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INSIDE:

PHOTO: COURTESY BIOINTERACTIVE TECHNOLOGIES

It's all in the wrist action

Simon Fraser University alumni Karim Merhi and Gautam Sadarangani have launched TENZR, a technology that uses hand and wrist movements as a human-machine interface. Their company, BioInteractive Technologies, has developed a whole platform that can be used to control medical equipment in operating rooms, complex robots, as well as in rehab medicine, training and other applications. **SEE STORY ON PAGE 17.**

St. Michael's devises high-powered forecasting tool

BY JERRY ZEIDENBERG

LAS VEGAS – St. Michael's Hospital, in Toronto, has created a business intelligence (BI) and forecasting tool that enables the acute-care centre to answer questions in just two hours, down from the three to five days it took previously.

"Now it takes us longer to get a good question than to answer it," quipped Jeremy Petch, PhD, Project Direct, Quality and Analytics, who gave a presentation on how St. Mike's built the AI-powered system.

Dr. Petch was a speaker at the annual Healthcare Information Management and Systems Society (HIMSS) meeting, which attracted over 40,000 health I.T. professionals to sunny Las Vegas. It was held in March.

St. Mike's "rapid response" tool, developed in partnership with the hospital's Decision Support team, enables managers in the hospital to forecast, for example, expected volumes in the Emergency Department. And it's doing it within a 6 percent error rate. With 200 or so visits per day to the ER, the

> The tool is also being used to create an Early Warning System for the Intensive Care Unit.

tool is off by only 12 visits, at most, which still gives managers a pretty accurate idea of what to expect.

By knowing what to expect in the way of patient volumes, hospitals also get a better idea of their staffing needs.

It can be deployed, moreover, to forecast whether various programs will meet their quarterly or annual targets.

And it can also be used for retrospective studies – to determine whether a change implemented by a department actually worked.

Moreover, a group at the 463-bed hospital is now using the system to develop an Early Warning System for the intensive care unit. It will determine which patients on medical floors are about to crash, so they can be helped before they need to be moved to the ICU.

For years, as Dr. Petch described, it was difficult to answer various questions about past performance and to forecast the future, as the information needed was housed in different silos. As well, the hospital lacked a powerful analytics tool.

"Any analyses that were done were purely

St. Michael's devises a high-powered forecasting and analytics tool

descriptive," said Dr. Petch. "There wasn't much rigor behind the analysis."

However, a group of managers in the Quality, Performance, Information Technology and Information Management portfolio, and scientists at the hospital, wanted to change this.

"A few of us had a vision to transform St. Michael's into a data-driven organization," he said. The goal was to support high-quality patient care and to increase operational efficiency.

In 2016, they created the Centre for Healthcare Analytics and Training (CHART), based at St. Michael's, which is part of a new network with St. Joseph's Health Care Centre and Providence Healthcare. And they have started to recruit data scientists with expertise in machine learning, neural networks, biostatistics, simulation modelling and industrial engineering.

Dr. Petch commented that hospitals have to compete with companies like Google for AI-experts and other data scientists, but in Toronto they had something attractive to offer. As a teaching hospital and affiliate of the University of Toronto, St. Michael's was able to facilitate professorships at the university for highly qualified individuals.

This attracted high-calibre talent, as many data scientists also want to make an impact as teachers and academic researchers.

"That's something that Google and other companies can't do," commented Dr. Petch. "We can give them a good salary, plus an academic career."

Finding talented junior staff is also a challenge. Many younger people, in search of fame and fortune, take quickie courses in Deep Learning or neural networks, and then dub themselves data scientists.

"There's a proliferation of online courses available," said Dr. Petch. "People are taking them, but then you discover they can't write a line of code."

To weed out the better candidates, CHART invited applicants to come in to do three or four hours of coding. "75 percent don't even show up," he said. "They know they can't do it."

By assessing the skills of those who do show up, CHART has been able to recruit a talented team.

Jeremy Petch

On a lighter note, he commented that St. Mike's has created a looser "culture" for its CHART think-tank, as computer professionals like a more free-wheeling atmosphere.

To solve the problem of disparate sources of information, with data separated into silos throughout the hospital, the team spearheaded the creation of a data warehouse.

Dr. Petch said there was a decision to be made about whether to invest in a data warehouse or a data lake. Data warehouses contain information of a more structured variety, while data lakes contain "raw data", in all and any formats.

As the information in a data warehouse is more usable to researchers, and can be used more quickly to answer questions and solve problems, the team decided to go with this option.

To build the BI tool itself, the CHART team used R software – a language and environment for statistical computing and graphics. Not only is it high quality, but it also happens to be freeware – a big advantage for cash-strapped hospitals.

Today, the forecasting tool enables St. Michael's Hospital to answer questions faster and more accurately than before. It is also reducing the staff time needed for forecasting and analytics.

Dr. Petch noted that in the ED, it could previously take 1.5 person days to answer a particular question; now, that can be done in a couple of hours.

Of course, not everything is perfect. He observed that data quality is still an issue, and that often, the problem occurs right at the point of entry – when clinicians are entering their data into various systems.

Dr. Petch said some organizations have been successful at improving their data quality, and singled out the Centre for Addiction and Mental Health (CAMH) in Toronto, as a leader in this area.

For its own part, in building the tool, Dr. Petch said that St. Michael's learned a great deal from others. In particular, he acknowledged InterMountain Healthcare, in the United States. "They were mentors to us," he said.
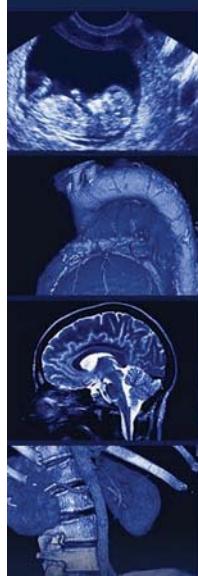
Portable imaging could shed light on concussions

CALGARY – Concussion is one of the most talked about injuries in sport today. Yet, there is no accepted way to image a concussion. University of Calgary scientist Jeff Dunn, PhD, hopes to change that. He and his team have developed a portable brain imaging system that uses light to detect and monitor damage in the brain from concussion. Researchers and doctors will be using the technology in an upcoming study at the Alberta Children's Hospital.

The device, using Near-Infrared Spectroscopy (fNIRS), measures communication in the brain by measuring oxygen levels. When the brain is working well, major regions on each side of the brain are communicating and so have similar patterns of blood flow and oxygen levels in blood.

Researchers measure the changes in blood oxygen levels as a marker of brain function. "The one thing we know is that there can be physiological changes in the brain that last for months to years after a brain injury due to concussion. We discovered a new technology that is portable to measure those changes," says Dunn, director of the Experimental Imaging Centre at the Cumming School of Medicine (CSM).

William Osler Health System launches MyChart and other technologies

BY JERRY ZEIDENBERG

BRAMPTON, ONT. – After a year-and-a-half of development, testing and partnership with Sunnybrook Health Sciences, William Osler Health System (Osler) has rolled out its MyChart patient portal to patients at all three of its sites – Brampton Civic Hospital, Etobicoke General Hospital and Peel Memorial Centre for Integrated Health and Wellness. The web-based MyChart system allows patients on-line access to their lab and pathology results, along with their diagnostic imaging and diagnostic cardiology reports.

While lab results are available in real-time, pathology, diagnostic imaging and diagnostic cardiology reports are available to patients 14 days after being electronically signed.

The hospital engaged in significant stakeholder consultation including with Osler's Patient and Family Advisory Council (PFAC), along with clinicians and administrators about this decision.

"The technology supports real-time access to the results," noted Mary Jane McNally, Chief Patient Experience Officer at Osler. "Some of our patients said they preferred hearing important clinical information from their care provider, while others acknowledged the value of accessing their own test results right away. As an organization, we had to find a middle ground."

The hospital will be monitoring the use of the system and will be continually interacting with patients and clinicians to revisit which results should be posted earlier. As well, in the next couple of months, the plan is to post patients' scheduled appointments in MyChart.

So far, over 18,700 patients at Osler have signed up to use MyChart, noted Marla de Souza, Project Manager for the Osler initiative. Osler continues to promote this and other new patient-facing

technologies to the communities it serves, and is confident the number of active users will continue to grow.

De Souza said that in December, Sunnybrook implemented a new account management feature allowing patients to use a single login to access their records from multiple MyChart network sites. In addition to Sunnybrook and Osler, member sites include St. Michael's Hospital, Michael Garron Hospital, Baycrest and the Ottawa Hospital.

Opening up access to patient information is a top priority for Osler. "It's all about access to information," commented James Moolecherry, Osler's Chief Technology Officer. "The patients own the information that is collected about them. MyChart gives them access to their own information, and the patients can approve access to family members and caregivers when needed."

Moolecherry explained that in the past, "Patients would have to physically come into the hospital and make a request for their records. MyChart makes it much easier – they can access their information whenever they want, from wherever they may be."

He also added that making a patient portal available to Osler patients and enhancing the patient experience is a key part of the organization's corporate strategic plan.

Not only is it a matter of patient rights and satisfaction, it's also a way of improving medical outcomes. "Patients are ultimately the experts in their own conditions," said McNally.

They do even better when they have up-to-date information about their health. "People have been coming in to see their doctors, armed with information from Google," said McNally. "Now, as a result of having timely efficient access to their results, they are coming in with questions and concerns based on their own factual information."

McNally also points out that if patients are able to ask their clinicians about their

own test results and therapies, they can achieve better outcomes.

Osler's implementation of MyChart draws its data from multiple sources, in real-time, using the Corolar healthcare integration engine from Dapasoft, commented Joe Cossu, Osler's Director of Infrastructure and Applications.

The combination of the Corolar solution and Biztalk technology ensures that the information presented to the patient – and his or her health team – is the most up-to-date.

Moreover, Cossu said that patients can rest assured their data is secure and protected, as the system has been validated by a privacy impact assessment and threat risk assessment.

MyChart is part of a group of new solutions at Osler that are designed to improve the patient experience, as well as medical outcomes and organizational efficiency.

Interestingly, McNally said technology is no longer seen as just an "enabler", but as a significant part of the patient experience.

Technology is now a regular part of everyone's day-to-day life – one just thinks of how often people are using their smart-

phones and apps like Facebook, Google and texting. "Technology no longer takes the humanity out of your experience, it's now part of it," said McNally.

Indeed, technology can be used to enhance nearly every part of the patient experience at Osler, and the hospital has a broad range of projects planned for the near future.

For example, the hospital is working on an early check-in system for patients that allows them to register from home or wherever they might be, to avoid lineups and waits at the hospital. "It's based on what the airlines are doing," said Moolecherry. "We're just working out now how far in advance patients need to check in."

Osler has already set-up self-serve kiosks for check-in at its Peel Memorial site, which is being met with great patient approval. "Eighty-five percent of the people who have been shown how to use the kiosks are continuing to use them afterwards," said Moolecherry.

Systems are also being designed with smartphone access in mind, as that's the platform most people are using today for web access.

Managers at the William Osler Health System see tech as a key part of a high-quality patient experience.

CADTH produces Canadian inventory of diagnostic imaging equipment

OTTAWA – Ever wonder what kind of diagnostic imaging machines are available in different provinces or territories? Will a patient be able to get a CT or MRI scan nearby, for example, or will they need to travel to another jurisdiction? What is the ideal location to place a new imaging machine and where should upgrades take place?

An updated, pan-Canadian inventory of DI equipment has just been released, containing a wealth of information to help answer these questions and more.

The Canadian Medical Imaging Inventory (CMII) is now available, with open-access at www.cadth.ca/imaginginventory.

Developed by CADTH, the CMII reports contain high-quality data obtained in 2017 on the quantities, locations, ages, technical specifications, and uses of imaging machines installed across the country.

Since 2001, national statistics have been

collected on imaging modalities by various Canadian organizations – with CADTH taking on the responsibility in 2015.

As these technologies rapidly advance, the continual need for an updated picture is imperative to help decision makers understand the evolution of medical imaging, the influence of emerging technologies, and the expansion of clinical applications and population needs.

Public and private health care administrators were invited, on a voluntary basis, to complete a comprehensive web-based survey on six specialty imaging technologies including:
  • computed tomography (CT)
  • magnetic resonance imaging (MRI)
  • single-photon emission computed tomography (SPECT)
  • positron emission tomography/computed tomography (PET/CT)
  • single-photon emission computed tomography/computed tomography (SPECT/CT)

  • and positron emission tomography/magnetic resonance imaging (PET/MRI).

Analysis revealed that every province has at least one CT machine and that this imaging modality is the most common among those surveyed, with 561 machines in Canada, up from 419 a decade prior. This represents growth of approximately 35 percent in the 10-year period.

> **SPECT-CT experienced the fastest rate of growth, compared with all other imaging machines.**

Although an increase was observed, this technology actually experienced the slowest rate of growth compared to the other machines studied, which may be due to market saturation.

The number of CT exams being performed increased, with 5.61 million ex-

ams completed in 2017, up from 3.38 million in 2007.

With a 65 percent increase in the number of machines, MRI is the second most common technology surveyed, with 366 machines, up from 222 units in 2007. There were 1.86 million MRI exams performed in 2017, up from 1 million in 2007.

SPECT was the only modality in the survey to show numbers dropping over the past 10 years. There were 330 SPECT machines accounted for in the 2017 data, with trends suggesting that SPECT-CT machines are replacing SPECT machines. In fact, SPECT-CT experienced the fastest rate of growth compared with all other imaging machines.

There was a total of 261 SPECT-CT machines, 51 PET-CT machines, and three PET-MRI machines captured in the latest survey results. At this time, all three PET-MRI machines are located in

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Kim Garriott
Principal Consultant, Healthcare Strategies, Logicalis Healthcare Solutions

Watch the session and learn how to mitigate the pandemic of issues surrounding sub-optimal enterprise image management.

Made-in-Canada cloud solution identifies diseases and pandemics

BY MOHAMMAD QADIR

A recent Time magazine article found that infectious-disease outbreaks are increasing around the world at an alarming rate. In fact, the number of outbreaks per year has more than tripled since 1980.

In the United States alone, close to one million critically ill people remain undiagnosed each year, and many of them spend a long time in the hospital because of it, or even die. The cost to the healthcare system is staggering, estimated at US$27 billion.

Interestingly, tackling pandemics is at the very centre of our business model, thanks to leading-edge genomic technology and the IBM Cloud. Based in Vancouver, the Fusion Genomics team comes to work every day focused on reducing the impact of infectious disease through better diagnosis and detecting pandemics before they happen.

We've developed a process to identify any known pathogen in a single test, giving doctors the potential to diagnose illnesses at a much faster rate.

The solution involves disruptive DNA and RNA capture technology that we believe can positively identify infectious diseases and enhance the surveillance of emerging pathogens like MERS, SARS, avian flu, and swine flu.

So how exactly does this work? Let's start with the fact that there are roughly 1,400 known human pathogens, and our bodies contain more bacteria (good and bad) than human cells.

Current tests look for pathogens one at a time. Then our medical practitioners have to determine the strain, choose the appropriate drug and begin treatment.

Each step in this process takes up time

Fusion Genomics has developed a next-generation set of sequencing assays for infectious diseases.

that a very ill patient may not have. Our technology, on the other hand, can diagnose all known human pathogens in a single test within 12 hours and give detailed genomic data to guide treatment.

When employed for pre-emergence surveillance, the technology can help proactively identify threats, like swine flu, by taking aerosol samples in high risk areas, then analyze the sample to determine if there is potential to affect humans.

If there is a risk, Fusion Genomics can help groups like governments and hospitals make rapid and informed decisions for the health and safety of those that rely on them before an outbreak occurs.

Fusion Genomics has developed a next-generation sequencing-based set of assays for infectious diseases. Our platform, known as ONETest, sets us as apart from other genomics companies, because it is

up to 10,000 times more sensitive than other genomic solutions. Eventually, we believe, the cost per test using our platform will be one-tenth that of other genomic solutions.

With an increasingly urban and rapidly growing global population, any potential outbreaks of infectious diseases are a risk that Canada and the world cannot afford to overlook.

Cloud capabilities allow for the rapid recruitment of computational resources, whenever and wherever they are needed. Fusion Genomics chose IBM Cloud to ensure we had a highly flexible and secure computing platform so that we could strengthen our ability to react to potential outbreaks that continually threaten our public health and economy.

How is this being received by our healthcare providers who are on the front

line diagnosing patients and identifying potential outbreaks within their communities? With limited funding and resources, the challenges associated with managing pandemics within a hospital environment are significant.

Many diseases are not detected properly, driving up costs with incorrect, delayed decisions, and in some instances, there is no diagnosis at all. This is further compounded by the prevalence of hospital acquired infections and increasing presence of antibiotic resistance.

The ONETest is being used by public health agencies in Canada and the assays can serve any reference testing laboratory, public health agency, hospital or pharmaceutical company involved in pathogen testing and monitoring. With this single test, and timely results within 12 hours, front-line care delivery can be improved and costs contained with comprehensive genomic data to guide therapy.

This is, in fact, precision medicine specifically for infectious diseases. By successfully identifying the disease at the outset, our healthcare providers can now avoid contributing to antibiotic resistance by using the correct antibiotic for the disease.

Better surveillance of infections, whether they are acquired within a hospital or not, can lead to further targeted programs that can slow or prevent the spread of epidemics. This is a unique and compelling made-in-Canada story about how innovation and technology are being interlaced to help solve a significant and life-impacting medical challenge.

Mohammad Qadir is CEO of Fusion Genomics.

Shareable immunization record available on iOS and Android phones

BY NEIL ZEIDENBERG

An Ontario-developed application that safely stores a person's immunization records, and those of their families in the Amazon cloud, is now available as a mobile app on iOS and Android phones. It can be downloaded for free on Google Play or the App Store.

CANImmunize (www.canimmunize.ca) is a free digital immunization record where users can safely store, update and share their immunization records among family members. By setting up an account and registering a PIN, users can access their records using everyday technology like a smartphone.

The actual apps have been around in several forms for about six years, but now it's being connected to the cloud. "The Android version is already available, and the iOS is being rolled out over the next four or five-weeks," said Cameron Bell, Lead Technical Architect at The Ottawa Hospital mobile health lab.

The concept emerged a few years ago when Dr. Kumanan Wilson, a general internist at The Ottawa Hospital, whose

current research focuses on public health innovation, chatted with a frustrated mom in a park about the difficulty she had tracking and sharing her family's immunization records.

Dr. Wilson and his team saw this as an opportunity to make a difference for the public and the healthcare system.

"Originally, it was meant for people in Ontario to track their immunization records on their phones," said Bell. "We re-created the yellow card everyone gets to track their immunization records, and digitized it."

Then in 2014, the Public Health Agency of Canada expanded the program to meet the needs of all Canadians. "So, we digitized the immunization schedules of all provinces and territories – translating them into both English and French," said Bell.

In 2016, the app became cloud-based or account-based so people could create accounts and share their data between devices and between family members.

Since 2012, there have been over

215,000 downloads of the app, and it went live on Amazon this past October.

Amazon protects the data with several layers of security, auditing, and firewalls. "We also have stand-up servers on the inside, databases where we store our application data and functionality," said Bell. "Right from the start Amazon supported our technology stack really well."

A cloud-based record is a big improvement over paper, as the old yellow cards can be incomplete and easily misplaced. "Either people would lose them or forget to take them to their appointment, and would go home with a new one," said Bell. It's also harder to share those paper records between spouses when taking their kids to the doctor.

"Using today's technology, we can help people capture better data and engage them in the process of managing

immunization records. Public Health is dependent on parents to keep track of their records, and a parent is in the best position have a comprehensive view of their child's immunization records."

Moreover, it empowers Public Health to communicate with people over their mobile devices. "We're creating a two-way communication channel between Public Health, individuals, and their communities," explained Bell.

Previously, people couldn't reliably back up their information. But with an account on a cloud-based system, users can sync their records by default.

Even if you lose your phone, it can be restored. "Our primary user is a parent taking their child through the first course of vaccinations when they're first born, so we tend to have very engaged users. They care about this information, and care that they have it forever. Overall, we get a lot of positive feedback."

Features of the app include a vaccine fact sheet, provincial vaccination schedules, pain management techniques and a module for kids that uses games and videos to help them understand the importance of getting immunized.

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Five hospitals in northern Ontario sign-on for telepharmacy services

Looking to enhance their pharmacy services and improve medication management initiatives, five small hospitals in northeastern Ontario have engaged Northwest Telepharmacy Solutions (NTS) after a successful award by HealthPRO Procurement Services, Canada's national group purchasing organization.

Implementing a regional telepharmacy service will help hospital pharmacy departments provide extended pharmacy hours and a timelier clinical review of medication orders.

The service also supports the development and implementation of programs such as antimicrobial stewardship, medication reconciliation, pharmacy administration, specific policies and procedures, and pharmacy and therapeutics committee work.

The five committed hospitals will receive medication order review from 8am to 8pm, Monday to Friday, with on-call services outside of those hours for physicians and nurses to have 24-hour access to a pharmacist.

The hospitals are Lady Dunn Health Centre, Hornepayne Community Hospital, Services de Santé de Chapleau Health Services, Temiskaming Hospital, and the Weeneebayko Area Health Authority.

"It is very exciting to see these small hospitals implement enhanced comprehensive pharmacist services to support patient safety," says Northwest Telepharmacy Solution's Director and founder, Kevin McDonald.

"My heart is in northern Ontario, and our very first telepharmacy hospital client was the Weeneebayko General Hospital, in Moose Factory, back in 2004. As a result of this procurement, all of the committed hospitals will now receive longer hours of pharmacist support and valuable project hours to invest into more patient safety initiatives around medication management."

Hospitals in many small communities like those across much of northern Ontario have struggled to recruit pharmacists with extensive hospital pharmacy experience.

"Telepharmacy is revolutionary for introducing hospital-trained pharmacists, virtually, into small and rural hospitals for providing care," says Sammu Dhaliwall of NTS. "Now, a team of pharmacists located in a completely different geographical location can provide services to small hospitals in northern Ontario, all done by embracing innovative technologies which we are assessing and implementing across Canada."

One of those pharmacists is Satvir Bains, who recently received the Hospital Practice in a Rural Setting Award from the Ontario Branch of Canadian Society of Hospital Pharmacists.

"While covering several hospitals remotely has its challenges at times," says Satvir, "there is certainly a satisfaction that comes with the positive impacts we are able to make on patient care. The need for pharmacists to clinically review the impact of new medications started in the hospital is even more crucial today, as we have an aging population with polypharmacy challenges, dealing with antimicrobial resistance and of course, the opioid crisis."

"This is the first service-based contract

Sheldon, the robot, is ideal for remote medication reconciliation.

in our pharmacy portfolio," said HealthPRO's Christine Donaldson, Vice President of Pharmacy Services. "We know hospitals are looking for cost-effective ways to enhance their in-patient pharmacy services and believe telepharmacy is a viable option for many hospitals to consider. This service contract will help Ontario hospitals reach a higher level of compliance with more rigorous patient safety standards."

"Northwest Telepharmacy Solutions has been instrumental in improving pharmacy care for patients across the James Bay Region," says Crystal Culp, Director of Professional Practice at Weeneebayko. "Theresa Crann has been one of our own in leading projects for improving pharmacy's reach across the hospital. In the outpatient space, the pharmacist-assisted warfarin dosing program has been a consistent care improvement that is welcomed by physicians, nurses, and patients."

As quality improvement initiatives using technology such as Automated Dispensing Units, Bedside Medication Verification, and Computerized Prescriber Order Entry become a reality across the province, the need for pharmacist involvement for extended hours (including 24/7/365 as the goal) grows.

"Telepharmacy is the most efficient means to extend hospital hours," says McDonald. One area where telepharmacy may help with reducing hospital readmission is in the medication reconciliation process. Medication reconciliation associated interviews and teaching may best be provided by face to face interviews with hospital inpatients; however, NTS is striving to overcome this face-to-face barrier by researching the use of a telepresence robot nicknamed "Sheldon" to conduct those interviews. "Patients really light up when Sheldon wheels into their room to conduct a pharmacist interview," says Ms Bains.

The contract is open for commitment to all Ontario HealthPRO members to expand their pharmacy services.

How artificial intelligence is speeding up diagnosis and drug discovery

BY YING TAM

The complexity of the human body is mind blowing. A single chromosome can be up to 300 million base-pairs long, our genome contains 30,000 genes and inside our heads sits a tangle of 86 billion neurons.

The human mind can't make sense of all that information – so researchers are turning to minds that aren't human. Artificial intelligence has arrived in healthcare.

Here are three areas where Canadian companies are bringing AI technologies to bear in medicine. Many of these products are in still in development, but they point to a future where AI can improve clinical efficiency and sound the alarm about early signs of disease.

Drug discovery – without the guesswork: Researchers are using the vast data-crunching power of AI to shrink the haystack in the needle-in-a-haystack search for new therapeutics.

At the height of the West African Ebola epidemic in 2015, Atomwise, a medical AI company founded in Toronto, took a virtual model of the

virus and ran it past an AI system trained to analyze molecular interactions. In less than a day, the AI program had digitally thrown 7,000 existing drugs at the virus and identified a shortlist of 20 that could block a claw-like structure the virus uses to enter healthy cells. Human researchers then tested the shortlisted drugs on real Ebola virus and found two that could be potential treatments in the future.

Deep Genomics is taking a similar approach to the search for therapies to block genetic mutations such as those that cause Huntington's disease or cystic fibrosis. On the back of a US$13-million investment from Khosla Ventures, Deep Genomics is building a biologically accurate AI-powered platform will allow scientists to hone in on specific disease-causing genetic mutations and identify pre-clinical drug candidates to target them.

Diagnosis for the digital age: Computers already outperform humans in certain diagnostic tests, such as scanning lesions for skin cancer. But now machines are proving their worth in more difficult-to-diagnose diseases.

Determining cognitive impairment is

challenging and time consuming. Standard neurological checks involve an examination of reflexes, co-ordination, speech, sensation and sometimes brain imaging. Importantly, they are usually only ordered after symptoms become severe enough for a patient or their family to notice.

WinterLight Labs is taking a different approach: looking at speech patterns. Its

Ying Tam

software analyzes recordings of patients speaking and weighs hundreds of factors – such as verb choice, sentence length and complexity, changes in loudness or instances of repetition – to detect signs of dementia or Alzheimer's disease. The ease of testing means it could be used to spot signs of cognitive decline earlier than traditional testing methods.

Toronto-based company Analytics 4 Life is applying machine learning to detect another difficult-to-diagnose condition: coronary artery disease. The company's CorVista device and machine-learning software use skin-surface electrode measurements and other physiological data to determine signals of the disease. The company's goal is to eliminate the need to subject patients to invasive procedures involving radiation, contrast agents or cardiac stress testing.

Better wound care: Hospitals treat thousands of patients every year who have cuts, scrapes and other skin wounds. Swift Medical, a Toronto-based venture that recently announced its U.S. expansion, has developed an AI-powered application to assist clinicians in evaluating the severity of wounds. Doctors capture an image of the wound using a smartphone, and Swift Medical's AI program rapidly analyzes thousands of data points to provide an accurate indication of its size, depth and severity risk, helping clinicians treat the wound more efficiently, with reduced danger of infection. The technology is already being used on over 100,000 patients a month.

Ying Tam is Managing Director, Health Venture Services at MaRS Discovery District.

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Interior Health's diagnostic imaging network includes hospitals, clinics

BY JERRY ZEIDENBERG

Interior Health may be the only major jurisdiction in Canada that has created a region-wide PACS that consolidates the medical images of both hospitals and community imaging clinics.

It was no small task, as the project integrated PACS and RIS of two tertiary hospitals – in Kelowna and Kamloops – as well as 35 other acute care centres that do imaging, along with eight independent imaging clinics.

The unified network has resulted in substantial benefits for radiologists and patients.

"It doesn't matter where the patients go, the radiologists can easily access their images and reports," said Norma Malanowich, Vice President, Clinical Support Services & Chief Information Officer at Interior Health.

That translates into time-savings and access to more accurate information by allowing radiologists to see previous exams and make comparisons.

As well, noted Malanowich, radiologists can go from one hospital to another, and even to independent clinics, and still use the same PACS. They don't have to learn new systems, or try to remember how to call up exams or use the tools from one system to another.

GPs and other clinicians can also access the system from any site across Interior Health, which reduces the need to order duplicate exams.

The regional PACS had its origins in

Interior Health's Tim Rode, Norma Malanowich, and John Geistlinger lead the region's PACS strategy.

2004, when Interior Health was deploying a McKesson PACS. (The company is now known as Change Healthcare.)

Management at that time had the foresight to realize that it would make sense to extend the PACS to community clinics as well as hospitals, so that all images and reports could be captured and accessed.

"They knew from the start that there would be a hole in the data if the community clinics weren't included," said Tim Rode, Program Director, Medical Imaging.

The clinics account for 18 percent of the images in Interior Health – less than in many other jurisdictions, but still representing nearly one in every five exams.

It was necessary to provide an incentive for the independent clinics to come aboard, change their workflow and invest in the region-wide PACS. So Interior Health offered to pay the upfront costs of the PACS licensing and workstations. The clinics would only have to shoulder the cost of ongoing support and storage.

All the clinics jumped at the offer – with the exception of an MRI clinic in Kelowna that remains the only community clinic today that's not part of the regional solution.

More recently, Interior Health has been shifting to a centralized storage model, where community clinic images can be housed in regional servers, note John

Geistlinger, Corporate Director, Clinical Informatics. This means lower storage costs for the community clinics, but they've had to invest in faster online technology to upload and download images efficiently.

"After testing and seeing that it works, two of the largest community clinics are intending on moving to this model," said Geistlinger.

Creating a region-wide PACS would be harder if they had to start today, as it's likely that some community clinics would have their own PACS. That would require much more time, effort and money to integrate them into the IH PACS.

Still, Malanowich says, it's a model that some jurisdictions in Canada might want to look at, especially if many of their community clinics haven't installed PACS.

"It fits a rural environment," she says. "And there are lots of places across Canada that have a similar mix of urban and rural hospitals and clinics."

Interior Health continues to innovate. It has implemented voice recognition technology for dictation/transcription, and has extended the solution to radiologists in community clinics. The system has been a great success.

"97 percent of the radiologists have adopted it," commented Geistlinger. "They don't see a transcriptionist which has resulted in faster report turn-around times and lower costs."

A patient portal has also been deployed allowing patients access to their imaging reports online. Over 30,000 patients are now enrolled and reviews are very positive, Geistlinger said.

St. Mike's improves accuracy of AI by teaching it with simulated images

BY JAMES WYSOTSKI

TORONTO – A novel approach to obtaining big data has allowed the Machine Intelligence in Medicine Lab of St. Michael's Hospital to improve the ability of artificial intelligence to interpret medical images.

Radiologist Dr. Joe Barfett, one of the founders of the MIMLab, said the hospital databases of medical images that researchers typically use to train AI have imbalanced datasets. While the databases have numerous examples of common ailments, there are too few of the rarer conditions that also tend to be more life-threatening.

He said AI requires big data – the repetition of hundreds of thousands of labelled images – before it can recognize patterns well enough to identify medical conditions, but hospitals don't encounter enough cases of rare conditions for there to be enough sample images in their databases.

Not only is the amount of data a problem, but so is ensuring they are correctly labelled, said Dr. Barfett.

A standard approach to machine learning begins with importing a database of medical images, said Hojjat Salehinejad, an AI expert at the MIMLab

who is also a PhD student in the Electrical and Computer Engineering Department of the University of Toronto.

Next, a computer would scan the accompanying reports and use them to label the images. Once the images are labelled, a neural network – the AI – is trained to identify normal and abnormal cases.

Lacking sufficient information in the medical reports means some of the imported database images don't get properly classified, said Salehinejad. Having abnormal images classified as normal could confuse the AI system and prevent it from being able to identify medical conditions.

To overcome the problems of data quantity and the quality of its classification, Salehinejad said the MIMLab came up with two solutions. First, he set up AI to analyze radiology reports so that it could learn from the more thorough reports how to classify other images with less sufficient information.

"At the end of the day, you get more data that's better labelled," said Dr. Barfett. "Because of our AI, the data is sufficient to train a big artificial neural network to analyze it."

The second solution is what really makes the MIMLab unique, said Dr. Barfett. Instead of relying solely on real medical images, the team augmented its

database by programming AI to create computer-generated normal and abnormal chest X-rays.

The team used several methods to create the images, including a generative adversarial network, or GAN, which had two AI computers "play a little game" of

Artificial intelligence expert Hojjat Salehinejad compares real medical images with simulations created by a generative adversarial network.

sending ever-improving simulations back and forth, said Salehinejad.

Eventually, the collection of simulated images was added to the database. The team created enough images of rare conditions that the combined number of real and simulated images matched the totals of the more common conditions that were already sufficiently represented in the database.

Dr. Barfett said the technology isn't new, but the MIMLab's use of it is.

"Its principles are similar to what's used online to create fake images of celebrities," Dr. Barfett said. "But we are one of the few in the world to create such simulations for radiology."

To the untrained human eye, the simulated medical images are no match for true X-rays, said Salehinejad. But from the viewpoint of a machine or radiologist, there are enough features to distinguish one class of chest X-rays from another.

"You can train these neural networks with predominately simulated data, and maybe even completely simulated data," said Dr. Barfett. "And you're actually better off because you're appropriately representing the cases that you don't want to miss, not just the common ones."

The Machine Intelligence in Medicine Lab proved the effectiveness of this method by comparing the classification accuracy of one AI trained with just the original imbalanced dataset and another that used a dataset augmented with simulated images, said Dr. Barfett. For common diseases, classification accuracy improved by 20 percent. For rarer conditions such as pneumothorax (a collapsed lung), the improvement was about 40 percent.

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Imaging tech and Big Data key in Baycrest's brain health research

TORONTO – When studying the brain, you might imagine scientists peering into test tubes. That isn't the case for researchers at Baycrest. Imaging technology and big data are front and centre in Baycrest's aging and brain health research, work that lays the foundation towards the prevention, diagnosis and treatment for dementia and cognitive decline.

As Baycrest celebrates its centennial, media were invited to hear from researchers how combining care with research has led to many critical brain health and aging discoveries. They also learned about current work that will enable many more innovations to help people live long and live well.

"One of the unique aspects of Baycrest is that we are basically a one-stop-shop for cognitive neuroscience imaging," says Dr. Allison Sekuler, VP Research and Sandra A. Rotman Chair in Cognitive Neuroscience at Baycrest Health Sciences. "We are one of the few places in the world with facilities for magnetic resonance imaging (MRI), magnetoencephalography (MEG), electroencephalography (EEG), and transcranial magnetic stimulation (TMS) all within a single building, and a diverse group of scientists – from physicists to psychologists – to support research in these different imaging modalities."

Using MEG to guide treatment recommendations: As one of the few institutions around the world using MEG to study the brain, researchers can map an individual's brain activity while they are undergoing treatment.

Dr. Jed Meltzer, Canada Research Chair in Interventional Cognitive Neuroscience

Baycrest has become a one-stop shop for cognitive neuroscience imaging and uses a variety of modalities.

and scientist at Baycrest's Rotman Research Institute, is using this technology to determine a person's direct response to treatment and pinpoint areas of the brain that are responding positively to interventions.

"During a stroke, some areas are destroyed, but some regions are affected in a way that may be reversible," says Dr. Meltzer. "There are interventions out there that have enhanced brain function among patients. By improving our methods to characterize abnormalities in brain regions affected by disease, we will be able to tell which interventions are most effective at restoring healthy function and are likely to work for an individual."

Understanding this could fast-track re-covery for acquired disorders, such as stroke and traumatic brain injury, and improve resilience to progressive disorders like dementia by providing doctors with immediate insight into whether a treatment is restoring function in the appropriate regions, adds Dr. Meltzer.

Treating depression and dementia with TMS: Brain stimulation has the potential to bolster an individual's natural process of neuroplasticity (its ability to "rewire" or compensate at any age). TMS is a non-invasive procedure that uses magnetic fields to stimulate and inhibit targeted brain regions.

RRI Clinical Scientist, Dr. Linda Mah, and Dr. Meltzer are exploring TMS' ability to reduce symptoms of depression and Alzheimer's disease among patients. Up to 70 percent of people living with Alzheimer's also suffer from depression.

"Long-term sessions of brain stimulation are already being used in the clinical sphere to treat depression and improve a patient's mood," says Dr. Meltzer. "We hope to tap into TMS' benefits to treat other neurological conditions, such as dementia, as studies have shown that it can improve motor function and cognition."

MEG will be used to determine whether the treatment can reverse physiological abnormalities caused by brain disorders.

Detecting dementia earlier with fMRI: Scientists have demonstrated that blood flow to the brain declines with age, and autopsies have shown that vascular disease (disorders with abnormal blood circulation) are present in more than 90 percent of patients with dementia.

Dr. Jean Chen, Canada Research Chair in Neuroimaging of Aging and a Rotman Research Institute scientist, has developed an innovative functional magnetic resonance imaging (fMRI) technique that strives to alert doctors earlier of a person's risk of developing certain brain diseases, such as Alzheimer's disease and related dementias, mini-strokes (transient-ischemic attacks) and stroke.

Her approach aims to measure blood-vessel stiffness, which impacts blood flow, in the brains of older adults. "There are ways to improve blood flow through everyday activities, such as exercise and healthy eating," says Dr. Chen. "With our work, we could provide a brain health measurement for doctors to help them decide whether a patient should start preventive interventions before the disease develops."

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e-Health 2018 seeks to 'celebrate, grow and inspire bold action'

The 2018 e-Health Conference & Tradeshow seeks to Celebrate, Grow and Inspire Bold Action in Canada's digital health community. As Canada's largest national digital health event, the conference brings together passionate individuals from coast to coast to learn from digital health leaders and innovators from Canada and around the world.

Now in its 18th year, the conference offers top-quality learning and an opportunity to network with organizations and people that value quality health information and effective integrated system solutions. There is no shortage of activities to partake in and attendees can look forward to special events such as the Showcase, and Hackathon, and network with old and new colleagues at the Tradeshow and social events.

This years' event will be held in Vancouver Canada at the brand new JW Marriott Parq Vancouver, from May 27 to May 30, 2018. We hope to see you there!

Conference Program Highlights: With over 250 abstract presentations and presenters, e-Health 2018 offers an abun-dance of education and learning opportunities for all attendees.

This years' opening ceremony keynote address is: *Grand Debate: Systemic Transformation versus Incremental Change: Canadian Digital Health for the Future.* This session will examine strategies, approach, challenges and lessons learned on the journey to connected care.

In addition to plenary sessions and presentations, this year we are introducing 'Rapid Fire' – a live, interactive presentation format that will feature approximately six presenters, who will have three minutes to rapidly present their ideas. The result will be an engaging, fast-paced session covering a variety of topics.

Here is a look at some of the topics that have been selected for the conference program, created by the many great abstracts that were submitted from across Canada and internationally.

Monday, May 28 – 11:30am to 12:30pm. Emerging Technologies – Block Chain/ Genomics
• *Blockchain in Healthcare: Separating the* *hype from reality.* Glenn Lanteigne, Tectonic Advisory Services Inc., CA
• *Patient Control: How Blockchain can Transform Health Care and Society.* David Wiljer, University Health Network, CA

Artificial intelligence expert.

• *Genomics Data and Cancer: Risk Prevention to Diagnosis and Treatment.* Brandon May, CGI Group Inc., CA
• *Multi-Omic Analysis: Revolutionizing Personalized Health.* Robert Fraser, Molecular You Corp, CA

Tuesday, May 29 – 1:00pm to 2:00pm Expanding EMR Use in Communities
• *Increasing Access to Care with Patient Preferred Secure Communication.* Scott Wilson, Brightsquid Secure Communications Corp, CA
• *Electronic Medical Records: Information Aggregators or Gateway Systems?* Matthew Leduc, OntarioMD, CA
• *Standardizing Free Text in EMRs: Automating Data Coding in Primary Care.* Karim Keshavjee, InfoClin Analytics, CA
• *Optimizing your EMR: Tools and Processes for Understanding Patient Panels.* Delrae Fawcett, Doctors of BC, CA

Wednesday, May 30 – 10:30am to 12pm Disrupting Technology into the Next Decade
• *Distributed Consent Management by Blockchain.* Edward Brown, Memorial University, CA
• *Deep Learning Techniques to Improve Patient Care with Neural Networks.* Dan Connors, Allscripts Analytics, US
• *The Power of Patient/Provider Messaging: From Human to AI.* Anne Weiler, Wellpepper Inc, USA
• *Iris Scanners as an Identification Tool for Individuals Experiencing Homelessness.* Cheryl Forchuk, Parkwood Institute, CA
• *Using Blockchain To Enable Informed*

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2018 course schedule
Physician Leadership Institute (PLI)

	DATE	
NEW ONLINE Navigating Your Career: Essential skills for the modern physician	May 28 – July 8	Offered exclusively online
● **ONLINE** Leadership Begins with Self-awareness	May 28 – July 8	Offered exclusively online
Leadership for Medical Women	June 11 – 12	OTTAWA, ON
NEW Leading High Performance Culture	June 13 – 14	
● **ONLINE** Leading Change	Sept 17 – Oct 28	Offered exclusively online
NEW ONLINE Making Patient-centered Care a Reality	Sept 17 – Oct 28	Offered exclusively online
ONLINE Engaging Others	Sept 17 – Oct 28	Offered exclusively online
● Self-awareness and Effective Leadership	Sept 23 – 25	MONTREAL, QC
Leading Systems in Healthcare	Sept 26 – 27	
● **ONLINE** Dollars & Sense	Oct 22 – Dec 2	Offered exclusively online
NEW ONLINE Navigating Your Career: Essential skills for the modern physician	Oct 22 – Dec 2	Offered exclusively online
● Engaging Others	Oct 21 – 23	TORONTO, ON
Physician Leadership Focus	Oct 24 – 25	

● **CORE** : PLI courses that have been identified as essential training for physicians interested in or engaged in a position of leadership. These courses may be taken in any order. All PLI courses are also available in-house.
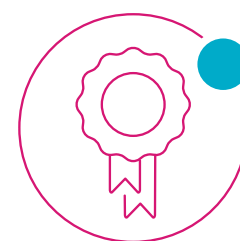
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#CanadaWaits and emergency department technology solutions

MetricAid's software optimizes departmental performance while minding physician preferences.

One of the most controversial topics in healthcare today is timely access to care and long wait times. Over the past months, members of the public have expressed their frustration on social media, with many responding to health columnist Andre Picard's call for wait time stories (#CanadaWAITS). The controversy rages over how to make improvements when funding is limited and infrastructure is aging. Long wait times associated with emergency departments (ED), result in decreased quality of care for patients and stress and burnout for healthcare providers. To address the problem, most governments have set timely access to care as a priority area.

To date, improvement strategies have centered on public reporting and transparency. While these efforts are a start, they don't address the innate problems, one of which is inefficiency. Ensuring each department is performing effectively, without additional HR, is difficult but can be done with the use of data and analytics.

Using data and analytics can shed light on patient flow patterns and group performance. Most EDs can anecdotally tell you when they are busy, and qualifying that with math allows the department to strategically plan for improvement. When the right complement of physicians is scheduled to meet the patient flow needs, there are fewer peaks, valleys and bottlenecks resulting in improved patient movement and lower wait times.

There are many positive outcomes resulting from lowered wait times. Not only does patient care improve, but the likelihood of a patient returning, often sicker, decreases, as does the number of patients who leave without being seen. We often forget about the patients who leave after registering but before being seen by a physician. The obvious problem this creates is that patients were not treated for their illness or injury. Less obvious, but equally important, is that the hospital is not compensated for the care or tests the patient may have had while waiting. When patients wait a reasonable amount of time to see a physician, they are less likely to leave, more likely to give a better medical history and are better positioned to follow through on their discharge orders.

Improvements to patient flow are also felt by hospital staff. When a department is working at a

> **Patients and healthcare professionals invoke a Supreme Court of Canada decision that stated, "access to a waiting list is not access to healthcare."**

more consistent and predicted level, there is less burnout resulting in improved staff retention and satisfaction.

There will always be unknowns in medicine but understanding trends can help a department strategically plan for sustained improvement. One company that understands the issues behind improving access to care is MetricAid. The Ontario-based

Dr. Sunny Malhotra is a US trained cardiologist working at AdvantageCare Physicians. He is an entrepreneur and health technology investor. He is the winner of Best in Healthcare - Notable Young Professional 2014 and the national Governor General's Caring Canadian Award 2015. Twitter: @drsunnymalhotra
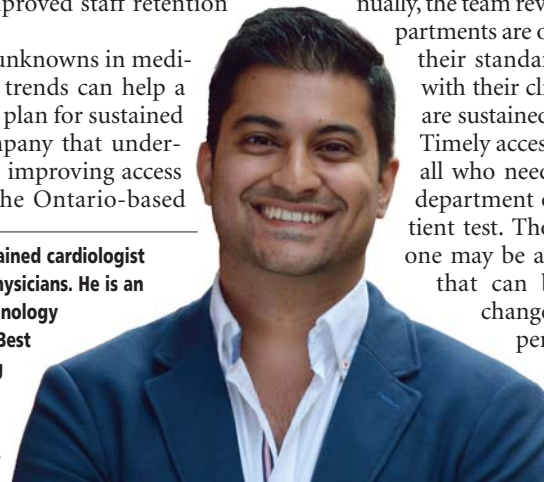
company leads the industry by delivering an intelligent, data-driven service that is transforming physician scheduling for healthcare facilities.

"After 15 years of working in Emergency Departments and recognizing how an optimized physician schedule can greatly improve patient flow, Dr. Scott Daley and I partnered to build an innovative solution to address these scheduling challenges," says Les Blackwell, CEO.

Having started with ED schedules but now grown to include other in-hospital departments, MetricAid has developed proprietary software that uses multiple axes of data to create physician schedules that optimize department performance, while minding physician preferences. Having a service that includes expert schedulers assigned to each physician group allows users to request a schedule suited to both their professional and personal needs. MetricAid's service includes efficiency analysis and recommendations. Annually, the team reviews hospital data to ensure departments are on track to maintain or improve their standards; they work collaboratively with their clients to ensure that gains made are sustained, year over year.

Timely access to care should be available to all who need it; whether in an emergency department or while waiting for an outpatient test. Though achieving this for everyone may be a few years out, there are steps that can be taken presently to effect change and improve the patient experience. Patients and healthcare professionals invoke a 2005 Supreme Court of Canada decision that stated "Access to a waiting list is not access to healthcare".

How Blockchain will transform the delivery of healthcare

BY ANYA KRAVETS

Heralded as one of the most fundamental inventions in the history of computer science, blockchain is set to revolutionize and disrupt hundreds of industries that rely on intermediaries – finance, banking, real estate, insurance, education, and legal, among others. And health care is most definitely one of them.

What is blockchain: Think of blockchain as a beehive with multiple contributors, where all the cells are linked to one another and are visible to all the participants of the network. By (more formal) definition, blockchain is a digital ledger in which transactions made in Bitcoin or another cryptocurrency are recorded chronologically and publicly.

Essentially, blockchain is a distributed database that maintains a shared list of records, or blocks, time-stamped and containing history of every block that came before it. The decentralized, open and cryptographic nature of blockchain also means that it allows storing and sharing data in a highly secure manner – when someone wants access to your blockchain data, you will know it.

Medical records: The need for innovation in electronic medical records (EMRs) is well-known, but the restrictive regulatory environment as well as privacy issues have created significant challenges for innovation.

Enter MedRec, a solution catering to the needs of patients, health care providers as well as researchers. It is a decentralized record management system relying on blockchain technology to handle electronic health records. MedRec does not store health records but a signature of the record on a blockchain, notifying the patient and providing a means to share that record as required.

This prototype also has a tremendous potential to power medical research by providing an opportunity for patients to share their personal medical information with researchers.

Digital medicine: Some of the most exciting opportunities exist in the consumer health space, where blockchain combines care delivery with rewards to encourage consumers' preventative actions when it comes to their health.

Anya Kravets

CoverUS, a U.S.-based startup, proposes an idea to monetize health-related data through a blockchain-powered marketplace, also making insurance cheaper and encouraging

consumers to become healthier in the process by rewarding them for taking good care of themselves. CoverUS CoverCoin rewards can be redeemed for everything from medical co-pays to the transportation needed to keep that doctor's appointment.

PointNurse is a blockchain-based virtual care network platform for delivering direct primary care and care management services to targeted populations. The platform enables nurse practitioners and other health care team members to conduct assessments, behaviour management programs and care coordination. A smart-contract-based cryptocurrency called Nursecoin is in development as well, with a goal to incentivize community growth, close gaps in care, reward patient behaviour and provider performance for improved health care delivery.

These solutions have a great po-

You can try hacking your own network to really see how secure it is

BY ALEX MANEA

As BlackBerry's Chief Security Officer, I regularly speak with Fortune 500 C-Suites and leaders representing the world's top global brands, listening and learning about what security concerns keep them up at night. I also try to spend just as much time speaking with security researchers – ethical hackers devoted to discovering security flaws and vulnerabilities.

Based on countless conversations over the past 12 months with customers, partners, government officials, our internal cybersecurity experts, and leaders from both the security and research communities, below are my predictions for 2018.

2018 will be the worst year to date for cyberattacks: With 2017 being the worst year ever for cyberattacks, it's tempting to think that we've hit rock bottom, but what we've seen so far is just the tip of the iceberg. The fundamental issues that have caused the majority of recent cyberbreaches have not been resolved. IT departments are being tasked to manage increasingly complex

Alex Manea

networks, support new types of endpoints, and protect more and more sensitive data.

Legacy systems are still rampant throughout most industries and cannot be easily upgraded or replaced. These systems often contain publicly known software vulnerabilities which can be exploited to penetrate the corporate network.

At the same time, attackers are getting increasingly sophisticated and have more incentives than ever to mount cyberattacks. From building ransomware or mounting DDoS attacks and demanding bitcoin payments, to working with organized crime and even national governments, malicious hackers have numerous ways to monetize their skills and to protect themselves.

Governments and enterprises are recognizing these new threats and deploying modern security solutions, but it will take years to decommission all of the legacy systems. 2018 will be yet another year where the shortcuts of the past come back to haunt us.

More importantly, we need to start planning for the future by addressing the new threats posed by the Internet of Things (IoT), which go well beyond anything that we see in today's cyberattacks.

Cyberattacks will cause physical harm: Securing the Internet of Things is even more important than securing traditional IT networks for one simple reason: IoT attacks threaten public safety.

A hacked computer or mobile device typically cannot cause direct physical harm. While it's certainly frustrating to have our personal information stolen, it doesn't compare to the impact of being involved in a car accident or having your infusion pump or pacemaker compromised. IoT security will literally become a matter of life and death, and we cannot simply wait for that to happen.

I've spoken recently about the need for stronger IoT security standards, especially as we continue to move towards smart cities. With the growing ubiquity of IoT and lack of focus on security, it's only a matter of time until malicious hackers breach critical connected infrastructure and devices and cause direct physical harm to individuals and innocent bystanders.

Hackers will target employees as a growing cybersecurity vulnerability: IT departments typically focus their spending on preventing external attacks, but the reality is that most data breaches start internally – either by sharing documents through unsecure, consumer applications or clicking on increasingly sophisticated phishing attacks.

While hackers are often depicted as technical geniuses using complex algorithms to break advanced cryptography, the reality is

Universities across Canada foster the growth of healthcare innovation

UBC, working with Vancouver Coastal Health, has spawned a leading-edge tele-monitoring system.

BY DIANNE DANIEL

In ancient Roman mythology, the god Janus is depicted as having two faces, one looking forward to the future and one looking back to the past. As the legend goes, he was well suited to presiding over beginnings and periods of transitions.

In today's fast-moving world of mobile health, researchers and medical graduates coming out of Canadian academic centres are no different, says Dr. Kendall Ho, a professor in the Department of Emergency Medicine at the University of British Columbia and lead of the faculty's Digital Emergency Medicine unit.

"They are learning what all of the giants before us have done to bring us to where we are, but they also have a way to look forward to identify gaps and challenges that still exist," said Dr. Ho, who believes it's prudent to put historical context around future innovation. "As we build a digital culture, it's important that we not lose sight of history but continue to advance as a profession to support our patients the best way we can."

UBC's Digital Emergency Medicine unit is doing just that as it engages medical, pharmacy, nursing and general science students – including international students – to assist on projects aimed at bringing new mobile solutions to the forefront of healthcare. One example is TEC4Home, which is applying remote monitoring technologies to keep heart-failure patients healthier at home after discharge from hospital.

The first phase targeted heart failure patients at Vancouver General Hospital, St. Paul's Hospital and Kelowna General Hospital. Upon discharge, they were provided with a touchscreen tablet, blood pressure cuff, weight-scale and pulse oximeter, supplied by partner Telus Health. Patients would take their measurements daily for a period of 60 days, and their results were automatically delivered to a web portal for monitoring by a TEC4Home nurse.

Patients were also asked to answer questions about their other HF signs and symptoms, such as shortness of breath, coughing and dizziness. By examining the results daily, the nurse could contact the patient about adjusting medications, visiting his or her family doctor, or going directly to the ED. The nurse could also answer questions from patients and coach them about taking care of themselves.

"Patients can start to measure, to know, to feel, so when they say, 'I'm dizzy', they can see their blood pressure or oxygen saturation is dropping and that maybe they should back off from exercise," said Ho. "They can actually see it in action."

Dr. Ho is one of the principal investigators, along with Dr. Chad Kim-Sing, department head and medical director, Emergency Medicine, at Vancouver Acute Community of Care VCH (VGH, UBCH, GF Strong), and Mary Ackenhusen, president and CEO of Vancouver Coastal Health. Also involved are researchers, ED physicians, family physicians, cardiologists, nurses, patients, technology partners, and healthcare administrators.

Early on, the study showed a reduction in the number of hospital readmissions as well as an increase in patient quality of life. Based on those findings, it is now being expanded from 70 to 900 pa-

tients within 20 communities, including regional centres like Surrey and Abbotsford as well as smaller, rural communities like Clearwater and Sechelt.

A second TEC4Home project has since launched to provide similar monitoring for COPD patients at Vancouver General Hospital, Richmond Hospital and St. Paul's Hospital, adding a pedometer to the equipment provided.

Remote monitoring allows healthcare professionals to intervene before a change becomes problematic, by reminding patients to restrict fluids or start a medication, for example. The sensors also help patients to improve their own health management because they start to see correlations between measurements and symptoms, and begin to monitor their conditions on their own, explained Dr. Ho, who calls the sensors "digital mirrors."

Just as dancers learn how to correct certain moves by dancing in front of a mirror, the wearable sensors help patients to learn and track their own symptoms, he said.

Each Digital Emergency Medicine project draws on the expertise

ILLUSTRATION: LINDA WEISS

of students in some way, while also providing an opportunity to learn. In the case of TEC4Home, students are involved in collecting and analysing patient data, as well as conducting focus groups to understand how patients and health professionals perceive the technology. An added benefit is the opportunity to observe a patient's lived experience.

Whereas TEC4Home supports the patient transition from hospital to home, other projects under way within UBC's Digital Emergency Medicine unit are focused on using smartphone apps and online resources to improve digital health literacy among the general population, including seniors, children in grades four to seven, and multicultural populations.

In Toronto, the first cohort to enrol in OCAD University's new Master of Design in Design for Health will graduate this year. Intended to fill a gap in the need for health design, and fuel an appetite to find solutions, the first-of-its-kind program attracted 12 students in each of its first two enrolments.

"We realized an enormous potential and need for

design in the healthcare sector because challenges are not being met through regular avenues," said program director Kate Sellen.

The interdisciplinary program has four main themes delivered through studio-based learning: health context; research and application; design and innovation; and, proficiency and leadership within interdisciplinary collaborations. For the most part, partners approach the school with their challenges, but students also work independently in their final year. As Sellen explained, each project provides a blueprint for change that usually involves reorienting their thinking.

One project, for example, looked at fall mitigation at Baycrest, a research and teaching hospital for the elderly in Toronto. Instead of examining the problem through the classic lens of fall prevention, which may include restraints or alarms, students looked at how design choices could improve fall response. The resulting prototype integrates unobtrusive fall detection sensors, embedded into the lighting of resident rooms, with a smartphone app carried by nursing staff.

When a fall occurs, nurses receive more than an alert; they also know whether it was a high impact fall or a slow crumple to the ground, or how long the person has been down, all of which informs the type of response required.
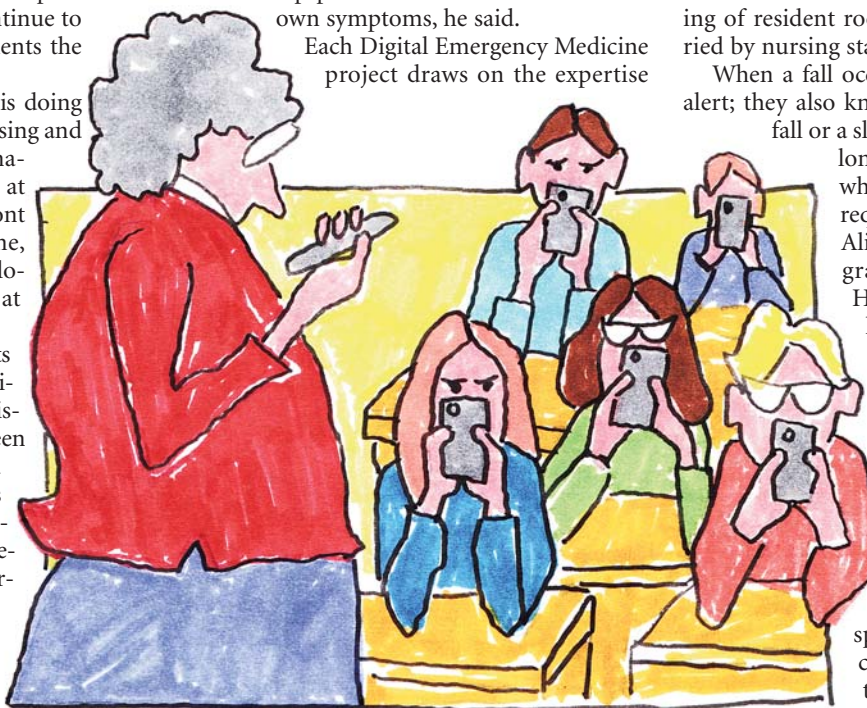
Alison Mulvale is among the first to graduate from OCAD's Design for Health program. After obtaining her Bachelor of Science in General Sciences from the University of Ottawa and Bachelor of Environmental Design at OCAD, she considered it the "perfect avenue" to blend the two.

For her independent study project, Mulvale is working on an early warning system to detect the possible onset of concussion in sport. The idea sprouted after she sustained a concussion while playing soccer. "I thought I knew everything about concussions until I actually experienced one," she said.

Drawing on her lived experience, she reached out to the Concussion Legacy Foundation Canada and originally set out to evaluate and redesign concussion training and awareness resources. Then she reframed her thinking. "The really key thing around concussions and awareness that began to emerge wasn't that concussion in sport happens necessarily, but that there are some pretty serious complications that emerge if they're not managed early and appropriately," she said.

The exercise led her to examine how smart sensors and emerging nanotechnology materials might help to form a solution. The result is a prototype that incorporates a smart, tape-like material, capable of detecting force, which can be adhered to the outside of a sports helmet. The idea is that as hits occur during play, the tape changes colour – from green to yellow to red, for example – to indicate when an athlete may have sustained a concussion, enabling them to be removed from play immediately.

"If you're going to impact concussions, you have to

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Hands-free communications enhances patient care at Runnymede

BY MICHAEL ORESKOVICH

TORONTO – Runnymede Health-care Centre, a 200-bed complex care and rehab hospital, has implemented a new, voice-activated technology to streamline collaboration among clinical staff. The centre is now using Vocera's hands-free, communication badges to support coordinated care for some of the most complex patients in the Greater Toronto Area (GTA).

By leveraging the new technology, Runnymede has increased its responsiveness to patients' needs, enhanced safety and elevated the patient experience.

Worn on lanyards, the badges recognize voice commands and respond by allowing staff to easily start conversations or receive incoming calls.

"The technology is lightweight enough to be comfortably worn at all times, so staff are always accessible during their shifts," said Runnymede's Vice President, Patient Care, Chief Nursing Executive & Chief Privacy Officer, Raj Sewda. "All they have to do is say the name of a person or department into their badge, and a conversation can start."

Prior to the badges' roll-out, clinical staff used mobile phones to communicate. Although practical, they were not ideal because staff often handle clinical instruments while treating patients. Hands-free badges enable staff members to talk with each other without interfering with the hands-on care they are providing.

The badges' ease of use also promotes increased collaboration among members of the clinical team.

Runnymede Healthcare Centre's adoption of Vocera communication badges enhances collaboration and the patient experience by increasing access to staff; the technology's portability is demonstrated by the hospital's Director of Patient Care, Frederick Go; Patient Care Manager, Simin Faridani; and Patient Care Coordinator, Victoria Forrest.

This enhanced collaboration also strengthens patient safety at Runnymede. If a patient has care needs that must be met urgently, the rapid communication facilitated by hands-free badges makes it possible for clinical team members to call others for support, or to quickly ask for additional supplies – all without ever leaving the patient's side or interrupting their care.

If the staff member they wish to reach is on their break, the system automatically sends the call to a designated back-up.

To further strengthen patient safety, badges will soon be linked to the hospital's nurse call system. "Before badges were implemented, it was only possible for nurses to be notified about patient calls through a digital display, and they had to go to the patient's room in order to talk with them," said Runnymede's Director of Patient Care, Frederick Go.

"Now we have the technology for notifications to be triggered on the badge worn by the patient's assigned nurse, who will soon be able to speak with the patient immediately after pressing their call button, to find out what they need and respond accordingly."

The badges are currently integrated with the hospital's main phone system, providing family members with a direct line to the clinical team if they have any questions.

"When a family member phones Runnymede, they're able to access our voice-activated system, and by simply saying the room and bed number of their loved one, they can be connected to the nurse who is assigned to them," said Go.

"This provides families with convenient access to our clinical team members whenever they need it."

If discussions are confidential and not suited to an open-air conversation, staff are trained to protect the patient's privacy by switching the badge's mode so that it works like a conventional mobile phone.

Runnymede anticipates the badges' recent implementation will support its delivery of safe, high-quality care. "The technology vastly simplifies communication and increases the accessibility of our clinical team, which benefits patients, families and staff alike," says Sewda. "It's an excellent tool for strengthening collaboration and enhancing our responsiveness to patients' needs."

Michael Oreskovich is a Communications Specialist at Runnymede Healthcare Centre, in Toronto.

Universities across Canada foster the growth of healthcare innovation

change the conversation," said Sellen. "Alison started to look at the moment of concussion and the motivators for actually changing behaviour and that's what led to this proposal with the helmet stickers."

Many of the projects under way in the program are designed for not-for-profit clinical environments where research and development resources are limited. There's no push to commercialize, but designs are often leveraged by other companies performing similar work, or further developed using government funds secured by the partner.

One student, for example, is working with the Schizophrenia Society of Canada's Youth Advisory Council to create a peer navigation app, intended to facilitate a more positive experience for youth with Schizophrenia through texting. Another project, led by Sellen, is developing an integrated digital strategy to provide easily accessible and brief first aid training to accompany naloxone kits used to treat opioid overdose. Randomized controlled trials of the digital training, available as a smart-

phone app, are scheduled to start at St. Michael's Hospital in Toronto.

At a time when mobile health apps are so pervasive, two Simon Fraser University (SFU) alumni have found a way to stand out from the rest by focusing on a next-generation, human-machine interface: wrist movement. Biomedical engineers Lukas-Karim Merhi and Gautam Sadarangani started to work with gesture recognition technology during their tenure as researchers at SFU.

They've since partnered with industry veteran and medical doctor Jose Fernandez to launch BioInteractive Technologies (BIT) and to develop a proprietary platform that accurately detects hand postures. Their flagship product is TENZR, a wearable wristband that detects six gestures out of the box: hand open, hand closed, up, down, left and right.

The product can be used to control medical equipment in operating rooms, complex robotic systems or mixed reality environments through gestures. It can also be applied to accurately monitor how people are using their hands.

TENZR is currently being evaluated by a lower mainland hospital as a tool to assist in stroke rehabilitation. Essentially,

the product is a smart strap, using sensors embedded along its entire length to measure tendon and muscle movement without the need for calibration or any external beacons and cameras.

"The clinicians are interested in using the device to tell the number of times that a stroke survivor opens and closes their hand in a day," explained Sadarangani, who serves as the company's chief technology officer, with Merhi and Fernandez taking on roles of

> **TENZR is currently being evaluated by a lower mainland hospital for stroke rehabilitation.**

chief executive officer and chief operating officer respectively.

"The premise is to encourage patients to move more or be more aware of days when they're not moving and to relay that information back to the primary care physician so they can intervene," he said, adding that up until now, that type of information was typically self-reported by patients.

TENZR is also well poised to play a

role in the emerging world of ubiquitous spatial computing, where shared reality environments are emerging to solve challenges related to pain management, rehabilitation, surgical simulations and clinician training.

"Imagine that these digital assets you're looking at are all around you in 3D, and you're interacting with those assets, using your hands in the same way you interact with physical objects today," said Merhi.

BioInteractive Technologies is currently based out of SFU's Surrey, B.C., campus as an incubator client of Coast Capital Savings Venture Connection. Recently, the company was selected to take part in the Techstars Anywhere program, which provides access to hands-on mentorship, funding and lifelong access to the Techstars Network, one of North America's biggest start-up accelerators.

As their company marches steadily forward, the support of their alma mater is not lost on the two alumni.

"SFU prepared us for the challenges we took on beyond grad school," said Sadarangani. "Coast Capital Savings Venture Connection is bridging the gap between when an idea is in a founder's head and those first few crucial months to get things started."

eHealth Conference

Patient Consent For Research. Bruce Mc-Manus, PROOF Centre of Excellence, CA • *Improving Management of Long Stay Patients with Machine Learning Prediction.* Patrick Tan, Fraser Health Authority, CA

Visit the e-Health Conference and Tradeshow website for the full program.

Hacking Health 2018: This year, Hacking Health is partnering with the eHealth Conference on a #patientsincluded hackathon set to tackle the pressing healthcare issue of chronic disease management. Participants will work hand-in-hand with patients and clinician experts, building innovative software solutions focused on prevention, home care, and community care.

The challenge will begin with the opening ceremonies on Sunday, May 27th, where the leaders of selected projects will give short pitches explaining the healthcare problems they seek to solve. Teams will then spend the next day and a half designing, building, testing, validating and tuning their prototypes in preparation for the demo competition, working with mentors to refine and improve their solutions.

Once the hacking is complete, the teams will present to conference delegates and be evaluated by an expert panel of judges on May 29th. Awards will be presented shortly after to the winners.

Registration is now open.

Patients Included: We are proud to announce that this year's conference is an accredited Patients Included event.

This means that we are committed to incorporating the experience of patients as experts in living with their conditions while ensuring they are neither excluded nor exploited.

As part of this commitment, patient speakers have been invited to be a part of this years' program curriculum. Patient advisors were also involved in the program planning.

Social Events and Wellness Programs: This conference offers many opportunities to mix and mingle with your peers – in both formal social settings, as well as activity-based programs.

The social events include Happy Hours, the Presidents Reception, the Welcome Reception, and the Pre-Gala reception and Canadian Health Informatics Award (CHIA) Gala.

For those of you who want to be physically active, this year we offer Morning Yoga and Morning Kickboxing sessions!

Register Now to Save: Registration for e-Health 2018 is now open. Regular registration rates are available until April 19, 2018. More information can be found in the Registration section of the e-Health website.

A New Conference Venue: e-Health 2018 will be held in Vancouver, Canada at

> This year, Hacking Health will partner with the conference on a patients included hackathon, with input from patients.

the JW Marriott Parq Vancouver, located in the city's exciting urban entertainment and resort complex, Parq Vancouver.

The complex rises against a backdrop of majestic coastal mountains on Canada's pristine pacific coast.

The City of Vancouver is a highly diverse and multicultural city with people from all around the world. It is a popular tourist destination and has been regarded as one of the most outstanding convention cities in the world.

The city offers plenty of fine dining and shopping, but it is also an excellent place for more outdoor pursuits such as hiking, golfing, boating, and surfing.

See you at e-Health 2018. We look forward to seeing you at this year's must attend event as we showcase the success stories, products, new ideas, and amazing people leading the way on Canada's digital health journey.

Visit our website at www.e-healthconference.com.

Try hacking your own network to see how secure it is

that simpler techniques can be just as effective. Criminal hackers aren't seeking style points; they're simply looking to breach the system as efficiently as possible.

As our technical defenses continue to improve, employees will become the weakest link, increasingly targeted by attackers as part of their overall strategy.

My simple advice to all CIOs and CISOs: go hack yourself. You can spend all of your time building and buying systems that you believe will stop intruders in their tracks, but until you bring professional ethical hackers and let them simulate a real-world cyberattack (including phishing and other social engineering techniques), you won't ever know if you're truly secure.

Our cybersecurity services team recently gained access to a customer's network by simply getting T-shirts made with their company logo on it and stating that they were "with IT." If your employees don't know how to use the technology you put in place, or realize that they all play a critical role in keeping your company secure, everything a CIO/CISO does is for naught.

Insurance and cybersecurity products will go hand and hand: In 2018, it won't matter which system or employee proves to be the weakest link, major corporate data breaches will happen and insurance companies are taking notice. They are taking notice because attacks to their clients could be as harmful to their bottom line.

This year I predict we will see firms not only add more cyber policy holders to their roster, but also seek out two strategic avenues to help manage risk for them and their customers: products and experts.

Just like Progressive's Snapshot plug-in device, which helps the insurer provide personalized rates based on your actual driving, insurance companies will start selling products to help track their client's security posture.

They will even partner with security experts to appropriately evaluate a company's ability to protect against a cyberattack. Scorecards will be given and companies that perform the best will be rewarded with a lower policy amount.

Next Steps: While many other things will impact the cybersecurity industry this year, I believe these are some of the biggest trends for 2018. We'll be diving deeper into these topics over the next few months, so make sure to follow me on Twitter and check the Inside BlackBerry blog for more updates.

Alex Manea is Chief Security Officer with BlackBerry.

CADTH produces inventory of equipment

Ontario and are being used solely for research purposes.

Most imaging equipment has been operating for 10 or fewer years, which is in line with the Canadian Association of Radiologists guidelines. SPECT is the exception, with 57.5 percent of units being more than 10 years old.

Not surprisingly, the greatest number and variety of machines are located in the highly populated provinces of Ontario, Quebec, Alberta, and British Columbia. Prince Edward Island and the territories have the lowest number of machines. For each imaging modality, approximately 60 percent of all growth in the last decade can be attributed to Quebec and Ontario.

As medical imaging continues to remain a vital part of modern health care, aiding in diagnosis, staging, and monitoring of an array of conditions and diseases, it is important to take stock of what is happening in our communities and in Canada as a whole. Trend watching will continue as a 2020 update is scheduled for publication.

CADTH extends an invitation to those interested in hearing more about these results to sign up for a free, online webinar as part of the official CMII launch on April 16, 2018 at the 2018 CADTH Symposium. Register at: www.cadthevents.ca/cmii/registration. To learn more about the CMII and other related reports, visit www.cadth.ca/imaging.

Blockchain transforms

tential of improving medication adherence, helping reduce morbidity and death and decrease costs – a great impact to the health care system worldwide.

Clinical trials: Patient enrolment, personal data privacy concerns and lack of reproducibility are significant challenges for clinical research, and blockchain can help address them. The current system makes it extremely difficult to process all the data generated and recorded. Blockchain could simplify and link the diverse, disconnected systems for accelerated medical innovation.

The smart contract functionality can help by streamlining the complex data flow of clinical trials, where consent for protocols and their revisions should be visible to patients and stakeholders. Blockchain allows storing and tracking consent in a secure, verifiable way and enables sharing of the information in real time, as required.

E-prescriptions: One of the more obvious applications of blockchain in health care is e-prescribing. Blockchain-powered solutions would make it easier for patients living with chronic illnesses to renew and refill prescriptions in a secure way.

An already successfully implemented e-solution in the space demonstrates the convenient access and savings. In Estonia's cutting edge e-health-care system, the electronic ID card system is powered by blockchain to ensure data integrity and provide secure access to a patient's record to authorized individuals.

Medications are prescribed electronically, and at the pharmacy, all a patient needs to do is present an ID card. The pharmacist then retrieves the patient's

> Blockchain would make it easier for patients living with chronic illnesses to renew prescriptions securely.

information from the system and issues the medication.

Medication quality: IBM submitted a proposal to the province of British Columbia outlining the use of blockchain to regulate and transparently capture the history of cannabis products. The company says it can do this, "through the entire supply chain while exerting regulatory control, ultimately ensuring consumer safety from seed to sale." Other companies are already working in this space, leveraging blockchain, include Budbo, Liberty Leaf Holdings and Blox Labs.

Opioid crisis: Canada's opioid overdose crisis is getting worse, with more than 4,000 lives lost in 2017 according to the Public Health Agency of Canada (PHAC), a significant increase from 2,861 opioid-related fatalities recorded in 2016. This public health crisis is a difficult, multi-faceted problem; however, according to some experts, blockchain has a potential to help resolve this complex challenge.

By incorporating traceable technology into the drug delivery process, manufacturers have the ability to safeguard medications produced and sold, throughout the entire system, including suppliers, distributors, physicians, hospitals and pharmacies.

Challenges: Blockchain technology translates into massive exciting opportunities for healthcare; however, organizational, regulatory, technical and behavioural challenges must be addressed before blockchain can be fully adopted and implemented by healthcare organizations across the board.

Governance and collaboration issues, and how Canadian organizations choose to tackle them in both public and private spheres, will determine adoption and implementation of blockchain in healthcare.

Anya Kravets is Director, Engagement, at Cossette Health.

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imagination at work