Changing What's Possible - S.1 Ep.7 Transcript

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SPEAKERS

Sam van Bohemen, Dr. Marie McNeely, David Smith

D **Dr. Marie McNeely** 00:01

Hello, and welcome to Changing What's Possible: The Disability Innovation Podcast brought to you by the Cerebral Palsy Alliance Research Foundation. I'm your host, Dr. Marie McNeely. And this season, we are excited to bring you remarkable stories of life-changing technology. Today we have with us Sam van Bohemen, Co-Founder, CEO, and CTO of the company Nuroflux. And Sam is going to tell us more about the wearable system they have developed that provides continuous quantitative monitoring for blood flow and activity in the brain designed for people to use after stroke. And in the second half of our episode, today, we're going to hear from David Smith, who's going to share his insights and experiences surrounding his stroke and his recovery. So listeners, let's get started today. Sam, thank you so much for joining us on the show.

S **Sam van Bohemen** 00:49

Thank you, Marie, for having me.

D **Dr. Marie McNeely** 00:50

We're delighted to have you with us. Can you start by telling us a little bit more about the company Nuroflux and your role there?

S **Sam van Bohemen** 00:56

Nuroflux actually started from a PhD I'm currently completing in Biomedical Engineering, where I've developed a new technology for the continuous monitoring of changes in brain blood flow or cerebral blood flow. And now at Nuroflux, we're commercializing this technology to develop a device so the continuous monitoring of both brain activity and blood flow in stroke patients.

D **Dr. Marie McNeely** 01:17

Fantastic. And I think as part of a PhD, most people don't form new companies! So can you tell us a little bit more about how Nuroflux got started, and maybe why?

S **Sam van Bohemen** 01:26

You're right, I knew that we were developing this technology and it had potential to be commercialized. So I went through two programs now to really explore the commercial potential and what's involved with commercializing the new technology. And yeah, I was really excited by the opportunity. So I took it with both hands, and here we are today.

D **Dr. Marie McNeely** 01:45

Fantastic. So did you know maybe when you were enrolling in your Ph. D program, that you had this interest in entrepreneurship, or that you wanted to be part of a startup company?

S **Sam van Bohemen** 01:54

Absolutely. I wanted to be involved in the industry. And I wanted to do research that had tangible output. So I was very interested in commercializing and getting involved in the industry from day one.

D **Dr. Marie McNeely** 02:05

Interesting. So what was it about this particular project that caught your attention and really captivated you?

S **Sam van Bohemen** 02:10

I don't know. It was just a very interesting project. One of my supervisors, especially his father in law, had suffered multiple strokes in between CT scans and hospital about a year before my PhD started. And my supervisor had an idea for a new technology that could be used to monitor changes and brain blood flow in hospitals. So he had this idea that he presented to me and yeah, I took it with both hands, as I just said, and started scanning and developing the technology that we're now commercializing in Nuroflux.

D **Dr. Marie McNeely** 02:39

So to give our listeners out there something to think about in terms of how things normally operate in the hospital following a stroke, versus how things could potentially operate with the Nuroflux system - can you maybe give a view into how things are now and how things could

be?

S Sam van Bohemen 02:54

Absolutely. So ischemic stroke is the most common type of stroke, caused by a sudden restriction in brain blood flow. But following a suspected stroke, a patient will come to the hospital where they'll have a CT scan to confirm the diagnosis. But CT scans provide an imaging snapshot in time but due to radiation exposure are only performed every 24 hours, and in that 24 hour window in particular, patients will receive treatment but also at risk of patient deterioration, which can occur and up to 40% of patients with acute ischemic stroke. However, there's currently no way to provide continuous monitoring of both brain activity and brain blood flow during the CT scans. Standard care currently relies upon waiting for the next scan, or on intensive nursing observations, which actually occurred initially every 15 minutes for the first two hours, and every half an hour for the next four hours, then maybe an hour for the next four hours, and maybe four hours after that. So as you can imagine, this is very intensive, very distressing for patients, can be very time consuming for nurses. It's also subjective. If a patient is sedated or unconscious, this method is ineffective. So we identified this gap. And with the technology that we've developed during my PhD, we now commercializing this to develop this wearable device that patients will be able to wear in hospital in between CT scans to monitor treatment outcome and also to detect patient deterioration faster than current methods leading to better patient outcomes.

D Dr. Marie McNeely 04:15

Definitely, and I think a lot of our listeners out there might be familiar about what a CT scan looks like. It's this large, kind of clunky, cumbersome piece of equipment. So can you describe what the Nuroflux system looks like?

S Sam van Bohemen 04:27

You're right, the CT scans on this large machines, very expensive, the Nuroflux device, actually utilizing existing technologies in a novel way to provide the monitoring that I described previously, but the device is very lightweight, portable device relatively cheap as well in terms of medical equipment. So we're really looking to provide, yeah, a cheap portable device that can be applied to stroke patients in hospitals, but there was also scope to use this device in pre-hospital environments, even at home. But also due to the low cost of the device, we're particularly interested in developing countries where the cost of a CT scanners is actually so high that patients often do not have these scans. So because of the cheap, portable nature of the device could have broad applicability across many different areas of stroke.

D Dr. Marie McNeely 05:08

Absolutely. And to help us visualize it, can you describe the actual hardware of the device?

S Sam van Bohemen 05:14

Right now the device has a fabric headband device that goes around the head with a number of electrodes placed across the scalp. And we also have two electrode leads some monitor the heart activity across the chest as well. So it's just a simple headband device that's pretty comfortable to wear.

D Dr. Marie McNeely 05:30

Fantastic. So maybe to go into a little bit more of the nerdy details here, what does the Nuroflux system kind of do with all these different parts and how does it work?

S Sam van Bohemen 05:38

So without going into too much detail, the technology we have developed monitors electrical signals produced by the body to infer changes in brain blood flow. This is the novel metric that I have developed during my PhD. So this is in terms of brain blood flow. But because the device utilizes electrodes placed across the scalp, which are referred to as electroencephalography, or EEG, the monitoring of brain activity, our device can compute simultaneously, our novel metric of blood flow with the traditional EEG measures of brain activity. And we hope to use both of these metrics in combination to increase sensitivity to stroke.

D Dr. Marie McNeely 06:14

Interesting. So what is the importance of monitoring both blood flow in the brain and also the brain activity, I know a CT scan, if you're doing just a normal sort of perfusion, CT, you would only be getting that blood flow information.

S Sam van Bohemen 06:26

That's right and a stroke as obviously, as I mentioned earlier, ischemic stroke anyways, when the book starts a reduction in blood flow, ischemic stroke is usually caused by a blood clot, whereas hemorrhagic stroke is the bleeding in the brain. But both of these ultimately result in reductions in blood flow to tissue in the brain, which causes neuronal death, which has knock on effects in terms of brain activity. So both brain activity and brain blood flow heavily implicated in stroke. So we hope to use both of these metrics, as described earlier to increase instability in stroke.

D Dr. Marie McNeely 06:55

So Sam, can you tell us a little bit more about the monitoring capabilities of this system and what people actually see while someone's wearing it?

S Sam van Bohemen 07:03

So we are still developing the user interface. And what people will see and hear as the device is

worn, but it could be something analogous to an ECG monitor that people are very familiar with in hospitals today. But that development of that part of the product will require some customer discovery and polling to doctors and patients to understand what's most suitable, but also what would be integrated into the hospital environment easily.

D **Dr. Marie McNeely** 07:28

Absolutely. And this device has potential applications, both in the hospital but also at home. So do you anticipate maybe the home monitoring would be a phone app or a tablet? What are you thinking for that piece of it?

S **Sam van Bohemen** 07:38

Definitely, I think in terms of the user interface, and the screen that people would see could be quite different in those two applications, there's also important to note that the device is going to have algorithms to spit out metrics in real-time. And we don't want nurses or doctors to have to go through and it's been a long time analyzing what the metrics are finding. So that's going to ideally going to be a device that can just tell people, something's happened, or the patient is okay, at the moment, nothing's going on, to allow easy interpretation and use.

D **Dr. Marie McNeely** 08:07

Absolutely. And we mentioned that it is a continuous monitoring device. How long do people have to wear it to start getting useful information from it?

S **Sam van Bohemen** 08:14

Yeah, that is a good question that I often get asked. And I think it also comes back to clinical trials that we have planned to conduct. I know the research shows that patient deterioration is most likely in the first few days following stroke. So in that instance, the first few days could be the most suitable time for the device. But you know, as I speak to people that have had strokes in the past, they would like to have this device at home, maybe while they sleep or just when they feel a bit worried about maybe having another stroke. So the short answer, is it more trials and researchers is required to really understand the duration of monitoring and use.

D **Dr. Marie McNeely** 08:48

Certainly, so people have one of these devices at home in the future, for example, would they just put it on for sort of a quick 10 minute check? Or what would that look like?

S **Sam van Bohemen** 08:56

You could do, of course, and reality as it stroke could appear at any time. So you could theory, put it on for 10 minutes, then it happens at the 11th minute. So again, research and more trials

are required to understand that duration of monitoring and use.

D **Dr. Marie McNeely** 09:09

Interesting. So can you talk a little bit about the impacts than Nuroflux is having or maybe it has the potential to provide for users in the future?

S **Sam van Bohemen** 09:16

Sure. So we are quite early in our journey. We have enacted a cliniccal safety study to show that the device is safe, feasible, and acceptable in a small population of ischemic stroke patients here in Sydney. However, the device has potential to monitor patients in hospital in between CT scans to detect treatment outcome and detect patient deterioration. And we're actually currently gearing up for a new clinical trial to assess exactly that.

D **Dr. Marie McNeely** 09:40

Interesting. So have you gotten any feedback from the people who have actually used the device in terms of how they perceived it? Was it comfortable? Was it something that they were excited to try?

S **Sam van Bohemen** 09:50

Absolutely. So that was the purpose of the clinical safety study. We recruited 17 ischemic stroke patients and there was a device for nine hours each and device comfort scores across all of those was patients across an analysis about 93%. So it was really high, showed that device is really comfortable. And the patients were very tolerant of the device and willing to use it. And they all actually reported that they would be happy to wear this device at hospitals in the future. But more interestingly, they would also be interested to hear the device from the comfort of their homes to detect future strokes as well.

D **Dr. Marie McNeely** 10:20

And you mentioned that you're relatively early in the Nuroflux journey. Do you have a sense of when it might be commercially available, or what these next steps are to get there?

S **Sam van Bohemen** 10:28

It does take a long time to commercialize a new technology. There's lots of hurdles to go through clinical trials and regulatory approval, but we estimate that we can get to market by 2026.

D

D Dr. Marie McNeely 10:39

And do you anticipate that you'll continue to work on the Nuroflux even after your PhD is completed?

S Sam van Bohemen 10:44

That's right. So my PhD is due to end at the end of this year. But we're putting measures in place to allow me to continue Nuroflux full time, early next year. And as mentioned, also, we have a clinical trial for NUroflux starting early next year, hopefully, so I'll be working on that.

D Dr. Marie McNeely 11:00

Fantastic. And I know our conversation thus far has really focused on the potential applications for stroke, because I think this monitoring, particularly continuous monitoring is so important for strokes where you might get recurrent strokes afterwards. But there are some other potential applications as well. Can you touch on some of the other things that this system could potentially be useful for other conditions or diseases?

S Sam van Bohemen 11:20

Sure, even in the context of stroke, there's a few areas that it could be applied. I mentioned pre-hospital, at home. There's also some types of stroke that it can be used as well. But in terms of other neurological disorders, we've spoken with many neurologists here in Australia, but also overseas, and they've highlighted to neurological disorders, including traumatic brain injury, delirium, even migraines where this technology could play a role.

D Dr. Marie McNeely 11:43

Interesting. Are there any additional considerations or adjustments you'd have to make to this system for it to be used with these other types of conditions?

S Sam van Bohemen 11:50

Yeah, absolutely. I think clinical trials, and research should be required to understand those, but the form factor would most likely be very similar as the current device, but it would probably be tweaking of algorithms and understanding thresholds of our metrics that indicate other diseases aside from stroke.

D Dr. Marie McNeely 12:07

And Sam, I have to ask, what are you most excited about in terms of the future of Nuroflux?

S

S Sam van Bohemen 12:12

I think it's just the potential to help so many people. It's incredible what we could achieve if we're successful. Obviously, as I said, we're still early in our journey. But it's a very exciting opportunity. And I'm very privileged to have done this PhD. and now be working on this exciting company. So, you know, stroke is the second leading cause of death worldwide, and we have potential to impact many lives in the future.

D Dr. Marie McNeely 12:32

Absolutely. Is there anything else you'd like to share about Nuroflux or your experience with it?

S Sam van Bohemen 12:37

Yeah, if anyone wants to find any more information now or would like to talk to me about what we're doing, feel free to reach out, connect with me on LinkedIn or send me an email. I'm happy to chat with them.

D Dr. Marie McNeely 12:46

Perfect well listeners, definitely get connected with Sam on LinkedIn. Send him a message if you have any questions or if you want to learn more about Nuroflux. And Sam, it's been such a pleasure to have you with us on the show today, and listeners stay with us, we'll be right back after this short message with more great content.

D Dr. Marie McNeely 13:06

Listeners if you're enjoying what you've heard so far, in this episode of Changing What's Possible, then there's another podcast we think you might like. Cerebral Conversations is created by Cerebral Palsy Alliance, an organization that works closely with CPARF. And this podcast is all about candid conversations exploring the biggest issues impacting people living with cerebral palsy and other disabilities. You can learn about early intervention, advocacy, research, inclusion, and more from experts and people with lived experience. Listen and subscribe to Cerebral Conversations on your favorite podcast platform. And visit cerebralpalsy.org.au to learn more about the Cerebral Palsy Alliance.

D Dr. Marie McNeely 13:48

Welcome back listeners. And I'm excited to introduce you all to our second guest today, David Smith. Listeners, David experienced a stroke a number of years ago before Nuroflux was created and he's here to talk more about his experience and how he thinks Nuroflux could help others who experienced a stroke in the future. So hello, David, and thank you so much for joining us today.

D David Smith 14:10

Thank you for having me!

D Dr. Marie McNeely 14:11

Well, we are excited to learn more about your experience and your thoughts on Nuroflux. So can you start by telling our listeners a little bit more about yourself and your personal connection to stroke?

D David Smith 14:21

Yes, so five years and three months ago, I had what's known as a subarachnoid hemorrhage, which I am one of the 13% of stroke sufferers that sits on the hemorrhage side. Most listeners would be familiar to people saying, oh, so and so had a brain aneurysm but hemorrhage is just a brain aneurysm bursting.

D Dr. Marie McNeely 14:39

Absolutely. So what are some of the impacts that that stroke had on your life and maybe what did your rehabilitation and recovery look like?

D David Smith 14:46

So I was 36 years old at the time, so I really didn't fit into the archetype of a stroke sufferer. I was extremely lucky. So I had a hemorrhage and my wife picked it up pretty immediately called an ambulance. We did what's called the fast test with triple zero, which is the Australian version of 911. And sure enough, I could not move my face anymore. So rushed into an ambulance taken to straight to an emergency room. Through a neuroward. I was explaining sort of circumstances that happened on the way to the hemorrhage. And then they started exactly what Sam was covering earlier. A lot of race testing, which is squeezed my hand was your leg, that sort of thing. Firstly, 15 minutes, then per hour, then every four hours. I had a CT scan, MRIs, and about two days into my recovery, I guess you could say they found another uburst aneurysm in my head.

D Dr. Marie McNeely 15:39

Oh, wow!

D David Smith 15:40

So we then spent five months trying to find a way to get to it. It wasn't a standard one that you could coil. And I ended up having interventional radiologists from Prince of Wales private hospital doing a stent, they got three femoral artery and latched the stent in.

D Dr. Marie McNeely 15:54

Absolutely. And I think a lot of the maybe stress surrounding a stroke is sort of this big scary event happens once but then there's sort of that looming fear that they could find something else in these scans that you're getting. So what was that waiting experience like for you?

D David Smith 16:08

My wife and I always told this story where I think we're sort of saying that, okay, I think we might have beat this I think we might be through. And then we actually overheard a nurse organizing a transfer for me. And she'll say, our patient Smith found a second aneurysm transfer to Prince of Wales. So I didn't even have a doctor tell me I overheard it from a nurse that was just trying to get something done. Oh, no, going to the psychological I wrote my will. It was simple - get me a pen and paper, these are the accounts, this is where all the money is. I thought that was the end to be honest. And they ended up deciding not to go in that day, because they would have clicked it and it wouldn't have worked. And it would have been extremely risky. And instead, we played a little game of working out a way to actually get to it.

D Dr. Marie McNeely 16:49

Absolutely. And I think being in the hospital is stressful experience as well. And not having that continuous information can be really frustrating, because you just want to know what's going on. So how did you find out about Nuroflux, this continuous monitoring system?

D David Smith 17:04

So I actually work in startups at the University of Sydney. And Sam came in and gave a talk to one of the students societies. And as he was talking, I'm like, "that makes a lot of sense!" because the absolute worst part of having stroke is sitting there in the neuroward. It's that uncertainty. It's just this chaos around you, you move from ED and you think it's gonna get better, but it actually gets a lot worse, because neuro boards are people at their worst. And as Sam was telling his story, I'm like, oh my lord, I could've used you five years ago.

D Dr. Marie McNeely 17:34

Absolutely. So for your own stroke specifically, did you have particular impairments afterwards? Did it affect your motor your speech or cognition?

D David Smith 17:42

Yeah, I do slur some words sometimes, my left arm I probably have about 60% use. But I think the main one is the sort of psychological, it is a huge burden. Especially I was young. I'm 36. I had a three year old, my wife obviously just became the breadwinner because I couldn't work. There was a lot of that sort of psychological issue.

D Dr. Marie McNeely 18:01

Absolutely. So let's maybe fast forward in your memory, if Nuroflux had been available, how do you think your experience would have been different?

D David Smith 18:09

It would have got me out of that neuroward so much quicker. I don't think there was a price I wouldn't have paid to be able to wear something around my head that I could just take home and just know that I had that peace of mind that nothing was happening. And the other thing that would have done is my wife was constantly there. But my parents are actually overseas when this happened. So they were trying to get flights back and everything else. And when you have something like this, people want to call and chat, but they don't want to call too much. So I had something like a Nuroflux, I could just send out a group text to my sisters, my brother, my parents...yep, two hours, still everything fine, it would have just eliminated so much of the psychological burden. And plus the burden of not having to have somebody around me all the time. If something flashed up on the Nuroflux, I could just call an ambulance. Whereas there's always the worry that if you're by yourself, you won't have the capacity or you'll get to it too late.

D Dr. Marie McNeely 18:58

That makes sense in terms of the monitoring capacity, David, can you tell us a little bit more about what you would want to see in a system like Nuroflux in terms of what it would be telling you?

D David Smith 19:08

I don't know much about the product as such, but it's one of those ones where I would like to see nothing. I would just like to put it on my head and just know it's there. Just know that it's monitoring and everything else. It's kind of like when you do an ECG in the hospital. That noise telling you nothing's wrong is actually kind of soothing. And that's what it would be for me.

D Dr. Marie McNeely 19:25

Yeah, once it starts beeping, everyone starts panicking, right?

D David Smith 19:27

Exactly, exactly. So I would love something that is just constantly telling me you're doing okay,

D Dr. Marie McNeely 19:32

Perfect. So can you talk a little bit more about I guess the benefits that you see Nuroflux providing patients, but also their families? You touched on this a little bit.

D David Smith 19:40

The families, it's unbelievable. I sort of flip it around on time now. So I'm in my early 40s, my dad's in his late 60s. If my dad was to have a stroke now I would put a Nuroflux on his head. I would be leveraging our relationship with Sam to get one there because it would just give me that peace of mind, it would just give me that ability to monitor without being intrusive, and it would just allow me to get on with my day knowing that something was monitoring and pass every so often turning up to a doctor's office and doing that race test, this is much more advanced, much more peace of mind, that would make me feel a lot better.

D Dr. Marie McNeely 20:14

Absolutely. And as we've talked about, during our conversation today, there's sort of these two different ways to use the device. There's this in-hospital monitoring, that clinicians would be kind of keeping track of all your information, but also this at home monitoring, where you could keep tabs on how things are looking for yourself and maybe give updates to friends and family. So is this something this at-home monitoring, something that you think you would be interested in to detect future strokes?

D David Smith 20:38

I would pay any price to be able to just put it on my head occasionally, just make sure that nothing's wrong. Even five years down the line, every time I get a headache, I wonder if this is if this is the next one. So just to have something that I could just put on my head, just get that relaxation and peace of mind and just move forward.

D Dr. Marie McNeely 20:55

Well, for people out there who are interested in learning more about Nuroflux and may be interested in trying it once it becomes available, do you have any message that you'd like to give them?

D David Smith 21:04

With all things like research, commercialization, and everything else - we need to support early and often, we need to open up our networks, whether it be the doctors, whether it be funding, anything we can do to get this closer to market because I think it has a huge mass market application.

D Dr. Marie McNeely 21:20

Well David, we appreciate you joining us today and sharing your insights. Thank you so much for your time.

D David Smith 21:26

Thank you.

D Dr. Marie McNeely 21:27

It's been a pleasure and listeners. It's been great to have you here with us as well. When you have a moment please subscribe and leave us a rating or review on your favorite podcast platform to let us know what you think of the show. And we look forward to connecting with you again in our next episode of Changing What's Possible.