

MARS

A Quarterly Publication

Future of Health

**Dr. Robot will see you now:
“Out there” innovations are
turning science fiction into reality**



MaRS is a journal conceived to reflect the creative spirit of our urban innovation hub, as well as the cultural and economic diversity of Toronto, the singular city in which MaRS is based. The mission of the magazine is to examine both new ways of thinking and new ways of doing things, from scientific research to technological advancements, always with a view to improving the human condition. MaRS maps innovation and highlights how it touches our lives.

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DISRUPTIVE DIAGNOSTICS

BY MARJO JOHNE

“Out there” innovations provide personalized care for patients

Image: Using the MolecuLight *i:X* device to scan an infected foot

VEERING INTO STAR TREK GALAXIES



Chad Pelley is an author, songwriter and journalist whose debut novel, *Away From Everywhere*, has been adapted into a film now making the festival rounds. But he might never have become the celebrated artist he is today.

The 36-year-old resident of St. John's has arrhythmogenic right ventricular cardiomyopathy (ARVC), a rare heart disorder prevalent in Newfoundland and Labrador. Its first and only symptom is often a fatal heart attack. Thanks to genome sequencing that identified the gene responsible for ARVC, Mr. Pelley was able to learn through a blood test that he has the disorder.

Today, he walks around with a defibrillator implanted under the skin on the left side of his chest. Should his heart suddenly falter or stop, the defibrillator will send an electrical pulse to start it beating again.

Mr. Pelley says his brother and father also have implants and both have had electrical pulses from them. "Mine has never fired at me, but there are times when my heart does something very strange."

The future of medicine has always seemed out there, as fantastical as *Star Trek's* fictional "tricorders." But in the realm of diagnostics, cutting-edge innovation is rapidly drawing this future within arm's reach of today's patients, professionals and the healthcare system.

In a triumph of science and high-performance computing, new technologies now make it possible for doctors to diagnose conditions with unprecedented accuracy, identify the probability of developing a disease based on genetic analysis, and tap into the wisdom of experts around the world.

As a result, "we're moving towards health and medicine that's much more personalized," says Will Falk of the healthcare services group at PwC Canada, which provides assurance, advisory and tax services. "This means doctors have to think about who you are and what's different about you as they design treatment plans."

As well as being more effective, treatment will become more efficient, says David Agus, a professor of medicine and engineering at the University of Southern California. According

to Dr. Agus, who is also a bestselling author on the future of health, personalized treatment and preventive strategies will lessen the financial burden on the system.

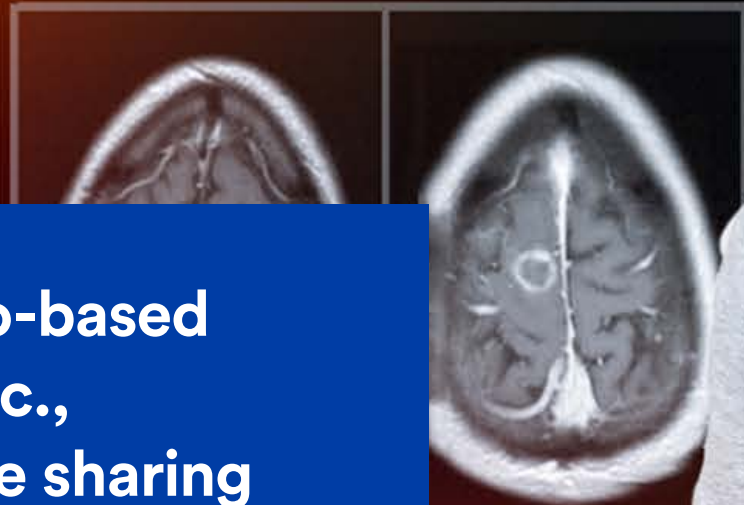
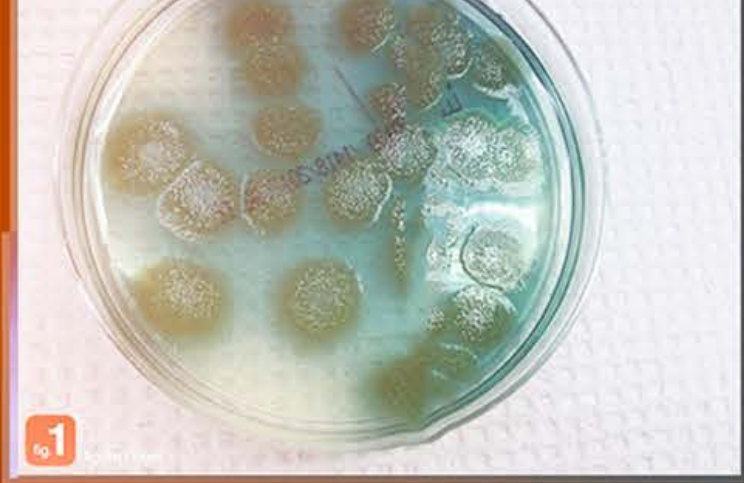
"IT'S PRETTY CLEAR THAT MEDICINE IS FUNDAMENTALLY CHANGING AND BECOMING MORE OF AN INFORMATION SCIENCE."

"It's testing the right patient at the right juncture in life," he says. Women now have a colonoscopy and a mammogram when they turn 50 even though thousands of people under that age die of breast and colon cancer every year. "Soon you'll be able to say with accuracy whether or not you will develop a particular disease, so you and your doctor can immediately discuss prevention. This will lower healthcare costs over time."

Some diagnostic innovators have already veered into *Star Trek* territory. Kitchener-based

At Toronto-based Figure 1 Inc., knowledge sharing takes place on a Pinterest-like platform that allows doctors to post (with their patients' permission) images and notes on cases they can't quite figure out.

(L-R) Richard Penner, Gregory Levey and Joshua Landy, co-founders of Figure 1



[Cloud DX Inc.](#), for instance, has developed VITALITI, a wearable device that uses biosensors to track vital signs and identify many medical conditions, including seven respiratory diseases that it can detect just by analyzing a patient's cough.

The VITALITI isn't for sale yet, but Cloud DX has other transformative technology, including cloud-based monitoring equipment that tracks patients' vital signs remotely and alerts doctors when trouble appears.

"We can spot adverse drug interactions before they even manifest symptoms — with our technology, you can actually see changes in the way the body is processing itself based on the different medications you take," says Robert Kaul, Cloud DX founder, president and chief executive officer. "Doctors have used our devices to monitor first-time moms subject to maternal hypertension, which can lead to preeclampsia, and we know of at least two cases where the intervention happened early enough so that the baby was saved."

MolecuLight *i:X*, another handheld device made in Canada, detects the presence of bacteria in wounds — information that's critical for patients with chronic wounds, and those who may not show symptoms of infection until it's too late.

Craig Kennedy, chief executive officer of [MolecuLight Inc.](#), the device's Toronto-based manufacturer, says MolecuLight *i:X* "makes bacteria visible and gives you immediate feedback on the status of the wound. It gives clinicians a tremendous amount of information."

"SOON YOU'LL BE ABLE TO SAY WITH ACCURACY WHETHER OR NOT YOU WILL DEVELOP A PARTICULAR DISEASE."

MolecuLight *i:X* is in good company. Toronto is home to 16 of the world's top 25 makers of medical devices — such as Johnson & Johnson, Medtronic and GE Healthcare — and more than half of the country's estimated 1,100 medical device companies. These Toronto-based innovators are developing products that are making a difference around the world. For example, last year [Profound Medical Corp.](#) sold its MRI-guided prostate care device to healthcare organizations in Spain and Germany. Another Toronto company, [BresoTec Inc.](#), got the go-ahead last February to market its sleep apnea diagnosis aid device, BresuDx, in Europe, and began selling the device in the UK last fall.

Advances in DNA analysis have also pushed the limit of diagnostic possibility. For instance, at the Ottawa-based Children's Hospital of Eastern Ontario (CHEO), doctors use genomic technology to identify the cause of rare diseases in young patients.

Kym Boycott, a clinical geneticist at CHEO, says genetic testing can uncover more than one rare

disease in the patient, which has a critical impact on treatment.

“Knowing that a child has two diseases dramatically changes the way [doctors] look after these patients,” she says. “It is absolutely disruptive technology.”

Many, if not most, of today’s disruptive diagnostic technologies rely on high-powered computing. In fact, complex tests such as exome sequencing — which involves analyzing as many as 20,000 genes all at once — would be near impossible to undertake without major computing muscle.

“It’s pretty clear that medicine is fundamentally changing and becoming more of an information science,” says PwC’s Mr. Falk. Not only will medical practitioners “need to deal with large data sets and multiple sources,” he adds, they will have “to share those sources with their patients.”

The idea of greater access to information is certainly taking hold in life sciences. McGill University in Montreal recently made all of its published research and data freely available to other institutions while, in the rare disorders

community, an online repository called PhenomeCentral now connects clinicians and scientists by matching their patients’ profiles with similar cases.

At Toronto-based [Figure 1 Inc.](#), knowledge sharing takes place on a Pinterest-like platform that allows doctors to post (with their patients’ permission) images and notes on cases they can’t quite figure out. Diagnoses are, in essence, crowdsourced among Figure 1’s more than one million registered users — all doctors, many of whom are experts in their field.

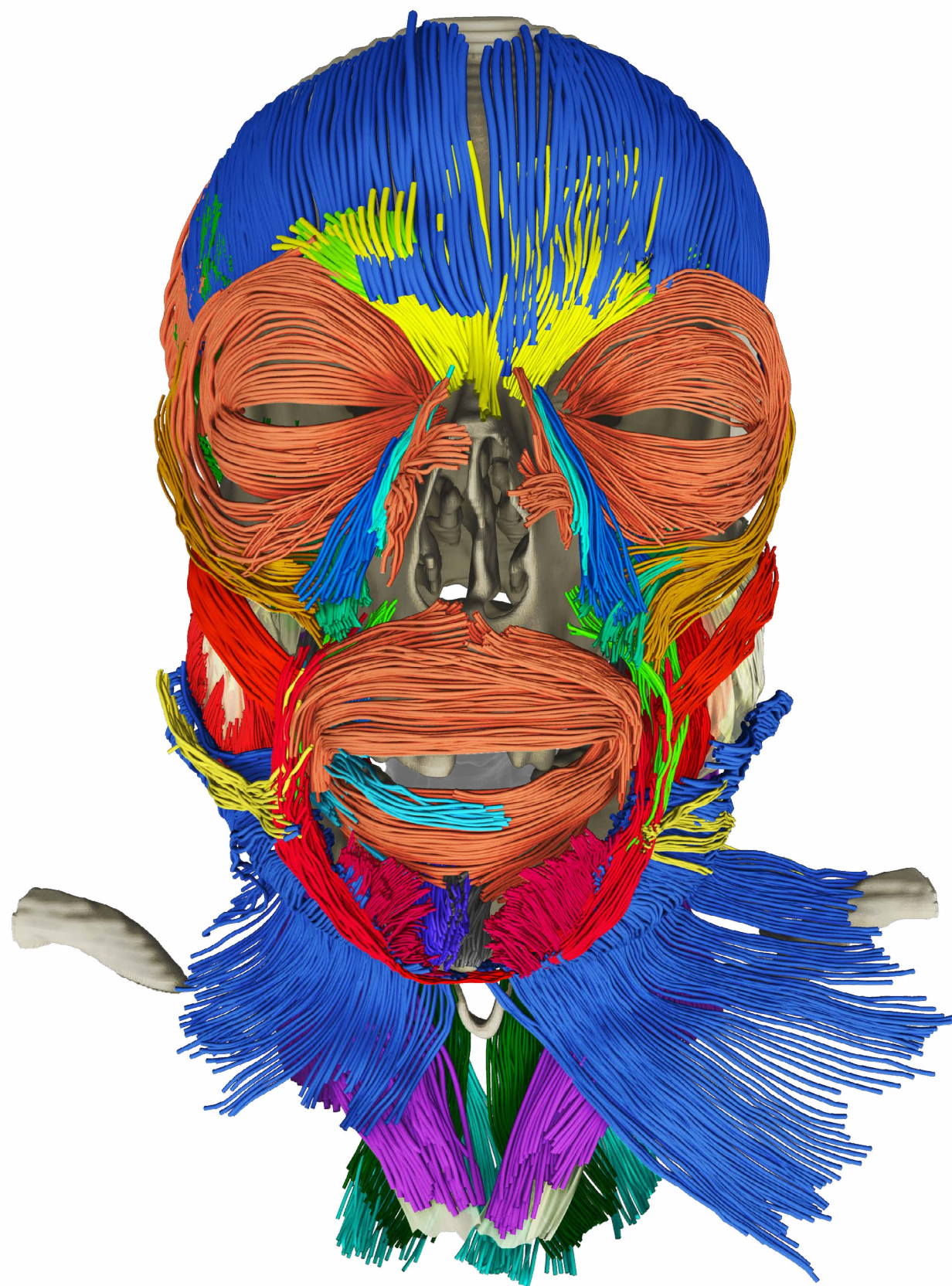
Joshua Landy, chief medical officer at Figure 1, says the system allowed a doctor in Los Angeles to help a colleague in Haiti treat a baby’s unusual skin rash and a lone physician in a Peruvian rain forest regularly posts photos of patients’ conditions, soliciting advice from other physicians on the platform before deciding whether to send them to a specialist.

“He’s cut down the number of people who need to fly to Lima,” Dr. Landy says. “What we’re doing is leveraging the power of the Internet, which is the power of distribution.”

Robert Kaul at Cloud DX sees a future in which automated systems diagnose, and perhaps even treat, health problems.

“We believe it’s inevitable,” he says. “And we believe health professionals will love it because it will mean better results for their patients.”

Chad Pelley won’t argue. Walking around St. John’s, he says, “it’s disturbing to think what could happen,” if advanced diagnostics had not identified his disease, prompting him to get a defibrillator that now constantly protects his heart.



THIS 3D HUMAN COULD REVOLUTIONIZE PRECISION MEDICINE

BY MARJO JOHNE

The Parametric Human Project is building
the Wikipedia of the human body

Imagine having a map of all the human anatomical parts and their possible variations: a digital collection of all the different types of bones, muscles and connective tissue in men and women from any race. And imagine that a high-speed computer could download personal data into this 3D simulated human and run tests for doctors to determine exactly how a patient will respond to a particular drug or treatment without first testing it on animals.

The promise of precise, customized medicine is still years away, but a cross-disciplinary team, involving 30 institutions around the world, is building a complete morphological and physiological virtual human dubbed the [Parametric Human](#).

Accurate diagnosis and treatment rely on solid information, yet “we really don’t know the human body,”

says Jeremy Mogk, Autodesk Research’s principal scientist on the project.

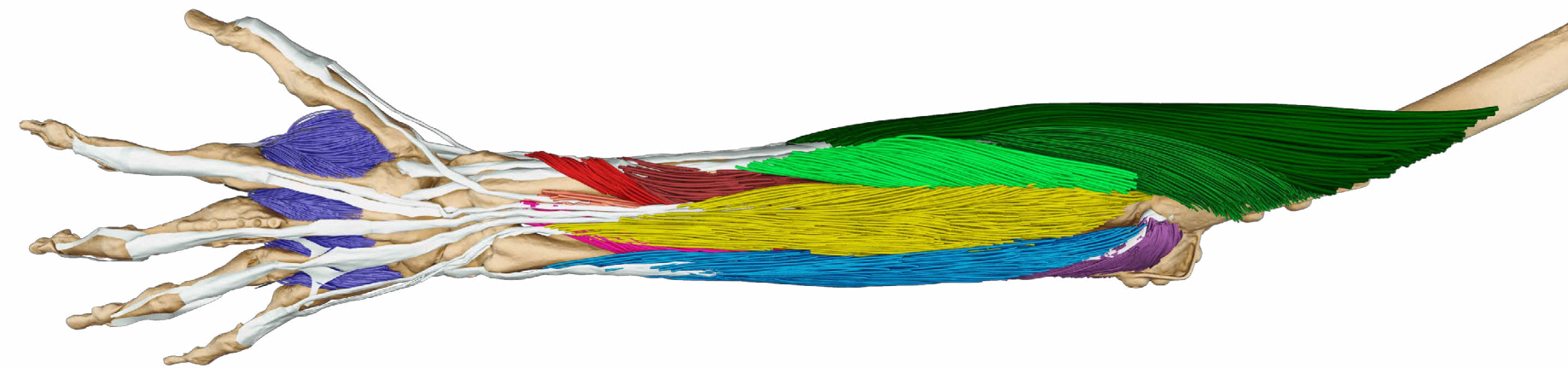
“Even when you look at anatomy textbooks, what they’re really showing is a relatively superficial view,” he adds. Mogk believes it’s time to go beyond the superficial — by graphically depicting, in minute detail, every part of the body, which is why he has spearheaded the project through Autodesk, one of the world’s largest software design firms.

But despite backing by both corporate and academic partners, intense effort is required. Mr. Mogk points to work under way at the University of Toronto, where Prof. Anne Agur of the department of surgery is digitizing muscle fibres, section by section, throughout the body with a miniature robotic arm.

“Through the digitization process that she pioneered, she’s discovering that we had no idea just how complex some of these structures are,” says Mr. Mogk.

The project’s overarching goal, he adds, is to create a central repository and platform where researchers can share their data — a Wikipedia, of sorts, for all things related to the human body. But the potential applications are no less exciting: the 3D model can be used to develop targeted therapies, to map complex surgeries and to create simulation-based training for healthcare professionals.

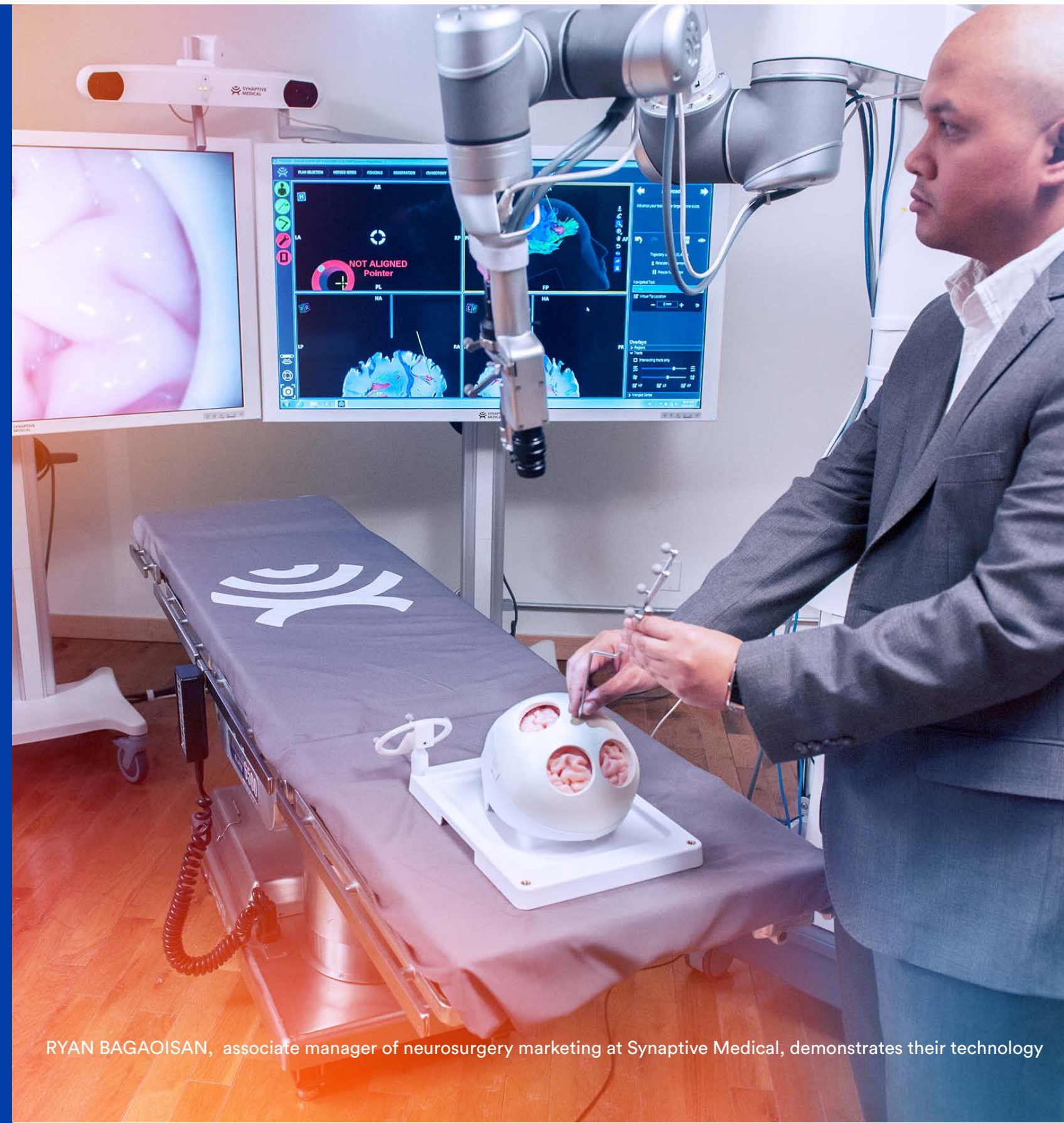
“By creating this model, we are building something that can be used as a reference or map of the human body, complete with all the possible variations so that, for example, surgeons know what to expect when they’re going into a particular bone or joint,” says Mr. Mogk.



WHY CAN'T OUR ENTREPRENEURS SELL THEIR HEALTH INNOVATIONS HERE?

BY SHELLEY WHITE

Innovators are suffering
from Sisyphus syndrome



RYAN BAGAOISAN, associate manager of neurosurgery marketing at Synaptive Medical, demonstrates their technology

Synaptive Medical wants to help neurosurgeons do a better job. The Toronto startup's suite of visualization equipment and applications for neurosurgical procedures includes high-definition, 3D imaging tools (for use before and during surgery) and even a life-like, simulated brain for practice purposes.

"We help surgeons be more efficient with their surgery and use better information to guide their decisions," says [Synaptive Medical](#) president Cameron Piron.

But the company has yet to make a sale in Ontario, its home market. And this, despite receiving Health Canada's green light for its suite of products last summer (the U.S. Food and Drug Administration gave its approval a year earlier). In fact, only after striking deals with the Aga Khan University Hospital in

Pakistan and 15 major US customers, such as Seattle's Swedish Health Services, Cedars-Sinai Medical Center in Los Angeles, Houston Methodist Hospital and Emory University Hospital in Atlanta, was the company finally able to find a Canadian customer — in Vancouver.

"Certainly, our neighbours to the south take a little more initiative in taking on new technology to impact change in their healthcare systems," says Mr. Piron, a medical biophysicist and serial entrepreneur who founded the company about four years ago.

International customers may be more willing (and more able) to make the significant investment required — installing the system can cost more than \$1 million — but not having a buyer at home can also be a hindrance when it comes to selling abroad, says Mr. Piron.

When potential clients come to visit, "it's a real loss that we can't take them to a local customer ... and be able to show an operating room," he says. "It's certainly an awkward conversation of, 'It's being used all around the world, but it's not being used here. Why not?'"

AN UPHILL BATTLE

Synaptive Medical is not alone. Waterloo-based startup [Intellijoint Surgical](#) produces a device that helps surgeons achieve better accuracy when performing hip replacements. Founded in 2010, Intellijoint received Health Canada approval in 2013. The first use of the product took place at Toronto's Mount Sinai Hospital that December, but since then, sales have taken off in the US, not in Canada.

Canadian surgeons realize "what Intellijoint Hip could do for their

MANY STARTUPS FALL INTO THE "VALLEY OF DEATH" — THEY LACK THE RESOURCES TO SURVIVE THE CANADIAN SYSTEM'S FREQUENTLY LONG SALES CYCLES.

"THE END GAME IS NOT ONLY FOR THE COMPANY TO HAVE ONTARIO AS THEIR FIRST CUSTOMER, BUT FOR THEM TO TAKE THAT DOSSIER AND SUCCESS STORY TO OTHER HEALTH SYSTEMS AROUND THE WORLD."

patients," says chief executive officer Armen Bakirtzian. "The problem for us was when surgeons went to their administrators to have the product paid for." Intellijoint charges \$1,000 per surgery for the license to use the technology.

Dr. Bakirtzian says the problem has reached the point that his company has pretty much stopped trying in Canada and is focusing mostly on the US.

Why are so many innovative Canadian startups facing such difficulty here at home?

Hadi Salah, manager of health ecosystem partnerships at MaRS Discovery District, says some of the challenge lies within the procurement system.

He explains that hospitals currently have to identify a need, find the funding for it and issue a public RFP (request for proposal) describing the solution and exact specifications it must meet. "When the healthcare service providers put out these specs, they're really limiting themselves ... because, if there's something radical out there

that's innovative but doesn't meet those specs, they're not eligible to even respond to the RFP."

Clients in the US do not face the same restrictions — they tend to buy anything that works for them. Mr. Salah points to Kaiser Permanente in Oakland and Cedars-Sinai Medical Center in Los Angeles as pioneers.

"We like to talk about Kaiser as a case study about how to do things," he says. "About 10–20 years ago, almost all of their care was delivered in hospitals; now it's significantly less because they've gone into mobile, they've gone into smaller clinics. So the whole model of care delivery is pretty innovative."

Cedars-Sinai has partnered with Techstars to launch a venture fund and an accelerator right at the hospital, Mr. Salah adds. "They select the top startups and they house them in their health system to see if they can co-develop solutions ... and then they actually invest in these companies."

Another barrier here is that many startups fall into the "valley of death" — they lack the resources

to survive the Canadian system's frequently long sales cycles. Also, most hospitals won't consider adopting a new technology if the cost isn't reimbursed by their provincial health ministry, notes Mr. Salah — which, in Ontario, can take years even after Health Canada has given its approval.

PREVENTING THE VALLEYS OF DEATH

One bright light is the MaRS Excellence in Clinical Innovation and Technology Evaluation ([EXCITE](#)) program, which works to get disruptive health technologies to market faster. In fact, it is designed for what Liana Di Marco, its project manager, describes as technologies with an impact great enough to be considered “changing the way that care is delivered.”

The program connects such companies with regulators, payers (insurance providers) and academic researchers, who all work to build an “EXCITE evidentiary bundle” demonstrating the value of the technology. This bundle includes clinical trial data, an economic analysis, a

systematic and comparative effectiveness review and a “human factors” review.

The results then go to EXCITE's management board members, among them William Charnetski, Ontario's chief health innovation strategist, who decide whether to recommend a product for adoption and use in the province. “But really,” says Ms. Di Marco, “the end game is not only for the company to have Ontario as their first customer, but for them to take that dossier and success story to other health systems around the world.”

Last fall, she adds, the ministry added a bonus to the program by committing to work with a company to help it recover in revenue, at minimum, what it paid toward the EXCITE study. (For example, companies underwrite any trials required.) “To my knowledge, no other health system has done that,” she says.

THE TEST CASE

Toronto-based [BresoTec](#) is the first company to go



“THE PROBLEM FOR US WAS WHEN SURGEONS WENT TO THEIR ADMINISTRATORS TO HAVE THE PRODUCT PAID FOR.”

(L-R) Andre Hladio, Armen Bakirtzian and Richard Fanson, co-founders of Intellijoint Surgical

“WE NEED TO REALLY ADJUST OUR THINKING ... BECAUSE TECHNOLOGY'S CHANGING QUICKLY AND WE'RE GOING TO GET LEFT BEHIND.”

through EXCITE. Its BresuDx diagnostic tool is a cheaper, simpler and more consumer-friendly home test for sleep apnea — what founder Dr. Geoff Fernie calls a “game changer” for those (one person in 10) who suffer from the disorder. The company was also supported by [MaRS Innovation](#), a non-profit that acts on behalf of 16 member organizations (15 of Toronto’s top universities, institutions and research institutes, plus MaRS Discovery District) to help commercialize discoveries.

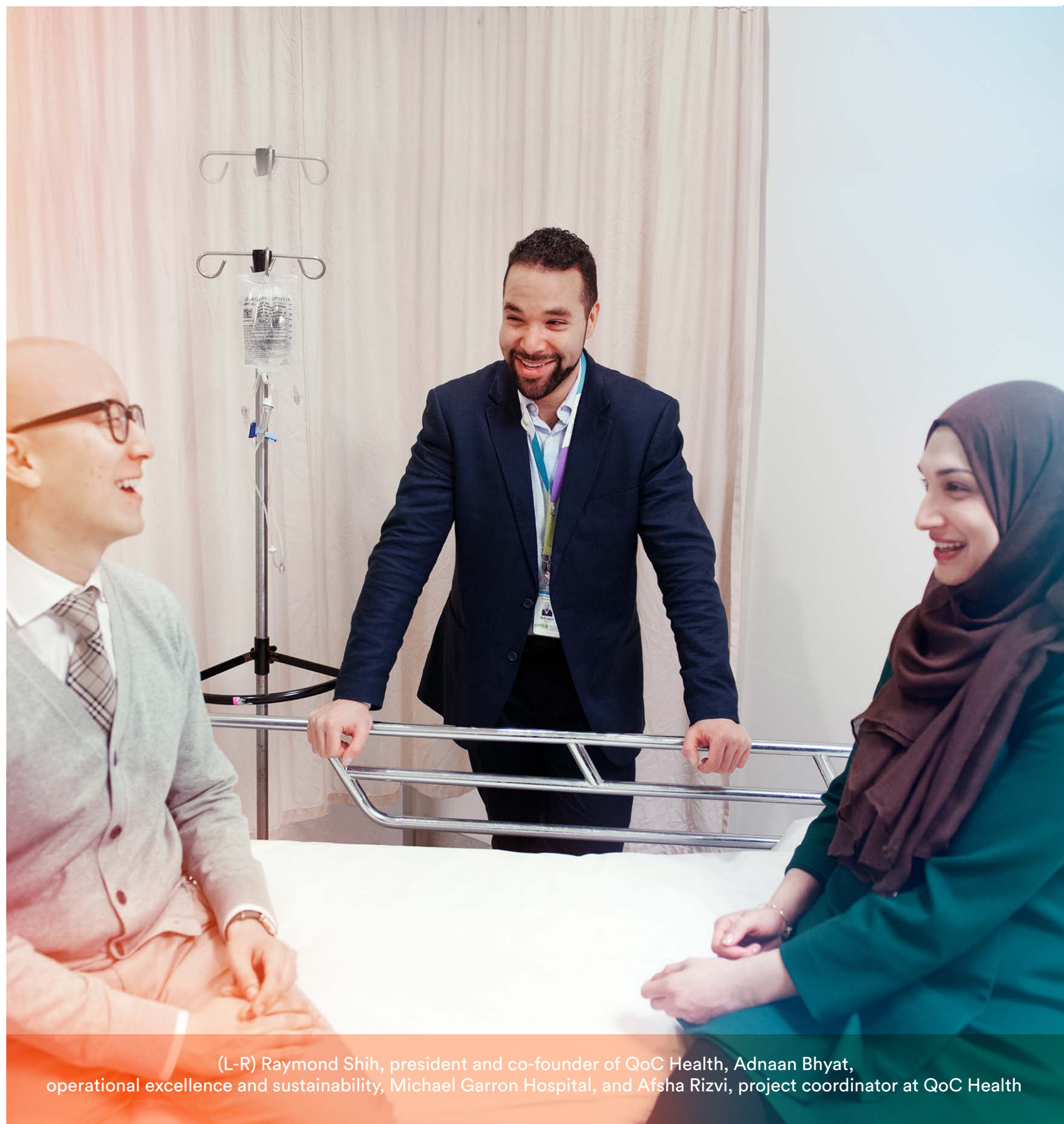
“The neat thing with MaRS Innovation and EXCITE is that you have a premarket evaluation,” he says. “So while you’re still continuing to do all your regulatory work, all your production engineering, they’re looking at the device and how it might fit into the Ontario healthcare system ... so you compress the time.”

With a green light from Health Canada to sell their product, Bresotec faces one last hurdle — adoption by the healthcare system. “Now it’s up to the Ministry of Health to come to a decision,” Dr. Fernie says.

Mr. Salah says he’s seeing “a lot of need and want” from across Canada and the world for programs that are similar to EXCITE. “This model is already being adopted by others,” he says.

In fact, a spinoff called EXCITE International has been launched, retaining the features of the Canadian program, but also including payer input from the US and UK. “Companies that want to basically launch in all three markets globally can use this as a single entrance point,” says Ms. Di Marco.

She hopes that EXCITE will show healthcare stakeholders that more can be achieved by working together: “We need to really adjust our thinking ... because technology’s changing quickly and we’re going to get left behind.”



MADE TO ORDER: HOSPITALS CO-DESIGN SOLUTIONS WITH ENTREPRENEURS

BY SHELLEY WHITE

A new program matches hospitals with
entrepreneurs to build solutions together

(L-R) Raymond Shih, president and co-founder of QoC Health, Adnaan Bhyat, operational excellence and sustainability, Michael Garron Hospital, and Afsha Rizvi, project coordinator at QoC Health

If technology can solve your problem, why not have it made-to-order? That's the question a dynamic new program at MaRS is addressing and, in the process, it's turning traditional healthcare procurement on its ear.

An experimental project launched last year in Ontario, it started with a simple idea: the team issued an open call to healthcare providers to describe a challenge their institution faces, and then directed these asks to entrepreneurs who will work collaboratively on solutions.

Launched in August 2016 in conjunction with the Ontario Ministry of Government and Consumer Services, the [Innovation Partnership: Procurement by Co-Design Program](#) is a “collaborative design exercise” aimed at helping leading-edge technologies reach the organizations — and patients — that need them most.

Overall, the response was enthusiastic — almost two dozen healthcare providers issued 29 challenges that were then listed on the program website. The entrepreneur community came back with over 140 proposed solutions.

Some of the challenges were quite broad in nature, others were looking for very specific outcomes.

“For example, one provider said they wanted a better way of managing wheelchairs and gurneys in their hospital to reduce the number of patients waiting for transfers,” says MaRS associate Lily Lo, who also serves as the project manager.

Pitch sessions helped to narrow the field, and the providers then selected the vendors they wanted to work with. In total, 17 project teams spent 12 weeks co-developing their innovations.

At the end of February, the teams came back to MaRS to compete for up to \$25,000 to spend testing the co-developed solutions right where they'd be put to use. Four of the 17 teams ended up receiving funding, including QoC Health, which is working with the Michael Garron Hospital to help manage post-anesthesia recovery, and VitalHub, which got the green light to proceed with two separate solutions for providers Markham Stouffville Hospital and Trinity Village Care Centre. The next step will see

“THE IMPACT IS BETTER SOLUTIONS, BETTER COLLABORATION AND LOWER COSTS OVERALL.”

the teams present the results of their testing in July, potentially receiving another \$25,000 for procurement.

But program manager Hadi Salah says the grants aren't the central goal — the venture is more about fostering a new “challenge-based, co-design approach” to procurement.

“This could be an open-source toolkit that a procurement department within a hospital could use and scale up on their own,” he says, adding: “The impact is better solutions, better collaboration and lower costs overall.”

TWO CASE STUDIES

[QoC Health](#) responded to a challenge from Michael Garron Hospital (formerly Toronto East General), which wanted to better manage traffic in and out of a post-anesthesia recovery room.

“We proposed an application that the staff scheduler would use to co-ordinate everything, all the way from the surgical procedure through to the recovery room,” says company president and

co-founder Raymond Shih. The two organizations will be working together on the app over the next several months.

Mr. Shih not only likes the co-design concept — procuring based on “the problem you're trying to solve and not on a set of specifications” — he finds the process useful from a business sense too because it provides “an opportunity for us to work with some folks that we may not have been directly connected to before.”

[VitalHub](#), a Toronto-based mobile health startup, is developing two solutions: an app to streamline the physician onboarding and orientation process for Markham Stouffville Hospital; and an app for Trinity Village Care Centre that provides quick access to a variety of forms and schedules, and also enables on-the-fly note-taking, task-tracking and team collaboration.

Andre Vandenberg, VP of mobile technology, says their proposed solution for Markham Stouffville Hospital would change how the hospital shares information and documents with its physicians, and how it collects their data, questions, feedback

and signatures as part of the onboarding and orientation process.

In the case of Trinity Village Care Centre, he says the goal is to streamline the way frontline staff document and access information about residents, explaining that they currently use multiple paper-based and electronic documentation systems located on separate computers throughout the facility.

He says he's had “a very positive experience” in the program so far because it enables providers to truly collaborate with the vendors who can help solve their problems. “Without going through such a process, providers and vendors are often on different pages when it comes to the interpretation and understanding of problems and how to solve them,” he says. “This program provides a repeatable approach to ensure the provider's real-world problem is appropriately addressed and successfully implemented.”

DR. ROBOT WILL SEE YOU NOW

BY ZAYNA KHAYAT

The balance of power in the traditional doctor-patient relationship is drastically shifting thanks to DIY healthcare and the patient revolution.

It's no secret that physicians have learned to cope with patients who turn up armed with reams of information gathered from the Internet.

But the next revolution in digital healthcare, which is gathering momentum, could pose a far greater challenge to the role of physicians as the traditional custodians of medical knowledge. In fact, it may reduce that role significantly.

With smartphone health apps, health-related wearables and real-time patient access to raw or minimally distilled lab test data via electronic health records (EHR), individuals are relying less and less on their doctors to interpret a growing range of specific medical data.

But this revolution goes beyond the democratization of test findings. Emerging crowd-based health platforms such as [CrowdMed](#) or [PatientsLikeMe](#) aggregate information from large sets of patients, and allow individuals to review their health situation in that wider context, thereby providing troubleshooting and decision support for health self-management. Others, such as [Human Longevity](#), a deep genome sequencing

service, provide a full assessment of all your data, including non-medical data, to give users a 360-degree understanding of what is going on with their bodies.

Yet the notion of unfettered access to all that information — both discrete results and more integrated ones — has revealed a battleground in healthcare, one that pits traditional practitioners not only against patients, but also against a new generation of colleagues who recognize that the democratization of such data is changing the role of the physician profoundly.

An [Accenture survey](#) of 7,840 adults in seven countries released last year reveals the depth of the attitudinal chasm: 92 per cent of US patient respondents believe they should have full access to their medical records and test results, while only 18 per cent of physicians share that view. The consumers surveyed were overwhelmingly in favour of sharing their own health data — gathered from apps or other devices — with their health practitioners.

The survey, however, showed that physicians

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MEDICAL DATA IS COMPLEX AND NUANCED – THE EPITOME OF THE SORT OF INFORMATION THAT REQUIRES THE DETAILED KNOWLEDGE AND INSIGHT THAT PHYSICIANS GATHER THROUGHOUT THEIR CAREERS.

are clearly losing their ability to control access to patient information. The proportion of respondents accessing their EHRs jumped to 45 per cent from 27 per cent between 2014 and 2016, while the use of apps and wearables, such as insulin monitors, has doubled in the same period. The fastest-growing categories of health information sought by patients, Accenture found, included lab work and blood tests, prescription histories and physicians' notes.

In the US, this sea change in the medical information landscape has been driven by a 2014 edict by the federal Department of Health and Human Services that mandates direct access for patients to their lab and test results.

While a growing number of Canadian healthcare institutions offer patients access to electronic records, such as Sunnybrook Health Sciences Centre's [MyChart](#), and entire health systems in Saskatchewan, Alberta and Nova Scotia, others do not or cannot do so easily because they are still in the early stages of digitizing their patient information. Many of these systems, moreover, don't take full advantage of the opportunity

because they take a passive approach to the information, allowing users to only read the data instead of sharing it seamlessly or connecting results to other tranches of patient information that will allow better decision-making. Given the proliferation of user engagement-oriented digital applications, the idea that patients can do no more than peruse their digital records suggests that the paternalistic approach to medical information not only persists but has been programmed into the architecture of our electronic health records.

Canada, moreover, has no overarching disclosure framework. While the right to access records is [enshrined in law](#), patients must pay hefty sums to obtain their own charts (\$75 as a start-up fee, and then \$1.55/page), and the charts themselves are legally considered to be the property of the physician or healthcare institution.

But even that non-trivial impediment has begun to crumble. [MedChart](#), a Toronto startup, has launched a fee-based service that gathers patient records from various health institutions, consolidates and sorts them, and then allows third

parties to access the information through a secure portal.

With the unleashing of the information comes other developments that will erode the exclusive interpretive role of the physician: test results automatically flagged or colour-coded to indicate whether a patient's readings — e.g., insulin or lipid levels — are within normal range, as well as natural language processing that presents patient medical information in more straightforward ways. But is this wise? After all, medical data is complex and nuanced — the epitome of the sort of information that requires the detailed knowledge and insight that physicians gather throughout their careers.

I'm not suggesting that "Dr. Robot" will render health practitioners obsolete. But there is a payoff — mounting evidence that informed and engaged consumers — as opposed to passive patients — will participate more fully in their own care, both in terms of preventing illness, and treating it.

Physicians should celebrate the looming information revolution, because it means that

the patients they treat will ask hard questions, monitor their own health indicators, and bring their own insights and interpretations to the data generated by and within their own bodies. In the process, we'll all become much more engaged and inquisitive — traits, incidentally, that seasoned physicians always value in medical students and younger colleagues.

But make no mistake: this evolution is drastically shifting the balance of power in the traditional doctor-patient relationship. And who knows? Once the data genie is out of the bottle, that relationship may evolve into a much more equal partnership.



Staff at League participate in a meditation session

THREE STARTUPS, THREE WAYS TO REDUCE STRESS ON THE HEALTHCARE SYSTEM

BY JOHN LORINC

The emphasis is shifting
from cure to prevention

Since Justin Trudeau’s federal Liberals embarked on testy negotiations with the provinces over health transfers for the next decade, Canadians have seen the re-emergence of a persistent public-policy issue: runaway medical expenses.

Those expenses now soak up more than 70 per cent of some provincial budgets, and Ottawa’s initial proposal — another 3.5 per cent a year — is widely seen as inadequate. The provinces feel that, even with an added \$11 billion the feds say they would spend on mental health and home care over the coming decade, that is simply not enough for a population that is both aging and ailing. Almost [four Canadians in 10 over the age of 20](#) report that they suffer from at least one of 10 major chronic conditions.

But in the face of over-stretched budgets (and rising political friction), there are now other options, many of which represent the long-sought shift in emphasis to prevention from cure. A growing number of entrepreneurs have recognized that, with the assistance of cutting-edge technology, employers can play a role in reducing stress on the healthcare system

by helping their employees fend off illness.

One such entrepreneur is Toronto investor and philanthropist Michael Serbinis, co-founder of Kobo and now founder and CEO of [League](#), a startup that provides digital access to a “marketplace” of health and wellness services.

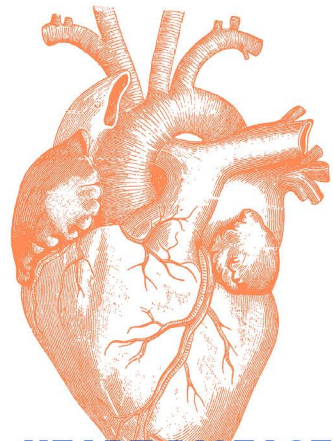
He looks ahead and predicts the rise of “life-optimization companies” that will “provide you with a personalized, always-on, preventative health plan.”

[Newtopia](#), another Canadian startup, already specializes in personalized medicine, and Jeff Ruby, its founder and chief executive officer, says some employers have begun to offer health plans that include new and highly individualized methods for helping people with metabolic disorders, ranging from diabetes and cardiovascular diseases to an elevated risk of stroke.

Some of the players in this field are leveraging the ever-expanding connectivity between various fitness wearables, big data, home-based medical

SUCH NON-TRADITIONAL BENEFITS PACKAGES MAY ALSO BE AN ATTRACTIVE RECRUITMENT AND RETENTION TOOL.

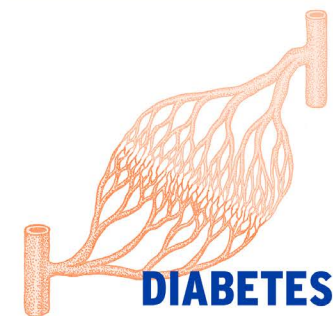
10 MOST REPORTED CHRONIC CONDITIONS



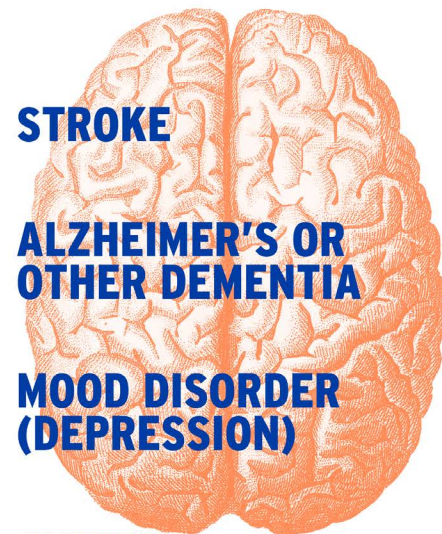
HEART DISEASE



CANCER



DIABETES

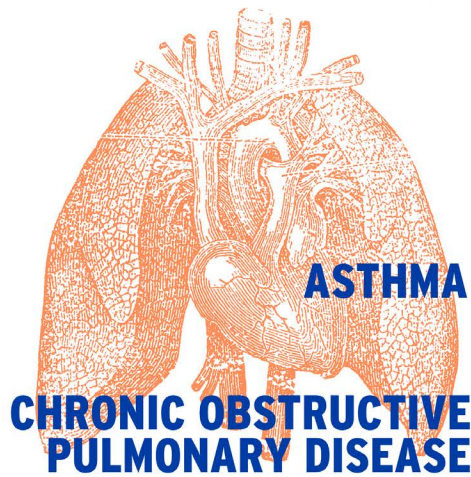


STROKE

ALZHEIMER'S OR OTHER DEMENTIA

MOOD DISORDER (DEPRESSION)

ANXIETY



ASTHMA

CHRONIC OBSTRUCTIVE PULMONARY DISEASE



ARTHRITIS

monitoring devices and smartphones. Others are marketing digital technologies that provide individuals and physicians better ways to manage chronic diseases.

There is little doubt about the financial windfall for governments and, therefore, taxpayers. According to Newtopia's research, a healthy adult consumes about \$3,400 in health services annually, while the figure for someone with a controlled metabolic disorder, such as Type 2 diabetes, rises to \$5,400. For those suffering from active diabetes or strokes, the numbers balloon to \$15,000 to \$20,000.

Newtopia works with employers and private health insurers to identify workers susceptible to metabolic conditions. Employees are invited to take special biometric tests to evaluate their risk factors. With the findings, Ruby says, the company will recommend a personalized set of lifestyle moves for exercise, nutrition, stress management and other behavioural changes. "You have to understand the person genetically and behaviourally," he says.

The company is testing its approach with Aetna, the insurance giant, through a three-year randomized control trial on 445 employees. The first results, published last fall in the *New England Journal of Medicine*, show 76 per cent of participants lost weight — an average of 4.5 kg each — and their overall health improved enough to yield savings in benefits payments of \$1,464 per person in the first year. The study's authors concluded the long-term cost reduction could be significant, and Mr. Ruby adds that "we're waiting to see what happens at the end of year two."

For employers, having a healthy labour force pays clear dividends: fewer sick days, improved productivity and the possibility of less-expensive health insurance premiums.

League, launched a year ago, is pushing the employer-focused approach one step further. It has created a wellness-minded health plan built around a flexible "lifestyle spending account" that allows employees to use their benefits plans to buy prevention-oriented services that range from

yoga and meditation to stress management and even registered naturopaths.

Indeed, the strategic insight that launched League has to do with building a health benefits plan that provides services employees actually want, such as stress management. “Most employees have health plans that offer benefits they don’t use” because they have too many restrictions or don’t cover areas such as mental-health services, says Mr. Serbinis, who is targeting the 70 per cent of small and mid-sized firms that have never had health plans, either because the company is too small or hasn’t been sufficiently profitable to offer this kind of benefit.

With all such ideas, the ultimate goal is to improve lifestyle choices and increase adherence to health programs designed to manage chronic conditions, and thus to prevent the onset of other medical problems. While an employer-based wellness or health-improvement plan has an implicit stick to accompany the carrot of better fitness, Mr. Ruby, at Newtopia, says employees who freely choose to participate in these prevention programs are much more likely to stick with them.

Mr. Serbinis, for his part, has his eyes on a demographic — millennials — whose members tend to be more comfortable with technology and oriented toward these kinds of lifestyle decisions. He cites such examples as an ad agency client with many younger employees who weren’t making use of the company’s health plan because it simply didn’t offer the kinds of services they were looking for.

In fact, at a time when many firms are scrambling to retain talented employees, such non-traditional benefits packages may also be an attractive recruitment and retention tool.

Last October, Starbucks [boosted annual spending caps on mental-health therapy from \\$400 to \\$5,000 per employee](#). Likewise, many tech companies have introduced yoga and meditation to their workforces as a productivity-enhancing perk in a sector with a lot of competition for talent.

But some health insurers are less interested in enticing employees than they are in using the power of technology to make sure they have the

WITH THE ASSISTANCE OF CUTTING-EDGE TECHNOLOGY, EMPLOYERS CAN PLAY A ROLE IN REDUCING STRESS ON THE HEALTHCARE SYSTEM BY HELPING THEIR EMPLOYEES FEND OFF ILLNESS.

FOR EMPLOYERS, HAVING A HEALTHY LABOUR FORCE PAYS CLEAR DIVIDENDS: FEWER SICK DAYS, IMPROVED PRODUCTIVITY AND THE POSSIBILITY OF LESS-EXPENSIVE HEALTH INSURANCE PREMIUMS.

best information to guide their ongoing prevention efforts.

Amos Adler, president and co-founder of [Memotext](#), has created a phone messaging service that pumps out timely reminders about medications and notifications about off-kilter glucose levels by connecting with an individual's health devices or the data from their electronic patient records. The service also provides users with motivational content specific to their condition.

The service, which is purchased by health insurers and pharmaceutical firms, relies on algorithms and user questionnaires that produce what Mr. Adler describes as a “dynamic” flow of highly personalized medical advice, but also educational information. He describes the return on investment compared with using a call centre as “very significant” because users receive highly tailored information automatically instead of having to deal with customer service representatives.

More broadly, he says, the explosion of health

data — drawn from wireless wearable devices, electronic medical records and other sources — flowing into smartphones has finally created a means for individuals to keep abreast of all the little decisions they need to make in order to prevent lifestyle-related diseases.

As he puts it, “We’re trying to ‘action’ the data so we can make use of it for patient purposes.”

The broader point, say the entrepreneurs working in these emerging markets, is that with governments increasingly pressed to stretch health budgets, the rapidly expanding troves of personalized health data has the potential to create a formidable digital bulwark against the skyrocketing cost of keeping an aging population healthy.

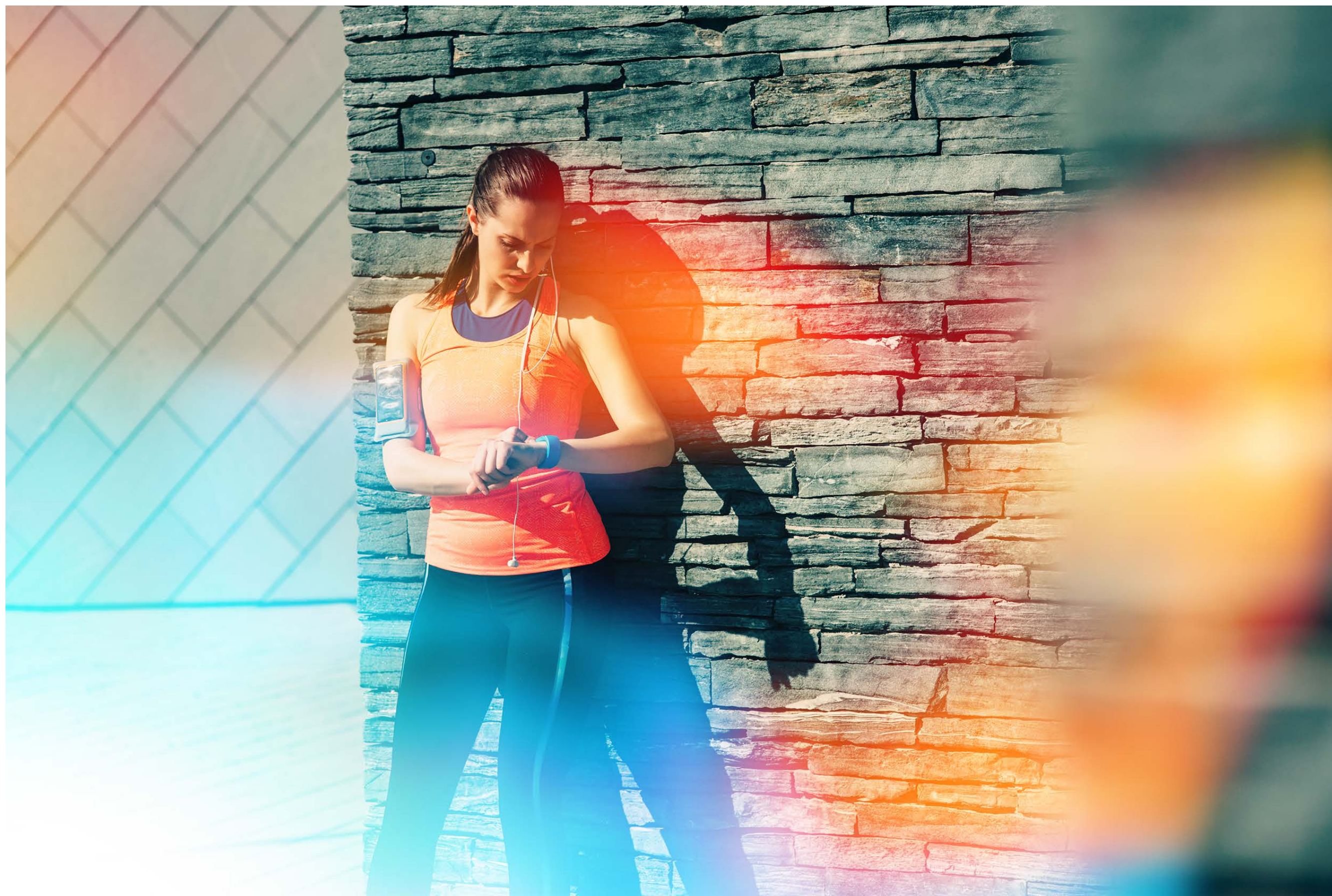
WOULD YOU QUIT SMOKING FOR AEROPLAN MILES?

BY JOHN LORINC

Carrot Insights is banking on it

So, you'd like to quit smoking: Why not collect points in the process?

Canadians are among the world's most eager consumers of rewards programs, and now our collective appetite for loyalty incentives can actually be good for our health thanks to a new health prevention app developed by the Public Health Agency of Canada, in partnership with [Carrot Insights](#), that is being rolled out across the country.



**“WE’RE SEEING ALMOST
INDUSTRY-LEADING
ATTRITION. NOBODY
QUITS THIS THING.”**

Carrot Insights is a rewards firm launched in 2015 by Toronto ad-agency veteran Andreas Souvaliotis. The Carrot Rewards app serves up points for most large consumer loyalty programs such as Aeroplan and Scene when the user performs tasks such as filling out an easy online quiz on smoking cessation or managing some chronic condition, exceeds a daily walking target, or even checks a map showing where to get a flu shot.

“[Canadians] love getting a bit of a deal,” says Mr. Souvaliotis, who notes that the app’s conversion rate — the proportion of users who act on the information they encounter — is enormous compared with conventional public health or wellness ads: 70 per cent click-through levels compared with 1 per cent for typical direct-marketing blitzes. In Newfoundland, the app captured fully 4 per cent of the province’s population within a month of roll-out last June. “We push out 100,000 messages and get 70,000 responses.”

In Ontario, where the app was released in the middle of February, Mr. Souvaliotis expects to

quickly see up to 250,000 active users. He also expects to see even more types of offers and earning options on the app, as governments continue to identify more ways of using Carrot as a public engagement platform. For example, beyond using it as a health and wellness promoter, it is already being used to encourage financial, environmental and civic/elections literacy, and to foster participation in public surveys.

What’s more, Mr. Souvaliotis adds, users don’t appear to tire of collecting points. “We’re seeing almost industry-leading attrition,” he says. “Nobody quits this thing.”

If Carrot’s insights are correct, all those incentives will pay off at the next check-up, as well.



US INVESTORS LOOK TO TORONTO TO SCOUT HEALTH INNOVATIONS

BY MARY GOODERHAM

Toronto's under-tapped market offers investors cutting-edge biotech and life sciences startups

Health investors from the United States are discovering vast prospects in Toronto as a hot-spot for biotech innovation and a place to invest in cutting-edge life sciences startups.

To Jerel Davis, managing director of [Versant Ventures](#), the global venture capital firm behind recent landmark deals in the city, “Toronto is pretty remarkable,” as a “completely under-tapped” market with strengths in fields ranging from regenerative medicine and oncology to heart disease, children’s health, radio medicine and imaging.

“The opportunity is huge,” he says, noting that US capital and large pharmaceutical companies are attracted by Toronto’s capacities “across the board” in science and healthcare delivery.

“There’s a very strong cluster of hospitals and research institutes in a very concentrated area. Many of them are top in North America, if not the world.”

The ease of access to those capacities is equally exciting, he says, with lower competition in the

emerging ecosystem allowing VCs “willing to do the hard work and roll up their sleeves” to tap into fundamental science, working with the best academics in their fields.

One indication of the growing interest in Canada’s healthcare scene is the number of investors drawn to the annual [Redefining Early Stage Investments \(RESI\) on MaRS](#) conference. Mr. Davis attended last year’s event and says it allows VCs to quickly scout and assess top Canadian health companies. “It brings together in one room all the key players driving innovation in the health sector — VCs, angels, startups, academics and corporates — and facilitates finding the most disruptive ideas.”

Recent data on venture capital investments in the sector also point to increased momentum. According to CB Insights, VCs invested over \$596 million in Canadian life-sciences companies in 2016, the most on record in a single year and almost 100 per cent higher than all of 2014.

Multinationals joining the Canadian health scene include Bayer, Celgene, Johnson & Johnson and

“THE VENTURE COMMUNITY IS UNIQUELY POISED TO FILL THE CANADIAN GAP; EVERYTHING IS READY FOR THEM TO STEP IN.”

Novartis, Mr. Davis says: “The list goes on and on and on.” Versant was involved in one of the biggest deals to take place in 2016 — the second-largest initial investment in a startup in the history of the biotechnology industry — joining Bayer to [invest \\$225 million US to create BlueRock Therapeutics](#), a new company with significant operations at MaRS that will commercialize regenerative medicines from stem cell research.

Mr. Davis says that MaRS “serves as an important beacon,” from its critical development infrastructure to introducing foreign investors to the Toronto scene. In fact, since the Versant-Bayer deal last December, two other big announcements involving Toronto-based health startups in the MaRS network have been made: Highland Therapeutics [raised \\$200 million](#) to shake up the multi-billion dollar ADHD drug market; and Meta, a startup that provides an AI-powered search engine for researchers and doctors, was the [first purchase made by the Chan Zuckerberg Initiative](#) for an undisclosed amount.

Mary Haak-Frendscho, a venture partner at Versant and CEO of [BlueLine Bioscience](#), which is also

based at MaRS and acts as the Canadian discovery engine for Versant, says that “MaRS is the centre of the hub and a key component of the ecosystem... You have everything right there, you have the entrepreneurs, you have the science, you have the clinical research for translation.

“I’M SENSING A TURNING POINT HERE AND IT’S PRETTY EXCITING. THERE ARE COOL THINGS GOING ON IN CANADA, IN TORONTO. WHEN YOU HAVE SOLID DEAL FLOW THAT IS AT A GLOBALLY COMPETITIVE LEVEL, PEOPLE PAY ATTENTION.”

“The venture community is uniquely poised to fill the Canadian gap; everything is ready for them to step in,” Ms. Haak-Frendscho says, pointing out that pharmaceutical companies are also increasingly involved. The recent increase in the size of investments in the Toronto market reflects the quality of science and innovation in fields such as regenerative medicine and neurosciences.

“I’m sensing a turning point here and it’s pretty exciting,” she says. “There are cool things going on in Canada, in Toronto. When you have solid deal

flow that is at a globally competitive level, people pay attention.”

Toronto is a test-bed for new business models that bring together VCs and big pharma to pool investments that speed up development. Mr. Davis says these include a “build-to-buy” approach, where partners help originate companies with an option to acquire them, while “other creative options continue to emerge,” including approaches where pharmaceutical companies like Celgene move in earlier to get access to technology and “bold collaborations” like the BlueRock deal.

“We want to accelerate innovation,” he says, adding that Toronto is an “obvious hub” in which to do it.

In early summer 2017, the next issue will examine the future of cleantech, highlighting some of today's greenest moonshots, from hydrogen fuel-cell-powered trains and lithium ion-propelled marine vessels to solar-electric airships and hyperloop systems.

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