Mark: Welcome to the Health Edge, translating the science of self-care. Looking at all that's rapidly emerging from the world of the life sciences and trying to frame it in a way that can bring some coherence and some traction in your life. Mark Pettus and as always joined by my good friend, colleague John Bagnulo. Good morning John.

John: Good morning Mark. Great to be with you today.

Mark: Great to be with you as well. We're going to follow up on the last podcast that we did, John. Looking at the mitochondrial cocktail and the importance of mitochondrial function. We talked about some of the supplements and dietary strategies for optimizing mitochondrial function which is largely uncharted territory as far as a lot of rigorous science, but I think very important as people look to apply some novel and, I think, pretty safe strategies in the effort of improving their health as mitochondria connect to all aspects of human health and chronic disease.

Today we're going to look a little bit at heavy metals, John. This is another one of those vast topics, and I'm sure we'll be spending future podcasts looking at this in various ways. Heavy metals frequently target biology from head to toe, Mitochondria particularly sensitive to that. This is, I think, one of the vast underrated, underestimated topics, John.

Certainly in my experience, gets negligible, if any, attention at the level of education, training. Rarely does it find its way into the traditional, western, allopathic model of assessment, treatment consideration, and yet there's really a growing mountain of evidence that human life at many levels is impacted by the enormous environmental toxic challenge.

John: Yeah definitely. It's timely, I think, that we discuss this because if you take a look at research centers around the world at some of the leading universities, there's a lot of really good work going on as investigators try to really get a full understanding of the various ways in which these heavy metals which are ...

The toxic burden of heavy metals, just to interrupt that thought for a moment, are at an all-time high. People are getting exposure to aluminum and cadmium, and, of course historically, lead and mercury. Those are one that people are more aware of.

Aluminum's at an all-time high. It's really frightening to take a look at, environmental aluminum and the levels that are being found in mammals and in humans, of course, all around the world. You can't find, really, an area on the planet where you don't have some level of aluminum exposure.

Is it atmospheric? Is it a by-product of the incineration of particular waste products that are being mixed with everything from jet fuel to just the incineration of fossil fuels? There's a lot of different theories around where this aluminum is coming from.

Certainly we're going to get some from our diet and we can go over some of those sources this morning as well. Yeah, Mark, these heavy metals are really everywhere, and when you look at how they influence human health, the mitochondria, which we talked about, it's the fundamental unit of maintaining a neuron's health.

Whether that's the myelinated sheath which protects that neuron and allows for rapid nerve transmission, which, of course, requires a large amount of energy to be derived or to be produced by the neuron. If the mitochondria within the neuron start to fail, if they start to become leaky or defective because of the way heavy metals are so caustic to the internal, what we call, the internal membrane of the mitochondria.

Once that happens, then neurons really start to degenerate. If we take a look at, whether it's Alzheimer's, or Parkinson's, ALS-type syndromes, and I say type because it's a spectrum. You have a lot of individuals that may not fit the classic diagnosis for one of the neurodegenerative diseases, but they have something going on where the nervous system is unable to communicate, either within itself or with a skeletal muscular system.

We've got an all-time ... Really it's just an epidemic of neurodegenerative diseases. We have unprecedented levels of aluminum showing up in people's bodies. It would be great, this morning, if we could help people learn a little bit more about how you can avoid some of this, but also how you can really protect yourself with a few different approaches. It's definitely a public health threat.

Like you just said, Mark, it's really interesting that it doesn't receive the attention as a family of toxins. We hear about lead and mercury, lead paint in homes is certainly still an issue. It was for our family when we moved here to Ohio. Mercury is certainly an issue, whether we're looking at sources like dental amalgams.

I know people really still have their attention turned to seafood, but I think personally that seafood is a far smaller source of mercury than usually the focus is on. I think mercury can be found in all your foods that have high fructose corn syrup in them, and a lot of foods that are processed in a certain way.

Things like aluminum and Cadmium really don't receive much attention unless you go to a functional physician where they do have you metal testing to try to get to the bottom of an individual symptom. It's a timely conversation and I'm glad we're having it because I think a lot of people that I've seen in my practice, I know you feel the same way, have suffered.

They've suffered physically and especially mentally, just unable to really get their mind back because they've really been exposed to high levels of heavy metals and sometimes from sources they never suspected.

Mark: People may be really surprised, John, to hear that aluminum as a point of growing concern and emphasis because to your point, historically if there's any discussion of heavy metals at all, the focus is generally on lead. With the Flint water, Flint, Michigan water supply contamination, I think that has put on the national and global spotlight, just how profoundly damaging heavy metal can be.

Many people are, I know, aware of what's happening in Flint, Michigan and all those ... Particularly at young ages, very susceptible to even tiny, tiny levels of these circulating heavy metals. aluminum, I think, is not one that we often are forced to think about, but these, from a human biologic perspective, John, I think what's so striking when you look at how metals impact human biology, they, by their very nature, they are profoundly disruptive.

These are the ultimate hacks of human biology in the ways in which they interfere with so many cellular, enzymatic mechanisms, whether you're talking about the sulfur of mercury, that basically mimics and interferes and disrupts enzymes that rely on Sulfur. Whether it's detoxification, you point out the neurologic, which is probably one of the major areas as so many people confront degenerative neurologic diseases to immunologic where these metals disrupt in such a profound way these rapidly, energy-contingent systems, neurologic, immune, detoxification.

These are the central metabolic pathways that we need to be humming along to navigate modern life and all the challenges it throws at us. These fundamentally get to the core of those metabolic systems so whether you're talking about autoimmunity and inflammation or degenerative neurologic diseases, or detoxification issues which we know will impact cancer risk, will impact autoimmune-related issues.

Probably more and more prevalent, and the other thing that sort of strikes me, John, when I look at some of the biology, is the tiny amounts, these picograms, these nanograms, there are not safe levels of these heavy metals in human health. While we have sort of guidelines, EPA guidelines, that may suggest a level below which human health is not placed at risk, it's hard to really accept that when you look at the fact that most of us will have multiple heavy metals in our system to some extent that, again, for many of the diseases and the systems that we've talked about can become quite disrupted, and often never go recognized.

Ultimately never go treated. I think that's ... By the time we conclude this, one of the most important aspects is that this is a treatable problem. Treatable, both in terms of being more conscious of ways to reduce the burden, which I know you'll get into, John, for many of these heavy metals, and also, treatable from the extent that working with a good provider, good dietitian can develop strategies over time.

It can take quite a long time to help people safely and effectively eliminate these toxins, often with dramatic improvements in their health.

John: Yeah. Those are great points, Mark. You don't have to eat an aluminum can to develop aluminum toxicity. I think a lot of people, as you mentioned, are under the impression that it takes profound levels of exposure, such as being a factory worker, let's say, in a facility where you're dealing with very heavy metal-rich substrates that are either being heated or manipulated, and that's not the case.

Certainly those are the levels of exposure, historically, with heavy metals that produce very significant changes in human health in a short window of time so those are the ones that have received the greatest amount of attention.

The EPA is certainly aware of workplace limits that need to be set when you're breathing hot gasses and things like that. They've taken the necessary steps, but as is the case with so many aspects of our environmental exposure concerns, is we've never really delved into these, what we call, low-dose exposures and how those influence biology over a longer window of time.

It's the same with Glyphosates and it's been the same with a variety of pesticides, but with heavy metals it's really apparent that we accumulate them. We're definitely going to accumulate them if we don't have some of the other pieces in place to a healthy diet which is going to help naturally reduce that toxic burden. Whether it's a particular type of fiber or having key nutrients that are involved with, let's say one of the detoxification pathways.

If you don't have those pieces in place and you have that low-dose exposure over years and years, by the time you're 50 or 60, neurologically, you've accumulated a lot of heavy metal baggage and that's going to really take its toll on the neuron as a model.

A lot of good points there about the tiny amounts that it takes with daily or weekly exposure to produce some level of pathology, as you mentioned, whether it's within some enzyme like Endothelial Nitric Oxide Synthase which we know would certainly damage by aluminum or it's looking at the effects of lead on cognitive performance neurologically in the central nervous system.

There is an area of our physiology that is spared when these heavy metals start to accumulate.

Mark: Yeah. Let's do a quick checklist, John. You've touched on aluminum. Let's maybe just go through a quick checklist of heavy metals and common sources for that. You've touched a lot on aluminum and one thing you've shared about aluminum recently, John, which I thought was so interesting, is these airborne particles, we don't typically think of air as a source of something like a heavy metal. We know a lot of health and hygiene products contain aluminum. Anti-antiperspirants ... These can be very subtle sources.

As we go through the ... We'll go through a checklist, John, and so lets just cover aluminum again really briefly. Where do you see the main sources there?

John: The leading sources of aluminum, by all counts now are nanoparticle forms that are being used in everything from deodorants, or anti-antiperspirants I should say, not deodorants, excuse me. Anti-antiperspirants, it's found in a variety of topical cosmetic-like things. Really if you read the ingredients on anything you're going to apply on your skin, and you see the words aluminum, you really want to put it down and look for a non-aluminum or even a non-titanium containing ... Titanium is another heavy metal that's a lot like aluminum and is being used in everything from sunscreens to, again, anti-antiperspirants.

Aluminum's found in cosmetics, anti-antiperspirants, it's certainly found in baking mixes because it is a primary ingredient to many leavening agents. If you're going to use baking powder, or you're going to use anything in the way of baking, you want to make sure it's a non-aluminum containing baking powder or leavening agent. You don't want aluminum phosphate to make your muffins rise.

You and I have talked about the reasons why you don't want to eat ... You don't even want to eat muffins. For those people who still want to have baked goods in their life on a regular basis, that aluminum that you get in that gluten-free bake mix or that you get if you buy some type of bread or baked product at a grocery store, they're predominantly using aluminum phosphate as their leavening agent.

That could be another significant source, would be baked goods, and the analysis that I found which was very in-depth, showed that the 3 leading sources of dietary aluminum, for Americans anyway, are anything that is baked because of this aluminum phosphate and then cocoa powder because of the way it alkalized.

They use various forms of aluminum and other, unfortunately, heavy metal-rich alkaline treatments for chocolate to make it less bitter and then chocolate itself which, of course, contains cocoa. It was shown those were the 3 leading sources, head and shoulders above the rest of the foods in our diet.

I think with chocolate and with cocoa powder, you want to get the non-alkalinized or you want to get naturally processed, if you can, cocoa powder or chocolate products, which there are some brands that will do that. You want to be careful if you're eating low quality chocolate or you're eating baked mixes, that's going to be a regular avenue for aluminum into the body.

The the third source of aluminum, which we call the unavoidable sources, are the atmospheric aluminum, and that's ending up in our soil, and there's really good evidence now that some of the leading seed developers are working on aluminum-resistant seeds because it's becoming a big problem for agriculture now, the amount of aluminum in our soils whether that's because of the mistreatment of those soils through fertilization with aluminum-containing fertilizers, that's been a big problem as well historically or that's because of really what's raining down on the soil.

Either way we know that aluminum levels in China and areas of the United States, really all over the world are accumulating in the soil and it's ending up in more of our crops and the plants we eat. It's really preventing a lot of plants from developing as farmers need them to. Those would be your 3 big areas of aluminum sources I guess.

Mark: Okay great. Yeah, we've talked a little bit about mercury and again I think also pervasive from cold fired ...

John: Absolutely.

Mark: ... burning and energy production and mercury produced in China will find its way around the globe, in the air, the soil, the water. I think the dental amalgams, while still a bit controversial in the minds of the dental association, inorganic mercury there, that to me, John, probably more than anything concerns me is this low-level perpetual absorption of inorganic mercury with amalgams that every time we're chewing, eating ...

John: That's the elephant in the room right? That's the elephant in the room.

Mark: That is the elephant in the room absolutely. You talked about fish and often we'll refer to game fish, higher up in the good chain, but all fish in contaminated waters are at risk of having mercury that ultimately we consume. There's organic mercury from those sources, what we would call methylmercury. There's inorganic mercury from say dental amalgams, and then we know, John, and this is, I think, probably true for all heavy metals that some people will be more susceptible to the accumulation of heavy metals in their body, mercury included, because they may have these genetic polymorphisms that specifically interfere with enzymes that help us eliminate metals, [metalafining 00:18:57] and sulfurtransferases.

Mercury continues to be, I think, a real problem that's under-recognized. What about things like cadmium, lead, even arsenic, John? Those are the others that come to mind that are not trivial in how they can impact human health. Again, we know these things often co-exist, so in the realm of environmental toxins, these are cynergistic effects, not additive. They accelerate and multiply, the whole becomes much greater than the sum of its parts.

John: Yeah definitely. You add aluminum and cadmium to the mix at the same time and it's not one plus one equals two, it's one plus one equals ten in terms of the physiological effects on everything from a Mitochondria to the ability to displace other biologically important trace minerals in those enzyme formations. That's what a lot of these heavy metals do is they can bump out a more, obviously, desirable on a biological level, trace mineral.

It gets replaced with something like aluminum because of how reactive they are. Yeah, Cadmium is widely distributed in a lot of foods. It is also being show to appear at higher and higher levels in our soil in many areas of the world. A lot of this has to do, as you just mentioned, with burning coal.

Coal contains a lot of heavy metals as it is and those would be less of an issue if they remained at the layers that they are under the ... deep in the earth's surface, but once those are brought out and incinerated and they go airborne, then they react, as you mentioned, they react with everything from bacteria to proteins.

They can be converted into these organic forms which are highly bioavailable. If you were just to take a piece of coal and to eat that coal, you'd have far less absorption than you would if it were incinerated, it became airborne, it reacted with proteins and bacteria, and then it takes on a whole new level of characteristics once it enters the food chain in that form.

Cadmium is found in fresh water fish. For a lot of people that fish and want to eat their catch, with lakes especially, that's an issue. The organ meats of wild game whether it's Maine or any area in New England, you really don't want to eat the kidneys, the liver. The deer that you shoot, or that you hunt on a regular basis, because those organs have been found to be enormous accumulators of cadmium.

Again, this is because these animals are spending a lot of time, typically, with water sources that contain cadmium, whether that's a pond or a lake where you have high levels of cadmium. Then the animal which drinks out of those bodies of water for the course of its life, accumulates the cadmium in the liver.

Cadmium's found in fresh water, derived game fish, and animals that drink the water. Cadmium also is found in cacao. High levels of Cadmium have been found in a wide variety of cacao products with raw cacao powder actually being a significant sources of Cadmium. That would be something that somebody who suspected they had heavy metal toxicity and then they went for testing and it showed that they had high levels of Cadmium.

You wouldn't want to eat cacao or even cocoa-based products on a regular basis and that's because that plant is a significant accumulator of Cadmium in the soils in and around those sites of agriculture, typically have higher levels of Cadmium as it is. Cadmium's found in, again it can be atmospheric in source, it can be found in foods, but it's a lot like Aluminum, Mark, in that it's pretty well distributed through our environment and our food supply.

Mark: Arsenic, I know, is another, John. It think these all have similar themes in their ...

John: Arsenic's ...

Mark: [crosstalk 00:22:52] sort of presence and ...

John: Arsenic's a good one though because I think a lot of people who have gone gluten-free, Mark, have really turned to brown rice-based products, and depending on the rice you get and where its grown ... If that rice is grown in any of the Southern US states, they've been using chicken waste, chicken manure, to fertilize rice fields in certain areas of this country for a long time. Chicken manure is an enormous source of arsenic. A lot of this has to do with what they fed chickens of course, but chicken manure can be a really significant source of arsenic.

It will accumulate in these rice fields and the rice is being shown, even organic brown rice is being shown to have the highest levels of arsenic of just about anything you can find in our food supplies. I think there are some companies that are trying to address this, that are trying to remediate their soil, which is really an amazing process. It takes time, but you can grow certain cover crops, whether it be a spinach-like plant or something like Swiss Chard which are [chelaters 00:23:56], they're natural chelaters, and they can pull all this arsenic and lead and other heavy metals out of, let's say, your rice field and they're not going to use spinach, but they'll use a plant that has similar attributes.

You can pull all of this out of the soil to try to really get those heavy metal levels down after a year or two and you can go back to growing your rice or whatever it is you want to grow there. The end crop will have just a fraction of the heavy metal that it had before. There's an effort by rice farmers, and by other farmers in general, to remediate their soils because we've mistreated our soils here in the US.

This is still going on in other areas of the world, unfortunately, but we've mistreated them for so long with fertilizers, whether they be animal-based or be chemical fertilizers that contained heavy metals and we're paying the price for that now. A lot of organic farms are really trying to address this. I know Lundberg is a good example. Lundberg is the biggest, I think, rice producer here in the United States.

They're really trying to remediate their fields and get their arsenic levels down , but there's some other things you can do with arsenic. One is, again, if you're going to use rice, try to wash that rice with some warm water before you cook it. That can get rid of, in some cases, 50%, 75% of the arsenic in the rice, and the dusty material that's on the outer service of rice.

You can wash things before hand. You can try to source them more appropriately by getting rice that's grown in farms that are at least addressing this or if you can go to their website, a lot of the big rice producers will tell their consumers what it is they're doing in an effort to lower levels.

Other sources of arsenic, because I know we've got to shift gears here, would be, believe it or not, you're going to find arsenic in some fruits, like peaches in very, very high levels because of the types of pesticides that have been used on peaches over the years. Peaches, apricots, and really, members of that family. That's called the Prunus family. All those trees are related. They use arsenic as a primary line of defense against certain pests as well as other environmental pressures, blights and fungus' and things like that.

Peaches are an enormous source of arsenic. I would avoid peaches unless they were certified organic. It can be found in fruits and vegetables, but I think you take a look at arsenic levels, the drinking water, you really should have your drinking water tested, the level or arsenic in it because wells in the United States have been shown to .. I think more than 20% of US wells contain significant amounts of arsenic.

Some of them are below what our threshold is for what we consider to be a public health threat, but most well waters contain some level of arsenic and 20& have contained significant levels. It's a big problem, I know, where we're from, up in Maine. Drinking water, rice, and then pesticides would really make up the 3 leading sources of arsenic.

Mark: Yeah, those are great summaries, John. Pressure treated wood, and I know wood that's often treated to preserve and prevent breakdown, often will have arsenic. I think as people listen to this, John, it is a bit overwhelming when you look at how pervasive and ubiquitous our exposures are.

Again, while the majority of people may not have exquisite sensitivity to these burdens over time, as you pointed out earlier, they accumulate and when you add these exposures on to chronic inflammatory sources and sleep deprivation, and the standard American diet, you can begin to appreciate how they all begin to conspire to alter, whether it's immunologic or neurologic function.

Let's, very briefly, John, shift our attention to testing, which is another area that that's a big controversial, but often ... So A, it's hard to find a provider who will even see the value of testing, and then it's important that that provider understand how to interpret testing. People can look at hair analysis, they can look at blood testing, and I would say, one area that continues, in my experience, John, and I think a lot of functional practitioners continue to use a post-chelation urine analysis for the burden of these heavy metals.

In that instance, you take a pill, this is usually a DMPS, it's a chelater, it's a prescription. You need to work with a physician who can get it for you. You take that and then collect urine over say a 6 hour period, which is extrapolated as a 24 hour urine, and heavy metals are measured there.

In my experience with this, John, looking at the research, they all offer some aspect of analysis that can help you interpret what the total body burden is but we know that hair and blood might reveal different things and I think the urine testing, even though its as close as a standard of testing as one can find, is not without questions around standards. What is positive? I guess one might make the case that anything that's showing up, you should be concerned if a person's not feeling well.

Testing is a bit controversial. I look at the Quicksilver labs, Chris Shade. Their founders and directors done some interesting work on testing, particularly for mercury, looking for both inorganic and organic. He calls that the Tritest. I do think these can be tricky waters and would underscore the importance of working with a provider that really, usually a functional medicine provider that really understands some of the nuances and has an understanding of the labs that do this reasonably well.

Doctor's data, the Quicksilver folks, but testing is ... It's not always straightforward.

John: No its not, and I think for our listeners, if this is confusing, you have to really think about it this way. If a child, for instance, was exposed to lead in a home where you had lead dust that was coming off of the walls and fixtures regularly, and you tested that child's blood lead levels, because there's a high level of exposure, you would find some of those children by just looking at a window of time, which is going to be a short one with the amount of lead in their blood.

Let's say someone had very, very low-dose exposure. Let's say they were getting lead on a regular basis from some lead coated with the enamel, let's say, and this is a big thing that we didn't talk about, but a lot of cookware, a lot of dishes, glasses, mugs, things like that are manufactured with a lead-containing enamel or glaze.

That's an enormous source of ... We've known several families over the years whose children tested off the charts for lead. They already had had cognitive delays and some serious health issues, and they didn't have lead paint in their home, but when they started to test the cookware in their home, Mark, they found that they had a set of mugs that the kids had hot cocoa or drank their fruit juice out of every day.

When they swabbed, the glaze on those mugs, they were off the charts because they were manufactured in a country where ... There's a lot of these countries where they really don't test these things as they're manufactured. Lead can be a major health issue and it doesn't have to do with the lead paint in your home, it can everything to do with just the cookware or the types of dishes that you use.

Let's say someone had a low-dose exposure through using this type of cookware a few times a week. You might not see that in their blood, and then that lead ends up in tissues. Those tissues can range from a bone to various organs. In that situation, this urine test that you described with a chelating agent used prior to that 6 hour urine collection, it's going to be much more useful because you might not catch lead in their blood in that short window of time with which you get that serum drawn.

If you chelate, if you challenge the body, and you pull some of this out of tissues, then you're going to have a much greater chance of an accurate ... Accurate is a word that we use loosely with heavy metal testing. You're measuring things in picograms that are infinitely small numbers.

I don't think we're at a point where we've got the gold standard yet, but I think if I had to choose one, I would certainly go with a urine analysis over hair, nails, or blood because I think those are going to reflect, typically, a much shorter of exposure. If you use a chelating agent first, you're going to draw our a certain amount of these heavy metals, and I think you're going to give a bigger window of exposure time that you can hopefully evaluate.

Mark: That's my practice as well, John. That's how I look at it. These really are revolving areas. There is no one gold standard in prototype. I think the average person who may be concerned about the impact heavy metals might be having on their health, which are many and hopefully people can begin to help their providers or find a provider who can perhaps take more seriously the potential impact that is having is just a critical first step in moving this forward.

John, just giving our time constraints here, there's so much that can be said about treatment, the detoxification, chelation, I'm thinking we can say that ... To squeeze that in to a few minutes would be an injustice to our listeners, so perhaps in our next podcast we can look more specifically at how to detoxify and there are a lot of very good strategies that can help people eliminate the burden of heavy metals.

When one adds that strategy to fixing the gut, and cleaning up the diet, and working on inflammatory pathways and mediators, it becomes an essential part to that self-care mosaic, but it is a little more complicated and it can take some time. There's no point in squeezing that into a couple of minutes.

John: No, that's for sure.

Mark: I have a nice foundation, John, for at least beginning to think about this topic and how pervasive and important it is.

John: Absolutely. I think in summary, I think people should just be as cognizant of this as they can by making sure that, let's say that the enamel on the bowls, the dishes, the mugs, whatever it is they're eating and drinking out of regularly, test lead-free. I think you can find lead test kits that are very inexpensive so that you can at least test those dishes that you use most regularly. As we mentioned, I think if you're going to eat rice, you might want to try to wash it first if you can with some warm water.

When it comes to aluminum, you certainly don't want to cook in aluminum pans or pots. If you boiled water in it, it might not be a big deal, but if you start cooking tomato sauce or you put tea or things like that which have the tannins or the acids in them, you're going to pull a lot of aluminum into the meal. You want to do what you can to minimize your exposure.

You have to, as you mentioned, Mark, you have to realize that at some level, this stuff is everywhere so you're not going to get to that point of absolute zero exposure, you're going to always have some. That takes us to the second aspect of this which we've already covered is do everything you can to defend your mitochondria.

If you're someone that realized, "Wow, I ate brown rice when I went gluten-free, every day for 10 years" then you might want to take a [inaudible 00:36:11]. You may want to take some of those supplements that we mentioned last week that can really help a mitochondria deal with heavy metal toxicity or exposure.

You want to eat, again, a high fiber diet. That fiber shouldn't come from Metamucil as much as it should involve a wide variety of fiber types which are really that's nature's great detoxifying ally or agent. Modified citrus pectin, we can go over this next time we talk, but modified citrus pectin is the fiber source which has been show to have the highest affinity for lead, cadmium, mercury, and there's people I've met who have used modified citrus pectin alone.

They haven't used a chelating agent to take care of their heavy metal issues so we can get into that next time, but I think it's just ... you have to have a higher level of awareness of where these heavy metals are. If you do that, and you really arm your mitochondria with the tools that they need to be healthier. Don't give them all the polyunsaturated fats that, unfortunately, most people do, and try to keep them away from the toxic levels of fructose.

The can sometimes stand on two feet, your mitochondria anyways, even with this chronic low-dose exposure to heavy metals. Unfortunately we've created a perfect storm in the standard American diet with all those other attributes that undermind the mitochondria as well.

Mark: Yeah, you nicely set the stage, John, for what will be Part 2 of this and we'll look in a lot more detail of treatment strategies, interventional strategies, John, both nutritional, dietary, chelation prtocols that are out there. Give people a sense of how they can be thinking about managing this in their lives.

Great as always John to connect and to share and we thank our podcast followers and appreciate the support and feel free to share this with your friends, those you love, those you care about, and check out our website thehealthedgepodcast.som. We're always uploading reference articles. Our podcast can now be seen on YouTube.

We have links on our website or you could just go right to YouTube and we're getting share notes out as well. Appreciate the feedback that we get from our listeners, John, this is always a lot of fun for us. It's just all about sharing the word and bringing the power back to the people.

John: You got it buddy.

Mark: As always, John, a great pleasure and thanks so much, and we'll talk very soon.

John: Thank you, Mark.