CENTENNIAL COLLEGE

kite WORKS

Volume 2
2021-2022

KITE AND CENTENNIAL COLLEGE UNITE TO SHARE STORIES OF RESEARCH INNOVATION

In this volume:

kite UHN

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Introduction

At the University Health Network, there is a research institute called KITE. KITE stands for: Knowledge, Innovation, Talent, Everywhere. This is a big mission statement. How are the staff, researchers and scientists at KITE able to uphold this? They unite. In ultimate collaboration, KITE soars beyond the boundaries of modern science. Professionals intersect in state of the art labs and embark on exciting research ventures, all for the goal of providing curated patient care.

In the spirit of unity, KITE also continues its relationship with students in the Professional Writing - Communications program and the Photography program at Centennial College. As part of our Storyworks curriculum, a class that provides students an opportunity to experience client relationships, we had the pleasure of peering into the work being done at KITE.

By talking to some of their top scientists and staff members, we saw the essence of KITE's mission statement. In this second edition of KITEworks, we are thrilled to showcase how the institute has united to become a world leader in rehabilitation science.

Sincerely,
Storyworks class of 2022

A MESSAGE FROM THE PROJECT MANAGERS

As the project managers for this year's KITEworks magazine, we could not be happier with the finished product and the effort it took to reach this point. This has been a labour of love, and an opportunity for our Professional Writing & Communications and Photography cohorts to actively express ourselves through our crafts. It also has allowed Centennial students to produce work that helps celebrate excellence in research and medical services.

We took on the roles of project managers not through a complex electoral process, nor a desire for power and control. We gained these roles simply because we were the first ones to put up our hands for it at the start of the KITEworks project. Who knew that the simple motion of sheepishly raising our hands could have resulted in an experience so deeply challenging and rewarding. We had the privilege of balancing the rigours of being a Centennial student with the demands of the teams and clients involved in the magazine's creation. Some days were more chaotic than others. But in the end, it led to a certain creative unity that we hope carries through to you, the reader.

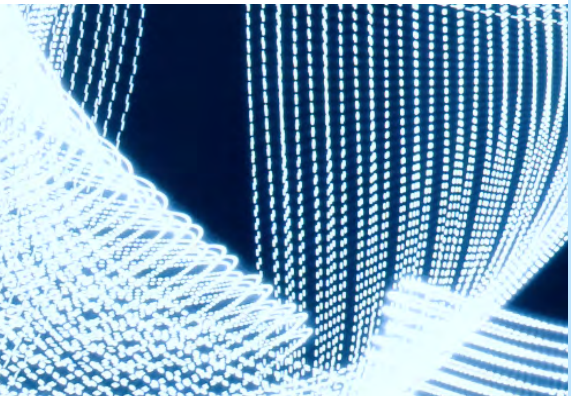
We would like to thank all of our peers for their tireless work in putting this magazine together: to all of the researchers and administrators interviewed for their help and cooperation, in taking time out of their busy schedules; to the KITE Directorate's Office team for always keeping us on track and supporting us when needed; and to the wonderful researchers and staff who aided in this process. If we learned one thing putting this together, it's that "unite" is about more than just KITE, Centennial College or the research that is showcased here. It is a way of emphasizing that when it comes to Knowledge, Innovation, Talent, and Unity, one craft or one individual should never be the sole focus. As the old adage goes, "it takes a village." Thanks to everyone for coming together to form an exceptional village.

Arjun Hari and
Quinn Henderson

A NOTE ON THE PHOTOGRAPHY

The photography featured in the magazine was shot by students of Centennial College's Photography program. Due to circumstances regarding the ongoing COVID-19 pandemic, they had limited access to KITE's facilities. To work around this, some of the photography on display here is light painting.

Light painting is a technique of moving a light source while taking a long exposure photograph. This tactic creates stunning visual effects, featuring powerful suggestions of movement, combined with luminous colours. The images they created using this technique are meant to capture concepts like motion, recovery and unity. Talk about innovation!



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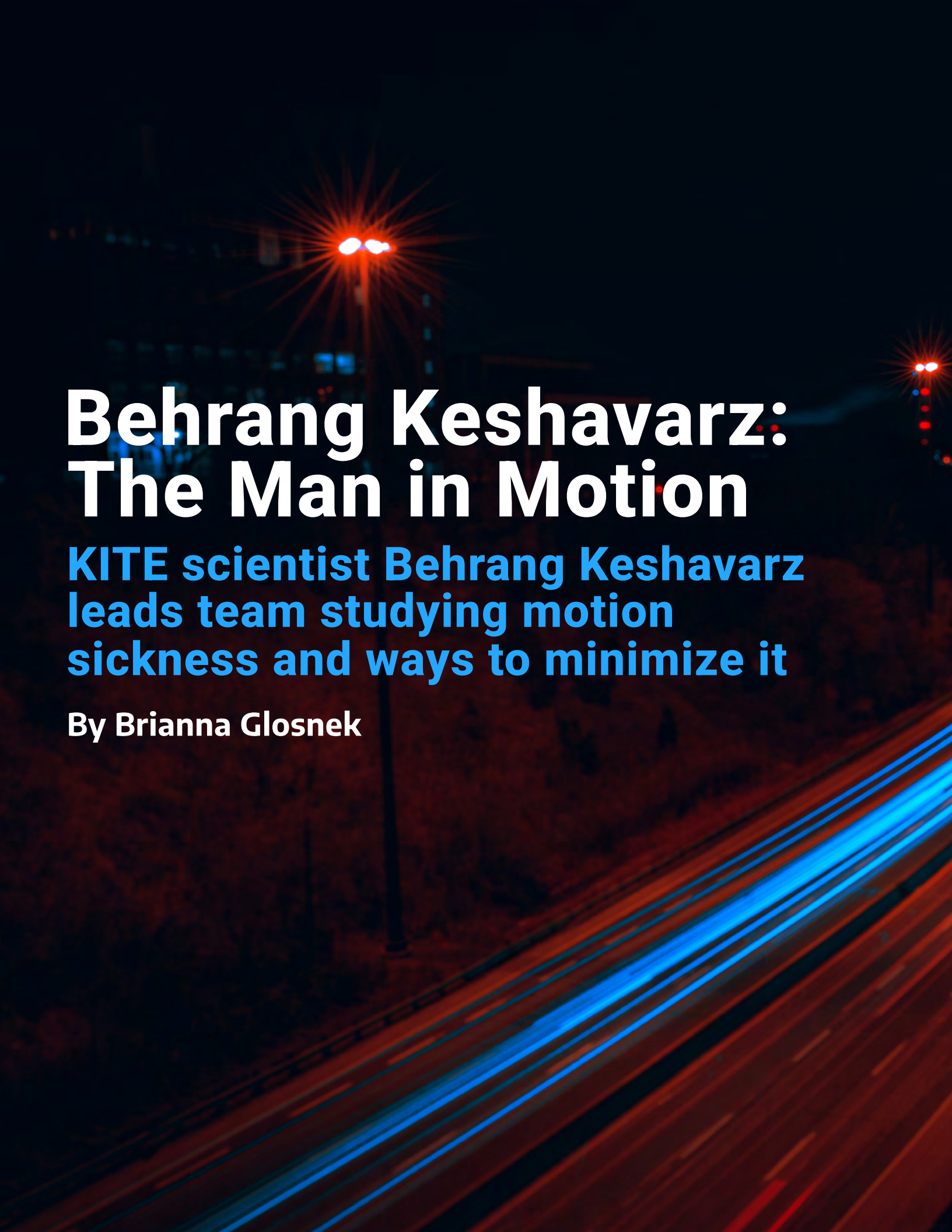


Behrang Keshavarz: The Man in Motion

KITE scientist Behrang Keshavarz leads team studying motion sickness and ways to minimize it

By Brianna Glosnek


“Everything that’s visual has to be perceived. And the perception, at some point, can cause negative side effects”

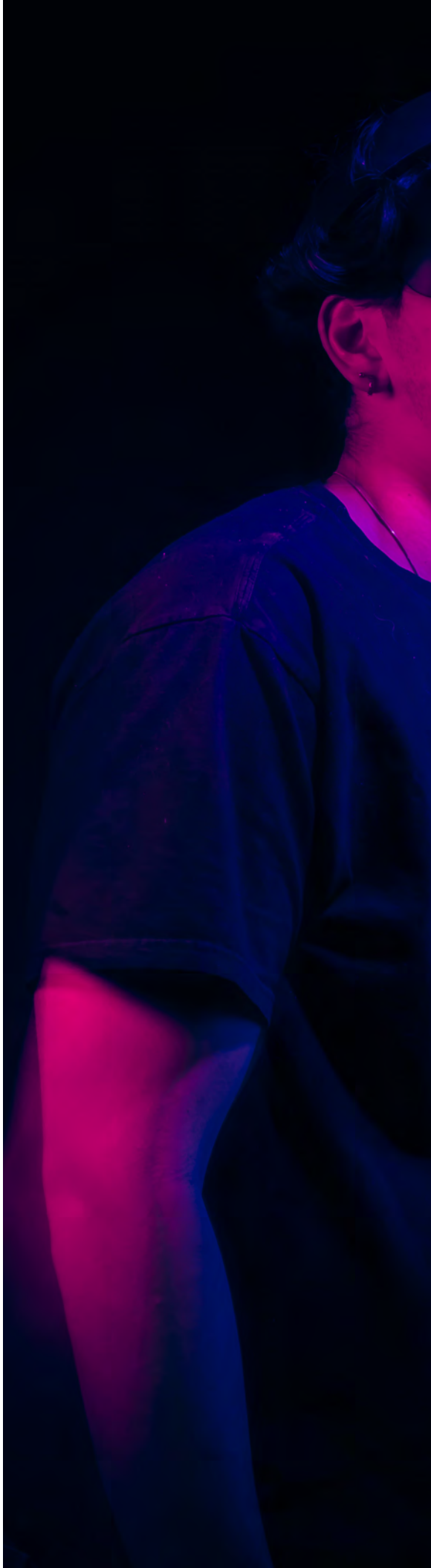
When Dr. Behrang Keshavarz started a postdoctoral fellowship at KITE in 2012, the team had a specific job in mind for him. It was developing DriverLab, a driving simulator that includes a 360-degree projection system with immersive view, surround sound and additional features, such as an eye-tracking system and rain simulator. It was the first of its kind in Canada and aids research surrounding safe driving and vehicle collisions.

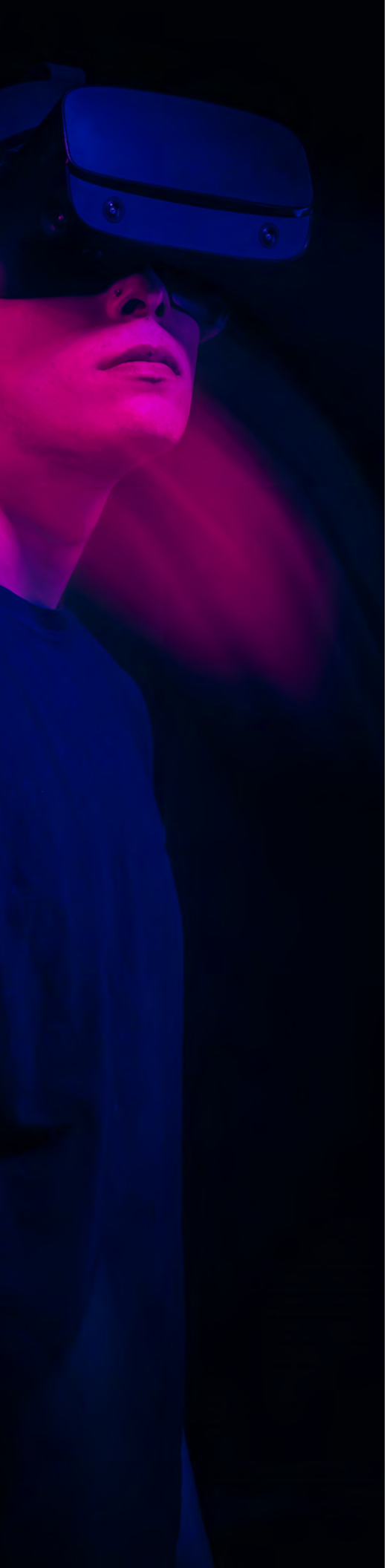
The team was aware of the potential for research participants to experience motion sickness in these types of simulators, so Keshavarz was tasked with studying ways to potentially control, or at least minimize, the side effects experienced in these instances.

Over the past 10 years at KITE, Keshavarz's research footprint has expanded beyond DriverLab, mostly because motion sickness isn't confined to a driving simulator. Similar issues also occur in StreetLab, another simulator based at KITE's Challenging Environment Assessment Laboratory (CEAL). Users of StreetLab are fully immersed in an audio-visual simulation that replicates downtown Toronto, including cars and pedestrians.

Another lab Keshavarz works in is called PerceptionLab. It is arguably the simplest of the group, but the most important to Keshavarz's everyday research. Screens, projectors and a head-mounted display (virtual reality headset) are available for research use. It's a small but crucial space in the study of motion sickness related to virtual reality and visual stimulation.

"A lot of things I investigate don't necessarily need highly sophisticated or advanced laboratories. You can induce symptoms in a very simple fashion in an effective way and then try to minimize it," Keshavarz states.





A primary area of research for Keshavarz is visually induced motion sickness (VIMS). The name itself is an oxymoron as the first two words contradict the third; the sickness comes on through visual stimulation, but there is no motion involved. Rather, it feels like you're moving.

"The word 'motion' is misleading, but the symptoms that you have are very similar. Nausea, disorientation, fatigue," he states. "Simulator sickness is only one special type of visually induced motion sickness."

VIMS is the overarching idea that crops up in most of Keshavarz's work, including driving research in the DriverLab. When you are completely still (while sitting and watching a screen, for example), what causes you to feel like you are moving? And what can you do to reduce this uneasy feeling? Also known as self-motion perception or vection, the feeling is "kind of like an illusion," Kesharvaz explains. "I'm trying to investigate which sensory information can play a role here."

When it comes to finding a solution, however, "there isn't one magic trick to make it go away. The best you can do is try to reduce it as much as possible." One of his main goals is to find new solutions (outside of medication, for example) to minimize VIMS.
In 2022, it is not hard to see why this work is so relevant.

"Everywhere we go we have visual displays," Keshavarz emphasizes. Many people are spending more and more time glued to visual displays, whether for work or play. They move from their school and jobs during the day to spending downtime looking at smartphones and TVs. There is also the growing popularity of virtual reality headsets as a form of entertainment. "Everything that's visual has to be perceived. And the perception, at some point, can cause negative side effects."

These effects are important to consider not only for the well-being of simulator participants, but also for the researchers as well; Keshavarz saw the value in being able to predict who was more likely to get sick to save everyone time and resources. To aid in his research (and help with participant selection), Keshavarz needed a questionnaire that helped with this process. As of a couple years ago, there wasn't a specific resource that would help predict the specific sickness he was studying, so he developed the Visually Induced Motion Sickness Susceptibility Questionnaire (VIMSSQ).

He hopes the questionnaire will be helpful to others working in his field, or any researchers dealing with VR simulators. If researchers dealing with simulators don't ask participants how sick they are before interpreting their findings, the results could be skewed. Since it was only published within the last two years, he says "it's hard to say if it's a game changer. It could be down the road, but that means we need more data and other people to use it and adapt it."

If you take a step back, it becomes clear that Keshavarz's questionnaire is not just helpful to his own field of study. Any researchers at KITE using a simulator like DriverLab or StreetLab, as well as outside researchers with other simulators, can make use of the questionnaire. "Let's say you're working in the DriverLab and are testing to see if a 75-year-old person recovering from a stroke is fit to drive," Keshavarz explains. "You do not want to make that person sick."

The reality of having participants come and use simulators is that it costs time and money. "You cannot afford to test twice the number of participants but lose half of them because they got motion sickness." Better

results will come out of the studies as researchers can focus more on their own work, and hopefully less participants will go home sick.

When you look at KITE and the research coming out of it, it's hard to not be impressed. Not only do the KITE facilities offer one-of-a-kind labs and tools, but there is such a diverse group of researchers all with different ideas and projects underway. Most importantly, they aren't isolated in their own work.

"When you look at the closest people I work with, there's a psychologist, a biomedical engineer, an aerospace engineer and a software engineer," Keshavarz explains. "Anything you can imagine, basically, and they all work together, which makes it pretty unique and exciting."

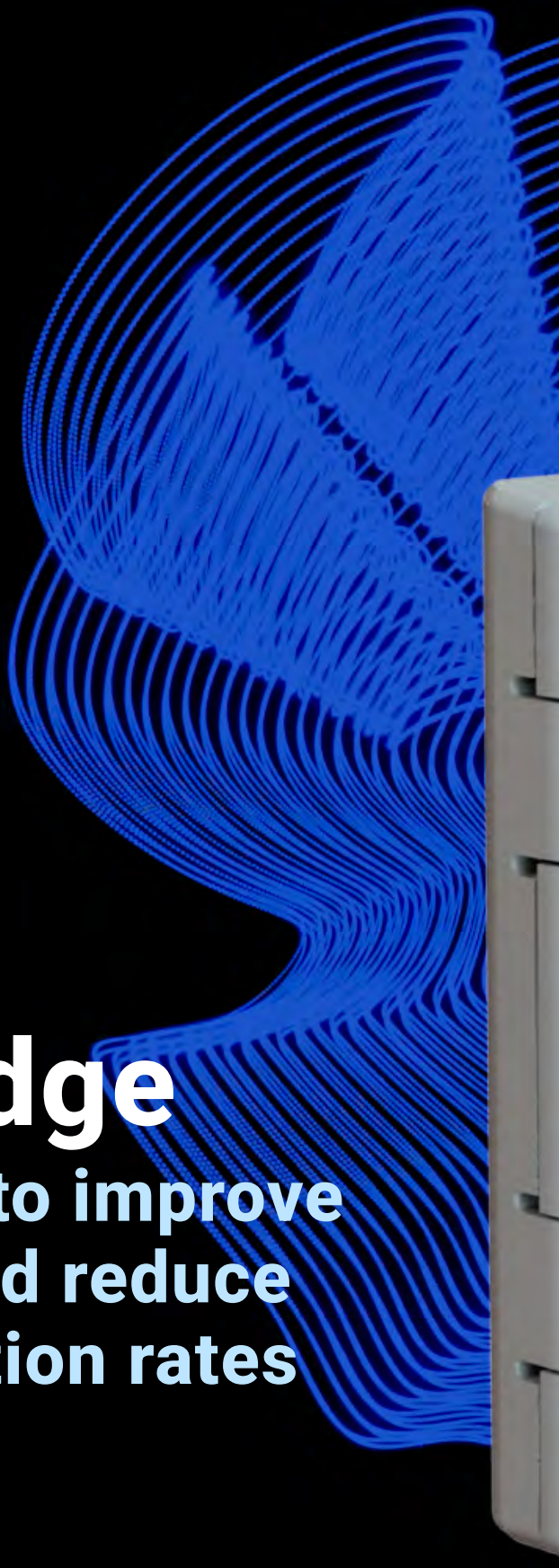
Different areas of interest can overlap, or scientists might need input from someone in another field, but the fact that KITE houses such an expansive team allows for high quality collaboration and innovation.

"[we] all work together, which makes it pretty unique and exciting"

Reminding Us to Care: The Buddy Badge

The Buddy Badge used to improve correct handwashing and reduce hospital-acquired infection rates

By Shannon Attard



“It isn’t just an engineering problem, it’s a human challenge”

Buddy Badge is a device used to reduce hospital-acquired infection rates and to increase the frequency of hand washing in hospitals, long-term care homes and similar environments.

Dr. Geoff Fernie, a senior scientist at the KITE Research Institute at UHN, is sitting down with Dr. Peter Norton, a Geriatrician, at Sunnybrook Health Sciences Centre. Dr. Norton was part of Dr. Fernie's team at Sunnybrook decades ago. Dr. Fernie and Dr. Norton are discussing major issues in caring for older people. The conversation turned to Dr. Fernie's and Dr. Norton's growing concerns about the rising number of hospital-acquired infections.

Hospital-acquired infections are infections that a visitor or a patient acquires after admission or a visit to a hospital. Monitoring and trying to prevent these infections are important because the infections can become antibiotic-resistant infections. Bacteria grow and can develop the ability to defeat the antibiotics used against them. According to the Government of Ontario, in Canada each year more than 220,000 hospital-acquired infections result in an estimated 8,500-12,000 deaths. These numbers are rising. To break these numbers down further, in Canada one in nine hospital visitors or patients get a hospital-acquired infection.

Dr. Fernie also worried about the potential for infection in North American nursing homes, which are often poorly staffed and under-funded. "Before COVID-19, others accepted this but they didn't fully understand it. Now the public and the government are very worried about it," Dr. Fernie says about the horrible impact COVID-19 has had in long-term care homes. The COVID-19 pandemic showed that when nursing homes are poorly staffed and under-funded, there is an increased risk for infections. Currently in Ontario there are 626 long term care homes. The total number of confirmed COVID-19 cases in long term care homes since April 24, 2020 is more than 33,000 and growing.

Dr. Fernie's research on preventing infections led him first to the development of a hand washing-type machine. It was designed so that the user would give the machine a little kick, the belly would open, and they'd be able to wash their hands. When finished, it would fold

back up with disinfected air. The initial thought process was to reward the most frequent users with the benefit of free parking as a form of motivation. “But it was the wrong approach. The issue wasn’t a mechanism that we needed for hand hygiene; the issue was remembering to do it.” Dr. Fernie says.

INTRODUCING THE BUDDY BADGE

In 2000, Dr. Fernie started his research in hand hygiene technology in an effort to increase health-care workers’ hand washing frequency and reduce the spread of infections. “I have always been driven by the most common problems that appear to be the simplest,” Dr. Fernie says. “These problems are always the most difficult to solve.”

Dr. Fernie had researched various types of hand hygiene technologies before developing a simple yet effective system he calls the Buddy Badge. The research program on hand hygiene has been published in over twenty peer reviewed papers. Testing was done at Bickle Centre and five Toronto Rehab units at Lyndhurst and University Centre. After prototype beta testing, Dr. Fernie found that implementation of the Buddy Badge in a care setting can double hand hygiene compliance.

The Buddy Badge is a small device that can be worn by frontline health-care workers. It clips onto the front pocket of a health-care worker’s scrubs; the word *Buddy* is visible on the surface of the badge. The nurse rolls over the blood pressure machine, checks the patient’s blood pressure, and rolls the machine back to its place. She heads to her next patient’s room a few doors down the pale-tiled hall. As she steps across the threshold, she feels a vibration across the front pocket of her hospital scrubs. She stands in front of the hand sanitization dispenser, sees a green light appear on the sanitizer’s system, and cleans her hands.

A green light appears on the top right corner of the Buddy Badge for one minute following the hand wash.

Hand washing has not always been a popular topic. Before COVID-19, seeing guidelines and TV reports about hand hygiene was not as common as it is now. Information and demand for hand hygiene products have surged because of the current pandemic. People are beginning to recognize the importance of hand hygiene.

“The Buddy Badge is all about care because it reminds you to care”

THE HISTORY OF HAND HYGIENE

Studies on hand hygiene stem from the 1830s with Hungarian obstetrician Ignaz Semmelweis. Known as the "father of hand hygiene," Semmelweis worked in the Vienna General Hospital. Around the 1830s, Semmelweis noticed that there was a difference between delivery death rates performed by midwives at the hospital or at home, and doctors in maternity hospitals. Around five in 1,000 women died from deliveries performed by midwives, while the death rates for deliveries performed by doctors in hospitals were ten to twenty times greater.

Semmelweis realized that before delivering these babies at the hospitals, doctors would often perform barehanded autopsies. The doctor would rush over from an autopsy room to deliver a baby when the woman was in labor. Semmelweis concluded these doctors were transferring bacteria, a "morbid poison," from the corpse in the autopsy room, to their bare, unwashed hands, to the women in the delivery room.

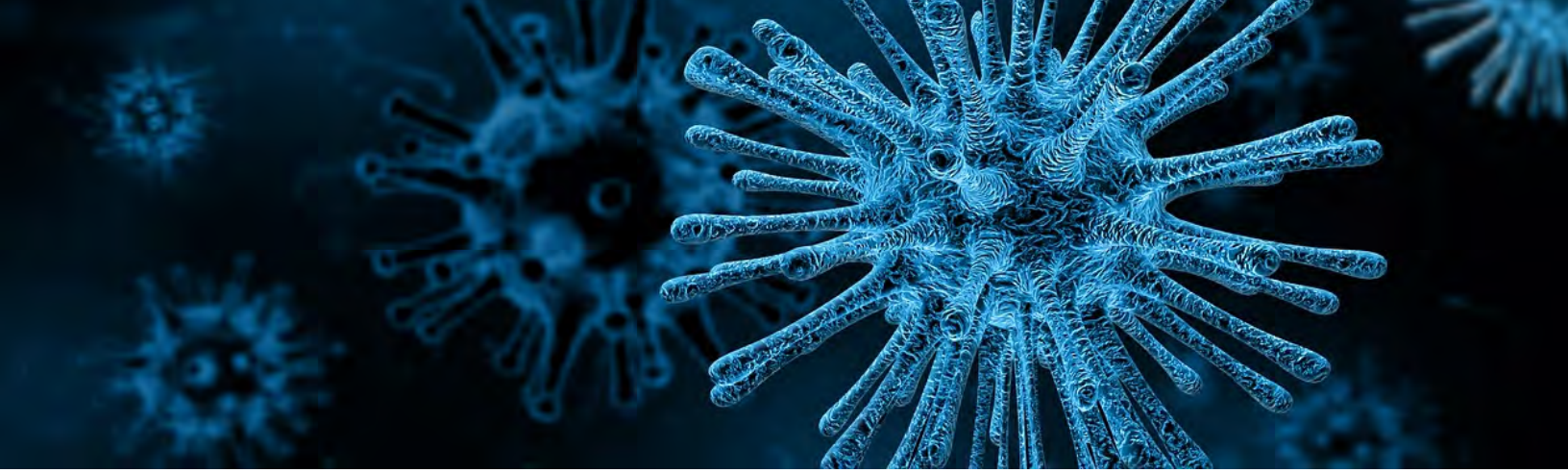
Before delivering a baby, Semmelweis had medical students wash their hands until the "foul smell of death" was gone. In 1847, the delivery death rates performed by doctors in the Vienna General Hospital decreased drastically. However, Semmelweis' clinical deduction was met with severe criticism. He was seen as erratic and was committed to an insane asylum where he was beaten to death by his guards.

Doctors at the time were outraged with Semmelweis because they weren't going to accept that they were the cause of their patient's deaths. "People generally do not believe they are the cause of a problem. Everyone thinks they do hand hygiene correctly. Imagine being a nurse and having to wash your hands 100 times in one day," Dr. Fernie says. "It's natural to overlook it when under pressure sometimes."

A HELPFUL SOLUTION

Viruses and germs can be spread by infected persons through droplets in the air or on surfaces, making hand hygiene crucial. If an infected person is talking, droplets of their saliva can infect people and surfaces that are within a three-foot radius. Germs, like the flu germ for example, can live for hours on surfaces. During this time, if someone touches the infected surface, the germ will then be on their hands. This is why washing your hands is so important. Germs are types of microbes that can cause diseases, though not every microbe can cause a disease. Using soap and creating friction when you wash your hands lifts off most potentially harmful microbes.

Dr. Fernie's hand hygiene research consisted of a device that would essentially remind people to wash their hands. The difficulty in this was



figuring out how to present the reminder in a positive way. “It isn’t just an engineering problem, it’s a human challenge,” Dr. Fernie says.

Catharine Hancharek, former Director of Toronto Rehab Research Operations, is currently the COO of Hygienic Echo, a start-up company that manages Buddy Badge. Hancharek started working with Dr. Fernie in 2012 and was inspired by Dr. Fernie’s vision in hand hygiene research. Dr. Fernie’s vision aligned with her own goals of finding solutions to problems she was passionate about, such as reducing hospital-acquired infections.

“We know that we needed to come at this research in a positive and kind way,” Catharine says. This was a top priority in the research because the badge is designed to be a “buddy” that can help staff, patients and loved ones stay safe. They designed the system to be as positive and friendly as possible so people enjoy using the Buddy Badge to help with hand hygiene.

Today, people are often worried about being monitored through their computers and cell phones. The Buddy Badge monitors how many times a user completes a hand washing. However, the Buddy Badge isn’t about monitoring hospital employees to see if they’re washing their hands correctly. It’s about care and reminding you to care.

“Buddy Badge cares,” Catharine says. “Take a moment to care because it changes the world. When you care you will wash your hands. It isn’t about ‘I don’t have time,’ it’s ‘can I afford to not wash my hands?’ It’s not that we’re bad people, we’re just so busy that we forget sometimes. The Buddy Badge is all about care because it reminds you to care.”

The Buddy Badge is there to help remind the user to wash their hands, and to be their buddy.

The Buddy Badge system is now ready for installation in hospitals, long-term care homes, and other health-care settings. The Buddy Badge system is there to help remind people to look after their health and their family’s health, in a positive way.

The Innovation Gallery: A Display of Integrated Care

An interview with Mary Lam about the Innovation Gallery, COVID-19 and KITE's mission

By Chinenye Egwuonwu


“the Innovation Gallery ... it’s a space where clinical care, research and education can meet”

BACKGROUND

It's been more than two years since the World Health Organization declared COVID-19 to be a pandemic. The announcement and subsequent impact of the unprecedented health emergency upended the lives of billions around the world. It changed the way we work, learn, do business and engage with family and friends.

At KITE, scientists, staff and research trainees pivoted to remote work in order to continue conducting important research into aging, injury and rehabilitation.

The reduced foot traffic at KITE's downtown Toronto location ended up providing an unexpected opportunity for the leadership team at KITE. Led by Mary Lam, Associate, KITE Directorate, the team quickly mobilized efforts to overhaul KITE's one-of-a-kind Innovation Gallery. Located in the lobby of Toronto Rehabilitation Institute, the gallery features a new look and feel that showcases both products and people. It includes a high-definition video wall and patient education portal.

The Storyworks team sat down with Lam to learn more about the Innovation Gallery, its purpose at KITE and the potential impact on its intended audience.

Q: What do technology and innovation mean to you?

A: Innovation to me means making changes in something established, especially by introducing new methods, ideas or products. When we talk about technology, I think of science or knowledge that's put into practical use to solve problems or invent useful tools.

Q: What excites you most about KITE and being on the KITE team?

A: I started working at KITE in 2018. We were smaller and fewer in size than we are now. Regarding your question, I would say that I'm excited to collaborate with so many wonderful individuals. I first came on board at the same time as our new institute director, Milos Popovic, and seeing all the great things that have been accomplished in the last four years has been really exciting.

Q: What is the importance of KITE's work?

A: I think this question speaks to KITE's mission and goals. Our research is dedicated to improving the lives of people living with the effects of disability, illness and aging. We do this by focusing our work on injury prevention, restoration of function and enhancing participation and independent living. So, our research is key to informing rehabilitation services, especially with the aging population today.

Q: What makes KITE different from other research labs or places you've worked before?

A: Yes, that's a great question. KITE is my first experience working in a research facility. I come from a clinical background and worked in a smaller setting. What makes KITE different from other places I've worked at is the number of people that I get to interact with, not necessarily just through projects but also within my daily work. It's wonderful to work with and be part of a larger team and organization, and that wasn't the case before I came to KITE.

Q: How does your project at the Innovation Gallery fit into the mission of KITE? And what is its purpose?

A: The Innovation Gallery aligns with KITE's overall mission and UHN's strategic priorities. One of these priorities is to integrate clinical care, research and education. The gallery is a unique space and platform where these areas can come together and collaborate. Visitors are welcome to learn more about the amazing scientific discoveries happening here, as well as the successful business partnerships, including international partnerships with startups and commercialization efforts. We also have educational resources available for patients and their families.

Q: So far, how has KITE helped to further advance your work?

A: I'm not a scientist and don't conduct research. But I've always been interested in the role research plays in improving the lives of individuals like you and me. With a clinical background, I've always helped people to improve their lives health-wise. Research does this in an indirect way. Working at KITE has given me the opportunity to understand how a research institute operates, and I've truly gained a greater appreciation for all the hard work that needs to be done behind the scenes in order for research to move forward.

Q: What has been the users' reaction to the Innovation Gallery so far?

A: The renovations for the Innovation Gallery were completed during the pandemic, so due to public health restrictions we haven't been able to open for very long. There hasn't been a lot of traffic in the space yet. Once the COVID situation improves, our hope is to start planning more activities and events for the space. That way, we'll gain more foot traffic and feedback, too.

Q: How will you, and the medical community, know that your work is a success? What are the measures of success?

A: Regarding the Innovation Gallery … it's a space where clinical care, research and education can meet. So, a few measures of success would be to have these separate areas converge together, to have each area highlight each other's successes, and possibly to increase collaborations between them. When solving a problem, it's always better to work together instead of alone. If there's an increase in collaboration between these three areas and more activity in the space overall, that's a pretty good measure too.

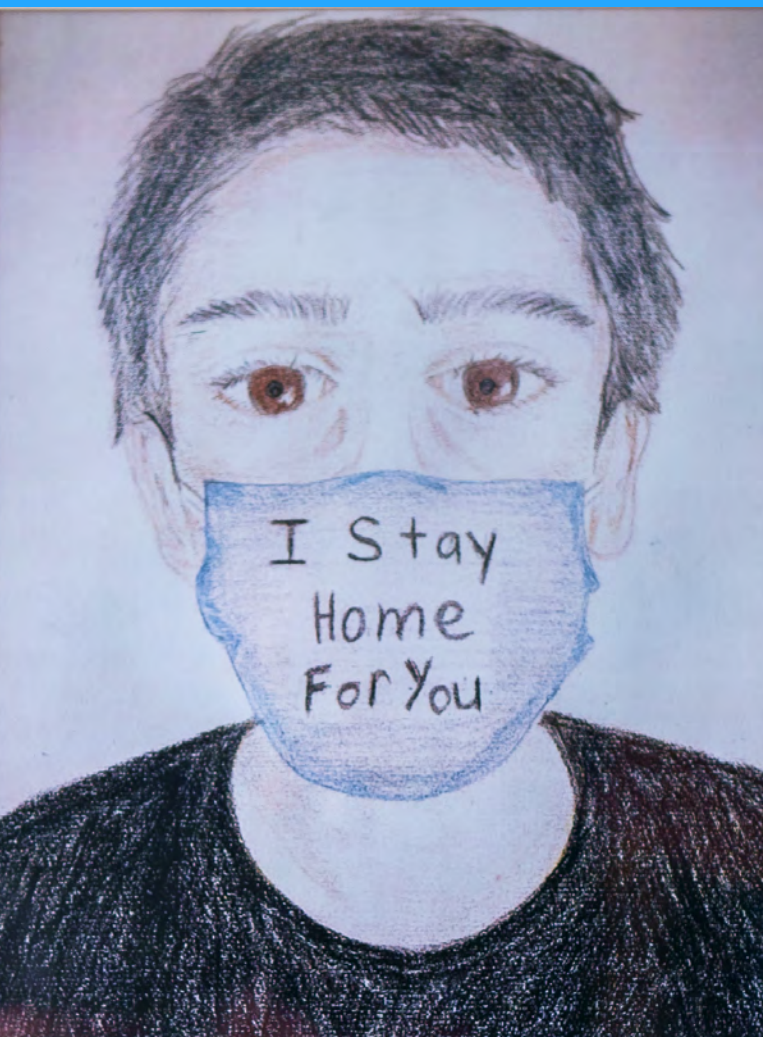
Q: Who is the Innovation Gallery's audience? Is it open to the general public?

A: Yes, the gallery is open to the public. Once restrictions are lifted, everyone is invited to visit. It's on the first floor. We've moved KITE's reception down to the gallery, too. Everyone is welcome to come in, including visitors, patients and families.

Q: How have the past 2 years (COVID) impacted and changed your work at KITE?

A: The most obvious way COVID changed everybody's work, including mine, has been the remote work aspect. At KITE, we've been quite productive while working from home … but I think there's a certain disconnect when you don't have regular opportunities to meet with your colleagues in person. There's something lost there. In some cases, work can be much more efficient when done in person instead of remotely.

"when you see individuals take on a leadership role and motivate or inspire others ... I find that really inspiring"



Q: What would you want readers to know about KITE?

A: I want them to know that KITE is on a mission to push the boundaries of rehabilitation research and to use this work to make a meaningful impact in people's lives.

Q: What's next for you at KITE? Looking to the future, what will be your next focus?

A: Like I mentioned earlier, I'm still a relatively new arrival to research and KITE, so I'm just going to keep focusing on how I can help to continue and improve the important work being done here. Whether it's in supporting our Director Milos Popovic in the Directorate or continuing my work in operations at the Innovation Gallery, I'll keep moving forward from there.

Q: Lastly, what inspires you?

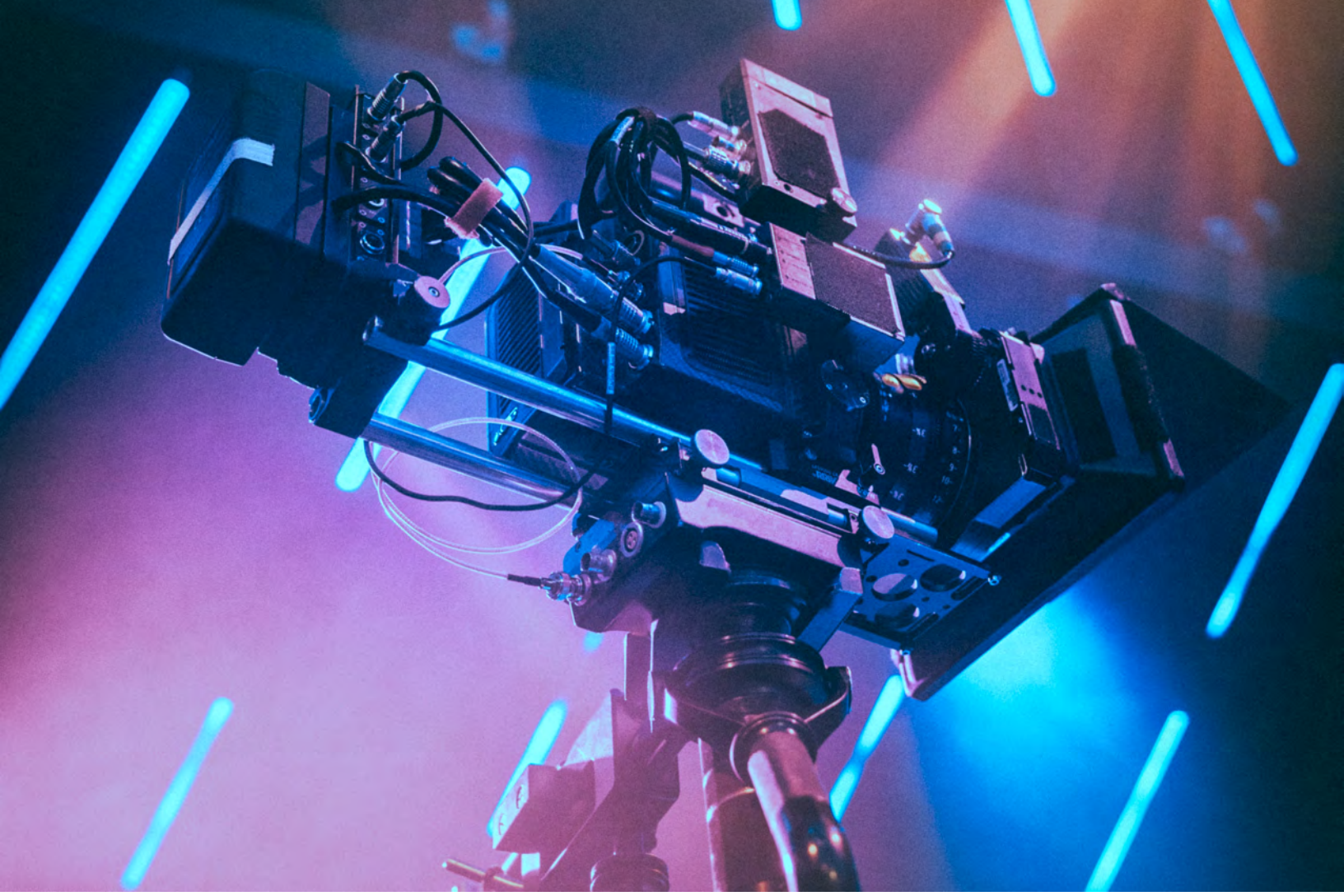
A: During challenging times, and especially in the last two years, what I've found to be inspiring is seeing individuals who, despite overwhelming challenges and uncertainty, continue to push on and do what needs to be done. It's very easy to get down and wallow. But everybody is going through the same thing right now, and when you see individuals take on a leadership role and motivate or inspire others to keep going despite everything that's happening ... I find that really inspiring.

Can the KITE CareLab Go Hollywood?

Huge potential for CareLab to expand use once COVID-19 restrictions are lifted

By Cassandra Mair

“a film studio for the weekend is now back to a research lab”



A patient lies in a bed in a hospital room. Nurses and doctors swarm around, checking for obvious signs of pain. Everyone is in a state of movement. Suddenly, a director yells "Cut!" and everything stops – instantly. "Let's roll it again" is heard as everyone shuffles back to their opening positions. This one scene will take all day. But that's not going to be an issue this time because filming is taking place in the CareLab, one of eleven real-world simulation labs located at KITE-Toronto Rehabilitation Institute, the world-renowned rehabilitation centre affiliated with the University Health Network (UHN). Scheduling, patient confidentiality and disruptions aren't issues in this space, which looks identical to a real-life hospital room. This seemingly ordinary research lab can double as a production studio. These are the kinds of productions KITE is hoping to attract by making the CareLab available for commercial film shoots. This lab space is unlike any other space at KITE. It is designed in the same general style as a standard single patient hospital room, with the exception of a much larger bathroom. This size accommodates accessibility for research and training purposes, and makes CareLab an excellent location for all

the people and equipment involved with productions.

KITE uses this space to test various products in a real-world environment. The research taking place in the CareLab is crucial to the health and safety of staff and patients. For example, ongoing testing of an automated patient lift is being done to prevent back injuries among nurses. There is also testing of a monitoring system that alerts nurses to turn patients to mitigate bed ulcers.

Although much vital research is taking place, the CareLab is not continually in use. There are times when it sits idle, especially on weekends. Despite COVID-19's impact on filming (outside media have rarely been allowed on the premises), Jarrett Churchill, Team Lead of Public Affairs and Communications at KITE, says the opportunity for video productions is a new revenue stream worth exploring.

Productions cannot begin until COVID-19 restrictions are lifted, but KITE is excited for the near future. Churchill says all productions will have to be scheduled around the research. Because research takes priority, any projects have to be scoped out well in advance and UHN has to grant permission for each production before filming can begin. Although filming hasn't started, the current goal is to make productions aware of what the CareLab can offer.

The CareLab is a perfect filming location for hospital shows due to its accuracy in mimicking an actual hospital room. It provides a safe, sterile and empty location that can be tailored to a production team's needs. Sophia Li, a staff scientist and manager of partnerships at KITE, notes that the room can be manipulated to a certain degree depending on what the production requires. For example, the CareLab currently has an open ceiling with a catwalk across, but they are able to add a temporary ceiling if the production requires it.

These productions could act as a platform to highlight certain accessibility standards within hospitals. The research being conducted

by Li is one such example. She says accessibility and inclusivity are primary social topics right now and the CareLab is built for accessibility. Examples include oversized doorways, a larger bathroom and grab bars on the walls. Li says many hospital rooms aren't equipped with these kinds of additions, but should be. Li goes on to say that the government could use the CareLab space to promote accessibility and universal design for hospital rooms.

The CareLab may also benefit from scientific ideas generated by productions with a science-fiction theme. Li says, "They could envision the kinds of technology that would be used in the future and what the room would look like in the future." This could help open new research avenues for KITE for medicine and rehabilitation in the future.

Li suggests professional consultancy as an additional option for incoming production companies. She says the professionals working at KITE can use their expertise to ensure authenticity in various medical situations. Li says, "This is a bonus of going with this location!" This sets the CareLab apart from other filming locations for these types of productions.

Because KITE pays general operational costs, including rent, electricity and maintenance, to keep

the CareLab functioning, every production would pay a fee to use the facility. A portion of this fee would also go to sustaining the CareLab for the future. In addition to the generosity of donors, this added income opportunity would support the incredible research that KITE is known for.

The CareLab is just one of the fundamental pieces that comprises the whole of what KITE does. KITE means many different things to many different people, but Li has specific ideas of what it means to her. Knowledge is beyond ordinary rehabilitation, which connects all the aspects of healthcare. Innovation is what enables KITE to go beyond in their rehab. Talent solidifies KITE wanting to attract people from not just medical fields, but all fields including film and media. Everywhere represents wanting to connect with not only active patients, but the entire population, "from young to old." Li concludes by saying, "[That's] my view of how we should really implement the vision of KITE into our daily research, daily work, and also how we approach new challenges."

"And that's a wrap!" The director cheers amidst applause at the end of the weekend filming session. Film equipment is packed away and the final person shuffles out the door, closing it behind them. The CareLab, a film studio for the weekend, is now back to a research lab. It's ready for Monday morning, when scientists will be back doing vital preventative research for patients and caregivers.

"The CareLab is a perfect filming location for hospital shows due to its accuracy in mimicking an actual hospital room"

The Smile Project

Dr. Milos R. Popovic and team study markers of a genuine smile, and how stimulating them can influence mood

By Emily Jordan

“participants expressed feeling more determined and less scared […] indicators of positive mood change”

As mental health struggles rise, teams of medical experts continue to explore alternative methods to treat patients in a safe and respectful manner. At the KITE Research Institute, a team led by Institute Director Dr. Milos R. Popovic is working to treat patients with major depressive disorder (MDD) by using a therapeutic method called Functional Electrical Stimulation Therapy (FEST).

Dr. Popovic's idea came from a book discussing the work of Dr. Paul Ekman, a psychologist who studied emotions and their relations to facial expressions. A short two-sentence passage about how Dr. Ekman's patients felt intense sadness after 15 minutes of frowning led Dr. Popovic to begin the Smile project.

First, a little background. There are two kinds of smiles: voluntary and genuine. A voluntary smile consists of movement of just the mouth. A genuine smile includes an involuntary muscle movement around the eyes and eyebrows called the Duchenne marker. Genuine smiles stem from feelings of positive emotion. Dr. Popovic shares that he wanted to see if stimulating the Duchenne marker would change the moods of individuals diagnosed with MDD, a complex mood disorder. Currently, there is no long–term cure for depression, only methods of managing symptoms.

The research for the Smile project began in 2013 when Dr. Popovic recruited Dr. José Zariffa to help him conduct a study using FEST. FEST uses electricity to stimulate muscles, causing them to contract. Stimulating weakened or paralyzed muscles while a patient attempts to contract those muscles works to retrain the central nervous system. In time, this can lead to a person regaining movement.

Much of Dr. Popovic's previous work contains the use of FEST to treat patients who have suffered a stroke, are diagnosed with Parkinson's disease or experience paralysis of the body. In Dr. Popovic and Dr. Zariffa's 2014 published study, they hypothesized that using FEST to stimulate the Duchenne marker would artificially induce positive emotions. This in turn may lead to a new method to treat symptoms of MDD.

The results of the 2014 study prompted Dr. Popovic to investigate further. As client assessments continued, participants expressed feeling more determined and less scared. It was these indicators of positive mood change that motivated Dr. Popovic to begin writing to grant agencies; however, he met with constant rejection.

Dr. Popovic recalls, "I got responses back that said, 'This is ridiculous,' 'You don't know how to handle psychiatric patients.'"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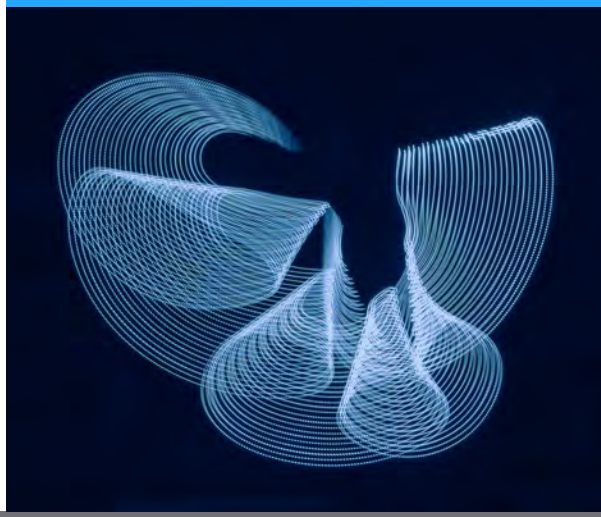
But Dr. Popovic pressed forward. It was the gift of generous donors – Dean Connor and Maris Uffelmann – that allowed Dr. Popovic to kickstart the next phase of his research. His team proposed their study to the KITE research ethics board, who with hesitation allotted the study ten hours per patient. Of the ten participants in Dr. Popovic's 2019 study, five requested an additional thirty sessions. Those five people found the therapy was improving their sleep and reducing feelings of sadness and guilt.

Today, Dr. Popovic and his team continue to further their research. Dr. Popovic is now working alongside psychiatrist Dr. Venkat Bhat as the project moves into clinical trials. The team is currently developing an at-home electrical stimulation therapy mask that modulates the Duchenne marker muscles. The goal is to provide MDD patients with an affordable and accessible treatment option.

Unlike medications and other forms of brain stimulation therapy, FEST is non-invasive and causes no side effects.

If successful, Dr. Popovic's device will allow patients the option to receive treatment without having to enter a clinical setting. Patients can be assessed from their homes and have a custom product sent to their front door. Because this treatment option can be done in the privacy of one's home, hopefully this will encourage more people to seek help. Dr. Popovic says that this could open the door for "other conditions that could be treated in this way that we have never thought about."

Since the publication of his 2019 study, public mental health has deteriorated significantly as a result of the COVID-19 pandemic, and includes a major rise in depression cases. With each lockdown and outbreak, a need for accessible mental health treatment increases. Dr. Popovic hopes that in the next few years his product will be available to the public and "that people can use [it], and if that helps, that would be fantastic."



"the current success of Smile is in part due to [...] taking a chance on an unusual idea"

Dr. Popovic attributes KITE's support as an important factor in his successful research. He notes that KITE's involvement in the study came with three elements:

1. CAPABILITY

From the start, KITE gave Dr. Popovic the ability to assemble a team to support the study. The clinical setting established at KITE, and the support KITE gave, made a huge difference for patients. "[With] the proper treatment team and proper caring team [at KITE], patients know they are coming to an institution where they feel safe and comfortable." When working on a project such as Smile, the confidence and caring aspect that KITE provided was essential.

2. EXTRAORDINARY PEOPLE

Dr. Popovic recounts that his idea was consistently met with hesitancy and rejection. Gathering a team to execute this research successfully and safely meant finding people who were willing to take risks to further rehabilitation methods. Dr. Popovic states, "You need to have the scientists, intellectual capacity, to actually try something. To come up with something totally new and innovative, and then try it in a safe and respectful way." The current success of Smile is in part due to Dr. Popovic's team taking a chance on an unusual idea – and that too is extraordinary.

3. DONATIONS

KITE's reputation as a space that fosters knowledge and innovation helped legitimize Dr. Popovic's unorthodox idea. He describes the relationship between his research team, KITE and donors as a partnership where "you have a wonderful donor who for one reason or another trusts you and believes that you are genuine and what you're doing is making a difference and takes a leap of faith. Then you have excellent staff who can execute on a tight budget and are able to do that in the right way; these are all ingredients of a successful scientific experiment." KITE's support of Dr. Popovic's idea is helping transform the treatment of major depressive disorder.

Rather than merely managing symptoms, Dr. Popovic remains focused on his patients' quality of life. As his team continues their work, Dr. Popovic looks towards the long-term success of FEST for stroke and paralysis patients. What his team is doing is taking an already successful treatment and using it in a new context. As Dr. Popovic likes to call it, "I have a nudging method, and I'm trying to use the nudging method to now help people who have depression, to nudge them out of it."


“There is no brain health without sleep health”

The Mysteries of Sleep

Two KITE scientists devote their research to finding answers about sleep health

By Mairi Sutherland

Everyone needs sleep, but why is it so important? And how much do we really understand about it?

Our bodies operate on a 24-hour internal clock called the circadian rhythm. If this rhythm gets disrupted by a lack of sleep, our bodies can no longer function at their peak. Long-term disruption can result in negative consequences for both our physical and mental health.

Scientists at the KITE Research Institute are working hard to uncover the mysteries of sleep. This includes furthering our understanding of the impacts of sleep on overall health and identifying ways sleep can be improved. Two scientists, Dr. Tatyana Mollayeva and Dr. Azadeh Yadollahi, are leaders in this research. While their respective research teams study different areas of sleep, both are focused on improving sleep health for us all.

THE BRAIN AND SLEEP

Dr. Tatyana Mollayeva is part of KITE's Acquired Brain Injury and Society team. She joined KITE in 2010 as part of her Ph.D. project at the University of Toronto. Her project evaluated sleep disruption in patients with mild traumatic brain injuries (TBIs) and its impact on recovery. Since then, her work has delved into other brain health topics at the population level as she analyzes how sleep disorders cause adverse cognitive reactions in patients.

"There is no brain health without sleep health," Dr. Mollayeva explains. "I want to help build a prevention framework for sleep health with a focus on restoring sleep structure in order to achieve optimal brain health."

Many sleep disorders such as insomnia, circadian rhythm disorders and parasomnia disorders often impact individuals with neurological injuries and conditions. As a result,

failing to understand and adequately manage these sleep disorders can affect an individual's cognitive abilities and decrease the effectiveness of treatment. For individuals who already have compromised brain or body function, this can critically impact their lives.

Dr. Mollayeva hopes to highlight the crucial role of sleep in brain health and prove why it should be added to the World Health Organization (WHO)'s framework.

"Sleep health is not currently part of WHO's framework, but over the past decade, there has been a remarkable rise in acknowledgement of [its] importance," says Dr. Mollayeva. "So, the change is underway."

Dr. Mollayeva also focuses on equity in brain health. She considers how disparities in sleep health may relate to various social inequalities, such as access to sleep literacy and the gender-based division of labour.

In addition to her research, Dr. Mollayeva educates Canadian youth on the importance of getting enough sleep through community outreach lectures. She also teaches a course on sleep at the University of Toronto Scarborough.

THE BODY AND SLEEP

Elsewhere at KITE, Dr. Azadeh Yadollahi explores another avenue of sleep research.

As part of KITE's Sleep Science team, Dr. Yadollahi works with the SleepdB, Canada's first soundproof sleep lab. One area of her team's research is the world of sleep apnea.

Sleep apnea is a sleep disorder where an individual's breathing stops and starts throughout their sleep, resulting in abnormal breathing patterns. If left untreated, this can increase health risks like heart attacks or strokes.

QUICK FACTS ABOUT SLEEP APNEA

- Approximately 10% of the Canadian adult population has some form of sleep apnea.
- Sleep apnea rates rise to anywhere between 40% and 80% among those with high-risk conditions like heart disease, diabetes, obesity and high blood pressure.
- An estimated 85% of those with sleep apnea do not realize that they have it.

"Much of the work I do is based on high-risk populations, including those with asthma, heart failure or those in underserved populations," says Dr. Yadollahi. "How can we bring the diagnosis and treatment of sleep apnea to those in shelters?"

Unfortunately, the process to get a diagnosis is often long and inconvenient. In KITE's sleep lab, Dr. Yadollahi's team is working to come up with more accessible and comfortable methods of diagnosis. For example, imagine wearing a shirt that tracks your sleep or having your sleep patterns analyzed from a distance by a machine. Specific types of technology being developed include functional articles of clothing, other wearable devices and cameras requiring no physical contact. One priority of the team, especially when designing clothing, is to create a device that monitors respiratory patterns and movement while remaining comfortable. Another is to develop diagnostic tools that can be used at home rather than in a sleep lab.

Beyond the diagnosis, the sleep lab team is considering treatments for sleep apnea. They want to evaluate what is currently available and discover more accessible and specialized solutions.

Two primary treatments currently available for sleep apnea are a mask device and oral appliance. The mask device consists of a mask attached to a small machine using a

tube. The mask pushes air through the airway, ensuring it remains open while the user sleeps. Alternatively, the oral appliance goes in the user's mouth and repositions their jaw to open the airways for easier breathing.

Though these devices work, they are not without weaknesses. The mask device lacks comfort and convenience, and remains inaccessible for many. The oral appliance may be less bulky in comparison, but it is expensive and not covered by health insurance. Generally, this means that the most consistent users of these devices are individuals with severe cases of sleep apnea. Many more individuals could benefit from these treatments but find that their inconvenience outweighs the value.

Depending on the specific conditions causing the sleep apnea, other treatments may involve modified sleep positions or lifestyle changes. Dr. Yadollahi wants to uncover the best solutions specific to each individual, group of people or overarching condition.

Her goal is to incorporate everyday needs into the design of new devices and give those with sleep apnea more choices for diagnosis and treatment. Connecting with human factors is essential for ensuring the appropriate use of these devices.

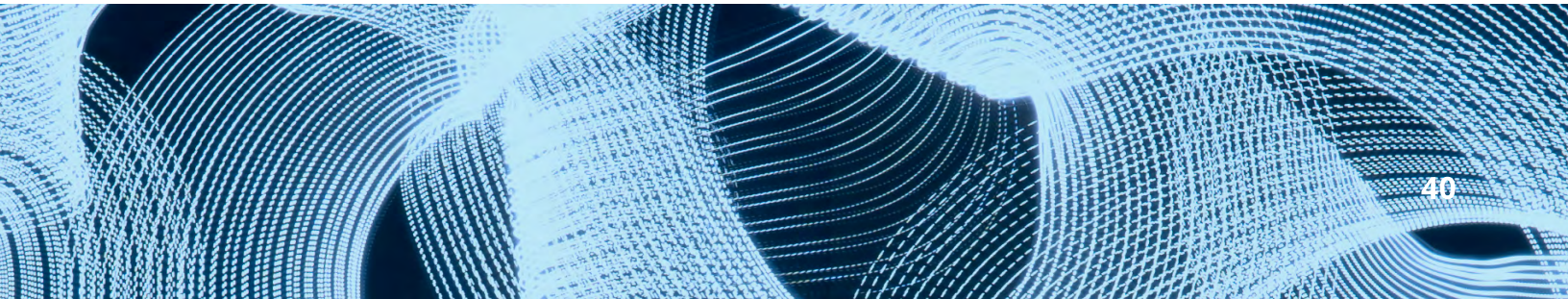
"It is about providing more accessibility to sleep apnea diagnosis and treatment, so we are not leaving people behind," says Dr. Yadollahi. "And making sure people have options when it comes to treatment so they can choose what is going to be best for them."

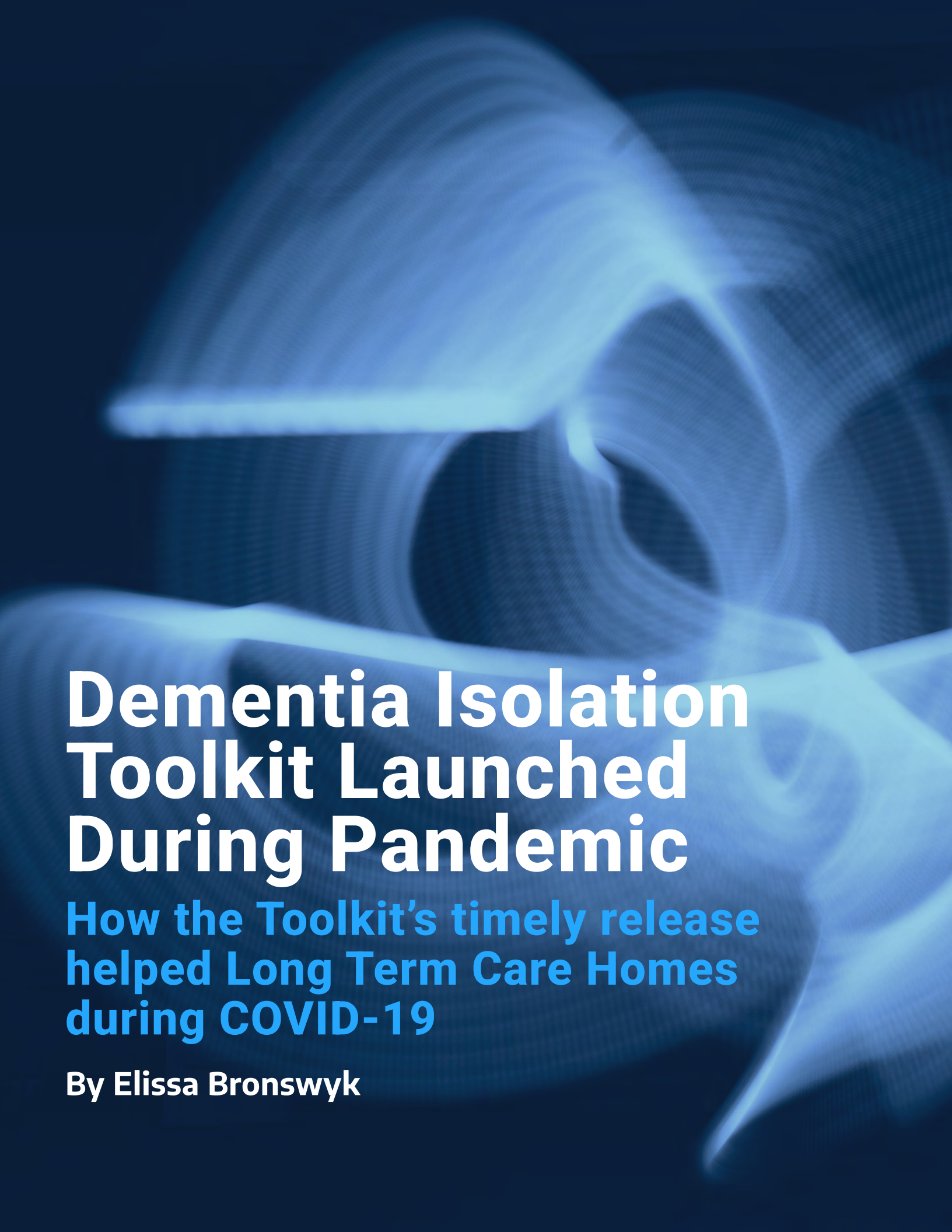
KITE AND SLEEP

Dr. Mollayeva and Dr. Yadollahi have rooted their research in equality and advocacy for accessibility regarding sleep health. As their work brings new understanding to the importance of sleep health and how to care for it, they are making positive impacts in the lives of all who sleep (everyone).

When asked about their experience at KITE, both scientists appreciate the level of collaboration and connection available within the research institute and, on a larger scale, the community. "It is a privilege and pleasure to be a part of the KITE team," says Dr. Yadollahi.

As the scientists continue their work, KITE provides a forward-facing space that supports their quest to understand the many unknowns of sleep.

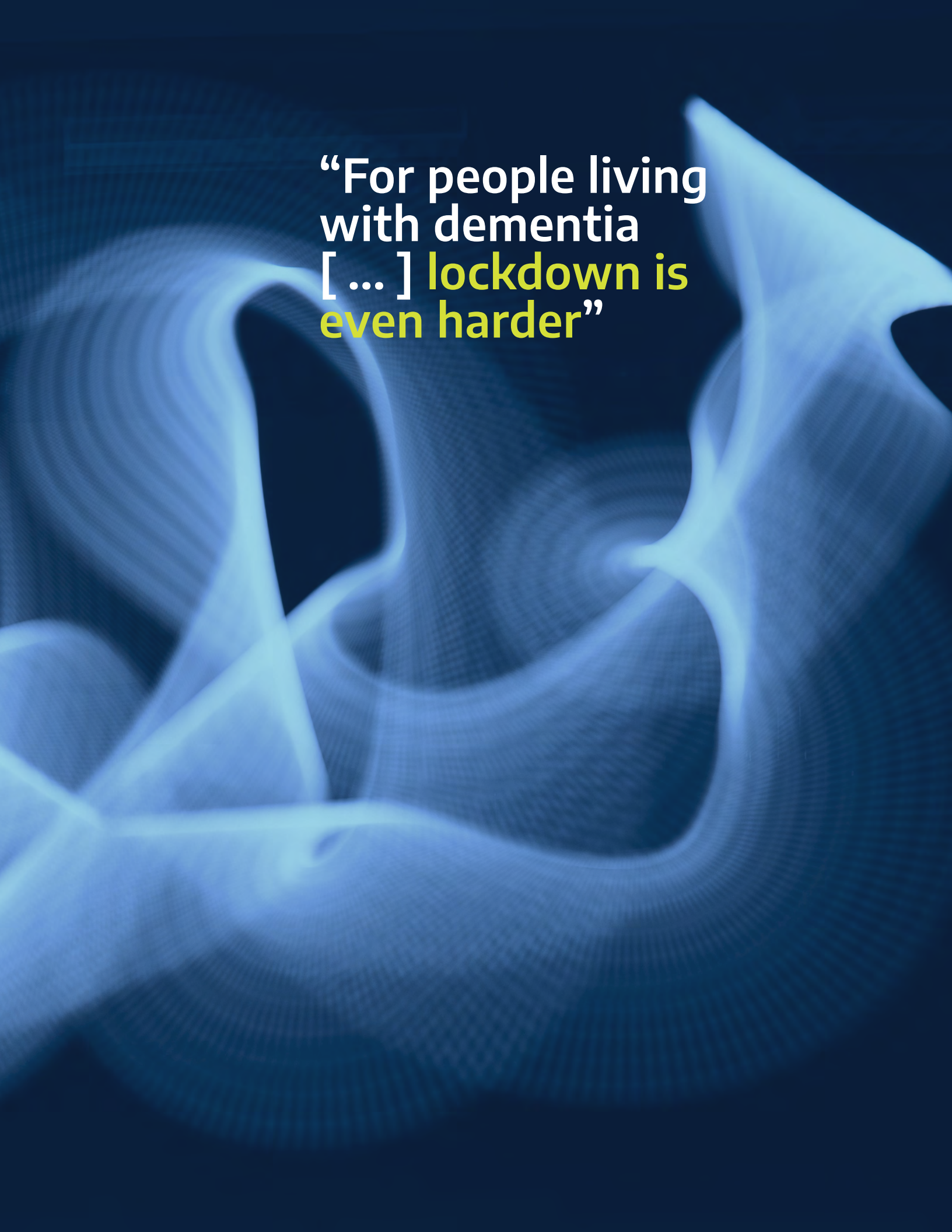




Dementia Isolation Toolkit Launched During Pandemic

How the Toolkit's timely release helped Long Term Care Homes during COVID-19

By Elissa Bronswyk


“For people living with dementia […] lockdown is even harder”

KITE GIVES RESEARCHERS THE CONFIDENCE TO LAUNCH NEW SOLUTIONS

It's hard being in COVID-19 lockdown. Having endured multiple lockdowns since March 2020, it's something pretty much everyone can agree on. Being separated from family and friends, being restricted in our movement and experiencing complete isolation can prompt a wide range of emotions and physical reactions. For people living with dementia and their caregivers, lockdown is even harder.

There's no doubt that the COVID-19 pandemic was catastrophic for Long-Term Care Homes (LTCH). Between March 1, 2020 and February 15, 2021, more than 2,500 care homes in Canada experienced a COVID-19 outbreak resulting in the deaths of over 14,000 residents and close to 30 staff, according to The Dementia Strategy for Canada 2021 Annual Report. The majority of those LTCH residents are living with dementia. This brutal reality, especially in the early days of the pandemic, underscored the need for some type of tool to help LTCH residents and staff.

Dr. Andrea Iaboni, a geriatric psychiatrist and clinical researcher based at the Toronto Rehabilitation Institute at UHN and the Medical Lead of the Specialized Dementia Unit, quickly put a plan into action to develop a Dementia Isolation Toolkit (DIT). She and a diverse team of both KITE resources and external partners got to work quickly on the first DIT as the pandemic was declared.

Within six weeks they had designed, built and launched DIT version 1.0. Since then, the DIT has been downloaded 9,000 times. When asked how they did it, Dr. Iaboni says, "the structure and support at KITE gives us the confidence to launch and ask people to use it."

The DIT's overall purpose is to provide ethical guidance on how to safely and effectively isolate people living with dementia in LTCH while supporting their personhood.

WHY WAS A DIT NEEDED?

The DIT has two specific goals.

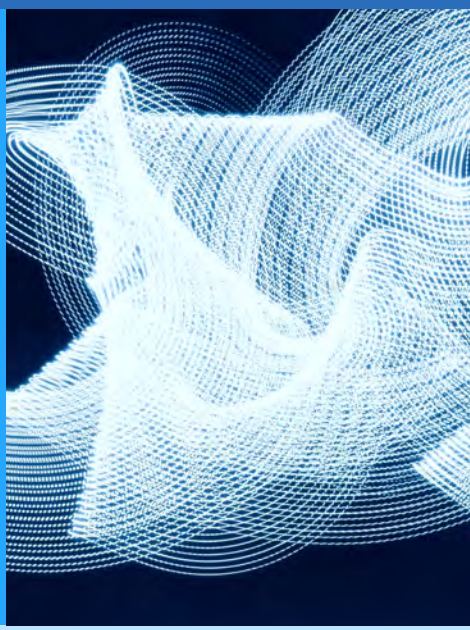
The first goal is to support the implementation of compassionate and effective infection control and prevention measures in LTCH, such as isolation and quarantine of LTCH residents.

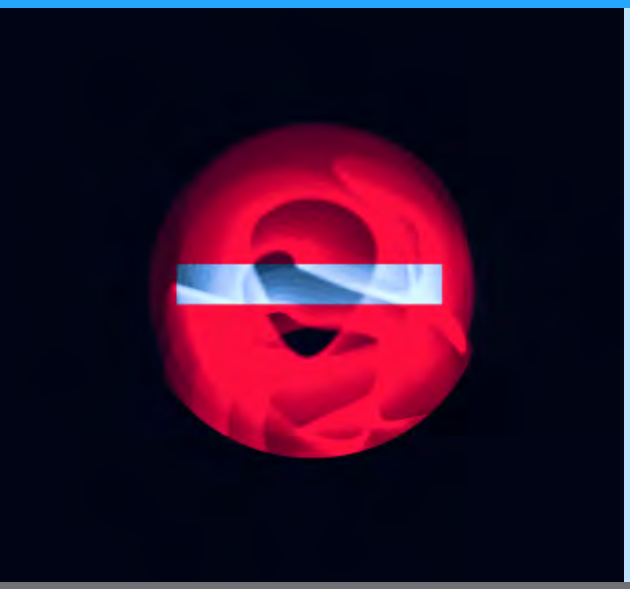
The second goal is to help caregivers with any moral distress they feel by having to enforce isolation and quarantine of residents. Keeping residents in their rooms is necessary for the good of the whole LTCH, but is also in conflict with person-centred care principles used to guide LTCH settings. This ethical conflict can cause moral distress.

IT'S WHAT'S IN THE TOOLKIT THAT COUNTS

The DIT is a set of three tools: Ethical Decision-making, Person-Centred Isolation Care-Planning, and Isolation Communication tools. The tools can be used together or separately, and each tool can be downloaded from the website at www.dementiaisolationtoolkit.com. Collectively, these three tools achieve the DIT's purpose and goals.

The **Ethical Decision-making tool** sets out the principles of public health ethics in the context of LTCH and provides a structured approach for LTCH staff to discuss and apply these principles. The tool is a worksheet that facilitates discussion and documentation on how to isolate a resident for infection control and prevention. It covers the strategies to be considered, risks and benefits of these strategies, and the chosen plan of action. It includes input from many stakeholders, including the resident and the resident's family.





The **Person-Centred Isolation Care-Planning tool** has been the most popular tool so far. This tool is also a worksheet that helps the LTCH staff identify and communicate practical steps that can be taken to support the resident in isolation. It prompts discussion on questions such as: why the person leaves their room and what brings them back, what they like to talk about, what kinds of reminders work for them and whether they understand why they need to stay in their room and can't visit others?

The **Isolation Communication tool**. This tool has 13 signs that are reminders for people living with dementia to stay in their room, stay back from others, wear a mask and wash their hands.

THE DIT IS MAKING A DIFFERENCE

In January 2022, Dr. Iaboni published DIT version 1.0 survey results. Of survey respondents that used the toolkit:

- 62% of DIT users found it fairly or very helpful

- 48% found it fairly or very helpful at reducing their level of moral distress in providing care during the pandemic

- DIT users reported less impact of moral distress on job satisfaction.

These results show that there is a role for DIT to support people with dementia and their caregivers.

THE STRUCTURE AND SUPPORT OF KITE PROVIDES MORE THAN JUST CONFIDENCE

Dr. Iaboni identifies many success factors that came together quickly for this project. She says DIT is reflective of KITE's "fundamental practice to rapidly move research into development and launch, then evaluate and improve, and re-launch." DIT is proof that this practice yields positive and meaningful real-world results.

This project truly embodies KITE's acronym: Knowledge, Innovation, Talent, Everywhere.

The **knowledge** and **talent** brought to bear were instrumental in creating the DIT. An integrated and collaborative team of research and clinical experts from UHN and external partners came together. This team included ethicists, researchers in person-centred care and relational care for people with dementia, experts in health systems and the LTCH setting, an epidemiologist, an expert in dementia technology and communication, implementation scientists, clinicians and even a graphic design student. From the start, they also had support from provincial organizations such as Behavioural Support Ontario, Ontario Centres for Learning, Research and Innovation, and the Regional Geriatric Program.

The **innovation** mindset at KITE was a driving factor. Identifying the need for DIT and then translating it into actual clinical practice by designing, building, and launching it in six weeks, shows the innovative spirit at work as well as the passion and commitment of the team to drive the project forward.

And finally, the DIT has applicability **everywhere** beyond its initial focus for LTCH. So far, Dr. Iaboni says the toolkit has been implemented in LTCH, acute care, developmental care and psychiatric settings, and in the community. It's a scalable solution, and has been accessed by people across Canada, in the U.S., U.K., Australia and New Zealand.

THERE'S MORE TO COME ON DIT

Dr. Iaboni and her team have their work cut out for them. Two evaluation studies are currently in progress. First, the team has a research paper currently under peer review which does a deeper dive on moral distress. Second, they're doing an implementation study at three Ontario LTCH to look at barriers to applying the DIT and find ways around them. This study will inform future research on how to support person-centred care in LTCH.

And, DIT version 2.0 is also in progress. It will reflect where we are now in the pandemic, as vaccinations have significantly reduced the risks in LTCH but those risks remain. It will also reflect feedback from users to be shorter and more geared for use in their huddle settings.

DIT version 2.0 will also be translated into more languages than version 1.0. Short training videos are already available in seven languages.

DIT FITS WITH CANADA'S DEMENTIA STRATEGY

The pandemic has heightened our awareness and understanding of the barriers to using isolation as an infection control and prevention measure in LTCH. Isolation can be harmful to people living with dementia and cause moral distress in caregivers.

In June 2019, Canada announced a Dementia Strategy with a vision for "a Canada in which all people living with dementia and caregivers are valued and supported, quality of life is optimized, and dementia is prevented, well understood, and effectively treated."

The DIT may have been a reaction to the unprecedented challenges of COVID-19, but it also directly supports Dementia Strategy vision. In fact, the DIT is featured in The Dementia Strategy for Canada 2021 Annual Report. It's noted as one of the highlights of Canada's dementia-related research responses to the COVID-19 pandemic.

And while we all hope to never see another pandemic in our lifetime, it's good to know that the DIT has broken ground on a vastly helpful resource for people living with dementia and their caregivers in future infectious disease outbreaks.

"DIT users reported less impact of moral distress on job satisfaction"

The Future is FIBRE

As “the interplay between art, design, science and technology” FIBRE could transform patient care

By Dawn-Marie Bennett


“Smart shirts could monitor heart rhythm in people recovering from heart attacks”

When we imagine fashion of the future, we often look to sci-fi depictions of utilitarian jumpsuits or outrageous, impractical outfits designed to shock and awe. We don't often think about the science of fabric, or the opportunity to embed nanotechnology into the clothes we already wear. At the KITE Research Institute at UHN, that potential is being realized with FIBRE, a smart-textile based research initiative founded by visionary scientist Dr. Milos R. Popovic.

In 2019, KITE embarked on a journey to explore how textiles might be used to create wearable tech for healthcare applications. Dr. Popovic and his team enlisted seven academic partners from colleges and universities in the Greater Toronto and Hamilton Area to work on the project. In the three years since, the FIBRE platform has experienced an explosion of interest, with more than 160 people from local, national and international organizations now involved. This growth is a testament to both the scale of this project and the benefits of mass collaboration.

This collaboration sees researchers and scientists working alongside fashion and textile designers to combine their skills and contribute to the project in innovative and exciting ways. OCAD University, one of the academic partners involved in FIBRE, views this collaboration as "the interplay between art, design, science and technology."

"The shirt you wear today can be the computer of the future," says Anthony Palma, Director of Research Operations at KITE. "This project has endless potential to provide practical solutions and access to healthcare for people around the word."

This sounds futuristic, but smart technology is already embedded in our world. The progression of

telephone technology in the last 30 years shows us how innovation can push the boundaries of what we think is possible.

"We've seen phones go from rotary on the wall to smart devices in our pockets that can do so much more than just make a phone call. Why can't we see the same shift in our clothing and textiles?" asks Palma. "We have the opportunity to incorporate unobtrusive monitoring and therapy into our clothes to transform the healthcare system."

And this major healthcare transformation is on the horizon. Demographic changes in the next 20 years will fundamentally change how Canadians access and interact with healthcare. Current models predict that within 20 years the population of people 65 and older will grow by 68 per cent.

This "silver tsunami" will quickly overwhelm the already stretched healthcare system, costing $62 billion by 2026 and up to $177 billion by 2046. The FIBRE platform is one solution to manage this stress. By reducing the number of hospital admissions we can increase independence and standard of living for seniors. Because these monitoring technologies would fit seamlessly into daily life, they would assist seniors in aging in place, without needing live-in support or admission to long-term care.

The development of these textile-based technologies starts with applying chemistry and material science. Developed fibres are made into strands that engineers then add sensors and other devices to. These technology-embedded strands are then woven into sheets of fabric. At this stage, fashion designers work with scientists to determine placement of the embedded technology and produce wearable garments that sit on the body in a functional way.

Throughout this creation process, KITE encourages patients living with

disabilities and illnesses to work alongside researchers to test these garments in labs throughout the facility. Because of KITE's unique collaborative nature and the impact of this new platform, it is critical that patients are included in the process early on in development and design.

"At KITE, our currency is our access to patients," says Palma. "These technologies are being developed alongside the people who would use them. They can test and provide essential feedback to researchers, in turn validating the garment and its functionality."

Although still in its infancy, FIBRE is already proving to have an impact on scientific research at KITE, with interest growing in many industries world-wide. As Palma explains, "Our experimentation with these embedded fibres is giving researchers across KITE another opportunity to apply their research."

In fact, the FIBRE platform can be applied to almost all the research happening at KITE. Millions of seniors experience falls and are hospitalized every year, and one third are then admitted into long-term care. Smart leggings could assist seniors by preventing or reducing the severity of falls. These leggings could provide compression and detect and support muscle movement to help keep seniors living independently with confidence.

Smart socks could greatly improve the quality of life for the 422 million people globally living with diabetes. These socks could monitor unnoticed changes in temperature and other factors that contribute to ulcers, alerting patients and care providers to act to prevent serious complications and amputations.

Smart shirts could monitor heart rhythm in people recovering from heart attacks, without the need for more invasive

"The collaborative nature of this project is where FIBRE really shines as a leader in the 'smart market' of wearable technology"

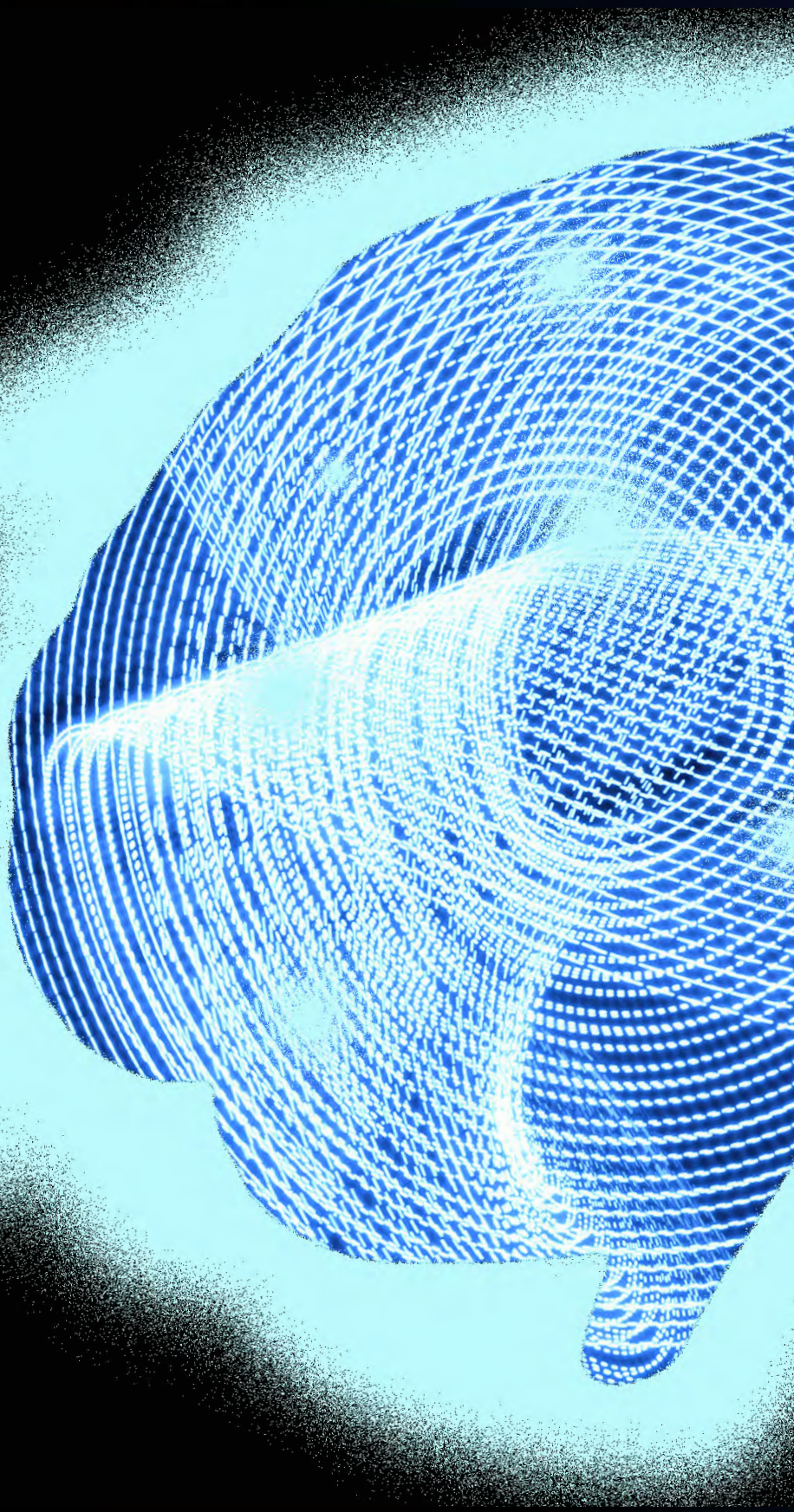
procedures and devices. Heart failure is the leading cause of hospitalization in Canada and 500 thousand new cases are diagnosed each year. This increase is expected to cost the healthcare system up to $722 million by 2030. FIBRE could reduce the number of repeat attacks and increase the quality of life for those living with heart disease.

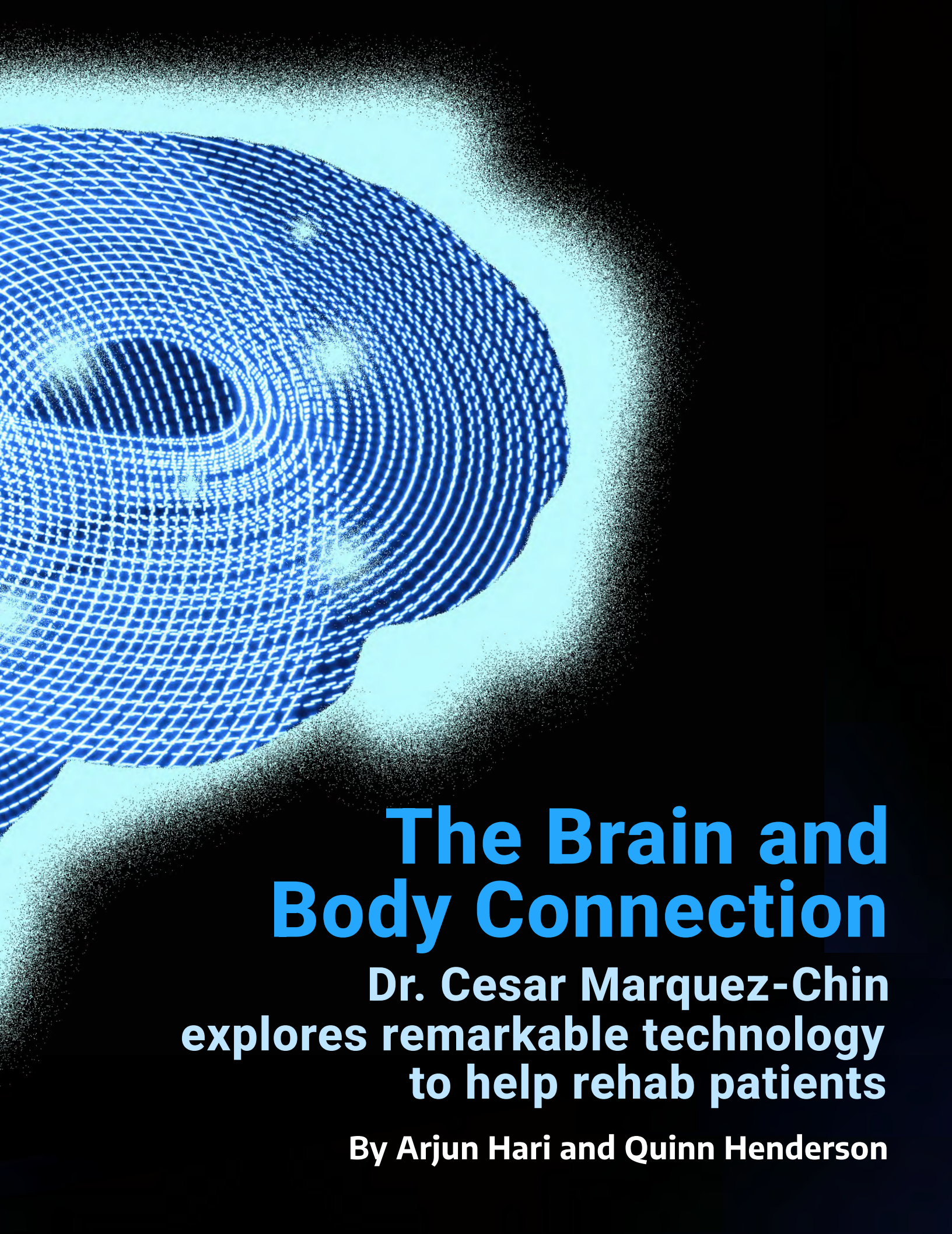
These wearable technologies will have a huge impact on patients and care providers living in rural and Indigenous communities. Travel and accommodation are huge barriers to care for those living far from hospitals and research centres, and regular monitoring of health conditions in those communities can be nearly impossible. By integrating smart textiles into treatments, patients will have better access to essential therapies, and care providers will be able to monitor their patients in real time to provide the best support possible. FIBRE would put otherwise unattainable treatment options within reach of millions of people, improving quality of life for people living with disability and chronic illness.

The collaborative nature of this project is where FIBRE really shines as a leader in the "smart market" of wearable technology. It connects multi-disciplinary partners from around Toronto and the world and encourages new ways of thinking about the future of healthcare. In a testimonial, the City of Toronto says the FIBRE platform "opens conversations around Toronto as a living laboratory for new care-enabled textiles," showing that FIBRE is changing the approach to healthcare research. In this, FIBRE embodies the key principles of KITE, combining knowledge to define the solution with innovation to find new ways to approach these solutions, proving that talent is everywhere and that everyone has something to contribute.

When asked about the future of FIBRE, Palma brings into focus the community aspect of the project, and KITE as a whole: "Textiles are all around us all the time. It's something we can relate to. Everyone wears clothes, so it's just a question of how to functionalize those clothes to help keep our global community healthy." With FIBRE as the future, technology will be weaved into the fabric of healthcare.

“people who have suffered significant injuries will get to live a fuller life”





The Brain and Body Connection

Dr. Cesar Marquez-Chin explores remarkable technology to help rehab patients

By Arjun Hari and Quinn Henderson

When you hear a term like "brain-computer interface," your mind might conjure an image of a mad scientist, donned with goggles, white lab coat, and spiky hair, whiling away in a laboratory on a dark and stormy night.

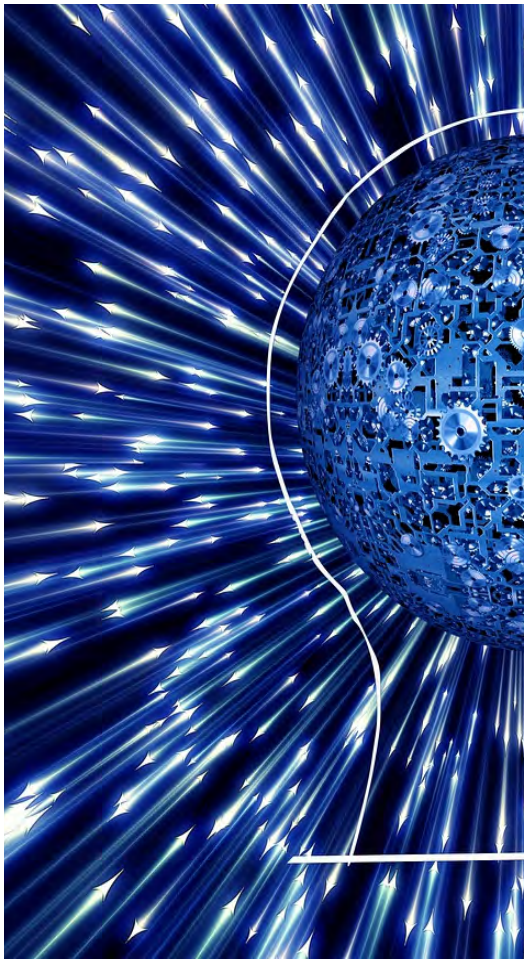
If this is the case, don't worry. Dr. Cesar Marquez-Chin, a scientist at the KITE Research Institute, University Health Network, doesn't mind such connotations. When asked how he feels about being heralded as KITE's resident "mad scientist," he basks in the title: "I love it!" He takes pride in thinking of outside-the-box solutions to address rehabilitation problems. One of those solutions could revolutionize the field of rehabilitation therapy. And if it sounds like science fiction, he's very aware of that.

There is a skeptical ethos in the academic research community that promotes the idea, "If it sounds like science fiction then it probably is."

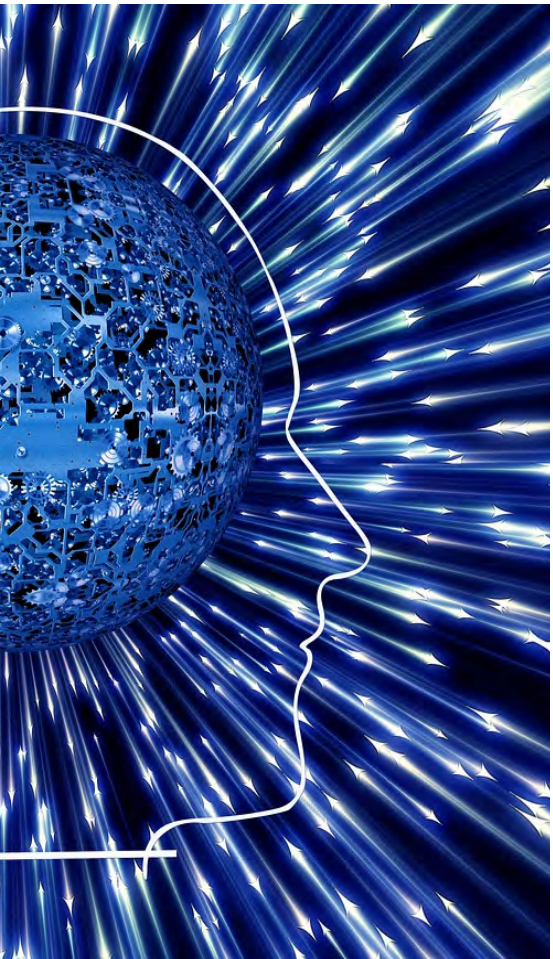
Twenty or so years ago, this was the label appended to brain-computer-interfacing (BCI). BCI is a computer-based system that acquires brain signals, analyzes, and translates them into commands that are relayed to carry out a desired action.

The fanciful-seeming nature of these ideas stopped BCI research in its tracks. However, as a young biomedical engineer out of Mexico working towards his PhD, Dr. Marquez-Chin and like-minded pioneers saw BCI as a way to revolutionise rehabilitative care. Sure, it's one thing to turn lights off and on with your brain as if one were Professor X of Marvel's X-Men. However, Dr. Marquez-Chin saw a use for the technology that could serve the greater good. Dr. Marquez-Chin's work seeks to explore BCIs as a new frontier to help paralyzed patients with serious rehabilitative needs.

In his research, Dr. Marquez-Chin uses BCI technology to help scan qualifying patients' brain signalling, while the patient attempts to move immobile body parts. The team then uses BCI technology to identify the areas the patient was trying to move, and the corresponding patterns and brain indicators. Next, external devices designed to assist the person in moving helps them to perform the desired movement. In the case of Dr. Marquez-Chin's lab, functional



electrical stimulation (FES) is used. This technique applies electrical discharges to selected muscles to create functional movements. Not only can patients regain sensation, but as a result of muscle contraction, they can perform functional tasks like grabbing a water bottle. Dr. Marquez-Chin is wholly aware of electroshock therapy's dark history, but he wants to redeem electrical therapy, and associate it with recapacitating, not incapacitating.



When asked about the future of the field, Dr. Marquez-Chin believes that in the next ten to fifteen years, a new generation of researchers will push towards a greater evolution between BCIs and possible rehabilitation. Another exciting area of BCI's potential is in its relationship to the brain.

Since BCI replicates brain signalling in real time, Dr. Marquez-Chin and his colleagues believe that there may be potential to allow for greater understanding into how the brain works. If we can now fulfil functions of the brain, then might that give us a clue into what's going on up there?

Yet, most of all, Dr. Marquez-Chin values his role as a mentor to a new generation of scientists beginning their journey at KITE.

Much like the rest of the working world, Dr. Marquez-Chin's work was disrupted in March of 2020 with the onset of the COVID-19 pandemic. When the initial batch of stay-at-home orders were mandated, he had two students working with him that were almost done with their studies. Fortunately, since they were so close to completion, the students had collected enough data that they could continue their analyses from home. Unfortunately for Dr. Marquez-Chin, this meant having to devise a way to help students with their studies – often requiring complex electrical engineering without the guaranteed ability to be on-site.

During the summer of 2021, Dr. Marquez-Chin had an undergraduate student assisting him with electrical programming. The catch: it was all done over Zoom. This was the first time he had to guide such precise technical work in a remote setting. Luckily, he was able to find humour and excitement in such a challenging situation. "We were laughing at how geeky this was," says Dr. Marquez-Chin, "because it felt like we were

astronauts." He played the role of ground control, communicating with his pupil, lost in space, trying to guide their malfunctioning ship home. Currently, he has one student working under him on the BMI project, who due to recent developments, is once again floating in space. But the research goes on.

These students are not the only remote collaborators on Dr. Marquez-Chin's project team. One group of researchers is based in Japan. After much hard work, the Japanese researchers were able to recreate the model Dr. Marquez-Chin had developed and got it to work. It was at that moment where he thought to himself, "Maybe this thing works after all!" As inspiring a moment as that was, he knows that more work needs to be done: more testing, more tweaks, to craft a sufficient and robust final product.

However, Dr. Marquez-Chin's journey has not been without its challenges; and those challenges are ongoing. To continue his research, more funding needs to come his way. "Funding is especially hard in the time of COVID," he says. "We have to park things for right now while we apply for more." Once more funding is forthcoming, Dr. Marquez-Chin says the next steps involve really understanding what happens in the human body when the stimulation occurs. They know the what and how FES works, they just need to get to the why.

For Dr. Marquez-Chin, the answers to these questions matter; it will mean more people who have suffered significant injuries will get to live a fuller life. "My passion is to help people," he says, "science, tech, engineering are just the vehicles I have chosen to do that." The results he has seen thus far with patients have been highly encouraging. The patients he took on were those who are traditionally considered difficult cases,

as all of them had tried other forms of therapy without any success.

Ultimately though, it's not about the technology itself. "If a rubber band around a pencil works [for some]," Dr. Marquez-Chin says, "then that's fine!" It's a "whatever works" approach. And he's betting that his research could be the thing that works for millions of people. When asked about what this means to him, he replies, "The privilege of seeing your work fulfilling that function is extraordinary. I am very, very lucky to be in this position."

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