust. All of these tests particularly put out 217 is does actually lasts for four weeks outside the freezer even or even a refrigerator.

Wow. Which is encouraging. And so I think that that's really built for a very, very good test. And as I said, it's it's funny because this is super low, abundant protein that we would, you know, ten years ago, we wouldn't be able to really measure these kind of things before these more sensitive instrumentation.

You know, so then 2 to 4 for a pizza. Then just from practical terms, it sounds like this can actually be shipped without ice. Is that right? We prefer it to bishop with with eyes at least.

So, you know, in the summertime and southern United States or other places, it gets hot. So we don't want to that, but we prefer an ice pack at least.

But I think Ice Pack is going to be sufficient in this case. What top tube, what color? So it's the purple top tube that you collect in and then you transfer you spend a dominant transfer to plasma.

So that was an EDTA tube, which is purple top. And then you take that and spin it, and then transfer it so that most labs can do that. Most collection sites can do that.

And then you take us to part. This is a yes. Please go ahead. Sorry. So I was just going to say so since you've been so, you know, so important in developing these tests and so fundamentally involved with them, let me ask, as someone who's interested in understanding what's going on in the brain of patients with neurodegeneration, I would love to see ultimately two other tests.

You're you know, you're giving us something for neurons. You've given us something for Alzheimer's. You've given us something for astro gliomas. How about micro glosses?

What is the potential for seeing a micro gliomas test? And then the other one would be mass cell activation. I love to know inside the brain is there mass cell activation?

So what is the potential for developing those tests? Well, there is I mean, that the field has particular pre you know, it's been dormant for so many years now.

We can't do this. We can't do this. You know, it was like before there was any you know, before our Dr. Farber came to to to to to the Boston Children's Hospital to start developing leukemia drugs.

There was no hope for cancer, right. I mean, together with with certain chemists that at certain pharmaceutical companies, I should mention as well, because there obviously was not only Farber himself, but, you know.

We saw that they just had to retract 37 papers that came out of Dana Farber a couple of days ago. So, oh, know that's tough. But anyway but I want to say is that, you know, you set off in a whole avalanche.

Right. And that's really what's happening now the from not being possible not possible not possible. We're now getting the confidence that we could do this for for pital which measures amyloid as well as tau pathology.

And, you know, if we can do that, we can do more and you know, we already had NFL and we are, you know, G fab we're upgrading to an even better method this year for g fab there is coming something called brain derived tile which is similar to tall tower and the CSF measurements that's coming later this year.

So, you know, the arsenal of tests will increase, will expand. At the same time, it's important to educate people, you know, particularly how to read the results.

And I think we might have a separate discussion on just, you know, how to read the results where maybe I can have some graphical explanations. And, you know, if you see what you see in different situations, but that could be for a more interest group.

I think this was a good talk just explaining these test for a more general, a bigger group. Yeah, great point. Yeah, well, I look forward to those. I think, you know, it's it's going to be really better and better and really going to make fundamental changes in the field for people to know early on.

I mean, when did they start measuring, you know, lipid changes, cholesterol changes when the 19, what, six early sixties or something like that. And we're, you know, kind of entering the same point here where you really can get

an idea, a quite accurate idea about what's going on in your brain with these blood tests, which is just fabulous.

And of course, it offers the chance to do something about it, especially early on. And I think we're going to see a whole wave, people who are trying to prevent people who have this in their in their family.

And as I've pointed out, you know, this should be the last generation that really worries about Alzheimer's disease. You know, our daughters my daughters are now in their thirties.

I would love for them not to worry about this. So they should all get their detailed check when they turn 40 and see where they stand and get it checked every few years and find out, you know, if they're if they're doing well and if they're not, there's a lot you can do about it.

And I, I, I'm totally with you. Nadal. I think this is, I mean, the work you've done is just amazing. And I, you know, when I grew up, you know, we were immediately afraid of first of of heart attacks and then of cancer.

And now everybody is thinking about the brain. Right. So it's, you know, with with a certain actor in Hollywood getting FTD. I think this was highlighting that suffering that certain of these narrow degenerative diseases have.

And we we are entering into an era where people are going to be afraid of this and then having the possibility to prevent and treat these and reverse these diseases is fundamental.

It's so important for our health span particularly. Yeah, I mean, it'd be a little bit like, you know, measuring insulin resistance and preventing diabetes.

So there's a. Tremendous. Amount you can do. So if this is fantastic, thank you very much. And I want to mention that there will be a significant reduction.

We're working with the neural code now. There'll be a significant reduction in cost through the APOE4 website. So I'm very excited about that. And as I said, I'm this is I think this is going to be the most important test that we do this year.

I'm as soon as this is as soon as this is completed and ready, I will be getting this myself because I want to know where I stand and make sure that, you know, over time I can do whatever it is needed to make sure that I don't undergo neurodegenerative process.

So Dr. Hans, thank you so much for joining us. Any any final words I think I've missed here on these tests that we should discuss? No, I don't think so. No, not right now.

I think this was very, very comprehensive. And there's lot lots of information. And, you know, obviously, of us that work with this deal is is all natural.

But I think there's lot for people to process. I would like to encourage people to not hold back if they have questions, you know, come, please come forward with the questions.

My emails can be perhaps displayed at the end of this talk and we have a full time neurologist with our company that is very experienced. And you can ask me, there's not a pathologist as well that has a Ph. D.

in ADI and Alzheimer's disease. So so there are there is back up for any practitioner that wants to ask questions to us. We want to service everybody.

Well, and that people walk away with a good understanding of what these tests mean and that with the help of of the of the House program, I think it would be really helpful to get on the right track to know where you are at and how you improved.

And then you have a objective measurement, how you improving, right. This is very important. Absolutely.

Absolutely. All right. Thank you. Again, thanks for all the great work you've done over the years and thanks for developing these.

And I think, again, it's going to change lives. So thanks very much, Hans. It was my pleasure. Thank you. Okay.