The Best Functional And Genetics Tests For Your Mitochondria And How To Understand Them

Laura Frontiero, FNP-BC interviewing
Samuel Shay, DC, IFMCP

Laura Frontiero, FNP-BC
Welcome back to another episode of the Restore Your Mitochondrial Matrix Summit, I'm your host, Laura Frontiero, I'm bringing you experts to help you boost your energy and fix your health so you can build the life you love, and today I'm bringing you Samuel Shay. Hi Samuel, welcome to the summit.

Samuel Shay, DC, IFMCP
Thank you, good to be here.

Laura Frontiero, FNP-BC
Yeah, now this is a really special talk because we're breaking down lab tests, and you are the expert coming on this summit to tell us all about how we test for mitochondrial function. And a really quick connection that we have, I studied with Dr. Dan Kalish for a year in his mentorship, he's the one who really introduced me to the importance of mitochondria and how foundational this is to all healing, and he really taught me that no matter what you're trying to do with the human body, if you don't address mitochondria, you probably won't be successful. It is so foundational, and I mean, you did the same program that I did, you also studied with other mentors, and I'll give you a second to introduce yourself with that, but we have this big connection and I was really excited when you said yes to come on here and talk about labs because it's complex, it's confusing, people don't know which tests to get, they don't understand the test, and to be quite honest, most practitioners don't even understand the test, you really

have to study them in depth like you and I did. I mean, I spent a year learning one test, and I know I could even go deeper on that, but anyhow, you are the creator of the 10 pillar method to properly assess the most important and most commonly missed components of health and wellness. You are literally an expert in all things labs in mitochondria, you have a group of people you tend to work with, health conscious entrepreneurs and mompreneurs, because you wanna help them have high performance so they create more freedom for themselves and others, and you've really dedicated your life to helping others through functional medicine and functional genetics. So, welcome, welcome, welcome to the summit.

Samuel Shay, DC, IFMCP
Thank you, Laura, I appreciate, and one of the group of people I really love serving is also just moms, just normal moms that don't have to be mompreneurs. And the reason I got into functional medicine is that I was supposed to be the third generation medical doctor in my family, both my parents are medical doctors, psychiatrists specifically, don't hold that against me. And my grandfather was actually the Founding Director of the Fels Cancer Research Center 1937 and wrote over 300 scientific articles and made some major advances in several fields until he actually died on the operating table for medical misadventure in 1965 before I was even born.

And I was supposed to be the third generation medical doctor and I took a hard turn into natural medicine because of my chronic, just being chronically unwell, and the philosophy at the time being raised by the two parents that I had was, it's in your head, you need a psychiatrist, and physical things going on, whether it's crippling insomnia, digestive problems, low mood, anxiety, depression, chronic pain, postural distortions, etc. It's primarily a psychological issue, or you're not grateful enough for whatever we've provided to you. And it was a very challenging time, I went through a lot of school, it was not helpful, a lot of violence at school, a lot of gaslighting, a lot of willful blindness on the part of the authorities and teachers and friends and so on.

So, it was a very rough go from age six to age 18, my parents had a nuclear divorce when I was six years old and me and all my sisters were caught in that blast radius. And you'd think two shrinks would know better, but they would weaponize those kids against each other, it was pretty awful. And what was happening is that Western medicine wasn't working 'cause the things that I was dealing with weren't being addressed by the latest version of Zoloft. And I decided as a teenager

to go into natural medicine, and I read "Dr. Jensen's Guide to Better Bowel Care," and he's a luminary, he's kind of the founding, you know, grandfather at this point of natural medicine in the West anyway. And I went on to do pre-med in college, went to chiropractic school, got very heavy into nutrition and especially functional neurology. And then I practiced within a clinic in New Zealand for eight years, got an acupuncture degree while I was over there and when I was over there, I really got into functional medicine and started doing testing while in New Zealand. And actually that's when I started studying with Dr. Kalish.

And Dr. Kalish, I studied with him for four years, and we went super deep into the mitochondria. And before that time period, the mitochondria was really this kind of vague existential organelle inside the cell that was like super complicated, full of all sorts of 50 point Scrabble words and was kind of obscure and difficult to figure out. And at the time everyone was blaming fatigue and low mood and all these other things on like adrenals and thyroid, low iron and gut problems, which have a major contribution, but they kind of left out the mitochondria piece. And in fact, something for our listeners, if you're dealing with, you know, "adrenal issues," which by the way, my first ebook was on adrenal issues, I studied with Dr. Wilson who wrote the book, "Adrenal Fatigue."

If you're not finding success with programs for working in adrenals, you really have to pivot to look at the mitochondria, then go back to the adrenals, or maybe do them in tandem, just a little side clinical pearl there. So, the mitochondria became of central importance because it was just a major gap in my education, and I didn't realize that basically at the root of all chronic issues, you can draw a straight line over 90% of the time back to some sort of dysfunction in the mitochondria, usually with a major contribution of a gut problem, a thyroid problem, an adrenal problem, a nutrition deficiency problem, like all the other problems and all the other systems that all of the clinicians like focus on, eventually wander their way towards mitochondria. And if the mitochondria is structurally sound and there's just the issue with that other organ system and you help that organ system, then great, but usually there's damage to the mitochondria as a result of this thing over here, so you have to ideally look at both because the mitochondria's affected no matter what. And depending on what stage and how early, you know, what stage you're in and how early you catch it, the mitochondria may be damaged to one extent or another. So, mitochondria eventually is gonna end up on people's radars in their health journey.

So, that's why I've put a major emphasis on it and worked really diligently to study up on it as much as I can and become highly proficient in, not only explaining, but interpreting these mitochondria tests. So that's how I basically ended up here.

Laura Frontiero, FNP-BC
Absolutely incredible that you're gonna go over this test with us today. So we're gonna do something different on this interview, we're actually gonna have you share your screen and we're gonna go through some visuals because it really helps to be able to look at pictures while we talk about this, so this is super exciting for our audience. So, you know, as you get ready here and pull up your presentation, can you tell us, you know, why this is so important? Why is functional testing so important when we're looking at mitochondria?

Samuel Shay, DC, IFMCP
So with functional testing... Can you see my screen, Laura?

Laura Frontiero, FNP-BC
Yes.

Samuel Shay, DC, IFMCP
Okay. So into why is functional testing so important? So, let me answer that in just one minute, so let me prepare to answer that question by explaining the system of the mitochondria, and then you'll see why the testing connects to it. So in summary, the mitochondria is a very complex piece of machinery. And the point of testing is to be able to identify which pieces of the machinery needs support as opposed to guessing. There's a lot of practitioners out there that just simply like hawk whatever, the special curcumin extract or whatever immuno acid blend or whatever, to support the mitochondria. And they can say it helps the mitochondria, and that's true, but there's like 50 things the mitochondria needs. So we can either guess and just point to a whole bunch of research that's all about bell curve stage statistics of populations. In general, people need this thing for the mitochondria, and that's great, but the point of testing is to find out, which of the 50 things, or a combination within those 50 things, you personally individually actually need. So, what testing will do is to get very specific, very granular, very personalized, I call functional testing the best of Western medicine diagnostics with the best of the natural

medicine lifestyle interventions. And so we have the benefit of the nerdy, you know, the machines that go, ding, you know, to make a money reference in Western medicine. And then we've got all the tools, nutrition, lifestyle, supplements, etc, of natural medicine to actually repair as opposed to patch, or numb, or just kind of keep it bay. So, with testing itself, the way to understand mitochondria testing is to understand what the mitochondria is. The metaphor is your cell, an individual cell is a city. And to run a city, you need an electrical plant. So like my grandparents lived in New York for over 40 years and you need electricity to run the whole thing, like if you have a house with no electricity it's basically a hut or a tent and you need to have electricity to make everything work. Otherwise, if electricity goes out in New York City, everyone hears around it worldwide, why?

'Cause you've got three days where people can kind of get by on batteries and flashlights, but after three days it's gonna go full mad max, and you need electricity to run everything. And the cell is the same way, they're emergency provisions that can last a short period of time in the cell if electricity factory goes down. So if you think about the mitochondria as the very fragile, very important, very efficient, very clean energy producing factory of the cell, and you hold that image in your mind, then all the other bits you're testing and the nutritional needs that you need make total sense. So, a mitochondria, like an electricity factory, has to have walls. So these are specialized fatty acids, so you need to know about fatty acids. The factory has to have security guards, this is your immune system. We have to make sure that there's janitors on the inside to clean up any sparks that fly off, those are the free radicals, these are the enzymes, MnSOD, glutathione peroxidase, these are the enzymes that clean up the sparks that come off from the electricity factory worrying and burning fuel in order to make the electricity.

So these would be the free radicals. You've got the machines inside the factory to make everything work and make the electricity, these would be vitamins. The machines need to have computer chips to run the machines, and those are called minerals. You need to have patchwork, you need to have things that are able to like patch the walls and things like that, PQQ is just an example, if there's damage done to it. You need to also have a communication from outside the factory to get information on how much electricity needs to be sent out, and if your city is also under attack, you need to, like if the Germans are bombing in World War II, you gotta cut the lights 'cause it's an emergency because you got other bigger problems to deal with. So, the

adrenal system influences the mitochondria system, so the mitochondria shuts down when there's an emergency because you can't be operating that, you have to switch to the emergency candles and flashlights 'cause, you know, the bombing's happening overhead. You look at neurotransmitter metabolites, you look at the entire gambit of nutrition that goes into the mitochondria, B vitamins, fat soluble vitamins, you gotta look to make sure that your factory isn't gummed up with toxic chemicals, or dirt, or tar, or you get like bad computer chips called heavy metals that go in, so you have to look at the liver detox pathways, you have to look at glutathione to make sure that you're pulling out.

You've got the systems to come in to remove garbage, to remove toxins, and that's basically the whole analogy. If you understand the mitochondria as a fragile, very expensive, but very needed electricity factory, then you can hold that in your mind and look at the functional tests, not as a series of complicated Scrabble words that you can't spell much less pronounce. It's actually a practical model for you to understand conceptually what you're doing. So, that's what the mitochondria is and why testing relates to it.

Laura Frontiero, FNP-BC
That is literally the best analogy I've ever heard on what's happening, that was brilliant. So, hats off to you, brilliant, I may have to share that in some of my classes but I will always give you credit. I will say, this guy .

Samuel Shay, DC, IFMCP
Sure, you can always feel free to clip and have like that, you know, picture of you the big smile with like some halo in the background, he explains the mitochondria. I'm also a stand up comic as a hobby, and a quick, quick sidebar, it's important, I really got into standup comedy for a number of reasons, but one of which is that my first bachelor's degree was in psychosomatic medicine, so the placebo effect. And for people listening, if you have to pick between two coaches or clinicians you're working with and they both seem more approximately the same, pick the one you like more, and I don't mean that metaphorically, I mean that technically, because the placebo effect is in effect how much you like and trust your coach. If you and people can just reflect on their experience, I reflected on my experience, if you work with someone that is brilliant but you don't like, every suggestion, whether it's a supplement, or a diet change, or a

lifestyle change, you'll have this cortisol response. So at best your progress will hit a cortisol tinged glass ceiling. And if you really like someone, if you really like and trust the person you're working with, then you will have a positive, emotional response, and therefore whatever you're doing won't be crushed down by cortisol and stress. And I know so many profoundly mediocre clinicians who get disproportionately good results and they all have the exact same commonality, they're so damn likable, right? And we both know super nerds that have the personality, you know, present commonly accepted of course, we know those super nerds who have the personality of a door stop, that have protocols that simply glow, just glow, but they do not get the results they should because they're not likable.

And it's not about clinical competence, it's about likability. So, me going into comedy has helped me in many ways, you know, be a better writer, better speaker, but it's also helped me be able to connect with people better. I'm also on the spectrum, surprise, and being in comedy has also helped me be able to read people better, and to become more likable. So for any clinicians that are listening to this, it is a clinical imperative that you are likable for your client's benefits, this is non-negotiable, becoming more likable is what you need to do not something that's nice to have. If you are truly in this to help people, be as likable as possible. So I hope the little .

Laura Frontiero, FNP-BC
This is great, and I will say, I know that you are an academic and bit of a genius and it's rare that we meet those types of people that we actually enjoy talking to and spending time with, and it is because you are so fun and likable. So, we have about 30 minutes left to go into a marathon deep dive on all the different tests. And, you know, if you're listening right now, make sure you have your pen handy, make sure that you go back and, you know, rewind and listen to this because we're gonna go deep. And so we're gonna cover what are the key mitochondria tests and which ones are the best ones to use and why? And so we're gonna go about 30 minutes, okay? Can you do it, Sam?

Samuel Shay, DC, IFMCP
We will do it.

Laura Frontiero, FNP-BC
Okay

Samuel Shay, DC, IFMCP
So testing, so testing is for people who are either chronically unwell, who are feeling normal and just wanna stay and maintain, and it's also for the opty, what I call the health aspirants, the optimal performers, the entrepreneurs and the biohackers. Testing is not to be done to the exclusion of ignoring lifestyle. I have a conception called 10 Pillars of Health, this is not a 10 pillars of health talk, but just to make the point that if you are gonna work with someone who does testing, you must make sure that your lifestyle is attended to as the foundation, because the whole reason that people need testing is they have a bad lifestyle choice or circumstance which then is interpreted through your genetics and then creates reactive responses in your body, inflammation, blood sugar dysregulation, tissue breakdown, free radicals, which then over time will hurt organ systems and then create symptoms, and then create coping for those symptoms, which then damages your lifestyle even more, which then leads to more adaptation, more damage, and then round and round it goes.

So where functional testing comes in is it identifies what organ systems are damaged, what process your body is genetically prone to, inflammation, blood sugar dysregulation, tissue breakdown, free radicals, so that you can create a customized lifestyle nutrition plan to reverse this whole process on the premise that you're working on your lifestyle which started the whole thing to begin with. So testing fits in in this entire process. Genetics is these green arrows that connects one thing to the next, but the testing is over here in this corner and this corner looking at which of the four processes you're most prone to and what organ systems get damaged.

Now, when we're talking about function, when we're talking about mitochondria testing specifically, originally it was the ION Panel developed by Dr. Lord in the '70s. Dr. Lord developed fatty acid testing for functional tests, immuno acid testing for functional testing, organic acid testing for functional testing, and the GI effects test. So he basically is responsible for influencing half of all functional tests that all of us use around the world, period, full stop. He didn't do hormone testing, but he did all the other stuff. Now, the ION Panel was the original, it was at MetaMetrics, and what happened was that Genova carbon copied it later as NutrEval, and then

later on bought out MetaMetrics at some point in the 2000s, I think. So there's actually competing or organic acid mitochondrial testing even within the same company, 'cause originally it wasn't the same companies. So this a big picture overview of what it takes to analyze the mitochondria, so we talked about the factory, when you're looking at a mitochondria test, you wanna make sure that it's testing for the actual how well is the factory working, mitochondrial function, can you make the electricity? The neurotransmitter metabolites, meaning are you getting signals from the outside of your electricity needs? For inflammation markers, 'cause inflammation also can really affect and slow down and cause all sorts of problems within mitochondria.

Free radical markers, detoxing, infections will affect mitochondria, the fatty acids, you know, amino acids, the building blocks, amino acids are used to build the walls, and not just the fats, amino acids are there to build the inside of the mitochondria, it's actually to run the electricity factory in the inside, etc, etc. So there's a couple major panels out there, there's the OAT test by Great Planes, there's the ION Panel by Genova, there's the NutrEval by Genova, there's the Metabolomix by Genova, there's the new one called OMX by Diagnostic Solution Labs who're most famous for the GI-MAP test for stool tests. And I'm gonna talk about comparing mostly NutrEval and ION Panel, and it will explain the other tests as well. And the primary reason...

Laura Frontiero, FNP-BC
Quick question, so Organix is another test by Genova, can you explain how that differs from the NutrEval?

Samuel Shay, DC, IFMCP
So there's checking for the organic acids of the mitochondria, which is, is the factory itself spinning and making the electricity? Then there's the ION Panel which is that test plus the peripheral nutrients around to make sure the factory is working well. So, the Organix Comprehensive Profile is the urine portion where it's checking for the primary function, is the actual factory working? And checking the detox pathways, it's also checking, there's a couple other metaphors I forgot to include, the mitochondria burns fat, it burns amino acids and it burns carbs. And you need to bring these things to the factory, you need to bring raw materials, you need to bring the oxygen, that's why we have red blood cells, you know, bringing around the

oxygen to bring it as oxygen to burn the fire in the furnace to make electricity, but you need raw materials, fuel. And so you bring fatty acids, amino acids, and carbohydrates. And there's three different . One has a different truckers union that requires to be paid in different things. So the fatty acids truckers union requires B2, carnitine, glycine, and magnesium. People don't know much about magnesium and glycine, they need to be paid, and if they're not, they don't deliver the fat, sorry, it doesn't work like that. The amino acid truckers union is paid in B vitamins, mostly B6, and then the carbohydrate truckers union is paid in B vitamins, chromium, lipoic acid, a couple other odds and ends.

Laura Frontiero, FNP-BC
Oh my gosh, I'm sorry, I have studied this test for a long time and studied with some of the best, and I just have a whole new eyeopening awakening around this just in that 30 seconds that you talked about truckers unions. Okay, carry on, amazing.

Samuel Shay, DC, IFMCP
Thank you. It's my very apt metaphor given what just happened in Canada, but that's a whole other story, anyway. People can get smaller versions of a mitochondria test, just the urine, where they're looking at if the function of the mitochondria itself, then I would recommend instead they get the larger panel that includes a serum or sometimes a blood spot of looking at, you know, like fatty acids, amino acids, heavy metals, minerals, other nutrients, inflammatory markers, and so on. So, the ION Panel includes the Organix Comprehensive Profile, it's nested underneath it. So, why do I like the ION Panel? One, it's the original and it's also the readout, only the OMX, the new one, has a similar readout. And this slide it's showing that the ION Panel is read in statistical quintiles, where that's really important, they're much easier to read, and also it's important because you can see very clearly if there's any defects between one enzymatic step to the other.

So if I have, now this is getting really into the weeds here for people who are the lay public and for the clinicians, you know, this can also get into the weeds But just looking, this is a much easier way to read the data in a clear, consistent quintile separation. So quintiles means it's a bell curve, and the bell curve, it contains 95% of the population. So from the bottom edge here on citrate, to the top edge is 95%. So above this line is the top 2.5% from 97.5 to 100% of the

population, the bottom is the bottom 2.5 to 0%, and everything else is a bell curve. And so the third quintile is kind of the very top part of that, and the bell curve, you know, becomes that bell curve shape towards the edges. And this is really important visually because you're gonna be able to see that if there is a block from converting one thing into the next, and there's enzymes that are in between these steps typically, and that if the enzymes aren't working properly, you'll see a really huge difference between something will be high up here and then low down here, that means there's not a deficiency in the one that's low, there's actually a block in the enzyme that converts the one thing to the next, and those enzymes are usually, like we described before, they require vitamins and minerals in order to work properly. But you can't really see that on these really weird color coded, floating bar thingies that you see on the NutrEval and all these other tests. So it's only the ION Panel and the OMX that has this really great readout.

Laura Frontiero, FNP-BC
Yeah, I love that readout, it's harder on the NutrEval.

Samuel Shay, DC, IFMCP
Really hard, I really dislike it a lot. Then there's the other thing is the creatinine level, and this is another thing that most people don't know.

Laura Frontiero, FNP-BC
Oh, so important.

Samuel Shay, DC, IFMCP
The creatinine is a measurement of how thick or diluted your urine is. And if your urine is way too dilute, that means that what you see on the labs are skewed, or if it's too thick, it's also too skewed, because these numbers, parts per million, parts per million of what? It's divided by creatinine, this kidney marker. So, if the marker is under 50, the creatinine level is under 50, Dr. Lord says himself, you gotta drop all markers by a quintile. That's really important 'cause if someone's reading all high, but their creatinine is really low, and that makes sense 'cause it's divided by creatinine, and if the lower the denominator, the higher the end result is, and the higher the denominator, if it's over 350, then the more dilute, the smaller the end result's gonna be.

Laura Frontiero, FNP-BC
I just wanna interject here, this is so important. So, this is something that you and I have learned because we've mentored with some of the best people. I mean, Dan Kalish is taught by Dr. Lord, I mean to be mentored by Dr. Lord is incredible, you and I could only hope, right? But at least to mentor with Kalish, who is studying with Dr. Lord right now, but the story I wanna say is, I have actually had conversations with the lab before where they said, oh no, no, no, no, no, we account for the creatinine, just take the test for face value, and no, that's not accurate, so a huge pearl right here for those of you who are practitioners, and even if you're a consumer watching this, to know that your practitioner better account for a low creatinine and shift all the markers need to shift down and you read it completely differently. So that will distinguish if you are working with a practitioner who actually understands that piece, you will get better results with your program.

Samuel Shay, DC, IFMCP
Yeah, I'd rather take the word of the guy who invented the test than reassurances from the lab company.

Laura Frontiero, FNP-BC
Exactly.

Samuel Shay, DC, IFMCP
So this is, Dr. Kalish called this the most important number on the entire test 'cause it determines how you look at the entire test. Then there's normal elevations that are circumstantial. So for example, we talked about the bell curve and if it's above the top line here, normally this test was originally designed by Dr. Lord to look for genetic abnormalities in metabolism, they didn't really have genetics testing back then. So, if things were over 2X the upper limit, then that means there was an underlying error of metabolism that was genetically based. There's a couple exceptions, beta-hydroxybutyrate being excessively high, you gotta look for a keto diet. If the HIAA or five hydroxyindoleacetic acid I believe is the Scrabble word. It can be super high if you're on antidepressants or if you're on a really high dose of St. John's Wort. Also I've seen lauric acid being just super high, and these are the coconut oil bulletproof coffee enthusiasts that are just taking way too much coconut oil than their system can handle.

Laura Frontiero, FNP-BC
And this is why taking a very thorough health history when you're reviewing an organic acids test with someone is so vital because these markers can be influenced by what people are intaking, supplements, pharmaceuticals, and food.

Samuel Shay, DC, IFMCP
Absolutely. So, actually I think what I wanted to demonstrate here is that this is what the amino acids, the next section is looking at the amino acids. Now, I'm gonna show you, when you look for patterns. So, we're gonna go into different sections of the ION Panel, and all these other tests have amino acids on them, so we can take learning from this panel and extrapolate the major, big picture lessons over here. So, if the amino acid is low, then it's in general, just point and click, like you just add the amino acid that's missing. If they're very high, then you think of, okay, the truckers union isn't happy, they need B6 to deliver. And very rarely do I see things down the middle perfectly, it does happen occasionally, but, you know, like it's, yeah ,and then you've come to...

Laura Frontiero, FNP-BC
So real quick just to break down what you just said, when you're looking at amino acids, if you see high levels on amino acids, then you know they need B vitamins. If you see low levels on amino acids, then you know they probably need more amino acids, but if it's high, that means the amino acid isn't getting into the cell, they need B vitamins.

Samuel Shay, DC, IFMCP
Correct, you need B vitamins, usually B6.

Laura Frontiero, FNP-BC
See, it's easy, it's actually easy to read this panel once you get these like.

Samuel Shay, DC, IFMCP
Easy asterisk, okay, I mean, the urea cycle is a whole other 30 minute conversation which we don't wanna convene into too much.

Laura Frontiero, FNP-BC
This is so much to know, but bear with me as we go through this if I wanna highlight something it's because in my own journey, when I was going through this, it was like that aha moment, like, oh, that's what this means, okay, let's get you some B vitamins. So there's some pearls here that we wanna highlight.

Samuel Shay, DC, IFMCP
Yeah, and things like also like phenylalanine and tyrosine if people are having low mood, like amino acids is one of the easiest things to help people with. 'Cause if you give people free-form amino acids, not collagen, not P-protein, not rice protein, you wanna give them free-form amino acids, 'cause people's guts are generally a mess, and the free-form amino acids, these are the Lego blocks. And your body, the whole point of digestion of taking protein, whether it's a steak, or collagen powder or P-powder, whatever, is it breaks down these jumbled together Legos that are all stuck together, it's 20 different color, you know, Lego pieces. The body in the bloodstream wants to break down all of those assembled Lego pieces into the individual Lego pieces, the individual Lego pieces.

Now, chewing, stomach acid, stomach enzymes, pancreatic enzymes, those all breakdown proteins to, at the smallest level two and three amino acids that are stuck together like little Lego blocks stuck together. Your body still can't use those to build things, to send to the other cells to use. In fact, those last two and three called di and tripeptides or two or three immuno acids that are stuck together like Lego steps, they're broken down in the cells that line the gut. And if your gut's the mess, it's leaky, it's inflamed, there's infections, the villi aren't working, like you can't absorb. And those two and three amino acid blocks leak into the bloodstream, your body interprets those as foreign invaders, and you can develop autoimmune responses to that and your cells can't use them.

So, if your gut is damaged, how are you possibly supposed to absorb amino acids in order to, one, heal the gut, and two, make sure everything else in your body is repaired and working properly, like your mitochondria? The answer is free-form amino acid powder, because they're already the individual Lego blocks, no digestion required, your gut can be thrashed and you can still absorb them because they literally just go straight in the bloodstream ready for use. That was a massive

revelation that I learned in studying the ION Panel in mitochondria is that I almost never give protein powders anymore, I give free-form amino acid if people's guts are a mess. So if people are struggling, you know, giving people the correct free-form amino acid, not just some broad blend, because you're gonna need grams, not 300 milligrams of tyrosine, you're gonna need like grams of this. And obviously if your tyrosine's low, work underneath someone who's trained, don't just go out and grab a bag of grams of tyrosine, you know, asterisks, asterisks, disclaimer, disclaimer, or whatever. But I'm telling people like amino acids is one of the most powerful sections on this entire bit, because if you find globally low, I mean, a client I worked with this past week who had 15, 15 out of the 20 as first quintile or lower, a disaster, absolute disaster.

Laura Frontiero, FNP-BC
And that equates to disastrous mitochondrial function as well, like that's foundational, you're in a hypometabolic state at that point with that level of amino acids, so you better fix that.

Samuel Shay, DC, IFMCP
Absolutely, so then we've got on the ION Panel, we've also got a marker of homocystine ideally we functionally want that below eight. And you can look at the ION Panel is also really nice to find the other things that influence homocysteine, all the nutrients that go into it, there's certain minerals that are tested for potassium, low magnesium, there's other markers that also check for the functional uses of magnesium. Erythrocyte magnesium measures only a certain section of the magnesium pool in the body, but there are other markers that are used, the tricarballylate marker, that's on the organic acid section. And you can check there's other ways to look for magnesium globally.

The calcium one is confusing, the calcium is not about high calcium, it's about membrane fluidity. And when I see this high, I look at how are the fatty acids messed up? And so the fatty acids damaged in some meaningful way. Then look at zinc and copper, and you can look at ratio selenium, I have seen people overdo the Brazil nuts, that's a thing, that does happen. And then the checks for heavy metals. Now, there's so many ways to check heavy metals, whole blood is a window into recent exposure in the past four months. There's many other, this whole Summit's devoted to metals, this is not a metal talk, this is really looking at recent exposure in the past four

months, why four months? Because red blood cells or whole blood takes four months to turn over, and that's what we're looking at.

Laura Frontiero, FNP-BC
While we're on this topic, just if you could sidebar real quick. So, this is looking at recent metal exposure, when we do urine tests, what's the time window for urine testing?

Samuel Shay, DC, IFMCP
My understanding of the urine testing, it's what you're getting rid of daily through the kidneys. And there's different types of urine tests, there's like the 24-hour collection, there's the spot test, and then there's the "challenge test," where you basically take a molecule, whether it's DMSO or a bunch of glutathione or whatever your jam is, or a suppository of stuff. You basically, they're pulling metals out of the tissues and then you're catching in the urine what was in the tissues versus what's just on a normal background level detoxing. And it's a whole other conversation.

Laura Frontiero, FNP-BC
Totally, and what I just wanna make sure practitioners and consumers know when they're watching this is, that it's really hard to test for heavy metals, your body sequesters those metals deep away in your tissues to get it away from your vital organs, your brain, because they're so damaging, and so you can be full of metals and test completely normal because your body isn't releasing it, it's too dangerous too, so that's a whole nother thing.

Samuel Shay, DC, IFMCP
And by the way, one of the things we both learned in studying with Dr. Kalish is like just because someone has really high heavy metals doesn't mean you go on a detox, because your mitochondria, your amino acids, your fatty acids, your adrenals, your gut, isn't ready to handle it. So if you see high metals, it doesn't mean you careen into heavy metal detox right away, you've got to make sure you're healthy enough to withstand the extraction of heavy metals, 'cause you can be in a world of hurt if you extract metals too quickly and you're not ready for it.

Laura Frontiero, FNP-BC
You better work with a practitioner who does foundational work, I mean, you don't wanna even start doing that kind of heavy detox work for at least a month or two until you're ready to tolerate it.

Samuel Shay, DC, IFMCP
I delay metal testing as much as possible until I know they can handle it.

Laura Frontiero, FNP-BC
Yep, yep, okay, good, this is great, so what else you got?

Samuel Shay, DC, IFMCP
So this is an example also of not having to do a heavy metal detox, but just working with a client that had arsenic and mercury, and all I did was attend to the other matters of the mitochondria. And you can see his heavy metal levels went down just without having to do a detox, you know, and his skin in like all these subjective things got so much better and I'll show you the skin stuff in a minute. So then we've got fat soluble vitamins, and CoQ10 being high is usually from supplementation or hypothyroidism. And then you got lipid peroxides, this one's an important one because this is telling you how damaged your fragile fats are. I have an entire separate video where I describe just the fatty acid portion of the ION Panel 'cause it's so complicated, that if you've got low fatty acids, but even normal or high lipid peroxides, that means any fragile fat, fish oils, flax oil, hemp oil, you put in your body is being nuked, it's being crisped when it hits your body. I've pulled people off of fish oil, off of flax oil for several months while I load them up with fat soluble antioxidants that they need, because if they take fish oil in a damaged state where their lipid peroxides are high relative to their fat, see how this is like globally low except for these three here, like you're gonna crisp all of those fragile and expensive fatty acid, you gotta wait until your body is .

Laura Frontiero, FNP-BC
Right, and by deep frying them you're causing free radical damage in the body, I mean, not only are you not getting the benefit of it, you're actually causing harm.

Samuel Shay, DC, IFMCP
Right, the other benefit of the ION Panel actually gives you the gross level of the fatty acid, because unfortunately the other tests only give you ratios. So you may have a great ratio of, you know, GLA to this or whatever, but you don't even realize that you're actually globally deficient. That's the other problem with the other mitochondria test is they don't give you these actual numbers. Now, this is an example here of an enzyme break between LA and GLA is what's called delta-6 desaturase or D6D, and this requires B2, B3, B6, zinc, magnesium, and vitamin C.

Now, Dr. Lord said, if there's a greater than two quintile difference, and this is one, two, three, four quintile difference, the mistake would be to give someone GLA, instead you wanna fix the enzyme that converts LA into GLA. And so you identify through the rest of the test, is it B2, three, six, vitamin C, zinc, or magnesium? Vitamin C I think I said already. Now, I had this, and then on my next ION Panel because I corrected the enzyme, they were perfectly overlapped above each other. It was an enzyme issue, not a GLA deficiency, and you just take that conceptually. Now, I also made a complicated chart, you know, to understand all the enzymes and everything. My nerd is showing, I know.

Laura Frontiero, FNP-BC
Yeah, this is good stuff, this is super geeky.

Samuel Shay, DC, IFMCP
Super geeky, but this is what's needed to actually analyze the test.

Laura Frontiero, FNP-BC
Yeah, walk us through, how does that work? Let's look at that real quick.

Samuel Shay, DC, IFMCP
Okay, so here we have, there's common enzymes that are shared across, like this column here, there's omega-3s, omega-6s, omega-9s, and omega-7s. Now, visually you read it from top to bottom in the line, so the omega-3s, there's no need for delta 9-desaturase enzyme that needs iron, that's only in the omega-9s and the omega-7s. So if there's a block, and there's like rules here in the bottom right here. So we start here on omega-3s, ALA was in the first quintile, right

here. And then we come down and then there's all these other steps that the test doesn't check for. And then we come here to EPA, which is in the fourth quintile. So, usually ALA has to convert into EPA, so how is it that you have something super low, then it's something super high, and in this case is supplementation. So they're supplementing with EPA, DHA, etc. And then we come over here and next column omega-6, and we have LA and then we have the enzyme, the delta-6 desaturase which converts LA into GLA. Now, this is in the second quantile, now it's in the first quintile, that means there's an enzyme break, that's what I was just describing before. And the enzyme required...

Laura Frontiero, FNP-BC
The fix for the enzyme.

Samuel Shay, DC, IFMCP
The fix is right here, B2, B3, B6, magnesium, zinc, etc.

Laura Frontiero, FNP-BC
So real quick, which you will see on the ION Panel. So what I wanna get to here is, so I don't wanna scare practitioners away from like, oh my gosh, I'm gonna have to study this for five years or four years like Dr. Shay did before I can do this, no, because the test actually gives you the answers. So you'll go through the ION Panel, you'll see that they have these deficiencies and you support that.

Samuel Shay, DC, IFMCP
Yes, exactly.

Laura Frontiero, FNP-BC
So you don't have to know this level of understanding that you have, you can actually successfully support people if you go to the big picture of the test.

Samuel Shay, DC, IFMCP
Absolutely, and just know like it's gonna be a journey, like it's gonna take some time to learn this, but it's totally worth it, because at the root of most people's issues is a major mitochondrial

component. Then we've got the other fatty acids, this is, you know, the coconut oil enthusiast, usually too much bulletproof coffee, odd chains, you know, this is a pretty straightforward, these are B12, carnitine, dysbiosis, or biotin issue. And this one's really great, the trans fat, if someone's got a high marker here, you hold your client to account say you are sneaking in trans fats.

Laura Frontiero, FNP-BC
Yes you are, you can actually tell if people are cheating with this test. And the other thing you can do is you can acknowledge people who aren't, I love it when I do this with people, I say, I can tell how hard you're working on your food because your trans fats are low .

Samuel Shay, DC, IFMCP
So, then we've got, this is an example of someone who's catastrophically low in fatty acids across the board, just catastrophically low, showed high fats in the stool, you can see that they're not absorbing. And then we come to the actual mitochondria portion, like the mitochondria itself. And there's three ways to look at this, and we're just finishing up 'cause we're kinda in the home stretch here. You wanna look for, is it globally high? Is it globally low? Or is it mostly in the middle with a couple odds and ends on either side? That's the main thing. So if it's high, like this person, their mitochondrial engine, their mitochondrial factory is running hot, it's burning fast, it needs more nutrients, it needs to keep things going 'cause it's running, running, running, running, running.

Laura Frontiero, FNP-BC
Which isn't good, running hot isn't a good thing.

Samuel Shay, DC, IFMCP
It's not good, so it's not as bad as if it were globally low, and now this is a new phenomenon if everything was globally low, which isn't in this case, that's called mitochondrial retraction, it's a new phenomenon in the past decade or so that Dr. Lord himself came out of retirement to research. And when people think, oh, this is high, oh, these are really bad, like, no, it's worse when it's all low, here's why, this portion of the test when checking them mitochondria, this is a urine portion, this is the equivalent of an emissions test of a car. This is looking at what has been used? You've put in oil, you've put in gas, what's in the blood is the equivalent of oil and gas. The urine is

what's come out the other end. So, if you turn on a car and you've got this massive plumes of smoke coming out, that's the high pattern, that means the end is totally working, you need more nutrients, like it's just overheating.

Laura Frontiero, FNP-BC
It's inefficient, it's inefficient and burning dirty.

Samuel Shay, DC, IFMCP
Burning dirty, now, here's the problem, you turn on a car and barely anything come, like eerily low emissions come out, like that's scary, that means half of your engine has melted and is not even running, that's way worse, that means you have to rebuild the engine 'cause it's not even working strong enough to even make emissions. That's why globally low is worse than globally high, you'd rather have a really hot high running engine that's just blowing through nutrients, than an engine that's half melted.

Laura Frontiero, FNP-BC
Right, because that leads to more chronic disease and illness and fatigue.

Samuel Shay, DC, IFMCP
Imagine if half your electricity factory in a city just stopped working, but your missions would be low, that'd be great, but they're not getting the electricity, you're not making the cells.

Laura Frontiero, FNP-BC
So real quick, when you see it, so let's pretend that this red box you have here was all the way to the left, like this was really bad, what do you do?

Samuel Shay, DC, IFMCP
So a slightly different protocol, so to rebuild a mitochondria, a rebuild of an engine is different than feeding an engine, feeding an engine is, I mean, it's even listed here, you know, carnitine and B2 and B vitamins, lipoic acid, CoQ10, amino acid, magnesium, that's great. But to rebuild, you need to add in tryptophan, you need to add in more amino acids, like a whole bunch, like a bolus, like seven to 10 grams or so, but again, there's some nuance there, so you gotta work with

a clinician who knows what they're doing. You add in a bunch more amino acids, you add in PQQ, which is a thing that patches up the walls of the mitochondria, tryptophan because that's the limiting step of all protein synthesis except for collagen formation, and you generally just need more of the nutrients that a mitochondria would regularly need. So, it's all the regular stuff plus extra amino acids, extra L-tryptophan, extra PQQ, some extra magnesium, and yeah, that's the core of it.

Laura Frontiero, FNP-BC
Yep, and, you know, I've seen that a few times in my practice, I've had people it's just like, I like to think of it as flat lined mitochondria, right? They're just laying there doing nothing, they can't even make energy.

Samuel Shay, DC, IFMCP
Absolutely.

Laura Frontiero, FNP-BC
So I'm glad we're breaking this down because...

Samuel Shay, DC, IFMCP
These are the people whose adrenal programs fail, that if they have low mitochondria, the low mitochondria people, they're the ones who they also have adrenal issues and they do this great adrenal program, those are the people with the adrenal systems that fail their treatment of their adrenal issues because actually the mitochondria needs to be attended to for the adrenal stuff to actually work.

Laura Frontiero, FNP-BC
That's why I love to run a mitochondria test alongside an adrenal test to see can this adrenal protocol even support. But people, you know, when you're doing that, I mean, your consumers, your customers, they gotta be bought in, this is not cheap to do all this stuff, a lot of times they're, well, just give the inexpensive adrenal test, right? But you won't get the whole picture.

Samuel Shay, DC, IFMCP
You can do the piecemeal kind of, this sounds awful, the serial testing monogamy where you, this serial test where you do one test and if that doesn't work out, you go to the next test, and you go to the next test.

Laura Frontiero, FNP-BC
Serial testing monogamy .

Samuel Shay, DC, IFMCP
It's an awful metaphor, but it's pretty hilarious. So, to give the other metaphor of doing all the tests at once is even worse sounding, so I wouldn't even go there.

Laura Frontiero, FNP-BC
I'm tracking, I'm tracking you.

Samuel Shay, DC, IFMCP
Thank you, I think most people are trying to suppress either a sigh or a smirk, either of the two works. So, ideally you work with a practitioner that looks at gut, mitochondria, and hormones, like adrenals, at a minimum, at a minimum. So, the way people can look at with testing is like, it can be layered, if people aren't able to prioritize resources towards like all of the tests, you can start in a meaningful foundation, just the urine portion of the mitochondria of the organic acids, you know, a stool test and the adrenals, that's foundation. Then you can layer, if you can do more you can layer instead of just the organic acids, you do an ION Panel, instead of just a stool test, you can do a stool plus say like a breath test for SIBO, or maybe some food allergies. And instead of just an adrenal, you can do say like a Dutch test where it's adrenals plus sex hormones. So there's ways to actually create real foundation at a lower tier of investment and still get a massive amount of information, and there's ways to layer on top while keeping with that same triumvirate of mitochondria, gut hormones.

Laura Frontiero, FNP-BC
Yes, and always what I say when I do this, I have clients that I work with where we run this whole group of tests. Once we get all that information, this is a six to 12 month process to repair that,

you can't physically take enough supplements to support every single problem we see, so you've gotta work with someone who can do it in the right order. So let's fix this thing first, and then once that's feeling better let's layer here because you can't do it all at once, you just can't. But it's good to see the whole picture to know where to start.

Samuel Shay, DC, IFMCP
Yeah, typically when I work with people, they usually have some severe gut issues, it's like the first six months is actually split up into three two month sections where you deal with one, in certain infections you gotta deal in a certain order, like you deal with infection number one plus mitochondrial stuff and whatever adrenal stuff you can sneak in there, and then the next month is this, you know, some low level mitochondrial support or the highest priority stuff in the mitochondria test. And then the next infection and the next infection, etc, then the next month, seven to 12, is almost all like straight up nutritional replenishment, mitochondrial, adrenal rebuilding.

Laura Frontiero, FNP-BC
You said something really important I just wanna highlight it, you said, in the beginning with this severe gut stuff you sneak in mitochondria support, and I wanna highlight that you just said that because this is so critical and it's the piece that's left out of a lot of functional protocols where people are like, we're just gonna blast your gut, we're just gonna kill some stuff and give you . It takes energy to heal the body and to remove infections and to support the immune system and to reduce inflammation, so you must sneak in mitochondria support, which is of course you and I know that, but not a lot of practitioners do. So if you're watching this right now, make sure that you are getting that mitochondria support in there.

Samuel Shay, DC, IFMCP
One additional thing, it's mitochondria support plus all the missing amino acids. It's actually one of the best things you could do to help someone's gut repair, is to identify all the deficient amino acids and replenish that along with whatever, you know, boiler plate amount of glutamine that it is. 'Cause you need the amino acid to rebuild the cells of the gut lining. So like this is where ION Panel is synergistic with gut testing, just like adrenals is synergistic we got testing 'cause they control the circulatory, IGA, you know, immune portion, you know, there's all sorts of stuff

crossover. So right here, this fatty acid metabolism right here, this is the truckers union for the fats, carnitine A2, glycine and magnesium should be on this also, glycine is specifically for the ethylmalonate portion down there for the longer chain fatty acids. Then we've got the carbohydrate truckers union, and down here where it says, B vitamin markers, technically it should be amino acid metabolism, this should have been renamed. This is the amino acid truckers union down here, and then this is the actual inside the factory, what's going on right here. So, I know we're running out of time, let me just quickly blast through all the rest of it.

These are the neurotransmitters. If people are not feeling well, this is one of the most valuable parts of this test is looking at if your neurotransmitters aren't working well, like tyrosine for vanilmandelate and homovanillate, you know, tryptophan, you know, down here for this one, also B6 antioxidants. There's also a secret copper metabolism issue you can find if the homovanillate marker is at least two quintiles above the vanilmandelate if people wanna, you know, they can pause on the screen on the video and kind of study that a bit more. Then we've got brain inflammation markers, free radical markers. Then we have the liver detox markers, there's three markers here just for glutathione.

Laura Frontiero, FNP-BC
Wait, let's back up one second 'cause, okay, we can't end, we just have to take more time on this. So, the brain inflammation is really important, you know, when you have people that are, you know, their serotonin is off, their dopamine is off, it's gonna be really hard for them to actually carry through the protocols that you are recommending. So you better look at this piece and support so that they can actually execute on that kind of emotional level, right?

Samuel Shay, DC, IFMCP
Yeah, and the thing is that if there's an amino, usually there's an amino acid deficiency when these are really low. And so with supplying the amino acids up above, you're gonna actually help people's moods just as a matter of course, and then if you identify if there's also a B6 antioxidant need as well, you're gonna be able to support their neurotransmitters, and like what we also learn when we study with Dr.Kalish is like the first few months are very critical, 'cause we want to help people feel better as quickly as possible, not resolve all the things. 'Cause that's rarely

possible, we wanna make them feel better so they get inspired to continue on until there's clear results.

Laura Frontiero, FNP-BC
What's your thought about, like if your clients don't have the money to do this extra testing, what's your thought about throwing MAP aminos into people's protocols? Just doing a really good health history, suspecting you've probably got some amino acid deficiencies, are we doing any harm by saying, take some, you know, MAP aminos a couple times a day?

Samuel Shay, DC, IFMCP
So, it depends on the dosage you're giving and if they have a history of recent cancer, because if you give like 10 grams of amino, this is the debate within this community is that, one of the reasons you give seven to 10 grams of amino acids in one bolus, in one shot, when they have all globally low mitochondria is because that triggers the mTOR function of the body to start rebuilding stuff rapidly, you build up mitochondria. So, there's a debate on, well, if someone's concerned about cancers and you stimulate the mTOR pathway, that that could then trigger proliferation of cells you don't want to proliferate. And then the other side of the argument is, well, how can the immune system and the entire mitochondrial system work properly in order to combat cancer even work without having sufficient acids?

So it's this kind of chicken egg thing, and so the solution that has been discussed, and again, people listening to this, you gotta work with clinicians, is like, okay, if they have that concern about growing tissues that don't want to be extra grown, you don't give the bolus of seven to 10 grams at a time, you give smaller amounts throughout the day 'cause it's the giant bolus, the giant one hit of amino acids that will spike the mTOR. So you can instead give drip in amino acids to help remove deficiencies. Now, aside from that concern, free-form amino acids is very, very useful, the only problem as a general thing to do, I mean, there's whole formulas of, you know, like the nine based, you know, essential amino acid blend, whatever, and they usually blend it according to the average amount of amino acids in the human body, you know, like 1% tryptophan you know, X% leucine or whatever it might be. And the only issue that I have with that is that if they're not taking enough B vitamins and they're having problems with B6, they

don't have enough, then they're just throwing extra amino acids into the bloodstream that are just getting kind of stuck circulating.

Laura Frontiero, FNP-BC
Yeah, 'cause remember the truckers union for amino acids.

Samuel Shay, DC, IFMCP
Yeah, it's mostly B6 and a couple other, you know, little currencies on the side of other B vitamins. And this is where nonspecific functional medicine comes in and this is where just people are selling their off the shelf mitochondrial kits, just like they're selling their off the shelf detox kits or their off the shelf adrenal kits. People have been helped meaningfully by not doing testing, but there comes a point where people either get unpredictable or plateaued results and they get stuck, and then they go into this thing where they just continue on the protocol harder, but they're not getting what they need and then they get frustrated, and that's where testing really shines. Ideally you avoid that situation to begin with 'cause then you can just get specific all the way. I personally think that investing in testing is gonna save you money in the long-term, not the short-term, but in the long-term, because then you actually know what supplements and dietary changes and the lifestyle changes you actually need as opposed to this, you know, chasing magic bullets and shiny object syndrome in the supplement world.

Laura Frontiero, FNP-BC
Totally, totally, okay, thank you for going on that sidebar, I know this is going longer than we thought but I think this is too important to cut this short. So, just apologizing in advance for everybody, I said this would be 30 minutes, but I'm not stopping.

Samuel Shay, DC, IFMCP
You can always split into two parts if you want, that's another option, but the other thing's to put, look shiny, Dr. Shay's speaking, this is the best interview ever, we gave him all this extra, anyway.

Laura Frontiero, FNP-BC
So where was the next slide?

Samuel Shay, DC, IFMCP
So the next thing is... So we talked this brain inflammation, free radicals, okay, then we come to liver.

Laura Frontiero, FNP-BC
Spend some time here because that sulfate level is so important.

Samuel Shay, DC, IFMCP
Correct, and I think that, I'm gonna crop in here an additional looking one here.

Laura Frontiero, FNP-BC
Get a bad one .

Samuel Shay, DC, IFMCP
I'm just gonna crop in this one right here. All right, we'll just start with that one. All right, so Dr. Lord, and he updated his book, his magnum opus last year, and it's this 1,400 page text on just all of his research. He's pointed out six different patterns of glutathione on collapse. And the first one is when...

Laura Frontiero, FNP-BC
Six, six .

Samuel Shay, DC, IFMCP
There's six of them. So the first one is where you see alpha-hydroxybutyrate shoot high alone, and then over the different stages you see pyroglutamate shoot high, and then sulfate shoot, then it goes low, and then this goes low, and then the worst one is when sulfate is low. And Dr. Lord called this marker aside from the creatinine, the most important clinical marker on the test, where if you have low sulfate, that means that you are lacking the most important component that is there to make sure that you are actually able to generate glutathione, and I'll show you...

Laura Frontiero, FNP-BC
And I've heard Dr. Kalish talk about it as like full system collapse.

Samuel Shay, DC, IFMCP
Yeah, full system.

Laura Frontiero, FNP-BC
It's bad. So as you're watching, when I'm looking at these tests, the first thing I do is I look at the creatinine, the second thing I do is I look at the sulfate, and I'm sure you do the same thing, and then you go back and you look at everything else.

Samuel Shay, DC, IFMCP
Correct, absolutely correct. So, if the sulfate is low, that's super bad. So glutathione is used as a heavy metal, it's used later as a radical scavenger, as things to help detox, like hormones, like estrogen and all the rest of it. So Dr. Lord thought it was so important to put three separate markers for glutathione, in his updated book, he talks about the different stages of glutathione collapse measured by the different permutations of these markers here. Now, one thing I wanna point out, pyroglutamate is inaccurate in only one specific population. So people may ask, well, if I test this from day to day, is it gonna be the same? What about after 30 days with this? Well, Dr. Lord tested that back in the '70s where he had everyone in his office or the clinic every other day do a test, and he looked for the ones that were outside a quintile difference. And the only one that was wildly variable was in menstruating women, pyroglutamate. So if you have a client that's a menstruating female, ignore the pyroglutamate marker, because it's just all over the place in the course of the month.

Laura Frontiero, FNP-BC
I have never heard Dan Kalish say that before, that is new to me.

Samuel Shay, DC, IFMCP
I think that was in the other three years I was in the mentorship.

Laura Frontiero, FNP-BC
Oh my gosh, that's amazing, that is a pearl I'm taking with me from this lecture today.

Samuel Shay, DC, IFMCP
So it works fine for premenstrual and menopausal women, and for all men. So that's really important is that a little pyroglutamate, it's the only marker that...

Laura Frontiero, FNP-BC
Is it only while they're menstruating or just a woman of menstruating age?

Samuel Shay, DC, IFMCP
If they are having active menstruation, it's not on the day of menstruation, that's not what we're talking about, it's the fact that they're in the ovulatory monthly cycle.

Laura Frontiero, FNP-BC
Yep, that they are ovulating.

Samuel Shay, DC, IFMCP
They're ovulating, ignore pyroglutamate, period.

Laura Frontiero, FNP-BC
Okay, so that pretty much we are ignoring that from teenager through menopause.

Samuel Shay, DC, IFMCP
Correct. So orotate is telling you how well urea cycle is, urea is important because basically it's how you get rid of ammonia, and if ammonia builds up in the mitochondria, it shuts down the mitochondria. I've had people with terrible fatigue and their urea cycle back in the amino acids was all messed up. I gave them products to support the urea cycle, they said their urine smelled like ammonia for a week, and huge amount of their energy came back.

Laura Frontiero, FNP-BC
And you better be thinking about gut health with this because where the heck is all that ammonia coming from, right?

Samuel Shay, DC, IFMCP
Correct. Methylhippurate is checking global toxic exposure, and glucarate is checking medication detox. And you see people with very high glucarate, they're not able to detox their medications well.

Laura Frontiero, FNP-BC
Yeah, we work with a lot of people on major prescription drugs and it's a problem.

Samuel Shay, DC, IFMCP
Then we've got the very last one which is the microbiome. There's a couple gems on here, not that many, but if benzoate is high, but hippurate is lower than normal, then you look it's a glycine issue. If hippurate is high and benzyl is low, it's a dysbiosis issue. If both are high, then it could be either both a glycine issue and also a dysbiosis issue. I really look at the D-lactate if there's a dysbiosis that's creating a toxic buildup of D-lactate affects the brain, and D-arabinitol is a yeast and fungal marker. This is actually really valuable because in a lot of gut tests, not all gut tests are optimized to find yeast based on the preservatives used when they ship the gut tests over to the lab. So sometimes you have to rely on this marker to see if they actually have a systemic yeast infection, because a lot of the stool tests aren't really optimized for that.

Laura Frontiero, FNP-BC
Before you leave this section, what do you say about the digestion markers that are here? Hydrochloric acid marker.

Samuel Shay, DC, IFMCP
So when I look here, you're talking about the phenylacetates and all that, the phenyls?

Laura Frontiero, FNP-BC
Like do you use this to kind of say, well, maybe I wanna do a challenge on somebody, do you ever use this to kind of say, well, maybe you need some digestive support?

Samuel Shay, DC, IFMCP
Honestly, I never run an ION Panel without doing a gut test, so I lean on the gut test instead of this when I look at someone's digestion. I mean, yes, you can infer if these numbers are really wonky that their digestion is generally off, but personally I just lean on the gut test for that. I'd say that tricarballylate is also an important one. If this is high that means they have a meaningful magnesium deficiency as well.

Laura Frontiero, FNP-BC
Say that again 'cause it trips people up, if it's high it means magnesium deficiency.

Samuel Shay, DC, IFMCP
It doesn't mean you have too much magnesium, it's that you need the deficiency, because you need magnesium to function, to stop the buildup of this thing, so if you don't have the magnesium, this thing builds up and that's the indirect marker. One thing also the clostridial marker, you have to ignore. Dr. Lord, back when he designed this test, they thought all clostridia was bad, but now there's like what, 2,000 different subspecies of clostridia. So he said ignore whatever this is on marker 45, just ignore it and run a separate, you know, gut test, etc. And don't check a urine marker for clostridia, check stool markers and so on.

Laura Frontiero, FNP-BC
Perfect.

Samuel Shay, DC, IFMCP
So there's that, and then just to round everything out, mitochondria, if someone has a thyroid issue, they must check for mitochondria, because the mitochondria is the business end of the thyroid. T4 is the four-wheel car that leaves the thyroid and gets to the mitochondria and opens the door to let the T3 out, which is the engineer, which turns on the dials and turns up and down the mitochondria. That's the connection, basal metabolic rate literally is how much protein, fats, and carbs you burn in the mitochondria. So people who have the appearance of hypothyroidism, but normal thyroid markers, check mitochondria because you can send all the engineers in the world to flip some dials, but if the factory is busted, then no engineer no matter how many times they toggle the switch is gonna fix it. So, I just wanna point this out 'cause there's an epidemic of

thyroid concerns out there and they're ignoring, but there's not a full appreciation of how important mitochondria is to thyroid. I mentioned these other things, estrogen can suppress thyroid, you know, adrenals can suppress thyroid, low iron can affect thyroid. And plus the mitochondria test tells you, are you missing vitamin A, vitamin D, D vitamins, selenium, zinc, and tyrosine and arginine, which are all required for thyroid function. So, please bundle mitochondria testing within any thyroid testing.

Lastly, there's genetics, I'm not gonna mention any labs, I'm just mentioning that there's certain genes to look for for mitochondria, specifically the three main genes that make the enzymes to break down, so to quench the free radicals, the sparks that are made from burning protein, fats, and carbs in the mitochondria. MnSOD, glutathione peroxidase, and catalase. The most important is MnSOD, because it's the one that starts the whole process. The body is amazing, it can take two free radicals, convert it to an enzyme into hydrogen peroxide, and then it takes two hydrogen peroxides and then converts it into oxygen and water. Wow, the body takes free radicals and then makes it into oxygen and water, that's cool.

Laura Frontiero, FNP-BC
You heard that right, your body makes its own water, everybody.

Samuel Shay, DC, IFMCP
It's amazing, and if you're like me and have a red dot here and a red dot here, I struggle with free radicals because I have problems, my genes don't make sufficient enzymes so I have to do lifestyle things to improve the expression of those genes to support my mitochondria. So genetics testing, a whole other set of topics for mitochondria. So those are the tests that people should be looking out for when it comes to mitochondria. If people wanna learn more about me, I've got plenty of three free eBooks, one on the 10 pillars of health, and goes into functional testing more, two books on genetics, and you can go to my website, and if people wanna work with me directly at the time of this recording, I still chat with people for a free 15 minute consult if they feel like you resonate with me and you like me because that's good for you if you like my sense of humor and the way that I explain things. So, that's a wrap, and you have any less questions or thoughts, Laura, anything for me I can help you with?

Laura Frontiero, FNP-BC
Yeah, this has been really, really incredible. This is super helpful. I think that it can be daunting when you're looking at, you know, an organic acid test, whether it's the full ION Panel, NutrEval, or just the urine portion. And a lot of times you look at it and think, I have no idea, it doesn't have to be that hard, you don't have to go as deep, I mean, clearly you love this stuff, like you are a scientist, you are an academic. I am not an academic, I am not, and I have a basic understanding of this test and I can get people better with the understanding that I have of the test. And so if I can do it, anybody can do it, that's what I'm saying, if I can do it, anybody can do it.

Samuel Shay, DC, IFMCP
I'm gonna push back, you are a scientist, you're the ones with a lot of pinned butterflies in the background, you collect stuff like a scientist.

Laura Frontiero, FNP-BC
Yeah, they're pretty special to me, but no, I mean, my superpower is really helping people get from point A to point B by simplifying things and making it easy, I don't personally get in the weeds of, you know, the Scrabble words on panel, I love how you call it that. So, it's been so helpful, I know that if you're a consumer of healthcare and you stuck with us to the end here, now you know what to ask your practitioner for, right? And you know when you're looking at this test, if they don't have that basic, you know, if they're not looking at the creatinine, if they're not looking at the sulfate level, if they're not helping you see that you might need some B vitamins, you might need some amino acids to solve this problem, then, you know, probably talk to another practitioner. And if you're a practitioner watching this, now you know how actually not too hard it is to, you know, understand this test.

Samuel Shay, DC, IFMCP
Yeah, the basic concepts are consistent across all the mitochondria tests, it's a factory in a city and you're testing all the parts that make the factory work, that feed into the factory, all the raw ingredients, and all the ways the factory can get damaged. And that's what the testing is doing, and then it's a matter of, are you picking a test that actually gives you clear readouts that are easier to interpret and to find all the hidden things within each test to identify the key nutrient

efficiencies and excesses in there? And so I love the ION Panel and I love the work that Dr. Lord has put together, and that was transmitted through Dr. Kalish onto both of us.

Laura Frontiero, FNP-BC
Yeah, and you took it way further than I did, so thank you .

Samuel Shay, DC, IFMCP
Thank you.

Laura Frontiero, FNP-BC
You're welcome. It's so good, it's so good, it's been wonderful, thank you so much for being here and sharing your wisdom and making it fun and easy to understand, it's been great.

Samuel Shay, DC, IFMCP
Thank you, I'm so grateful that to you and all the other summit leaders out there because it's summits like this that truly empower both practitioners and the lay public, 'cause we need to share, we need to simplify this, make it easy to understand, and demystify it and not make it so damn intimidating. This is winnable, lab testing is winnable, and it's just getting the right understanding of how it all works and getting the right test.

Laura Frontiero, FNP-BC
Perfect, thanks so much, you take good care, Sam.

Samuel Shay, DC, IFMCP
Thank you, Laura.

Laura Frontiero, FNP-BC
Bye now.