Introduction to the Summit and Guest

– Hello everyone and welcome to the Microbes and Mental Health Summit. I'm your host, Dr. Miles Nichols and I'm here today with Dr. Mahmoud Ghannoum. He is a PhD with some really fascinating research on depression in the microbiome. He has been a pioneer in the field of looking at the fungal colonies in the gut as well, and has coined the term the microbiome.

And I'm really looking forward to learning about how those topics are connected with depression and with mental health concerns. Welcome Dr. Mahmoud, – Thank you very much. Thank you for having me.

– It is an honor. And so tell us a little bit about your background, your story. How did you come to be researching the fungal colonies in the gut? – Well, you know, as you can tell, I am an old guy, So I've been in this business for over 40 years and in fact I started working on the fungal world, in the fungal world in about 1973 74. You know when I did my studies in England and at that time I used to look at, you know, the effect of antibiotics and steroids on candida and lo and behold what I learned is once you use an antibiotic, for example, women who used to track cycling, you know, they antibiotics, they end up having thrush, you know, so at that time I start to figure out, you know, these two communities live together and then – You're really that was a pioneering time because at that time really fungal infections were considered only to be for immunocompromised people.

So that was really new for you at that time wasn't it? – It really was.

Early Research on Fungi and the Microbiome

It really was like that's why like I really I'm very fortunate because when when people start talking about the microbiome and only thinking about bacteria, I said no no no we need to think about other organisms that live in our body. And that's where I connected it to those days when I used to look at cam Canada and how it is affected candida infection.

You know. And I gave you a simple example was vaginal candida diocese where where women you know antibiotics they developed thrush. So in 2010 I wrote an article saying that look we need we we really need to look at both not just bacteria but also fungus as well as viruses for that matter. You know.

But I am an expert in fungi. So I knew more about about that. So I said we really need to look at least these two major communities there. And of course nobody listened to me. You know how it is when you write something and then forget about it. This guy is bringing something which is we know fungus doesn't cause anything and you are absolutely right.

People used to think it's only immuno compromised patients that are affected. So then 2000 – Did you encounter some resistance from the medical community when you were starting to research this. – You know people as you know I whenever you start a new area whether it is with fungus or any other area the community which is of researchers which are mainly interested in this regard with bacteria.

They say forget about it. The bacteria is the most important you know. But even people who are studying for medicine, guess what They have only maybe a couple of hours lecture on fungus in there four years or five years in the school of medicine, you know. So we we as as part of the medical microbiology community which is the community that study fungus, we always used to think, you know you really need to think fungus not only with respect to the microbiome, but like in general when somebody comes to hospital or to a doctor they have an infection they give them antibiotics 23 days, you know four days don't improve the fever is still there. So they change the antibiotic.

We used to tell them no you really need to think it could be fungus as well you know. So that's that's where it's very

important educational effort which you do to try to bring this into limelight, you know. – Absolutely.

So that is really fascinating. And and the the the issue with with fungus is under appreciated and has been for a long time and you've done some great research and work to to bring awareness around that. So please continue with with how it's been and the resistance you've gotten in your your journey through this research.

– So you know like we we then I wrote another article in the scientist. It's called the microbiome which is the fungal community in our body. And I said look this is an ignored kingdom.

I gave them the exam samples of how we really should focus on not only bacteria but also fungi. So really you need to look at both. You know and that really received a little bit more more attention and then to really bring it home. I started to do actual studies in the first study we did in people which we looked at disease patients and with this chronic disease patients. What we found we found that that there is you know people with chrome have an increase not only in equal eye and sriracha which are two bacteria but also they have an increase in Candida species called Candida tropicals. So that really showed here is the evidence for this. You know and I tell you something this is very interesting question. You had the resistance and this kept going till now 2021 believe it or not. The National Institute of Dental and Craniofacial Research. I forgot it for really things start to change in 2021 where the National Institute of Dental and Craniofacial Research said we really need to look at not only bacteria, we need we need to look at fungi and in fact they invited me at the foresight institute in boston to get to talk about the microbiome and how it contributes to our oral environment as well as cancer and that's really where it started to be great.

And lo and behold believe it or not.

Resistance, Evidence, and Growing Recognition

Just late last year 2022 there were two big articles coming out from in a journal cell which is really a high-impact journal where they showed that the microbiome or the founder community is really pro at high levels in cancer patients as well as with people who have gastrointestinal issues.

– Yeah. That is fascinating. Cancer and G. I. Issues. And to your point where people have been talking about the microbiome for a long time and bacteria and antibiotics have been significant within the lesser appreciation for viruses although that's come up and and even lesser appreciation for fungal organisms.

And when people ask people talk about taking probiotics and were sometimes giving some probiotics in the clinic that are you know sometimes we will give sacrifices Belardi and people are they say oh that's a probiotic. I say well not really.

It's actually a fungal organism but it's it's like a healthy yeast that can crowd out pathogenic yeast. I try to explain it in a way that because usually people think yeast think fungus and it's a weird reaction and it's it has a balance and there are some that are quite helpful and some that are quite harmful.

Can you speak a little bit. – I'm really glad you brought this up because you are absolutely right. I mean the first point which we need to talk about fungus, not all fungus are bad, some of them are good. And the best example is what you just get Sykora mrs service here for example. And guess what in people who are healthy, we find a high level of sacrum isis which really related to sacrum isis Belardi, which is the provided we use. Okay now, whereas in cross these patients, what we showed that there is a decrease in sacrum isis.

So the good fungus goes down. The other point I want to bring here is even Candida could be good. You know if you think about it, 50% of us have candida and the oral cavity as well as in the Gods. Okay. As long as it is kept under control and that's where backed serious such as lactobacillus for example, keep it under control.

So when you kill these good guys, which is lactobacillus before the bacterium, you know then what happens Candida have the opportunity to over grow and start causing issues. So this is really it's the balance.

How can we maintain the balance by having the good guys like to bacillus bacterium as well as sacrum ISis is rightly so which is a remember sacrifices.

We use it for baking bread making bread as well as why beer, you know. So it's a good guy. – Yes, very, very good for multiple reasons. And what's interesting is also that there's a post antibiotic use very little very little done or recognized or tested for and and the fungal overgrowth when they do over grow.

There's the limited testing as well. I know the research is starting to come in about small intestinal fungal overgrowth. But right now the research setting they're actually culturing duodenal aspirate which is an invasive procedure that's not going to be done in a clinical setting. It's only really done in a research setting in.

They can show when they take these juices from the small intestine and put them into the Petri dish that and culture them they they see the growth of these fungal organisms in many people who have unexplained digestive symptoms that have not responded to other treatments.

And yet we don't see a lot of investigation and treatment focused on the microbiome. So do you find have you found anything in your research related to that as well?

– You know definitely definitely. As we said the really in general in general studies into the fungi are not as really exhaustive or as large as the bacteria. The good news.

Now the NIH National Institute of Health as well as the C. D. C. Are starting to look into the fungus. You know I tell you something I recently got a good Grant Big Grant it's called R.

01 which is investigator initiated Grant to look at Candida For us which is a new multi drug resistant fungus that really causing a lot of issues globally.

So now there are an Ih nationalist health as I mentioned, they really gave us a big grant $3.1 million dollars to look at how can we control these organisms also. You know the C. D. C.

Good vs. Harmful Fungi in the Gut

Just issued what you call broad agency announcement where they want to encourage the study of fungus. So I'm really pleased because people started to realize look you really need to look at the fungus.

And we in our own we are pushing the fact that fungus or the microbiome in our God play a role in various diseases. And as I mentioned in cancer and G. I. Issues you know, so we I think my prediction is that we are going to see more and more studies because you know, you know you are you are a researcher sometimes it takes time.

But once people realize is that everybody wants to go into it. And I think this will help in general addressing the health issues and different conditions because we are looking at the total picture rather than as part of it.

– Yeah absolutely. And the fact that this is cutting edge but it's being recognized, there's always a delay and where research the cutting edge of research and clinical practice it takes some time. But to see that there are these to see that you've received this large grant is amazing and I also I treat a lot of mold illness in the clinic. Of course there's these mycotoxins as well that some fungal colonies are producing. That can be problematic.

But even in that world it's still a stigma that as if all molds are bad, but people don't realize, well you you eat blue cheese in there and you know, there are some molds that aren't toxic. It's it's this very nuanced and it's like bacteria used to be where people thought, oh, it's all bad.

And then they realized, wait, there's a lot of good bacteria out there and it's really, really important and we can't just throw antibiotics at everything.

And so we're coming to that realization with fungal organisms. So how do fungal organisms tie in with especially

mental health, because a lot of people on this summit are really interested in understanding the brain.

There's a brain gut connection. There's also a cytokines or an inflammatory theory of depression. There's also a toxin relationship with mycotoxins potentially and damaging part of the brain and the brain tissue.

So, can we talk a little bit about that connection? – You know, this is really very, very, very nice question because again, it shows you shows you a little bit in more details how the fungus play a role in neurological diseases, for example. Okay, like really the increase in the interest of looking into the microbiome in neurological diseases is really driven by the fact that, you know, the fungi can modulate the host immune system immunological responses.

And of course with modulating it or changing those immune immune response response is we have a really add a new risk factor for immune diseases. You know? And the best area where a lot of people connected the fungus with neurological diseases come in multiple sclerosis.

You know people with multiple sclerosis as you know, they have immunity, inflammatory disease and what you find that this this disease really there's observation that connect that the microbiome is connected because people with M.

S. Or multiple sclerosis, what they do is they have G. I. Issues. So really bob returning the gut microbiome community, you are causing changes in the neuro developmental process or conditions which affects like for example red syndrome, you know? So that's how we're starting to gain more and more information in how fungi can influence the neurological diseases. – And that immune connection is so important because when modulating immune functions. So if we have these fungal organisms that are actually changing the immune system function, then that can set us up for other infections that could become systemic and we know so many viral infections can impact the brain and certain bacterial infections can impact the brain.

So do you believe that some of the setup for how people might be more susceptible to infections might be because of an underlying fungal issue, Do you believe that to be true? – I really think so because if you think about it sometimes also fungi cause some pro inflammatory you know effect.

Fungal Overgrowth, Testing, and Research Gaps

And really if we put it in a bigger picture I think inflammation is that at the core center of all of these issues you know? And when you have for example I can give you how this fungi could do this business fungi in that G.

I. Track as we mentioned we have 50% of us have it. But in our studies we showed that this fungus comes with E. Coli and see Russia and they form what you call a biofilm.

It's like the plaque in your teeth. Okay. And then by forming this biofilm. What happens we the morphology like for example when we talk about Canada it has two forms, it has yeast form which is like you know the elliptical small rounds, a round shape and you have a high fee or filaments.

Okay so what we found in our study was very interesting when these bacteria equalized Russia comes with Candida. Candida changed its form and start to cause really damage to our gut lining.

And of course by damaging the gut lining you have inflammation coming in and of course by inflammation you are going to have to start to have not only damage to the gut lining which allow all these toxins to come in and cause issues but also they help the inflammatory process which could affect our brain as through the gut brain access as you know.

– Yeah. And there's actually a whole body of research that looks at inflammation and depression the connection. And there's even this whole cytokine theory of depression where depression is very tied to when there are people who are going in and out of depressive episodes.

The inflammatory markers go up when the depression gets worse and down when the depression gets better and

there's this very strong link and then when we go trace it back to why the inflammation. In some cases there is this amazing thing that happens with synergy in what you're saying between bacteria and fungus between e.

Coli and candida that are creating this damage to the gut lining and the systemic inflammation which then can impact mood and can impact a person's ability to feel good in themselves. And and so this is really important.

And another a test that we do in the clinic is we do a sinus swab and we look in the sinuses and sometimes we do find fungal organisms in the sinuses.

Have there been research into some of the effects of fungus and the sinuses? – Oh definitely. I mean what you're referring to is really, I'm not surprised at all. They were studies some time ago about spirituals, you know one of the filament or malls one of the malls which they found a lot of it when they took swabs from the uh nasal firing and there's an opening.

But they found that there is a lot of spiritualists and as spiritualists you know can lead to a couple of things. First of all a lot of people sometimes when you have fungus and then and nasal cavity you have allergic reaction.

You also have inflammatory reaction. And you know I remember long time ago, long time ago that fight sir we're doing a study. They had a drug called Morricone is a long time ago I'm talking about you know where they had very good activity against a spiritualist and they were looking at the cavity.

Fungi, Inflammation, and Mental Health

So yeah there is literature to show this very nicely that there is fungus especially aspergillus in the in the in the nasal cavity. The other thing which is important in the nasal cavity is some other mold which is like rise opas you know UKa UKA or micro sis as you as you know which of course if it is left unchecked it could spread and cause a lot of issues not just in our nasal cavity in our nasal cavity in the eye and and and uh all over you know E. N. T. Basically. – Yeah. So then because we have some fungal organisms that are contributing to biofilm that are contributing to gut problems and immune problems and inflammation in the body sometimes even in the sinuses which is very close to the brain and and maybe impacting things there.

How can you The link to cancer? A link to multiple sclerosis. A link with some other gut issues like Crohn's disease, which is a gut autoimmune issue.

So since we have these links with different of these disease processes and these things in the body, what do we know about what to do about them? What do we know about how to to balance the, because we just said there's some healthy ones too and we don't want to destroy all the fungus in the body.

So how do we how do we work with the microbiome? – You know, I think really this is a great question and I spent a lot of time thinking about this, you know, in fact I wrote an article about microbiome based approach to manage what we call depression during covid and you know it's really there are a couple of different things which we can we can do and then basically there is the diet supplements as well as lifestyle, exercise and sleep. So these are the ways which we can do to try to really balance this microbiome and by doing that in the guard by what by these activities, lifestyle which I mentioned as well as diet and supplements, we will be able to nurture the beneficial microorganisms and by nurturing them, we are gonna as you you know they are going to be able to keep the bad guys under control, they are gonna produce short chain fatty acids or metabolites which is gonna help us in having more diverse microbiome. So yes there are very clear ways to try to address this imbalance and it could be summarized simply as three things diet nutritional supplements and lifestyle.

– Yeah these are the foundations of of prevention of longevity of functional medicine of many people who are trying to help people understand and we have definitely some information out there of course that a lot of people are aware that too many processed and refined foods and sugars may contribute to candida overgrowth. I think that idea has been around for a long time when I was looking at the research on Candida and I want I want to get your thoughts on this. I I saw that it could actually survive also on protein and even potentially ketone. So it maybe wasn't a full picture to just eliminate carbohydrates and have you seen research like that?

– You know, I tell you something, this is so funny. The first time I heard of this candida and all the different health issues was when I first came to the US is over now.

30 years ago I went to a meeting it's called Candida and Candida Diocese which is the disease caused by Candida. And there was you know what you call the yeast syndrome. The East connection, I'm sure you heard about it. Integrative medicine.

Integrative medicine and you know people were talking about if you have too much growth of Candida, you are gonna start to have certain issues like to me, I like to put it into perspective, like not everything that we suffer is because of Canada but definitely Candida can play a role in various various uh situation like as you said short what we call safe and C Z bo and CFO and whatever.

Sinus Fungal Issues and ENT Effects

So yeah, I mean this idea of how Canada can affect our health early nineties or maybe late 18 eighties, it was very, very active group of people looking at that.

– Yeah. And how about diet in in the research on diet and yeast overgrowth or microbiome balance? have you been part of any of the research on the dietary connection?

– In fact I published a book, it's called total gut balance which really targeted how can we rebalance the microbiome and of course the main player in the microbiome, bad news is the Canada. So definitely in that, in that what you call presentation, we talk about, you know what you need to eat, for example what we need to do, we need to encourage the growth of good guys and inhibit Canada.

One way to do it is we need to cut sugar sugar. Candida loves sugar and and that's why it's really very critical that you cut that. The other thing you need to do is you need to have proteins but you should have some proteins that are from plant for example based or fish or chicken, you know, these are really very very good because compared to when you have that meat for example because that meat, it encourages the growth of pro inflammatory bacteria, which bacteria that can cause inflammation.

And also you need to have what you call some tumeric for example. You know garlic is great actually I published three different articles many years ago okay on the effect of garlic on candida and it's really fascinating.

I have to tell you a story about this. You know when I was before I came to the U. S. I came after the invasion of Kuwait you know because I lost my job but before that I was at University of Kuwait Kuwait university where I studied Canada and this guy Kuwaiti faculty member every day he comes and bothered me you should study Canada and garlic because they were you know Carla kills it. I said leave me alone, I don't want to study garlic you know and guess what he kept at it.

How to Balance the Microbiome

So what I did just to keep him away from me like jokingly you know I published three papers on effect of Candida allium settled you know its name scientific name on Canada and honestly it has fantastic activity. So that's why I recommend garlic.

I have to tell you, I have to continue this story. If you don't mind then I was invited before the invasion of Kuwait to come to DC at the Willard hotel, there was the first world congress on garlic believe it or not.

So I already published that. They invited me, can you come and give a talk? I said fine. And I was supposed to go back from my holiday to Kuwait and then come to America but I already have the Visa everything. So lo and behold I said oh my God I have the visa to come to the U. S. I'm gonna go get a job.

Okay and that's what exactly happened. I came to the D. C. I presented at that meeting, I went to Nationalist Health, met really some great great people.

One of them his name Jack Bennett, I owe him a lot because he helped me to get a job. I'm not gonna say much about more about this. It was in Washington post this story Maybe 3 4 years ago.

And honestly this is garlic. I dear to my heart my friend because of this because it really keeps candida. But tumeric is very good as well and antioxidant. You know you need to have a lot of fibers for example. So all of this is outlined in the book total got balance. – Fantastic total gut balance and garlic is one that I there's some research that in the clove that stores the the Allen and the heat sensitive enzyme that combines with Allen to make Allison in separate parts. And so some people just cook with garlic right away And then they're not getting that reaction between that end time that makes the antimicrobial Allison. And so I encourage people to to to crush it and let it sit on the cutting board for about 10 minutes and then they can combine and make the Allison and then to cook with it. And a lot of people don't know that.

– I really completely agree with you. That's why I think like it has to be fresh and as you say, take your time to break down let's get the Allison and yes I really agree this is a good way to do to eat it. – And then what's up with supplementation of course. Now there's very high concentrations of Allison that you can get a stabilized Allison powder or you can get a full garlic extract and supplementation form as well. And I use that in the clinic for people with issues got issues quite frequently and it's very effective.

– I really think I think it is the right thing but you can see like there is like we need to inhibit the bad guys, we need to encourage the good guys, you know fibers so you you don't eat sugar because we are going to encourage candida and you know use the antioxidant things that can break the biofilm.

You know it's very very important and you know nutritional supplements, we did a number of studies and we published in that area and you know we showed that the nutritional supplement which we put together based on our current study, can break this biofilm. And really very interestingly we just finished a a clinical trial where we showed that having these supplements can address digestive issues. You know before this we published a paper where we showed it can change the microbiome in a positive way.

Diet, Garlic, and Gut Support

So you can see all the science coming together to really help the story. And of course you need the evidence in our business as you know. – Yeah. And what are what are some of the constituents that showed efficacy with biofilm breakdown in in your research?

– Well, a couple of things we found that and that's really, you know, the more you do science, that's why I'm always excited about these things. The more you learn, we started by doing probiotic strains lactobacillus, baby privy and sacrum, isis Belardi.

But in addition because of the biofilm, we added an enzyme called MLS, which you know, unless we have it naturally now. And guess what? When you put them together, they can break the biofilms really very, very nicely, much better than using the MLS alone or the probiotic streams. And we just have a paper accepted in IBD inflammatory bowel disease where it shows in an in a gross disease model or a lightest model that we using the two together, this combination probiotics as well as the mls really is the way to go. So it's it's we're learning.

– Fantastic and that's so important to do that research. I'm so grateful that you're doing that research. How about antifungal medications and drugs? That what what would you say and what research have you done in in looking at how does that affect the microbiome when people are taking antifungal drugs? And are there are there durations and dosages that tend to make bigger differences? Does it is it becoming an issue like antibiotic overuse? Has do you fear that or do you think that it's underutilized and and tell us more about fungal drugs?

– You know, this is really very important question. Also, again, let me just for the sake of clarity and transparency, I have companies develop their antifungal like you know because I I direct the Center for Medical Psychology. So I you know I I always joke like I'm in fungi, I studied a lot of fungus and I help developing antifungal for systemic infections or for even topical skin and this sort of thing. What you are talking about is if we take an antibiotic, how does it affect our microbiome? And guess what?

This is becoming a very important question that people as well as physicians are asking. Okay, we have a new antifungal, what does it do to our gut microbiome.

You know, including bacteria. Remember because we don't we really need this bacteria and we just published a paper uh in the journal antibiotics. Where first we looked at antimicrobial agent called Siri cycling. And it is a narrow spectrum antibiotic.

And we compared it with a broad spectrum antibiotic mina cycling. And we found that the narrow spectrum can have less effect on disturbing our gut microbiome. Okay, so now along the same path people now asking me can you evaluate our antifungal which just can be being approved does affect the microbiome. Okay. And because we have these models, I'm starting to test this and honestly we are in the middle of finishing a study in this regard. So I would love to talk to you maybe in you know 2-3 months. Not necessarily of course in here but I love to stay in touch with you and I can tell you what we found you know and what we did.

You know it's like what we are doing actually is we collected strains of microorganisms that are known to be present in our gut and we are exposing them to these new antifungal. And we are seeing we want to determine do they kill these organisms, the beneficial organism or those that are usually present.

And yes we are going to have answers soon on these things. – Good. Good. I will definitely keep in touch and I want to understand more about what your findings are there because it is a little bit of unknown territory when we're utilizing antibiotics and antifungal.

We're still learning about how does that impact the gut microbiome and the gut microbiome and the immune function and the inflammatory function and the gut barrier and all of these things are very very important.

Supplements, Biofilms, and Clinical Trials

And and and that's part of why sometimes the some of the natural substances you know like garlic that that that tend to be a little more targeted just like the targeted antibiotics versus the broad spectrum might be a little safer in terms of for right now until we have more data.

And do you agree with that? – I really agree with you. I really agree with you know the other thing, what's so interesting, I know you asked about antifungal and we talked about antibiotic but look at cancer drugs for example, not only these cancer and this cancer drugs can affect our microbiome but they are affected by the microbiome like sometimes our organisms and our God can break down that those therapeutic agents you know, which we use them to treat to treat patients. And the best example is checkpoint inhibitors for example, we did a study, we used two models or mouse models because some people who take checkpoint inhibitors, they are great drugs.

Others they don't do very well in in their cancer and why we found that the microbiota in our gut can break down those checkpoint inhibitors and make them less effective. So you can see this is really an area gonna explode in the and I really believe the F. D. A. Is gonna start asking companies that they are developing new drugs irrespective of what it is. You know whether microbial and cancer or whatever doesn't have effect on the microbiome because we know now the microbiome play a central loan in our health and disease. So it's exciting area.

– It is, it is. And so to summarize for people where we've been and what we've talked about, we're really talking about the fungal organisms in the gut or the microbiome. But we've also talked about that fungal organisms systemically or environmentally through mold toxins or in the sinuses can have impact on health. They can combine with bacteria create biofilm that can then damage the gut barrier that can create inflammation in the body which inflammation in the body can lead to depression and mood imbalances.

And we've also talked about and explored how diet and some aspects of bacterial populations in the gut can almost balance out the it's their related it's not we're not in isolation of bacterial population and a fungal they're related to each other interact with each other and nutrition that can address and balance the gut microbiome. The bacteria and the fungus are important for controlling the fungal aspect of things and not allowing it to overgrowth.

Antifungals, Antibiotics, and Drug Effects

But also knowing there are healthful fungus is like sacrifices Belardi that can be taken and that when combined with things like an enzyme like amylase and some bacterial probiotics that can even break down some biofilm and be very effective with inflammatory bowel diseases. We talked about Crohn's is one example of that and that fungal connection with autoimmune issues like multiple sclerosis with cancer with general inflammation and immune dis regulation, which could leave people more susceptible to infections and mood imbalances. So that's a little summary of what we've talked about. Anything you'd like to add to that in terms of of either practical things that we can leave the audience with or or some exciting future research beyond what we've already talked about.

– First of all, with this, back to the audience, I think that my main message is that, look, it's in your hand to really try to balance your microwave.

It's not rocket science. If you eat the right stuff. If you try to have a good lifestyle. Like if you are stressed out, do a little bit yoga, do a little bit of you know, meditation, sleep, try to sleep well, you know, all exercise.

If you do these things, you are gonna be in your way to have a balanced microphone. Now, that's one thing for the for the audience. The other thing which is exciting, I tell you, I just putting something together to talk about.

Look with the microbiome, we had three different phases. The first phase is we start learning at the beginning, Oh, there are organisms that live in our body and they can affect us number two, we found that, you know, the phase two is these organisms they could be good to us or they could be bad to us depending on you know, how how they are balanced or not.

But now is the exciting time which can we have this data about the imbalance or this bio sis as you call it. You know, can we have this data and people for example, who are stressed, see what is there?

Okay, that is out of balance. What can we do about bring it back to maintain the balance as well as like first of all you re balance it and then maintain your balance because this will be the way of the future.

Future Research and Closing Resources

Using big data to develop targeted products that hopefully is going to help people and I am very excited about that? – Well Dr. Mahmoud this has been absolutely an amazing conversation.

I think it's going to be an incredible value for people who want to understand more about the relationship between microbes and mental health and brain function and body function and disease. And we've really gone into a lot there.

I know people are gonna wanna learn more or understand more and I know you mentioned your book, tell the audience, how can they what's the what's the best way for them to find out more? Is it to go get the book?

Is it to go to your website, what would you like to invite the audience to do? They want to learn more. – Thank you very much for this. I think basically you can get the book in amazon it's available.

Also Barnes and noble, you know, so you can get total gut balance and then if you want to know more about you know how to balance your gut, how to learn what is available, for example, God testing what sort of nutritional supplements available you can go into biohmhealth.com, biohmhealth.com.

Where there is a lot of information there that can help people and now we really are working to put some cmi continued medical education so that we can help the integrity uh Integrative medicine and functional medicine demystify the microbiome.

And I really hope this will help. – Fantastic. So biohmhealth.com is the website. And also check out the book. Thank you so much for joining Dr. Mahmoud, It's been a pleasure and thank you to everyone who has watched this

this interview. I'm Dr. Miles take care and have a wonderful day