

COVID DRIVES DEMAND  
FOR VIRTUAL SERVICES

SURVIVORS FACE LONG  
ROAD TO RECOVERY

NEW DEVICE SLOWS  
SPREAD OF INFECTION

# kite

The Kite Research Institute | Toronto Rehabilitation Institute | Volume 1

## How wearable tech can save your life

Smart textiles address need for  
remote care during the pandemic

# KITE AT A GLANCE



**127**  
scientists



**56k**  
sq. ft. research space



**627**  
publications

20 other students



26  
research  
fellows

105  
graduate  
students

**151**  
trainees



**\$30.6M**  
external funding



**175**  
staff

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# TORONTO STARTUP'S 'BUDDY BADGE' SLOWS COVID'S DANGEROUS SPREAD

*Wearable device helps reduce hospital-acquired infections by prompting health care workers to wash their hands*

A nurse walks quickly down a busy hallway in a hospital, navigating the usual obstacle course of medical carts, patient visitors and health care professionals in her path. She's carrying a blood pressure monitor, and has some pills to administer, when she enters the patient's room. She knows she needs to pump some sanitizer on her hands, but before she can put down everything she's holding, her patient calls her over. As she's about to help the patient out, a small device clipped to her scrubs vibrates.

"That's my reminder to start looking for a wall unit with a hand-sanitizer dispenser or a sink," says Dr. Veronique Boscart, a registered nurse and an affiliate scientist at the KITE Research Institute, currently working at Conestoga College. "It's not that I don't want to wash my hands, I just forget because there's so much going on."

The wearable device, called the Buddy Badge, was spearheaded by Dr. Geoff Fernie, senior scientist and former Research Director of the Toronto Rehabilitation Institute, to address a simple but critical problem: how can we increase hand hygiene to reduce the incidence of hospital-acquired infections? His work is the culmination of 17 years of KITE research – it just so happens that it became ready for use just as COVID-19 hit.

"Each patient admitted to hospital in North America has a 5 per cent chance of catching something they didn't have when they walked in, resulting in 100,000 deaths per year," says Dr. Fernie, adding that the situation is even more dire at long-term care facilities, with probably approximately 400,000 such deaths per year – and that's before the arrival of COVID-19. "Handwashing is the most effective way of limiting those infections."

Indeed, studies show that a 20 per cent increase in hand hygiene compliance can cut hospital-acquired infections by up to 80 per cent, he notes.

**“ This virus has finally woken people up... that antibiotic resistance is climbing and there are a growing number of infections that are untreatable. This is a huge challenge facing mankind, and the biggest thing we can do is improve hand hygiene. ”**

– Dr. Geoff Fernie

Dr. Geoff Fernie's Buddy Badge – the white lanyard affixed to his jacket – lets him know when he needs to wash his hands.



Dr. Geoff Fernie is leading the Buddy Badge project at the Kite Research Institute.

Previous efforts to improve hand hygiene were flawed. It wasn't enough to monitor overall compliance among health care workers who pop in and out of patients' rooms and might wash their hands 100 times in a single shift. They needed real-time feedback to change their behaviour.

"It's not much help to get a notice a week later telling you your hand hygiene was 4 per cent lower than it was the week before," says Dr. Fernie. "You need a kind and supportive tap on the shoulder in the moment."

# 99,000

Patients die every year from an infection they caught while in hospital (US only)

Source: Centers for Disease Control and Prevention (CDC)

## REMEMBER TO WASH

That's what the Buddy Badge does – it offers a friendly reminder to wash your hands, and only when necessary. The 17-gram wearable device, which looks like a large domino, clips to a shirt and communicates with sensors that are mounted on doorways and hand-sanitizer dispensers to detect when the wearer enters or exits a patient's room and whether they've cleaned their hands. If they have washed, it lights up green; if not, it vibrates. It's discreet enough not to embarrass the wearer, and smart enough to detect if they've washed their hands when necessary.

As an added bonus, users can download their hand hygiene reports to their phones or computers to see how they're doing – and can do so anonymously, if they prefer.

The device has been wildly successful. After completing prototype beta testing, Dr. Fernie and his team published three papers in the American Journal of Infection Control in 2018 and 2019 finding that the Buddy Badge system can double compliance with hand hygiene. That means a 1,000-bed hospital using the system can save 50 lives per year, notes Dr. Fernie.

To make the product commercially available, Dr. Fernie licensed the technology from University Health Network and launched a startup called Hygienic Echo, which is now marketing the Buddy Badge system to hospitals, nursing homes and retirement homes, with demonstration centres being set up at three Ontario hospital wards and a long-term care home where prospective buyers can observe the system in action.

## BUDDY BADGE FOR EVERY SECTOR

As the COVID-19 pandemic has shown, residents in long-term care homes are particularly vulnerable to infection – in part because they tend to be frail seniors and have underlying conditions – but also because there are so many people coming in and out of long-term care homes, and in general, residents don't stay in their rooms. "We associate hand hygiene with doctors or nurses, but someone serving a meal, giving a haircut or just visiting a resident can spread a virus just as much as a health care professional," says Boscart, who was one of the nurses who pilot tested the Buddy Badge at Toronto Rehab. "I can see a time when anyone coming in will get a Buddy Badge, in addition to a mask, to better protect residents."

With the new reality of COVID-19, Dr. Fernie can also see the technology finding a foothold in the food processing and travel (e.g., cruise ships) industries, as well as others. "This virus has finally woken people up – not just in healthcare, but in the whole economy – that antibiotic resistance is climbing and there are a growing number of infections that are untreatable," notes Dr. Fernie. "This is a huge challenge facing mankind, and the biggest thing we can do is improve hand hygiene."

To learn more about Hygienic Echo, please visit: [hygienicecho.com](http://hygienicecho.com) or contact: [info@hygienicecho.com](mailto:info@hygienicecho.com).



# COVID FORCES REHAB LEADERS TO RETHINK APPROACH

*Many coronavirus sufferers face a long road to recovery. Here's how Toronto's KITE Research Institute is trying to help*

It's been more than nine months since the first cases of COVID-19 showed up in Wuhan, China. Doctors had thought it was a respiratory illness that only deeply affected the elderly, with mostly everyone else able to recover fairly quickly. Now, though – with more than 30 million cases reported worldwide – it's clear that the novel coronavirus is a lot more dangerous than first thought.

Many survivors have experienced strokes, kidney failure, breathing issues, swallowing problems and a host of other ailments. While most people will feel fine after a few weeks, others face a potentially long recovery, explains Professor Catriona Steele, Director of the Swallowing Rehabilitation Research Laboratory at Toronto's KITE Research Institute.

"Many survivors are going to need a lot of help," she says.

Fortunately, researchers at KITE, the research arm of the Toronto Rehabilitation Institute, are searching for new treatments to assist those in need. While much of the world's medical community is focused on developing a vaccine or finding pharmaceuticals to treat the disease, KITE's staff are examining the after-effects of the virus and redeploying rehab resources to help.

"There are still a lot of unknowns and that's a challenge," explains fellow KITE scientist Dr. Azadeh Yadollahi. "We know patients are going to need a lot more rehab. We know some things

based on what we see in the ICU, but there's a lot we don't know. We have to design programs and run them at the same time now."

Here are four areas where KITE scientists and Toronto Rehab clinicians are helping COVID-19 patients recover from the virus:



## 1) SWALLOWING ISSUES – PROF. CATRIONA STEELE

Ventilators impact muscles, says Prof. Steele, as every muscle associated with breathing becomes weak. That includes the throat right down to the diaphragm. A breathing tube can also damage the throat and esophagus.

"The sensory nerves and receptors may become bruised or may not work," says Prof. Steele. Some patients may no longer cough when liquid or food goes down the wrong way, and coughing is an important protection mechanism for keeping the airways clear of foreign material.

“ There are still a lot of unknowns (with COVID-19) and that's a challenge. We know patients are going to need a lot more rehab. We know some things based on what we see in the ICU, but there's a lot we don't know. We have to design programs and run them at the same time now. ”

– Dr. Azadeh Yadollahi



Swallowing issues, specifically, are showing up in many COVID-19 patients. That's caused partly by weakness of the muscles of the throat – about 50 pairs of muscles are involved in swallowing. Steele explains that people who have been through serious respiratory problems can't hold their breath to swallow like most people, which then causes their swallowing function to erode even more.

Patients who have become too weak after intensive care may not meet this standard. Steele says, "They often end up in long-term care, and there's effectively no rehab for swallowing or other conditions there."

To help these patients get the support they need, and hopefully have them return home, Prof. Steele has applied for funding to conduct a study that will provide swallowing assessments for patients a month after their release from hospital. If persistent swallowing problems are found, then these patients could be offered rehabilitative treatment through the research study. The not-yet-funded research would look at COVID-19 patients, but ultimately, similar programs could be developed for those with head and neck cancers, stroke and other conditions that impact swallowing.

# 45

Estimated percentage of COVID-19 patients who need ongoing medical care after hospitalization.

Source: UK National Health Service



## 2. GERIATRIC ISOLATION – DR. ANDREA IABONI

KITE is also helping those in long-term care homes, which have been the epicentre of numerous outbreaks. Geriatric psychiatrist Dr. Andrea Iaboni has been working closely with several long-term care facilities since March and has discovered that some of the COVID-19 safety protocols that were put in place led to mental and physical decline among residents.

She's now working on a research project where an isolation-care planning toolkit is used to help prevent the fear, isolation and the lack of activities that occurred in long-term care facilities.

"If we're going to isolate someone, we're doing so with a plan in place," says Dr. Iaboni. The toolkit provides suggestions for how to keep seniors supported if they must be isolated, and teaches them to use tech tools, like FaceTime and Zoom, to communicate with others. "We have to prevent the virus from spreading, but also mitigate the negative effects of those preventative measures," she explains.



## 3. CARDIAC CARE – DR. PAUL OH

Dr. Paul Oh, Medical Director of the Cardiovascular Prevention and Rehabilitation Program and a senior scientist at Toronto Rehab and the Peter Munk Cardiac Centre, says COVID-19 forced the cardiac rehab team to limit in-person visits with cardiac patients. The team had to act quickly to provide remote rehab to 750 people in their care.

His team began leveraging its patient education platform (Cardiac College), which has extensive content, including nutrition and fitness information, videos and webinars, to help with this task. They also measured everything they were doing. "We had a chance to do a number of observational evaluations as well as structured surveys," says Dr. Oh.

The team discovered that patients, with support, were able to get active on their own, and adopted a routine of walking or doing light exercises from home, plus they appreciated getting one-on-one support via phone calls from staff. However, issues with the internet and using technology were a barrier for some patients, and many missed out on making friends and getting peer support, which is a key element of cardiac care at Toronto Rehab.

Dr. Oh's team is now using this data as they design and implement hybrid rehab care – a combination of virtual and in-person rehab – making sure that those limited face-to-face interactions have an impact.



## 4. WEARABLE TECH – DR. AZADEH YADOLLAHI

There are a number of other innovations being developed at KITE related to COVID-19. Many services and research projects have been modified to help those with the virus. That includes an internet-based cognitive therapy project that's been adapted for survivors – indeed, this virus impacts the brain too, and many people experience cognitive decline after being bedridden and on painkillers for long periods.

Dr. Yadollahi develops wearable medical devices that can measure respiration and heart rate, among other indicators. She's adapting these tools to help diagnose COVID-19 and track recovery, and will possibly use them in high-risk groups, such as people experiencing homelessness, to help manage outbreaks in at-risk communities.

While there's still a lot of work to be done, researchers are excited about new opportunities that COVID-19 is presenting for rehab research and services.

"We're going to be able to deliver rehab to as many patients as possible in new ways. Not only those with COVID-19," says Dr. Yadollahi. "If we can deliver great rehab remotely and effectively, we can take a lot of pressure off the health care system and caregivers."



Dr. Robin Green regularly uses video conferencing tools to do telerehab with her patients.

## COVID-19 FUELS DEMAND FOR VIRTUAL REHAB SERVICES

*The pandemic is forcing clinicians around the world to rethink the ways they treat patients in every area*

A man who sustained a brain injury in a car accident is sitting in front of his laptop at home, while a researcher asks him to perform a variety of tasks. In this case, the doctor asks the patient to find the best route between a hotel and restaurant in Milan. He clicks through Google Street View, taking in the cafés and storefronts. But wait, the instructor

says, we want to avoid construction on the route. Can you find another way?

This exercise, developed by Dr. Robin Green, a KITE Research Institute scientist and Canada Research Chair in Traumatic Brain Injury, Dr. Asaf Gilboa, an affiliate scientist at KITE and others, is helping people with brain trauma

improve their problem solving and memory. What's more, this kind of mind-saving exercise can be done at home, without any in-person interaction with the instructor. It's just one example of virtual rehab, also known as telerehab, which has, naturally, taken off since the pandemic began.

Over the next months and potentially years, demand for telerehab is expected to explode. COVID-19 has forced clinicians around the world to rethink the ways they treat patients in every area, including rehab. Instead of having a patient drive to a hospital, which comes with risks for injured or elderly people, including potentially being exposed to the novel coronavirus, they can get the same kind of treatment without leaving their home.

“This is an opportunity to springboard telerehab forward,” says Dr. David Alter, a cardiologist and senior scientist at KITE. “We launched virtual rehab in a matter of weeks in response to the pandemic. Going forward, we can take advantage of the technology KITE has to monitor people in their homes and make sure the rehab they get is the best possible quality.”

While the pandemic caught a lot of medical professionals off guard, KITE already had some of the technology and tools in place to launch a COVID-19-related telerehab program. For the past three years, researchers have been testing out various telerehab methods, involving video chats, exercise-tracking software and wearable monitors. They've found that patients who engage in virtual rehab participate more consistently and for longer than those who do traditional in-person rehab. While many challenges still stand in the way of wide-scale adoption, from spotty internet to technical issues, KITE researchers are determined to make telerehab more accessible and more effective.

### ACCESS TO HIGH-QUALITY CARE

In 2017, Dr. Green helped establish the Telerehab Centre for Acquired Brain Injury at the University Health Network (UHN) because she saw that many people with an acquired brain injury – due to a stroke or an accident, for example – don't have access to scientifically proven rehabilitation methods. There may be a local community centre that offers helpful social programming, but not therapies and exercises that have been developed and tested specifically for patients with a brain injury; therapies that protect the brain and enhance thinking and mood, she says.

While Dr. Green uses new therapies like her Google Street View exercise, the main

telerehab she and her colleagues provide is through live video conferencing to groups of patients in remote regions throughout Ontario. A therapist meets with groups who have similar brain injuries, and provides them with proven cognitive and mood therapies to help them adjust to and recover from brain injury. Teletherapy is powerful because it brings people with specific types of brain

injuries together, even if they live hours apart. This is important, as research shows that engaging with people who are going through similar traumas is hugely helpful to patients, she explains. “Telerehab lets you reach and bring together very vulnerable people who are often already economically disadvantaged due to their disability; marginalized groups who have little access to care,” she says.

“ We launched virtual rehab in a matter of weeks in response to the pandemic. Going forward, we can take advantage of the technology KITE has to monitor people in their homes and make sure the rehab they get is the best possible quality. ”

– Dr. David Alter

## MORE PRECISE REHAB REGIMES

While telerehab for brain injury requires only a video conferencing app and an internet connection, Dr. Alter is looking into how wearables and other home monitors can enhance telerehab for cardiac patients. He’s researching how to best incorporate everything from wearable fabrics, home heart rate monitors and blood pressure machines so he can offer guidance to other telerehab providers. “We have a lot of technology, but we need to be able to validate that technology scientifically to know that it is providing accurate information,” he says.

For the last three years, Dr. Alter has been leading a team of physicians, kinesiologists, dietitians and others who provide telerehab to patients with heart disease or those who may be at risk of getting it. Through weekly video conferences, they help patients adjust their diet, quit smoking, lower their stress levels

and, most of all, exercise. Patients can track their exercise duration and intensity using software that allows the providers to follow their progress.

Dr. Alter’s research has shown that, thanks to the video lessons, patients feel confident measuring their exercise progress each week, based on their heart rate and the duration and frequency of the exercise. They also know how much easier it is to set up appointments, which helps them keep their rehab going for longer, he notes. Most importantly, telerehab improves people’s health. Patients with heart disease who’ve received telerehab often experience improvements in cardiac fitness, blood pressure, blood sugars, weight and quality of life, with less measurable breathlessness, within as little as three months, as compared to their health status prior to telerehab initiation.

## ADOPTING TELEREHAB DURING A PANDEMIC

With COVID-19 now making virtual rehab a must-do, doctors, therapists and others from across the world are turning to KITE for insights. Dr. Mark Bayley, Psychiatrist in Chief at UHN, and Medical Director, Toronto Rehab, has spent the last few months researching the adoption of telerehab in the pandemic. He’s looking at the barriers patients and providers have faced, including “video fatigue” and people’s ability to download rehab-related apps. He wants to find ways to overcome these challenges and better understand in which situations in-person or telerehab is best.

For his own stroke patients, Dr. Bayley sees telemedicine as an important tool for getting a real-world view into a patient’s life, which then helps him both care for his patients and find new ways of providing rehab. “If one wants to do a kitchen assessment (a type of assessment to see a stroke patient’s

everyday level of functioning), I don’t have to bring them into my lab. I can watch them go through the routine of preparing lunch in their own environment.”

While telerehab has been around for a while, COVID-19 will only speed up its adoption – and the development of technology to enable this kind of care. In the future, artificial intelligence bots might tell a patient if they’re working too hard or if their heart rate is high and they should ease off what they’re doing, says Dr. Bayley. Basic video conferencing and even old-fashioned telephone appointments will also become more widespread. Dr. Green has already demonstrated that phone therapy has as many benefits as face-to-face therapy when it comes to treatment of depression and anxiety in neurological patients.

The ultimate goal is not to create a fancy new gadget – it’s to provide care in an environment that people are comfortable in, and to remove the stress, time and cost of travel. As Dr. Bayley explains, “We know that when we provide care to people in their own homes, many people will do better.”



# 90.3

Percentage of patients in 2019 study who said they would willingly recommend telerehab

Source: Grand View Research





Partnership between KITE and Toronto-based textile technology company Myant will soon make remote care as easy as putting on a pair of underwear

## HOW WEAVING WEARABLE TECH INTO YOUR WARDROBE COULD SAVE YOUR LIFE

*Toronto's smart textile industry addressing need for remote care during COVID pandemic*

It sounds like science fiction: imagine being able to slip on a pair of otherwise average looking underwear, knowing that conductive fibres in the garment's knit will capture a continuous picture of your heart rate, breathing patterns, body temperature and other important biometrics. If you were to experience a sudden decrease in activity or a medical episode like an arrhythmia, caregivers in a remote location would be able to intervene immediately, possibly saving your life or eliminating the need for long-term rehabilitative care.

As COVID-19 hit Canada in March, the then pervasive "stay home" message left many elderly Canadians and people living with disabilities in isolation, making the need for remote monitoring devices particularly acute. While limiting people's movement protects them from contracting the virus, the decrease in face-to-face visits from caregivers and loved ones means that crises ranging from minor strokes to depression can go unnoticed for substantial lengths of time. Even though many organizations have experimented with remote monitoring devices for years, a new, and timely, partnership between the KITE Research Institute and Toronto-based textile technology company Myant will soon make remote care as easy as putting on that pair of underwear every morning.

### PRIVATE SECTOR PARTNERSHIPS

KITE has long prioritized partnerships with private sector companies. Not only do for-profit startups like Myant have a built-in motivation to get products to market as soon as possible, but unlike some slower-moving academic institutions, the private sector tends to be more overtly solution oriented. When KITE Director Dr. Milos Popovic learned that Myant CEO Tony Chahine was motivated to develop easy-to-use wearable biometric interfaces after seeing his own father's struggle with dementia, Dr. Popovic knew that Myant could benefit from KITE's expertise, and vice versa.

"For many years we've worked aggressively with various companies to create solutions that will improve the experiences of aging populations and people with disabilities in Canada," Dr. Popovic says. "If we make solutions that are available to the wider majority of people, we essentially enable people to benefit from our work and the money that society has invested in us through taxpayer dollars. This is the kind of work that really goes back to the community."

Of course, the partnership goes both ways. While KITE actively looks for private sector companies that can efficiently provide

solutions to patient problems, businesses like Myant want to ensure that their products offer legitimate medical benefits. The two organizations work as partners to scientifically “validate” the technology so that medical professionals can feel confident that the garments are more than flashy gadgets. Clinical validation, says Chahine, is a key step in getting this kind of transformative technology to those who need it, while the partnership between KITE and Myant is “monumental” for the development of textile computing, he notes.

“As a company, it’s important for us to think beyond the product itself and focus on the outcome that it will bring to the public,” explains Chahine. “Our purpose is to provide a new kind of care, one that is continuous and will truly predict and anticipate things before they happen. For that we need validation through a top-of-the-line research institute, and in Canada there is none better than KITE and University Health Network.”

## MORE REMOTE MONITORING

Myant has already put in more than 10 years of research and development into its textile computing technology, commercially known as Skiin. The line includes underwear, bras and tank tops – clothes that touch the skin – and are made with conductive fibres that can pick up and transmit biometrics through the capture

# \$5.6B

Expected size of the smart textile market by 2025 in U.S. dollars.

Source: Grand View Research

“Our purpose is to provide a new kind of care, one that is continuous and will truly predict and anticipate things before they happen. For that we need validation through a top-of-the-line research institute, and in Canada there is none better than KITE and University Health Network.”

– Tony Chahine, Myant CEO

of an electrocardiogram reading. The Skiin garments are a potential game changer in that users can simply slip them on and go about their day without having to worry about pushing buttons or interacting with any kind of interface. That makes it ideal for elderly, physically impaired or cognitively impaired populations.

“It’s unique in that it’s like any other garment that you might have,” notes Milad Alizadeh-Meghrizi, Myant’s Vice President of Research, Development, and Partner Integration. “We’ve come up with a very unique way of coating the yarn with conductive materials so that when you wear or wash it the conductive properties don’t change.”

The ability to monitor patients at home has become especially pressing in the era of COVID-19. Myant’s products are not intended solely for elderly users, but they certainly are ideal for aging patients, who are the very same people most at risk when it comes to the virus. The Skiin garments would limit these patients’ exposure to the virus, while still allowing caregivers to keep track of their changing health care needs.



Dr. Milos Popovic (L) and Myant CEO Tony Chahine (R) inspect remote monitoring undergarments at the company’s plant in Toronto.

While the immediate applications would be to alert remote caregivers if a patient experiences any concerning changes in biometrics, the technology offers many other possibilities, given that patients would theoretically be wearing their Myant underwear up to 24 hours a day over the course of multiple months or years. With such a significant amount of continuous information, KITE scientists may eventually be able to use data patterns to predict when a patient may be headed for a stroke or similar medical emergency, giving caregivers the opportunity to take preventative action. Since the garments don’t require any contribution on the part of the patients beyond putting on their daily pair of underwear, the possibilities for long-term data collection are endless.

“If we have more data about things like heart rate collected over a longer period of time, we’re going to be able to discover new things,” says Bastien Moineau, a postdoctoral fellow working with KITE. “We can collect that data

because patients don’t need to change their lifestyle to use it. It’s about simplicity without the need to change behaviour.”

## A CANADIAN SOLUTION

Dr. Popovic is also proud that this win-win relationship is a wholly made-in-Canada solution. While the Skiin garments will potentially have an impact around the world, especially as COVID-19 remains a global concern, everything from conception to validation to implementation has taken place in Canada.

“What’s exciting about this is that it’s homegrown,” Dr. Popovic notes. “We have a Canadian company, Canadian innovation and a Canadian health care institution trying to create technology that has the potential to solve problems related to aging, disability and within the wider population. I’m very excited by that.”

A woman with brown hair, wearing a black jacket, black pants, and a black safety harness, is holding a thick black rope. She is standing on a red floor in a laboratory or gym setting with white walls and blue lighting. A bright light source is positioned near her feet, creating a lens flare effect. The text "i am kite" is overlaid on the image in white, lowercase letters.

i am kite

The KITE Research Institute  
Toronto Rehabilitation Institute - University Health Network  
550 University Avenue, Toronto  
416-597-3422 x7800  
kite@uhn.ca

 **UHN** Toronto  
Rehabilitation  
Institute  
The Kite Research Institute