Intro 00:00:01 Inventors and their inventions. Welcome to Radio Cade a podcast from the Cade Museum for Creativity and Invention in Gainesville, Florida. The museum is named after James Robert Cade, who invented Gatorade in 1965. My name is Richard Miles. We'll introduce you to inventors and the things that motivate them, we'll learn about their personal stories, how their inventions work and how their ideas get from the laboratory to the marketplace.

James Di Virgilio 00:00:35 Welcome to Radio Cade I'm your host, James Di Virgilio and alongside me today is Carlos Moreno. He is the co-founder of ResonanceDX. He is an associate professor at Emory University. He's got a plethora of experience in many interesting and exciting things. Carlos, welcome to the program.

Carlos Moreno 00:00:54 Thanks for having me. It's a pleasure to be here.

James Di Virgilio 00:00:56 Now tell us about ResonanceDX. What is it and what is really the main goal it's trying to solve?

Carlos Moreno 00:01:02 ResonanceDX is a startup point of care diagnostics company. So, we have a new technology. You may be familiar with the rapid COVID tests, protein antigen detection tests. It's doing a similar type of a test, but with a different type of approach. So ours as an electronic approach. So the patient sample goes over an electrical detector that has antibodies on it. And based on that, you can get your results very rapidly, like in five minutes. And so we're, developing that for a whole host of potential applications, because it's a, it's a new approach for doing this type of biological detection. It can be applied to many types of tests. The first one we're going after is one that has to do with a very urgent situation, which is septic shock. Cause that's in a type of test where you need an answer right away.

James Di Virgilio 00:01:54 And so let's talk about septic shock and start with how this works. So right now, if I am in a hospital setting or in any particular setting where I need a test, what does that look like? If they're gonna test me for septic shock?

Carlos Moreno 00:02:07 Well, really the test that we'll be going for is what type of a medicine do they need to give you when you're in septic shock? So they're already gonna be able to tell that you're in shock, cause that has to do with a precipitous drop and blood pressure. And so the first thing they try to do is to stabilize you. And there's a new drug that's called Angiotensin II. And what our test would be would be a companion diagnostic that would identify patients who when they get this drug do increased survival. So in studies with this particular biomarker, that show that patients with high levels of serum renin, they have a 20% increase in survival if they get Angiotensin II. So this test would be applied to any patient who is in shock to determine whether or not they might benefit from this new drug.

James Di Virgilio 00:02:52 And in absence of this test that you've designed what what's currently happening without this test.

Carlos Moreno 00:02:57 Currently, what happens now is they give them a different drug and then if they don't respond to that other drug, then they might try Angiotensin II, or they might not. And not all hospitals use Angiotensin II it's relatively new. It's been approved on the last few years and it's not really taken off a lot because when you do the head to head comparisons on all patients, they seem to do more or less the same with the two different drugs. It's only with the use of this test that you can see that actually the patients who have high levels of this biomarker, they do much better when they get

this Angiotensin II. So it basically changed the way patients are treated, who are in septic shock because it would potentially save lives.

James Di Virgilio 00:03:35 So this allows for as you're mentioning a more precise treatment towards people who have a more precise version, if you will

Carlos Moreno 00:03:42 It's precision medicine, it's basically finding the right drug for the right patient.

James Di Virgilio 00:03:48 And so how does this test work here? I am. They're gonna give the test to me what exactly is happening?

Carlos Moreno 00:03:53 Well they would take a sample of the patient's blood and put it into a test cartridge, take that test cartridge, put it into a reader instrument. These are like single use disposable cartridges. And five minutes later, it would give a result of the level of the renin that is in the blood. And if the levels were high, then they would give them the Angiotensin II. And what's going on inside is that the blood gets passed over a detector and that detector that has animal bodies on it to renin. And if there is renin there in the blood, then it will change the frequency that these, uh, antibodies are vibrating at. So you may be familiar with, if you have a crystal wine glass, right, and you run your finger around the rim, you can get a tone, a resonance tone. That's basically same thing that we're measuring here is this frequency it's in the gigahertz range.

Carlos Moreno 00:04:44 So you can't hear it, but it's a frequency that is natural to the antibodies. And if you run your finger around a wine glass, and then you take a sip of wine out of it to reduce the amount of liquid that's in there and you do it again, then you get a different tone because the mass and the glass has changed. Well, the same thing's happening here and these tests. So basically when the renin binds to the antibody, that changes the natural frequency that these things vibrate at. And so we can detect that change in frequency electronically, almost instantaneously, and it doesn't require any reagents or lasers or, or anything like that. So it's very simple and easy to use. So that's the reasons that we're excited about the technology,

James Di Virgilio 00:05:23 Speaking of the technology, are there any other tests that use a similar methodology to what you are using now using this sound as you're mentioning to detect?

Carlos Moreno 00:05:31 No, actually there's not. There are these things called quartz, crystal micro balances, but those are different in the way that they work and the way they're applied, they're not quite the same and they're not used in clinical testing. They're more research type devices and they are in a completely different frequency range. Ours are based off of basically Silicon wafer technologies. So it's something that's relatively inexpensive to manufacture the test chips and it can benefit from the whole silk and wafer manufacturing industry to allow us to produce things at scale. Once we've gotten to the point where we're doing that,

James Di Virgilio 00:06:07 How broadly can this be applied? Does this have a wide use down the road potentially? Yeah,

Carlos Moreno 00:06:12 Absolutely. Because this isn't the only test that we could use this for. One of the nice about these chips is that they have multiple resonators or detectors on them. And so we can test for multiple things at the same time. So we could potentially have a test that discriminates gram

positive from gram negative bacteria could help decide which drug antibiotic to give to a patient septic shock or whether or not it's actually viral or, or fungal type of, uh, an infection we could for the next pandemic. For example, we could have something where we could detect whatever the pathogen might be. We can have actually antibodies to multiple different pathogens. So we might be able to discriminate the flu from COVID from some other infection or discriminate viral from bacterial infection, say in the doctor's office or urgent care facility. And you go in and, and you feel sick and they want to know whether or not they should give you antibiotics. Well, they could potentially use this test to determine whether or not you should get antibiotics or not. There's also applications potentially for at home tests for patients with like kidney disease would be a potential application. So there's a wide range of possible uses because it can be used for any test that uses an antibody to detect a protein of interest.

James Di Virgilio 00:07:27 And when we think about false positive, something that obviously has really come to light, I think to the public more so now than ever. Does this test throw off very few false positives given how it's working, using the sound or

Carlos Moreno 00:07:39 A lot of it depends on how good the antibody is. That's on the detector, but our preliminary findings are that it has very good specificity. Of course, we're still in the development phase right now we've gotten to FDA clearance or anything like that. We're still doing some research and, and developing the platform and the tests. So that will be something that we will have to demonstrate to the FDA when we cut to that point.

James Di Virgilio 00:08:02 Okay. So unknown there, but I'm sure your hopes are high, that if the antibody is good enough, that you should hopefully obviously have a nice yes. False positive rate.

Carlos Moreno 00:08:10 Absolutely. Yeah. That's certainly our hope and our expectation

James Di Virgilio 00:08:14 And looking at your path to market, how far away do you think you are from having something that's marketable?

Carlos Moreno 00:08:18 That always depends on our ability to raise investments in capital funding to be able to do these things. And so that's one of the things that will depend on how long it takes us to get to market in an ideal case scenario where we've got funding in the next month or two, then we might be able to get to market in a year. If we don't get funding right away, then it can take a little bit longer. It's all dependent on our ability to race capital.

James Di Virgilio 00:08:42 Yeah, sure. As an investor. I definitely understand that. And it should be said at this point of the podcast that Carlos and his team at Resonance DX did finish in the top five for the Cade Prize. And the Cade Prize is seeking to award each year, some of the top innovations in the Southeast. So congratulations, obviously on your success there. And I know that's just part of the journey towards raising capital. So assuming, let's assume we're in the future. At some point in time, the capital is raised. We're now out in the marketplace who is primarily going to be purchasing these tests?

Carlos Moreno 00:09:09 For our first test. They would be hospitals that would be purchasing the test and then they would be deploying it, it in ICUs and emergency departments, because that's where you're gonna be having patients that are going into septic shock. It would be of interest to the hospitals for basically improving patient outcomes and saving the expense to the hospital of having patients spending extra days in the ICU. Obviously the quicker that patients respond and the better they do, the

fewer costs there are to the hospital. So that would be our first target, but ultimately we could have many types of customers, physicians, and minute clinics and drug stores potentially even direct to consumer if there's an at-home test.

James Di Virgilio 00:09:48 So what's the biggest hurdle from an investor standpoint, when you're pitching this to investors, you're saying here's how much money we're looking to raise to get to phase two or three or four, one, whatever phase that you're in with your fundraising. What is the most common objections you tend to hear?

Carlos Moreno 00:10:01 Well, it varies from an investor to investor. Some have said, oh, well, we've already invested in something else in septic shock. And so they don't wanna invest in two things in septic shock. Sometimes they say, well, it looks like you're very early. And so it might be a long horizon before an exit. Diagnostics is always a, a little bit of an orphan stepchild in startups. They tend to be a little more difficult to raise funds for than say a company that's developing a new drug.

James Di Virgilio 00:10:29 We've had a couple of other diagnostics on here, and it's funny, I think to the layperson, it seems like this is great, this something important, but as you mentioned for the dollars, it, it is a necessary step obviously to get to the drug, which you've so eloquently laid out, but oftentimes not as easy to raise capital for. So how did you get to this point? Your background has varied, even a lot of really interesting things. Let's start first with the near term. What gave you the idea to start ResonanceDX in the first place, and then we'll work backwards with your history?

Carlos Moreno 00:10:57 So the company came out of a patent that I was one of the co inventors on that was between Emory and Georgia Tech. We have a collaborator and professor of Georgia Tech, who is working on this electronic technology, and he wanted to look at biomedical applications. And so I worked with him along with other professors at Emory and showing that this form could be used to measure biologically relevant proteins. And in that case, we happened to be looking in cancer, which is one of the areas of, of my own research. So we had this patent that we filed, and then there was some potential interest in the patent. There were some people that were thinking about maybe licensing the patent, but when we, with them, we weren't too excited about how that was gonna work. And we thought that it would be better if we just started a company and tried to do it ourselves. And so that's how we founded ResonanceDX. And, uh, we've been working on it ever since.

James Di Virgilio 00:11:51 Let's go back in time now and take a look at your background. You went to MIT, you worked for NASA during your university years, your college years. What were you thinking your future would look like? And how is that different from now and wrap the answer of that question. If you could taking us through some of your history and some of the things that you've done.

Carlos Moreno 00:12:09 Sure. Yeah. When I went to MIT, I went with the plan of majoring in aerospace engineering. And that's what I did. I had always had a fascination with the space program when I was a little kid, 5, 6, 7, 8 years old. I was watching the Apollo landings on the moon. So originally I wanted to be an astronaut, but I realized that I did not have 2020 vision and I was not gonna be able to be an astronaut. So I got really interested in aerospace engineering and I got interested in engineering in general, in high school. And when I was at MIT, my vision was to go work for NASA. I wanna work on the space program and work on space missions. So I got two degrees from MIT and an Astro and got a job at JPL and Jeff propulsion lab and working on the Mars Rover.

Carlos Moreno 00:12:52 The very first Mars rover. This was back in the late 1980s, almost a decade before the first one was launched the Pathfinder Rover. So if you remember the movie, the Martian, there was a little one that Matt Damon had, that was about the size of a microwave oven. That was the first one. And that was the one that I was working on when I was at JPL. So I actually got to be where I had envisioned I wanted to be when I was in college. But when I was out there at JPL, working on the Mars Rover, my brother's wife was diagnosed with breast cancer. She was quite young, she was 36 and it was shortly after the birth of their daughter, my niece. And I started just reevaluating what I was doing and whether or not working on Mars Rover was really gonna make much of a difference in anyone's life other than maybe a planetary geologist.

Carlos Moreno 00:13:41 So I started thinking more and more about doing cancer research. And so I started taking some classes in biological sciences and biochemistry, organic chemistry and genetics. At that time, I had moved back to Boston and I was writing the flight software for the shuttle to integrate GPS into the navigation. And at the same time I was doing that, I was taking classes in organic chemistry and biochemistry and genetics at MIT and Harvard. And, and, and then I applied to get a PhD in genetics, microbiology at Emory, and came to Emory and got my PhD in genetics, molecular biology. And I've been doing cancer research at ever since.

James Di Virgilio 00:14:16 Now. Carlos, how often is it for somebody to take a deviation like that? From what you're working on, you're working on space related projects, some of the neatest ones, some of the most pioneering frontier oriented projects. And then you're gonna switch to a different frontier, obviously, as you mentioned, but how often is someone making the move from NASA to cancer research?

Carlos Moreno 00:14:35 You'll be surprised. There are some people that do outstanding cancer research that started out in physics or computer science. And right now biological science and cancer research is really one of the most interesting areas of science and one of the most fast paced and exciting areas to be doing research in. You know, it's just like in the early 20th century, it was kind of the golden age of physics, all these advances with relativity and quantum physics and things like that. But since the discovery of the structure of DNA in the early 1950s and becoming more and more over the last 30, 40 years, it's really been kind of a golden age of biological discovery and really very exciting. So there's been more than a couple of people that I know who are doing some outstanding work in biological sciences and in cancer who started out in very different fields.

Carlos Moreno 00:15:27 It's not the traditional path. Oh, I will agree. Most people started either going to med school or biology as their undergraduate major. And, you know, I guess sometimes I wish I had maybe not been so focused on aerospace. You know maybe been more open when I was an undergraduate exploring the other areas of science, then I might have had a very different path, but as it turns out, it worked out very well for me because at the time when I finished my PhD, there were very few biologists who were very well trained in quantitative science, in math and computer programming and statistics. And so having that dual training engineering software development and biology actually put me in a very unique position when there was a great demand for bioinformatics and analysis of big data, which nowadays actually biology really is a science of big data. So it worked out, it turns out that the years of training and engineering didn't really go to waste. Didn't completely go to waste at least.

James Di Virgilio 00:16:23 No, no, definitely not. In fact, I think you hit the nail on the head there, that you really are, are probably an unintentional pioneer of where the world has gone with quantitative

of methods reaching into basically every field and here at the University of Florida, obviously in Gainesville, there's a strong push for the entire university to use collaboration between the engineering colleges and every college to make sure that you have kind of exactly what you mentioned, actually right there, whether it be a coding approach or an engineering approach, or a mathematical approach to whatever you're researching and looking at to problem. So I think that you definitely found yourself on the forefront. Now, given that background, given all the learning you've done, you're obviously a lifelong learner. I think your evidence of a lot of successful people that oftentimes you don't exactly know what you may wind up becoming one day, but if you're flexible and you're looking to achieve things that are passionate, that are close to your heart, you can do it. So what are some words of wisdom you have are people that are perhaps at any stage of their life, but just in general, what are some words of wisdom for those that are trying to solve problems in the world around them? What can they do to, to better that?

Carlos Moreno 00:17:23 Well, I would say you definitely want to always stay open to exploring new areas of knowledge that maybe you're not so familiar with because that's how you learn, right? And try to learn from the best, seek out people who are really good at things and learn from them. I would say that success is a function of many factors, certainly hard work and persistence is maybe the biggest factor, but there's always an element of luck and of making the right connections with people who maybe can bring something to the table that you don't have people who different areas of background, and actually having that diversity of experiences and backgrounds leads to new ways of seeing things or possibilities are coming up with new solutions. Even though I was an aerospace engineer, I was not an electrical engineer. And so this whole ResonanceDX thing came out of a collaboration with the field that I don't really have a lot of background in, which is electrical engineering and being open to that resulted in this incredible new opportunity for me.

Carlos Moreno 00:18:28 So I think that all of those factors are important, but another thing that's also really important is to work on something that motivates you. For me, that's been trying to come up with better ways to treat patients, whether that's cancer patients or patients in septic shock, but, and making a difference in health outcomes. Right. I find that to be rewarding. And also I enjoy being at the cutting edge of science. Right. I find that exciting and interesting, right? So being able to work on something that excites you helps you be able to be persistent and work hard. And so that can give you the motivation. Sometimes things don't work and it can be very difficult and they don't always work the first time. In fact, they almost never work the first. So you have to be able to have that grit, that ability to just say, okay, well, let's do it again. And then let's make it work. So I guess those would be my words of wisdom, if you can call 'em that.

James Di Virgilio 00:19:22 Yeah. Those are great words of wisdom, especially failure. We could probably spend an entire episode talking about failure and how I'm sure that's led you to where you are is failure often is something that's bad, but in reality, in the case of innovation, it's something that's necessary. And I think your words of wisdom alluded to that, all right. Should someone wanna find out more about ResonanceDX or perhaps even become an investor? What's the best way for them to do that?

Carlos Moreno 00:19:42 They should go to our website, which is just www.resonancedx.com and they can find our contact information. They can find out a little bit more, more about us and we will definitely be happy to respond to any inquiries for sure.

James Di Virgilio 00:19:57 All right. He is Carlos Marino, the Co-founder and Chief Scientific Officer of ResonanceDX. And I am your host, James Di Virgilio and on behalf of Radio Cade thanks for listening. We'll see you next time.

Outro 00:20:11 Radio Cade is produced by the Cade Museum for Creativity and Invention located in Gainesville, Florida. This podcast episode's host was James Di Vigilio and Ellie Thom coordinates inventor interviews, podcasts are recorded at Heartwood Soundstage and edited and mixed by Bob McPeek. The Radio Cade theme song was produced and performed by Traci Collins and features violinist Jacob Lawson.