Introduction and Speaker Background

Hi everyone. I'm Doctor Sanjeev Goyal, and this is the advanced Anti-Aging and Technology Summit. Today I have Doctor Karan Krishnan with me. Hi, Corona. How are you?

I'm great. Sanjeev, thank you so much for having me. Thank you so much for joining me today. So I'm just going to read your bio. Doctor Karan Krishna is a research microbiologist, has been involved in dietary supplement the nutrition market for the past 20 years.

He comes from a strict research background, having spent several years with hands on R&D in the fields of molecular medicine and microbiology at the University of Iowa.

He left University Research to take several leadership positions in global companies in business development and product development. Most recently, Karan is the co-founder and Chief scientific officer of Microbiome Labs, a leader in microbiome and probiotic research.

He's a frequent lecturer on the human microbiome at Medical and nutrition conferences. He's an expert guest on national radio and satellite radio, and has been a guest speaker on several health summits.

As a microbiome expert. He's currently involved in over 18 novel human clinical trials and probiotics in the human microbiome. He's also on the scientific advisory board for seven other companies in the industry.

Karan has published clinical trials in peer reviewed scientific journals and several global patents in his name. So thank you again for coming. So I want to start off by, maybe just telling us why did you devote your, like, clinical life to, to research in the microbiome, like how did that happen and and what made you make that decision?

Yeah. So, you know, thank goodness for movies. It's really about movies. So I wanted to be cool, like, like some people in movies I saw. So, you know, I, I've always been a big science nerd.

My mom is a medical doctor. My my dad is a, microelectronics engineer. And so I've always had that science influence in my household. I grew up in India and Malaysia and as you know, in South Asian culture, you know, science, math all extremely important.

So, but I always took to it, you know, it never seemed like a chore to me. It was it was something that was really, fed my curiosity and the natural inclination I had towards trying to figure out the world around me.

So, so medicine science research was kind of a natural fit when I was, the first week at university. And this is in, undergraduate, I was trying to figure out what I wanted to study as a major.

And in that very first week, they were playing a movie in the dorms. And the movie was that movie outbreak. Which is actually kind of apropos for right now.

Right? It was, that's amazing how realistic, it came through everything. An outbreak came true. Everything. Yeah. You know, and all of the craziness associated with it.

Right? Was, in fact, reality was was much more crazier than fiction. When when we did end up having a significant outbreak. So, that was Dustin Hoffman, Morgan Freeman, and they were playing a movie.

And it was so exciting to me working as a virologist or microbiologist, chasing down disease, you know, and of course, that's what really triggered me into the idea of studying microbiology to the very next day when, to the to the Department of Microbiology, which is in the School of Medicine in Iowa, and, and, you know, enrolled for that and started studying microbiology.

And to me, that was an absolute in a match made in heaven because, what's what's interesting about the way my mind works is I've always been very interested in physics and, and in, both astronomy and quantum mechanics.

Right. So these are things that that you cannot see but influence your life in huge ways. And in fact, these are things that require really interesting, array of imagination.

In your ability to think about these concepts because they're not tangible, right? You can't see the atomic particles, you can't see things, in the universe.

So you just have to be able to measure it. But I was never good enough for the mathematics that's involved to really excel in those, in those areas. I could do mathematics at a certain level and said to me, wait a minute, microbiology?

Why Microbiology Led to the Microbiome

Here's another unseen universe that impacts us in a huge way, and it doesn't require as much math. So I love this. So, it was a nice fit. And the reason I jump into the microbiome side of it, you know, one of the things that that happens in microbiology is you you get steered towards, focusing on pathogens.

Right? That was, for the longest time, the most exciting part of microbiology. Again, like virologists who are studying outbreaks or microbiologists that are studying, pathogenic bacteria and so on.

So you get kind of honed in on that area that becomes the most engaging, exciting area. However, you start to realize that less than 1%, maybe even fewer than that of microbes that have ever been discovered are actually harmful or pathogenic to the human host.

Right? So 99.99% of the microbes that we interact with on a day to day basis are either benign or beneficial. And then there's so much effort being put on that point 1 or 0.01%, that it's harmful, that we're really ignoring the massive amount of value that we get out of the rest of the microbiome world.

And so when the when the Human Microbiome Project kicked off, that was a natural fit for me because it was to understand the symbiosis with the microbiome world, right, rather than the pathogenesis or the pathologies that are associated with disease, disease.

So has it been calculated that has the Human microbiome Project been completed, like, have the catalog have, you know, the whole microbiome microbiome for humans?

Yeah. So the the work that the NIH started, back in 2006, 2007, they've wrapped up their work and it's basically now hand it off to the multitude of research institutes throughout the world.

Right. So the NIH really kicked off the project. They got a really nice grant. I think it was somewhere around $150 million to kick off the the microbiome research work.

And they took it to a certain level. And, and at the end of the NIH work, really, what was happened is we were left with far more questions than we had answers.

Right. And so that, though, gave the impetus for lots of research institutions to be able to tap into research dollars, to be able to further study the microbiome.

What we know so far about the microbiome, which is already mind boggling and fascinating, is like a tiny, tiny scratch on the surface. Right? There's a massive iceberg below that.

We're we're still slowly tapping into. And just to give you your viewers perspective on that, in the last five years, there's been over 50,000 published studies on the microbiome, 50,000.

Right. So more than 10,000 published studies a year on the microbiome. It is the biggest evolution and revolution in biological science. And it's the biggest, you know, basically highlight on enlightenment, on our understanding of how we function.

I remember I when I first got introduced, the concept and somebody said we should think of ourselves as super organisms and we're carrying around these this all these bacteria, and we're actually just like an envelope or like a, a casing around them.

Like I thought it's a something like ten times the amount of we have, ten times the amount of bacteria than we do human cells or something like that. Is that. Yeah. Yeah.

Have perspective. Yeah. You know, in fact, those two fancy words I can teach our audience, they can they can use a cocktail parties to sound, extra smart.

One is hollow beyond. So a hollow biome is a super organism. And then the second word is symbiote genesis. Right. And, well, let's unpack each of those.

So we are. I'm absolutely a walking, talking rainforest, right? If you think about a rainforest as a really complex ecosystem, you've got different, physical structures within the rainforest.

You've got the canopy at the top and the canopy and itself is a completely different ecosystem than on the floor of the rainforest. And every few feet of the rainforest is a different ecosystem with different, animals living in them.

And then they all have to work together in order to perpetuate the health and stability of the entire ecosystem. If something goes wrong with a canopy, the entire system breaks down or something goes wrong at the base.

The entire thing breaks down from the bottom up. And that's the same thing in the human system. So we have somewhere around 60, 70 trillion microorganisms that live in and on our system.

The latest estimate is we have somewhere around ten, maybe 20 trillion human cells. So it's somewhere 2 to 3 times more microorganisms than human cells.

But the more fascinating part, even beyond that, is the fact that we have over 250 times more microbial DNA in our system than human DNA, right? That's the part that's really key, because one thing we've all learned about biological science and studying the human system is that our DNA codes for all of the mechanisms and functions that we conduct.

Right. And then there was something before the human, microbiome project called the Human Genome Project, that revealed a massive question that had to be answered.

So prior to sequencing the entire human genome, the estimate was that we would have somewhere around 130 to 150,000 genes in our chromosomes because of all of the complex biological functions that we can conduct as a species.

As it turns out, once they once they sequence their entire human genome. We barely have 22,000 functional genes, right? Compare that to an earthworm that has about 38,000 functional gene.

So we're a lot less cooler than an earthworm is. And here we are. We would laugh and make fun of another form of how primitive it is rolling around in the dirt. Right.

But we're not anywhere as cool as an earthworm. Now, the reason why we are at the top of the food chain, top of the evolutionary ladder, is because we have over 3.5 million microbial genes in our system, most of which we use for our own function.

So some of the estimates are that more than 90% of all of the metabolic chemical functions that occur in our body

that make us human come from microbes, right?

So so basically we could simplify the body to could simplify it its own genes because it's getting so much signaling, I guess from, from the microbiome DNA.

Is that what you're. That's exactly right. Yeah. So one of when you look at, evolutionary biology or an or you match it up with anthropology, what you, what you start to understand is that the reason why mammals, for example, moved up the evolutionary ladder and we are, of course, at the top of the mammals, is because we created a large ferment of base in our digestive system, in our case of the colon.

Right. And then in ruminant animals like cows and all that, they have four of these kind of, fermented stomachs. So the ability to, to, accommodate and bring in a large number of microorganisms that creates our fermented base, their metabolic byproducts have allowed us to escalate in our capabilities.

And, in the topic of, of what we'll talk about today, I'll, I'll mention some of the key things that we've outsourced to microbes that we don't have the genetics to do.

Right. So it's a perfect, analogy to what you see in industry, in business today, where you've got a company that doesn't have enough resources internally.

The Human Microbiome Project and Superorganisms

Human resources, where. So then you will outsource the legal to a set of lawyers, the accounting to an accounting firm, the marketing to an outside firm, you know, the manufacturing to a contract manufacturer because you're not doing you don't have the human capital to do all of that internally that same way in our own genetic material, we don't have the resources to conduct the vast majority of functions we need to.

And that's what because we've designed a way of of outsourcing most of that to the microbial world that we've now brought into our system. So that brings that second term.

I mentioned that I, that I would, unpacked some bio genesis SIM biogenesis is a perfect illustration of how humans evolve. It is forced exposure of of numerous organisms, where that forced exposure causes us to have to develop a symbiotic relationship in order for all of the organisms to survive.

Right. So what we've done is given microbes a home in and on us, and then they have developed, services for us that are required to us. So now our immune system has gone, okay, we're going to allow all of these microbes to live here and not attack them and fight with them all the time.

And but because we're giving them a home, we need you guys to produce a bunch of things that we need to function so that sin biogenesis is occurred over millions of years.

And here we are today, this walking, talking rain forest that is made up of thousands of different organisms, and all of them have to work together in concert in order for the human host to survive.

And in fact, the vast majority of chronic illnesses can be traced back to some ecological disruption in this ecosystem, including, of course, aging. Well, okay, we're going to get to aging, but I you just you touched on something I just have a question about is that if, you know, about the diet, the impact of diet and you said about the there's a, you know, we have these stomachs that ferment food and, the colon, sorry.

That ferments. So does that what do you think, then? I mean, if people are we specifically designed for a particular type of diet or is this how is this very individualized as humans?

Yes, that's a question. And I think when you look at, you when you look at it from the microbiome perspective, which is what is eating, quote unquote, eating the vast majority of what we actually consume. Right?

So we as humans really only assimilate a small proportion of nutrients from what we consume. The rest of it's going to feed the microbes. So when you look at the characteristics of the microbes and what the what a healthy microbiome should look like, it becomes extremely clear that the real human diet is a very omnivorous, complex diet.

Right. And and that matches up with anthropological studies as well that showed that early humans, our ancestors, consumed upwards of 600 different types of foods each year, a very complex diet, you know, and then you take an average Westerner that's consuming maybe 15 types of foods, right?

So there is a massive danger we are facing as a population, and that is a mass extinction of organisms within our microbiome. The diversity in your microbiome is the absolute deciding factor on how healthy you're going to be, how long you will live, how disease free, or what your disease risk is going to be.

Oh my God, this is yeah, the brain. Just think, are you saying this extinction, this whole thing, just you just raised the whole thing for me? Are you saying that we're having extinction happening like in the human race of particular microbes that never may come back, or at least certain populations?

That's exactly right. They may never come back. And we have completely lost functionality because of that. Right. So there are, researchers like Jens Walt Walter, who's a microbiologist who's studying ancient, the ancient gut microbiome.

And he's doing it through studying hunter gatherer tribes. That's still like a hunter gatherer type of lifestyle, similar to what all our ancestors did.

And mind you, you know, I want to be clear that hunter gatherer, even the word hunters first, it doesn't mean that they hunted more than they gather, right?

In fact, anthropological studies indicate that early humans gathered and foraged a lot more than they hunted. So I don't want people to think, oh, that immediately means I should be on a carnivore diet.

That's not that's not actually true. So, the key to hunter and gatherers is that they eat a very large diversity of foods, right? They eat, nuts and seeds and roots and tubers and fruits and berries and animals and insects, all kinds of things.

And so what what what is being discovered when you study the Papua New Guinea tribes that you studied the Hadza tribes in Tanzania, their microbiome diversity and their gut is almost double that of the westernized modern population.

So in this period of having gone from being hunter gatherers type of, lifestyle to where we are today, we've lost almost half of our, of our ecosystem.

Right. And and there is indication that with each generation that's born, we're shrinking the microbiome. And conversely, of course, we do 1,000,001 things that hurts our microbiome.

We can we can list those, as well. But all of the things that we're doing to hurt our microbiome and the lack of things that help the microbiome means each generation is being born with fewer organisms.

And each time we lose sets of organisms, we lose critical functionality. We lose whole sets of DNA that we require to function. So the analogy I give people is imagine if I said that because of our behavior today, our kids would be born without a spleen and their kids would be born without a spleen and a gallbladder, we would all be freaking out like, whoa, wait a minute, we're really destroying the human race, right?

And that's that's the same thing that's happening, right? So there's all this research work that I get to be involved in. Very gratefully called rewilding the gut microbiome.

That is, how do we get back closer to that more ancient, like microbiome. And it involves diet and involves certain kinds of supplementation, reintroducing species that have been lost over the over the last, you know, 100 years, 150 years.

And that's absolutely critical for human existence, right? Because there are transgenerational effects on losing these species. In fact, there's studies being done on fertility and showing how fertility is declining over time.

Right? Our infertility rates are going up higher and higher. And part of that infertility driver is a loss in certain key microbes within the gut and within the vaginal microbiota.

And that has transgenerational effects. So, think about this. This is mind boggling when a, when a woman is gestating a baby so the baby's in utero developing if the, if the mom's microbiome is not healthy, especially with regards to the health of the reproductive system, the the fetus's reproductive system suffers developmental dysfunction.

So then when the fetus is born, it's already born with a dysfunctional reproductive system, so that then when the fetus is old enough to try to have babies of, of her own, she's going to struggle with fertility issues because of something that happened during her gestation.

Right. It's just it's mind boggling to think about it. Yeah. So is it, you're I mean, I know that, you know, the Microbiome Labs has a spore based probiotic, but are you saying that there's other things out there, like, you can take some of these things that have gone extinct or not, you know, to repopulate?

I mean, the the gut. And like, I've heard about people even taking, like, parasites or worms to like, reduce like allergies and things like that. What are your thoughts about those types of products and there so, there's, there's going to be a few categories of organisms that, that come out over the next few years.

And we're working on some of them that can basically rewild your microbiome. One of one set are, anaerobic organisms that are critically important in the large bowel. Right.

And these are difficult organisms to work with because they tend to be hypersensitive to oxygen. So the moment you pull them out of the gut and you try to grow them in a factory like a probiotic, they'll die.

In some cases, they die within 30s of being exposed to oxygen.

Microbiome Diversity, Diet, and Lost Species

So the so the technology involved in managing and handling these organisms are critical. We are working with, with one such organism, called a bureaucracy caucus.

Policy cum bureaucracy caucus is a really important butyrate producing bacteria that is obligate anaerobes, meaning if it's exposed to optional dye. But we've found a way to produce it from beginning to end in a completely anaerobic room, meaning that room has no oxygen.

So you imagine the people that are working in that room actually all wearing full face masks and all that, right? Oxygen tanks and so on to protect that bacteria.

And from the start to the finish of the of the production, the fermentation starts on this end and at the very end of the, of the system comes out the bacteria in a highly specialized capsule that takes it all the way down to the colon and only releases it in the colon.

Because if it releases in the small intestine, part of the small intestine is still aerobic, there's still oxygen in there. So, so that kind of thing.

And then, actually, we're working with the NS Walter, who's probably one of the most well known microbiome

researchers in terms of ancient microbiomes.

And he's actually isolated some species from the digestive track of, of hunter gatherer tribes that he still exists today. And these are, species that seem to be, for the most part, missing out of modern, in modern humans.

Or in westernized humans, I would say not not necessarily modern, but westernized humans. And what's interesting about it is these organisms are predominant in the hunter gatherer tribes.

So not only are they not present in us, they're not predominant like they should be. So they were predominant in our guts at some point. And then when you look at them and the function of them, so many of them play a really critical role in the function of our immune system and in inflammation.

Right. And it's like every time you find these critical organisms that seem to be highly present in the guts of, of hunter gatherer individuals and not very present, not very present in westernized population, they always seem to have an impact on the immune system and inflammation.

Right. And and of course, as we know, inflammation is probably the biggest driving force of disease within our, within our society. So, so it's going to be, ancient bacteria that we'll go back to.

There'll be anaerobic bacteria. Those are two categories. And then there will be other, like how might and other things like parasites, worms and things like that that actually should normally be in our system, but we've completely eliminated them because of our sterile living.

Right. So let's let's go. Right. We can I think it's a perfect segue to talk about aging. And so what are your thoughts about how does the microbiome contribute to aging and how does aging change the microbiome?

I'm curious. So so and this is a very complex subject. There's a lot of active research going on, but I think for for your audience to focus on three aspects of it, would bring them a lot of value because that that should empower them with enough knowledge to know how to control some aspects of their aging.

The first part of it is that the microbiome can be the biggest driver of age related degeneration, tissue degeneration. And we'll talk about how that is right.

And then thus the last two parts. So one part is the microbiome as a driver of aging. And number two is the microbiome as the savior against age related degeneration.

Right. And there there are two components of that I'll talk about, that are, that are simple. And yet people can do the very next day to improve. So the first part, I'm sure through the program you've talked about inflammatory aging, right?

And aging is really the big driver, right? It's inflammation associated tissue degeneration that happens with your neurological system, with the with the, muscular system.

It happens with every organ. Your eyes, your hair, your skin. Everything gets driven in in terms of a degenerative, methodology through inflammation and chronic low grade inflammation is a massive driver of that.

You can characterize that in a number of ways. There are all these inflammatory cytokines that we measure, right? Interleukin six, interleukin one beta, TNF alpha, all of these things, when elevated, chronically indicate an inflammatory state.

And those inflammatory states are associated with rapid aging or, you know, nonmalignant aging. I would say, you know, because, of course, we we don't want to lose function quickly.

Time is always going to keep moving. But we don't want is we don't want to prematurely lose function. Right. Whether it may be cosmetic things like skin health or, you know, more important things like cognitive function.

Right. And one of the things that's absolutely clear is neuroinflammation and microglial influence. Inflammation in the brain is the biggest driver of age related, dysfunction in the brain.

Right. That's early onset Alzheimer's disease, senile dementia, Parkinson's, all of those things. Even prior to all of that brain fog, memory loss, inability to learn to slow down and learning capacity, you know, emotional, imbalance, especially when you, when you, create issues around the hippocampus.

All of those things are driven by inflammation, a leaky gut. So intestinal permeability is the biggest source of chronic inflammation in the body. Right.

So when your microbiome is dysfunctional and it's not providing protection against the barrier or system in your intestinal lining, it drives the highest amount of chronic low grade inflammation.

In fact, a 2015 study in the frontiers of immunology, which is a meta analysis study, showed that, intestinal permeability and the associated chronic inflammation from intestinal permeability was the biggest cause of morbidity and mortality worldwide.

It was the biggest driver of chronic illness and age related dysfunction. And so the and I would say, you know, this, how did they how did they determine who had a leaky gut or at the disturbed, and intestinal barrier?

How did they determine that? Is that a blood test or how other people find that out? Yeah. So there's a couple of different ways now. It's really hard to do that in practice. Right.

Because we don't have a commercial leaky gut test that you could get it from the lab or places like that. But in research, the gold standard way of measuring leaky gut is measuring a migration of an endotoxin called LPs lipopolysaccharide.

Right. So LPs moving from the lumen of the gut past the intestinal lining into circulation indicates intestinal permeability. That's been published by the American Diabetic Association, American Heart Association, the NIH, all the biggest research institutes in the world have published large studies on that being a gold standard of measuring intestinal permeability and what we call barrier dysfunction, or what we've been saying in the functional medicine world now for decades.

Leaky gut. Right. It's it's it's a it's a term that that has been frowned upon by allopathic and conventional research for a while now. However, that's a very widely accepted term.

And you see leaky gut, that term, being described in lots of really high level papers. And what about lasagna? And so there's a mix, right? So Zainudin is not necessarily, present at, at elevated levels in, in everyone that has intestinal permeability.

So it's one of those markers that can indicate a problem, but it's not definitive. And I think that is described by the, by I think Fasano who was, who had discovered Zombieland to begin with.

So you can use online as a way of saying, okay, there may be something going wrong with the gut, with the gut lining. You can use surrogate markers like interleukin one beta or soluble CD 14 or even interleukin six.

These are these are your quintessential inflammatory markers. And typically people with elevated levels of those tend to have leaky gut. One of the ways I've advised clinicians is you, the way to look at those markers is actually to look at it.

Postprandial right. So you get a patient to come in faster for your study on this. I saw a study you did looking at markers postprandial after they were given a biotic right.

Yes. Yes. And they take a meal. Right. So and the reason for that is when you have leaky gut, the, the time when you see a huge inflection of those endotoxins migrating into circulation is during the process of digestion.

So the so the biggest impact of leaky gut comes 4 to 5 hours after you eat a meal. That's when you see the heightened maximum amount of inflammation in the body.

And then your your body keeps trying to deal with that inflammation, you know, after that. And so what I've advise clinicians to do is get a patient to come in fasted.

You pull, a blood sample. And of course you're going to be looking at soluble CD 14, which is a known marker, interleukin one beta, interleukin six. Even if you just look at those three, you'll get a good clue and then have them go out and have a meal after that, that blood pool.

And it's better if they have a high caloric, high fat meal. So this is the this is the time when you could say, go to McDonald's and have, a Big Mac, you know, and fries and a shake, because if you really want to see the Delta, it's driven higher by those kind of meals, and then they come back 4 to 5 hours after that meal, and you pull another blood sample.

And then when you're looking at the results, you're looking at the delta between the two. So if you see a rise in the inflammatory markers after the meal, then that pretty definitively indicates, leakiness in the gut.

But here's the thing. I tell people, if you live in the Western world, you can assume you have leaky gut. Almost everybody does.

Rewilding the Gut and Restoring Microbial Function

You know, if you have any chronic condition, then all of you have allergies, if you have indigestion, if you have food intolerances, if you have sleep issues.

All of those are associated with leaky gut. So just the fact that we live in the Western world and we've all had multiple courses of antibiotics, so our lives were all exposed to roundup all the day, all the time, you know, like all the water here, our tap water, you know, is is so unfit that, we've been struggling with this.

I'm trying to start a fish tank for my seven year old daughter. And every time we fill the fish tank, we conditioned the water to put fish in, and they're dead in 24 hours, right.

Because the water sucks. It's full of things like lead and cadmium and chlorine and all of that stuff. Right? So, all of those things are detrimental to your microbiome as well.

And so, so the only way to keep the fish alive, we have to go and buy our own water. That is, and we're not, you know, drinking our water most of the time. So.

So if you live in the Western world, you pretty much have a leaky gut, and you should you should approach your microbiome as if you have leaky gut, right.

So the first part of it is that leaky mess in the gut and that migration of LPs is one of the biggest driving factors in inflammatory aging. And that's the driving of tissue regeneration based on inflammation that LPs itself, that endotoxin that's made in the microbiome that is supposed to be sequestered in the lumen part of the gut, if it's allowed to leak through, can also accumulate in places like your brain and accumulates in the hippocampus.

It accumulates, and it interferes with serotonin binding with except with dopamine binding, it creates all kinds of inflammatory conditions going on in the brain.

And that's the biggest driver of, of, age related degeneration in the brain and neurological system. Is that inflammation? So is there any relation with is there any relation to able to people for. Yes.

So I mean it's totally increases. Yeah. That's exactly right. Yeah. So when you look at people that are either homozygous or heterozygous for AP, one of the key things that occurs is they tend to be more susceptible to,

inflammatory damage in the gut lining and also more susceptible to high dietary fat intake, creating intestinal permeability as well.

They don't absorb the fat soluble vitamins as well. Right. So they don't absorb vitamin K2. Well, vitamin D, vitamin E or A. So they don't absorb these antioxidant vitamins very well.

So they tend to have more damage in the gut lining as well. So though for those individuals I would say, that they want to pay particular attention to their fat soluble micro vitamin A, micro nutrients and, and actually look at higher intake.

And then they also want to pay attention to the diet and maybe not have as much of saturated fat and, high oxidative fats in their diet as well. So, you know, just let's talk about then how we can help the viewers who have, everyone's got leaky gut.

And I'm using I'm using the Total Gut restoration program. So maybe it's a three step kind of solution. Maybe just want to take us through that. Like, what's the kind of the the the thinking behind it.

It can understand why they're doing it instead of just taking a supplement. Yeah. No. Absolutely. So, one of the things we've been doing over the last, like 7 or 8 years is we're trying to figure out what does this standard American gut look like, right?

We've got the standard American diet. We've got, you know, certain conditions that are highly prevalent in the Western world, very common among people, especially adults.

In the US, the CDC has shown that at least, 50% of adults have at least one chronic illness, 40% of adults have multiple chronic illnesses. So so we know that we've got very common dysfunctions, across the board.

And then there are all of these independent studies that show that, you know, seemingly unrelated conditions like reflux and diabetes and depression and acne.

You know, these are a completely different kind of conditions, but they're all related to dysfunctional microbiomes. And so our thinking was, okay, these seemingly unrelated conditions are all somehow related to a dysfunctional microbiome.

Is there a standard dysfunction or universal dysfunction that's going on in the gut that can that can end up, you know, manifesting as these different conditions?

Right. And and again, in, in the typical practice of medicine, if you go to a doctor and say, hey, doc, what is my reflux have to do with my diabetes would say nothing, right?

The reflux is an upper GI thing. Your diabetes is a pancreas issue. Or if you say what is my diabetes have to do with my depression? And they may say, well, that's you go see the psychiatrist for your depression that's in your brain.

And then you go into your, your, you know, internal medicine doc or whatever to start managing your diabetes. So it's completely compartmentalize. And, and it's made to seem that these conditions have no, connection.

But when you look at the macro physiology of what drives these conditions, it comes down to a dysfunctional microbiome. And here's the thing. It's the same kind of dysfunction in the microbiome in all of these conditions.

Right. And again, it comes back to the whole idea of of inflammation. So the so the concept behind total gut restoration was let's follow the path of what starts to become dysfunctional in the gut microbiome that leads to intestinal permeability and dysfunction in the intestinal mucosa.

And then let's start reversing that trajectory. Right. Let's repair the things that go wrong first and then allow a

cascading effect to to fix the rest of the system.

So the first thing that goes wrong in your microbiome is a loss in diversity. Right. That's the first thing. And I mentioned earlier diversity is the most important thing in terms of of association with health and wellness within your microbiome.

So a loss in diversity. And one of the things that is hallmarks of a loss of diversity is a loss of keystone species. So these are organisms within your microbiome that have been designated as keystone organisms because they play a huge role not only in the maintenance of a healthy, balanced microbiome, but also are typically inversely correlated with disease in the host.

So I'll give you a couple examples. Aquaman, can you send a fella. Right. There's numerous studies that show that it's inversely correlated with everything under the cardio metabolic spectrum.

Right. So obesity, diabetes, cardiovascular disease, senile dementia, polycystic ovarian syndrome, all of these things that fall into cardio metabolic disease are inversely correlated with Aquaman's here.

If you have high Aquaman's here, you're protected against these conditions. If you have low Aquaman's here, your risk for these conditions go way up. And in fact, some of these conditions, like diabetes, can be reversed if you increase Aquaman's here.

Right. So it's a very important keystone species. Another example of that is fecal bacteria, its proximity. That's a obligate anaerobes only found in the colon.

Again, cannot live in an oxygen environment very unique to the human species. And for killing bacteria, nets are protects against all kinds of inflammatory conditions in the bowel.

It's also IBS inflammatory bowel disease like Crohn's colitis, micro colitis, colorectal cancer and so on. When you have high fecal bacteria protected against all these conditions, when you have low, your risk for these conditions go way up.

Right. So keystone species and diversity in the microbiome those are two hallmarks of standard American gut dysbiosis. When your gut is dysfunctional you've lost keystone species.

You've lost diversity. Now the next thing that happens is when you lose keystone species in diversity, you lose post biotics, right? Post biotics are all of these compounds that are made by the microbiome that are critical to our function.

These are compounds that we cannot make ourselves. We don't have the short chain fatty acids. Kind of. Yeah, that's exactly right. Yeah. Short chain fatty acids.

And another one I'll mention as it relates to aging your listeners. Right. So those are two great examples. Your lithium and short chain fatty acids. We cannot really get those from diet.

We cannot make them ourselves. We count on microbes in the microbiome to take the food we're eating and convert it into these important compounds. Right.

So when you lose diversity and you lose the keystone species, you start losing the production of these critical post biotics. Now, as you start losing the production of these critical post biotics, many of them, including the short chain fatty acids you mentioned, are critically important for maintaining the mucosal system and the immunological response in the mucosal system that sits on top of the gut lining.

Right. So the mucosal system for your audience, if they're not familiar with it, is the largest surface area in the body. We used to think of our skin as a large surface area.

Our mucosal system is somewhere around 200 times bigger. We've got about at 4000ft², our 400m². If you're using a metric system, of of surface area inside the body, that is all mucosa.

And in that mucosa, what's happening is that's where most of the microbes live in your system, and that's where most of your immune system is as well.

So that's the interface between the immune system and the microbes that live in your system. And a lot of decisions on how your body's going to react to the foods you eat, the environment around you, the microbes that enter your system.

All of those decisions are made in the mucosa. And the maintenance of that mucosal structure is critically important because when the mucosal structure starts to break down, what happens is you lose a very important physical barrier, right.

That prevents things from flooding into your system, past your intestinal lining, into your blood circulation. So your immune system goes haywire. When your mucosal barrier is dysfunctional, the immune system reacts inflammatory to anything that enters the system.

Right. So I have a diagram here actually I can show to help illustrate this for people. So I use this quite a bit. Right. So this is a this is a healthy gut intestinal lining a healthy microbiome up here.

This is a nice thick inner lining of your mucosa. This is called a museum to layer. It's a thick gel like structure. The communication between the microbiome up here and the immune cells down here is all occurring in this space.

When you've got a biotic gut and you've got a breakdown of this mucosal system, you tend to have an influx of microbes from up here, moving inside the inner part of the mucosa and closer to your intestinal cells.

When they move closer to the intestinal cells, your immune system freaks out because it thinks there's going to be a flood of bacteria entering your system and your immune system now sends a lot of inflammatory immune cells into this area.

And you get constant inflammation in your mucosa, right. So what happens in the gut mucosa translates to the rest of the body. So when you have constant inflammation in the gut mucosa you tend you start to have constant inflammation in the lung mucosa, in the sinus mucosa in the vaginal canal.

All of these other mucosal tissues that take their cues from the gut, right. And that completely disrupt your immune function right now, your immune system, instead of tolerating things that you should your body should have learned to tolerate like ragweed and pollen and, you know, proteins from your diet and so on, it now reacts to everything in an inflammatory manner.

Right? So that's central command system of the gut mucosa dictates how the rest of the immune system functions throughout the body.

How the Microbiome Drives Aging and Inflammation

So now when you start dismantling that gut mucosa because of the lost of of post biotics, because of a loss of diversity and loss of keystone species, you start creating a pro-inflammatory, focus of your immune system, not only in your gut, but now to the rest of the body as well.

Right. And people may experience status, allergies that start coming on right. You start experiencing that as food intolerances that come on later on in life.

You know, I know so many people that were never allergic to things as a kid. And then now they're sensitive to things that, that, that, are now driving histamine reactions.

People are getting, concerned about in a mast cell disease and all of these things that are basically immune dysfunctions all the way up to autoimmune conditions.

Right. Because one of the consequences of this kind of constant inflammatory response, right, is that is that that does damage to your own intestinal cells here.

And when there's damage to your own intestinal cells and your own cells release its proteins, your immune system may erroneously target your own cells.

And so when an erroneously target your own cells, it starts driving autoimmune response. Right? So that whole inflammatory state, that immunological dysfunctional state in the body is the next step which, prior to the final step, which is your intestinal, system becomes permeable.

Right. So those are the four steps that occurs. That's the dysbiosis characterized by low diversity, low keystone strains, then low production of post biotics like short chain fatty acids and your lipids.

Then you start getting a dysfunction in the mucosal structure. Then you start getting a disrupted immune response. And then finally your intestinal epithelium itself gets destroyed and you start getting a huge influx of toxins and other things into circulation, basically dismantling your body's ability to deal with the world around you.

Right. And the vast majority of chronic illnesses relates back to this, this, this type of dysfunction. So when we look at it, something like the total gut restoration that you mentioned, we started saying, okay, how do we walk this back?

Right. How do we're fix how do we fix this? This system. Well, it starts with dealing with the dysbiosis, right. In order for this downstream process to have to work, we have to address the low diversity and the low keystone species.

And so in order to do that, we have the spore based probiotics, which we've shown in clinical trials and other trials and animal studies and gut modeling systems and so on, that when you add the spores into the system, it actually increases the diversity of the microbiome.

Right? We're not putting in with that happens. I was curious what happened. Like it sounds to me right. We can increase Bacillus subtilis. But why would you increase something else. Yeah.

So that's the total counterintuitive part about it. And the way we even discovered that that would occur is because we know that Bacillus has this ability to do something called quorum sensing, where it can read the microbial signature of the, of the microbes in the in a particular environment.

And because it can do that, one of the big uses for Bacillus since 1952 is to treat gut infections. There are a number of prescription drugs on the market, the first one launched in 1952 by Sanofi-Aventis.

It just which is still in the market today, to treat dysentery and other gut infections. Right. The reason is you can put but still listen to the microbiome.

It reads the microbial signature it hones in on the pathogenic microbes, sits around the pathogenic microbes and brings down the growth of the pathogenic microbe.

We published a study that we did with Cleveland Clinic on C diff and how the spores, can actually target Clostridium difficile and bring down the growth of Clostridium difficile.

Right. So it has that intelligence in understanding what shouldn't be in the microbiome at certain levels. So our hypothesis is that we can do that for problematic organisms.

Maybe it can do the same by identifying that beneficial organisms at such low levels that we that it can perhaps increase the growth of beneficial organisms.

And sure enough, what we found is that when you add bacillus into the system, not only does it bring down the overgrowth of of, problematic organisms, it produces a bunch of compounds to actually help grow the rest of your commensal organisms as well.

So you may have an important bacteria, like take Aquaman's here that I mentioned. Right. Aquaman's here in a healthy microbiome, should be about 5% of the total microbe microbial population. 5%.

That's a huge amount for a single species. Right. And but in a in an unhealthy microbiome, you would have it at somewhere around 0.1%. So it becomes a tiny, tiny fraction of the population, which means we're not getting all of the functionality at a micro out of Sacramento.

So then the bacillus comes in and the bacillus identifies the microbes that are suppressing our commands here, and it comes to those microbes and brings them down.

And in fact, the bacillus then can produce compounds like short chain fatty acids or subtilis and and so on. That will feed the Aquaman's here and bring it back up.

Right. So we showed in one of the studies we published that when you add bacillus, you can increase Aquaman's your growth tenfold. You know, not doubling it, not tripling it, but a tenfold increase in Aquaman's here, a tenfold increase in scaling back to our present time.

So it's kind of the orchestrator of the gut. And this is an amazing example of symbiote genesis, right? Because we don't have a capability of doing that ourselves.

Right? We can't go. All right. My microbiome is dysfunctional. My own body is going to go in there and make adjustments, bring down the bad ones, increase the good ones.

We don't have a mechanism for that right? We we've outsourced that job to microbes that we are supposed to encounter every single day of our lives. So think about it through the course of human evolution, we've been eating Bacillus all day long because there are ubiquitous organisms in the environment, right?

Our ancestors ate dirt, they drank water from rivers and streams and so on. And Bacillus has been here well before humans is the oldest bacillus they found is about 250 million years old, still alive.

In fact, you know, fossilized in the salt crystal in a cave. So they've been here way before us. Our ancestors consume them every single day. We develop the same biogenesis with them where we go, okay, Bacillus, we're going to give you a home. It's a temporary home.

They they leave the gut after about, you know, two, 2 or 3 weeks. But in that meantime they kind of clean up the system. So they act as the regulators of the microbiome.

So they reverse that issue with diversity. So they increase the diversity. They bring back organisms that are struggling that are at a very low level.

And then they bring back the keystone species as well. Right. And so then the second phase of the total gut restoration is as the bacillus is starting to do that, then we want to reinforce those new microbes that are now growing and proliferating with the right kind of prebiotic.

So we created this thing we call precision prebiotic that are made up of oligosaccharides that very specifically feed these keystone species and feed these important, anaerobic bacteria in your gut.

Right. So we're reinforcing those positive changes. Now, another thing the bacillus is doing is it's bringing back these organisms. It's it's increasing the expression of tight junction proteins.

These are the proteins in between your intestinal cells that bring them back together. When your gut becomes

leaky. Right. So when you got becomes leaky, the cells open up.

The space in between them allows things to leak through. The bacillus increases a tight junction protein so it seals up the gut as well. So it's sealing up the gut lining and it's starting to proliferate and improve the dysbiosis within the gut microbiome.

And then the last step of the total gut restoration is providing your new microbiome, your new diverse microbiome with that has lots of these keystone species with tools that they need to fix the mucosal layer that's been damaged and then revamp the immunological response within the gut, within the mucosa as well.

Right. And we do that through polyphenols, amino acids and a number of other things. So that's the idea. The idea there is that this is a this should address the most common dysfunctions.

And dismantling that occurs in the westernized gut, and that those common dysfunctions are a big driver of risk for conditions and how, how fast you think a user would feel difference or like, I mean, I think you should a program I think is a three month program.

But, just from your experience with talking to patients and, and other, customers, like, what are they, what are they telling how fast, they see a response.

Yeah. It is not at all uncommon for people to feel something measurably different going on in their system within the first three weeks. And that's just the probiotic part of it, right?

Total Gut Restoration and Clinical Strategy

So the way the system goes, it's probiotic for the first month, and then the second month you keep the probiotic, but you add in the prebiotic, and then the third month you keep the end pro, and then you add in what we call the mucosa, the mega mucosal product.

So in that first three weeks where you're still just on the probiotic, if your issue is primarily digestive, meaning you've got IBS type symptoms, right, you've got either constipation or loose bowels or you got a lot of intolerance.

A lot of people feel a significant, relief of that kind of symptomology in that first three week period. If you're dealing with things like mood disorders, a lot of people find changes or measurable changes in how they feel, how they sleep, their ability to get get rest, you know, energy levels, those kind of things people start to feel.

Because when you start changing your gut microbiome, it's it can be quite profound, right? For your system. But we always tell people to go through and do the full 90 day and then really assess where you are at the end of that 90 day.

And the way clinicians here and, certainly in the US and Canada work as well, is at the end of that 90 day, they take the patient, they assess, okay, how much progress have we made on what we're trying to control here?

And if the progress is significant. And at that point the patient's fine with just maintenance, then what they do is they just keep them on the probiotic as maintenance.

They take that every day and then the prebiotic in the mucosa, they might use it intermittently once a week or something like that. If they find that the patient has made significant progress but still needs more, then they'll do that, that that cycle of the three products for another 30 days and then evaluate again, and then another 30 days and evaluate again.

Okay. And they can also do it, I guess you would see changes in the and the microbiome test as well as that. That's another piece of it's just going to help.

Nice. Yeah. Buy on effects test. That's right. Yeah. The effects test looks at functionality within the microbiome. So

it gives you all of the key things like the diversity of your microbiome, the level of those keystone species, the proportion of different functional groups of bacteria.

So it's really looking at functionality and characteristics of the microbiome that are that are well known to be associated with health and wellness. And so you'll be able to see a significant change in those characteristics and pair that up with how you feel.

At the end of that 90 day period. So we're we're getting more and more docs now incorporating the microbiome tests into the the initial stage of evaluation.

Because beyond the total gut restoration system, some of the things you may need to adjust to really get the the biggest bang for your buck is dietary changes, right?

So people there are either foods that they should be adding in that are going to be very deliberately trying to feed certain groups of bacteria that are very low, or certain foods that you should reduce because of the type of tendencies you have.

One example of that are, foods that are, high in sulfate. So if and there are lots of healthy foods that are high in sulfate right there. Seafood that's high in sulfate mushrooms, leeks, certain types of onions, you know, things like brussel sprouts are tend to be high in sulfates.

And those are all healthy foods objectively. However, if you have high sulfate reducing bacteria in your microbiome, if you eat sulfate rich foods, those microbes are going to convert that sulfate to hydrogen sulfide.

And hydrogen sulfide is very inflammatory for your large bowel. So it can actually, you know, disrupt your progress, right. But you would never think that you would you would go, these are all healthy foods.

So start adding these healthy foods into your diet. But because of the way your microbiome is at the moment, that could actually be detrimental to progress.

So so they do the biome effects test in the beginning as well, to understand the tendency of the patient's microbiome to potentially adjust things like diet.

If, just one last question. I know we have to end soon, but, so I'm going to take a course of antibiotics. I mean, they had to, you know, that was an infection.

Their doctor gave it to them. Should they be taking, a spore based, probiotic with it or after it or what's what's the evidence saying about that? Yeah. So there's there's two aspects to it.

And in fact, we published a study on this, in August of last year where we showed that when you take a course antibiotic, it's not only are you disrupting the microbiome so the microbes themselves, but you're changing the immunological response that occurs in the gut lining, and it's actually making the intestines more permeable.

So a single course antibiotics can actually increase intestinal permeability and leaky gut and of course start to dismantle the microbiome itself. So what we showed is that when you take the spores with the antibiotic and then for for a few weeks after the antibiotics done, you actually prevent a lot of those changes from occurring.

And whatever changes do occur when the antibiotic is gone from the system, the spores will actually start reversing those changes. So we highly recommend it to people to take it.

During the course of antibiotics, you can take it with the antibiotic. We did a study on, liver failure patients, which we published last year as well, who were taking rifaximin every single day to manage their blood ammonia levels.

And what we showed is that taking the spores with the rifaximin at the same time actually still allowed the spores to function in the gut, so the spores can function in the presence of antibiotics.

They basically stay in the spore form, and the antibiotic concentration is high in the small bowel. At the moment the antibiotic concentration lowers, then they come out and they start functioning trying to repair the damage that occurred.

Now here's another tip. And this is, based on a fascinating study out of Johns Hopkins, right? They they did this study where they where they followed individuals that were given a prescription of antibiotics.

They took a bunch of microbiome samples prior to them starting the antibiotic. They took samples during the course, antibiotics, and then they took samples every month for the next six months after the antibiotic prescription was done.

Right. And no surprise, they found that based on where they started, they had a significant shift in the microbiome, which was not a positive shift. And that negative shift was still observed six months later after the course antibiotics were done.

And that's not surprising because there have been other studies in the past. It showed that same trajectory. Here's a crazy, surprising part about it.

They also happened to measure the microbiome changes of individuals that lived in the same household as the person taking the antibiotics, but those individuals weren't on the antibiotic, and they saw that same kind of shift in those individuals.

Right. So it's it's our negative changes in our microbiome in this case because of of course, antibiotics can actually influence the microbiome of those that live in our household.

And these were non platonic non intimate partner. So these were platonic roommates platonic partners mother child you know those kind of relationships just being in the same household and same ecosystem.

I wonder if vice versa, you could also improve your family member's microbiome by taking by taking care of your microbiome. I'll be very interesting if they.

Yeah, absolutely. 100%. In fact studies that have yeah, they've alluded to that. Right. So there are studies that show that households that have for for example, 6 or 7 or more individuals in a single household, everybody in the household tend to have a healthier microbiome versus households that have 2 or 3 individuals.

So the more influence on the microbiome, households that have dogs have people with more complex and healthier microbiomes because dogs go out, bring all kinds of bacteria into the system, right?

Keeps the system from going sterile. And so we we live in this with this microbiome cloud that we are all influenced by.

Antibiotics, Household Effects, and Environmental Hygiene

So the reason for that tip is because if you are on antibiotics or have been on antibiotics any time in the last two years, because there's another study that published showed that a seven day course of clindamycin, they can still measure the dysfunction from that seven day course up to two years after the antibiotics.

Right? So if you've been on an antibiotic any time in the last two years, not only you should be on the spores and total gut restoration and, improving the diversity of your diet and so on, you should also make sure you're doing that for others that live around you, because likely that had also influence their microbiome in a negative way.

A last question, because, just a very timely what are your thoughts about like the impact on the microbiome, I guess the cod microbiome, with all the, hand sanitizers and, and hand washing with the detergents and things.

What's your thoughts about that? Yeah, almost. Yeah. So to me, that that is going to have a detrimental effect. And

I think more so than washing, it's going to be more the sterilization of the environment, the surfaces within your home.

Right. And I know early on in the pandemic and I'm guilty of this too. We ended up it was I joked in a couple of interviews I did it was a first time in forever that I bought like Clorox wipes, right?

Because I just didn't know what was going on. Right. We didn't know. Is this stuff coming in on your packages? Is it, you know, how is it tracking into people's homes and so on.

So people were hyper cleaning everything and that in fact has a long term negative, benefit. Sorry, not long term negative, effect on your system. The environment hyper cleanliness does.

And in fact, this was illustrated by a study called a Finnish allergy study, which is fascinating to mention because, there's an area of Finland that is geographically very close to a town in Russia.

And there are only about 100km apart. Right? So geographically, they're essentially the same. The difference is in that Finland town, the allergy and asthma rates are through the roof.

And in their Russian town they're very normal levels. So the low levels. So then there's been this, huge funded study called the Finnish Allergy Study to understand what are the practices that are different between those two towns that causes this big shift in immunological response and immune system function, and the one thing that they found was that in the town in Russia, they don't sterilize their environment, their surfaces and all that.

They keep their doors and windows open more. So you're getting a lot more of the outside environment into the system. And then Finland, of course, you know, conversely, they sterilize the, the countertops and environments.

That's the notion of clean. And then the doors and windows and all that are closed a lot more. So you're not introducing organisms into your, your household.

And because of that, your immune system suffers. Right. So, it's fine if you want to increase your handwashing and maintain that kind of cleanliness hygiene, but you don't need to sterilize your, your home environment.

You know, you don't need that kind of paranoia, sterilization. And I think one of the things that we were missing, you know, that that was an issue even prior to the pandemic is we're not spending enough time outside, you know, because there are lots of studies that show the more time we spend outside in natural environments.

I'm not talking about just sitting on your patio drinking a beer, right? That's not the tech, the kind of outside I'm talking about. I mean, going for a hike in the in the woods, or if you live near the coast, going on the beach, there's lots of studies showing that that kind of outdoor exposure dramatically improves your immunological response, your mucosal immune response, your, tolerance for for things that you shouldn't be targeting through your, your immune system shouldn't be targeting and also increases diversity within your microbiome.

So my recommendation to people always is make outdoor time almost prescriptive, just like your doctor would prescribe a medicine or something to you. Make it prescriptive. I tried to do that myself.

I try to go, okay, I'm doing 2 or 3 30 minute sessions outdoors somewhere each week, right? And unfortunately for me, I have a lot of forest preserves around me, so it's a matter of going for a walk through the forest reserves, or riding my bike or doing something like that, engaging with the environment that has a huge impact. So.

So yeah, I don't think we need to keep we need to sterilize our environment. And I'm not wiping down my steering wheel every time I get in the car and every doorknob and all that. Right?

I am washing my hands, of course, trying to maintain some some degree of hand hygiene and trying not to pick my nose all the time. Like, I, like I tend to do.

And so, sorry, we shouldn't be admitting that on a on a professional talk, but, you know, they, that that kind of basic thing is fine, but we don't need to sterilize our world.

Okay. Thank you. I think we're just about done. Maybe. Any last words you want to tell our viewers? Like the main message to get from today? And, you know, it's never too late.

I think that they can take charge of getting their microbiome back on track of if, you know, if it's off kilter, I. What what's your kind of main message?

Totally. That's that's absolutely that's part of it. You know what I want to tell people is, in in the last ten years, we've learned more about the human system and how it functions.

And in the previous 100 years combined. Right. So we're finally getting a peek into that 90% of what makes us human. Everything we've done for medical and scientific research up to that point was only looking at less than 10% of how we function.

And then now with that peak, we're starting to understand that the vast majority of chronic illnesses are driven by an ecological dysfunction. In this walking, talking rainforest.

And it starts in the gut and it starts in the gut microbiome. When your gut microbiome is dysfunctional, your gut is leaky, you've got inflammation. That is the groundwork for the vast majority of chronic illnesses.

And the good news about that, the good news here is because the vast majority of chronic illnesses are based on an eco logical dysfunction, you can fix that ecosystem, which means you can really make progress on those conditions there.

The vast majority of diseases are not driven by a genetic dysfunction, which you can't change, right? If you've got a genetic dysfunction, you can't change your genes.

But if it's an ecological dysfunction, you can change the ecosystem and make progress. So there's lots of hope out there that whatever you're you're suffering from, you know, whether it's a chronic condition, it's an acute condition that there's likely things you can do to reverse, the outcomes of those conditions.

And you have a lot more power in your own hands to control your own health destiny, because every little choice you make impacts these microbes that are in your system.

And as they get impacted, they either favor your health or they can be a detriment to your health. Right? So these kind of programs are really empowering.

And that empowerment, that knowledge base that you're getting from a program like this is going to be the key to the future of health and wellness and the future of health care in general.

Right? So, you know, thank you for putting this program together and having somebody like me on here to talk about this. And I can't emphasize for people enough how important it is for them to learn about how their system works through programs like this, because there's so much you can do, you have so much more control of your outcomes than you thought.

Yeah, that's a that's a critical message. Thank you. I really appreciate the time today. Karen. This is and people can always go to, where they go to learn more.

Microbiome labs.com. Would that be a good resource? Yeah, that's a great place. So go to microbiome labs labs within ask.com. You'll find a lot of information there.

And then if you if you just throw my name in YouTube or Google, your own question and you'll find tons of interviews and webinars and all that I've done that people have very kindly uploaded, on there.

So there's almost any topic you can look at. You can actually put my name plus autoimmune or weight management or allergies and all kinds of stuff comes up.

So, my, my whole goal has been about educating and, discovering tools that are really going to help people and then also putting out information. So, yeah, feel free to Google and then reach out to me on social media as well.

I try to engage with people as much as I can. Okay. Thank you so much. All right. Have a great day. Thank you. Okay. Bye.