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CANADIAN Healthcare Technology

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INSIDE:

Dr. Ryan Margau, chief and medical director, Medical Imaging at North York General Hospital, has been one of the team leaders driving the implementation of a clinical decision support system for DI at the hospital. It's among the first hospitals in Canada to make use of CDS in radiology, and the solution is already helping referring physicians make the best choice of exams for their patients. **SEE STORY BELOW.**

NYGH deploys clinical decision support for DI

BY JERRY ZEIDENBERG

TORONTO – To improve the ordering of diagnostic imaging exams, North York General Hospital has implemented one of Canada's first "clinical decision support" systems that quickly shows referring physicians what the best options are for imaging their patients.

"The CDS tool is a continuation of what we've already been doing with Choosing Wisely. We're leaders there too," said Dr. Ryan Margau, chief and medical director, Medical Imaging, at North York General.

Choosing Wisely is an international program that encourages physicians to check on the appropriateness of the tests and procedures they order. The new system, however, gives doctors a tool that's integrated into the ordering module of their electronic record system, so they've got a quick guide at the touch of a few buttons.

"It's embedded into the EMR, and it helps facilitate decisions using evidence-based guidelines," said Dr. Margau.

The Clinical Decision Support system installed by NYGH, called iRefer CDS, is from Toronto-based MedCurrent, a company launched by radiologist Dr. Stephen Herman.

Dr. Herman, a specialist in thoracic imaging at the University Health Network, created MedCurrent in 2013. As it happens, until now all of MedCurrent's sales have been made outside of Canada – the installation at North York General is the company's first in this country.

"We look forward to bringing the benefits we have seen in other regions to

> It's embedded in the EMR and it helps facilitate decisions using evidence-based guidelines.

NYGH, including reducing patient exposure to radiation, optimizing clinical workflow and achieving operational cost savings," said Dr. Herman.

The MedCurrent CDS platform embeds the latest version of iRefer, a set of internationally recognized referral guidelines from the Royal College of Radiologists in the UK, into a cloud-based offering that leverages Microsoft Azure. The platform also provides

a business intelligence module and content authoring tool that allows organizations to embed various best practice guidelines, such as Choosing Wisely or iRefer, into their existing electronic workflows.

So far, the MedCurrent system has been applied to the use of MRI exams at the hospital.

Dr. Margau explained that MRI is a sophisticated modality with many nuances. It's not just a matter of whether or not a patient should receive an MR exam, but what kind.

"There are issues of whether the exam should be contrast-enhanced, of the sequences that are used, and other factors," he noted.

Because the system has been integrated into the Cerner electronic health record solution used at the hospital, it can automatically pull data from the EMR to determine whether the patient has conditions that should be noted. It will then provide a caution to the referring physician.

"It will customize the exam recommendation by accounting for the patient's age, gender, kidney function, allergies, and other

NYGH among the first in Canada to roll-out decision support for DI

variables," said Dr. Jeremy Theal, NYGH's chief medical information officer and a gastroenterologist. "It takes all of this from the EHR."

It can also show him or her what other DI exams the patient has had, and in this way, the doctor can avoid duplication.

Already, after just one month of usage, "providers are changing the type of MRIs they're ordering at least 10 percent of the time," said Dr. Margau.

As well, the MedCurrent system has prompted them to cancel their MRIs in 2 percent to 3 percent of the cases. "They're deciding instead to do other kinds of exams, such as ultrasound," he said.

Another advantage of the system is that it has turned MRI ordering from a paper-based process at the hospital to an electronic one. Before now, ordering for all modalities was done digitally, except for MRI.

"The message that we're getting from the doctors is that this has been great, they no longer have to go looking for a paper form," said Dr. Theal. "It's a huge convenience."

Dr. Theal said he's heard no complaints from the ordering physicians about the switch to the decision support system for MRI. That in itself is an endorsement. "If physicians don't like something, you hear about it," said Dr. Theal. "Especially when you're introducing new steps in the ordering process."

So far at the hospital, since the iRefer CDS solution has been implemented, the majority of MRI exams have been ordered by general internists, neurologists, GI specialists and ER physicians.

Dr. Theal noted that iRefer CDS provides analytics, and can show trends and patterns for modalities, patients and physicians. If a physician's ordering pattern seems to be an outlier, "we can have a conversation to see how to optimize their ordering practices," he said.

It's not meant to be a punitive issue, however, but an educational one.

In the future, the hospital plans to extend the use of the MedCurrent system to other modalities, such as CT and ultrasound. In this way, patients will receive the optimal test, with customized procedures.

NYGH also intends to extend the CDS system to outside physicians – such as family doctors – who direct their patients to the imaging department at North York General.

At the moment, the roadblock is that these physicians are using EMRs other than Cerner, such as OSCAR, Accuro or Practice Solutions. But Dr. Margau said it's just a matter of building the integration from one system into the other.

Since clinical decision support in DI has benefits for the hospital and patients, one may wonder why more hospitals in Canada haven't adopted the systems, especially since they're widely used in the United States and the United Kingdom.

Dr. Theal noted that CDS requires a higher level of computerized infrastructure than is found in most Canadian hospitals.

"In Canada, we're still below average when it comes to HIMSS EMRAM," he said, referring to the scale that's used to measure the level of sophistication that a hospital has, in terms of computerized equipment and software applications. The scale runs from 0 to 7, with 7 indicating a very high-performing facility.

"Unless you have electronic ordering, you can't take advantage of this," he said, noting that hospitals with computerized provider order entry (CPOE) are at the EMRAM 4 level or higher. Canada has a relatively small proportion of hospitals at this stage of development.

"And even those who have e-ordering are still at the early stages of their implementation," he said. "They may be working on other priorities."

For its part, North York General is a highly computerized hospital, and has achieved Level 6 on the EMRAM scale. It is a Canadian leader when it comes to adopting new solutions to enhance patient safety and medical outcomes, and scores highly in international surveys of top performing hospitals.

A recent Newsweek study lists NYGH as the second highest-performing hospital in Canada, just behind the University Health Network. Adopting CDS is another step on the ladder of continuous improvement.

Dr. Jeremy Theal: The CDS system can pull information from the EMR and alert the referring physician.

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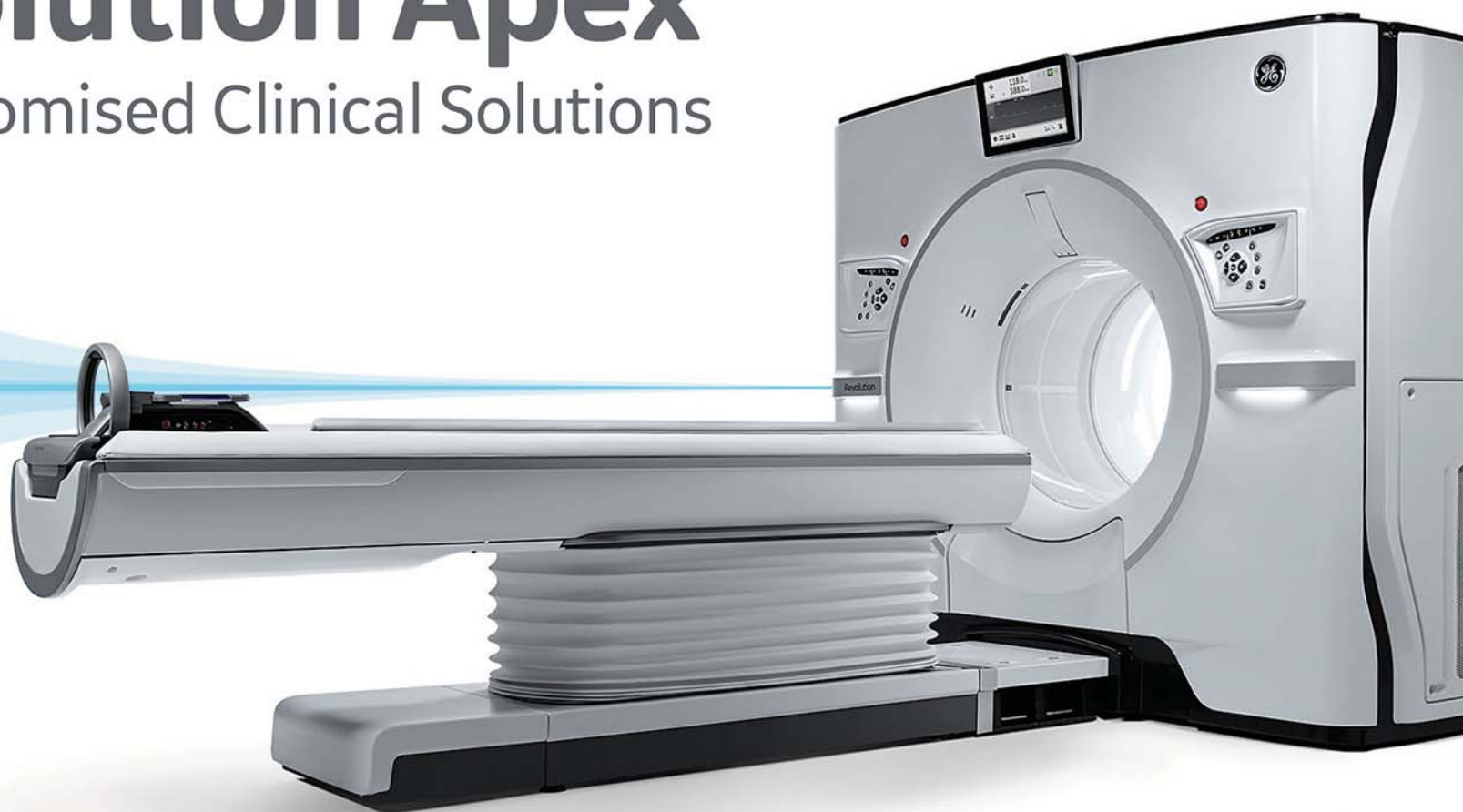
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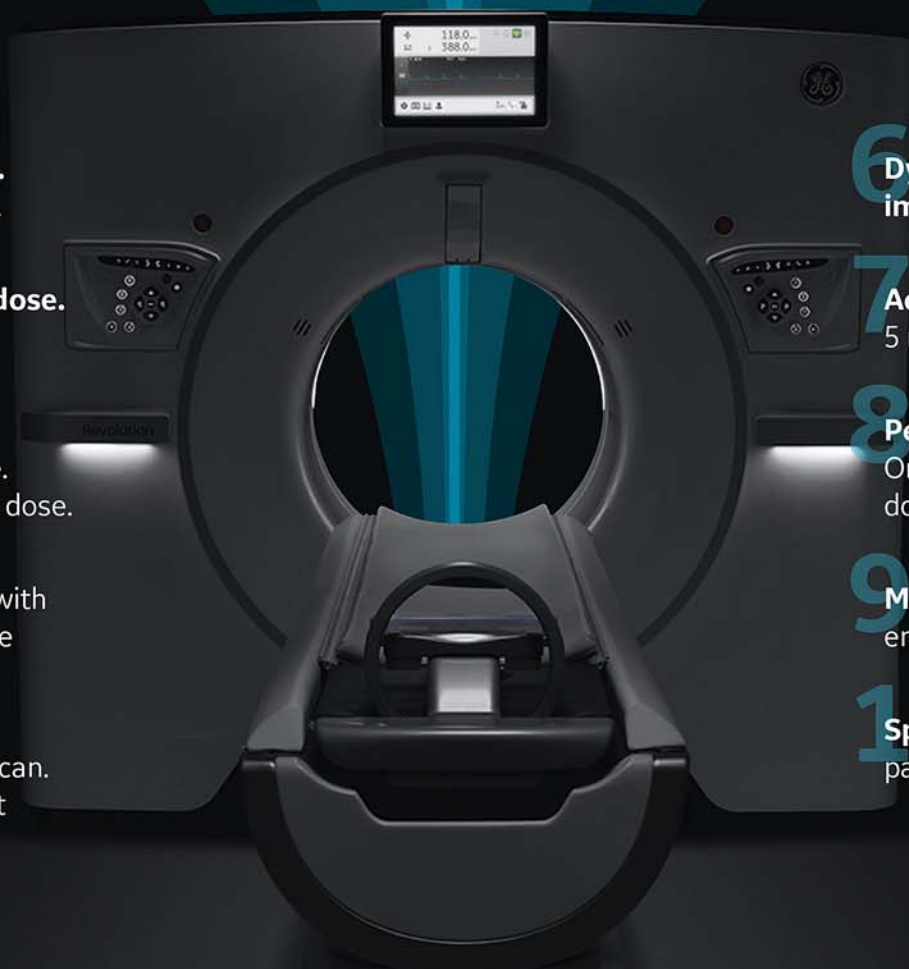
New system eases clinical communication at Michael Garron Hospital

BY JERRY ZEIDENBERG

TORONTO – Michael Garron Hospital – formerly the Toronto East General – has deployed Hypercare, an enterprise-wide messaging system that allows clinicians to communicate with each other through an instant messaging app installed on their phones. Hypercare enables users to securely share clinical information and manage medical on-call schedules.

The Hypercare system runs on a cloud-based network that is independent of the hospital's existing communication networks. In this way, it acts as a messaging back-up, in case of outages.

This scenario actually occurred about year ago, in September 2019. The hospital experienced a ransomware virus that disrupted its email service and paging systems. The Hypercare system, however, which had been deployed in a pilot to a limited number of users, still worked and enabled the enrolled clinicians to communicate.

"Hypercare really showed its value through the code grey time," said Dr. Patrick Darragh, chief medical information officer at Michael Garron Hospital. The pilot project of 20 users quickly scaled up to 300 users by February 2020. And with the impetus of COVID-19 in March 2020, nearly all of the hospital's clinicians have joined – about 700 users in total.

"We've had such good feedback about [Hypercare] that it's become an essential way for clinicians to communicate with each other in the hospital," said Dr. Darragh.

It's not just the quick communication that's appealing to clinicians. The hospital and Hypercare have together created a directory function that has transformed managing medical on-call schedules from a paper-based task to an automated, electronic one.

Dr. Darragh noted that creating the on-

Dr. Patrick Darragh, CMIO: Hypercare has also been used as an effective COVID-19 alerting system.

call schedules used to be done by collating the various departmental schedules into a paper-based master list – a painstaking and time-consuming task. Instead, Hypercare allows departments to create their on-call schedule electronically.

On-call schedules are consolidated automatically and posted immediately to the Hypercare messaging app on users' phones. Clinicians can instantly find and contact the on-call specialists they need.

"You used to have to look up phone numbers or contact the call centre, find the right person, and wait for a call-back," said Dr. Darragh. "Now, I just open my phone and it's all right there."

"It's a better use of hospital resources, and it leads to better communications," he added.

Albert Tai, CEO and co-founder of Hypercare, said the application easily supports even last-minute changes – something that

was difficult to do in the previous way, using paper lists and requiring manual preparation of a master list the day before.

Moreover, clinicians can trade shifts online, and the changes show up in the system in real-time.

"The scheduling piece adds a lot of value to the system," said Tai.

Dr. Darragh noted that of late, Hypercare has also been used as an effective COVID-19 alerting system. When patients were tested for the coronavirus, adding the final result of the swab to the electronic record was inefficient. Dr. Darragh said there could be hundreds of these patients with pending results in the system at any time.

Now, using Hypercare, "when the swab goes positive, [Hypercare] sends an alert to the most responsible clinicians." Then, appropriate next steps can be taken by the infectious disease and infection control teams.

As well, a Hypercare alert goes out to the hospital's infection control team when an inpatient COVID-19 swab result is negative. By reducing the time that patients are in isolation, the hospital can conserve personal protective equipment.

He noted that this alerting system has the potential to be extended to other areas, such as positive blood cultures for a number of conditions, and for deteriorating patients.

Many hospitals have early warning algorithms, but it's sometimes a problem to get the word out to the right personnel. Hypercare can be used to trigger alerts and send messages to the smartphones of the appropriate caregivers.

Tai noted that Hypercare can be programmed to escalate – if one person doesn't respond in a given period of time, the message will be sent to the next person in line, ensuring that nothing falls through the cracks.

Messages can go not just to individuals, but to "roles" – such as the attending nurse, resident or physician. "The individual may change from day to day," said Dr. Darragh. "Hypercare makes sure the alert goes to the right person who needs to know the information."

Alerts can also be sent to entire groups or teams.

As well, being adopted throughout Michael Garron Hospital, the Hypercare solution is now being extended to clinicians in the community. Family physicians and other clinicians who work with the hospital are using the application – making it one of the first cross-organizational communication systems to be used in the province's new Ontario Health Teams (OHTs). Hypercare is already being used by East Toronto Health Partners, an OHT in East Toronto.

"Since April 1, we've opened it up to all of our groups," said Dr. Meera Shah, a

Canadians are ready to embrace greater use of technology in healthcare

BY SHELAGH MALONEY

Canadians and clinicians have met the unprecedented challenge of the COVID-19 pandemic head-on by embracing change in the way care is delivered – from in-person to virtual. What will it take to maintain this momentum and, more importantly, is this what Canadians want for the long term?

The answer to the second part of that question is yes. The appetite for "virtual first" when it comes to healthcare visits is building, among those who have tried it and those who would like to experience it. The answer to the first part of the question is more complicated, and it's tied to how Canadians feel about the use of technology in healthcare more broadly.

Late last year, long before we knew about the pandemic, Canada Health Infoway undertook a broad initiative to envision our health system five to 10 years into the future. We would examine the use of emerging technologies for healthcare,

such as artificial intelligence (AI), precision medicine and robotics, for example. And because our health system exists to serve Canadians, we asked them how they thought these technologies would impact their healthcare experiences.

We called this part of our work A Healthy Dialogue, and we believe it's one of the largest public consultations about digital health ever conducted in Canada.

We engaged with more than 58,000 Canadians through: two national surveys (pre-pandemic and a few months after onset), online focus groups, in-person focus groups with Indigenous peoples, interviews with people in vulnerable and underserved communities (e.g., new immigrants, members of the LGBTQ community), and an online forum.

What became evident through the consultation was that, while Canadians believe technology can help improve the health system, they are keen to have it resolve the issues they are currently facing before addressing other more abstract or futuristic concepts.

For example, reducing wait times and improving equitable access to care are a priority over using artificial intelligence to predict health outcomes. They know that technology can improve their health experience by providing faster and more convenient access to physicians and nurses.

In fact, 92 per cent of Canadians want technology to make healthcare more convenient. They have seen how technology has transformed the rest of their lives and are ready

Shelagh Maloney

for the same experience when it comes to their healthcare.

Another thing that came through clearly in the consultation is that Canadians are concerned about health equity, so it's important for us to ensure that all Canadians have access to health services.

Twenty-six percent report that they have poor internet connectivity, and 40 percent said they aren't comfortable with apps and technology in general.

These findings confirm the need for digital health literacy in Canada as well as the need to bridge the digital divide, improving access to internet and broadband.

In an Infoway survey conducted a few months into the pandemic, 84 percent of respondents told us that, given the opportunity, they would use more technology tools to manage their health. Eighty-six percent said the pandemic had shown them that virtual care tools can be important alternatives to seeing doctors in-person, and 72 percent said they'd be willing to use virtual care, even if they hadn't tried it yet. That's solid evidence that Canadians are ready to embrace a much greater use of technology in healthcare. Bring it on!

Shelagh Maloney is Canada Health Infoway's Executive Vice President, Engagement and Marketing.

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Analytical tools and skilled people are key parts of Alberta's strategy

BY NORM TOLLINSKY

The COVID-19 pandemic has forced public health agencies and governments across Canada to make difficult decisions about social gatherings, mask use, testing, elective surgeries and lockdowns. Most if not all of them have some kind of analytics strategy to guide them, says Greg Horne, SAS Institute's Global Principal for Healthcare. "It's just a question of how sophisticated that strategy is and how it's being used to drive change and patient outcomes."

Alberta Health, one of the most adept practitioners of health analytics, hit the ground running when the news of the virus began circulating around the world.

"Once we heard about the first cases in Wuhan, we started thinking about what would happen if the virus appeared in Canada," recalled Larry Svenson, provincial health analytics officer and executive director for analytics and performance reporting for Alberta Health. "We started putting things into play in late January, early February because anytime we see something of international concern, we ramp up very quickly."

The essentials, including the infrastructure, the partnerships and the data flows, were all in place. All that was required was to adapt them to accommodate the specific information needs related to COVID-19.

Alberta Health relies on SAS Institute's Viya platform and licenses a variety of other SAS visualization and statistical software, including SAS Grid Computing. It also uses R Studio and a variety of other software products.

Modeling based on the early experience of Wuhan and Italy, said Svenson "painted a picture that was quite frightening if we had not acted at all," prompting the province to impose the necessary public health measures to flatten the curve and prevent adverse impacts on the health-care system.

"As we started having cases in Canada, we began using more local data, but in the absence of local data, our initial models were based on what we were seeing internationally."

The objective was to "understand at what point we would see a trigger that could cascade into overburdening the health-care system and require us to make adjustments such as slowing down elective surgeries and ramping up testing."

Models also tried to forecast what would happen when students returned to school and at what point lab testing would exceed the province's daily testing capacity.

"The models are mathematically quite intense with sophisticated differential

Greg Horne, Global Principal, Healthcare, at SAS

equations," said Svenson. "We're using tools like AnyLogic and Mathematica to create these models and run them on a mainframe environment because they're so resource intensive. We're quite lucky because we have a person with a PhD in Applied Mathematics whose doctorate was focused on modeling infectious disease outbreaks, and we have a strong connection with the math department at the University of Alberta both for COVID and for our work on the opioid epidemic."

Data is collected from diverse sources, including the province's Communicable Disease and Outbreak Management system, Communicable Disease Reporting System, Alberta Precision Laboratories, the National Ambulatory Care Reporting System, the Discharge Abstract Database, physician claims data, and Alberta's Pharmaceutical Information Network, along with feeds from Alberta Education about potential issues in the schools.

"The overriding objective, said Svenson, "is to make sure that we have high-quality evidence to support the public health response and understand how the pandemic is affecting Albertans. We report on everything from how many new cases we have on a daily basis, how many people end up in hospital, the number of deaths, how many outbreaks we're dealing with and

Larry Svenson, Executive Director, Analytics, AH

whether they're in long term care facilities, schools, workplaces or other locations.

"The chief medical officer of health, Dr. Deena Hinshaw, relies on us to provide her with everything she needs to know. We also provide evidence to the Minister of Health and the Premier so they are well briefed and can make decisions based on the best possible evidence."

Data presented in charts, graphs and interactive maps is also uploaded to Alberta's COVID-19 surveillance website every weekday, allowing everyone in the province to see the number of active and total cases by age, gender and geography, the total number of deaths, the number of people in hospital, the number of patients in intensive care, the average age at death, how many comorbidities

they had, the number of tests conducted, and comparisons with other jurisdictions across the country and around the world.

The daily uploading process is almost entirely automated using R scripts.

Svenson credits the "unbelievable talent" of his team and the quality of the relationships with organizations supplying data for the reputation Alberta Health has earned in the analytics space.

"It's the relationships that are far more important than the data," noted Svenson. "Once you have solid relationships with all of your stakeholders, their willingness to share the data is a non-issue. It just happens seamlessly.

"We continually work to keep those relationships strong, so when we have events like COVID-19, we're not running around trying to establish new relationships or trying to convince people to do something. We just move straight into implementation and action mode."

"Alberta has always been a very analytically savvy province," said SAS Institute's Greg Horne. "They've always had the use of data at the heart of everything they do, so I wasn't surprised when they were the first in this current environment to use analytics to inform their public health response. They're very forward thinking about what they do.

"Globally, we see that hospitals and government departments that are using analytics are coping with this crisis in a much better way than those that are not as proficient at it."

Of course, the value of analytics in health care extends beyond public health emergencies like COVID-19 and the opioid epidemic, notes Horne.

"We see around the world a very consistent problem in health care, which is that the demand and need for health services far exceeds the ability of any system to fund it. Analytics," he claims, "can drive value into the decisions that need to be made with the ultimate goal of making health care more accessible, more affordable and safer."

ICES refines list of COVID-19 cases in Ontario facilities using analytics

BY NEIL ZEIDENBERG

Back in March, soon after the COVID-19 pandemic was declared, ICES – formerly the Institute for Clinical Evaluative Sciences – an independent non-profit clinical research organization – began receiving a data feed from eHealth Ontario (now Ontario Health – Digital Services) containing information about completed COVID-19 tests. The information was streamed automatically on a daily basis creating a rich data repository.

However, by using the feed alone, it was difficult to determine what type of facility the person tested was living in – something essential for decision-making and managing the pandemic.

"Although we had some ways to

identify individuals testing positive and negative for COVID in long-term care homes, we were unable to identify individuals in retirement homes, homeless shelters and correctional facilities," said Mahmoud Azimaee, director, Data Quality and Information Management, ICES.

ICES acquired master lists of addresses for all of these institutions to be matched with the individual's addresses in the daily COVID-19 data. Getting perfect matches was nearly impossible considering unstandardized addresses with countless typos.

ICES made use of a solution called SAS DataFlux to standardize COVID test data, taking steps to match addresses reliably by street, city and postal code. This led to an enriched COVID-19 data with flags for institutions where the

patient lived. Entity Resolution and fuzzy matching features in DataFlux were used to achieve this goal.

However, there were still some addresses missing, and better standards were needed to match the remaining

> **With analytics, ICES was able to determine the types of facilities in which patients were living.**

addresses. "We utilized DataPack Canada Addresses, an add-on to the SAS DataFlux to validate the addresses in the database, improving the linkage rate," Azimaee explained. "The software also corrected many misspelled street names in the database."

From there they used the positive and negative cases by institution name. But with data streaming into ICES every day and multiple COVID tests creating multiple records the data grew exponentially. In the end, SAS DataFlux helped ICES maintain an accurate work list.

To make the most of using SAS DataFlux, all team members for this project were provided one-week of system training.

More recently, ICES is using SAS DataFlux on a new project, even grander in scale. "We're looking into a database of everyone ever issued a health card in Ontario – alive or dead," said Azimaee. "It's in excess of over 20 million records." Using the addresses registered to these individuals they aim to determine how many of them are family, or live/lived under the same roof.

"I love treating my patients, but not the paperwork."

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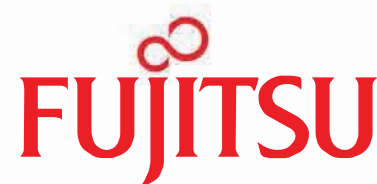
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B.C. companies provide easy-to-use digital solution to First Nations

BY DAVE WEBB

Two home-grown BC tech companies are teaming up to provide virtual healthcare solutions to First Nations communities. Wel-Tel Health and Mustimuhw Information Solutions Inc. (MSI) announced in late September that they will partner to provide an SMS-based solution to community healthcare providers to improve follow-up and communication with patients.

For patients, it's as easy as replying to a text message.

"Solutions tend to be over-architected," said Mark Sommerfeld, chief executive officer of MIS, which provides Indigenous health, child and family services to 285 First Nations communities in seven provinces. And that's not just in the tech field. Sommerfeld recalled a state-of-the-art garbage disposal system in one remote community which was powered by diesel fuel – prohibitively expensive to deliver and consume. A new and better solution was found.

Urban system designers often don't take into account such limiting factors, Sommerfeld said. According to a report by Future of Good, a "social impact" website published by philanthropic strategy veteran Vinod Rajasekaran, only 10 percent of First Nations households have access to reliable Internet or broadband services. This has cut them out of alternatives to communicate and get telehealth services during the ongoing COVID-19 pandemic.

"First Nations are on the wrong side of the digital divide," Sommerfeld said.

"Telehealth is not new to First Nations communities," said Gabrielle Serafini,

First Nations communities in British Columbia are benefiting from a host of new health technologies.

CEO of WelTel. But often it's in the form of overly sophisticated, over-designed solutions that aren't practical, given geographic and socio-economic considerations. "I'd bet you'd find those video-conferencing carts sitting in a closet."

Enter the ubiquitous cell phone. While those in underserviced areas may not have a smartphone or high-speed Internet, most have a mobile that can receive text messages. Additionally, SMS services are less infrastructure intensive and less expensive – with no data plan required – and they're easier to use.

WelTel, co-founded by Dr. Richard Lester, an infectious diseases specialist with Vancouver Coastal Health, began its work in African nations, including Rwanda and Uganda, where the company's solution was used to monitor adherence to medication for HIV patients.

"Almost all healthcare is voluntary: patients choose when to engage in care, when to take their medicine (if they choose to take it), and whether to return for follow-up visits," Dr. Lester wrote in a 2013 paper. "In human immunodeficiency virus (HIV) infection and other chronic diseases, the benefits of medication adherence for the patient and public health are tremendous."

The company is currently offering tracking support and tracing for COVID-19 patients in the region. There's a similarity in the remoteness and marginalization in Canadian First Nations communities, Serafini said.

In Africa, she said, it's not unusual to have a cohort of 4,000 people being tended by two nurses. The SMS-based solution is 50 to 100 times faster than following up by phone, she said.

On the patient side, it can be as simple as a follow-up text message: "How are you?" There are no app downloads, no portals to sign into. They simply respond. WelTel has found that three to 10 percent of patients require a follow-up each week.

"We (both companies) believe in meeting people where they are," said Serafini.

On the provider side, there's a lot more sophistication involved. Providers access a Web portal that serves as a communications hub, said Sommerfeld. It can automatically triage messages for follow-up or readmission; can establish targeted cohorts with customized messaging; and gather and use rich data, he said. Serafini said the solution can also be integrated with electronic medical record (EMR) systems aside from MIS's. "It's entirely interoperable," she said, although each EMR system has its own integration protocols.

But there is more on the horizon. With the rich data being collected, WelTel is looking to analytics and artificial intelligence to enhance the solution. The company is working with the University of British Columbia's Michael Smith Laboratories, named for B.C.'s first Nobel Laureate, on integrating the solution with AI technologies like machine learning and natural language processing, together with analytics technologies, to forecast future outbreaks and patterns of epidemiology.

AI will create new kinds of jobs, merging data and clinical work

BY DENIS CHAMBERLAND

In their 2019 report, titled Promoting an Overdue Digital Transformation in Healthcare, global consultants McKinsey maintain that the promise of automation and its benefits largely remains to be defined in healthcare. This is partly because the sector has been noticeably late to embrace digital technologies. Still, the opportunities to improve patient care from the effective use of automation appear limitless.

Take artificial intelligence (AI), for example. In Transforming Healthcare with AI: The impact on the Workforce and Organizations, released earlier this year, McKinsey expect that AI will come to be applied in three phases: first, to routine, repetitive and largely administrative tasks (which can take up to 70 percent of a practitioner's time); second, to support the shift from hospital-based to home-based care (i.e., remote monitoring); and finally as a clinical decision-support tool, to augment the work of physicians and staff.

All agree that the benefits of AI in healthcare delivery will be transformative. Some predict that AI will improve the accuracy and timeliness of diagnoses and provide better treatment in developing countries and remote regions that lack radiologists. Others posit that it may also help to calculate the probability that an individual may contract a condition, therefore significantly enhancing the chances of healing the individual.

Despite concerns that automation may threaten human labour, a broad consensus exists in healthcare that automation may actually alleviate the labour shortage problems which are expected to plague the sector for decades. According to McKinsey's findings early this year, the general lack of fear of job loss is partly because only 35 percent of time spent in healthcare is potentially automatable.

In that same vein, most analysts believe that automation will eliminate some human effort from the healthcare system without eliminating the humans because human empathy is central to healthcare.

In fact, AI that performs its tasks well could free radiologists from drudge-work, allowing them more time to interact with patients and colleagues. As one leading team of radiology experts put it, "the only radiologists whose jobs may be threatened are the ones who refuse to work with AI." (T. Davenport and K. Dreyer, AI Will Change Radiology, but It Won't Replace Radiologists, Harvard Business Review, 2018).

Automation is not only changing the scope of existing jobs, it likely will lead to the creation of new jobs. In healthcare this is expected to happen at the intersection of medical and data-science expertise – for example, the emergence of clinical bioinformaticians.

Denis Chamberland

Automation is also a vibrant topic of discussion with healthcare decision makers, governments, investors and innovators, indicating that leaders are looking at new ways to adapt their business models to the needs of the 21st century.

Because healthcare is under tremendous pressure to deliver more and better care at a lower cost, many expect automation to form a part of the solution, by helping to reduce operating costs, by reducing the need for staff overtime, cutting down on medical mistakes, and improving efficiency.

Without doubt the most important threat to the success of automation in healthcare globally is the largely still non-existent regulatory framework. For example, if a machine misdiagnoses a cancer case, who is to blame? The physician, the hospital, the imaging technology vendor, or the data scientist who created the algorithm?

Similarly, cyber threats loom large in healthcare, a heavily targeted sector which has seen a 63 percent rise in cyber attacks in 2016 alone, according to Derek Marky, in How Automation and AI Improve Healthcare Cybersecurity (2018). Indeed, automation may significantly transform healthcare in the years to come, but only if the legal framework catches up and adequately supports the new technologies.

Denis Chamberland is CEO of MES Group, which works with hospitals on managed services projects, including Managed Equipment Services and Managed ICAT Services. MES Group members were engaged on all of the MES projects concluded in Canada. He can be reached at dchamberland@mesgi.com. See www.mesgi.com.

UK doctors combine AGFA HealthCare XERO and Microsoft Teams to share images quickly

Instead of deploying multiple systems to collaborate, clinicians are using a unified solution.

Physicians in England have come up with a fast and easy way to share diagnostic images – and to consult each other on the images in real-time – by integrating Agfa HealthCare's XERO viewer with Microsoft Teams. The combined system allows a doctor to share the images with other physicians at a touch of a button. Clinicians can also chat about the images, providing advice by voice or text at the same time.

"Normally, sharing and discussing images would take a significant amount of time – two people would have to log in to a computer simultaneously, share patient details, and debate their findings, and often these computers take several minutes just to boot up. Image sharing between staff now takes milliseconds, and it can be done from anywhere in the hospital," said James Diss, radiology registrar at The Princess Alexandra Hospital NHS Trust, in Harlow, England, a three-hospital network.

The hospital had already been using Agfa HealthCare's technology, and when the UK government rolled out Microsoft Teams nation-wide – in response to the outbreak of COVID-19 – managers and clinicians at The Princess Alexandra Hospital decided to combine them, creating an even more useful solution.

The integrated system is proving to be of immense value to clinicians, especially when they have questions about diagnostic images and reports. In some cases, the quick feedback from radiologists has reduced the need for ordering new or additional diagnostic exams. Moreover, different imaging systems can be included, such as vascular imaging – something the group at The Princess Alexandra Hospital has already deployed.

Now, other departments are interested in getting involved, too, including cardiology, surgery and ophthalmology.

"With this technology, we are providing clinicians with a much more efficient workflow process, where they don't have to take down details, login to computers, request unnecessary tests, or chase people," said Dr. Diss.

According to Dr. Diss, the COVID-19 crisis has sparked a surge in creativity at hospitals across the country. "One of the few positives to come out of the pandemic is the enthusiasm from staff for innovation; we have achieved more in the past couple of months than we have done in the last five years. Staff have seen the benefits that technology can provide in improving productivity and collaboration amongst teams, and most importantly, clinical care and patient outcomes."

In collaboration with radiologists and clinicians, Agfa HealthCare has implemented a host of innovations to combat the COVID-19 pandemic. Here are some of them:

COVID-19 Specific Priority Work Lists in Enterprise Imaging:

To help the radiology team of a Belgian University Hospital to keep track of the COVID-19 cases among other high importance cases, a dedicated COVID-19 worklist has been created. From the Agfa HealthCare RIS, a COVID-19 indication is communicated to Enterprise Imaging, resulting in the creation of a COVID priority reading task.

To quickly configure the reading priority, without the need for additional manual intervention by users,

an unused order priority was used. In the list area, a special color code is given to the COVID-19 cases to highlight the cases, so they stand out in the task list. Task assignment rules are configured if these specific cases need to be assigned to a specialized group of radiologists for reading. Escalation rules can also be employed to ensure quick response on highlighted cases.

Faster Reporting with COVID-19 Drop-down Menus and Text Macros:

With suspected COVID-19 cases increasing rapidly, efficiency of radiology reading needs to be maximized. In collaboration with an Enterprise Imaging customer, a series of COVID-19 specific drop-down menus with text macros have been created, covering ground-glass opacity, vascular thickening and scoring of affected areas in the lungs. Apart from a faster reporting, it will also result in more consistent reports, which in a longer term will be beneficial for analytics and statistics.

Balance the load – Image-sharing across hospital networks and regions:

In many countries, the COVID-19 outbreak requires the collaboration and image sharing across hospitals, hospital networks and geographical regions. Some hospitals are centralizing triage of patients and depending on the case severity, patients are sent for admission to different hospitals. Others are looking to balance the bed capacity and load with hospitals inside or outside their network. In the United Kingdom we are supporting customers balancing the COVID-19 load by connecting different sites, using the XERO Exchange technology. They can
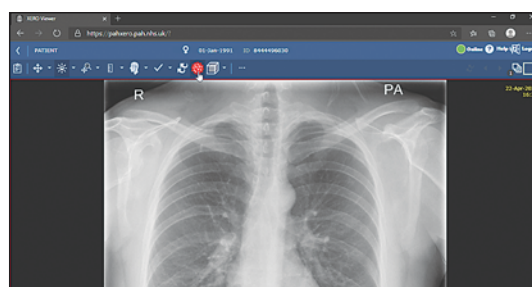
view, share DICOM images and reports stored within the Enterprise Imaging for Radiology solutions. Based on hospital request, patient history can be shared as well.

With new diseases come new terminology:

Since they are not standard in the Radiology lexicon, we received feedback from some radiologists their speech recognition software for fast reporting was struggling with the recognition of new terms like Corona or COVID-19. This was slowing down the reporting turnaround, since repeated manual correction of the not-recognized terms was needed.

Customers in Belgium and Luxembourg, using Enterprise Imaging integrated with the Nuance Speech Magic recognition software, have quickly retrained their Nuance Speech Recognition systems and added those new terms to the speech lexicon. Once the new terms added, the speech accuracy for dictated words like COVID-19 has improved significantly and supports fast and accurate reporting in times that patient need fast diagnosis most for timely treatment.

Business intelligence – using data to measure, understand and predict:

Customers around the globe have been using Business intelligence tools to mine their radiology order and report data. Not only to help monitor the current pandemic, plan for radiology capacity, but also to learn and be better prepared in case any future outbreak might occur.

Text search in radiology reports is a powerful tool to find emerging trends. A pandemic usually starts small, but once gaining traction, can have a steep growth pattern. Catching it first signs early can help stop the spread. Or in this case, finding the root of when and where exactly the disease started to emerge. This is what customers in Italy have done. With text search in radiology reports on term like 'pneumonia', 'pneumonitis', or any other relevant terms, they were able to back-track the start of the outbreak. At a later stage, once the disease was confirmed, report text search on terms like 'COVID-19' can be also be used for further research purposes.

# Orthopedic surgery nurses accelerate learning using immersive VR

BY DIANNE CRAIG

PrecisionOS, developers of a virtual reality (VR) training platform to enhance surgical readiness, are transforming the approach that nurses take to enhance their skills with OR training. In a pilot project taking place at the Burnaby Hospital, near Vancouver, operating room nurses specialized in orthopaedics are using the VR platform to refresh and advance their understanding of surgical procedures.

"We learn primarily by failing," said Dr. Danny Goel, an orthopaedic surgeon and CEO of Vancouver-based PrecisionOS. "With this understanding, we are challenging the current model by allowing our users to make mistakes and learn from them in a risk-free environment."

While Precision's VR training to date has primarily been focused on delivering a platform geared toward surgeons, it recently developed a version that caters to the specific needs of nurses, who ultimately work together collaboratively in the operating room. "This is a novel way to train all members of the OR team, including surgeons, nurses, and medical device professionals," said Dr. Goel.

During the early months of the COVID-19 pandemic, elective orthopedic surgery had been postponed at all B.C. hospitals. In late May, PrecisionOS sent two VR headsets to the Burnaby Hospital that nurses could
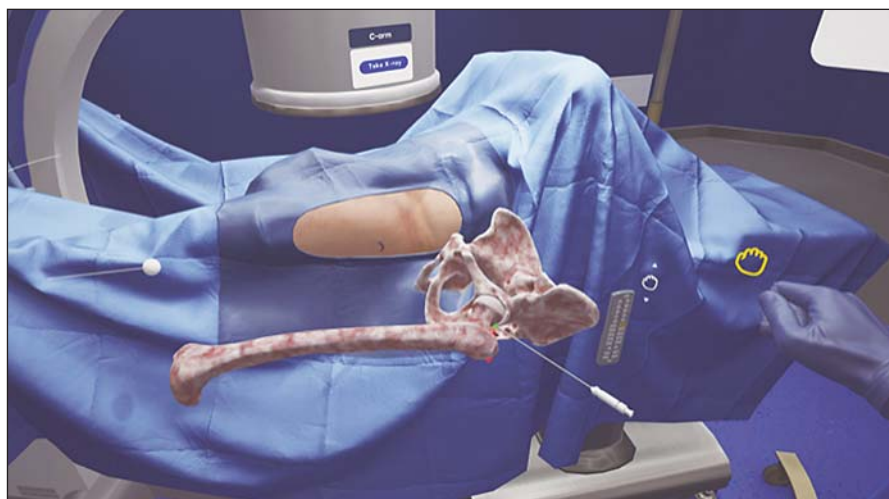
Virtual reality allows surgeons, nurses and other professionals to practice in a risk-free environment.

use for experiential learning. "PrecisionOS came to us at the right time," said Sandeep Randhawa, clinical nurse educator at Burnaby Hospital, explaining they had been looking for ways to elevate their training procedures for nurses.

Typically, said Dr. Goel, operating room nurses learn through an apprenticeship model, where they are learning by watching as opposed to learning by doing. "New OR nurses were monitored by experienced nurses," said Randhawa, adding that that will continue, but VR now further progresses their training.

Randhawa said that in addition to pro-

viding enhanced operating room training for new nurses, the VR experience acts as a "refresher for nurses who haven't been in surgery for a while, to bring them back up to speed."

"The feedback has been very positive," said Randhawa. "They value the 'safe space' to practice and be comfortable with that procedure. It helps them refresh their memory."

Leslie Romero, an operating room nurse, was among the first of five orthopaedic nurses there to use the PrecisionOS VR platform. Romero explained, "it's giving me a greater understanding and

visualization of the steps for the surgeries. It gives me a chance to look at and to see what they are actually doing."

Founded by Dr. Goel, along with two experienced gaming professionals, chief creative officer Roberto Oliveira, and chief technical officer Colin O'Connor, PrecisionOS currently has a highly experienced and well-rounded team of nearly 40 people, including industry advisors.

"There are experts in surgical education, human design interface, simulation, haptics, software developers, technology artists, visual effects and medical device experts," said Dr. Goel. The company uses Facebook's Oculus Quest for the headset and powers its VR platform with the Unreal Engine used by gaming professionals.

The VR learning process, explains Oliveira, starts with selecting a module. "You can select from several procedures. For the shoulder alone, there are nine different pathologies. Learners are taken through each protocol step by step, as they drill a guide hole or place a saw. During this whole process, there are "audio and visual instructions guiding you on what to do. You can also repeat a step, skip ahead, or skip back," he said.

"Once you've completed a procedure, you are presented with a metrics screen which provides specific feedback on how you did," added Oliveira. The next time you put on the headset and handset, you'll

Decision support tool helps diagnose COVID, heart failure, or both

BY KIRSTEN LEWIS

One of the most complex challenges in caring for those affected by COVID-19 is attending to underlying medical conditions that have been shown to influence how sick a patient becomes. Having multiple health conditions also impacts timely and accurate diagnosis of either COVID-19 or an exacerbation of their current conditions due to overlapping symptoms.

Heart failure is very common, affecting an estimated 600,000 Canadians. It is both an underlying risk factor for more severe COVID-19 illness, and a condition that may be missed or overlooked as many of the symptoms of COVID-19 are similar.

According to the European Society of Cardiology and Centers for Disease Control and Prevention, heart failure patients are at an elevated risk of severe illness from COVID-19, though most patients with the virus experience mild infections and fully recover. This means heart failure patients, if they do get sick with COVID-19, can become very unwell and require longer recovery times.

This clinical complexity of evaluating individuals with difficulty breathing underlines the importance of frontline medical staff providing accurate prescreening for COVID-19. Having the right tools allows for COVID-19 to be ruled in or out. Appropriate tools also

allow for quick recognition of heart failure symptoms as the care priority.

Great progress has been made since the start of the pandemic in aligning knowledge with on-the-ground practice through the development of new screening tools, knowledge networking and guidelines.

For example, the Canadian Cardiovascular Society has created a tool to assist with remote assessment of patients, providing a process to help differentiate between COVID-19 and heart failure symptoms, ensuring the best diagnostic and treatment approach.

In addition to the risk of diagnostic confusion between heart failure and COVID-19, there are other priorities that are supported with screening tools, including keeping patients out of healthcare facilities to reduce exposure risk and save resources.

Among the various ways our healthcare system responds to the pandemic is an emerging key area: equipping health professionals in hospitals, primary care, or other areas, with the tools to put emerging knowledge around COVID-19 into action. These tools help ensure patients get the best available diagnosis, and best possible treatment, from their first point of contact.

Our clinical R&D team has been assisting these efforts by authoring useful decision-support tools to help provide leading-edge care. Mobilized via point-

of-care technology to be easily accessible, they have been continually updated to meet the needs of COVID-19 healthcare. These tools help ensure healthcare professionals can act on the best-available knowledge when they make decisions and enable consistent high-quality remote screening by phone or through a virtual visit platform.

In a perfect world, clinicians would have ample time outside their key duties to keep up with the latest research developments. Even before the pandemic, that proved challenging. Now, with our entire healthcare system facing a common threat and constraints unlike anything we've seen before, it's become even more difficult.

Kirsten Lewis

This is compounded by an extremely high volume of evolving knowledge on treatment and diagnostics – often with conflicting data. According to CDC data, there are now more than 100,000 published COVID-19 research articles.

Decision supports have been proven to help clinicians to differentiate between the diagnosis of two similar conditions, heart failure and COVID-19, whose overlapping symptoms otherwise

form a diagnostic grey area.

To help, we have developed a heart failure/COVID-19 triage tool that has illustrated the value of leveraging medical technology to action the latest clinical research content. The triage tool is part of our extended COVID-19 library of order sets and tools that has had tremendous uptake, with more than 7,500 downloads of the triage tool alone.

The order sets and tools support fast diagnostic testing, early infection control, and an inventory of best practice interventions. This is part of our ongoing commitment to build COVID-19 decision support tools that make a difference – adopting the most up-to-date, evidence-based practices and improving outcomes for heart failure patients and others exhibiting possible COVID-19 symptoms.

As we enter the second wave of COVID-19 infection, these complex medical challenges are not going away, and ensuring medical professionals are properly equipped to promptly respond and better diagnose such patients is an ongoing priority for us. Putting the best-available decision-support tools in the hands of frontline healthcare staff will help the Canadian healthcare system weather the storm and provide the best possible care for everyone.

Kirsten Lewis is Think Research Vice President, Research and Development.

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"OK Vocera. Call Cardiologist on call."

Virtual care eases access to mental health and addiction services

BY NICHOLAS CHEPESIUK

We are at a crossroads in mental healthcare. The pandemic is leading us to either turn a blind eye to the growing wave of mental illness and addiction in Canada or use the circumstances as an opportunity to adapt and improve mental health services.

In a recent survey done by Statistics Canada, over half of all participants reported that their mental health has worsened since the onset of physical distancing.

This survey aligns with research undertaken by CAMH, which shows an increase in the number of Canadians with increased alcohol consumption, elevated anxiety, feelings of loneliness, and who are grappling with depression.

Soon after the pandemic started, many healthcare organizations launched virtual care for at least some of their services.

Trafalgar Addiction Treatment Centres, a CARF-accredited private provider of addiction and mental health treatment that offers residential and outpatient clinic programs in person, transitioned all outpatient programs to be fully virtual when the pandemic hit.

"When COVID hit and we had emergency orders coming in telling us, 'you've got to lock down,' we knew that we couldn't send anybody home without access and support," said Shane Saltzman, CEO of Trafalgar Addiction Centres.

"We reached out to OnCall Health and said, 'How quickly can you get me activated, signed up, and start onboarding my staff?' Within 48 hours we started delivering virtual care."

Headquartered in Toronto, OnCall Health provides secure virtual care software that powers over one million virtual healthcare appointments each year for healthcare providers and organizations throughout North America.

Although Saltzman admits that his team had aspirations to implement virtual care at Trafalgar Addiction Centres before COVID-19, the pandemic acted as a catalyst, driving the organization to act fast in the face of change. Trafalgar launched a virtual rehab program to replace its outpatient services that were typically held in person.

OnCall Health appointed a full-time account manager to ensure Trafalgar's employees were adequately trained, onboarded, and able to access knowledgeable technical support 24/7. Trafalgar was using the system in its practice in only two days.

Mental health and addiction services like Trafalgar have seen improved outcomes while using virtual care platforms to connect with patients remotely, streamline administrative tasks, and even host internal meetings for clinical supervision.

Virtual care allows practices like Trafalgar the capacity to schedule flexible appointment times that are more convenient than in-person visits. Providers and healthcare organizations can use this versatility to expand and improve access for their clients while increasing revenue for their business.

"This virtual realm makes mental health and addiction treatment much more accessible," said Saltzman. "We can now provide essential treatment, safely and securely. We can manage full group sizes and scale up and down quickly."

Trafalgar's four-week Virtual Rehab Program provides patients with 20 hours a week of individual group and family therapy. Online treatment delivery has also enabled Trafalgar to expand its services nationally, with patients from across Canada participating in the three Virtual Rehab Program groups that it offers each day – with six to 10 people in each group. Before the pandemic, Trafalgar was only able to offer one rehab program.

The virtual care platform allows healthcare providers and patients to interact using one to one and group video conferencing, but it doesn't stop there. The platform also enables secure instant messaging, file sharing, screen sharing and the ability to schedule and manage phone appointments.

For its part, OnCall Health has seen a spike in the use of subscription text therapy services among clients, a feature that allows providers to use a messaging application to either complement a video appointment or confidentially engage in professional counselling. These unique telehealth applications now grant people access to licensed therapists in the palm of their hand.

Virtual care in a mental health context has also improved outcomes for providers in unique ways. In one application, a behavioural therapy provider that assists children with autism recognized that video conferencing allows children to be accompanied by their parents in the comfort of their home. Children get to learn skills in the same environment in which they need to apply them, making it easier for them to replicate the behaviours.

Seniors have also reaped the benefits of virtual care. Ageing populations are especially vulnerable to the mental health challenges that result from isolation due to social distancing protocols amid COVID-19. Seniors that engaged with virtual care platforms for their primary care needs reported unexpected mental health benefits. They were also satisfied with the opportunity to remain active in the management of their health.

Healthcare providers are embracing the efficiency of virtual care as it enables them to not only connect with clients virtually but also efficiently manage operations with features like automatic scheduling, appointment reminders, consent forms, and secure payment processing. Privacy is also protected with end-to-end encrypted, PHIPA and PIPEDA compliance. Learn how virtual care is useful to healthcare providers in a wide range of industries at https://oncall-health.ca/use-cases/mental-health/

Nicholas Chepesiuk is CEO of OnCall Health, a provider of virtual healthcare software.

EMR vendors join forces to create fast-growing and innovative company

In July, Montreal-based MEDFAR Clinical Solutions acquired PLEXIA Electronic Medical Systems of Burnaby, BC. Even though the two EMR developers have impressive growth trajectories and a similar vision for healthcare, successfully merging both teams at both ends of the country during the COVID-19 pandemic meant exploring uncharted territories.

Wesley Wong, PLEXIA's general manager, reflects back on the process: "Since mid-March, all of our colleagues in both British Columbia and Quebec were working from home. As you can imagine, finalizing a transaction of this size requires the collaboration of many individuals at different levels of both organizations. And, with restrictions on air travel, all of this was conducted and completed via videoconferencing. I am proud of our teams. Everybody worked really hard to bring all the pieces together and we are pleased with the results."

COVID-19 forced both organizations to adapt to an unexplored and unstable business landscape, but it did not distract PLEXIA or MEDFAR from their vision to drive excellence and efficiency in healthcare.

Wong shares his thoughts on the journey: "I am thoroughly impressed by the level of respect, understanding and engagement of the entire Montreal team while we worked together to align our resources, tools, and processes. Four months after the acquisition, both teams are already reaping the benefits from working together."

The enthusiasm is also shared by MEDFAR's CEO and co-founder, Elias Farah: "We are confident that our laser-focused EMR strategy improves the experience of clinicians and their patients. With the addition of PLEXIA, we are now the largest and fastest growing pure-play EMR provider in Canada. The transaction gives us scale to double down on our plan."

The acquisition of PLEXIA accelerates MEDFAR's expansion and increases its footprint in Canada. More than 6,000 physicians and 20,000 users working in 1,500 clinics delivering 6 million patient visits per year nationwide have benefited from MEDFAR's EMR, so far.

Over the past 10 years, MEDFAR has evolved its MYLE EMR into a Care Management Solution that follows all aspects of the patient journey, whether

> **The merging of MEDFAR and PLEXIA creates a company that offers a full-featured EMR for both GPs and specialists.**

care is delivered virtually or at the clinic. This unique solution fully integrates e-fax, videoconferencing with MYLE Telemed, the MYLE Patient Portal, appointment confirmation with text messages, a statistics and reporting module with MYLE Analytics, as well as the new MYLE Kiosk that allows patients to self-register at the clinic.

With all these powerful features triggered in one click from the MYLE control panel, clinicians and staff are empowered to deliver care with enhanced safety and efficiency.

Interestingly, PLEXIA's innovation roadmap has been following a similar path with a comparable vision, but in mirror image for specialists of the features that MEDFAR was developing for family physicians.

"PLEXIA and MEDFAR are a perfect match," said Farah. "As much as we share the same vision and values, our features are designed for different groups of clinicians: MEDFAR with a focus on family medicine and PLEXIA with an emphasis on medical specialties. Add to the equation the fact that PLEXIA grew in Western Canada, while MEDFAR expanded in Eastern Canada and the result is the combination of two very complementary organizations that now have the scale to innovate faster and better, as well as the critical mass to thrive coast-to-coast."

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*Cloud DX Connected Health is Health Canada licensed and FDA cleared.

"*Remote automated monitoring of vital signs after discharge - post surgery - is the way of the future. This technology gives health care providers the ability to detect early signs of complications and optimize medical management, offering the potential to keep patients out of the hospital and in the process facilitate more elective and urgent surgeries and reduce the spread of COVID-19.*"

- **Dr. PJ Devereaux,** *Professor, Director, Division of Cardiology and Scientific Leader of the Anesthesiology, Perioperative Medicine and Surgical Research Group at PHRI, McMaster Health Sciences.*

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CLOUD DX

Quebec continues leadership in PET/CT, deploys scanner in Val d'Or

BY NORM TOLLINSKY

Earlier this year, the small mining town of Val d'Or, 525 kilometres north of Montreal, welcomed the arrival of a state-of-the-art PET/CT, bringing advanced imaging to the 135,000 people in northwestern Quebec's Abitibi-Temiscamingue region.

The GE Healthcare Discovery MI PET/CT at the 90-bed Hôpital de Val d'Or will serve patients throughout the sparsely populated region, including the towns of Rouyn-Noranda and Amos, as well as patients flying in from Indigenous communities in the province's Far North.

The $7 million project – $3.2 million for the PET/CT and $3.8 million for an expanded suite to accommodate it – was funded entirely by Quebec's Ministère de la Santé et des Service Sociaux, underlining the province's commitment to ensuring equal access to advanced medical imaging outside the province's major urban centres.

PET/CTs have also recently been deployed in two other mid-sized communities across Canada – Kelowna and Sudbury – but Quebec leads all provinces in the number of PET/CTs and accounts for more than half of the PET/CT exams performed in Canada.

Preliminary data from the Canadian Agency for Drugs and Technologies in Health's (CADTH) 2020 Canadian Medical Imaging Inventory, scheduled for release in January 2021, reports 67,849 PET/CT exams for the 2018-2019 fiscal year in Quebec and only 23,564 exams in Ontario for the fiscal year 2019-2020.

That equates to 1.6 exams per 1,000 population for Ontario's 20 PET/CTs and 8.0 exams per 1,000 population for Quebec's 23 devices.

Dr. Francois Lamoureux, a nuclear medicine specialist at Hôpital de Val d'Or and president of the Canadian Association of Nuclear Medicine, attributes Quebec's leadership in PET/CT accessibility to a long-running education campaign to educate specialists, general practitioners, healthcare administrators and the general public about the value of PET technology.

Whole body PET scans show abnormal metabolic activity at the molecular level using an injected radioactive sugar solution that "lights up" fast-growing lesions, while CT scans show physical structures using X-rays, allowing for precise localization.

PET technology has come a long way in recent years, said Dr. Lamoureux.

"Ten years ago, when we started talking about using more PET technology clinically, there were many drawbacks. It was difficult to have the tracers and the ones we were using were very limited. You needed a cyclotron that cost $15 million and specialized staff. Now we have much less expensive radionuclide generators to produce tracers."

Using PET/CT imaging, "you can change the therapeutic approach for patients in 30 to 40 percent of cases," claims Dr. Lamoureux,

Using a CT or X-ray imaging alone, there's no way of knowing if a pulmonary lesion or nodule, for example, is benign, requiring in some cases a very invasive biopsy, he explained.

However, if a PET scan is performed and there is no uptake of the tracer, the patient will be deemed to have a benign lesion, and no further investigation is required. "If there is an uptake – because it's a whole body investigation – you are able to see not only the primary lesion, but also the metastases that could exist elsewhere."

With the Discovery MI PET/CT at Val d'Or, said Dr. Lamoureux, "we are able to detect lesions as small as four millimetres. To see a lesion using a CT, it has to be about one centimetre."

PET/CTs can also be used to assess how a lesion is responding to chemotherapy.

"Suppose you are prescribed six rounds of chemo. It's very expensive and very hard on the patient, but if you do another PET study after the first treatment and find there is no more lesion, you can stop the treatment," he said.

PHOTO COURTESY OF DOMINIC CHAMBERLAND – JOURNAL LE CITOYEN/VAL-D'OR

Dr. Francois Lamoureux with the GE Healthcare Discovery MI PT/CT at l'Hôpital de Val d'Or. Formerly, chief of the nuclear medicine department at l'Hôpital Notre-Dame in Montreal, Dr. Lamoureux is the president of the Canadian Association of Nuclear Medicine and serves as a nuclear medicine specialist at l'Hôpital de Val d'Or.

That's what happened with Montreal Canadiens captain Saku Koivu, who was diagnosed with non-Hodgkin's lymphoma in September 2001. A PET scan performed in Sherbrooke prior to the conclusion of the prescribed course of chemotherapy pronounced him cured, allowing him to return to the ice the following April.

Having to endure more chemo than necessary, said Dr. Lamoureux, "is almost unethical."

"The technology has evolved so rapidly that we can now use it to diagnose cardiac and neurodegenerative diseases like Alzheimer's, Parkinson's and vascular dementia (in addition to cancer)," he noted.

"In Canada, neurodegenerative diseases cost us $33 billion per year, so you can see the importance of making the right diagnosis. With PET imaging, you can distinguish between different neurodegenerative diseases and offer the appropriate treatment."

According to Dr. Lamoureux, the Montreal Heart Institute performs 60 PET/CT cardiac studies per week, but because of the shortage of PET imaging availability in the other nine provinces, studies are mostly limited to oncology.

The CADTH's 2020 Canadian Medical Imaging Inventory reveals up to 11.8 percent of the 128,121 PET studies performed in Canada during the most recent fiscal year (or for 2018-2019 in Quebec) were for cardiology cases and only up to 5.7 percent were for neurological investigations.

"The other nine provinces are 10 years behind the rest of the world in PET use," said Dr. Lamoureux. "I think the general public should be aware of that because in many situations, patients aren't being offered the appropriate investigation.

"The situation in the rest of Canada is completely unacceptable. The technology is there. The specialists are there, and it's no longer an expensive tool. Every nuclear medicine centre should have a SPECT/CT and a PET/CT. It should be the same for all of Canada."

Dr. Lamoureux also disagrees with the policy in Ontario and other provinces of relying on local fundraising to cover the cost of PET/CTs.

"I'm completely against that," he complained. "Doctors are like soldiers. We're

68
bpm
heart rate

CHOLESTEROL

TOTAL: 160

HDL: 44

LDL: 100

25   50   75   100   125   150   175   200

steps

stairs

exercise

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Modern storage infrastructure helps McArthur Lab speed up lifesaving results

Using flash storage, the lab is able to analyze huge data sets 24 times faster than before.

HAMILTON, ONT. – McMaster University's McArthur Lab, which conducts data-intensive research on the genetic makeup of superbugs – including the SARS-CoV 2 virus that causes the COVID-19 disease – has installed high-powered flash storage from Pure Storage. The Pure FlashBlade system provides the lab with 72 terabytes of digital storage and delivers data to the desktop much faster than conventional systems.

"There's no point in playing with traditional storage because it's just not fast enough," said Andrew G. McArthur, Ph.D., associate professor at McMaster University, in Hamilton, Ont. "With Pure Storage we can stay ahead of the curve as we fight global threats to human health."

The McArthur Lab is home to 30 investigators, including professors, students and postdoctoral fellows with expertise in infectious diseases, human genetics, microbiology and drug discovery. They're also collaborating with numerous colleagues and partners outside the lab – across Canada, in the United States and around the world.

The lab has been deeply involved in deciphering the transmission of COVID-19 using proprietary technology that it developed itself along with off-the-shelf equipment. Because the COVID virus mutates slowly, it's possible to take meaningful "genetic fingerprints" as it works its way through the population.

The McArthur lab can detect chains of transmission by sequencing the genomes of the viruses found in people who have tested positive. If the sequences are similar, the patients were probably infected by each other. If the sequences are different, the infection likely came from elsewhere.

In this way, researchers and public health officials can establish chains of transmission. Doing this kind of detective work – for COVID-19 and many other diseases – requires researchers to work quickly while using enormous data sets. They're sequencing the virus

> "What once took one to two days to conduct, now can be done in two to three hours," commented Andrew McArthur, lab director.

in thousands of patients, and each virus consists of 28,000 base pairs that must be analyzed. The immense volume of data that's generated by genetic research prompted McMaster's McArthur Lab to opt for the Pure FlashBlade storage.

"FlashBlade speeds drug discovery and pathogen biology by analyzing select data sets 24 times faster than before," said McArthur. "What once took one to two days to conduct, now can be done in two to three hours."

The improvement in speed and results benefits not only the researchers, but healthcare providers, policy makers and patients, as well.

"Data is critical to the daily insights in the lab," said McArthur. "How-

Andrew G. McArthur, Ph.D., associate professor at McMaster University in Hamilton, Ont.

ever, the vast and growing amount of information relies on near-instant processing times. By replacing our legacy storage infrastructure with Pure, we have the ability to gain insight into the virus through next-generation sequencing."

As gene sequencing technology continues to advance, rapid scalability and performance will remain critical to the lab's efforts.

"The need to quickly identify and respond to global threats to human health has never been clearer," said Josh Gluck, vice president of Global Healthcare Technology Strategy at Pure Storage. "With FlashBlade, researchers at McArthur Lab can continue to conduct research that has widespread global impact."

For its part, Pure Storage (NYSE: PSTG), based in Mountain View, Calif., is an IT pioneer that delivers storage as-a-service in a multi-cloud world.

Pure's FlashBlade now serves as the digital backbone of the McArthur Lab, as it continues to combat the spread of superbugs and other major issues, such as the rapid spread of antimicrobial resistance – the ability of pathogens to develop resistance to antibiotics.

"FlashBlade generates results in three hours or less for insights that can save lives and lead to better public health decision," said McArthur. "Not only can McMaster process more data, it is processing better data, leading to better, faster outcomes. Since moving to a modern data-centric infrastructure, the lab's results have become even more accurate."

Technology can help with Canada's chronic wait times problem

BY DR. CHRIS SIMPSON

"Never waste a good crisis", the change management experts say. As the COVID-19 pandemic continues, and we reflect on the massive disruption it has caused, I have found myself searching for opportunities for healthcare transformation amongst the chaos.

Many have said that this crisis has not really generated new problems so much as it has exacerbated old ones. One good example of this is the Canadian healthcare system's chronic wait time problem. Waiting for medical care is as Canadian as maple syrup and poutine. But now, thanks to COVID-19, things have gotten a whole lot worse.

Even before the pandemic, Canada was a poor wait times performer; finishing at or near the bottom of the list of peer countries when it comes to access to primary care, specialist care, tests, procedures and surgeries.

Now, as we look back over the past few months, we see that the problem has worsened, with backlogs in surgeries and procedures (let alone the backlog of other kinds of medical care) estimated to be in the hundreds of thousands across the country.

As with any complex issue, the answer is never easy, nor is there a single "silver bullet". One highly effective but underutilized solution may just be ready for prime time. We have always known it works, but maybe we just needed a crisis to move to widespread implementation. I'm speaking, of course, of single entry models (SEM), also known as central intake.

Recall your last trip to Walmart. When you go to pay for your purchases, you'll notice that there aren't 12 lineups for 12 cashiers. There is one line up for 12 cashiers. Whoever gets to the front of the line first goes to the next available checkout. That's a single-entry

model. And Walmart does it this way for a reason: you can get more people through faster.

The same principles apply for queues of patients waiting for a medical service, like hip replacement, a consultation with a psychiatrist, access to addiction services, or a diagnostic test, like an MRI. It is far more efficient for patients to wait in one queue, and go to the first available provider, than if they form numerous queues for those same providers.

Dr. Chris Simpson

Common intake is cost effective, more equitable, and it drives down wait times. The goal is simply to get the right patient in front of the right provider at the right time.

Too often, still, referring doctors are not aware of the referral options out there for the myriad of clinical services available, and they default to the people and services they know and have known, usually with little idea what the wait times are.

The result is that a patient waiting for a medical service may find themselves waiting for months longer than another patient down the street for the same service, simply because the referring provider doesn't have the tools available to "comparison shop".

But there are some areas that are doing great work in this space. The Mississauga Halton region of Ontario has perhaps one of the widest implementations of a single point-of-entry system. Managed by the Mississauga Halton Central Intake program, the program reviews, triages and routes referrals for diabetes, foot care, mental health, addictions and hip and knee

BC launches new form of virtual care for patients with chronic illnesses

BY ROBERT KAUL

It's not news that COVID-19 has significantly impacted the healthcare system and the way services/programs are delivered. What is worth noting is that the pandemic has spurred the introduction of new models of care and patient interactions that could have long-lasting, positive outcomes.

At Cloud DX we recently joined an initiative led by Curatio Inc., a digital health company headquartered in Vancouver, to support the urgent need of patients who are no longer able to take part in face-to-face outpatient programs due to the pandemic. The goal of the aptly named Stronger Together program is to safely support outpatients at home during the pandemic, especially those who are frail, vulnerable and isolated.

BC Interior Health, The University of British Columbia, Pacific Blue Cross and United Health Network are among the partners involved in the program. Stronger Together is supported by a $1.4 million co-investment from the Digital Technology Supercluster, an industry-led consortium investing in innovation projects with funding from Canada's federal Ministry of Innovation, Science and Industry.

Robert Kaul

People living with chronic disease, the disabled and elderly typically visit hospitals and community centers for rehabilitation and disease management programs in group settings.

These programs deliver education, information, exercises, coaching and critical peer support, that address both the medical and psychosocial needs of patients and families. Often, these programs also have some form of monitoring and clinical evaluation to catch issues before they become acute and thus prevent complications and hospitalizations.

It's not considered safe for these individuals to participate in these types of programs during the pandemic, so a virtual care solution makes sense. However, the providers who typically deliver these programs lack the technology to deliver them virtually and don't have the remote monitoring tools to safely track patients at home.

Similarly, there is no commonly accepted standard for this type of delivery and no platform on which multiple offerings can be integrated. In fact, use of mainstream 'consumer' technologies and platforms are often problematic for healthcare organizations as they may not have the privacy and regulatory requirements needed, nor have they generally been designed for clinical use.

The Stronger Together initiative was developed to fill these gaps and create support for patients. Stronger Together leverages Curatio's secure, private social network to deliver peer support, coaching from nurses and experts, evidence-based health literacy programs and daily check-ins alongside Cloud DX's award-winning remote patient monitoring technology.

A multi-phased project, Phase I of Stronger Together was deployed within BC Interior Health to help patients prepare for joint replacement surgery. Together, patients worked through weekly evidence-based educational programs and participated in daily group discussions led by Community Coaches, all while checking and monitoring their vitals each morning from the comfort of their homes.

Prior to the program launch, research and interviews identified a gap in patients' understanding of the power and control they have over their own health outcomes.
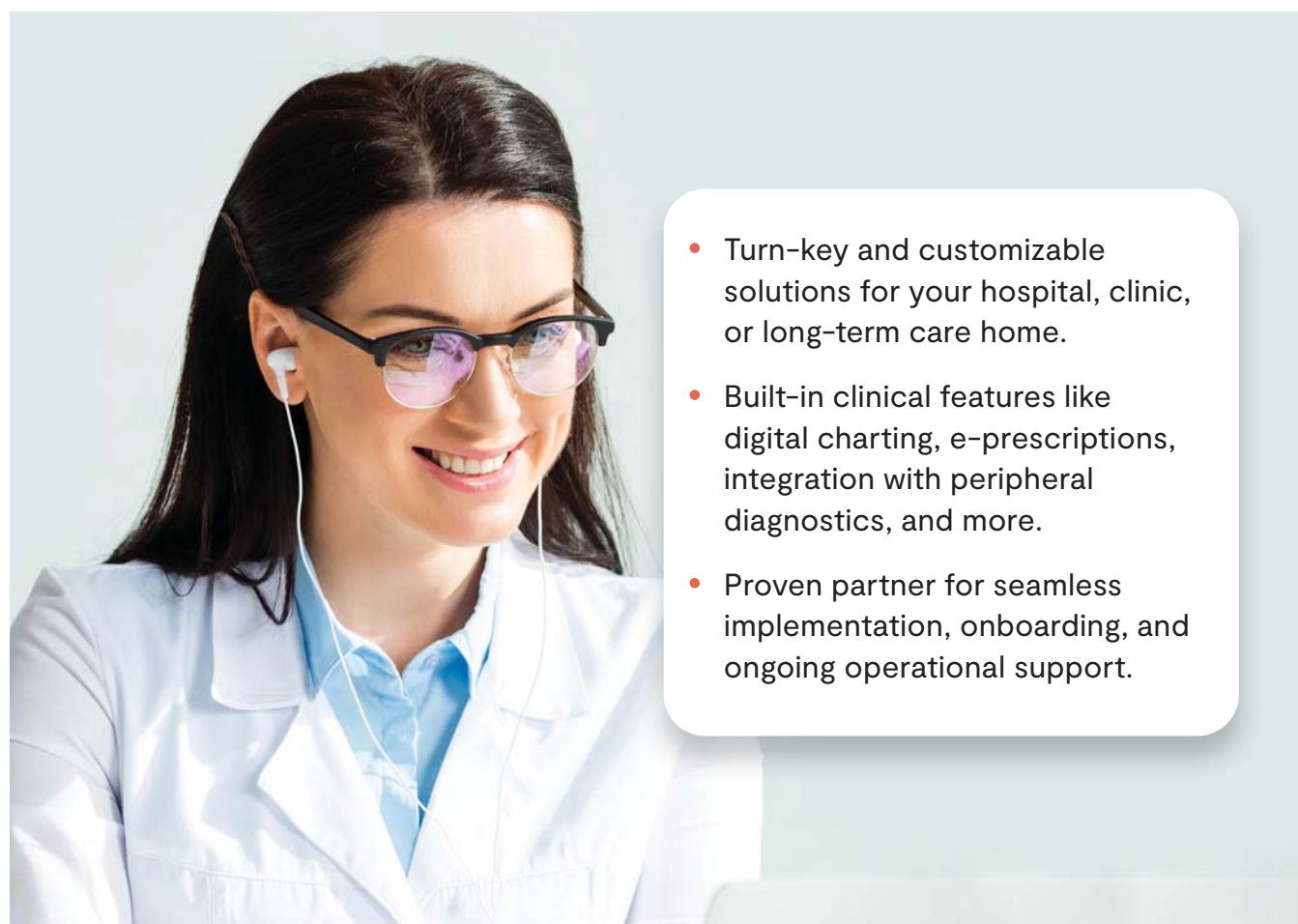
Also highlighted was the need for information around the importance of a patient's role in healthcare. There turned out to be a real potential for improving health outcomes by assisting with patient education and process transparency and to provide

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Machine learning makes progress in clinical care at hospitals across Ontario

AI is getting better at detecting problems in patients, and at alerting the right clinicians.

BY DIANNE DANIEL

Consider the following urgent situations:
• Concerned parents rush their child to The Hospital for Sick Children (SickKids) emergency department in Toronto. After checking in with the triage nurse, they go to the waiting area and a short while later, they receive a message that a urine test and X-ray have been ordered and are told what to do next. By the time they see the physician, she's already armed with the results and makes an informed decision about their child's care on the spot.

• The condition of an inpatient at St. Michael's Hospital in Toronto starts to deteriorate, putting him at high risk for an adverse event. A secure email is immediately sent to the nurse's desk and the attending physician receives a page, allowing for early care intervention and preventing a sudden trip to the ICU.

• A critically ill infant in the neonatal intensive care unit (NICU) at Southlake Regional Health Centre in Newmarket, Ontario, starts to develop sepsis, a condition that appears suddenly and can turn fatal within hours. Clinicians are alerted and quickly intervene with life-saving measures.

The common thread between all three of these research scenarios, currently under way in Ontario? A branch of artificial intelligence called machine learning that is poised to reshape medicine, one predictive model at a time.

"This is a major data and computing revolution of our time," said Dr. Amol Verma, an internist and scientist at St. Michael's. "If we're going to figure out how to harness it for healthcare, to really improve how we deliver care for our patients, it's going to take a lot of hard work."

Dr. Verma is part of a multi-disciplinary team at the hospital working on an early warning system called CHARTwatch, designed to reduce mortality and improve the quality of care of patients on the general internal medicine ward. One of the first Canadian hospitals to establish an in-house data science and advanced analytics team – including a multimillion-dollar infrastructure investment and the creation of a vice-president of Data and Analytics position – St. Michael's recognizes machine learning as a "key area of healthcare development and innovation," he said.

In simple terms, machine learning is the process of using algorithms to teach a computer to make accurate decisions and predictions based on data. The goal of CHARTwatch is to improve real-time clinical decisions by automating the process of rapidly collecting and analyzing data from the hospital's electronic medical record (EMR).

Whereas similar predictive models, widely used in the U.K., were designed to analyze five to 10 data points and use simple statistical algorithms, CHARTwatch analyzes more than 100 data elements stored in the hospital's EMR. Its complex algorithms run like a digital assistant in the background, operating in parallel to the hospital staff's existing workflow and making accurate predictions based on real-time patient information, including length of stay.

It took two years, a great deal of input from clinicians and analysis of 10 years' worth of historical data to develop the model, which is designed to provide 24 to 48 hours advance notice when a patient is at risk of deteriorating. Clinicians are alerted by se-

cure email, page or through the hospital's physician sign-out tool and patient risk scores are assigned according to three categories: green, yellow or red.

Before launching their model in a clinical setting this past summer, the St. Michael's team conducted a real-time comparison between the model and clinicians. After comparing more than 3,000 prediction instances over a four-month period, they determined their model was 20 percent more accurate than clinicians at identifying patients who were either going to die or end up in the ICU, said Dr. Verma.

"I think what's really exciting about this is once you deploy to the real world, it's actually not that the model is better than the clinician. Ultimately, it's the combined intelligence: How does the model inform the clinical judgement of the doctor, who can then help the patient," he said.

Now that the model is live, researchers are carefully monitoring results through weekly team meetings and

ILLUSTRATION: LINDA WEISS
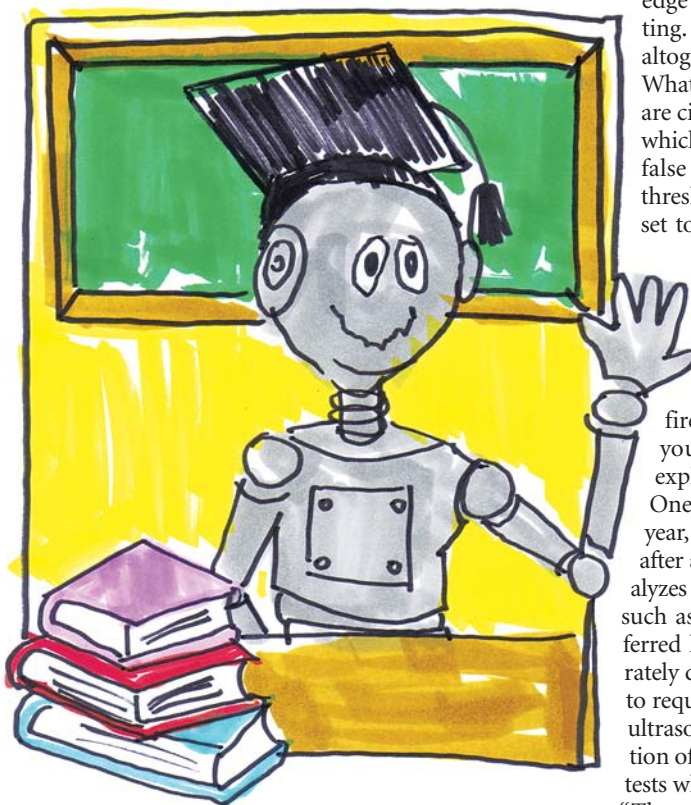
a full year of qualitative and quantitative evaluation is planned. Anecdotal evidence shows that CHARTwatch is accurately identifying outlier patients, prompting clinicians to reassess patients they may have otherwise missed. At the same time, the model sometimes tells clinicians what they already know and in some instances, the clinicians override the model's decision.

An added benefit is that the model is being used to strengthen communication between patients, their families and clinicians. "We had patients who had a very long and complicated hospital stay and their family members were very anxious about leaving them overnight on the ward," said Dr. Verma. "The model predicted the patient was low risk and we were able to share that with family and reassure them."

Improving communication is also one of the objectives of researchers at SickKids who are working to develop early warning systems to detect sepsis and cardiac arrest, as well as predictive models to better manage patient flow and patient volumes.

The hospital's multidisciplinary research team follows a structured pipeline to advance machine learning projects, starting with clinical use case design, followed by data acquisition and preparation, model development, model and user validation, and ending with clinical integration. Legal, privacy and ethical considerations – including steps to identify model bias and ensure fairness and equity regarding who will benefit from the model – are emphasized throughout the process.

The end goal is to translate academic studies into real-world, meaningful action, said Dr. Devin Singh, physician lead for Clinical AI and Machine Learning in Pediatric Emergency Medicine at SickKids.

"You could run these models as decision support, where all that's happening is an alert is firing but there's no impact directly on patient care," said Dr. Singh, who recently launched a health technology start-up lab called Hero AI to help translate leading-edge research at SickKids into the clinical setting. "The more interesting step is to avoid that altogether and go straight into action," he added. What's different about their approach is that they are circumventing the challenge of alert fatigue – which occurs when a predictive model generates false positive results – by setting their model thresholds high. For example, a model could be set to react only when it is 99 percent certain it has identified a positive case or that a waiting ER patient requires a specific test.

"The sheer act of programming your model that way means you're going to end up missing a bunch of cases that come through, but when the model does fire, you're so confident the result is correct, you can add automation to that workflow," explained Dr. Singh.

One project, expected to go live in the ER this year, is a model that predicts downstream events after a patient arrives. The model collects and analyzes triage data from the electronic health record, such as demographic details, vital signs and preferred language, as well as nursing notes, to accurately detect common ailments that are most likely to require routine tests such as urinalysis, X-ray or ultrasound. It then triggers the automatic generation of orders and notifies patients to complete the tests while they wait to be seen.

"Those tests can now be done ahead of time, during the period of time that you're waiting, adding efficiency and value to your stay, and by the time the doctor sees you, they can go straight to decision making," he said. "That's really powerful."

Instead of trying to program a predictive model that will be right for every patient, every time, the approach focuses on automating care for a subset of patients with confidence. The end result is a two-pronged ER workflow where testing is automated for those patients identified by the model, while remaining cases follow the normal pathway of care.

"Our hypothesis is by adding efficiency for 20 percent of patients, we're actually adding efficiencies to everybody, said Dr. Singh.

Other leading-edge research being explored at SickKids focuses on using available data to predict patient volumes, including weather and traffic patterns, COVID case numbers, prescription usage and possibly even Google search hits. Researchers are also looking at developing a chatbot to serve as a virtual

assistant for parents at home, helping them to know when they need to take a child to the ER.

"If you come too early and you're too reflexive in your response to unwell children, then you start to overcrowd and overwhelm a publicly funded healthcare system and that leads to adverse outcomes," he explained, noting that a late trip to the ER can also be devastating.

Carolyn McGregor, the Canada Research Chair (Alumni) in Health Informatics based at Ontario Tech University in Oshawa, said the simplest way to think about machine learning is to call it automated decision making. Known for her breakthrough work to detect early onset of sepsis in infants in neonatal intensive care units (NICUs), Dr. McGregor is now working with a variety of stakeholders to further advance machine learning in healthcare.

Her patented approach to monitoring infants in the NICU – which resulted in the Artemis Cloud Health Analytics-as-a-Service (HAaaS) platform – examines the interplay between respiration rate variability and heart rate variability. The model essentially watches for changes in heart rate or breathing that are signs a child is dealing with infection, and then alerts physicians to intervene and decide next steps.

The cloud environment supporting Artemis is provisioned by the Centre for Advanced Computing at Queen's University in Kingston, Ontario. Artemis runs continuously in the background of the NICU, processing roughly three million data points per infant per hour, as it analyzes changes in infant physiology.

The approach is unique in that it allows treating physicians to 'see' changes in behaviour they might not pick up at bedside. "The second by second numbers (on a monitor) help them to see in the moment if the patient is still alive, but it doesn't answer questions about how the patient's physiology is changing such that they are showing signs of infection, a hemorrhage or some other condition," explained Dr. McGregor.

Based on a study of Artemis deployments at McMaster Children's Hospital in Hamilton, Ontario, and Southlake Regional Health Centre in Newmarket, Ontario, the platform was proven to maintain service availability as high as 99.7 percent and McGregor's team was on the cusp of releasing a decision support protocol for early detection of sepsis when the COVID-19 pandemic launched them into a holding pattern. "We're looking forward to when we can restart the studies," she said.

One of the challenges to the approach of using real-time physiological monitoring to inform predictive models is signal quality. In the NICU, the advantage is that babies sleep for long periods, allowing for uninterrupted data flow. The data from McMaster's NICU is collected from Philips Intellivue monitors, while Southlake uses GE Dash monitors. As Dr. McGregor's team now works to apply the platform in other real-world environments, they need access to low-cost, easy-to-wear sensors capable of transmitting data at a fast frequency to a public cloud.

"We're trying to create the digital twin of the human and then do analysis on the information of that digital twin," she explained. "At the moment, we're still having trouble getting that exact replica and en-suring the digital twin is an actual representative of the human."

Last year, Ontario Tech University partnered with University of Technology Sydney (Australia) to launch a Joint Research Centre in Artificial Intelligence for Health and Wellness. As a co-director of the centre, Dr. McGregor is applying her expertise to improve health, wellness, resilience and adaption in several different populations. The extended technology platform is called Athena Cloud, and incorporates environmental and activity data in addition to physiological data.

The centre is collaborating with the Canadian Space Agency to predict how astronauts adapt to weightlessness, as well as with firefighters, tactical officers and members of the Department of National Defence to monitor physiological changes that occur during intense training scenarios, such as running into a burning building. Another project is working to develop an early indicator of aggressive behaviour in mental health patients.

"As much as I realize the possibilities are infinite, I've been very fortunate that other people are coming to me and saying, 'Can we use it to do this?'" said McGregor. "The answer is yes you can and the beauty of that is we're solving real problems."

As AI works its way into healthcare, nursing roles must be integrated

BY RITA WILSON RN, MN, M ED.

A new era in healthcare and in nursing has begun in Canada. COVID-19 has accelerated the adoption of virtual care delivery models across the country. And health technologies powered by artificial intelligence (AI) such as predictive analytics, robotics, virtual care apps, and smart hospitals are beginning to appear on the Canadian healthcare landscape.

As demand for artificially intelligent health technologies (AIHTs) grows, clinical settings in Canada will undergo significant changes that will have a ripple effect across all health sectors, impacting all healthcare professionals. The nursing-AIHTs interface will require new skills and expertise to ensure the integrity and ethics of the nurse-patient relationship.

This emerging trend gives rise to important questions, including: How will these technologies influence the patient/family/caregiver's experience of compassionate care? What impact will these technologies have on nurses, patients, families and caregivers? And, how will nurses safeguard compassionate care in an age of AI?

The Registered Nurses' Association of Ontario (RNAO), in partnership with AMS Healthcare, is raising awareness of the emerging AI and nursing interface to stimulate critical reflection and fuel discussion about actions that nurses and other stakeholders need to take to shape AIHTs.

"This new world for our profession, in which nurses, AIHTs and compassionate care co-exist, can be seen as threatening or exciting, depending on how we choose to embrace it, shape it and prepare for it," said RNAO CEO Dr. Doris Grinspun. "There are endless possibilities with AIHTs to enhance care and advance best practices using predictive analytics that enrich nurses' decision-making power.

In addition, the potential to increase access to health services, and to support people at home with virtual care apps is real, especially if leveraged for hard to reach populations."

Research suggests that between eight and 16 percent of nursing time is spent on non-nursing activities and tasks that could be managed by advanced technology. "The implementation of AIHTs to perform routine activities would provide nurses with the opportunity to spend more quality time on compassionate patient care," said AMS CEO Gail Paech.

"Technology could play an enormous role in the future, providing solutions for clinical activities including patient vital signs monitoring and alerting, or falls monitoring and prevention," she said.

In the age of AI, an increase in virtual nursing roles is likely. The deployment of AIHTs to support these roles will require nurses with the knowledge, judgment and skills to effectively use the new technologies. Future nurses will need adequate education and training, as well as decision support tools to identify patients that are appropriate for virtual care, interventions that can safely be completed virtually, and, clinical conditions that are conducive to patients' use of AIHTs, such as virtual care apps.

Gail Paech, CEO of AMS

A thorough review and reform of nursing curricula to ensure congruency of the nursing role with present needs and future demands of the emerging AIHTs is also critical.

The implementation of these complex technologies will necessitate governance structures that integrate nursing informatics roles (e.g., chief nursing informatics officer) to assist nursing and other executive leaders to make informed clinical and business decisions and to lead the technical aspects of the implementation. It is important for executive leaders to advocate for technology-related governance structures that include these roles and afford nurses decision-making authority.

The emerging future constitutes a major paradigm shift that necessitates strong and proactive nursing leadership – in all

Doris Grinspun, CEO of the RNAO

roles and sectors. This leadership is vital to actively assess and guide the nursing/AI interface, encourage and support the contribution of nurse leaders in all roles and sectors, and ensure fulsome patient engagement throughout the technology life cycle.

RNAO and AMS recently published a report titled *Nursing and Compassionate Care in the age of Artificial Intelligence: Engaging the Emerging Future.*

It outlines key recommendations that serve as urgent calls to action on the interface of Nursing and AI. RNAO and AMS want the report to spark vigorous discussion on what is needed to shape the emerging future. The report is available at RNAO.ca

Rita Wilson RN, MN, M Ed. is the eHealth Program Manager at RNAO.

How machine learning can reduce the backlog of surgical procedures

BY ALAN SARDANA AND DR. JOSHUA LIU

An analysis published in the September 2020 issue of the Canadian Medical Association Journal estimates that it could take one and a half years to clear the backlog of almost 150,000 surgeries created between March and June 2020, due to the pandemic. It is imperative for our healthcare system to not only help Canadians get surgery, but to do so safely and in a manner that minimizes risks associated with hospital care during the pandemic.

Digital patient engagement is a promising virtual care technology that presents an effective way to deliver safer surgery during COVID-19. Digital patient engagement involves empowering patients to be guided through their pre- and post-surgery care via their smartphone, tablet or computer.

Patients receive electronic reminders about key steps in their care plan (e.g. when to stop eating or drinking before surgery), access interactive education (e.g. exercise videos for rehab) and track symptoms or progress (e.g. pain scores, vital signs, etc.). Healthcare providers at the hospital can get alerts and access dashboards to monitor patient progress

(e.g. photos of surgical incisions) and catch problems earlier.

While this may sound futuristic, a Canadian health technology company called SeamlessMD has been pioneering digital patient engagement for several years. Prior to the pandemic, SeamlessMD's platform was being used by Canadian healthcare organizations to guide patients through surgery, such as at Sunnybrook Health Sciences Centre and The Ottawa Hospital.

In fact, Trillium Health Partners launched the SeamlessMD platform for Cardiac and Orthopedic surgery during the pandemic, and when in-person, pre-surgery education classes had to be cancelled, the hospital innovated quickly with SeamlessMD to deliver pre-recorded classes virtually to patients through the platform.

Leveraging Patient-Reported Outcomes (PRO) data collected on platforms such as SeamlessMD (e.g. pain scores, vital signs data, etc.), with A.I. and Machine Learning to better predict adverse health outcomes and deliver safer surgery has always been a vision for the Canadian healthcare system. Now, the COVID-19 pandemic appears to be the turning point needed to not only accelerate the adoption of digital patient

engagement platforms, but also the use of AI & Machine Learning to deliver more predictive care.

In August 2020, the Digital Technology Supercluster announced the investment of about $30 million in federal funding for 17 projects to help tackle COVID-19. One of these projects is being led by SeamlessMD to help hospitals use digital patient engagement technology and machine learning to deliver safer surgery

> **Patients receive electronic reminders about key steps in their care plans, and they can track symptoms and progress.**

during COVID-19, thereby helping to reduce the backlog of surgeries.

A consortium of seven hospitals in Canada, including Trillium Health Partners and Michael Garron Hospital, have already signed up to participate, and this number continues to grow. Besides SeamlessMD, industry partners involved in the initiative include AltaML, Xerus Medical and Excelar Technologies.

Through this project, Canadian hospitals will integrate the SeamlessMD platform with their existing Electronic

Medical Record systems, and enable patients to be digitally screened for pre-surgery risk factors, COVID-19 symptoms and post-surgery symptoms of complications (e.g. fever, surgical incision photos, etc.). This will allow healthcare providers to remotely assess patient readiness for surgery, avoid unnecessary in-person follow up visits and catch problems earlier in the post-surgery recovery process.

In addition, the collaboration will involve training machine learning models with both historical surgery data and real-time symptom data to better predict the risk of cancellations, readmissions and emergency room visits. This project represents a paradigm shift in healthcare, from a historically paper-based model of patient education to a digital model of intelligent, personalized patient care.

While several of the hospitals involved in the initiative are already using digital patient engagement technology, many will be implementing this type of technology for the first time. While we do not know how long the impacts of the pandemic will last, one thing we know for sure is that the pandemic has accelerated Canadian healthcare into a far more digital future, and there is no turning back.

Transform decision-making with a micro-certification in Data Analytics

BY SHIRLEY FENTON

We live in the information age and an era of Big Data. However, without analytics, that data can be meaningless. Organizations urgently need people who know how to explore, analyze, and extract value from data – and deliver the right insight at the right time to the right people.

A new micro-certification in Data Analytics is now available, thanks to a partnership between McMaster University Continuing Education (McMaster CE) and National Institutes of Health Informatics (NIHI).

In June 2020, eCampusOntario, a provincially-funded, non-profit organization, awarded a $15,000 grant to McMaster CE to pilot this program, as part of their initiative to broaden micro-certification in Ontario by working with universities and colleges in collaboration with industry partners.

Micro-credentials are a hot new approach to education, a response to the skills gap caused by new technologies, rapid digital transformation in industry, and the need to continuously upskill. Essentially, a micro-credential is official certification of acquisition of a specific skill or set of skills or capabilities.

It is awarded in a digital form, which is verified, secure, and shareable with peers, employers. and educational providers. Digital credentials can be curated, annotated, and distributed over digital networks under the earner's control.

According to RMIT University in Australia, "Micro-credentials also certify an individual's achievements in specific skills and differ from traditional education credentials, such as degrees and diplomas, in that they are shorter, can be personalized and provide distinctive value and relevance in the changing world of work."

Shirley Fenton

"Micro-certifications are a fantastic complement to our traditional Certificate and Diploma programs," said Dan Piedra, assistant director, Program and Online Development at McMaster CE. "Pairing theoretical knowledge with micro-certifications allows individuals to clearly demonstrate their specific skills and capabilities to future employers. The fundamental skills and competencies needed for today's jobs are constantly evolving –

micro-certifications are a great way for post-secondary institutions to stay agile and meet industry demands."

Why data analytics?

Skills in data analytics are one of the most sought-after skills by employers. LinkedIn's 2020 Global Talent Trend Report identified data analytics as one of the most in-demand skills for employment.

"Data analytics is a strategic asset to any organization to support evidence-based decision-making," said Trevor Strome, instructor for the NIHI-McMaster CE program, and one of Canada's leading data analytics experts.

"Data overload can risk impeding, not improving, the decision-making ability of leaders, managers, and quality Improvement teams," added Strome, who is also the author of Healthcare Analytics for Quality and Performance Improvement. He emphasizes that it is not only the volume, but also the variety of data that has grown exponentially with the inclusion of multimedia and image files.

Strome said the courses in the NIHI-McMaster CE program are applicable to professionals in all industries. For his part, Strome works in two different fields: he is the director of Digital Airport Solutions at the Winnipeg Airports Authority, as well as assistant professor in the Department of

Emergency Medicine at the University of Manitoba.

The Data Analytics program is designed to help professionals develop their skills in the fundamental elements of data analytics. A digital credential will be awarded upon successful completion of the three courses: Data Analytics I, II and III, which are offered through the NIHI-McMaster CE partnership. All courses are online, with more than 30 hours of instruction, including both live sessions and recorded content.

The courses were developed by NIHI in close collaboration with the dedicated Instructional Design team at McMaster CE. The micro-credential will be issued by McMaster CE.

This program is aimed at anyone interested in learning how data analytics can support evidence-based decision-making that reduces costs, improves outcomes, and provides better service to clients, customers, and constituents. The program will be of specific interest to executives, clinicians, technicians, e-health teams, quality improvement teams, data scientists, business analysts, database administrators, and solution providers.

All three courses are now open for enrolment. For further information including how to register, please see: www.nihi.ca.

Shirley Fenton is Vice-President, National Institutes of Health Informatics; Co-Founder, Waterloo MedTech.

AI is quickly developing and taking different forms

BY THOMAS HOUGH CMC

In every healthcare technology event, and in every trade journal, you can now expect a barrage of information on how Artificial Intelligence will change Diagnostic Imaging and the entire healthcare delivery system. The big question is when will we witness the appearance of products or services that will improve healthcare delivery and what part of healthcare delivery will be first affected?

Diagnostic Imaging is one of the areas front of mind for us; to date, GE Healthcare, for example, has Health Canada approval of a system that can better identify cases of pneumothorax and prioritize them for readings by radiologists. For its part, Intelerad has been working with Zebra Medical to make AI-powered tools available to Canadian radiologists, as well.

At the same time, there are many other healthcare initiatives that could benefit from AI in healthcare, including but not limited to: Screening; Psychiatry, Primary Care, Disease Diagnosis, Telehealth, Electronic Health Records, Drug Interactions and Creation of New Drugs and workflow optimization.

St. Michael's Hospital, Toronto, has been using AI for improved scheduling and workflow optimization. As we note in our feature section, St. Mike's is also developing an AI system that will detect patient deterioration. Unlike many Early Warning Systems that use six or seven variables to detect patient decline, the St. Mike's application uses more than 100! No wonder artificial intelligence is required!

When we think about AI, most of us are

familiar with the terms expert system and machine learning. But there are additional categories that data scientists are working with, and that laypersons are now becoming more familiar with. Here are a few of these categories:

• Artificial General Intelligence (AGI) refers to a type of artificial intelligence that is broad in the way that human cognitive reasoning can be broad; which can do different kinds of tasks well, and that really simulates the breadth of the human intellect, rather than focusing on more specific or narrower types of tasks.

• Narrow Artificial Intelligence (Narrow AI) is a specific type of artificial intelligence in which an algorithm outperforms humans in a narrowly defined task. Unlike General AI, Narrow AI focuses on a single

Thomas Hough

subset of cognitive abilities and advances in that spectrum.

• Strong Artificial Intelligence (Strong AI) is an artificial intelligence paradigm that has mental capabilities and functions that mimic the human brain. In the philosophy of Strong AI, there is no essential difference between the piece of software, which is the AI, exactly emulating the actions of the human brain, and actions of a human being, including its power of understanding and even its consciousness. Strong AI is also known as Full AI.

• Artificial Super Intelligence (ASI) is used to create computer applications

which surpass humans, when compared to what humans can provide. In other words, ASI cognitive ability is superior to a human. ASI is what is required for complex clinical diagnostic algorithms capable of developing and publishing a diagnostic report that will direct a patient treatment plan.

In conclusion, Narrow AI applications will be the fastest and first to be developed for actual healthcare enterprises to adopt. Some of these Narrow AI apps are currently adopted and employed in Canadian healthcare facilities today.

General AI Apps are well along the development path and – like humans – can do a broad range of human cognitive tasks and will be implemented within the next five years. Artificial Super Intelligence is by far the most complex challenge; applications of this sore will be the most sought-after, certainly in the DI sphere. I predict that we'll see pilot versions within five years, while Super Intelligence Apps capable of workflow orchestration with complex and complete diagnostic and report capabilities will appear some 10 years in the future.

Just think, only three years ago, there were 70 Diagnostic Imaging AI companies; two years ago there were 200 companies, and as of this year, there are 700 companies racing to develop AI technology. Add that to the activity going on in hospitals, universities and government labs, and I'd say the next five to 10 years are going to be interesting.

Thomas Hough is founder and President of True North Consulting, based in Mississauga, Ont.

PET/CT in Val d'Or

fighting disease. We don't rely on local fundraising to buy tanks for the military."

Reliance on local fundraising also discriminates against smaller, remote centres of population like Val d'Or that don't have the ability to raise large sums of money.

"Radiotherapy for six weeks costs $30,000," he said. "It's expensive and time-consuming, and it's a very local treatment. If you give chemo to a patient who doesn't need it or you do extensive surgery on a patient and it's not the right treatment, it's very expensive."

PET imaging, he claims, can save money and result in better patient outcomes.

Until now, Abitibi-Temiscamingue patients prescribed a PET/CT scan had to travel to Montreal or Gatineau, but 60 percent of them declined the opportunity because of the cost, the time required, the distance and the danger of traveling by car – especially in winter, said Dr. Lamoureux.

The recent acquisition of PET/CTs in Val d'Or, Sudbury and Kelowna will allow patients to remain close to home and to take advantage of the same advanced imaging modalities available to patients in larger communities.

BC Interior Health

patients with immediate positive feedback for helpful behaviours.

Phase I of the program included the participation of a clinical counsellor, a social worker and a physiotherapist, with whom patients could book virtual appointments. The pre-surgical optimization information traditionally provided in person to patients was woven into the four-week program that was provided to patients in-app.

Programs consisted of various steps including videos, worksheets, links to external references and daily vital sign checks with the Cloud DX Connected Health Kit, provided to patients free of charge. Pa-

tients had the opportunity to discuss any of the steps with the peers and coaches within their groups and with the in-app community at large.

The four-week pilot program began with 22 patients who were awaiting joint replacement surgery at Penticton Regional Hospital (PRH). Nineteen continued to monitor their vitals remotely over the four-week period, and 16 were onboarded into the Stronger Together app to participate in the four-week in-app program.

Upon onboarding, patients were directed to complete a clinically validated baseline questionnaire to assess their health and wellness prior to beginning the program. At the end of the four-week period, patients were prompted to complete the questionnaire again to help assess any

changes in responses and overall wellness.

Early results from the program are positive. A notably improved response in outcome measures was observed, and participants who have not yet gone for surgery

> **The Stronger Together program is helping diverse patient populations stay healthy at home during the pandemic.**

appear to have increased their physical activity after the four-week program. The greatest change noted was in self-efficacy for managing chronic disease. Patient survey feedback was positive and highlighted the ability to support patients safely and

remotely across social, physical, and mental dimensions of their healthcare journey.

Several participating patients reported feeling motivated and actively interested in their own self-care. Others reported feeling that they received personalized care and enjoyed the feedback from other patient participants. Providers reported feeling that the program helped patients to take a greater interest in their own health.

The Stronger Together team is now preparing to enter into Phase II of the project. This next phase will include a number of additional programs to support diverse patient populations across Canada as they work to stay "healthy at home" during the ongoing COVID-19 pandemic and beyond.

Opportunities and programs like these have propelled us into a new remote world, in spite of pandemic-related disruptions. With careful planning and consideration, new care modalities such as Stronger Together can create enduring improvements in patient outcomes, rather than being merely a stopgap solution. We at Cloud DX look forward to helping create a healthcare system where technology continues to be leveraged in unique and exciting ways to create better patient outcomes.

Robert Kaul is Founder, President & CEO at Cloud DX. The company is headquartered in Kitchener, Ont.

Michael Garron Hospital deploys enterprise messaging

family physician and co-leader, Digital Health, East Toronto Family Practice Network. "We're using it for urgent communication, from physician to physician, nurse practitioner to physician, physician to dietician, specialist to family doctor."

Dr. Shah said that she has made good use of Hypercare to reach specialists at Michael Garron Hospital when questions come up that can be quickly resolved. The Hypercare messaging system allows physicians to communicate with specialists, often enabling their patients to avoid trips to the ER.

During the current COVID-19 crisis, keeping patients away from the hospital when possible has been a big plus for infection control.

She mentioned the case of a patient with very poor kidney function and no urologist. Normally, the patient would be sent to the emergency department for further tests and treatment. However, Dr. Shah contacted a urologist at the hospital using Hypercare and arranged an office appointment for the patient the next day.

She said the application has also been useful for patients with post-operative complications. Instead of sending them immediately to the ER, she has messaged surgeons

using the Hypercare directory and app, getting fast responses to clinical questions.

The East Toronto Family Practice Network has opened up the Hypercare application to its 200 family physicians. Not all are using it yet, but many have started, said Dr. Shah. As well, an initiative is in the works to extend the application to allied healthcare professionals in home care, in-

cluding wound care, so that visiting nurses and PSWs could send questions to clinicians when needed.

"It's so much better than the phone," said Dr. Shah. "The phone just isn't the way people function today. As a doctor, I don't have time to put in a call and to be put on hold – not with four or five patients in my office waiting for me."

Orthopedic surgery nurses accelerate learning using VR

have the option to turn Assist off and go through the procedures as a surgeon would, actually doing it. In this mode there is no skipping back and forth.

"From there, you are presented with an evaluation that can analyze angles, screw placements, success of cuts, the amount of time you took," said Oliveira. Participants can experience VR training on their own or in a classroom setting where the instructor can compare students' performance data. Anyone using it on their own has the option to turn off Assist, and not have the data sent to the dashboard.

Asked if there was any resistance to us-

ing the VR platform, Romero said that at first, "Like with anything new, it took a bit of getting used to, pushing the buttons, but once users get used to it, it is easy to use."

Romero likes that the evaluation at the end assesses key performance measures,

> **VR is much more cost-effective than sending professionals to courses, or obtaining single-use cadavers for surgical training.**

such as how the user held a drill or made a cut in the tibia or femur, as well as the degrees or angles used. "At the end, it will

thoroughly tell you how you did. A big advantage – I thought that was really cool," said Romero.

Oliveira said the company is currently working on gathering information from this pilot initiative to further adapt the VR training experience to nurses. "We will customize it and get it right back into the hands of nurses," said Oliveira.

According to Dr. Goel, VR training's key benefits include the ability to increase learning speed while decreasing costs: "We demonstrated that you can learn 570% faster with VR. In a second randomized controlled trial, our platform was identified as being 37 times more cost-effective than traditional models of simulation and training," Dr. Goel said.

Speaking about traditional costs versus those for a "cost-effective, scalable platform," Oliveira said, "For example, it will cost between $5,000 and $10,000 to get a surgeon to a course. A cadaver can cost upwards of $5,000, as well, and only provides a single opportunity to learn. We can educate an unlimited number of healthcare providers, with unlimited repetitions, at a streamlined price for the headset of $1,000."

It is important to note that VR training doesn't exist in a vacuum. "It has to be combined with mentorship, didactic and curriculum training," said Dr. Goel. Having VR training in that mix, he observed, "tends to push people beyond their current level. It enables collaboration and elevates critical thinking through a problem-based approach."

Currently, with COVID-19, "we are limiting the number of people in the (operating) room. So there are fewer learning opportunities," said Dr. Goel. "VR offers a completely different approach to learning – experiential, no risk, highly convenient. It's fully immersive and designed for active learning."

Wait times problem

referrals for a population of 1.2 million.

While the benefits of single-entry models and common intake seem intuitive enough, it is also readily apparent that this can't be done with papers piled on the corner of the physician's desk. And certainly, a regional model intending to serve many patients can't be paper-based, fax-based or spreadsheet-based. The clerical requirements would be huge and unmanageable. An enabling technology is needed.

Novari eRequest is one such enabling technology – a 3-in-1 system with referral management, central intake, and workflow management capabilities. Importantly, it is customizable to each client and each clinical service's unique needs.

It can be implemented in an organization like a hospital, across a region or even province wide, as it

recently was in Saskatchewan, where Novari eRequest is serving as the technology behind the province's successful COVID-19 testing and assessment program.

For individual hospitals and regions, setting up a single entry for all inbound referrals, then electronically routing them to the appropriate clinic or

> **Central intake and the enabling technology it requires are in play and have been proven to work.**

provider has many benefits, like real-time tracking of referrals, real-time data on internal wait times, identification of bottlenecks, no lost paper/fax referrals and automated feedback to the sender of the referral on the status on the referral.

The deferral of care experienced by hundreds of thousands of patients across Canada as a result of the

COVID-19-associated slowdown in services has exposed in the starkest way possible our country's chronic access-to-care problem.

Clearing the backlog and getting wait times down to acceptable levels will take a lot of work by a lot of people. Many solutions will need to be devised and implemented. But some solutions are already ready to go.

Central intake, and the enabling technology to make it happen are already in play and have been proven to work. The transparency and efficiency of a professionally managed wait list facilitated by the appropriate enabling technology will go a long way to demonstrating that our healthcare system truly is worthy of Canadians' confidence and trust.

Dr. Chris Simpson is a Cardiologist at the Kingston Health Sciences Centre, and Vice Dean, Queen's University School of Medicine, and Chief Medical Information Officer, Novari Health.

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