17 Samuel Mugo-Edited Audio-Edited Transcript

Fri, 4/1 11:37AM 1:11:32

SUMMARY KEYWORDS

crosstalk, sensors, people, chemistry, food, laughter, point, waste, research, platforms, therapies, students, idea, chemical, sweat, clinical diagnostics, application, prototypes, absolutely, grew

SPEAKERS

Dylan Cave, Samuel Mugo, Brittany Ekelund

B **Brittany Ekelund** 00:00

We would like to first acknowledge that we are on Treaty Six Territory, the traditional gathering grounds for many diverse First Nations, MÃ©tis and Inuit, whose footsteps have marked this land and whose presence continues to enrich our vibrant community.

D **Dylan Cave** 00:13

[Intro music plays] Hello, and welcome back to Research Recast(ed), the knowledge mobilization podcast. I'm Dylan cave, and I'm here with my co host, Brittany Ekelund. Joining us today is Dr. Samuel Mugo, a professor of analytical chemistry at MacEwan University, whose research program involves developing point-of-need frugal smart sensors for human and animal health and wellness, as well as agrifood chemical analytics. Dr. Mugo is also passionate about teaching students to think innovatively and use chemistry to solve societal problems aligned to the United Nations Sustainable Development Goals. And we're gonna talk about that a little bit later. But first, Samuel, thank you so much for joining us.

S **Samuel Mugo** 01:01

Thank you. Thank you for having me.

B **Brittany Ekelund** 01:03

Yeah. [Music fades out] So first, we just want to learn a little bit of more about you. So what attracted you to the sciences? And specifically, why pursue chemistry?

S **Samuel Mugo** 01:15

Now - and I think that's a good question, because I think we are really a totality sometimes, you

know, of where we start our lives from. So maybe I'd like to say that I grew up, you know, in a farm in the tropics. And if you think about the tropics, you know, there is a lot of life, you know, around you - be it the insects, be it the plants. And so I actually used to work in the farm. And I was very curious, you know, about the physical world. And, of course, growing up in a farm means that really, you're grounded and interacting a lot with nature. But I think did not read the crystallized to me, until I grew up and went to the University. And when I went to the University, the situation was, uh, you would get enrolled to a program based on the discipline grades that you get. And so I was enrolled, you know, for a Bachelor of Science degree, and then I had the options of choosing between chemistry, computer science, mathematics, and in a very fast year you did all those courses. And then the second year that's when you had to specialize. And so I was selected, sort of, you know, based on my grades, to specialize in computer science and statistics, as well as chemistry. And so I had a difficult choice, you know, choosing between those two. However, you know, I think my teacher I think made a very big impression on me, that connected me, you know, to how I grew up, with regard to, should I say, the centrailty of chemistry in nature. And I think he explained that so vividly, you know, where chemistry comes alive in nature. So, he will draw, for example, those kinds of structures on the board, say, a benzene ring and try to connect it to, you know, this is a makeup of plants that I actually grew up seeing and so on. So it was so relevant to me, thanks to that instructor, you know, that made chemistry really alive to me, and--

D **Dylan Cave** 03:37

Relatable to everything in your life too.

S **Samuel Mugo** 03:39

Absolutely, and relatable as well. And, of course, he would really connect it, you know, this idea of medical diagnostics, and many applications, you know, in the society. He'd bring it home, and I could see myself, you know. . . [pause] getting appealed to being a player in the discipline.

B **Brittany Ekelund** 04:03

Yeah, I mean, it's really incredible, the effect that a good teacher, or mentor can have on you, like, you literally could have gone either way, but. . .

S **Samuel Mugo** 04:15

Absolutely. And I think that's why I think instruction is such key, you know, it inspires students and to some extent, it influences really the direction that they take, you know? It influences their learning.

B **Brittany Ekelund** 04:31

Mm hmm.

S Samuel Mugo 04:32

And so, that's why I chose actually chemistry because it was so relatable, you know, to to how I grew up, and I could see myself being a practitioner in the field, because of the relevance that was brought home by the instructor.

B Brittany Ekelund 04:49

And I think it's really interesting because I remember chemistry, you know, in high school being like, balancing equations and being like, Oh, gosh, I can't do this!

S Samuel Mugo 05:00

[cross talk] Right.

B Brittany Ekelund 05:00

But when I was reading through, like your pre interview form, relating it to, like life, and even the chemistry of emotions and what happens with like, our bodies and the interactions of those different, you know, hormones and stuff.

S Samuel Mugo 05:16

Right.

B Brittany Ekelund 05:16

But I was like, Oh! I thought this, this should be a high school curriculum. [laughter]

S Samuel Mugo 05:21

And I think, probably that informs really my teaching. You know, the way it was taught to me - the relatability, the relevance. And I think it's one thing to balance equations and so on and pass exams, but I think, until it's made relevant on the why you are doing it, you know, where do you see it in life? And so I always tell my students, if I'm not able to explain why it's relevant, why you should bear the pain of understanding balancing the equations, I'm probably wasting your time. And I make a lot of effort, you know, to try and help the students see, why are they doing what they are doing. Why are they learning what they are learning. You know, why should my grandmother, their grandmother, who doesn't know anything about chemistry, care to listen? You know, because it's relevant to her as well.

B Brittany Ekelund 06:23

Yeah. [crosstalk] Fantastic--

D Dylan Cave 06:25

[crosstalk] Well, it seems-- It seems like you're really passionate about teaching your students to think innovate--inovatively about chemistry, especially to solve perhaps societal problems aligned to your work, or the the work around uh the United Nations Sustainable Development Goals. What drives your passion to kind of like, I think we, you know, almost touched on it a little bit like the the relating it to something real life? [crosstalk] Right.

B Brittany Ekelund 06:53

Yeah. And could you tell us a little bit, I guess, in that, about what the United Nations Sustainable Development Goals are?

S Samuel Mugo 07:00

Well, I think as a globe, we've realized, you know, that we are very interconnected. I think previously that the world would be divided often in to, you know, the so-called developed countries - or what people call that global north - and sort of it would be contrasted with the Global South - what they call the developing countries. But people have realized, you know, most of the problems that the globe faces they are very, very interconnected. And so the United Nations, you know, Sustainable Development Goals, they came up with these 17 overarching global issues that the world should focus on, with the understanding that these global issues are interconnected. I'll give you an example, you know, something like food security.

B Brittany Ekelund 07:58

Which is huge, and like, all across-- even in big cities, here in Canada, like, food security is an issue.

S Samuel Mugo 08:05

It's a big issue, you know, talk about food globalization as well - chances are most of the foods that we consume, you know, we don't grow them in Canada. Chances are, they come from many different countries. Some are from the US, you know, some you know, in these so called global southern countries. And so, the way the food is produced, for example, in those global southern countries affects the people who consume those foods across the world. You know, talk about water and sanitation. Talk about maybe the biggest issue of our time, the climate change - again, you know, it affects it affects everyone in the globe. So, those are some of among the others, you know, such as accessible education and so on. So, those are some of the issues, you know, that-- listed in the 17 United Nations Sustainable Development Goals. And

the idea is to make sure that as a globe, we we are healthy. And what I mean by healthy means that we've got access to all these things, irrespective of where you actually live. And so, I think the 17 Sustainable Development Goals, you know, really unite us. And so that's why I think, when I'm teaching chemistry, I try to connect the relevance of the chemistry to how we can solve, based on the chemistry expertise, the 17 Sustainable Development Goals that unite us, you know, as a globe. And I think irrespective of who is seated in that class, chances are of course, they're interested with the food that they eat. They're interested in the water that they drink. They're interested, you know, in the quality of education that they are acquiring--

B **Brittany Ekelund** 10:15

Mmhm.

S **Samuel Mugo** 10:15

The climate, you know, affects everyone as well. So everyone finds a place that they can play along in solving the 17 overarching goals that connects us as people across the world. And these issues are urgent, you know? If we look at the United Nations, they say that 2030 is the time by when we should, as a globe, make progress. Irrespective of where you are, you know, you can access some of all these things that embodies really humanity. And so equity becomes key on those, you know, 17 issues that--

D **Dylan Cave** 11:02

[crosstalk] Not everywhere is-- I mean, we, like you said, everywhere is so, so different in how we contribute to that, that all these different things, like every country is so different.

B **Brittany Ekelund** 11:14

[crosstalk] Yeah equal--

D **Dylan Cave** 11:15

In their resources, in-- equal not-- equity not equality, right?

B **Brittany Ekelund** 11:19

Equal doesn't always mean equitable. So, I mean, that's fantastic. I feel like I need to go back and get another degree in the sciences. But first, I think we need to introduce your research. So can you tell us about point of need frugal smart sensors? For people that might not be familiar with that kind of terminology - what are they and how do they work?

D **Dylan Cave** 11:19

Dylan Cave 11:19

[crosstalk] Yeah--

Samuel Mugo 11:47

So point of need, you know, chemical analytics is sort of a new term to suggest that we need to do things differently in the way we do chemical analysis. Now, chemical analysis is averarching issue to all of us. Whether you're interested in determining how healthy you are, chances are all of us, you know, we go to our physicians every year, possibly for our physical exam, and often, you know, they would ask us - the physician probably - to, you know, have our blood analyzed--

Brittany Ekelund 12:28

[crosstalk] Mmhm.

Samuel Mugo 12:28

You know, probably have our urine analyzed and so on. And all these specimens, they're taken and sent to a centralized lab with equipment that is localized. They often-- most of these equipments, you know, they're fairly big, so chemical analysis - the conventional way of doing it - is in a centralized place being ran by experts. And it's sort of disconnected from the person who is actually looking for the answers, you know?

Brittany Ekelund 13:06

[crosstalk] Yeah.

Samuel Mugo 13:06

So the answers come a little bit later after the expert, you know, use these equipment to analyze [inaudible] - in this case, for example, blood sample, urine sample - to determine what is present. And, and so, if you look at their footprint of doing that, you know, one - it takes a lot of time. Most of these equipments, you know, are very, very expensive. You need of course, you know, experts who can run those instrumentation. So again, it's fairly expensive to hire experts to do that. Now talk about also the fact that, you know, the, the regions of the world are different, not everyone can really afford these expensive instrumentation. So, already, you've got inequality in the way we do chemical analysis, not to mention also the idea of time. Chances are if you are a patient, you're looking for those results fairly quickly. You know, there is a bottleneck of the time when you give that sample for analysis to that time when you get the results back--

Brittany Ekelund 14:16

Yeah. Especially right now, not only is it taking for-- you might be waiting a month, a month and a half, to even get an appointment to get a blood draw, and then that's stuck in a system and you don't know you're waiting on results being like, Why do I feel this way? [laughter]

S Samuel Mugo 14:34

So, the point of need really is to change the way things are done. You know, instead of these expensive chemical analytics platforms, instead we fabricate very small devices that can be attached, for example, to the person who really need the answers. And you know, the person really is involved in the data analytics of what they are really interested in. For example, in the case of clinical diagnostics, you would have sensors attached to the body and they can monitor things like the heart rate, you know, they can monitor things like the chemical composition of somebody's sweat, and so on. And so you can get, you know, the information in real time and that saves money. [crosstalk] Absolutely.

B Brittany Ekelund 15:27

[crosstalk] Mmhm.

D Dylan Cave 15:27

Would this be similar to people with diabetes who have like a, the sensor in their arm, you can take your phone and scan it, and it'll tell you your blood sugar levels? Is this kind of a similar thing?

S Samuel Mugo 15:39

Absolutely. And maybe that's the most classic example of a very successful point-of-need, you know, diagnostic systems. And in fact, you know, when we are trying to develop new systems, usually that's the model, because it's been very, very successful.

B Brittany Ekelund 15:55

This was something that jumped out to me immediately, when I was looking at your research was, you say, they could monitor the chemical composition of somebody's sweat? And I have a question of like, what can you learn from sweat? [laughter] And the second part, is flop sweat - like nervous sweat - actually different because I'm a nervous person. So... [laughter]

D Dylan Cave 16:20

I sweat a lot, my hands get clammy. [laughter]

B Brittany Ekelund 16:22

Brittany Ekelund 16:22
Yeah. [laughter]

Samuel Mugo 16:23
And you guys don't look nervous. But I think all of us, you know, have got different levels of nervo usness, no question. [crosstalk] Mmhm. And now think about it - traditionally, clinical analysis is done by using blood as a specimen of choice. Now talk about being nervous, if somebody is drawing blood from you, chances are you're gonna be nervous, too. You know, it's very invasive, you know, sort of biological fluid.

Brittany Ekelund 16:55
Mmhm.

Samuel Mugo 16:56
And so, scientists start to think, you know, Can we look for other non-invasive biological fluids that lend even better for point of need diagnostics. For example, even say, you know, you're trying to do the chemical profiling of the well being, say of a baby, chances are they won't be very, very comfortable, their blood being drawn and so on--

Brittany Ekelund 17:28
[crosstalk] Yeah.

Samuel Mugo 17:28
It's very invasive, it's uncomfortable, and so on. And so people have been thinking about other ways of doing clinical diagnostics that are not invasive. And where you can get the chemical profiles in fairly good, should I say, quality even compared to, to blood? And sweat is one of that. Sweat has got lots of the metabolites that are pre sent in, in blood. They could--

Brittany Ekelund 17:58
[crosstalk] I had no idea!

Samuel Mugo 17:59
Absolutely. Yes. Yeah.

Brittany Ekelund 18:00

B Brittany Ekelund 18:00

That's so interesting! Sorry I cut you off... [laughter]

S Samuel Mugo 18:02

Absolutely. You know, so you can actually do a lot of disease diagnostics from the chemical composition of the sweat. And, of course, it's fairly easy to get the sweat. It's, it's not uncomfortable to, to draw the sweat. You know, right on us on this table, you know, we are sweating [laughter] and you know, it's fairly easy to do sweat diagnostics, and get a lot of clinical information from it.

B Brittany Ekelund 18:30

So, how did you get involved with doing this point-of-need research?

S Samuel Mugo 18:37

Yeah, I think that the reason I got involved is, I look at the footprint-- Again, I say that grew up in the tropics, I started in an environment where we didn't have lots of resources. And so I cared a lot to find approaches other than the conventional, where we do chemical analytics with big instrumentation, but instead, you know, to look for better ways of doing chemistry that everyone has got access to. And, and so when I went for my postdoc, actually, after my PhD, I specifically chose to go into an environment where people are trying to make these very inexpensive platforms that can be used, you know, towards clinical diagnostics, or even agri-food monitoring and so on. Reason being you know, it saves money and you can-- it's accessible to to everyone and like I said, you get real time, real time data from it.

D Dylan Cave 19:49

There's a there's a term that you used, that these sensors are democratize the field of chemistry analytics--

S Samuel Mugo 19:59

[crosstalk] Right. Right.

D Dylan Cave 19:59

Could you explain a little bit of what you mean by that?

S Samuel Mugo 20:02

Right, right. And democratization as sort of-- we borrow this term I guess from the politics, you

know, and so on-- about the idea of participation, where everyone finds an opportunity to participate, for example, in the science, in the data analysis, in collecting the data. And the good thing with these point-of-need devices is that you don't have people being necessarily used as specimens, instead you're giving them the tools that they actually need. And they collect the data themselves. For example, you know, I attach, say, a sensor on my arm to actually monitor, again, the chemical composition of the sweat that I'm generating so that I can get the well being information that is related to me.

D Dylan Cave 21:02

Yeah.

S Samuel Mugo 21:02

And if at all I see an anomaly, you know, then I can consult, probably a physician, you know, and so on. So, the idea of democratization, really is changing the playing field where each one of us can truly participate, and we give them the tools that they need in terms of generating the data that they need to make the decisions, you know, related - like I say - to their well being. Probably, if they are farmers, to the well being of the enterprise and so on.

D Dylan Cave 21:38

That's really interesting.

S Samuel Mugo 21:39

And maybe also to comment on that, you know, back to the United Nations Sustainable Development Goals, is the fact that you find most of the global southern countries, you know, the truth is they cannot afford the conventional chemical analytics platforms. You know, like I say, they need centralized lab, lots of infrastructure, lots of money. Some of these environments, you know, they've got restraints in terms of how much money is available, for example, for their health care, and so on. And so these point-of-need devices, again, democratizes that in the sense, what's available to us in the global north can be available to everyone, irrespective of where they are. Because these devices, they are inexpensive. And those people can equally generate the data that they need, relevant to their context, and so--

D Dylan Cave 22:39

Interesting.

S Samuel Mugo 22:39

And so it democratizes that, you know-- [crosstalk] I see what you mean, yeah. [crosstalk] Across the globe. Yeah. I see what you mean, now, by that, for sure.

B Brittany Ekelund 22:48

So, you've been working on these point-of-need kind of frugal smart sensors for about five years?

S Samuel Mugo 22:55

About five years, maybe a little bit longer. Maybe around 14 years actually.

B Brittany Ekelund 23:01

Oh! That's a lot longer! [laughter]

D Dylan Cave 23:03

[crosstalk] Wow.

S Samuel Mugo 23:03

[crosstalk] It is. But maybe over the last five years, I've focused a lot on the point-of-need devices, specifically for clinical diagnostics, especially wearable sensors where we can use them specifically to analyze a sweat composition and then use that information for clinical applications. And also the point-of-need for food-- for analysis of food quality. So that's what I've focused in, you know, in the last five years.

B Brittany Ekelund 23:35

Okay, so, can you give us just, like an idea of-- for example, if you've been working for the last five years kind of focused on clinical diagnostics, what are some examples of things that could be diagnosed using one of these smart sensors or, you know, something that might raise a red flag?

S Samuel Mugo 23:57

Right. Now, they're very versatile. And that's the beauty of chemistry, you know, chemistry is very, very versatile. Meaning that you can almost create a sensor for anything if you understand it's chemistry. And and so what we actually do is create what we call molecular receptors or plastics really, you know, that are smart, that can actually capture any analyte or any compound or any chemical that we're interested in. In our interest in in the last probably three or four years, you know, has been chemical compounds that are relevant or that can be an indicator of mental health. And so we look for things like stress hormones, you know, that would be present in sweat. And like I say, the-- we can make plastics, or what we call

[inaudible] you know, that are very, very specific to capture some of these stress hormones. And when you capture them, you can always play around, you know, with chemical properties that you can measure now that you have captured what you're interested in - in this case, you know, stress hormones.

B Brittany Ekelund 25:19

I mean, that's incredible. So this sensor could analyze your sweat and tell you like you have elevated stress hormones, like you need to chill out? [laughter]

S Samuel Mugo 25:33

And in real time, in real time, and that's the beauty. Because I think we all know that we respond to the environment, and the environment keeps changing, you know, you keep getting exposed to different things across the day or during the day.

B Brittany Ekelund 25:50

Yeah, hour by hour sometimes.

S Samuel Mugo 25:52

[rosstalk] Absolutely. Absolutely. And so you can actually monitor, you know, what are the stress triggers, you know, as you're doing the activities of the day. And I think that makes you able to, or informs you, you know, how you need to adapt or how you need to respond when you've got that data available to you. Yeah, and so, yes, you know, you can actually monitor, you know, your stress level using what we're developing in the lab--

B Brittany Ekelund 26:23

[crosstalk] I--

S Samuel Mugo 26:23

[crosstalk] In real time.

B Brittany Ekelund 26:24

Yeah. And I think that's so amazing. Because if you're ever a person who's dealt with, like, anxiety, stress, sometimes the biggest problem to treating or adapting to living with that is knowing why why do I feel stressed? Why do I feel anxious? Why do I feel like I'm going to lose

it right now. So being able to through the day be like, Hmm, I'm seeing a pattern here, now that I've identified the problem, I can actually start to address it. Absolutely. So I think that that's really, really, fantastic--

D **Dylan Cave** 26:55

[crosstalk] It's really interesting. And my, my, my mind is going so many different places with this research, it's going, Okay, this is the first step of human cyborgs like this is us being able to monitor what our body's doing, be able to see what the insides and it's not necessarily like, in my mind, I'm thinking, you know, human cyborgs like crazy, like, a huge global event of everybody having being a computer themselves. And I'm starting to like the idea more and more, as I'm thinking about it. Yeah, I think I think I need one of these. [laughter]

S **Samuel Mugo** 27:03

[crosstalk] Being just a human is very hard--

B **Brittany Ekelund** 27:22

[crosstalk] Right. You never know why your body is doing things.

S **Samuel Mugo** 27:33

[crosstalk] Right. And, and we are very different too, you know. We respond very differently. And I think if you look at, you know, the conventional way of doing clinical diagnostics is very depersonalized. You know, but we certainly need more personalized clinical diagnostics, because we are very, very different. And so this point-of-need devices brings the idea of personalized medicine, which is which is really needed.

B **Brittany Ekelund** 28:03

Well in clinical diagnostics, to mental health, which, for the most part - and I'm not an expert on this - but for the most part, mental health, there aren't a lot of blood tests, usually you can take. A lot of it is diagnosed through therapy, psychiatry, things that are very expensive and not often accessible to a lot of people. So I think that's really fantastic.

D **Dylan Cave** 28:27

Yeah. Well, you mentioned you're currently working to optimize these devices, with in collaboration with people from the UK, Netherlands, to translate this to a commercial platform.

S **Samuel Mugo** 28:39

Yes, I am.

D Dylan Cave 28:40

When might these devices become commercially available to the public?

S Samuel Mugo 28:45

Now that's a good question. And I really care about knowledge translation. I think it's one thing to do cool stuff, and they remain in the lab. [laughter] I think it's another, you know, when you get these platforms being used by the public, which, which is really the purpose of knowledge, you know, to have the community use that which has been developed. And having said that, you know, these platforms equally take a lot of time, you know, they ecosystem, to build the ecosystem from the lab, you know to--

D Dylan Cave 29:22

Getting a user experience design application.

S Samuel Mugo 29:25

[crosstalk] Absolutely. So, I think we are in that stage where we've confirmed, especially the stress sensors, what we call emotional sensors, you know, work very, very well. And, actually the gentleman in UK, after he saw our publications, they contacted us about working together - them, they are electronic engineers, and as we are chemists, you know, so what they're doing is to create an electronic smartwatch that we can insert our sensors - our stress sensors. And we are hoping that by the summer that we gonna have enough pieces, you know, that we can actually beta test more with a lot more people. So I'm hoping by the end of the year we can actually have, you know, hundreds of devices that you can play with and give to students to play with. And-- [crosstalk] Yeah, like if you're looking for volunteers--

D Dylan Cave 30:30

[crosstalk] I'm not a chemistry student but-- That's, that's, that's amazing. This, this sounds like pretty pretty like this could affect millions and millions of people in a very positive way. And this might be a good time for us to take a short break. [music plays] And we'll be back after some of these short messages.

B Brittany Ekelund 30:54

[music fades out] Are you cool? And do you like cool things, then you'll like River City Revival. They're a local place that supports other local places, from sourcing locally made foodstuffs to supporting local artists and musicians through fun events each week, you can catch comedy, hip hop, singer/songwriters, or come for the Funk Work full-band open jam on Sundays. Plus,

according to our own Dylan, best wings in town, hands down. You can find them right underneath the city's famous Starlight room, and you can check out their menu and upcoming events at revival-edmonton.com. See you there! [music plays] And we are back. So next up, we would love to talk about your research on transdermal drug delivery platforms. [music fades out] So can you explain to us kind of how these work and tell us about your research?

S Samuel Mugo 31:46

Right. So the transdermal drug delivery, actually, they're very connected, you know, with the wearable sensors. I think we try to be holistic, I think it's one thing, you know, to do detection, but after you realize, you know, probably, you know, say the cortisol levels are high or you're being stressed out - what can you do about it? So we thought, to actually close the gap, then we need a way to release the therapeutic on the same platform. So you do the sensing, and then you release the therapeutic on demand. So if the stress level is high, probably you need a dose of, you know, something that can regulate that and that can be released right on the skin. And again, this is to try and do things differently and make, you know, should I say, therapy fairly comfortable. Instead, for example, of using hypodermic needles to do drug injections, which of course we all know is very uncomfortable, so you can have wearable patches that releases the drug on demand when the patient actually needs it. So you can, again, you know, Dylan brought the issue of the glucose sensors. And the model for that now is that, you know, they've got an insulin pump, you know, at the same time. So you do the diagnostics for the glucose monitoring, the glucose is high, you know, you've got an insulin pump. So very, very similar, where you can use it really for other therapies as well beyond the glucose. You know, I think there's a lot of empty space in my chest cavity where I could just have like, all these little devices, with like, insulin and like all these other things, that when you find a chemical imbalance, to fully start thinking about the human cyborg thing, I think this is the thing that we need to start looking at. [laughter] Right. Yeah. And so these might-- so the way we design it, you know, is that, we got the sensors, and then we've got these transdermal delivery, and maybe somebody would ask, How does the drug actually get delivered to the body? And you have the skin, and of course the skin is a barrier, and so the way we do it is we've got some very small micro needles that we attach on the skin, that only poke the barrier. And now, you wouldn't feel pain until you penetrate the barrier to where the nerve endings are, but our micro needles are not that long so they only poke the barrier. So you don't actually feel pain. And then the drug is released to what people call the interstitial layer-- [crosstalk] Mmhm. That is just above where the nerve endings are.

B Brittany Ekelund 34:56

[crosstalk] Oh, okay.

S Samuel Mugo 34:56

[crosstalk] It's a very comfortable system.

B Brittany Ekelund 34:58

Yeah. So what would it-- would it feel like a little like Velcro?

Yeah. So what would it -- would it feel like a little like Velcro?

S Samuel Mugo 35:02

Oh, a little itch probably. And the drug, the drug is released. So I think it's a very should I say, convenient way of doing drug release, drug release.

B Brittany Ekelund 35:19

So what are some examples of treatments or therapies that can be delivered through these platforms in particular?

S Samuel Mugo 35:29

Now, there are a couple of them. For example I'm drawn to mental health and of course, I mean, people who use a lot of say, you know, antidepressants and or stimulants, you know, for example. I can see on the table right now, we are taking water, but we don't have caffeine. Caffeine is a is an excellent example of something that can actually be delivered right on the skin. Another example, you know, is cortisol. Okay.

B Brittany Ekelund 36:02

Okay.

S Samuel Mugo 36:03

And it's very interesting, because, while we say that cortisol is the stress hormone.

B Brittany Ekelund 36:10

Yeah.

S Samuel Mugo 36:10

You can have some cases where you've got very low amounts of cortisol. And when you've got very low amount of cortisol, that can equally be a bad thing. Some people call it you know, hypercortisolism. And so that is when a patient sometimes is immunocompromised, and so they are not able to produce a lot of cortisol, but especially, you know, with people who are undergoing cancer treatment. And so again, in that case it's possible to actually deliver the cortisol right on their skin.

D Dylan Cave 36:50

Wow.

S Samuel Mugo 36:51

Maybe another example, you know, is - I don't know, if I'm allowed to talk about it, but from the chemical point of view, I can, is cannabis. Okay. All right. The active compound is what you call the tetrahydrocannabinol.

B Brittany Ekelund 37:07

Mmhm. THC.

S Samuel Mugo 37:08

The THC.

B Brittany Ekelund 37:09

Yeah. [laughter]

S Samuel Mugo 37:09

That's right. And, you know, there are many ways of administering it. I think some people it's administered by smoking and so on. And there's so many people who might be uncomfortable with that kind of therapy - especially if at all. Again, I'm not talking about, you know, using it recreationally. Yeah, I'm only focusing on the medical use--

B Brittany Ekelund 37:34

But even like smoking THC is, arguably-- Yeah. Not great for your lungs. So it's not maybe an ideal...

S Samuel Mugo 37:39

Absolutely. [crosstalk] Absolutely.

B Brittany Ekelund 37:43

[crosstalk] Method of delivery.

S Samuel Mugo 37:44

So that's how, again, you can really use it for lots of different types of therapies. You know, with the examples that I just gave.

B Brittany Ekelund 37:55

Okay, I'm kind of interested. So these would be more of like a short term, it would sense, say, stress levels rising, and it would be able to deliver a dose of whatever you need. Could this kind of sensor also be used, perhaps for other kinds of drugs that you would take every day? For example, you wouldn't want a sensor that sensed stress, and then released an antidepressant? per se, but what if you were a person who took an antidepressant daily, and you had a terrible memory? And so would it be able to sense you know, like, a falling level and be like, you missed your dose? Boop, here you go.

S Samuel Mugo 38:43

Right. So yes, you can use it, you know, for many different types of therapists. And of course, like I say, you know, it's much more convenient, it's a lot more cheaper, talk about waste as well. You know, the hypodermic needles, you know, are one of the materials that produce a lot of medical waste.

B Brittany Ekelund 39:06

Yeah.

S Samuel Mugo 39:06

You know, again, so using these types of therapies, you know, you're also trying to solve, you know, the medical waste problem.

B Brittany Ekelund 39:15

Yeah, that's cra--well maybe you could--

D Dylan Cave 39:17

[crosstalk] That a great way of thinking about it.

B Brittany Ekelund 39:18

Instead of having epi pens, maybe it would be more affordable and accessible to be like, Whoa, you're having a crazy allergic reaction, like, bam, there you go. [laughter]

D Dylan Cave 39:28

So these platforms, kind of use the same technology we were talking about before with the smart sensors. Are there also plans to translate these technologies to commercial platforms? And what might the timeline be on that as well? Because all the things that I care about are like, how can we get this out to the world?

S Samuel Mugo 39:48

And I think that's a good question. Yes, there are. In fact, my collaboration with the people in Netherlands is specifically to pair the detection and the drug delivery. So the people we are working with Netherlands, you know, they're actually oncologists. And, and so they are interested in delivering therapies right from the skin. You can do say the sensing, for example, of different cortisol level if a patient has got this condition of the hypercortisolism, then they can actually deliver the hydrocortisone right on the skin. So, this one is a bit farther off, you know, we started just [inaudible] collaboration this year. So, in the summertime we will be trying to develop the prototypes, and then hopefully next year and so on, that's when we are really hoping to ramp up the idea of translating that possibly into a commercial platform.

D Dylan Cave 40:55

Now, now, do you think that releasing this to the public or on a commercial platform, there could be some misuses of something like this?

S Samuel Mugo 41:06

That's a good point. Um, I think anything can be used inappropriately. As you well know, I think people are ingenious. And, and ingenuity, you know, means that we can release, you know, some of these products, and those products are gonna inspire others to produce other products, you know, that are beneficiary as well. I think we always say, you know, knowledge is cumulate, you know? You look at what has been done out there, and you enhance it, you know, probably for another application. We say that's the art of innovation, you know, looking at what's available, and probably repurposing it for another application.

D Dylan Cave 41:56

Yeah.

S Samuel Mugo 41:57

So, actually, my focus more is what can be, you know-- In a positive sense. Because when you release it, people are ingenious, you know, they, they innovate. You know, a lot [inaudible] can be used, you know, for other types of therapies that we are not doing in our lab ourselves, or

other types of diagnostics that you're not doing in the lab.

D Dylan Cave 42:00

[crosstalk] Of course.

S Samuel Mugo 42:07

[crosstalk] Yeah. So, so I think it's gonna be a net, a huge net benefit to the community in that sense.

B Brittany Ekelund 42:26

What kind of therapies would you focus on first, like, what would be the first ones, if you were, you know, once you get to the stage where you're ready to start creating these delivery patches?

S Samuel Mugo 42:37

Right. Now, it's very important that from my end, you know, I always go with what's available to me. And what has got, should I say the least path resistance - especially in terms of regulations, and so on. So if something requires a lot of regulations, then I have to work with people who are experts in that field. And that's sort of what we are doing, for example, like I say, with the people in Netherlands, if at all, it's something that is related to drug deliver of patients. Again, I'm not a medical doctor myself, so again I have to work with people in that field who understand the regulatory aspects related to that. And so actually, from my end, I think I'm more interested, you know, with things related to lifestyle that do not require extreme levels of regulation. And for issues that need extreme levels of regulation, like I said, I work with the medical doctors, and we collaborate, and they can take care of the pain of the regulation, because they actually understand it.

B Brittany Ekelund 43:54

Yeah, exactly. So, yeah, okay, um, I guess we will jump right into now, sensors. And these are the same kind of point-of-need sensors. But you're using them to monitor food quality. So this is a really fascinating topic. So can you tell us all about how you are using these sensors in this very, very different application?

S Samuel Mugo 44:26

Well, it sounds different, but from the chemistry point of view, they're very identical. And I think, from chemistry, we always say, What we look at is nothing but biochemical machines, including ourselves. But so is food - it's made up of different types of chemicals. And maybe that's what we always say, you know, about the evolutionary convergence, things are very,

very similar. If I look at a plant and it's physiology, for example when it gets stressed out, just like a person, it releases certain types of chemicals that may be slightly different, you know, than a human being or than an animal.

B Brittany Ekelund 45:13

Yeah.

S Samuel Mugo 45:14

But nonetheless, you know, it responds by releasing different types of chemicals--

B Brittany Ekelund 45:19

Well, don't they say, say when you cut grass, the smell of the cut grass is actually the grass being like, Ahhhhh! [laughter]

S Samuel Mugo 45:26

[crosstalk] That's right. Yeah. [laughter]

D Dylan Cave 45:27

[crosstalk] That's horrifying! [laughter]

S Samuel Mugo 45:28

That's right. That's right. [laughter] You know, so yes, they're very similar. So different application, but at the chemical level, things are very, very similar. So yes, we've been trying to develop wearable sort of sensors that can index food quality, particularly foods that spoil quickly. Now, they say that almost 30%, you know, the food is wasted in the distribution chain. So that can be, you know, at the grocery store, when that food has been transported from one location to another. I think we all know that we are experiencing these [inaudible] in their supply chain, right now.

B Brittany Ekelund 46:16

[crosstalk] Yeah.

S Samuel Mugo 46:17

So who knows, you know, there might be [inaudible], you know, lots of foods that get wasted

from spoilage. And, and so what we are trying to do, you know, is creating sensors that are still wearable, but in this case that attaches on the food, for example, a piece of fish, and then it can monitor the quality of that fish in transit and when it's on the shelf. I don't know if you've ever gone to a shelf, or a grocery store, and for most people, the way we determine if the food is good quality is by smelling it. And you know, which is not a very, should I say sensitive [laughter] way of doing it--

B Brittany Ekelund 47:01

[crosstalk] It's not. [laughter]

D Dylan Cave 47:01

[crosstalk] No, not. Not right,

B Brittany Ekelund 47:02

[crosstalk] It's not a very scientific method of calculating freshness

D Dylan Cave 47:05

You look at it, you smell it--

B Brittany Ekelund 47:06

You poke it. [laughter]

S Samuel Mugo 47:08

That's right. That's right.

B Brittany Ekelund 47:09

This particular piece of the point of sensor technology is so promising to me is that food waste and food production, things like best before dates, I think a lot of people think of them as expiration dates. So we are wasting so much food all the time.

D Dylan Cave 47:33

Imagine the commercial kitchen applications to these sensors, having sensors on our food and our refrigeration is keeping people more safe, reducing the risk of foodborne illness.

B Brittany Ekelund 47:43

And reducing waste, right? [crosstalk] And reducing waste.

S Samuel Mugo 47:45

[crosstalk] Right. Right. And, and maybe just to point out, you know, the fact that then we make decisions by assuming. And I think that's what Brittany you say, just because just because something says "Best Before" days, you know, then you throw it out after that date, because you assumed that it's not good to consume--

B Brittany Ekelund 48:09

[crosstalk] Yeah, it's like, a stigma or something.

S Samuel Mugo 48:11

That's right. But again, if [inaudible] you had sensors that index that quality of that, then it informs you to make the most appropriate decision based on evidence, rather than assumptions. And and so, yes, and of course, think about the climate change and the footprint of throwing that bucket of, that bucket of milk that costs a lot actually to produce.

B Brittany Ekelund 48:38

Mmhm. And to package and then to get shipped across maybe a province, maybe it's coming from Ontario, like the transportation costs, fuel burning. Like it's the food production, how we eat and what we eat is such a major contributor to climate change, and like food inequality, like grocery stores have to throw out food, when there are literally people who are hungry and need to eat so that to me is like [buzzer noise].

D Dylan Cave 49:06

[crosstalk] Yeah, just crazy

B Brittany Ekelund 49:08

[crosstalk] but that's a different podcast. [laughter]

D Dylan Cave 49:08

So have you ever-- has either of you been to the TELUS Smart Home when it's touring around? Like a few years ago, there's the TELUS Smart home it was a trailer that they brought to like

Like a few years ago, there's the TELUS Smart home it was a trailer that they brought to like this the Telus space and science center. Well, TELUS made this smart home, right? You walk up to the door, it scans you with a with their Xbox Connect, right? And it's, it recognizes your face and it opens the door for you and things like that. Same with the facial recognition on our phones, but the kitchen I was extremely intrigued by because they had the smart fridge and the smart cooktop, okay, so you would have food in your fridge it would, you know, at that time, they don't have any like the actual technology that they said they did. But essentially each food in your fridge has a scanner tag on it, and it recognizes when you've run out of it and it puts it on an order list. But when you put your food on your counter, there's a little scanner, that tells you what the composition of the food is, okay, this is rice, it's this much protein in this much so and so. So looking at the different different applications of how we might be able to use these new sensors that you're working on. But this, what we're more specifically talking about the production of food and the traveling of food and everything. How are there other uses for them, maybe examples of like, the stress levels in Plants versus monitoring the freshness of packaged food, I guess,

S Samuel Mugo 50:37

And I think you really raise a good point about the idea of, you know, precision sort of nutrition. Now, we are getting into a world, you know, that is very, very interconnected digitally. And not just interconnected in terms of people, but in terms of the things that we engage with, and I'm sure you're-- what you talked about Dylan, is this idea of, you know, the Internet of Things, where be it, the food that you're consuming, you know, sort of is digitized in a way and the way you're engaging with it, you're generating a lot of data. When you consume it, you can even determine the amount of calories, you know, like you said, that you're consuming and so on. So I think the sensors are fast tracking, as the food sensors are fast tracking us in these-- to this frontier of precision nutrition, where you just consume and track actually how much you consume based on your needs.

D Dylan Cave 51:53

Yeah.

S Samuel Mugo 51:54

It's very interesting in terms of the divisions of the world, that in North America, you talk about a problem with over-nutrition, where we consume too much. Whereas in other parts of the world, the problem is under-nutrition. And so again, you know, the precision sensors can help in that end, you know, to, should I say bridge that gap for us in North America. We just want to consume just what we need, because there's too much around us.

D Dylan Cave 52:27

Yeah.

S Samuel Mugo 52:28

Other parts of the world, you know, they want to consume enough as well. So, again, you know, the sensors will be very helpful towards not just monitoring that quality, but also monitoring the composition, and the caloric content and the nutrients content in some of these foods, and of course, indexing, you know, how much you're consuming and so on.

B Brittany Ekelund 52:52

For many women in the entire world. Something like iron deficiency is a huge deal, especially in pregnant women. Would a point of need sensor be able to monitor from, like, a non-invasive bloodwork that could say, Hey, you need to be supplementing with iron, or you need to eat more kale or whatever?

S Samuel Mugo 53:17

It's a great point. And I think, you know, Brittany you are being a good student in the sense - and that is the art of innovation, you know - as somebody, somebody who is not a chemist, recognizes probably I need out there. And certainly, it's in the purview of chemistry. And a very, very good problem. And I think, in lots of countries, particularly the tropical countries, iron deficiency is a big, big problem. But think about it, it's a very simple way to detect, you know, nutrient or other iron deficiency.

B Brittany Ekelund 53:59

Mmhm.

S Samuel Mugo 54:00

So, absolutely, you said something that can be-- In fact, you're giving me an idea now. [laughter]

B Brittany Ekelund 54:03

Well yeah. Even thinking for like, you know, during pregnancy, like folic acid, things like that, if you had a patch, that was monitoring your deficiencies, and even when you say, right now, we're living in a culture here of excess, like your patch could be like, Yo!

D Dylan Cave 54:23

[crosstalk] Yo, you're eating too much. [laughter]

B Brittany Ekelund 54:24

Eat some vegetables, like maybe you're, you haven't gotten enough vitamin C today. So most people, I would say the majority of people might not be highly educated on nutrition.

S Samuel Mugo 54:37

Right.

B Brittany Ekelund 54:37

It's not something I think is taught enough. So right, across Canada, in every community, people could benefit from understanding Oh, I'm not actually getting what I need.

S Samuel Mugo 54:47

Right.

B Brittany Ekelund 54:47

And like that could solve so many health issues down the road. So...

S Samuel Mugo 54:51

And I think you're right and the way it's done right now, even in simple things as determining deficiency nutrients such as iron, you know, the patient goes to the hospital - because after so much has happened for them to go to the hospital - it means they are doing very poorly. And blood is drawn again back to a centralized lab to monitor something as simple you know, as iron content. Again, you know, with sweat, that's something that can easily be done, you know, the monitoring of iron, just using our wearable sensor, right on sweat that we produce every day. So, again, it can be, you know, in real time, day by day, what do you need? Yeah.

B Brittany Ekelund 55:42

I think that that's, like, so fascinating. Um, so for kind of this work with the sensors, applying them to food quality? Where did how did you get involved with us? Like, where did the idea come from, to apply this technology, to food, and health and wellness, right?

S Samuel Mugo 56:03

Maybe, for me, that was the easiest actuall, to get into, because I think all of us eat food. And like I said, where we grow up, it's informs, you know, how we think and how we engage with life, even when we get older. Like I said, I grew up in the tropics where food get wasted. Partly because there's no preservation - especially when I was growing up. Things have changed now,

of course, now preservation, and so on. So food waste becomes a significant problem in an environment when it's very limited of that resource. And then, of course, you come again to a different context, you know, where we produce or consume a lot of food that is imported with a huge environmental footprint. And so again, you know, that draws my attention. So, I'm always drawn to working on areas, you know, on conservation. Can we just use less, and can we conserve, you know? The idea of, you know, wasting food and so on, like I say, if you look at the statistics - big, big problem in North America, you know, 30% of what we actually get to the grocery stores and so on, you know, is actually wasted. Big, big problem. And, and so I, you know, I was drawn to, can we conserve the food that we produce. And then the idea of the interconnected and interconnectedness you know, with these 17 United Nations Sustainable Development Goals. Food security remains a big problem across the world, and I think for a long time in North America, you know, we were averse, or unaware of food security. I think that COVID, you know, is bringing it home - that you go to the grocery stores now, and then you realize, for most of us food insecurity can happen anywhere. So in order for this to work, it would have to be pretty inexpensive for producers and stuff to have to attach one of these to, say, like, a fish producer or something like that. With-- would such a widespread application be achievable with with something like this. Absolutely. And it's back to the idea of point-of-need. Point-of-need, by definition, you want them to be as inexpensive as possible for it to be actually feasible. So, our type of sensors, actually, we've got a budget of two dollars, so the sensor itself should not cost more than two dollars.

D Dylan Cave 59:06

Wow.

S Samuel Mugo 59:07

And so, again, you know, I guess that's achievable to to lots of people.

D Dylan Cave 59:12

Yeah, I mean, you could look at this, as soon as we started thinking about, it's like, okay, well, does every head of celery need a sticker? or need a need a sensor? Or do we incorporate this into like a, like a, like, we have temperature guns. So if we have like a little gun, you just like tap it down onto the, so you can have one thing for multiple things. But, yeah, no, but it's achievable.

S Samuel Mugo 59:38

It is achievable.

D Dylan Cave 59:38

It's like two dollars added cost to something like that. But it could also extend the use of of a lot of this food.

S Samuel Mugo 59:47

And maybe that's the other point, you know, that we have to really look at the cost of not doing something. I think the cost of what is actually wasted, and should I say the multi-layers-- Oh. Fair enough The multi-layers of costs that people forget to put in their calculations of what costing, for example, to produce food or to waste food. And so the idea of conserving food, you know, I think we need to invest more in that. But as I say, we've made sure that the types of sensors that we have are not a barrier just because of because of cost.

B Brittany Ekelund 1:00:24

Well, I think that this kind of technology, if inexpensive, and if available, could play a part in this kind of growing movement against food waste that we're seeing in the world. I don't see why you couldn't lobby the government to say, Actually, you know, at least all perishable products in Canada must carry the sensors or something like that, like, it's, maybe that's 10, 15 years in the future, but like--

S Samuel Mugo 1:00:51

And again, if you think about the impacts-- So, I think food, freshness, food quality, and then back, I guess, to health, you know, food poisoning. I think if you add on that cost, probably productivity as well - if somebody is poisoned, they won't go to work maybe for a couple of-- so, it really, really adds up. I think, as stakeholders, I think we need to think about the interconnectedness of things and try to solve some of these issues. Especially, you know-- but I think using technology, we can do that,

D Dylan Cave 1:01:34

Imagine a grocery store that has a computer server room to monitor all of the vegetables that they have. And instead of, instead of having to spend time and go and look at all the fruit or whatever you have to do, all that information's there. So it can send you an alert that says, Oh, hey, you remember row three that has the iceberg lettuce, the one in the back needs to get thrown away or something like that, right?

B Brittany Ekelund 1:02:01

For me, for me, especially just because I'm like, animal production is so hard on the environment, what kind of energy went into raising this animal transporting this animal, it is a living thing, right? Basically, that is not alive anymore. And then we're going to take that and package it, and throw it in the garbage. And it's like, such an egregious crime against humanity.

S Samuel Mugo 1:02:31

So, and in fact, I like the way you're putting it. I think it's almost an-- almost borders on an ethical issue. You know, I think when you produce something, and especially in the case of animals, and then with all that footprint, they end up in the garbage. And with the inequality that we face across the world? And, yes, I think we've got the technology to solve that, because we do, you know, we got all these sensors that we are talking about that we can track the food from the way it's grown. You know, lots of people now care about what they are consuming, and the way it's grown. You can track that food, all the way until it becomes you know, a nutrient for someone and I think we need, you know, to invest in those technologies that, should I say secure, really, a future. And that secure, you know, our globe.

D Dylan Cave 1:03:36

This definitely seems like something a lot of money needs to get behind. You know, the I hope you have enough funding to be able to make this make this possible, because I think there'd be a lot of people interested in funding a project like this.

B Brittany Ekelund 1:03:47

Yeah, we are getting towards the end. But before we move away from this, again, very fascinating concept - and yeah, huge ethical implications - where is this kind of research? Like, how far are we do you guys have a workable sensor? Like when might we see this technology being used?

S Samuel Mugo 1:04:10

Now, the good thing I think, with what we do - we do Applied Chemistry. So, before we talk about it, you know, it's not just an idea. I's something that we have developed and, should I say, we've got a working prototype. So the things that we talked about, are things probably-- we've probably, you know, published on. And to publish in our field, you know, you need a working prototype. So we've got, yes, a working prototype. Now, to go back to Dylan's point, you know, that you need investment. And I think we are in that space of looking actually for investment in order to close that gap of having prototypes to making things into commercial products. And so the most of my time is really spent looking for collaborators, looking for money, you know, to try and get get these prototypes into, you know, into lots of prototypes that can be tested and then, you know, into into commercial platforms.

B Brittany Ekelund 1:05:27

I mean, I would give to a GoFundMe, find me for this research, you have my few dollars! [crosstalk] Well that sounds--

D Dylan Cave 1:05:35

That definitely sounds like it should be a federally funded project, it sounds like this could better a lot of Canadians and a lot of people in the world. So, um...

S Samuel Mugo 1:05:44

And maybe I should acknowledge that, you know, that most of the work that we have actually done, the reason it was done in the first place is because it was funded.

D Dylan Cave 1:05:54

Funded. Exactly.

S Samuel Mugo 1:05:55

You know, so yes, we've got a n NSUB Tri-Council grant that we use to do the work that we do, to pay the students, get the reagents that we need. And so we are really, really thankful for that. Do we need a lot more to scale up to create commercial products? We certainly do. Yeah, of course. Yeah.

D Dylan Cave 1:06:18

Before we let you go, we just want to leave the conversation with you and just ask, Do you have any last words of wisdom or something that we didn't cover in the episode today? Basically, anything, maybe something new you're working on, we just want to leave it with you to say anything that you'd like to say?

S Samuel Mugo 1:06:39

Well, maybe I should first say, and then acknowledge, you know, the fact that what we do, you know, we largely do it with the students, you know, we really engage the students in the whole of this process. And so my research program, really, you know, it's about, yes, creating these products. However, most of it is having the students involved in the art of innovation and having them trained, you know, in these art of innovation. Because, of course, for most of us, we're only gonna be here for a short time. But when you've got lots of students, then you're able to skill that mindset, you know, and they can go and produce--

D Dylan Cave 1:07:26

[crosstalk] Future generations.

S Samuel Mugo 1:07:28

Absolutely. So I would say, you know, most of my research, yes, in most cases, I come up with the idea, but the people who actually do the execution, you know, are my excellent, my excellent students.

D Dylan Cave 1:07:41

Big shout out to the students!

B Brittany Ekelund 1:07:42

Well, that is everything we have for you, unless there's anything last last chance...

S Samuel Mugo 1:07:50

So again, thank you for this opportunity to engage and to have my, some of our research - not mine, just our research ventures to the audience of these podcasts. Maybe my other comment, my very last comment, you know, is the idea of investing in innovation ecosystems. If you look at, should I say, different countries, the innovation ecosystem is such that you've got products that we are making in the lab, and for them to end up in the market place, you need to invest in the entire ecosystem. Now, in Canada, actually, we've got a significant gap in that ecosystem - particularly Knowledge Translation. You know, where we do excellent, I think generation of ideas, developing of prototypes. But in that ecosystem, I think, to end up with a finished product, some of that technology is lost and doesn't end up in the community. And I think we should be very intentional, all stakeholders - you know, universities, governments and so on - to make sure that our innovations do not get lost in this thing that we call a chasm between knowledge translation. And I think all universities, you know, should really invest in that - in incubators and so on, that tap into these ideas, you know, that--

D Dylan Cave 1:09:40

Really see them to fruition.

S Samuel Mugo 1:09:42

Absolutely. And not just by the faculty members. But also I think the students. I've worked with many, many students, and they always come up with just amazing ideas, that you know, if we provide that environment, to incubate those ideas, now these guys can, you know, develop those ideas, develop businesses out of those ideas. So my point is, I think we need to really find then entire ecosystem in order to make sure the investment that we put in, you know, in research early on, you know, we get a return out of it by having it translated into final products that the communities can use.

D Dylan Cave 1:10:29

That's a really great point.

B Brittany Ekelund 1:10:30

I think it's fantastic. [Outro music plays] Samuel, thank you so much for joining us today. This has been another episode of Research Recast(ed), the knowledge mobilization podcast of MacEwan University. Well, that's all we have for today's episode of Research Recast(ed). If today's episode left you positively charged, please follow up with any links in the episode description to learn more. If you think we've got chemistry, you can support us in this podcast by visiting Research Recast(ed) on your favorite podcast platform to catch new episodes every two weeks. Also check us out on Instagram at Research Recast(ed) where you can leave a like, give us a follow or send a message if you have any follow up questions from today's episode.

D Dylan Cave 1:11:11

Research Recast(ed) is hosted and produced by Dylan Cave and Brittany Ekelund. Music, sound design and editing by Dylan Cave, with research, copy editing and scripting by Brittany Ekelund. Our executive producer is Ray Baril.