



# CANADIAN Healthcare Technology

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### Patient access to images

St. Michael's Hospital, in Toronto, is making diagnostic images easier to access for patients. With partner PocketHealth, the hospital puts them into the cloud, where they can be securely reached by patients, at their convenience.

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### Ottawa's VR lab

The Ottawa Hospital, a leader in 3D printing, has now launched a virtual reality laboratory where



physicists are working with clinicians on a system that makes it easier to visualize the anatomy of patients and to plan surgeries and radiation therapy.

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### Compassion and data

Speaking recently in Toronto, U.S. quality guru Dr. Donald Berwick urged his audience to treat patients with more compassion. He critiqued the current American system, which he said is too concerned with data and finances.

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### Learning with the HoloLens

Montreal's CAE Healthcare has released the world's first augmented reality childbirth simulator. CAE Lu-



cinaAR uses Microsoft's HoloLens to offer a simulator with integrated mother-baby physiology.

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PHOTO: COURTESY HUMBER RIVER HOSPITAL

Humber River Hospital hosted politicians, business leaders and visitors from Canadian and U.S. hospitals at the launch of its Command Centre last November. Pictured (l to r): Jeff Terry, GM of GE Healthcare Partners; Board Chair Terry Leon; Laura Albanese, Ontario Minister of Citizenship; Reza Moridi, Minister of Research; Barbara Collins, Humber River's CEO; John Flannery, CEO of GE Global; Peter Bak, Humber's CIO.

## Humber River Hospital opens futuristic command centre

BY JERRY ZEIDENBERG

**T**ORONTO — Humber River Hospital announced the opening of its Star Trek-like Command Centre with an auditorium full of visiting luminaries in attendance — including GE's CEO John Flannery, two Ontario government cabinet ministers, and doctors and administrators from 13 U.S. hospitals who came to learn about the AI-powered centre.

It's the first Command Centre in a Canadian hospital, and only the second in North America — the Johns Hopkins University Hospital opened one about 18 months ago, but the facility at Humber River builds on the U.S. centre and extends the concept further into managing quality.

"Not only is Humber monitoring the physiology of the patient, they're also monitoring the physiology of the whole hospital," said Jeff Terry, managing principal of GE Healthcare, which partnered with Humber River to design and build the system.

He explained the system at Humber River gives doctors and administrators the information needed to spot delays and bottle-

necks across the site, so they can address these issues quickly and restore patient flow to the desired rates.

Using data feeds from a raft of IT systems around the hospital, including the Meditech EMR, Medworxx bed management system and an Ascom communications system, information is displayed on 16 GE Tiles, each with real-time analytics to synchronize, co-

**At the Command Centre, a clinical expeditor helps speed up processes and solve problems.**

ordinate and help ensure better outcomes and patient flow.

They include bed management to track bottlenecks, ED admissions and waits, an early warning system to detect patients in distress, and a pathways module that displays what needs to be done to keep patients on track for timely discharge.

Not only is this expected to result in a more efficient hospital, but it will also raise the quality of care and enhance patient satisfaction.

While the technology is leading-edge, the

facility also deploys new forms of organization. The Command Centre brings together professionals from different parts of the hospital, so they're working together in one room.

"We've already noticed an improvement in communication," said Carol Hatcher, a Humber River VP. "Hospitals tend to be siloed into departments, and this breaks down the silos."

And Dr. Susan Tory, command centre medical director, observed that staff members in the Command Centre have been specially trained to monitor and solve the problems and challenges that emerge. A new role has even been created, that of clinical expeditor, to take on tasks that will speed up processes or eliminate problems.

For example, if it's found that a patient is supposed to have a consult/assessment or diagnostic test, and it is taking longer than it should, the clinical expeditor can get involved and help to make it happen faster.

Barb Collins, president and CEO, asserted at the launch event that the Command Centre is aimed at creating the "high reliability hospital."

She observed the idea for the technologi-

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# 'Wall of analytics' launched at the high-tech Humber River Hospital

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cally advanced centre emerged at Humber River 10 years ago, when management visited a Dell Computer command centre. They were impressed at how efficiently the company could operate using the alerts that were generated.

While flying back to Toronto, they realized the airline industry has been using command systems for years to ensure patient safety. "That's why it's safe to fly on an airplane," said Collins. "We thought, that's what we ought to do with healthcare."

Soon after, the team at Humber River started talking to GE Healthcare about creating such a system at the hospital, which was planning a new site – now considered North America's first 'digital hospital'.

CIO Peter Bak noted in a video produced for the launch that Humber River's digital systems have already produced a 20 percent increase in efficiency. The Command Centre is expected to achieve another 20 percent productivity gain, which will be like adding 40 more beds without any new costs.

"That's like adding a small hospital within our hospital," said Bak.

At a tour of the Command Centre, Andy Day, managing principal, Hospital of the Future at GE, noted that when the new Humber River Hospital opened in 2015, ED visits exploded from 97,000 per year to over 130,000.

That has put special pressure on Humber to manage patient flow and outcomes, starting in the ED.

Day explained the different monitors – called tiles – in the Command Centre, all of which are graphically oriented and colour-coded. These 16 analytic tiles monitor dozens of hospital processes in real time, display visual alerts, and have different teams monitoring them.

The overall hospital bed management system showed the occupied beds on the medical floor running at 104 percent – triggering a red alert. "We have a team working together to see what can be done, to accelerate discharges and balance the house," said Day.

An ED tile uses feeds and analytics to track visits, 'door-to-doc' time, and even multiple visits by patients. For example, it can spot patients who have visited the ED 10 times in a one-month period – the fre-



Electronic screens display information collected in real-time from a host of systems across the hospital.

quent fliers who may be drug addicts, or have other chronic problems. "We want to deal with it, and to find solutions for them," said Day.

Commenting on the pressure on the Humber River ED, he noted the hospital is experiencing days where 350 to 400 patients visit. "That's bigger than Mass General," he said.

As such, paying attention to the ED is of

prime importance. The analytics system for the ED is using a 12-stage scale to monitor patient volumes, and has extensive capabilities to spot problems. "It will show you exceptions, too, that must be dealt with," he said, like patients who are waiting too long to see a doctor or have yet to receive their X-ray or CT scan.

There is a 'pathways' tile that ensures patients are receiving all of the care they should be, using various order sets. This ensures quality care and appropriate discharge times.

As well, the Command Centre makes use of an early warning tile, which spots patients with abnormal readings. "An abnormal cardiac enzyme for a non-cardiac patient, or a white blood cell count spike in a post-surgery patient, are indicators that a clinician in the command center can investigate and act on," said Day.

"By combining alerts from one system with event or patient state information from another system turns data into decision support, allowing intervention before a patient becomes critical."

It's been well-publicized that Ontario has a problem with Alternate Level of Care patients – those who are awaiting a place in a nursing home, and are occupying hospital beds. Unfortunately, when nursing home patients go into hospital for more than 30 days, they lose their place in the home and must re-apply.

The Command Centre system has a 30-day countdown, showing the days left for these patients before they lose their place in their nursing home. It's a reminder to complete all of the care-related tasks needed for discharge, in order to safely return the patient to the long-term care centre.

Not only does the system spot bottlenecks and delays, it can also predict them. The system will use the data that's compiled each day to learn, for example, when to expect increased patient flow in the ED, the ICU or the operating rooms.

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Address all correspondence to Canadian Healthcare Technology, 1118 Centre Street, Suite 207, Thornhill ON L4J 7R9 Canada. Telephone: (905) 709-2330. Fax: (905) 709-2258. Internet: [www.canhealth.com](http://www.canhealth.com). E-mail: [info2@canhealth.com](mailto:info2@canhealth.com). Canadian Healthcare Technology will publish eight issues in 2018. Feature schedule and advertising kits available upon request. Canadian Healthcare Technology is sent free of charge to physicians and managers in hospitals, clinics and nursing homes. All others: \$67.80 per year (\$60 + \$7.80 HST). Registration number 899059430 RT. ©2018 by Canadian Healthcare Technology. The content of Canadian Healthcare Technology is subject to copyright. Reproduction in whole or in part without prior written permission is strictly prohibited. Send all requests for permission to Jerry Zeidenberg, Publisher. Publications Mail Agreement No. 40018238. Return undeliverable Canadian addresses to Canadian Healthcare Technology, 1118 Centre Street, Suite 207, Thornhill ON L4J 7R9. E-mail: [jerryz@canhealth.com](mailto:jerryz@canhealth.com). ISSN 1486-7133.

#### Publisher & Editor

Jerry Zeidenberg  
[jerryz@canhealth.com](mailto:jerryz@canhealth.com)

#### Office Manager

Neil Zeidenberg  
[neilz@canhealth.com](mailto:neilz@canhealth.com)



#### Contributing Editors

Dr. Sunny Malhotra  
Twitter: @drsunnymalhotra  
Dianne Daniel  
[dianne.l.daniel@gmail.com](mailto:dianne.l.daniel@gmail.com)  
Richard Irving, PhD  
[rirving@schulich.yorku.ca](mailto:rirving@schulich.yorku.ca)  
Dianne Craig  
[drcraigcreative@yahoo.ca](mailto:drcraigcreative@yahoo.ca)

#### Art Director

Walter Caniparoli  
[art@canhealth.com](mailto:art@canhealth.com)

#### Art Assistant

Joanne Jubas  
[joanne@canhealth.com](mailto:joanne@canhealth.com)

#### Circulation

Marla Singer  
[marla@canhealth.com](mailto:marla@canhealth.com)



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# Ottawa Hospital's VR system used for surgical and radiation planning

BY JERRY ZEIDENBERG

A trio of bright and innovative medical physicists at The Ottawa Hospital's new realizeLAB, for virtual reality solutions, have created a VR platform that enables surgeons and other clinicians to don headsets and seemingly enter organs like the colon for a better look at the anatomy.

By manipulating handheld controllers, they can also slice and pull apart 3D renderings of the thorax and skull – compiled from CT and MRI scans of their patients – that appear to be floating in space in just front of them.

Drs. Justin Sutherland, Dan La Russa, and Jason Belec put the system together, which is powered by their own software and off-the-shelf hardware. The Vive headsets are made by HTC, and other vendors, and the team cobbled together a number of other consumer technologies.

"It runs on a gaming computer," said Dr. Sutherland. "All together, it cost less than \$5,000 to put together."

Amazing then, the enormity of capabilities the system has to offer for such a low cost.

"Our clinicians are very interested in this because it saves time, money and patient lives," asserted Dr. Frank Rybicki, chair of the department of radiology at the Ottawa Hospital, and mentor of the VR project at the realizeLAB. He also heads the 3D printing project at the hospital – one of the most advanced in the country.

Dr. Rybicki explained the VR system enables surgeons, for example, to look at the position of a brain tumour and its relationship to adjacent structures, before going into the operating room to conduct the surgery.

Moreover, by manipulating the VR tools – two handsets that are like Wii controllers – you can turn the object, remove blood vessels or other tissue, and view the tumour from various angles.

Sutherland, La Russa and Rybicki demonstrated the new solution at the Radiological Society of North America (RSNA) conference in Chicago last November. They gave visitors a chance to test-drive a demo version of the system, while wearing the headset and using the handheld controllers.

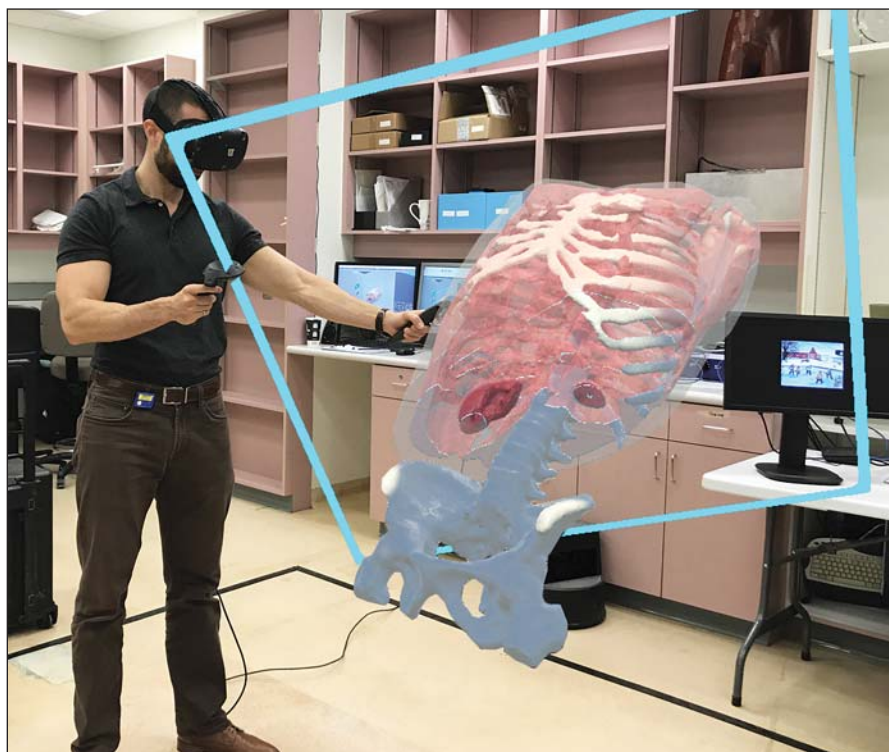
It's a mind-altering experience, to be sure, to wave your hand and see the bones of a patient disappear before your eyes, revealing only the soft tissue organs.

And it all seems so easy, like playing a video game. Put on the glasses, and a number of semi-transparent orbs are circling before your eyes. Simply grab one with your handheld controller, and drag it into a bigger circle, and you've activated that app – it may be the patient's colon, skull or chest.

Wave again, and you remove bone or software tissue, or you can zero in on areas of interest.

"It gives you an excellent understanding of the tumour before going into the OR, of the spatial relationships," said Dr. Rybicki. "You'll never get this on a 2D monitor."

With 3D virtual reality, "You can see 20



Users of the system can manipulate the 3D patient images, which have been converted from CT and MR scans.



Dan La Russa, left, and Justin Sutherland, demonstrated the solution at the recent RSNA conference in Chicago.

different views," said Dr. Rybicki. "You can visualize things in this way with 3D printing, too, but you wouldn't want to make 20 different models."

He explained that 3D printing is a bet-

ter option for procedures like stent grafts, where there are not so many options and variables for the surgery, but you still need a good view of the anatomy. Sometimes, as well, you want to be able to hold the

anatomy in your hands, which 3D printing allows you to do.

Dr. Dan La Russa noted that many of the data sets for VR come from the models generated by the 3D printing lab, which makes use of CT scans and other exams. "There's a complementarity, and we can use their data, and they can use ours."

The realizeLAB, which has been up and running for about a year, has recently been assisting radiation oncologists as they plan procedures like brachytherapy and the positioning of radioactive seeds.

"They are the biggest users of VR, so far," said Dr. Rybicki. "But we're now explaining virtual reality to others."

Other clinicians, including surgeons, cardiologists and orthopedic surgeons have all expressed an interest in the platform, as it gives them a much better idea of how to plan the most effective surgery or procedure.

The hospital's 3D printing lab now has eight employees, and Dr. Rybicki is confident that the VR lab, which now has three PhDs splitting part of their time there, will expand to five employees in the next year or two.

Dr. Sutherland commented that a lot of discussions have been going on with surgeons, radiologists and radiation oncologists. "We're working with them to develop the tools they'd like to see."

"It's a new domain," he added. "We expect to be creating applications that we never imagined."

Indeed, the field of VR is brand new, and many concepts are just being developed and rolled out as practical technologies. "Anything you can coherently explain, we can build," said Dr. Sutherland.

Having the realizeLAB right in the hospital is a definite advantage, as it puts researchers like himself, La Russa and Belec in the midst of clinicians working with patients. Together, they can fine-tune solutions that solve real-world problems.

One radiation oncologist, for example, has asked for an app that allows him to stand inside the blood vessels running through the brain, giving him a better view of the anatomy of the issues he is dealing with.

Dr. Rybicki commented that not only is VR a big help to clinicians inside the Ottawa Hospital, but it could be used as a telehealth platform. Images could be taken of patients at a remote location, and experts at the hospital could wear the VR goggles to obtain a better look at aneurysms, tumors and other problems.

They could then advise local doctors on the best ways of treating the lesion or neoplasm. "You could do a consult with someone in Nunavut," he said, effectively raising the level of care given to patients in remote regions.

Moreover, it's a group activity. "You can collaborate with clinicians in a remote location, and you'll see others [in your field of vision] as avatars," said Dr. La Russa. Your collaborators appear as heads on-screen, and you can interact simultaneously with patient objects while conducting an exam and consultation.

"It's easy to have a discussion about the images," said La Russa.

## Fast-growing market for AR and VR tech

SAN FRANCISCO – The global augmented reality and virtual reality markets in healthcare are expected to reach (US) \$5.1 billion by 2025, according to a new report by Grand View Research, Inc. The market size was valued at (US) \$568.7 million in 2016 and is projected to grow at a rate of 29.1 percent annually during the 10-year period.

The growing adoption of Augmented Reality (AR) and Virtual Reality (VR) in medical field, increasing investments in such emerging technologies, and constant developments in healthcare IT are

some of the key factors responsible for growth of this market.

The market is being driven by applications in surgical simulations, diagnostic imaging, patient care management, rehabilitation, and health management.

The Grand View Research report notes the application of AR and VR in training medical professionals provides enhanced understanding of anatomy and physiology. It also assists in complicated surgeries that require precision, thus, resulting in reduced complications and lesser trauma.





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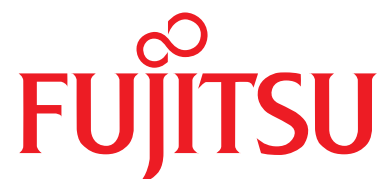


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# Accessing diagnostic images is easier for patients using PocketHealth

BY JAMES WYSOTSKI

TORONTO — St. Michael's Hospital's new image-sharing platform, PocketHealth, puts patients first by making it easier to obtain and share medical images.

Created and run by the PocketHealth company, the online platform allows patients to use mobile devices or desktop computers to access their medical images anywhere, including from their own homes.

Previously, the only option was to order a CD-ROM with the images.

"The sharing of imaging records has historically been very challenging," said Jennifer Meher, the manager of Medical Imaging operations.

Often, patients can wait while a CD is prepared, said Meher. But some facilities require 48 hours to process the request, causing patients to make a second trip to the hospital. While the CD was free, patients often incurred other costs such as public transit or parking. Frequently, it also meant taking a day off of work.

If patients needed to see a series of specialists, Meher said the process became even more arduous. Patients would have to return to the hospital's Film Library and request a free CD for each new physician.

"Sometimes patients would come in for an image only to find it wasn't ready yet, and they'd have to come back another day," said Cristhian Moran, a radiology software administrator who helped integrate the new, PocketHealth platform with the hospital's systems. "Some patients live far away, and it's stressful for them to make the journey here. By using PocketHealth, they no longer have to make the trip."

While ordering CDs is still an option, Moran said patients can avoid the hassle and take control of their imaging records by using PocketHealth, which St. Michael's launched in August 2017.

"The new system is fabulous because patients can share images with many

physicians without incurring extra costs," said Moran, "You have to pay only \$5 for the images once, and then you're in control."

Instead of waiting at least 48 hours, patients can get their images from the PocketHealth website in just a few minutes. After logging in and providing a credit card to cover the \$5 fee for each new set of images, patients fill out an online version of the release of information form and then enter the date of when their images were taken. Moments after submitting the request, they have full access to all images.

Moran said patients can store the images indefinitely on PocketHealth's servers, knowing they're always available to be downloaded or shared at no extra cost. Patients can transfer the files to their computers or USB sticks, and they can even burn their own CDs.

If patients had images taken elsewhere, and they'd like to keep them with their other pictures in the PocketHealth server, there's an upload function. And then, with just two clicks of the mouse, they can share the images with any number of physicians through the website's easy-to-use interface.

Patient control over the images doesn't stop there, said Moran, because they choose how long doctors can access the images on PocketHealth's servers. Doctors get an email, but no images or private health information is attached.

Instead, there's a password-protected URL pointing to both the medical images and any accompanying reports. Patients can deactivate the link at any point. Until then, doctors can view the images or download files in DICOM format for analysis.

The next phase in integrating PocketHealth — ready in early 2018 — will allow patients to access their images moments after a scan, said Moran. Removing the time spent waiting for disks to be burned means patients can see doctors sooner. They can even send access to the images in



Maggie Dubrawski, operations leader for general imaging, prepares an X-ray for upload to PocketHealth.

advance of a visit, allowing doctors to preview images before a consultation.

Moran said another 2018 upgrade will provide medical images to other facilities making after-hours requests when patients are transferred. As long as the patient gives consent, then images would be transferred instantly via PocketHealth to that facility instead of having to wait until the next day for a CD.

PocketHealth protects personal health information with 256-bit encryption, an industry standard that Moran said is one of the strongest formats available. PocketHealth is also compliant with the Health Information Protection Act and has built-in privacy features that include verifying a patient's identity by OHIP number, date of birth and the St. Michael's Hospital Medical Record Number.

Integrating PocketHealth has resulted in improved efficiency at the hospital, said Meher. A 10 percent to 20 percent reduc-

tion in burning CDs, resulting from roughly 200 PocketHealth requests each month, has freed up staff resources to support other Film Library activities.

"There is absolutely no reason why everything can't be done electronically," said Moran. "In time, we expect requests for physical CDs to virtually disappear."

Moran said PocketHealth is proactive about collecting feedback and making improvements. They created a feedback survey for patients, and they also addressed issues reported to their toll-free patient support line and 24-7 support email. Moran said the feedback has been positive, especially about how easy it is to use the platform.

"At St. Michael's, any process that focuses on improving the patient experience is one we strongly believe in," said Meher. "PocketHealth is the future of health care within the imaging environment, and St. Michael's is happy to be a part of it."

## PocketHealth eases image sharing for patients, clinicians and hospitals

PocketHealth is a company dedicated to making it easier for hospitals and medical imaging centres to share imaging records directly with their patients — instantly and in full diagnostic quality. The company was founded in 2016 by two brothers, Harsh Nayyar (a former Google engineer) and Rishi Nayyar (a former Citigroup investment banker), who felt that a flexible, patient-friendly platform could replace the industry's current reliance on CD-burning.

"Historically, it's been very difficult for disconnected systems to electronically exchange medical imaging information," said Rishi Nayyar, PocketHealth's CEO.

"That's how CDs became the common language between, for example, a hospital imaging department and a patient's surgeon. But CDs are slow, costly,

and demanded regular couriering by patients, and we knew we could embed that same interoperability into a digital replacement. What resulted was a platform that can pull data from any RIS/PACS environment and send it to any authenticated patient, who can then share with any member of their circle of care."

Unlike patient portals and government repositories that require physicians to pre-register and leave their EMR environment, PocketHealth allows patients to share directly into a physician's EMR for storage alongside the rest of their records. This flexibility in sharing gave the company crucial early traction with referring physicians when it was launched in Summer 2016.

Since then, the cloud-based platform has grown to over 100 installations across Canada. Their partners range from rural community imaging clinics

to large, urban research centres like St. Michael's Hospital in Toronto. Building on their Canadian success, the company expanded operations into the United States in December 2017.

Perhaps the most unique element of their model is that the platform is

**The platform is funded by \$5 micropayments made by patients in return for secure storage and access.**

funded solely by micropayments made by patients (typically \$5) in return for secure storage and permanent access to their requested records. Hospitals, clinics and physicians can in the meantime deploy the system without cost — an uncommon model in health IT. With tens

of thousands of registered patients, this seems to be a model that has resonated with patients frustrated with travelling back to their hospital to pick up or drop off a CD.

Their current progress aside, the Toronto-based company has its sights on a much larger mission.

"Our long-term goal is to become the pipes — the underlying infrastructure — for the future of patient-centric data sharing," says Harsh Nayyar, PocketHealth's CTO. "We want to put patients at the centre of every single exchange involving their health data. When a healthcare organization commits to that goal, the results are clear: records go where they need to go, outcomes improve, and we resolve many inefficiencies in the healthcare system."

You can learn more about PocketHealth by visiting [www.mypockethealth.com](http://www.mypockethealth.com).



# AUGMENTED INTELLIGENCE

## THE NEXT FRONTIER IN HEALTH IMAGING

Unlike Artificial Intelligence, which tries to replicate human intelligence, Augmented Intelligence works with and amplifies human intelligence.

**Anjum M. Ahmed**  
Global Director Imaging Information Systems  
AGFA HealthCare

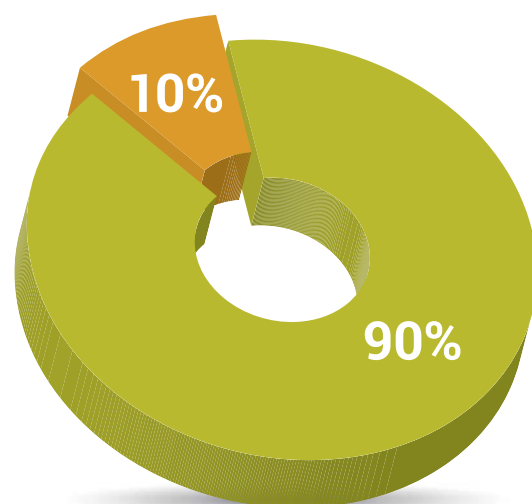
New imaging techniques are helping radiologists, cardiologists, oncologists, and other diagnosticians with greater anatomical and clinical details, highlighting the need for fast access to imaging reports and results and collaborative workflows. Augmented Intelligence can ease the workload on health imaging experts and simultaneously improve their performance. AGFA HealthCare reached out to senior radiologists, surgeons, and clinical leaders around the world, and have included their responses in the following perspectives.

### Task-based workflow optimization

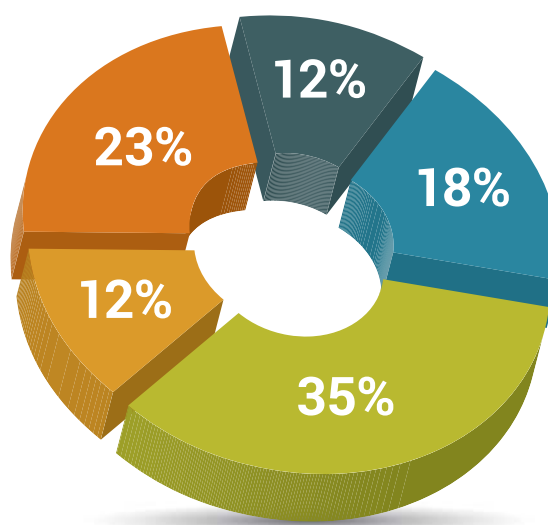
AI will not replace radiologists or other physicians, but in fact enhance their workflow, helping them to make collaborative and intelligent decisions. Enterprise Imaging, powered by AI, will help improve radiology even further with task-based workflow optimization. Physicians will obtain faster access to critical results, helping to reduce wait times and improve referral services for cases that require and urgent patient care coordination.

In a recent survey, our respondents emphasized the need for exploring capabilities of machine learning

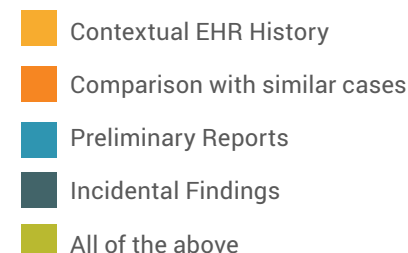
AUGMENTED INTELLIGENCE SHOULD OPTIMIZE A TASK-BASED WORKFLOW



and AI in addressing certain mistakes and errors that could alert radiographers and radiologists, and automate certain non-essential tasks to ease workload. "We should free our experts to undertake expert work by removing as many non-essential



WHERE COULD AUGMENTED INTELLIGENCE HELP TO IMPROVE CARE PATHWAYS?



tasks for them as possible," noted Angie Craig, Assistant Director of Operations and Performance, Leeds Teaching Hospitals Trust, NHS, UK. "That's where artificial intelligence comes in."

### Disseminate DI intelligence with AI

As we breakdown silos of imaging workflows and enable multidisciplinary consolidation and collaboration, the power of a consolidated platform results in creation of a vast data lake, ready for analysis by radiologists, diagnosticians, researchers and academics to help improve quality of care by better understanding disease and population health data.

This helps care organizations progress from Descriptive to Predictive Analytics models to improve early detection of diseases, and introduce care plan models that help enforce and improve patient engagement and compliance. During discussions with senior radiologists and diagnosticians, we witnessed consensus regarding the clinical application of AI to help address screening challenges associated with pressing healthcare problems that include cancers, chronic chest diseases, musculoskeletal conditions, neurological disorders, cardiac conditions and detection of various other clinical conditions. When it comes to oncology, our respondents discussed the significance of AI not only for initial diagnosis, but also for follow up after the treatment in helping track the potential recurrence.

"In my group, we've already demonstrated that an AI system for chest x-ray triaging and prioritization can lead to much faster reporting turnaround time," said Giovanni Montana, Professor of Data Science at Warwick University, UK. "We've also shown potential diagnostic benefits in early detection of lung cancer."

### Personalized medicine and smart applications

Care organizations and health authorities across the globe are faced with pressing population health challenges. Whether it comes to detecting cancers, or chronic diseases, Machine Learning and Advanced Analytics will help improve radiologists

and diagnosticians focus less on manual repetitive tasks, and more on improving care pathways.

"I think one of the biggest contributions deep learning/artificial intelligence will realistically make to me as a radiologist in the near future is not directly helping with image interpretation, but in bringing the relevant information out of the electronic medical record (EMR) and presenting it to me in a meaningful way to better inform my clinical judgment," said Dr. Bill Anderson, Edmonton Zone Medical Director, Diagnostic Imaging, at Alberta Health Services. "Incorporating this directly into the report will be how we can really add value as radiologists using Deep Learning. It not only will streamline my workflow, but will also be a major step towards more personalized medicine in radiology."

Agfa HealthCare's approach of building an ecosystem of Augmented Intelligence powered by Machine Learning, Cognitive Reasoning and Task-based rules engine will help enable delivery of innovative solutions to enhance care delivery. Agfa HealthCare Enterprise Imaging platform is standards-based, designed for interoperability and enables a leading-edge approach to seamlessly embed machine learning algorithms.

# Quality guru Don Berwick calls for less data, more civility in medicine

BY JERRY ZEIDENBERG

Speaking in Toronto in October, Dr. Donald Berwick, co-founder of the US Institute for Health Improvement, had a surprising message: there's too much measurement and analysis going on in medicine.

The guru of evidence-based medicine and the application of scientific methods to healthcare had this advice. Bring more compassion to medicine. "Cool the measurement," said Berwick. "Measurement needs to be a servant, not a master."

Dr. Berwick was the keynote speaker at Health Quality Ontario's annual confab, where one speaker after another repeated the mantra of quality control. Namely, the belief that you can't manage what you haven't measured.

Nevertheless, Berwick argued convincingly that the United States – and suggested the case was similar in Canada, too – has lost its way in recent years. That a spirit of greed and indifference has taken over.

"Today in my country, we've lost the touch of compassion and embrace," he said.

The problem is dire, he asserted. Berwick cited studies showing 50 percent of physicians today don't recommend becoming a doctor. "The workforce is demoralized," he said.

To be sure, there are onerous demands on physicians in terms of reporting, paperwork, and electronic forms. The result has been burnout for many.

And the relentless pressure on performance has, ironically, put quality into jeopardy, Berwick said.

He spent a good deal of time recounting the story of a patient he treated as a pediatrician. The boy of 11 was part of a family with an abusive father. As a result, the youngster became anxious and suicidal.

In response, Dr. Berwick worked with the boy's mother to establish a network of caregivers and supports for him. They included doctors, psychiatrists, social workers and other therapists.

Over a course of years, with ups and downs, they restored the boy's health; he became a high-ranking officer in the United States military, and served with honour in Afghanistan.

Unfortunately, he died just a few years ago of a brain tumour. But before passing away, he personally thanked Dr. Berwick for his work – saying it saved his life as a teenager, and that it gave him the opportunity to go onward.

Dr. Berwick asserted it was really the 'village' of caregivers who took an active interest in the young man's welfare, led by his mother, who was tireless in advocating for her son. In short, it was compassion and teamwork that made a difference. Measurement and statistics had little to do with it. "You can't measure your way to excellence," said Berwick.

He followed the story with an anecdote about his own medical training, under the auspices of a wise teacher. Dr. Berwick started an exam with an elderly woman, Mrs. Goldberg, standing over her and asking for history.

He suddenly felt a hand on his shoulder. The teacher counselled him to sit with the patient, at eye level. Berwick sat and began again, asking his litany of medical questions. All of a sudden, the teacher again interrupted: "Did you know that Mrs. Goldberg has a brand new grandson?"

He had injected a human dimension into the encounter. Dr. Berwick said he im-



Dr. Don Berwick spoke at a recent HQO conference.

mediately got the message. "We need a new mission in medicine," he said. "Not measurement and money, but joy and relationships."

He lauded a nurse in Florida he recently encountered, who found joy in her work in the maternity ward. Each time a baby was born, she held the child and wondered, "Could this be a future president?"

Berwick said more of this humanistic

approach is needed in medicine today, where the value of patients as people is recognized. Patients, he emphasized, are also parents, musicians, teachers and workers – all with families and loved ones. It's important not to lose sight of that.

When healthcare professionals do lose track of this, it's often because they are part of a system that values reams of statistics and information – and profits.

Studies have shown, he said, that more than 30 percent of the costs in the U.S. healthcare system can be attributed to waste, greed and fraud. Berwick showed how the emergency room visit of a friend resulted in a \$7,000 bill – with many of the charges being unnecessary or verging on the fraudulent.

It's not that the young doctor conducting the ER exam was corrupt, he said. Rather, he said, she was stuck in a system that imposed excessive testing and charges on the encounters with patients.

"It's all about the money," he said. "And it doesn't feel good." Berwick averred that medicine has lost its 'noble intent'. He outlined a number of ways for the profession to get back on the right track. First, he said, "Stop focusing on the money. The best route to financial success is to focus on what people need." He also advised reducing the amount of measurement that goes on. While some measurement is required in a modern medical system, it shouldn't be taken to extremes.

## MedTech conference brings together innovators and users

BY DOUG DITTMER, MD  
AND SHIRLEY FENTON, MA

WATERLOO, ONT. – Last November, at the Waterloo MedTech conference, clinicians, industry, academia and start-ups converged in the heart of Canada's Toronto-Waterloo tech corridor. This second annual symposium,

supported by local government, incubators, accelerators and industry, had over 150 participants from across Ontario who gathered to look at the barriers that innovation faces in healthcare.

The conference opened with keynote speaker, Hon. Kathryn McGarry, a provincial cabinet minister and a former nurse representing Cambridge, with the challenges she faced as a nurse and how medtech could have been a solution to problems she encountered. Kevin Tuer spoke about Canada's Open Data Exchange and growth in data capabilities.

Dr. Alexander Wong, a Canada Research Chair in Medical Imaging Systems at the University of Waterloo, spoke about deep learning and the artificial intelligence (AI) revolution. Because AI can remember orders of magnitude more cases than clinicians, he noted we should not fear AI, but embrace it, to augment clinical intelligence and improve the healthcare system.

Breanne Halyk, from JLABS Canada, talked about the entrepreneurial spirit in a 129-year-old company. She explained how small companies can gain the benefits of partnering with a big company.

Simon Cheeseman, from Baycrest Health Services, talked about their prototype to procurement model, and their journey through the innovation ecosystem. They have invested over \$38 million in 67 projects, leading to the development of 84 new products, processes or services.

Fiona Fitzgerald, from GE Healthcare, discussed the barriers to innovation in a large company. These include understand-

ing change, customer focus, organizational structure and connection to the ecosystem.

Dr. Matthew Bromwich, from the Children's Hospital of Eastern Ontario, asserted that you need vision, skills, resources, incentives, and an action plan to be successful, otherwise you will run into false starts, frustration, resistance, anxiety and confusion.

Dan Sinai, from IBM, discussed IBM Watson Health in the continuum of care and the body as a source of big data. Sarina Cheng from Sunnybrook Health Sciences

**After the success of the 2017 event, plans are now under way for a 2018 Waterloo MedTech conference.**

spoke about their 10-year journey with "MyChart" and the barriers and resistance faced with placing such a novel idea into a large hospital.

The keynote was Bill Charnetski, Ontario's chief health innovation strategist, who spoke about value-based innovation. His office is focused on accelerating the adoption and diffusion of new health technologies into Ontario's health system. The hope is to provide better care, closer to home, by using virtual, mobile and digital health technologies.

*Dr. Doug Dittmer and Shirley Fenton, MA were the Co-Chairs, Waterloo Region MedTech Conference 2017.*

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# Holland Bloorview scientific team given award by Governor General

**T**ORONTO – An inter-professional team of Toronto-based scientists, including a biomedical engineer and music therapist, has been recognized with one of Canada's highest honours – the Meritorious Service Cross (Civil Division), presented by the Governor General of Canada. The decoration recognizes Canadians for exceptional deeds that bring honour to the country.

The team, from Holland Bloorview Kids Rehabilitation Hospital, started developing the Virtual Music Instrument (VMI) software in 2003 to help individuals with complex disabilities express themselves and experience the benefits of music therapy – including an increased self-esteem and sense of personal accomplishment. To date, the VMI has impacted the lives of kids and families in over seven countries worldwide.

“We are deeply honoured by this recognition, and humbled that our work has impacted the lives of people with disabilities across the world,” said Dr. Tom Chau, Holland Bloorview's vice president of research. “Our work in driving research discoveries into action means that technologies such as the VMI are accessible to the very people who would benefit most from them.”

Dr. Chau, alongside Andrea Lamont, music therapist and educator; Pierre Duez, software engineer; and Eric Wan, engineer, began developing the VMI to create the opportunity for kids with disabilities to play music – without having to hold or manipulate an instrument.

“Whether it's making music through



The team from Holland Bloorview received awards from the Governor General of Canada, Julie Payette.

dance, finger movements, or even an eye blink, the VMI gives a meaningful musical experience for children in recreation, education, and therapy settings,” said Lamont.

One of the VMI's most unique features is that in contrast to current technologies and apps, it adapts to a child's abilities and physical commands by acting as an extension of their body. For children and their families, this is often a life-changing experience. The VMI has been adopted by rehabilitation institutes worldwide with

kids, youth and adults both with and without a disability.

To use the VMI, a computer and webcam are required. The individual's image gets projected onto the screen with large coloured shapes superimposed on the space around them; representing different notes, chords, and even bars of music. When a child moves a part of their body, the camera captures the movement over the shapes and translates it into musical sounds.

“What began as an exploration of the

potential of technology in music therapy has become an instrument that has allowed kids with disabilities to engage more fully with music, even to the point of performing in concerts,” said Duez.

The VMI also has the potential to address goals in the physical, cognitive, communication, sensory, and social domains. It gives children and youth with disabilities access to a leisure activity, encourages exploration, and offers a channel for emotional expression.

“It is incredibly rewarding to see this innovative technology have a positive impact on the lives of kids with disabilities and enable them to do what they haven't previously been able to. It makes kids feel special and challenges the perceptions of what a person with a disability can and cannot do. The Governor General's recognition of our work is a triumph for Holland Bloorview and kids with communication and mobility challenges across the world,” said Wan.

The Meritorious Service Decorations (Civil Division) are an important part of the Canadian Honours System. They recognize individuals who have performed an exceptional and often innovative deed or activity that sets an example for others to follow, or improves the quality of life in a community at a local, provincial, national, or international level.

Her Excellency the Right Honourable Julie Payette, Governor General of Canada, presented the decoration to the team during a ceremony on December 12 at Rideau Hall in Ottawa. To learn more visit [www.hollandbloorview.ca](http://www.hollandbloorview.ca).

PHOTO: MCPL VINCENT CARBONNEAU, RIDEAU HALL © OS GG, 2017

## Virtual Care network launched to help patients with spinal cord injuries

**T**ORONTO – Spinal Cord Injury Ontario, in partnership with the Toronto Rehab Institute, ForaHealthyMe Inc. and the Centre for Family Medicine, has started a pilot project that enables patients with spinal cord injuries to use a new, virtual care system.

The new platform delivers tools and applications that enable communication between clients and their community support staff and physicians without travel. Instead, the computerized platform offers videoconferencing and the ability to share medical records and other documents.

These ‘virtual visits’ will reduce the need to make in-person appointments with a family doctor or specialist – which can often take weeks or months, and may also involve long and difficult trips.

“Accessing support is even more difficult, the more remote you are,” commented Dr. Stuart Howe, CEO of Spinal Cord Injury Ontario, which is partnering with Toronto Rehab – part of the University Health Network – on the project. Other partners include technology company ForaHealthyMe Inc., which is providing the technology platform, and the Centre for Family Medicine, a family health team with expertise in spinal in-

juries, based in Kitchener-Waterloo, Ont.

The project, called the VIRTUAL Platform for Spinal Cord Injury (ViP-4-SCI), has been funded with a grant of \$424,638 from the Office of the Chief Health Innovation Strategist. Speaking at an event launching the project, Bill Charnetski, the province's chief health innovation strategist, noted that his office is investing \$5 million a year in leading-edge projects for four years.

The project for patients with spinal cord injuries will start with a group of 50 patients, located across the province. They and their families will be able to contact experienced physicians, clinicians and providers of social services online when they have medical or everyday issues.

The project will evaluate how SCI clients use a virtual care solution to access support and healthcare services from home. If the results indicate that larger groups of clients can benefit, then more clients will have access to services and support through the platform.

Dr. Cathy Craven, a physiatrist and clinician scientist at Toronto Rehab and one of the leaders of the project, noted the network will act as a referral service, helping patients with spinal cord injuries set up the appropriate appointments.

For this and multiple other issues that

may arise, it's far better to contact a group of physicians who are experienced with spinal cord injuries and can provide accurate assessments and fast, appropriate referrals.

The family health team in Kitchener-Waterloo, led by Dr. James Milligan, will do this, to start.

Dr. Craven said the goal is to expand across Ontario, creating networks of patients and expert providers of medical and social services.

It is important to find the right care methods for spinal cord injury patients, as it is difficult to get them to medical appointments. The new network, using ViP-4-SCI, can not only speed up access to appropriate care, it can also answer questions that might otherwise have required a trip to a physician.

Such trips are time-consuming for patient and their families, and they're often dangerous, too. Dr. Craven observed that wheel-chair-

bound patients must be transferred to cars, and they can sometimes fall, breaking limbs, resulting in the need for more care – including nursing, physio, wound care and even management of depression.

There are huge benefits to the patient, in terms of health promotion, if such trips can be minimized.

As well, the overall cost to the patient can be greatly reduced.

How easy is such a system to use for a spinal cord injury patient, some of whom are paralyzed from the neck down?

“You'd be surprised,” commented Dr. Brian Chan, a post-doc fellow at UHN. “They have become very good at using new technologies.”

Dr. Matheus Wiest, also a post-doc fellow at UHN, explained: “There are now things like eye-motion detectors, and interfaces that can be controlled by sticks held in their mouths. They get quite good at this.” Of course, the families of patients can also assist.



Dr. Cathy Craven



# Making data actionable

Cloud-based systems produce useful EMR summaries

**W**ith the advent of Electronic Medical Records (EMRs), clinicians are drowning in data, and they struggle to pull out specifics that help them make the right clinical decisions. They have become data rich, but information poor.

Frontline providers of patient care spend a great deal of time collecting data. Although onerous and time consuming when done on paper, the digital process can be even more burdensome. Clinicians are forced to learn new systems and asked to make notes they might not otherwise bother recording. As healthcare becomes more electronic, the data workload increases, unabated.

"The EMR has become the core system used in hospitals," said Dr. Simon Kos, Chief Medical Officer at Microsoft. "The paper record certainly had its limitations, particularly for patients with chronic disease, who might have multiple volumes of paperwork, but the EMR has turned into a dumping ground for any digital source of information. It's the clinician's job, the doctor especially, to know everything in the electronic medical record, and if you miss anything, well shame on you."

An EMR may contain pages of narrative from social workers describing their interactions with patients and their families. It may include lab results, EKGs, and medical imaging from multiple episodes. "Suddenly you have a document that probably requires hours to internalize," observed Kos.

"Clinicians are saying, 'I don't need this. I don't want it. Help me get my hands on what I need to provide the care I want to provide. I don't want unnecessary information, or worse, information that exposes me to medical or legal risk. Just what's pertinent.'"

**Making information actionable.** According to IDC, the "Health Digital Universe" is growing 48 percent annually. "The problem isn't lack of data," said Tom Lawry, Director of Worldwide Health at Microsoft. "It's getting easy access to it so you can turn it into something useful." Historically, health data has been stored in different places, or silos, usually in different formats and under different ownership. Applications that capture and store data, such as EMR apps, don't integrate well with other systems. Even within a single organization, it's difficult to access the right information at the right time to make decisions.

"If I have to rely on busy IT department analysts to run reports for me, I may have to wait days, weeks,

or months," said Lawry. "By the time I get my report, everything has changed." Acting on old, incomplete, or fragmented information is like trying to drive forward while staring in the rearview mirror. "But what if all these constraints went away?" Lawry posits. "What if you could use every piece of clinical data you have, no matter how much there is or where it is, and you had unlimited resources to process and analyze that data—in near real time? What if you could not only understand what happened in the past and why, but predict what may happen in the future and take prescribed action to prevent it? With cloud



analytics, we can do this—today. This is the new data paradigm."

**Self-service, evidence-based analytics.** The new data paradigm uses self-service analytics tools, which provide research-on-demand with immediate insight into data through dashboards, visualizations, and alerts. Staff can segment and cross-reference the most current data available, while analysts can focus on helping them interpret results instead of programming complex data queries.

As new data comes in and trends change, the results update instantaneously, so health organizations can quickly formulate ways to respond. "The role for analytics going forward," said Kos, "is to provide, at a minimum, that automated summary based on the needs of the clinician. Without it, there's a sea of unstructured and unformatted notes to pore through."

Clinical analytics can benefit hospital department heads, as well as frontline clinicians. "If all this data

is being collected," Kos continued, "why not use it to gauge departmental performance? How can the department improve the care it delivers? How is it doing quarter to quarter? How does one department compare with other departments in the hospital? What is best practice? What are the areas for improvement?"

Aside from informing quality and performance, clinical analytics can lead to risk stratifying patients who are frequent attenders. It can systematically answer questions like: Which patients are falling through the cracks? Who is missing follow-up appointments? Who is trending poorly?

**Predictive patterns.** Hidden patterns and trends become visible when health organizations apply analytics to large amounts of data from sources such as EMRs, smart medical devices, patient and population demographics, and the public domain.

"When we tell health organizations that we can predict five years ahead of time whose congestive heart failure will progress and how rapidly, they have trouble conceptualizing that,"

said Dr. T. Greg McKelvey Jr., head of clinical insights at KenSci, a Seattle-based Microsoft partner specializing in health analytics.

Predictive analytics is a data-driven crystal ball taking analytics to the next level, beyond descriptive or diagnostic methods that look backwards on what happened and why. You can look at what happened, and what is happening in real time, to not only predict what will happen, but to shape it using advanced methods known as prescriptive analytics.

Clinical analytics makes use of a steady stream of data to reveal trends applicable not just to individual patients, but also to large patient populations. Continuous data feeds from smart devices, along with scheduled interactions with chronically ill patients, help clinicians fine-tune personalized care plans and intercede before crisis events occur. This is particularly useful when the window of opportunity is in minutes, or even seconds, and care teams need to make very quick, critical decisions that may save lives.

# Hospital transforms its sedation practice using analytics, dashboards

BY DIANNE CRAIG

**P**ediatric cardiac intensive care physician Barbara-Jo Achuff, MD is acutely aware of the responsibility that comes with leading her hospital's sedation stewardship committee.

Not only is the 33-bed Cardiac Critical Care department at Texas Children's Hospital the largest of its kind in the United States, but U.S. News & World Report has also ranked the hospital as the best in the country for pediatric cardiology and heart surgery.

"Being number one comes with responsibility," she said. "We need to establish and follow the quality metrics for best practice."

Speaking to attendees at Tableau Conference '17 in Las Vegas recently, Dr. Achuff said heart defects are the leading cause of birth defect-associated infant illness and death, and that one in 120 children are born with a heart defect.

"Heart defects can be quite complex. We sometimes refer to it as 'cardiovascular origami' – how some babies are born with quite jumbled hearts."

And when patient recovery after corrective heart surgery is under way, there is no shortage of information to assess. "It's like a 'data hurricane' – information is coming from all the life-giving machines in the room, and from the baby. We have situations where a decision has to be made very fast," she said.

The number one goal for all their patients is comfort, said Dr. Achuff, noting that children get "many, many doses" of

medications in order to achieve relief from pain and anxiety.

With a passion for ensuring the comfort and care of her young patients, Dr. Achuff's mission became sedation management in pediatric critical care. At the same time, she knew that comes with a cost; some drugs can cause addiction, PTSD, and other issues.

"Sedative drugs can have effects on developing brains. But, we can't avoid them – we just have to know how to use them safely. We wanted to assess the sedation practice, make changes, and measure improvement," said Dr. Achuff.

At the time, there was some usage of business intelligence (BI) software at TCH, but not directly by care providers. Also, notes Dr. Achuff, requests to IT were long and arduous, since that department is incredibly busy and sometimes overburdened.

The medical teams weren't getting a response near real-time, when they needed it, and data architects were not really familiar with the clinical relevance of their requests. Still motivated to find the right tool that could help them improve their sedation practices, Dr. Achuff began looking for other options.

She had heard about Tableau business intelligence software, and read about how it had been used, for example, by the Texas Rangers Baseball Team to gain a full 360-degree view of operations and by banks to track and follow dollars and profits.

"I needed a powerful, quick tool. I thought, why can't I use that resource for my patients?" said Dr. Achuff. Eager to move forward quickly, she purchased a

desktop version of Tableau. She wondered if Tableau's Self-Service Visual Analytics could give them the ability to look at everything over the past five years in terms of medication dose and duration, by year,



Dr. Barbara-Jo Achuff, Texas Children's Hospital

month, day, hour, and provider – nurse or practitioner.

They started working with the analytics by looking at intravenous doses per patient – all medications given through IV as needed, and then noted variations by hour of the day. The graph showed a trend of spikes two to three times higher at 4 a.m., 7 a.m., and 7 p.m. It visually showed a distinctive pattern with significant difference in day and night dosing totals.

The most frequently administered medication was Fentanyl, and the other top drug was Midazolam. When the team

evaluated frequency spikes, and saw nighttime dosing was much higher than daytime dosing, they wondered, is this following the rhythm of the patient or what the nurses felt was right, or another reason?

Their next move was to introduce S.T.A.R. activities, including: Staff Education, Fellow Education, Standardization, and Assessment Tools. As well, clinical guidelines were established.

After the practice change and implementation took hold, adjustments in sedation were evident. "We aimed to decrease doses by 20 percent. Now Fentanyl dosing frequency is down 12 percent and Midazolam frequency is down by 26 percent," reports Dr. Achuff.

"All the while, the complexity of our little patients is probably the highest in our history. And patient, parent, and nurse satisfaction have all skyrocketed."

Dr. Achuff believes the benefits of visualization are immense. "So far, we have been able to describe and provide insight into previously unavailable data. We hope to see outcomes change, including reduced ICU length of stay, reduced total dose exposure, translated into less patients experiencing addiction and improved developmental outcomes."

"By using Tableau, and showing the data, we've changed the culture," she added. "We're making practice changes, cultural changes, and writing publications about sedation ... and I will not go back to what we had before, now that I see what we can do," said Dr. Achuff, adding, self-service analytics puts the data in front of the people who know what to do with it.

## Innovation Lab allows solution developers to create EHR prototypes

BY CATHERINE KREVER

**T**ORONTO – eHealth Ontario's Innovation Lab is an online space where healthcare developers, individuals and startups from around the country can learn how to write software that interacts with Ontario's electronic health record (EHR). So how does the lab work and what does it mean for healthcare in Ontario? We spoke with Mike Krasnay, eHealth Ontario's Director of Enterprise and Integration Architecture, to find out.

What exactly is the Innovation Lab?

**Mike Krasnay:** The lab contains everything an innovator would need to write software that can interact with the provincial electronic health record (EHR). It contains descriptions of EHR services, interface specifications, sample code and messages, a test harness for learning, test data, and crucially, actual web services that innovators can connect to.

Currently, the lab contains two provincial EHR repositories and two infrastructure services. No personal or personal health information is contained. Participants use the lab to test how their systems interact with an EHR

service to validate their planning, make product adjustments, prove concepts, build and experiment with clinical prototypes, and better understand and estimate the cost and effort of conforming to EHR specifications.

Why did you build it?

**Mike Krasnay:** To create opportunity for more companies and individuals to enter the digital health market. We wanted to provide a place where all ideas can be showcased, not just those from large organizations, but also from startups, individual clinicians, students and professors.

The goal is promoting innovation that leads to engaging Ontario clinicians and patients in using technology for better health.

By putting our systems online, innovators can learn how to write software prototypes that interact with Ontario's EHR and create real production-grade software. This helps them garner

support, be it financial or clinical, because they can now demonstrate that their idea is technically feasible, show how it works, and display the benefits.

How does the Innovation Lab work?

**Mike Krasnay:** There's no cost to using the lab, but registration is required. Once registered, innovators have access to all of the lab's resources. These resources (specifications, samples, test harness, and forum) equip software developers with the knowledge they need to integrate with the EHR. With this

knowledge, innovators can write software that interacts with the EHR web services in the lab. There are two types of services: Lite, and now Full. Those new to healthcare integration can experiment with our Lite Service: these are like the Full Service, but without cryptography, authentication, and other security controls that can be complex and intimidating to newcomers.

Lite Services help participants learn and show the benefit of inte-

grating with EHR information. Once they have mastered the basic exchange of EHR information, they can proceed to Full Services; it's essentially Lite Services with the addition of privacy and security controls.

What's next?

**Mike Krasnay:** We are constantly adding new services and data sets, and are continually improving the experience in the lab by upgrading the test harness, making the data more clinically representative, and adding a code sharing facility. Later this fiscal year, the province's provincial drug and immunization repositories will be available.

An open provincial EHR platform that allows ehealth solutions to be tested in a virtual EHR environment, the Innovation Lab gives innovators a space to prototype new ideas.

The virtual environment allows users to understand and experiment with basic EHR services and connectivity. For those building custom applications or solutions, it's a place to validate planning, make product adjustments, and prove concepts. It can be accessed through eHealth Ontario's website – <https://www.innovation-lab.ca/>.



Mike Krasnay, eHealth Ontario





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# Judgement test, in addition to scholastic ability, is changing the face of education

Patients are increasingly looking for doctors who are more than just knowledgeable about medicine.

BY RICH EMRICH

The Internet provides an abundance of resources for the public to make better-educated decisions about their health, which has put the patient-doctor relationship on more equal footing. Family doctors used to be the primary source of guidance for health issues, but patients are now armed with a wealth of knowledge and a variety of tools to inform themselves.

Given that part of a patients' medical knowledge can be gathered without the assistance of a medical professional, patients are increasingly looking for a different kind of doctor – one who is not only knowledgeable about medicine, but also personable, has strong communication skills, and is empathic when providing care.

In addition, research shows that weak “non-academic” traits and professionalism issues are at the root of almost all legal complaints against physicians.

Licensure exams are increasing the emphasis on assessing non-academic based attributes of graduating students, probing for aptitude in public health, ethical, legal, cultural competence, and communication skills. Programs are also moving to assessing non-academic traits in the form of in-program assessments like peer-reviews and supervisor evaluations.

While admissions departments in medical schools have a collection of good tools to assess the academic and knowledge (or cognitive) attributes of applicants, historically very little reliable information existed to support a more holistic screening process.

To address these concerns, Dr. Harold Reiter M.D., a radiology oncologist who past-served as the Admissions Chair for the Michael G. DeGroote School of Medicine, and Dr. Kelly Dore Ph.D., an as-

sociate professor and senior scientist the Program for Educational Research and Development at McMaster University, constructed the CASPer test as a cost-effective tool for medical programs to use in the admissions process to assess the personal and professional competencies of their applicants.

The test is a form of situational judgement test (SJT) that involves viewing a series of videos depicting challenging ethical or conflict situations in everyday contexts, and answering questions about what students would do and why. Unlike other standardized tests like the MCAT, CASPer is completed online and is remotely proctored to prevent cheating.

CASPer was first introduced at McMaster's Michael G. DeGroote School of Medicine in 2010 after research and pilot studies showed good reliability

**Admissions departments want to get a better view of the non-academic traits of applicants, using tools that are evidence-based and effective.**

and predictive powers of the test. In late 2014, Altus Assessments was formed, and assumed responsibility for the development and delivery of CASPer.

By the end of this year, well over 100,000 applicants will have written CASPer since it was launched, including over 50 percent of all U.S. and Canadian Medical school applicants. It is also used in other healthcare programs, including nursing, veterinary, optometry, pharmacy, and physician assistants, and used as far away as teachers education programs in Australia.

One of the first schools to adopt CASPer in the US was New York Medical College (NYMC). The associate dean of admissions from NYMC, Dr. Fern Juster

M.D., a pediatrician, has conducted research showing that CASPer can help address some of the barriers for applicants with diverse backgrounds.

At the 2016 Canadian Conference on Medical Education (CCME) in Montreal, she presented an analysis showing that CASPer was less disadvantageous to underrepresented groups in medicine, such as Black and Hispanic applicants, and those from low-income backgrounds than traditional cognitive measures such as GPA and MCAT.

The lack of representative diversity in medical education has long been a problem, and despite recent initiatives aimed at increasing the representation of under-presented minorities, little progress has been made.

Black individuals make up less than 1 percent of Canadian medical school students, despite accounting for almost 4 percent of the Canadian population aged 15 to 24. A lack of diversity in medical education translates to a lack of diversity in the healthcare profession, which can negatively affect the quality of healthcare for underserved minorities.

While CASPer helps programs to get a more reliable and holistic view of applicants in the initial admissions screening process, many schools have also embraced a more rigorous interview process by replacing the standard panel interview with the more rigorous multiple mini interview (MMI).

Both changes are similarly driven by admissions departments wanting to get a better view of the non-academic traits of applicants while moving towards tools that are evidence-based and effective. More diverse and holistically stronger physicians is something we should all be excited about.

*Rich Emrich is CEO of Altus Assessments. For more information, please see: <https://takecasper.com/>*

## Simulator uses augmented reality, offers mother-baby physiology

MONTREAL – CAE Healthcare has announced the release of CAE LucinaAR with Microsoft HoloLens, the world's first augmented reality child-birth simulator with integrated mother-baby physiology.

For the first time, clinical teams and learners will be able to practice emergency labor and delivery manoeuvres on a high-fidelity patient manikin while guided by 3D holograms of the baby as it progresses down the birth canal. The first CAE LucinaAR learning module will provide immediate visual and physiological feedback on the effectiveness of evidence-based clinical emergency measures to resolve shoulder dystocia.

“CAE LucinaAR delivers a breakthrough simulation training experience that allows learners to see the anatomy inside the patient simulator,” said Dr. Robert Amyot, President of CAE Healthcare. “We chose



Lucina as the first CAE patient simulator for integration with our augmented reality platform because we believe it will have an immediate and powerful impact on the management of shoulder dystocia deliveries and on mother-baby safety.”

Shoulder dystocia is a specific

case of obstructed labour whereby after the delivery of the head, the anterior shoulder of the infant cannot pass below, or requires significant manipulation to pass below, the pubic symphysis. It is diagnosed when the shoulders fail to deliver shortly after the fetal head. Shoulder dysto-

cia is an obstetric emergency, and fetal demise can occur if the infant is not delivered, due to compression of the umbilical cord within the birth canal. It occurs in approximately 0.3-1 percent of vaginal births.

Following the release of its CAE VimedixAR ultrasound simulator with Microsoft HoloLens in 2017, the first such solution for the healthcare industry, CAE has realized another industry first by integrating augmented reality into its patient simulators with both didactic and interactive content.

“We are delivering on our commitment to innovate with integrated simulation technologies that will dramatically improve clinical learning environments,” said Dr. Robert Amyot. “Today's generation of learners expects immersive, engaging and accelerated educational experiences that will prepare them to meet the high demands within healthcare as they constantly adapt to advancing technologies.”





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# What to expect in healthcare technology for 2018

An interview with Dr. Darren Larsen, chief medical officer with OntarioMD.

BY DR. SUNNY MALHOTRA

I recently had the opportunity of speaking with Dr. Darren Larsen. He is Chief Medical Information Officer with OntarioMD, and is a candidate to become President Elect (Nominee) of the Canadian Medical Association. Dr. Larsen has leading-edge insights about the state of medical care in Canada and the application of technologies that could solve current problems.

**Dr. Malhotra:** What are the biggest areas of opportunity for technology in healthcare today?

**Dr. Larsen:** I think that artificial intelligence and machine learning are real opportunities. The embedding of evidence-based algorithms into our electronic medical record systems and the introduction of clinical decision support tools will make our decisions stronger and less variable.

This will be a huge advance in the care of our patients. We will need to learn how to trust these systems, and the evidence-base around them.

As we do so, we will find our clinical quality and outcomes can improve. These systems will allow us to involve patients in decision-making. When they are presented with a list of choices with confidence intervals around those choices, we allow them to be active participants in the care being offered to them.

This will build trust, not erode it. Admittedly, this is nascent work, but the technology in this domain is improving quickly and dramatically. There will need to be a strong change management and educational approach around this work. I believe there is a role for the CMA in this, either through the Association or its subsidiary, Joule.

**Dr. Malhotra:** Where does privacy fit into all of this?

**Dr. Larsen:** This Big Brotherish idea – of data moving out of EMRs for analytics – scares some clinicians. We will have to work with them closely to en-

sure they understand the benefits versus the risks. As well, privacy of personal health information must be guaranteed.

There is no room for data breaches or PHI to fall into the wrong hands. This will require both robust technology and strong public policy.

Furthermore, education plays a huge role. Clinicians will need to know exactly their role in maintaining privacy and security.

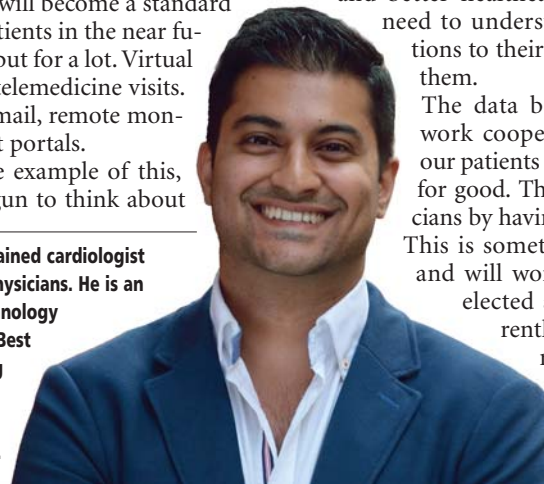
**Dr. Larsen: Patients should have full access to their complete healthcare data sets ... and they should be able to contribute to their health records.**

**Dr. Malhotra:** Virtual visits with doctors are just starting in Canada, but they could have a big impact, on both patients and the healthcare system. Do you think they will?

**Dr. Larsen:** Virtual care will become a standard way of caring for our patients in the near future, not for everything but for a lot. Virtual care doesn't only mean telemedicine visits. It also includes use of email, remote monitoring, and even patient portals.

Tele-homecare is one example of this, but we haven't even begun to think about

**Dr. Sunny Malhotra is a US trained cardiologist working at AdvantageCare Physicians. He is an entrepreneur and health technology investor. He is the winner of Best in Healthcare - Notable Young Professional 2014 and the national Governor General's Caring Canadian Award 2015. Twitter: @drsunnymalhotra**



the ways that virtualization could expand into broader healthcare knowledge and use.

Even the vast volumes of data being collected by our wearable devices can be incorporated into an overall health plan for patients. We must create a space where technology companies and start-ups can produce products that succeed, making adoption of innovation easier in Canada.

It is frankly easier for start-up companies to market and grow in the United States than Canada. The brain drain of Canadian talent is a real issue. I would love to see this brain drain stopped.

**Dr. Malhotra:** Should patients be given more access to their health records?

**Dr. Larsen:** I strongly believe that patients should have full access to their complete healthcare data sets. Not only can they or should they be able to read and consume the information, but they should also be able to contribute to it.

There are many studies now that show that open notes have a strong positive impact on patient care and better healthcare outcomes. We physicians need to understand how patients' contributions to their data set will help us as well as them.

The data belongs to patients. We must work cooperatively as team players with our patients to ensure that their data is used for good. They can help us be better clinicians by having full access to their records.

This is something I stand strongly behind and will work actively to promote if I'm elected as CMA president. I am currently doing that even now in my role as CMIO at Ontario MD. Open access will be revolutionary for healthcare in Canada. And as a patient, or potential patient, I can't imagine any other way.

## Team approaches to implementing technology are keys to success

BY ROSEMARY GRAY

Rather than a new eco-adventure, BCHIMPS is the British Columbia Health Information Management Professionals' Society. They've been bringing together BC's health informatics, IT, IM and clinical leaders for three decades to network, share experiences and participate in professional development opportunities such as the recent Fall Symposium, held in September at Vancouver's Sutton Place Hotel.

This was the biggest BCHIMPS event to date, with a sold-out venue and more than 140 registrants in the room. When I walked into the corridor to fill my coffee cup, and returned to the room, it was like I crossed a force field that could barely contain the wall of positive energy,

curiosity, and passion for making things better for the patients we serve in our health system.

**The Triple Aim:** The Institute for Healthcare Improvement's (IHI's) Triple Aim construct now has worldwide acceptance as an approach to optimizing health system performance. Canada has definitely bought in – the construct, even if not named, underpinned each speaker's approach.

The Triple Aim refers to the simultaneous pursuit of improving the patient (and provider) experience of care, improving the health of populations, and reducing the per capita cost of healthcare. Its power is that it is actually a single aim with three dimensions – you can't achieve and sustain quality outcomes for patients and populations without working simultaneously in all three areas.

Dr. Jeremy Theal, CMIO for North York General Hospital, in Toronto, laid out the themes quite clearly. Patients deserve and demand better quality and safety – for instance, preventable deaths in hospital are inexcusable.

**Quantitative measurement and reporting:** Increasingly, there's an em-

**You may achieve positive or negative outcomes with the same tools. It's a matter of approach.**

phasis on accountability for eHealth investment that relies on a measurement and reporting framework that supports the Triple Aim. We are starting to assess the quantitative impact of change, by measuring improve-

ment (or lack of improvement) in terms of lives saved, costs avoided, harms prevented, patient outcomes improved, and provider experience of the change. These are the kinds of measures that are meaningful to providers, patients and other partners, and help us all to understand the tangible impact of investment.

**Evidence-informed clinical decision making:** There's an increasing emphasis on the incorporation of clinical decision support into the day to day workflows of clinicians. Adoption of clinical standards is about making the best path to follow, the path of least resistance – the lessons are to make the right way, the easy way, and "don't impede clinical workflow".

North York has had success with

CONTINUED ON PAGE 23



# AI can involve new forms of procurement, along with new legal issues

BY DENIS CHAMBERLAND

**M**ackenzie Health, in Richmond Hill, Ont., recently launched an innovation procurement to acquire artificial intelligence (AI). AI is simply software, but software that harnesses big data analytics, which is the process of examining large and varied data sets (ie, a collection of related sets of information) to uncover hidden patterns, unknown correlations, market trends, individual preferences and other useful information that can help organizations make better informed business and clinical decisions.

The exponential growth in machine processing power in the last few years has enabled the technique of machine learning,



Denis Chamberland

ing, in which computers learn by example and teach themselves to carry out pattern recognition tasks without being explicitly programmed to do so. Healthcare is now regarded as a highly promising sector for AI.

Mackenzie Health's innovation procurement was initiated to address the province's privacy and security requirements. As the province embraces universal Electronic Health Records for all Ontarians, a significant challenge for hospitals relates to the handling of the ballooning volume of personal health information.

The growing mass of information that privacy officers need to deal with is daunting, particularly in the light of the guidance issued by the Information and Privacy Commissioner of Ontario (IPC), directing hospitals to audit all accesses to personal health information in electronic systems. The IPC's guidance was issued in the aftermath of the launch of a \$412 million class action lawsuit in 2014 after a hospital admitted to privacy breaches resulting from two employees selling patient information over a two-year period.

To ensure it has the capacity to comply with the IPC's guidance, Mackenzie Health sought to procure a health record privacy solution that not only meets the IPC's auditing requirements, but also proactively identifies trends and strategies to prevent future unauthorized access, promotes real-time access to shared patient records, and improves the cost-efficiency of care delivery.

By contrast, conventional technology solutions focus on simple rules-based auditing, which can result in a very large number of false-positives needing to be manually reviewed, an impossible task to achieve in real-time.

With the objective of leveraging big data analytics and machine learning, Mackenzie Health tapped the market to procure a solution capable of conducting audits in real-time, of performing autonomous and/or semi-autonomous event analysis to maintain a low false positive rate (with a high accuracy rate), and providing a range of tools to expedite the investigative process. This, it is hoped, will

slow or reduce the growing cost of privacy compliance and transform privacy auditing from a reactive after-the-fact investigation model to a pre-emptive, real-time protection model.

To procure its health record privacy solution, Mackenzie Health's project team

adeptly leveraged the Competitive Dialogue, a highly effective type of innovation procurement flagged by the Ontario Centres of Excellence.

Although new to Canada, it has been used in Europe, where the Dialogue's procedure allows a buyer to hold separate but

contemporaneous negotiations with qualified parties. Unlike the classic request for proposals (RFP) process, where only the solution described in the RFP is considered, the Dialogue produces a variety of different and more responsive solutions,

CONTINUED ON PAGE 23

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# 3D medical printing is producing better medical outcomes

Additive technologies have led to reduced time in the OR, fewer complications and faster recoveries.

BY DIANNE DANIEL

**D**on't be surprised if '3D Printing Lab' signs start popping up at Canadian hospitals. Early adopters of the technology say it's only a matter of time before 3D printing reaches even the smallest community institution.

A little more than a year after launching its multi-departmental 3D printing program – one of the first hospital-based programs in Canada – The Ottawa Hospital is printing every day, mainly for cardiology, oncology and orthopedics. Applications range from personalized, anatomically correct models that help physicians visualize surgeries, set complex fractures and resect tumours, to advanced prosthetics and in some cases, equipment parts.

"Now we need to maintain the quality and the safety of the program so that it can be portable to other institutions in a safe, efficacious and cost-effective way," said Dr. Frank Rybicki, Chief of Medical Imaging at The Ottawa Hospital and Chair of Radiology at the University of Ottawa. "That really is a huge job."

The lab has grown from one to two Stratasys printers, including the original Objet500 Connex3 PolyJet printer and a second fuse deposition modelling (FDM) printer. It is primarily operated by University of Ottawa engineering students and overseen by a first-of-its-kind 3D clinical fellow who is in the lab full-time. Vaughan, Ont.-based Proto3000 remains a strategic partner as the hospital continues to explore possibilities, such as printing titanium bone implants, organ implants and even skin in the future.

Based on early results, Dr. Rybicki is confident that "3D printing is poised to save enormous amounts of money" in healthcare. In one instance, the lab printed MRI replacement parts required to biopsy breast lesions, saving close to \$100,000. In another, surgeons saved an estimated four hours of expensive OR time by rehearsing a complex procedure on a 3D printed model.

Now the hospital is working to develop a formal 3D medical printing policy to ensure the longevity of its program. "We're working towards getting reimbursement for 3D printing; we know in the cases where we appropriately use it, it will save time and money," he said, noting that the goal is to manage 3D medical printers much like other medical devices. Cases where 3D printing is deemed not appropriate include routine lung or colon cancer surgeries, simple fractures or appendicitis, he added.

Appropriate use is just one area under investigation. Other topics include: How often do printers need to be calibrated and serviced? What are the training standards for people working in the 3D printing lab? How will residents be trained? Does the 3D design software, used to translate high resolution scans to printable digital files, need to be approved by Health Canada? Just as MRIs, CT scanners and surgical robots are regulated healthcare devices, the entire 3D printing program "needs to be up to snuff for medical standards," said Dr. Rybicki.

Reuben Menezes, Marketing Manager at Proto3000, believes a formal policy is necessary and will help to spur widespread adoption of 3D medical printing. "There needs to be a framework, there needs to be standards, really a defined process of when, how and why to print," he said.

Funding for the technology has to "catch up," he

added. "One of the things holding it back in Canada is ... that 3D printing is seen as a luxury item, a nice-to-have, but not a necessity that needs to be funded," said Menezes. "As the government continues to have a deeper understanding and more studies show how it impacts the bottom line, we'll see better adoption."

Right now, 3D printing is primarily found in research hospitals and centres across Canada where the majority of printers are donated or purchased with donated funds, and where young researchers and professionals are pushing the boundaries to evolve the technology where it makes the most sense. Anatomically accurate models for pre-surgery planning and education purposes are a clear early winner because 3D printers can replicate 3D images affordably and with a high degree of accuracy.

Early adopters include the Institute for Reconstructive Sciences in Medicine, based at Misericordia Hospital in Edmonton, where 3D printing is improv-

give more informed consent. Printing a heart model may cost anywhere from \$500 to \$2,000, but the potential savings related to fewer complications, quicker recovery and reduced lengths of stay are closer to \$20,000, he said.

Instead of trying to visualize the geometry of a patient's heart on a computer screen, surgeons are able to hold an accurate model in their hands. They can then devise and attempt several plans before coming to a decision on the best way to attack a problem, and in some cases can print custom parts required for the surgery. Once they've settled on a plan that indicates a positive outcome is highly likely, they present it to the surgical team as well as to the patient or patient's parent.

"This is about outcomes and economics," said Brown. "Patients are going to get better surgery, better informed consent and higher satisfaction; providers will be able to align complex surgical teams, reduce waste and gain better reputations; and,

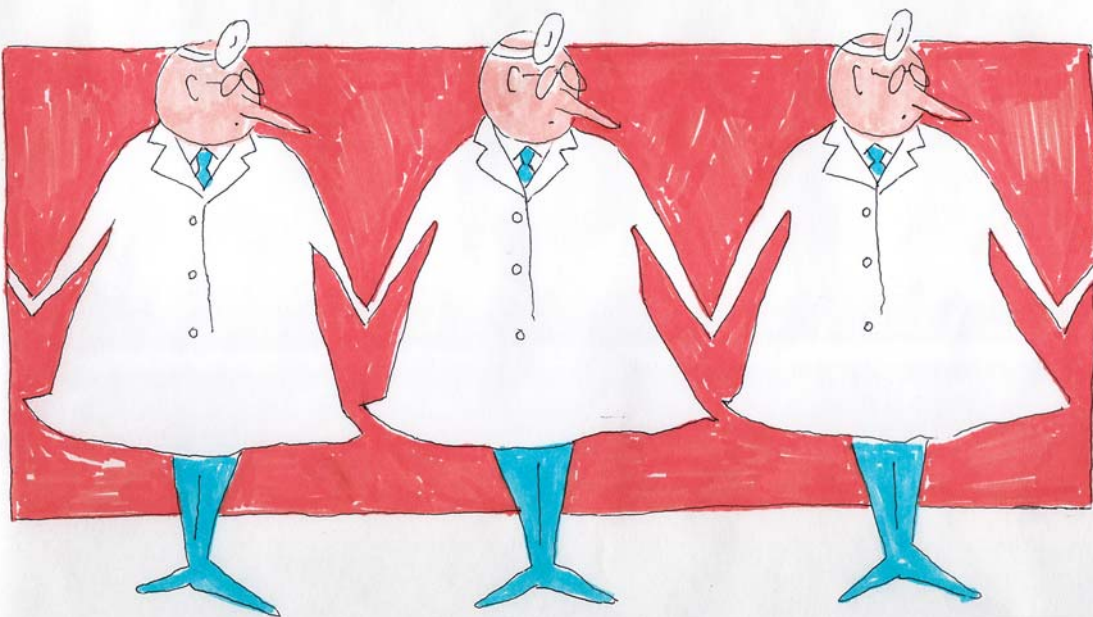


ILLUSTRATION: LINDA WEISS

ing treatments for patients with serious skull and facial problems. The team uses sophisticated computer modelling and 3D printing to prepare detailed surgical plans and templates, improving precision of reconstruction surgery and reducing mean operating time by as much as 18 per cent.

Surgeons at The Hospital for Sick Children (Sick-Kids) in Toronto have partnered with Stratasys to 3D print pediatric heart models in-house, using a softer more realistic material that provides realistic haptic feedback. Surgeons are excited about the new material and the ability to provide real physical models for surgical practice, particularly for students.

Recently, Stratasys introduced its BioMimics Medical Service to provide similar realistic models for a broader range of clinical scenarios, including bones, hearts and blood vessels. According to the company, "different materials can be used together to produce complex combination models, such as a spine with vertebrae, discs and nerve roots." The intent is to print and deliver models to hospitals as a service.

John Brown, Director of Additive Solutions at Javelin Technologies Inc., a Stratasys reseller headquartered in Oakville, said lifelike 3D printed models are transformative because they are enabling surgical teams to be more efficient with better outcomes, and giving patients an unprecedented opportunity to

payers will avoid costs and complications and drive down the costs of longer term healthcare."

Another anticipated benefit is that lifelike models will enable a new, accelerated way to train doctors, he added, by allowing them to amass experience through practice early on in their careers. "We want to get them as good at 30 as they are at 60," he said.

The process of 3D printing an anatomically correct model typically starts with a high resolution scan (DICOM image) that is segmented and converted to STL, a 3D printable format. In the case of medical 3D printing, the STL file enables the printer to distinguish skin, bone, muscle and open space, for example. The printer selects appropriate digital materials according to the data it receives and uses a layering process to build the fully formed object, a process called additive manufacturing.

Jeff McIsaac, General Manager of Mohawk College's Additive Manufacturing Resource Centre in Hamilton, Ont., believes 3D printing has huge implications for the medical space. The centre is working with a handful of healthcare partners, including a Niagara region dentist who is 3D printing custom dental implants.

"One of the most interesting things to me about additive manufacturing for healthcare applications is the idea of controlling the geometry of the part for mass customization," he said. An example would be hip and



knee replacements. Rather than selecting the best fit from a catalogue of artificial joints, a knee could be 3D printed from a precise scan. "It wouldn't be the closest you can get and hope it fits, it would be the exact anatomy you need," he said.

What's required, said McIsaac, is a new design paradigm, one that opens up an entirely different world where it's possible to create weird curves and organic-looking structures instead of relying on square corners and round holes. "We're very early days in terms of people getting that thought process through their heads. Once that starts to take over, people will be using additive manufacturing to make stuff we haven't even heard of yet," he said.

One group of Mohawk students is already thinking outside of the box. On their own time, and without earning any credits, they formed the Mohawk 3D Printing Group with the aim of producing extremely life-like medical models, known as phantoms, by applying advanced additive manufacturing techniques to print synthetic flesh, bones and organs. They are an open source, not-for-profit project with the sole intention of advancing research.

Mechanical engineering student Addison Wood co-leads the group with Lauren Stephen, a student studying software development. Wood said the main challenge presented by existing multiple extrusion systems – 3D printers that can print in more than one material – is that the types of materials available are limited. "We're trying to make multiple, very different materials work together in one whole successful print," he explained.

Ballistic gel, for example, is proving to be a good material to replicate synthetic flesh. The students are working to ensure it maintains the right temperature during printing in order to obtain the necessary viscosity. If the temperature rises too high, the material can bubble. They are also considering NinjaFlex, a flexible 3D printing filament, as a viable material to print organs.

"We haven't quite figured out organ tissue, but we are going to do bone plastic and ballistic gel," said Wood. "Incorporating those two together is a huge step."

"We're in agreement that this is the future of medical phantom production," added Stephen. "If we can nudge it forward and some other player takes some of our research and perfects it, that's also a success in our minds."

As an academic centre, the Mohawk Additive Manufacturing Resource Centre has the luxury of working with new materials and taking risks that aren't always available to industry. Failures are as important as successes, said McIsaac.

"In the next 10 years, additive manufacturing will affect every industry at some level," he said. "Students who've been working with us have had the opportunity to be in here working on real engineering problems...and everyone is trying to explore and learn. It's a fantastic opportunity for them."

As early adopters of 3D medical printing continue to push the technology forward, the Canadian government is also weighing in.

In October, 2017, the standing senate committee on Social Affairs, Science and Technology released its report *Challenge Ahead: Integrating Robotics, Artificial Intelligence and 3D Printing Technologies*

into Canada's Healthcare Systems. As part of their investigation, committee members visited the general campus of The Ottawa Hospital to examine a range of 3D printed objects and watch a 3D heart model print.

The report states members were "amazed at the innovations ... humbled by the ingenuity on display and overwhelmed by the potential impact these disruptive innovations can have on the healthcare

system" and goes on to suggest that "in order to be successful in integrating robotics, AI and 3D printing into healthcare delivery, Canada has to address the hurdles that lie in the way."

Some of those issues include trusting the technology, protecting patient privacy and addressing ethical concerns, as well as making necessary adjustments to training and education, and changes to the regulatory

framework for medical devices. One of several recommendations made by the committee is that Canada convene annual national conferences attended by all key stakeholders to ensure that new challenges will be identified and addressed as they emerge.

"These technologies are going to revolutionize the way Canadians live and specifically the way healthcare is delivered," stated the report.

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# Deep Learning has a long way to go before it replaces radiologists

BY JERRY ZEIDENBERG

**C**HICAGO – There’s been a furor of late over the role of artificial intelligence and Deep Learning in radiology – with some observers surmising that computers will someday supplant radiologists. That day, however, appears to be a long way off, says Dr. Paul Chang, professor and vice chairman of radiological informatics at the University of Chicago.

“Replacing radiologists? That’s hard,” said Dr. Chang. “It’s going to take a long time.”

He explained his skepticism in a standing-room only session at the RSNA conference. “There’s a hype cycle going on,” said Dr. Chang. “I’m an old guy, and I’ve been through this before,” observing that PACS, EMRs and structured reporting all generated waves of excitement that took a long time to produce value to physicians, hospitals and patients.

He assured the audience that, “I am an advocate of Deep Learning.” However, he said the claims made about artificial intelligence and its current capabilities are exaggerated. A good deal more work must be done before it can deliver on its promise.

That may indeed happen, he said. And if it does, it could be of great benefit to radiologists, who are becoming overloaded with studies to read and reports to write. Smart systems could be a godsend that takes some of the mundane tasks away.

“What we do as radiologists is unsustainable,” said Dr. Chang. “Our heads are going to explode.”

He said the image sets are getting bigger, in both numbers and complexity. In this environment, with huge volumes of scans, radiologists have only a few seconds to read an image.

At the same time, the analyses are ex-

pected to be more precise than ever before, with demands surging for “multidisciplinary synthesis and actionable information.” Rads are now expected to combine their verdicts on whether there is a mass or lesion with related data about its characteristics, along with suggested therapies.

So the need is there to become more efficient. “But I know of no way of doing this without I.T.,” said Dr. Chang. Computerized tools will be the way out of the morass.

He said that Deep Learning systems in radiology, at least so far, have only accomplished simple tasks and are nowhere near replacing radiologists.

Examples include organ segmentation, lesion measurement, and even the identification of osteoporosis.

Harder tasks, like the identification and classification of lung cancer lesions, haven’t been perfected – at least, not to any great extent.

According to Dr. Chang, that’s because Deep Learning requires huge data sets, and comparatively speaking, lung cancer is rare and the images are hard to come by.

“The Deep Learning applications are boring,” said Dr. Chang. “It’s because they don’t have a lot of studies available to them.”

And there’s a Catch-22 at work, he noted. Because the studies aren’t available, the more challenging applications haven’t been developed. And until more useful applications appear, hospitals and universities are hesitant to invest in the infrastructure needed to produce and test Deep Learning systems.

Meanwhile, some have been caught up in the hype about Deep Learning in radiology. Some of that hype has been spawned by the plethora of papers posted on arXiv, the free repository of academic papers. However, Dr. Chang warned the audience to be extremely wary of these papers, as they are not peer reviewed.



The University of Chicago’s Paul Chang led a well-attended session on Deep Learning in diagnostic imaging.

And while papers must be accepted by group moderators on arXiv, Dr. Chang said the standards seem to have dipped lately when it comes to moderating.

Without the skeptical eyes of radiologists reading the papers, some of the methodologies and results have been questionable, he said.

“Early validation methodologies are surprisingly lightweight and suspect.”

Nevertheless, the potential is there in Deep Learning for great gains to be made. In particular, the technology could be used to help solve the productivity conundrum that radiologists currently face. Indeed, systems that automate mind-numbing or time-consuming tasks would be greatly welcomed.

Initially, these solutions, rather than representing huge strides in AI or Deep Learning, will consist of “minimally heuristic use case sweet spots.”

There is equal danger, he said, in missing the boat in Deep Learning because of disappointment with the early systems. The radiology community, he said, should start investing in the infrastructure that will enable Deep Learning, and get into it slowly.

“The stuff that needs to be done is not very sexy – it just needs to be done.”

He observed that high capacity systems like Hadoop should be investigated and prepared for, as they are capable of handling large data sets. As well, hospitals should start thinking about the processing power they will need.

The hardware leader that has emerged in this area is NVidia, commented Dr. Chang. “Neural networks are not new. What’s new is the enabling technology – the drug dealer. Which in this case is NVidia,” he quipped.

## Deep Learning – coming soon, to a radiology department near you!

**C**HICAGO – Dr. Paul Chang, radiologist at the University of Chicago and a respected commentator on digital health systems, cautioned his colleagues at the recent RSNA meeting to avoid the current hype about artificial intelligence and machine learning. Not much has been accomplished yet, he warned, although he said to stay tuned, as things are likely to happen faster than expected.

“We are too early [as radiologists] to embrace the hype before it can help our patients,” said Dr. Chang at an overflowing session on Deep Learning. “But then we’re often late when it can help them.”

To be sure, radiology vendors are working feverishly to bring “helpful” machine learning applications to fruition, and it’s good to keep an eye on them. Several companies demonstrated solutions that could have a huge impact on the way physicians conduct their work – though rest assured, none are going to replace radiologists any time soon.

Instead, they will enable DI experts to work more effectively, while simultaneously improving the delivery of care for patients.

Here are some cases in point:

The team at IBM Watson Health demonstrated a technology called Patient Synopsis that digs into the hospital’s EMR to find patient information that could be useful when a radiologist is conducting a study. The goal is to save time and effort for the radiologist, who could use the data in the EMR, but is already hard-pressed to complete the readings on his or her worklist.

When a radiologist is conducting a CT liver exam, for exam, Watson can search the EMR for important data in patient encounters, vitals and other exams. “Watson can scan the whole record, including unstructured data, to find what’s relevant,” said Alex Abed, AI Solution Expert with IBM Watson Health. “For example, if there are notes about persistent nausea and vomiting, and loose bowel movements. It also gives the radiologist the

name of the doctors who did the notes, in case they want to follow up.”

This kind of information gives the radiologist a much more complete picture of the patient’s condition. And it does it automatically, when the radiologist opens the patient’s studies in the worklist. Watson Imaging Patient Synopsis is

**Patient Synopsis is expected to save time and increase the quality of readings for radiologists.**

a work in progress, but a commercial release is planned for 2018.

The system uses machine learning, and has been trained to watch what radiologists look for when searching through EMRs so that it knows what to do on its own. Patient Synopsis is expected to save time and increase quality of readings for radiologists.

For its part, GE Healthcare is also

working on bringing more context and information to the radiologist, as he or she works. At RSNA, the company demonstrated Imaging Related Clinical Context (IRCC) and enhanced reading workflows, which were developed in partnership with University of Pittsburgh Medical Center (UPMC). IRCC will deliver patient clinical content in context, including EMR data such as surgical notes, pathology reports and clinical notes, directly to the radiologist as part of the existing workflow.

The new IRCC algorithm is expected to be available in 2018. GE Healthcare said it learns directly from radiologists through semantic feedback (the relevance of certain key words and sentence structure) how to best select and present relevant clinical data when contemplating a diagnosis.

Also on the AI front, GE Healthcare showed a new X-ray quality application featuring Repeat/Reject Analytics (RRA). According to the company, hospitals are

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# RSNA serves as showcase for new diagnostic imaging technologies

**C**HICAGO – The annual Radiological society of North America (RSNA) meeting in Chicago, held after the American Thanksgiving in November, is always an eye-opener when it comes to innovative technologies. The latest version, held last fall, was no exception, with advances in Deep Learning, virtual and augmented reality, and new techniques for all imaging modalities being discussed in educational sessions and demoed in three big halls.

Siemens Healthineers showed off four new CT scanners, two of them in the SOMATOM.go family, and two more in the high-end line – the SOMATOM Edge Plus, a premium single-source system, and SOMATOM Force, the new version of the dual-source CT, quipped with two X-ray tubes and two detectors. Speaking of the Force, Eberhard ten Weges, VP of global CT sales, said: “It’s the fastest in the market. It’s a beast.”

Ten Weges noted the new SOMATOM go.All and SOMATOM go.Top scanners are especially useful if space in short supply, as they can be configured as “one room solutions” using a shelter instead of a dedicated control room. Moreover, the set-up can be controlled using a tablet computer, meaning the technologist can remain closer to the patient during the exam process. The 64-slice SOMATOM go.All can cover scan ranges of up to 100 mm in one second, while the 128-slice go.Top can perform whole-body scans of up to 200



By using a tablet computer to control set-ups, technologists can spend more time closer to their patients.

cm, with a scan speed of up to 175 mm per second. These systems can be used in emergency medicine, interventional radiology and cardiology.

On the high-end side, the SOMATOM Edge Plus and SOMATOM Force allow clinical users to cover all CT applications, regardless of patient or clinical issues. Both systems also offer high-precision diagnostics, which is a prerequisite for individualized prevention and therapy. “More than 200 scientific papers show what SOMATOM Force is capable of,” said Andri

Hartung. “With this new version of our top-of-the-range system, we want to help our customers take the next step on their way to precision medicine.”

Such precise diagnostics come from the FAST applications that are integrated into the premium systems. One application is the FAST Integrated Workflow with the all-new FAST 3D Camera for automatic patient positioning. In many CT examinations, incorrect patient positioning is an obstacle to achieving optimal results. Ten Weges pointed out the camera uses infrared

sensing and Deep Learning to optimize patient positioning for specific protocols.

“This technology enables institutions to potentially have fewer rescans, decrease the time required for patients and staff, and therefore benefit from precise diagnostics at lower cost,” the company says.

Siemens Healthineers also announced an innovation in the MRI area, specifically for knee imaging. A company spokesman noted that knee imaging is the third most scanned region, after MRIs of the brain and spine. So it’s significant that the company has produced GOKnee3D, an MRI application that shortens the time required to perform comprehensive diagnostic exams of the knee. Currently, a typical knee examination can be roughly 20 minutes. GOKnee3D enables a push-button, high-resolution diagnostic 3D knee exam in just 10 minutes.

At the Hologic booth, the company showed the Affirm Prone Biopsy, the first dedicated prone biopsy system that is upgradable to allow for 3D (tomosynthesis) imaging-guided breast biopsies. Both 2D and 3D image guided biopsies can be performed with this system. According to Hologic, this marks the first significant step forward in prone biopsy technology since systems were first introduced more than 20 years ago.

The product was showcased at RSNA 2016 after receiving FDA clearance; Health Canada approved the system in 2017.

Older breast biopsy systems are restricted to 2D imaging, which has a narrow

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## DI companies are devising new strategies for their IT businesses

BY THOMAS HOUGH

**A**t RSNA17 I was expecting to see some new functionality and a lot about Artificial Intelligence (AI); instead, I heard something entirely different. The real news was the condition of healthcare IT in Diagnostic Imaging.

IT firms like Canada’s Intelrad are in full growth mode and prospering. In a number of ways Intelrad is starting to act like a \$100 million company with plenty of capacity for growth worldwide. Meanwhile, other firms like GE, Agfa, and Siemens are making organizational changes by segmenting their DI IT divisions as sub-sets of their DI businesses.

Word on the RSNA floor is that some of these firms are preparing to sell-off or spin-off their DI IT divisions. Example: McKesson spinning off DI IT into Change Healthcare in order to recoup their DI IT investment.

Why? We once thought DI IT was going to be a billion dollar global market and it likely is; however, Fortune 500 vendors are finding this market has a very high cost for product development, marketing and sales and very slim margins.

There is not enough ROI to meet shareholder needs, and the low returns also make it difficult to sell off the division. Thinking about this, McKesson

was smart in their strategy to recoup their investment.

I am not saying this is what is going to happen for every firm. However, let’s consider a DI IT world where the large players are out of the DI IT game and mid-sized to small firms dominate the market. What are the advantages to this? Firms like Intelrad, Visage, and Vital Images, to name a few, leverage significant advantages over Fortune 500 firms.

First, they can incorporate new technology, functions and interoperability much faster than large firms. Second, this size of firm has lower overheads, resulting in products development at less capital cost and more importantly, less costly long-term service agreements.

Third, these firms can grow to be \$100 million to \$300 million firms, perhaps the most efficient size to serve the marketplace. Fourth, they can focus on DI IT, resulting in a less costly R&D, while enjoying fewer distractions than Fortune 500 companies with their many internal agendas and constant need to satisfy the shareholders.

So, what does this say? Perhaps market consolidation is not always the best for the industry as a whole. Perhaps mid-sized firms are best suited to be agile, cost effective and customer focused.

So, where does this leave firms like IBM Watson Health? It does not happen

very often, but once in a while a disruptive technology comes into a market that can have a huge effect on the industry – Watson Health may be one of these.

However, IBM with all its resources and abilities, is a massive company and it will have trouble providing viable working solutions that meet FDA and other

regulatory requirements in a short time to market. Perhaps it recognizes this issue, and has forged a new path. It is partnering with a wide range of small to mid-size companies, and it is letting them integrate Watson



Thomas Hough

into their products to create interoperability, resulting in the workflows and cost benefits the industry needs.

Remember, IBM is doing this for not only healthcare, but in every other industry that is data rich and insight poor. There are a lot of industries where Watson can play huge roles to make them more efficient; the last time something so disruptive came along was when PC computers were introduced.

This strategy limits the amount of investment IBM needs to make in any one

industry and produces a revenue stream long before it could develop solutions and get regulatory approvals on its own. This suggests there is still space in the DI IT market for large Fortune 500 firms.

So, let’s go back to the Fortune 500 firms mentioned before. What happens to them and why do they want to sell off the market share they fought so hard to gain 10 years ago?

By selling DI IT, these firms will focus on their core competencies, such as MRI, CT, PET, US and Digital Radiology technologies. The DI IT business will no longer cost them bottom line money.

Effectively, they can connect with all the IT solutions in the hospitals via DICOM, HL7 and FHIR. Firms like Philips have stated, they will not develop a HIS as they know they do not have expertise to do this cost effectively for the client or themselves.

Case in point – Siemens, with acquisition of the SMS HIS firm 10 years ago. Simply, healthcare IT needs a full time focus to be successful. Should this not be the firm’s focus, experience shows it will cost money to participate in this market.

Thomas Hough is President of True North Consulting & Associates, a Diagnostic Imaging consulting company based in Mississauga, Ont. For more information, see: <http://truenorthconsult.com>



# RSNA showcase

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window for targeting lesions. Multiple X-ray exposures are required to find and position the suspect tumor for the biopsy needle. The Affirm prone table allows you to make fewer exposures (lowering the radiation dose compared with a traditional 2D biopsy); and because the table uses 3D technology, you use fewer steps to target and getting biopsies (faster, more comfortable). The Affirm Prone Biopsy system is available in Canada from Christie Innomed.

For its part, GE Healthcare showcased the Senographe Pristina Dueta, an industry-first patient-assisted mammography device that puts women in control of their own mammograms. Designed by women for women, an innovative wireless remote control allows patients to manage their own compression, under the supervision of a technologist, during the exam performed on GE Healthcare's newest mammography system, Senographe Pristina.

After the breast is properly positioned by the technologist, the patient has the option to adjust her compression using Pristina Dueta. Studies in Europe show four out of five patients using Pristina Dueta said it made the exam more comfortable, and more than half said the device led to less anxiety.

Clinical evidence used in the FDA evaluation and clearance of Pristina Dueta shows use of the device does not compromise image quality or increase exam time. For women with dense breast tissue, supplemental screening may be recommended.

The Invenia ABUS (Automated Breast Ultrasound System) is proven to increase invasive cancer detection by 55 percent and is the only FDA-approved ultrasound system for dense breast tissue screening when used in addition to mammography.

SenoBright HD is a next-generation Contrast Enhanced Spectral Mammography (CESM) diagnostic exam intended for patients who have just had an inconclusive mammogram or ultrasound, or are at high risk of breast cancer. SenoBright HD exams are performed at the same time, same location, and with the same mammography equipment – Senographe Pristina – enabling the entire exam to take less than seven minutes.

As compared to the first generation CESM, SenoBright HD delivers clearer images and improves acquisition time by 40 percent in women with large breasts. CESM provides high specificity to reduce false-positives and helps prevent unnecessary exams. Images are immediately available for review following the exam.

Meanwhile, Toshiba Medical, which is now a Canon Group company, premiered the Aquilion Precision (pending regulatory approvals). According to Toshiba, it is the world's first Ultra-High Resolution CT (UHR CT), and it's capable of resolving anatomy as small as 150 microns, providing CT image quality with resolution typically seen only in cath labs.

The UHR detector is newly designed to provide more than twice the resolution when compared with today's CT technology, representing a breakthrough in CT imaging with an all-new detector, tube, gantry and reconstruction technologies. This new system required a complete re-engineering of the detector manufacturing process, said Dominic Smith, senior director, CT, PET/CT, and MR Business Units.

# New forms of procurement with AI can bring legal issues

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though it requires a good knowledge of the legal procedural fairness duties.

Here the buying hospital and each bidder collaborate in real time to devise a solution that truly meets the needs of the hospital. "We had a common problem that required an innovative solution and the Dialogue provided the flexibility we needed to achieve our goal," said Richard Tam, executive vice president and chief administrative officer, Mackenzie Health.

The legal aspects of procuring AI raise substantial challenges for law and policy makers, as the law struggles to catch up. Procuring AI is more complicated than procuring a physical product or off-the-shelf software.

What is being procured specifically should come from an interchange with the market, which an RFP does not easily accommodate. The Competitive Dialogue process is well suited for defining complex needs in the healthcare sector and is one that hospitals should embrace.

But attention will need to focus on how the Dialogue works with the procurement requirements set out in the newly-promulgated trade agreements that apply to hospitals across Canada (see the Canadian Free Trade Agreement, which came into force on July 1, 2017, and the Canada-European Union Comprehensive Economic and Trade Agreement, on September 21, 2017). In Ontario, the rules set out in the Broader Public Sector Procurement Directive apply to provincial procurements.

Any contract for the purchase of AI almost inevitably requires a 'bedding-in' period to allow for deep learning, the process in which large datasets are fed into the AI software to accurately recognize patterns from the input data. Once trained, the software's decreasing error rates gradually allows it to make more accurate predictions.

If the AI software fails to reach the targeted level of predictive analysis during the bedding-in period, a contractual exit ramp should be available to the hospital. The legal consequences of such an exit need to be accounted for.

There is also data law, which is at the heart of AI. Data privacy and security are

now prominent in the business world, but of equal importance are the legal rights and duties around data licensing (which party to the contract has the necessary permissions to do what they are aiming to do with the data?) and data ownership (which party owns the data that is produced from the AI software?). And with AI software, there is the question of whether the software is regulated as a medical device under the federal Food and Drugs Act.

For now, AI is so new that the focus is

still on getting the basic details of the deep learning phase right, such as agreeing on realistic expectations in the statement of work.

*Denis Chamberland is a commercial lawyer with extensive procurement, technology and trade law experience in the healthcare sector in Canada and Europe. He worked with Mackenzie Health in the above-described AI innovation procurement. He can be reached at [dac@chamberlandlawcorp.com](mailto:dac@chamberlandlawcorp.com)*

## New app encourages patient engagement

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challenged to get the best possible image while keeping patient radiation exposure to a minimum. Rejected images often are a significant barrier to achieving this goal, with some U.S. healthcare providers seeing X-ray reject rates of up to 25 percent. The U.S. recommended target reject rate is 5-8 percent.

Repeat images lead to unnecessary patient radiation dose and inefficiencies such as decreased throughput and wasted staff resources and time. RRA is a software applica-

**Aidoc's algorithm does image analysis on the head and neck and determines if patients should be at the top of the queue.**

tion that helps automatically identify and analyze the root causes of rejected X-ray images for quick and easy review, so healthcare providers can take action with staff training.

Another hot area is the use of image analysis to spot potential problems in diagnostic images, such as CT scans. These scans can be flagged and pushed to the top of the workload of radiologists, so a patient who may have an aneurysm or brain bleed isn't left waiting.

Carestream demonstrated this capability at its booth; the solution works with the Carestream radiology system, prioritizing exams for radiologists. Carestream does much of its software development in Is-

rael, and it has also partnered with Zebra Medical, an Israeli company that's become a global leader in Deep Learning for the healthcare sector.

Fujifilm, too, demonstrated this year how it leverages its expertise in image processing and pattern recognition and showed how AI can be immediately applied to create a 'smart' worklist, by flagging studies with abnormalities, bringing them to the attention of the radiologist before the exam is even opened. Christie Innomed has represented Fujifilm in Canada since 1964.

Another Israel-based company that's quickly gaining traction in Deep Learning for the healthcare sector is Aidoc; it demonstrated its technology and approach at RSNA 2017. "We're not focused on specific use cases or diseases," commented Tom Valent, VP of business development. "Our focus is on trauma, where time is of the essence."

Valent explained that Aidoc's algorithm does image analysis on the head and neck – a wide area of coverage – and quickly determines if patients should be moved to the front of the queue for a closer look.

He said the system is primed to look for 15 different pathologies, including epidural hemorrhage and mass effect – the movement of the brain inside the skull. It's conditions like these, he noted, that require fast attention. "A brain bleed or a fracture of the spine is time-sensitive," said Valent. The system is designed to flag problems for radiologists, not to replace them.

and develop solutions that the end users perceive will add value, and the solutions will be more likely to result in added value once implemented.

Island Health's experience "pausing" the CPOE initiative, gave all the providers a chance to learn the many transcription and re-transcription steps of the manual paper processes, and deeply understand the risk to patients (and the wasted clinician and staff effort) introduced by so many opportunities for transcription error that can lead to patient harm.

Once providers saw the alternative, the value of automating became clear. In the words of Dr. Ben Williams, Island Health's Executive Lead for Strategy and Engagement, "Keep going! It's better for patients. Make improvements, but keep going."

*Rosemary Gray is a member of the BCHIMPS Board.*

## Team approaches

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full adoption of several clinical best practice workflows by working with their clinicians to embrace many of the constructs of world-class health systems such as Sweden's Jönköping County and InterMountain Healthcare in Utah. Clinicians review their individual practice patterns and preferences and come to agreement as a group to co-design an acceptable workflow to support best practice and eliminate unwarranted variation.

**Ownership:** In the words of our world-class facilitator, Yoel Robens-Paradise, "What's the Secret Sauce?". The same answer echoed through the day – building local user ownership of the change is critical to success. It isn't rocket science, but it continues to be elusive.

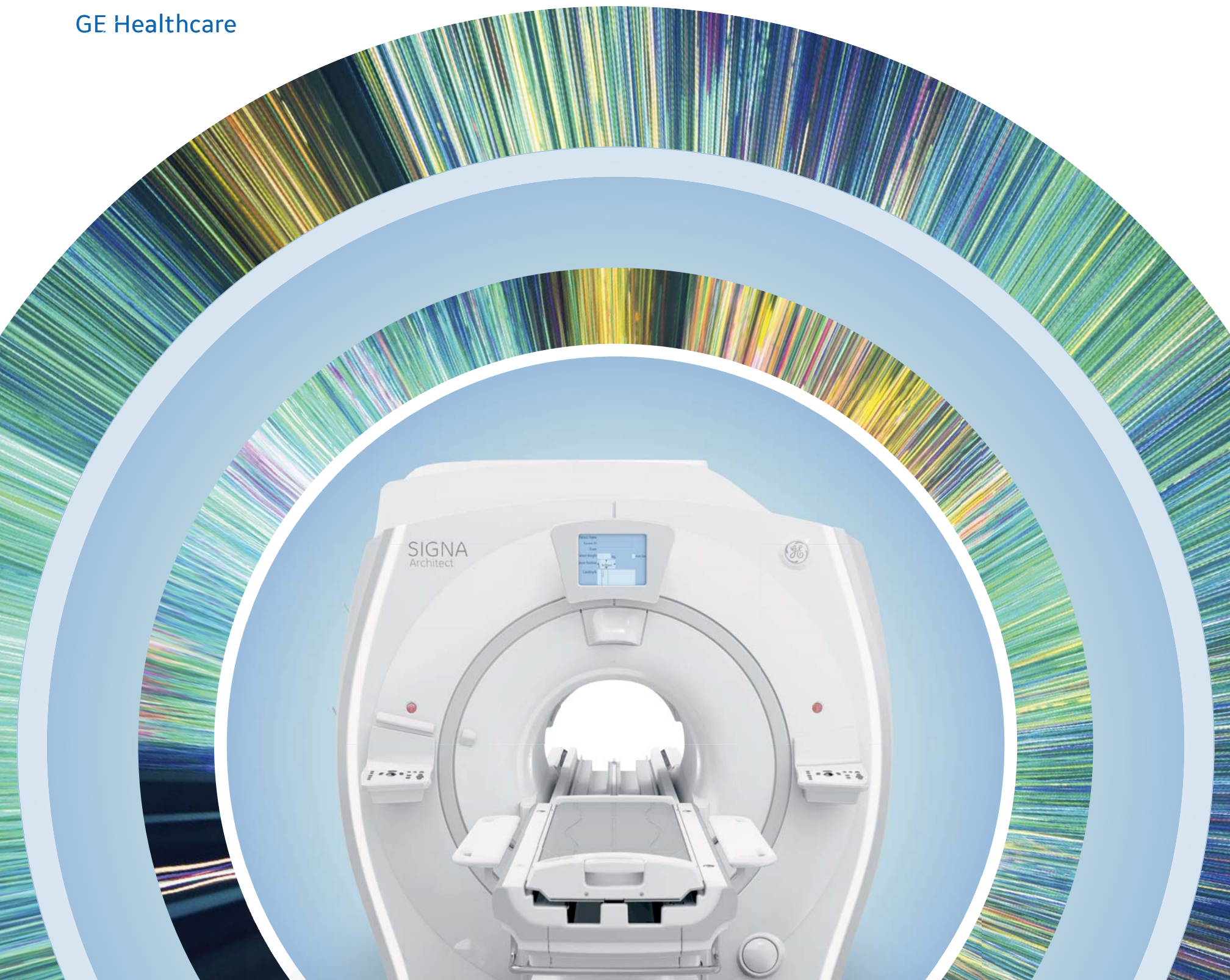
Local clinicians and informaticians must work together to co-design solutions to improve patient care, and workflows must support the improvement result you're seeking – careful review and design by the users impacted by the workflows is essential.

As Dr. Jeremy Theal said, we must remember that it's possible to achieve

**Local clinicians and informaticians must work together to co-design solutions to improve care.**

both positive and negative outcomes with the same tools, and the same vendors – the difference is in the team and the approach. The Island Health team from Nanaimo echoed the same sentiment – understand the user community and engage with them early to identify





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