The Link Between Immunity and the Gut Microbiome: A Special Interview With Rodney Dietert

By Dr. Joseph Mercola

Dr. Joseph Mercola:

Welcome, everyone. This is Dr. Mercola, helping you take control of your health, and today, we are joined by Professor Rodney Dietert, Ph.D, who is a Professor Emeritus of Immunotoxicology at Cornell University. He's going to have a discussion with us today about the interrelationship between the immune system and the gut microbiome. So, welcome and thank you for joining us today.

Rodney Dietert:

Oh, thank you. It's a pleasure.

Dr. Joseph Mercola:

So, what started your fascinating journey on this topic?

Rodney Dietert:

Well, I've worked for several decades in protecting the developing immune system. That was my main focus in research, and teaching in immunology and toxicology at Cornell. Then really through serendipity, I became involved with the microbiome and the microbiome aspect, which we now know is so critically important to not just the immune system and its status, but all of our physiological systems. That happened when I was given an opportunity to write a paper that I couldn't resist, and that was, "What would be the best biomarker or sign that you could measure in a newborn baby that would best predict whether that baby had a life filled with health, or a life filled with disease?"

Rodney Dietert:

I thought that was a really intriguing question to develop a paper around, and I was pretty sure decades of work on the immune system in the young, prenatal and neonatal, that I probably had an answer and I became very frustrated because I wrote a couple of paragraphs and it was unpersuasive, and went to bed extremely frustrated. Woke up in the middle of the night from a dream with what to me, was an answer, and that was that it was the extent to which the newborn baby became complete or completed itself, and that self-completion is really the installation of the microbiome, largely from the mother, but both parents contributing; vaginal delivery when possible, skin-skin contact, and then of course, followed up with prolonged breastfeeding when possible. And, that the extent to which that baby self-completes with what is really the majority of that baby's genes, more than 99% of our genes are from the microbes, not from our chromosomes and that would be the best measure at that given point in time.

Rodney Dietert:

Now, the baby obviously has life experiences, there are different diets, there are different environmental exposures, a lot happens during life and that obviously modifies and contributes

to health risks as we age. But at that point in time, that was really the best biomarker or sign. My wife helped me write and translate my jumbled ideas from this dream and we published a paper in an open access journal, "The Completed Self: An Immunological View of the Human-Microbiome Superorganism and Risk of Chronic Diseases." That really led to a whole host of other lectures, books and writing scientific journal articles, and appearance in a documentary movie, "MicroBirth," which really is a wonderful film. Won the Life Sciences award for 2014 for documentary films. So, that launched a second career really as a result of a dream, and paying attention to that versus the linear progression of 30-plus years of research.

Dr. Joseph Mercola:

Well, thanks for that explanation. It conflicts with the commonly held belief that newborns are born with an intact immune system, essentially with everything they need to fight microbial diseases. Obviously you put together a compilation of material that counters that narrative. I'm wondering if the original question that catalyzed that journey was – if you actually came up with a marker or was it just a, I guess a description, a historical description of the infant's experiences? I mean, was there a lab test or an assay you could do to make that prediction?

Rodney Dietert:

Well, I think at that time no, and certainly on my end of things, no single measure of one particular bacterial species for example would be the answer. It was more the compilation of the seeding process and because we know that for example with elective cesarean and with antibiotic regimes both in the pregnant woman and then the baby. Cesarean is a surgery usually with antibiotics administered, that those kinds of things degrade the microbiome. So, really it was the idea generally of completeness as a starting point for a robust microbiome to be seeded into the baby. I think since that time, and that dream was back around 2012, since that time there are measures that are more specific that one would include in a predictive map. So I think we could get more specific now, but I should say there is no single ideal microbiome. There are many different healthy microbiomes.

Rodney Dietert:

These arose in our ancestors depending on their geography and their diet, and a whole host of factors that were honed over thousands of years. For example, if I wanted, and I have in my 60s, tried to modify my health constructively, positively by modifying my microbiome. And in my case for example, it would've been a long reach to get an ideal Asian microbiome, because that's not really my ancestry or where I was growing up, or the soil I was living on and the food I was eating, it would've been – so, looking at healthy microbiomes that are more connected to what my ancestors had and has been lost through a lot of unfortunately what were short-sighted practices and technology installations. Trying to head toward that is much more constructive than me trying to completely overhaul something to a group of microbes my ancestors never saw.

Dr. Joseph Mercola:

Okay. Again back to the newborns, having a C-section puts a newborn at serious risk for developing a less-than-optimal microbial population. So, have you summarized or researched the best strategies to compensate for that at birth? I mean, what can the mother do? She has an

elective C-section, she knows the child's not coming through a vaginal delivery. So what can they do in the delivery room to compensate for that choice?

Rodney Dietert:

Right, and I should say that there are obviously C-sections that are medically necessary.

Dr. Joseph Mercola:

Right.

Rodney Dietert:

Dr. Maria Gloria Dominguez Bello at Rutgers hasreally pioneered a lot of the work on – she uses a vaginal swab technique, sort of banks the mother's microbiome that would be installed and then manually installs that at birth and has been able to show that while it's not 100% equivalent, it is very good. It is a very good representation. Those types of strategies are the direction we need to head in to really aid parents and aid mom in being able to deliver what's the majority of the baby's genetics. And again, I point out that those microbial genes are making proteins and enzymes, they're modifying what we see from the external environment, they're modifying our diet before our mammalian human cells ever see anything. So, that is actually controllable and we should.

Rodney Dietert:

In effect, if you look at the interference with seeding the microbiome, to me, and I wrote a paper on this for Teratology Society journal, that is like a birth defect. If you were missing an organ or a limb, that would be a birth defect. Here, you're missing the majority of your genetics. And yet, that is a correctable birth defect and we need to keep that in mind. That would really be the push and the goal, is to ensure the baby is able to have as soon after birth as possible, the robust microbiome that would normally be there. Now, the parents can have chronic diseases and they can have microbial dysbiosis with the gut and other – I should say, microbiomes go beyond the gut. They're in the skin, they're actually in breast tissue, and what's that in breast tissue is different from what's in breastmilk, your genital tract.

Rodney Dietert:

They're all the portals of entry and all the routes of exposure from a toxicological viewpoint, portals of entry from an infectious disease view. That's really where they're concentrated, and we have an opportunity to manage those. I think that's extremely important as early as possible in life, to help manage the microbiomes in the newborn and in the child. And we know from experience that status of the microbiome dramatically impacts things like risk of asthma at age 7, and then subsequent health risks as well. Even picking up atherosclerosis markers, which you now can measure biomarkers of those in children even though the disease onset will probably be decades off.

Dr. Joseph Mercola:

How is a vaginal swab applied to the infants in order to optimize seeding the flora?

Rodney Dietert:

Well, it's again, a way to install in particular the gut microbiome, and then skin-skin would help provide the dermal.

Dr. Joseph Mercola:

Is it a throat swab or is it just applied in the skin and the rectum? I mean, how is it applied?

Rodney Dietert:

I would refer to her papers because there's been some evolution of that, so I think – and again, she and Dr. Martin J. Blaser are a team, a couple and team and they've done remarkable work at Rutgers presently. But, she has really been a leader in pioneering and advocating for getting that installation as early as possible. If you miss those windows, then obviously – you're absolutely correct. The immune system, that's a dogma that we brought over from the 20th century that is incorrect. And I used to teach at Cornell when I arrived in the 70s, "Oh, the baby is good to go at birth. The immune system's there, we can count all the cells, it looks great," but no. Now we realize that the baby is not nearly ready to go.

Rodney Dietert:

The baby's come out of the womb, the baby had unbalanced immune development while in utero because you couldn't risk graft rejection essentially, from the paternal antigens. So, everything is skewed in terms of immune development. Mom's immune system is skewed a bit, too. That's why you see different symptomology of people carrying chronic diseases during pregnancy. Lupus for example, may be more serious during pregnancy because of the skewing. So, we have to rebalance that in the baby and the microbiome is the way to do it. That's what happens normally. If you're growing up on a farm and having raw milk, and exposed to animals and the microbes that go with that kind of environment, it turns out that's rather protective against asthma and allergy later in childhood, as long as you're not directly encountering pesticides on that farm that will eliminate the benefit.

Rodney Dietert:

Those kind of things, those microbial exposures early in life are really what our ancestors had to develop that appropriately balanced the immune system, and regulated the immune system. If we don't do that, then you're shifted toward a pro-inflammatory state, your regulation of immunity is off. And keep in mind, the majority of our immune system is actually located in the gut. 60% to 70% of the immune cells are in the gut. They're in contact with the gut microbiome rather exquisitely and intimately. That is where the immune system gets honed and a lot of the interconnections and regulation happen, and if we miss that, the risk of allergic and autoimmune and inflammatory diseases are dramatically increased. It's a just a matter of which disease and which decade it shows up in terms of that cohort that has missed microbial seeding.

Dr. Joseph Mercola:

It's generally recently appreciated that 99% of all the genes in our body are microbial, either bacterial, virus or archaea. I'm wondering how this percentage is calculated. Is this distribution in the entire body, mostly the colon, or it's not in the cell is it?

Rodney Dietert:

Well, it's not in the mammalian cell. I mean, there are approximately 3.3 million microbial genes, probably more accurately bacterial mainly, that a given individual will carry, so 3.3 million. The chromosomal genes, which by the way were analyzed through the Human Genome Project that was supposed to solve most of our disease problems turned out to be underwhelming. It's about 22,000 to 25,000, [and] 22,000m there's only only about 2,000 more genes than what is in an earthworms' genome. We can't get too arrogant when you think about that. We're just marginally above an earthworm in terms of chromosomal genes. The 3.3 million again, means you're more than 99% genetically microbial. And across the entire population of humans, there are just under 10 million different microbial genes that are carried. So, a given individual doesn't have everything that's represented on Earth among humans.

Rodney Dietert:

But it turns out again, it's not just us. I mean, Earth's a microbial planet, a bacterial planet primarily. That is the predominant life form and any complex organism on Earth, including plants, other animals have microbiomes. That is really the state of how things work. In most of my presentations now, I start off by showing about five 20th century scientific dogmas that need to be discarded because they are holding us back from actually better health, and one of those is this idea about the baby having an immune system that's just ready to meet the world, ready for everything. There are several others.

Rodney Dietert:

For example, the microbiome, that 99% of our body's genes is so important in crafting what happens to the immune system and other physiological systems. That, (the crafting), you can literally create different species based on microbial-immune interactions. And I was always taught, I probably taught in my genetics teachings at Cornell in the '70s that are more Darwinian, or a Charles Darwin-based thing that, "Well, the chromosomes carry the genes and when there are incompatibilities in chromosomes, the hybrid is either lethal, dies or is sterile, can't reproduce." This is how we look at species and it turns out, that's not the only way these things happen. In fact, the microbiome has to have some compatibility with the immune system as they are co-maturing. And where you get microbiomes that are really foreign to an immune system, the immune system responds with a massive inflammatory response, so there's a self-attack and the hybrid dies.

Rodney Dietert:

There are a couple of different labs that have worked on different species incompatibilities and they can show that basically, they can take what are different species or different subspecies, and they treat those animals with antibiotics, wipe out the microbiome, and now the species barrier disappears. Who would've ever thought that the microbiome-immune interaction is so biologically sacred that it leads to separation of species or not depending on the status? That's how important and critical in the evolution of life on Earth and in our own human existence that interaction is, so we can manage that. We need to ecologically manage the microbiome-immune interaction at the gut interface, and with the skin and in the respiratory tract and the urogenital tract and so forth.

Dr. Joseph Mercola:

Before we go there, I just had a quick question on the number of genes actually not being as critical because as you pointed out, there is not quite a bit of difference between us and many other species that are lower on the totem pole, so to speak. So, I'm wondering if there is interaction between the microbes and the epigenetic expression of our genes?

Rodney Dietert:

Oh absolutely, and there are numerous examples of this. I mean, some of the premier researchers – I'd mentioned Curtis Klaassen, Ph.D., who is president of the Society of Toxicology, sort of a liver guru in terms of liver metabolism and protecting the liver, and toxicity and the like. He really several years ago, shifted over a focus to the microbiome metabolism, and why? Well, why is because they (the microbes) have got the majority of the genes, and they epigenetically, through a couple of different routes, can influence liver metabolism as well. The microbes, again, keep in mind, they're sitting (at the routes of our exposure to the external environment: food, air, water, etc.) – they see our food first, they see our environmental chemicals first. They see drugs through most routes of administration first, and what they do with those determines what the body sees.

Rodney Dietert:

So, they're our gatekeeper, they're our filter for our whole environmental existence. As a result, it's important to know what happens there. An example is cancer therapeutics. Most of those have to be metabolized by the microbiome and if only we manage the microbiome more effectively in patients, we very likely could increase the efficacy of those drugs across a population of patients. I think the U.K. said they're about 50% effective was one of their recent calculations. That could be increased because we've ignored the microbiome and its role, even though these drugs don't work unless they're metabolized by the microbiome.

Dr. Joseph Mercola:

Okay, good. Historically, the thymus gland has been known to be really important for the development of the immune system but there seems to be an emerging appreciation that because of the fact that two-thirds of our immune system is located in our gut, that may be even more important. So I'm wondering how you would compare the two, especially to an aging population where it seems like immunosenescence, or the deterioration of the immune system due to aging, seems to be due to thymic evolution. Can you compensate for the normal aging deterioration of the thymus gland with improving the competency of the gut microbiome?

Rodney Dietert:

To some extent, absolutely. First of all, I should say that the idea that we have immunosenescence, and I think – a couple years ago I was involved with a paper on aging of the immune system. Aging of the immune system is really dependent upon your lifetime diet in large part. So, you don't have to buy into the fact that there is only one end for an 80-year-old's immune system, and it's senescence and lower responses to certain infectious disease agents and more risk of auto-reactivity. You really don't have to buy that, because it is largely influenced by diet and microbial metabolism. People are finding, in fact that if you start installing some of the earlier life microbes that have evolved out of our gut through, well, probably decades of polypharmacy in my opinion. I mean, you have to keep in mind drug safety never included the

microbiome until recently and a lot of, 25% to 50% of all the drugs, including over the counter damage the microbiome, and in very predictable ways for those that have been examined.

Rodney Dietert:

So the more that we have piled on a number of drugs that never were screened for what they were doing to the microbes, the more degradation occurred with aging. You combine that with diet and with metabolism of diet, again being altered, and you'll get to immunosenescence, but it's not a given. It doesn't have to work that way. So relative to the use of gut and other locations, yes, you can change. Things like metabolic syndrome, for example, there are some remarkable findings where if you really focus on certain cell populations and adipose tissue, and the gut integrity and barrier function, and some of the microbial gatekeepers like Akkermansia and others that are so critical for mucin layer protection in the gut and for barrier integrity, that you can do a lot with that and some dietary shifts in combination to really reverse things in a useful way.

Rodney Dietert:

Now, as always, when you're dealing with the immune system and inflammation, it's a matter of tissue integrity and the question of whether you've so damaged an organ that it's going to be tough to come back from the damage. You want to make these corrections before you've completely lost airway function or lost gut function because of massive inflammatory damage over decades.

Dr. Joseph Mercola:

It seems one of the simple strategies that we want to be promoting for quite some time now is to avoid antibiotics. Not necessarily the ones that are prescribed for you, that's certainly an important component, and sometimes can be life-saving although that in my views tends to be an exception rather than the rule. More often than not, they're damaging. But, 80% of the ones that we're exposed to are through the ones that are fed into industrially fattened CAFO, animals confined animal feeding operations. That's one of the reasons why we strongly support and recommend eating organic, largely because of avoiding these antibiotics. Not only the antibiotics, but the antibiotic-resistant organisms that come embedded with that type of meat.

Dr. Joseph Mercola:

And then of course, this emphasis now with the COVID pandemic on continuously cleaning your hands and using sanitizers that have antibiotics in them like triclosan, which I think should be banned but nevertheless it still exists. People think they're killing the organism, but actually they're killing their immune system with these dangerous chemicals. I'm wondering if you can elaborate on that.

Rodney Dietert:

Oh, absolutely. I'm thrilled to have that opportunity. I'm a big fan of regenerative agriculture. I'm emeritus now, not back on the Cornell campus but out where I can have high vitamin D levels where we can have a longer growing season. We can grow a lot of our own food or at least try to make a dent there in that regard. You have to support the entire body and you have to support the immune system as well. I'd point out that for example, glyphosate, or glyphosate is an

antimicrobial. It's labeled as an antimicrobial so it's working through the food system. It's first destroying soil microbes and then plant microbes, and gets into animals and gets into us. We're exposed directly and we're exposed through our food, and it's horrific. Again, it's widespread and it's just one example. You can take the plasticizers, Bisphenol A and others, where these things were never screened properly and the attention to the microbiome was never given. That's a huge mistake and we need to reverse that immediately.

Rodney Dietert:

But I'm a big proponent of regenerative agriculture, managing intended diversity of plants, soil microbes and all the way through the food systems. Getting the most out of the foods that we're going to eat in terms of composition. Organic and natural health is a huge opportunity for us to apply more broadly and more extensively, and for people to understand the benefits of food produced in these ways, and for the entire system as well. I look at ecological management of microbes and robust diversity of plants, animals, and our food production is as critical. I'd like to point out that even with the COVID-19 pandemic that we're facing at the moment, that it is in fact, a cytokine storm. It is an improper host immune response that is what leads to lung pathology and increased risk of death. And yet, there's been almost no attention paid to the multiple factors that influence the immune system and influence inflammation. And, also what's called colonization resistance.

Rodney Dietert:

We carry coronaviruses in our airways. Almost everybody has some coronavirus in the airway sitting there not causing disease, because they have a good airway microbiome. They have a good lung microbiome and it's being managed, and they're doing healthy things. They're getting exercise, they're getting outside, they're getting vitamin D, they're going to the beach, unless various governors and the like impose rules that don't let you do that. So, I would contend that it's one thing to take a look at a pathogen and its spread, and the risk of that, and it's another thing to actually take a look by risk analysis, and there are professionals – there's a Society for Risk Analysis – that we really need to pay more attention to. Those individuals look at all the health risks and all of the benefits that can come from various practices in their totality.

Rodney Dietert:

That's what we should have done and we certainly should be doing now. Because people are going to either live or die not just because of COVID-19, but because of metabolic syndrome, because of heart disease, because of a whole host of other chronic diseases that either the management has interrupted, or they're at more vulnerable risk because they're pro-inflammatory already, and very little of this has even been considered. So really the opportunity for us to grow our own food, get outside, visit animal farms and have microbial exposures in a healthy way, and increase our vitamin D, and tend to our immune system and our overall health is absolutely critical. The more robust the microbiome, the better the colonization resistance we have against these pathogens, including the secondary bacterial infections that will arise in the mix of changing the lung environment and the pro-inflammatory state. We should've been doing that from the word “Go,” but unfortunately we have some scientists and we have some bureaucrats who focused in one place and didn't really focus in my opinion, on human health.

Dr. Joseph Mercola:

Yeah. Just recently within the last few days, the World Health Organization has actually retracted their recommendation of lockdown now so it seems like we're going back in a sensible direction. We can finally get some sanity on board. But, you had mentioned that you were part of the Organic & Natural. Most people don't have any clue what that is, but it's actually a trade association in the health food, or the natural foods industry and supplements. We are strongly in support of that association. We think it's the best one out there, and thankfully is gaining wider acceptance and adoption and appreciation of what it's able to do. So I'm wondering in what capacity you're doing that, and have you – I'm glad you're out of Cornell because Cornell has been tied very deeply to the Bill Gates Foundation and the Alliance for Science, and the destruction of science as we know it. I'm glad you escaped that and are working in regenerative agriculture, but what are you specifically doing and where are you?

Rodney Dietert:

Well, my connection is really through the opportunity to present at these conferences, to visit and to see the terrific participation from such a diverse group of experts, professionals, practitioners. When you combine things like the Regenerative Agriculture Group and Organic & Natural Health, and you see everything from ranchers and farmers through to ecologists of soil, plant, animal, and then every type of medical doctor and profession who are really looking at integrative and holistic ways to benefit human health individually and across populations, it's mind-blowing and it's so encouraging. And, I think that's where our future lies, really. I've only dipped my toe in there by being very fortunate to be invited to present at conferences, and also to really attend the presentations and participate in group discussions.

Rodney Dietert:

It is something I would encourage everyone to get introduced to, and to find people – we know, for example, nearby, a wonderful group producing organic meats grown there using regenerative agriculture, and you just – through the phytochemicals that are stored in the meat and the differences in what you're actually getting in terms of nutrition, it's been glorious for us. You combine that with our trying to grow some of our own crops, on a small scale, but better than we used to be able to do and that is a wonderful combination. People can do things on a small scale for themselves, but they also can support the companies, and the individuals, and the food producers who are following this path as opposed to, as you say, prophylactic use of antibiotics and animal feed. I think I was published in a Christian Science Monitor opinion piece or article back in the ‘90s railing against that.

Rodney Dietert:

I would say that people don't realize that it isn't that large scale agriculture has a history only of that. In fact, the idea of using probiotics for colonization resistance was impactful in our having a surviving poultry industry. My first start was actually working on young chickens and their better natural health, and then I moved over to children during my career in terms of focus. But in the ‘80s and the early ‘90s, there was a salmonella outbreak and it was being chickens were infecting each other, but it was going through the oviduct and infecting again, hatched chicks. It was also a food safety issue because it was infecting humans, it was zoonotic, and what they found is that they could load up these birds with gut probiotics because they control the environment totally. They control the diet. They could load them up with the probiotic bacterium lactobacillus acidophilus and it blocked the salmonella in this case.

Rodney Dietert:

Those products are still out there and they're used, and you never hear about that. You don't realize that egg consumption was essentially saved when it was in dire straits back in the ‘80s and early ‘90s because of massive probiotic interventions. How about that? So, we now know that we can do similar things in humans and there are some wonderful products out there, particularly when supported by prebiotics, the food for the microbes, which can really be beneficial. I think this shows that we need to be managing how we produce our food. We need to be recognizing the benefits of variety of supplements. By the way, we're big fans of the Mercola products and have been for decades. I think that is what's going to help get us out of the polypharmacy rut that we've been in, quite frankly.

Dr. Joseph Mercola:

I couldn't agree more. So, we've focused the first half of this dialogue with – painted a framework as to why paying attention to the microbes in the gut is so important for your immune capacity and immune competency so I'd like to get into some real practical strategies. We've already mentioned several, which is the elimination of any potential antibiotic exposure and then compensating for the ones at birth, a C-section by doing these vaginal swabs, installation of the flora, seed the baby with the normal flora. And of course, eating organically exclusively. But, what are some of the other specific ones?

Dr. Joseph Mercola:

When you were talking about improving the immune competency of the microbes in the gut as opposed to the thymus, you were suggesting that we go to an earlier stage in our life before they were devastated by these exposures to the environmental toxins and antibiotics. Is there an assay that you can do, because there are so many of them out there that paints an accurate picture of where you're at and then once you understand where you're at, then target a specific population of bacteria to complement that? Or, do you just recommend a less expensive shotgun approach to generically help improve the populations in the gut?

Rodney Dietert:

I think it's contextual. For example, I would say that even with the uncertainties and the different ways you could approach microbiome analysis, that if we're going to have annual checkups and we're going to be banking blood profiles of a whole variety of factors and that'll be part of your annual record, how can we not be having any microbiome information based on patients? So, knowing where you are is extremely useful. That might be more of a shotgun approach just to keep track of where you are, and I'll give an example. Within my own family, we had a family member who was administered a drug that was not really supposed to be very broad spectrum in effects, and side effects in particular. It really shouldn't have damaged the microbiome, but we could see because we were doing regular microbiome analysis, that it did. It devastated the microbiome and it took nine months of very judiciously building that back to get it back to where it had been.

Rodney Dietert:

And so this was again the best medical information at the time said, "Oh, this will be good. You're not going to do anything to your microbiome." Well, yes that happened, and it was very

clearly tied to the drug because there had been very frequent analyses done. So, I think that the physician managing a patient should have that information available. For example, here's just one case that's historic. Digoxin, long-standing heart medication is required to be metabolized by one specific bacterial species. Now depending on the level of that species that you have in your gut, the drug will either be ineffective because of the metabolic level, it will be effective, or it will be toxic and kill the patient. That is known based on just the idea that the therapeutic range with Digoxin is a bit difficult. It's a bit of a problem in terms of prescribing a safe, yet effective dose, even though it can be an effective drug.

Rodney Dietert:

So, knowing that and knowing it's one specific bacterium, which could be measured, could be supplemented, the level could be changed or the drug level could be changed. Why wouldn't you do that if you were going to administer this type of drug? Then you go back to things like knowing that NSAIDs (non-steroidal anti-inflammatory drugs) damage the microbiome if they're taken for any prolonged period of time at high enough levels. And not only do they, but a microbiologist can tell you what NSAID you've been taking because they each have a different pattern of changes to the gut microbiome. Different NSAIDs have different patterns of damage. Then you might be at risk for gastric ulcers so you got proton pump inhibitors, they damage a different part of the microbiome in the gut in a very specific way. So, we can do several things. Knowing where you are annually with your microbiome is useful because you can see big changes. It could've been environmental chemical damage, could've been diet, could've been lifestyle changes, a whole host of reasons how you got there, but your managing physician needs to know that.

Rodney Dietert:

In addition, the contextual is if you were going to give a particular drug like a cancer therapeutic, why not increase that 50% efficacy rate and include that patient in a success story? So, we can eliminate side effects from some of the existing drugs or reduce the prevalence of those, the severity of those. We can make increase efficacy where there are useful drugs that could be more useful and in any new drug, it needs to work – I mean, it's got to be in the context of the microbiome. We can't really allow those things to come on the market without that knowledge. It just needs to be part of it, and we've advocated that. We had a 2015 paper in Toxicological Sciences with Dr. Ellen Silbergeld in [Bloomberg School] of Public Health at Johns Hopkins. She and I basically said, "We get to redo toxicology, because we didn't do it to protect the whole human. We did it for the human mammal, we didn't do it for the human super organism and the 99% microbial genes."

Rodney Dietert:

So there should be a standard, generic analysis with probably a shotgun-type of approach that gives you some idea where the patient stands, then the patient knows what is balanced or out of balance, and the patient can look at diet and other potentially useful changes. If you don't know where you are, you don't know where you might be going and you don't know where you want to go. So knowing where you are is useful, and keeping track of those things. Then you'd have just as you would on blood profiles and other measures in the patient. You have an annual analysis that then helps direct both preventative and therapeutic approaches.

Dr. Joseph Mercola:

It seems like you're a great fan of doing these assays so the obvious next question is the generic recommendation. There's a fairly significant number of companies out there that provide these tests and services and there can be based broadly into doing the – they're taking advantage of the genetic analysis technologies developed so they can do this much better than actually culturing the organisms out and identifying them. That would be way too costly and ineffective, but they essentially measure the DNA, at least some of them do. They measure the DNA and can identify the species as a result of that, but there are others that actually measure the RNA. So I'm wondering, based on the relatively large number of companies that do this, if there are any that you've found to be particularly beneficial or helpful, or do you just recommend find one and stick with it and use that for your serial and subsequent follow ups?

Rodney Dietert:

I wouldn't give a specific recommendation on a single company. I don't want to be in that position of touting. I think what you said at the end is the best, identify one that has a good reputation, that's shown to be where there's utility in what's been generated and then because there is variation, consider sticking with that for a while. I think that would be a useful approach there. There are numerous good companies but I'm not going to tout one over the other. And I do want to self-identify that I have consulted for our probiotic company, Seed, in Ventura County, California, just to identify that I have that connection there. They're not in the analysis business, but I would mention that in terms of my disclosures. So, I think finding a good company and then and then persisting with that because if you go to another company immediately, then you don't know if you saw a change in your annual evaluation or in a nine-month, I mean a three-month period, whether that was due to changing companies or changing diet for example.

Dr. Joseph Mercola:

Yeah. I mean, how stable are these analysis? Because, there are certain costs to doing these, and obviously people aren't going to be doing them every day, or every week or month. Probably it's an annual thing, maybe semi-annual. So, are they relatively stable or is there quite a bit of volatility with respect to the populations that are growing based on the food they choose? They had a binge of junk food. Could you radically change your populations almost overnight or is that shift something more gradual?

Rodney Dietert:

There again, I think the data would say that depending on where you are with your microbiome. If you have a particularly robust microbiome, you're actually probably more resilient to a junk food weekend. If you are already dysbiotic or you're weakened in your microbiome because of chronic conditions and polypharmacy and the like, glyphosate exposures, then you probably are pretty vulnerable to further shifts. Again, it's how well are you seated with a robust diversity, and then it's again, forest management in ecology or coral reef management. If you've got a coral reef that's already damaged and sick, then it isn't going to take much to really put it over the top in terms of serious changes. This would be the same for us in terms of immune inflammation, pathology, and/or an infectious agent getting a foothold, whereas it wouldn't otherwise.

Rodney Dietert:

Now, one thing I would mention is that the RNA or the metabolic analysis is extremely useful, and that is a decision that is still out there, whether you go with the genes or whether you go with the metabolic profile. Here's an example. People ask a useful question on this colonization resistance and that is, if you had a really critical pathogen that was of concern for humans, how many bacteria would it actually take in your gut to give you the protection as if you had thousands and this terrific, robust diversity there? What would you actually need if you started from almost nothing and just had a few bacteria? The answer was given in a – it was a mouse model, but it was a human pathogen and installing bacteria to show protection against the human pathogen, just by the microbes in place blocking a salmonella pathogen from getting a foothold and taking off.

Rodney Dietert:

What they found surprisingly is if they use metabolically matched bacteria that they had done trying to create an ecological niche, an environment of metabolism that would stop salmonella, it took as few as 15 bacteria if you can imagine. Now, that's only one, nevertheless, important pathogen. In humans, we have a lot of pathogens to resist but that suggests that we can have terrific benefit by paying attention to what's called colonization resistance and that is using the natural barriers of our friendly microbes to resist pathogens from being able to actually get started. If you do that, then the immune system's your fall back, but you're not relying necessarily on the barrier and the immune system in every case. You actually have probably 95% of your infections that would happen never happen, because you've maintained the friendly microbes, and they're doing their job and just keeping everything else from getting started.

Dr. Joseph Mercola:

A classic example of competitive inhibition.

Rodney Dietert:

Absolutely.

Dr. Joseph Mercola:

I'd like to get into some specifics with respect to strains, because there's two functions of the microbial populations that are important. One is the production of butyrate, which is a nutrient for the intestine, and then mucin for the protection. It's a layer that protects the intestine. Are there any strains that would produce those? And I think butyrate particularly is what I've always found intriguing because it's so close to one of the ketones, a major ketone. It only exhibited changes by hydroxyl position at a certain area, beta-hydroxybutyrate would be one of the most common ketones. So, are there any strains that help in particularly to produce the butyrate and the mucin production?

Rodney Dietert:

That's an amazing question because we recently just started a new probiotic for us and I know my wife is already seeing some dramatic results. It's a butyrate producer. And keep in mind, ideally you'd like to see these installed in your gut but even in situations where you have a pass-through of the microbes, if they're metabolizing and you have a sufficient level of them, you can have metabolic benefit from those as well. So, there are probiotics that will give you very

specific metabolic end results and these can be extremely useful. And again, part of that is knowing where you are and whether additional butyrate would be useful. So, I think that's exactly the right question, exactly the right direction to be taking. That's where you do get some targeting, but that's still based on having an understanding of where you are metabolically and in terms of your microbiome.

Rodney Dietert:

Now, I did want to mention since you brought up butyrate, that there are also – keep in mind that neurotransmitters, there are more of those neuroactive peptides in our transmitters produced in the gut than in the brain and that while gut enterocytes are making these, that's regulated in part by the gut microbiome, but also the gut microbes. The gut bacteria make neuroactive peptides and neurotransmitters. There's a whole field that's been developed called psychobiotics, and among those are John Cryan and Tim Dinan at University College Cork in Ireland, pioneers in this area. There are other researchers working on it too. But, they have found that there are specific bacterial species and strains that will produce serotonin, others will produce dopamine, some produce GABA, acetylcholine. You can go down the whole line of neuro-modifying neural chemicals that can address things like major depressive disorder and simply by adjusting the level of these you can change your chemistry.

Dr. Joseph Mercola:

I have a question on this.

Rodney Dietert:

Yeah, I'm sorry.

Dr. Joseph Mercola:

It is my understanding that these – there's no question that the bulk of the neurotransmitters are produced in the gut. But the challenge with that understanding, because I was confused on this earlier is that most all of those neurotransmitters are unable to penetrate the blood-brain barrier. They don't go into the brain.

Rodney Dietert:

Well, there are I think three different routes that have been described for how these can modify brain physiology (e.g., vagus nerve signaling). I mean again, the trials that have been done are showing that you really – if you change those levels in the gut, you get some of those effects that you would predict in terms of other ways to measure neurological function.

Dr. Joseph Mercola:

It does it indirectly then?

Rodney Dietert:

Some of those are indirect, yeah.

Dr. Joseph Mercola:

Okay.

Rodney Dietert:

The point I would make there is as with butyrate, that these are not new drugs that you're administering that the body hasn't seen. You're putting in something where you're changing the balance, you're changing the prevalence of microbes that are metabolizing in a particular way. It may be producing butyrate, or again it's serotonin or dopamine. You're changing those balances of what's already there, and you're getting physiological benefit or bringing your body back into balance in a useful way and not having to rely on what are pretty hardcore drugs, in some cases with very problematic side effects. So I think this whole idea of yes, getting at what are epigenetic regulators and amazing – People didn't use to think things like butyrate, these small molecules, were doing anything and they're quite remarkable in their effects. So, it's an area where we need to pay a lot of attention.

Dr. Joseph Mercola:

Okay, good. One of the areas I'd like to review is leaky gut, which many years ago was thought not to exist by most conventional physicians but now it's pretty well-accepted that this is in fact, indeed a clinical entity and contributes to a lot of pathology. There's one strategy I know that works for sure. I just want to mention it here and get your take on it, but that's vitamin D, because I've done a lot of study on this. It upregulates the innate immune system and increases your body's ability to repair the epithelial cell damage and repair those gaps in the barriers, and perform a protective inflection. It's probably one of the main reasons why vitamin C is so effective for the immune system. I'm wondering if you can comment on that, and then I have another way that I've heard recently could be useful, which is something as simple as bicarb helps improve the leaky gut function?

Rodney Dietert:

I think that's absolutely correct. The other thing is, you're repairing it, but also this is where some of these, what are called keystone species bacteria, Akkermansia is one of these. The genus Akkermansia is one of these that's involved with mucin regulation. There are only a couple of bacteria that really do that. So, managing those and managing the levels of those is critical in – even as you're repairing some of the cell damage, you've got to maintain a mucin layer and keep the bacteria that would produce immune inflammation at the barrier, which is contributing to the damage there, keep them at a respectable distance where they need to really be in your gut. Keep in mind, the gut is really the external to your body. That's the outside so they're sitting there connecting you to the external environment, but they're really – it's a tube and they're on the outside, and you need to keep them there and not penetrating through the barrier in ways that are going to cause immune system to do self-damage.

Dr. Joseph Mercola:

Great. Well, that's lots of good information. With respect to the bicarb, are you in agreement with that and the vitamin D?

Rodney Dietert:

Yes, yes.

Dr. Joseph Mercola:

The bicarb, I mean typically we think of sodium bicarb, baking soda, which is inexpensive and easy to get. But I'm a particular fan of potassium bicarb because most of us just have potentially too much exposure to excess sodium and not enough potassium, so I think it's a little better strategy. I personally take about a half a teaspoon of potassium bicarb three times a day, and use the urinary pH to monitor and make sure that's the right dose for me because it could be completely different for someone else. It could be half or a quarter of the dose, or four times the dose for someone else. The urine pH is about 7, which is neutral and really something to strive for. It also prevents leaching of minerals from your bone to compensate for the acidity in a normal acidic urine. Any comments on using that therapeutically?

Rodney Dietert:

First of all I need to say I'm not an MD, so this is not medical advice if I say anything, it's metabolic opinions. I think it's extremely important, yes, the pH measurement because there's no one-size-fits-all on the way we interact with the environment and food, and drugs and again, metabolic shifters. In this case, sodium bicarbonate as well. So, monitoring an endpoint that's going to tell you whether this is enough, too little or too much, is really useful because what works for one person where they're starting from versus another can be widely variable. I think that that's hugely useful advice, what you're describing. I would say that's the case always when you're coming to food, diet environment and the microbiome.

Rodney Dietert:

Again, you can go back to things like arsenic in drinking water, and actually an individual's risk from a heavy bolus of arsenic in drinking water is determined by the gut microbiome, because it depends on the metabolic profile that comes out of that exposure. That is not to say arsenic in drinking water is safe, it's to say that the ramifications of a good exposure to that, heavy exposure to that is going to depend on what's sitting in your gut. And in this case, you're saying the exact regime for potassium bicarbonate is something that you can evaluate based on this wonderful downstream endpoint of urine pH. So really, really useful in describing that.

Dr. Joseph Mercola:

All right. Well, I really appreciate the opportunity to connect with you, but are there any closing statements or points you'd like to emphasize?

Rodney Dietert:

Well, I just encourage people to do things that support their whole body, do things that support their immune system even as they're focused on a specific disease or a specific pathogen. And keep in mind, these are interconnected. We're now realizing that the boundary between infectious diseases and what were called are NCDs, or also known as communicable and noncommunicable diseases may not be as rigid as we used to think, because people have been able to show that you install the wrong microbe into your gut microbiome and one that's not very robust and dysfunctional, you probably can wind up with a predictable increased risk of very specific, so-called noncommunicable or chronic diseases. We never thought that was the case, but there's evidence that's emerging, really within the last couple of years, that these are all about microbial

management. Understanding our body, understanding our genetics and taking advantage of that to be naturally healthy.

Dr. Joseph Mercola:

All right. Well, thank you for your insights and your wisdom. Greatly appreciate it.

Rodney Dietert:

Well, thank you for all you do, Dr. Mercola.

Dr. Joseph Mercola:

You're most welcome.