



**EMPOWERING INNOVATION
IMPROVING HEALTH**

INNOVATION REPORT / JUNE 2022



**Hamilton
Health
Sciences**
INNOVATION



At Hamilton Health Sciences, health innovation has assumed a central place in the care and well-being of our growing and aging population.

While innovation has long been a pillar of our strategic plan, increasingly strained resources are driving the need for health organizations to find ways to work smarter and more effectively. Accordingly, HHS has invested in a suite of new resources aimed at enabling innovation including a new, modern hospital information system and an innovation program stocked with industry expertise. We're in a better position than ever before to improve the health of people in Hamilton and around the world through innovation.

**ROB MACISAAC,
PRESIDENT AND CEO,
HAMILTON HEALTH SCIENCES**



Hamilton Health Sciences has a long tradition of curiosity, discovery, and willingness to think outside the box to transform health care through

innovation. In collaboration with our team of health professionals, we foster the spirit of inquiry to identify problems that need solving. We forge strategic partnerships to find solutions to challenges that we can't tackle alone. And, through our commitment to innovation, we're revolutionizing health care by empowering patients to partner in their own care for a more patient-centred, seamless system.

Hamilton's innovation community is extremely collaborative. We have the expertise and drive to share and optimize connections in the bigger world, with an aim to improve our broader health system and create better outcomes for the people who rely on it.

In this report, you'll find a collection of stories and data that exemplify the quality and breadth of HHS' innovation strategy, inspired by our vision to provide the best care for all.

**DR. TED SCOTT,
CHIEF INNOVATION OFFICER,
HAMILTON HEALTH SCIENCES**



Key Pillars of Innovation at HHS



-  **EMPOWERING PATIENTS**
-  **NURTURING TALENT**
-  **CONTINUOUS CONNECTION & CARE**
-  **STRATEGIC PARTNERSHIPS**
-  **TRANSFORMING SYSTEMS**



Innovation accomplishments in the 2021-2022 fiscal year

\$2,250,000

REVENUE GENERATED

1,245

PATIENTS INVOLVED

9

INNOVATION TOOLS, PRODUCTS
AND PROJECTS IMPLEMENTED

17

PUBLICATIONS/PRESS
EXPOSURES

CREATING CAPACITY TO DRIVE INNOVATION

Hamilton Health Sciences has developed the CentRE for dAta science and digiTal hEalth (CREATE) - a multidisciplinary team of specialists in health systems, data engineering, data science, software engineering and interoperability. The team is partnering with scientists and innovators to create digital solution that will advance how health care is provided. Some of these partnerships are featured in this report.



AI predicts best test option for improved patient safety

Heart disease is the leading cause of death worldwide. The most common type being coronary artery disease (CAD), which occurs when the vessels that supply blood to the heart are blocked or become narrow.

A test called an invasive coronary angiography is the gold standard for diagnosing CAD. During this procedure a catheter is inserted into the blood vessels through the patient's groin or arm as a route to the heart. Then, a special dye that's detected by X-ray is released in to the bloodstream. This allows doctors to see how the blood is flowing and identify any blockages.

Every medical test carries some level of risk. Globally, more than 50 per cent of patients who receive an angiography will have a normal test, and/or their CAD is not due to a blockage. This means these patients are exposed to unnecessary procedural risks. Plus, an angiography is a costly procedure that requires a highly skilled team.

To address this challenge, a research trial was created and led by Dr. J.D. Schwalm, an interventional cardiologist at Hamilton Health Sciences (HHS), director of HHS' Centre for Evidence-Based Implementation.

"About 90 per cent of patients referred for angiography have an appropriate referral based on clinical guidelines," says Schwalm. "The problem is that our ability to determine which patients are

best served by this test is poor and leads to a high rate of normal results, and potentially unnecessary procedures."

The study assessed using a non-invasive imaging test called a coronary computed tomographic angiography (CCTA) instead of an angiography. When provided to the right population, the CCTA is a lower risk, highly accurate test that costs less. Radiation and X-ray dye-related risks are still present, but the procedural risks are eliminated. Study results showed that this approach could successfully reduce the number of angiographies by 76 per cent.

"The hardest part of the study was that we used an archaic system to pull out the right patients for CCTA. It was a labour-intensive process for the triage staff and cardiologists," says Schwalm. "In practice, it's not ideal."

Bringing solutions to real-world healthcare challenges is where collaboration between HHS' Centre for dATA science and digiTal hEalth (CREATE) and Centre for Evidence-Based Implementation come into play.

With funding from the trial, the team evaluated 10 years' worth of patient data. Then, using artificial intelligence (AI) machine learning models, the CREATE team analyzed the data and determined the predictors of a normal angiogram, thus determining which patients would and wouldn't



PHOTO Dr. J.D. Schwalm is working with the CREATE team to develop a more effective process for diagnosing coronary artery disease.

benefit from the procedure. The AI model provided a better prediction than existing clinical prediction scores and algorithms.

“We look forward to integrating the AI machine learning model into a decision support software tool that can be used by the referring physician or in the cardiac catheterization lab,” says Schwalm. “This will help reduce the number of unnecessary angiograms, reduce health system costs and help ensure that patients receive the best test based on their risk for coronary artery disease.”

“The AI model provided a better prediction than existing clinical prediction scores and algorithms.”



Surgical patients recover at home with remote monitoring technology

Lesley Cavanagh-Burns was diagnosed with aortic valve stenosis more than 10 years ago, a heart defect she likely had at birth. She knew the valve would deteriorate over time and would one day require surgery to be replaced.

That time came in March 2022. Just five days after open heart surgery, the Burlington resident returned home to recover with support from the Greater Hamilton Health Network Virtual Surgical Transitions program.

The program is a joint initiative of Hamilton Health Sciences (HHS) and St. Joseph's Healthcare Hamilton that enables patients to recover at home while being remotely monitored by a hospital team. The program operates seven days a week, 12 hours a day, with after-hours paging.

Enrolled patients use a [Cloud DX Connected Health](#) kit, which includes a tablet paired with equipment to capture vital signs and weight. While she and her husband don't consider themselves 'tech-savvy,' Burns-Cavanagh's initial concerns about using the equipment were promptly addressed by the virtual nursing and Cloud DX teams.

"Once initial setup on the technology has occurred, there's great uptake since patients and their caregivers see how easy it is to use," says Jennifer Lounsbury, chief of interprofessional practice at HHS and operational co-lead of the virtual nursing station.

The at-home virtual care routine for patients includes checking their vital signs (temperature, weight, oxygen saturation and blood pressure), video visits and assessments with a nurse, surgical wound review, and medication and pain assessments. The virtual nursing team reviews this data each morning to identify any issues that may require escalation to a specialist or surgeon.

"Having the ability to video conference patients and their physicians is much more person-centred than having the patient come into the hospital," says Lounsbury. "We're building a synergistic virtual care community of practice designed around patient experience and quality care."

With the support of her husband, Cavanagh-Burns reported her vital signs three times a day for a week, then once daily for a second week. They found it especially helpful to take and share photos of her eight-inch surgical incision to ensure it was healing properly and address minor complications simply and efficiently.

"In times gone by, you'd go home and hope for the best," says Cavanagh-Burns. "Having access





PHOTO After open-heart surgery at HHS' Hamilton General Hospital, Lesley Cavanagh-Burns recovered from the comfort of her home while receiving virtual follow-up care.

to the virtual nursing team was instrumental in my healing. Any concerns or blips in my vital signs, and the virtual team would call me. It was very reassuring to access my health-care team without leaving our home, especially during a pandemic.”

With surgical backlogs at an all-time high due to the pandemic, the program aims to reduce patients' length of stay, promote early discharges, reduce re-hospitalizations and emergency department visits, and improve patients' experiences and surgical outcomes.

Cavanagh-Burns says she is extremely grateful for the opportunity to take part in the program and wishes that one day every patient could experience the amazing care she did.

“Having access to the virtual nursing team was instrumental in my healing.”



The desire to make change comes from a deep partnership with clinicians.

While physicians, nurses and other health-care professionals often envision superb solutions for patient care or workflow, they don't always have the expertise needed to turn promising concepts into real-world solutions. The CREATE model showcases our expertise in software engineering, data science, AI and interoperability and what can happen when those things come together in a meaningful partnership with clinicians.

CREATE unites ideas with tech solutions to improve health.”

**DR. JEREMY PETCH,
DIRECTOR, HAMILTON HEALTH SCIENCES
CENTRE FOR DATA SCIENCE AND
DIGITAL HEALTH (CREATE)**





NURTURING TALENT



STRATEGIC PARTNERSHIPS

Merging medicine and engineering to advance breast cancer care

Hamilton has a long history of excellence in breast cancer research which has led to advances in treatment and outcomes worldwide. The same innovative thinking led the Hamilton Health Sciences (HHS) oncology team to assist in selecting Dr. Ashirbani Saha as the first-ever BRIGHT Run Breast Cancer Learning Health System Chair.

Saha is an engineer with expertise in artificial intelligence and using advanced analytics, including machine learning to develop applications for health-care data.

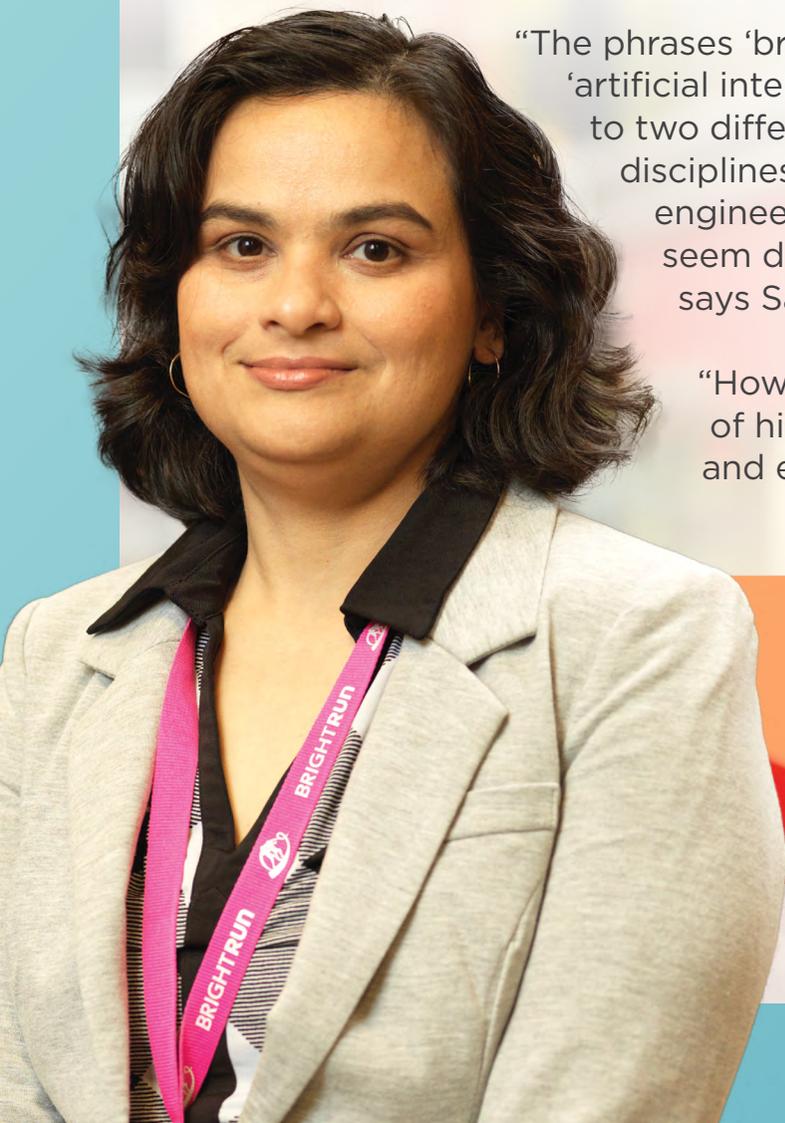
“The phrases ‘breast cancer’ and ‘artificial intelligence’ are related to two different academic disciplines – medicine and engineering – which might seem disconnected,” says Saha.

“However, in the course of history, medicine and engineering joined

hands to drive innovations in health care. Examples of such technology include the MRI (magnetic resonance imaging) and radiation treatment planning systems.”

BRIGHT Run is an annual volunteer-led community run/walk in support of breast cancer research in Hamilton. The event contributed \$2 million to permanently fund the new endowed research chair, with McMaster University contributing another \$2 million.

“The recruitment of an engineer to a clinical department is unique and innovative. We’re inspired by the potential to enhance our research agenda by adding advanced analytic techniques including machine learning and artificial intelligence to an already incredibly strong team of researchers,” says Dr. Jonathon Sussman, a radiation oncologist at HHS, and professor and chair of the department of oncology at McMaster University’s Michael G. DeGroote School of Medicine. “We are fortunate to have a data scientist of Dr. Saha’s calibre join our team.”



**DR. ASHIRBANI SAHA,
INAUGURAL BREAST CANCER LEARNING
HEALTH SYSTEM CHAIR**



Empowering patients living with chronic concussion symptoms

Approximately 15 per cent of people diagnosed with a concussion will experience chronic symptoms lasting longer than three months. An innovative new app has been developed at Hamilton Health Sciences (HHS) to help these individuals manage their recovery.

Dr. Gihan Perera, co-creator of the MyHeadHealth app, is a physical medicine and rehabilitation specialist at HHS' Regional Rehabilitation Centre (RRC). He works with those living with chronic concussions and provides assessments and treatment plans to help manage symptoms. These include healthy lifestyle habits like daily exercise, stretching, meditation, good nutrition and getting enough sleep.

Perera noticed that many patients struggle to maintain their essential daily regimen as well as providing their doctor with detailed updates at follow-up appointments and thought an app could help them. So, he turned to HHS' Centre for data science and digital health (CREATE) to make it a reality.

Staffed with experts in software engineering, artificial intelligence and data sciences, CREATE works with health-care professionals to develop new ideas and create digital solutions that are designed for use in a clinical setting.

“We know that there are clinician innovators like Dr. Perera with really great ideas about new ways to deliver health care, but without the technical expertise to carry out their vision,” says Jeremy Petch, CREATE's director.

The MyHeadHealth app offers patients the ability to track their daily activities, symptoms, and nutrition and sleep habits. In turn, this gives physicians more detailed information about the patient's ability to follow their daily care routine and recovery process.

“Connecting with CREATE was the turning point for the development of this app,” says Perera. “They immediately understood the medical and research implications of this project.”



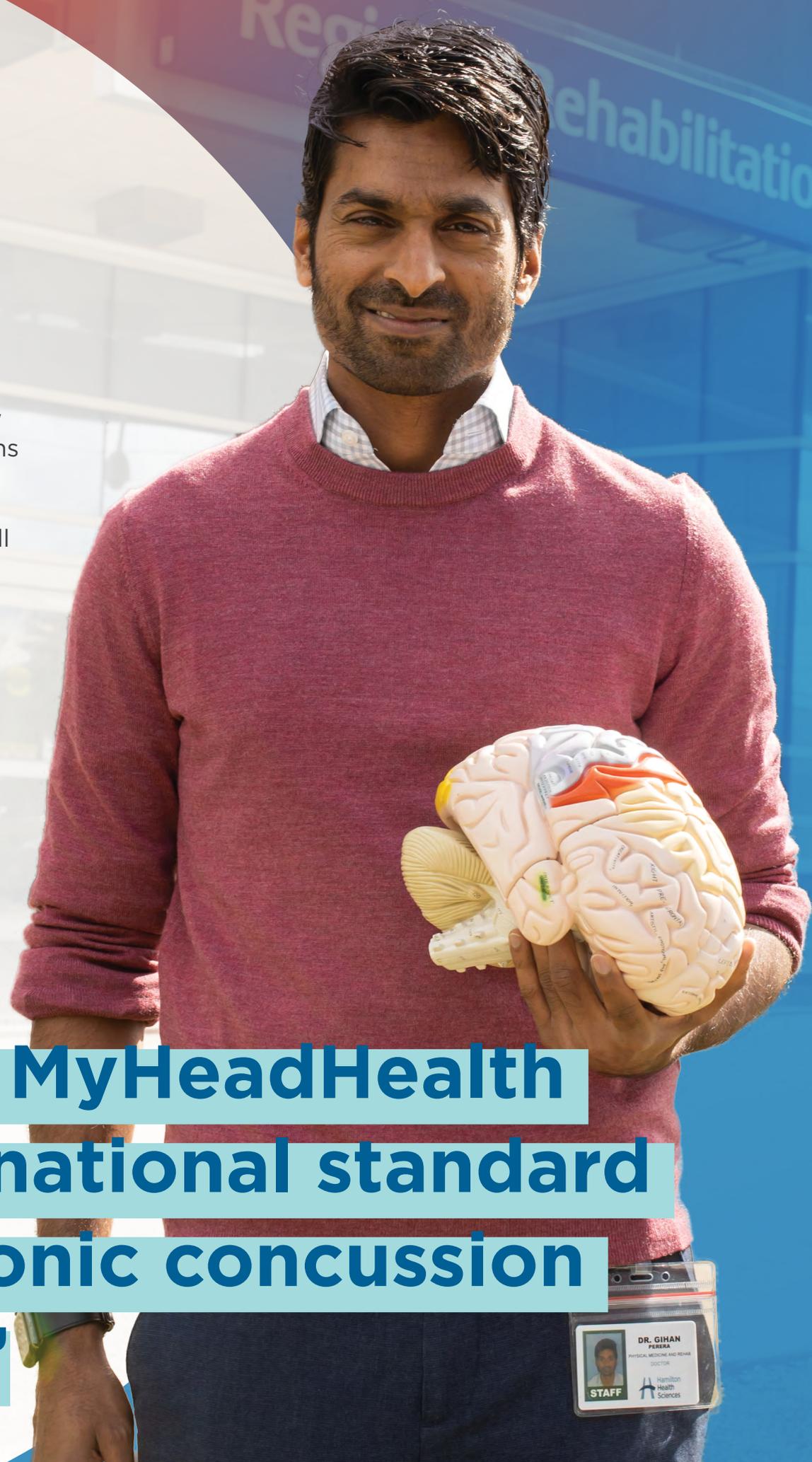
PHOTO Dr. Gihan Perera is developing a new tool to help people manage their chronic concussion symptoms.

The app also holds great promise as a research tool since data collected could help unlock new information about chronic concussion symptoms and how best to treat them.

The RRC will begin testing the app with a small group of patients in 2022 to get feedback on the features and functionality. To ensure the app is as useful and effective as possible for patients, testing is expected to take approximately one year.

“Our goal is for MyHeadHealth to be the international standard of care for chronic concussion rehabilitation so that patients around the world can benefit from the leading-edge research and innovation happening here at HHS.”

Our goal is for MyHeadHealth to be the international standard of care for chronic concussion rehabilitation.”





STRATEGIC PARTNERSHIPS



TRANSFORMING SYSTEMS



NURTURING TALENT

A search engine for disease diagnosis

For more than 300 years, pathologists have looked at blood and tissue samples under a light microscope to diagnose disease, slide by slide. Dr. Clinton Campbell, a hematopathologist at Hamilton Health Sciences (HHS), envisions a future where slides are digitized and pathologists are working in sophisticated computer labs with the world's best data at their fingertips, through a search engine of sorts.

One of the reasons this search engine doesn't already exist is because scanned pathology images are very data-intensive – as large as one gigabyte each. A single diagnosis alone can require a specialist to review of dozens of slides.

“The system we have currently works well, but we can't share images of human tissues in real-time with colleagues or do a 'virtual peer review' where multiple pathologists can examine slides together at the same time,” says Campbell.

Campbell is a specialist in blood and bone marrow pathology. If a pathologist at another hospital wants his medical opinion, they have to ship the slides to him in thick cardboard folders. This can lead to delays to a patient's diagnosis.

“Imagine how much better it would be if we could share these slides digitally, in real time,” says Campbell. “It would allow for wider, faster consultation. If you add machine learning into the mix, you then also have access to a vast amount of

knowledge that's sorted to prioritize the very best information to help with your case.”

Machine learning, a type of artificial intelligence, can automatically learn patterns from data and then use this knowledge to make useful predictions. This means faster, better reports because machine learning will help extract essential information from pathology images and instantly compare to tens, hundreds or even thousands of other previously diagnosed samples.

“It's kind of like having Google for pathology, with a team of virtual pathologists on standby in the cloud 24/7,” says Campbell. “This could transform the way diagnostic medicine is done.”

To work towards the world's first commercial image search engine for pathology, Campbell led a one-year pilot project in partnership with Ontario-based company, [Huron Digital Pathology](#). The company's software uses barcodes to convert pathology images into just 10 to 15 kilobytes of data, making it possible to search images quickly.

“Pathologists, machine learning scientists and industry need to work as an interdisciplinary team to engineer these technologies from the ground up. You can't do it alone as a pathologist and you can't do it alone as a scientist,” says Campbell. “This project allowed us to test in a real clinical setting how this artificial intelligence-based technology can work.”

PHOTO Dr. Clinton Campbell is working towards an advanced digital method to replace looking at blood and tissue samples through a microscope.

The pilot helped Huron Digital Pathology gain valuable insight into the number of pathology images required to generate accurate results, and considerations to implement the technology on a larger scale.

Marrying health-care experts with companies at the forefront of leading-edge technology is what the Ontario Bioscience Innovation Organization (OBIO®) is all about. This not-for-profit selected the Huron Digital Pathology/Hamilton Health Sciences project as one of eight Early Adopter Health Network innovation projects - which highlights health technology companies and health organizations coming together to evaluate technologies in a real-world setting.

“It’s kind of like having Google for pathology.”



Innovation is about making a difference that matters to people.

As a world-class teaching and research organization, innovation is a core purpose and it's how we stay on the leading edge. Given the wide range of patient needs that Hamilton Health Sciences serves, we discover problems that can be brought forward as opportunities to solve and connect to those who might help develop solutions.

Sometimes, companies need on-the-ground experience and feedback from clinical experts and patients to continue developing their products to achieve optimal impacts. That's where we play a role - we have many different patient populations, and we also have a wealth of diverse individuals who are very strong in the fields of clinical care and evaluation.

People's hearts and minds drive their eagerness to really make positive differences.”

**KIRSTEN KRULL,
VICE PRESIDENT, QUALITY AND
PERFORMANCE & CHIEF NURSING
EXECUTIVE**





STRATEGIC PARTNERSHIPS

Developing collaborative healthcare solutions with the CAN Health Network

The [CAN Health Network](#) is a Canada-first approach to technology adoption. It helps health-tech companies quickly and easily bring their innovations into the health-care system by facilitating collaborations with health-care organizations. Through the CAN Health Network, Hamilton Health Sciences (HHS) has partnered with two companies, SterileCare and Verto Health to find solutions to some challenges it has faced.

As a regional cancer program, HHS cares for many patients who require central venous catheters, a tube that's connected to the bloodstream to provide medication. Care and maintenance of these 'central lines' are essential to patient safety to prevent blockages and infections that can occur when bacteria grow in the line and spread to the bloodstream. HHS has partnered with SterileCare to use its KiteLock™ solution for oncology patients. This new, advanced product keeps venous catheters clean and free of bacteria.

"KiteLock bridges a significant gap in the market. With the prevention of infection and blockages as our top priority, our catheter lock solution is the only product proven to eradicate all problematic bacteria," says Karen Mueller, CEO of SterileCare. "By working with the CAN Health Network, we are improving care with each partnership we form while continuing to scale our business."

Since the pandemic began, thousands of patients have missed medical appointments because they were concerned about entering the hospitals during the pandemic. To help keep patients up-to-date on hospital protocols and provide appointment reminders, HHS partnered with Verto Health to use a patient notification and queue-management technology at two of its clinics.

With the CAN Health Network facilitating these partnerships, HHS has been able to explore possible health-care solutions while supporting innovative Canadian companies.





CREATEing global impact: WHO's SMART Guidelines for Immunization

Countries worldwide rely on the World Health Organization (WHO) as the master resource for health-care guidelines across a wide range of areas. Yet, in many countries, guidelines are paper-based, which makes adoption and assessing compliance challenging.

In response, the WHO has developed the SMART (Standards-based, Machine-readable, Adaptive, Requirements-based, and Testable) Guidelines project to accelerate the availability and impact of guidelines, even if a country is not yet fully digital.

The WHO's SMART Guidelines will support guideline developers, policymakers, technology teams, and health workers by adapting and applying WHO recommendations to countries' existing – and evolving – digital systems. SMART guidelines are a [five-step process](#) that provides a systematic, transparent, and testable structure for countries.

“We want to give countries a standardized way to move from paper to digital, supporting data sharing across linked systems,” says Dr. Garrett Mehl, director, digital health technology unit within the digital health and innovation department of the WHO. “SMART guidelines introduce essential content and coding standards and map out the

care protocols in a computable format, allowing for use in any digital system.”

Hamilton Health Sciences' (HHS) Centre for dAta science and digiTal hEalth (CREATE) will be leading a Canadian consortium specifically on the SMART guidelines for immunizations. This consortium also includes:

- [Canada Health Infoway](#)
- [Canadian Institute for Health Information \(CIHI\)](#)
- [IntelliSOFT](#) Consulting Limited, a Kenyan digital health software development and consulting firm
- [SantéSuite](#), a Canadian immunization management system software company
- [PuraJuniper](#), a Canadian digital solutions firm
- [Liz Peloso](#), an advisor who led global immunization initiatives with the Bill and Melinda Gates Foundation

“The project will help build digital systems for tracking and storing immunization information,” says Ted Scott, chief innovation officer at HHS. “The idea is to automate the management of vaccination guidelines so we can report against them and identify barriers to care for patients around the world – including in Canada, which has quite a fragmented system.”



PHOTO Our CREATE team is working with the World Health Organization to develop a globally accessible system for digitally managing and reporting routine immunizations.

In Canada, the SMART guidelines approach will make a difference in vaccination tracking, allowing governments to better understand and serve people who haven't been able to access this basic health-care tool.

"This project has the potential of enabling better health outcomes in Canada as well as globally," says Shelagh Maloney, executive vice president, engagement and marketing, Canada Health Infoway.

We want to give countries a standardized way to move from paper to digital."



TRANSFORMING SYSTEMS



CONTINUOUS CONNECTION & CARE



STRATEGIC PARTNERSHIPS

Something to SMILE about: Making it possible to age in place

The desire to age well is a universal sentiment. This includes aging in place – having the health and social services to live safely and independently in one’s own home and community for as long as possible, even with chronic health challenges.

Hamilton Health Sciences (HHS) with support from McMaster University is part of an important multinational initiative, called the SMart Inclusive Living Environments (SMILE) project that will support aging in place. It combines an innovative smart living environment (SLE) ecosystem model and a set of complementary eHealth solutions co-created with older people.

SMILE is a three-year-long project that includes 13 organizations from Canada, Norway, Denmark and the Netherlands. It will provide digital solutions to enable older people to live a healthy, self-determined, safe and socially integrated life in their current living environment. This “everyday life” support combines prevention, prediction, communication, timely care and assistance. The program will help older people remain connected with their community and foster collaboration with their care team while living in their preferred place of residence for as long as they can meet their changing medical needs.

The team will co-create and demonstrate the SLE ecosystem in “everyday life” across four pilot sites in Norway, Denmark, the Netherlands and Canada. It will include diverse populations

of older people with severe dementia, chronic obstructive pulmonary disease (COPD) and care transitions during post-surgery recovery. Approaches in one pilot site will be tested and evaluated in the other sites using an iterative approach. This will provide traction for sustainable cooperation in the long term.

The Canadian contribution to the SMILE project builds upon HHS and McMaster University’s proven [research expertise with remote patient monitoring](#) technology by CloudDX. For this project, the Cloud DX Vitaliti™ remote patient monitoring platform will be used. This includes proprietary medical devices, mobile apps, clinical dashboards, artificial intelligence and integration with the hospital’s medical records system to monitor patients at home while recovering from surgery. The team plans to collect data from 900 patients undergoing non-cardiac surgery.

The knowledge gained through the SMILE initiative will not only have global impact, but will help strengthen HHS’ existing hospital-to-home initiatives, which support older adults to remain and thrive in their home environment.

SMILE is funded by the EU Horizon2020 Research and Innovation Programme and Canadian Institute for Health Research.



PHOTO Annette Atwood participated in a program developed by the GERAS Centre of Aging Research which has also allowed her to age well at home.

A partnership formed by a “smart” collaboration

HHS was invited to join the European Union (EU) consortium of organizations to contribute to the SMILE initiative due to a successful collaboration in 2017 with Innovation Norway. This was a research study by HHS’ GERAS Centre for Aging Research which trialed one of the world’s first **“smart” hospital beds** from Norwegian health-tech company Aply Medical. The bed combines a movement system with a range of sensors that monitor and improve patient comfort to help prevent pressure ulcers and falls. The design is also meant to make it easier for nursing staff to safely maneuver patients in their bed. The study results provided valuable feedback on the bed’s functionality.

“The knowledge gained through the SMILE initiative will not only have global impact, but will help strengthen HHS’ existing hospital-to-home initiatives.”



TRANSFORMING SYSTEMS



STRATEGIC PARTNERSHIPS

Priming Hamilton's innovation pipeline worldwide

Hamilton Health Sciences (HHS) plays a proactive and valuable role in the innovation commercialization process across southern Ontario and Canada.

“In the first instance, HHS has a culture that fosters innovation and problem-solving. They’re a critical source of intellectual property and general research that lays the foundation for products and services to be developed and deployed into the market,” says Alex Muggah, director of Synapse Life Science Consortium, a not-for-profit, regional cluster organization for the life sciences ecosystem in the greater Hamilton region. “The second, indispensable role that HHS plays is validating and supporting entities on their commercialization journey, once they’re ready for their products to be evaluated in a clinical setting.”

Through careful vetting processes to ensure organizations are ready, collaborators of the Synapse Life Science Consortium can tap into the infrastructure and expertise that resides at HHS, secure regulatory approval, and assess and refine their product due to that collaboration.

Without hospital support in the validation process, Canadian life science companies face additional hurdles in bringing their products and services to market.

“Hamilton has a rich history of world-leading research and innovation in medicine and health care through its hospitals and academic institutions. While, fundamentally, Hamilton’s innovation landscape hasn’t changed that much in the last five years, one thing that has shifted significantly is recognition of Hamilton as a key player in the innovation community,” says Muggah. “More than ever before, I hear, ‘There’s lots of buzz in Hamilton,’ from government officials, investors, universities, companies and other hospitals across Canada and internationally. We’re solving problems that currently perplex us and hopefully result in better patient care made right here in Canada.”



Hamilton's Innovation Ecosystem

As a member of the Synapse Life Science Consortium, Hamilton Health Sciences contributes to the growing success of the research and innovation ecosystem in Hamilton's health-care sector. Here are some accomplishments of the Synapse Life Sciences Consortium.

\$623,900,000

FUNDS RAISED BY HAMILTON'S PRIVATE COMPANIES IN THE PAST FIVE YEARS

\$462 Million

ANNUAL RESEARCH SPEND

6,709

TOTAL NUMBER OF RESEARCHERS

50+

RESEARCH INSTITUTES AND CENTRES

\$5.7 Billion

OPERATING BUDGET

3,982

RESEARCH PROJECTS
CURRENTLY UNDERWAY

8,700

PUBLICATIONS

**TO LEARN MORE ABOUT COLLABORATIVE OPPORTUNITIES
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