

Health Matters Bulletin

BY *REBOOT HEALTH CONSULTANCY & ADVISORY SERVICES INC.*

WITH FOUNDING PARTNERS: *ROCHE AND ORACLE HEALTH*

Are we Ready for the Coming
Era of Genomic Medicine?

The 80% Problem: Leveraging
Data to Achieve Health Equity

AI and GPT: Catalyzing the
Fifth Industrial Revolution

The Fastest Path to Early Wins
in Data Sharing for Critical Public Health
Applications Using Privacy-Enhancing
Technologies (PETs)

Collaborative Innovation: Working
Together to Think Differently



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Foreword

Issue 8

Welcome to the Health Matters Bulletin, a regular quarterly publication provided by the Reboot Health Consultancy & Advisory Services Group and our Founding Partners. The group's objective is bringing together policy, industry and health leaders to discuss poignant topics in healthcare by creating opportunities and organizing formal, ongoing dialogue, and focused communications on health innovation topics with specialized Health Matter's subject experts.

We invite you to review articles which provoke thought leadership and foster collaboration, catalyze healthcare innovation to optimize the use and deployment of increasingly scarce resources in this country.

We bring knowledge, views and perspectives which focus on these key strategic pillars advancing healthcare:

OUR KEY STRATEGIC PILLARS



**Health Data
Privacy, Policy and
Security**



**Personalized
Medicine and
Genomics**



**Artificial
Intelligence in
Healthcare**



**Value Based
Healthcare,
Operational
Efficiency and
Health Policy**



**Health Innovation
Development**

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Reboot Health Consultancy and Advisory Services Inc.



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Are we Ready for the Coming Era of Genomic Medicine?

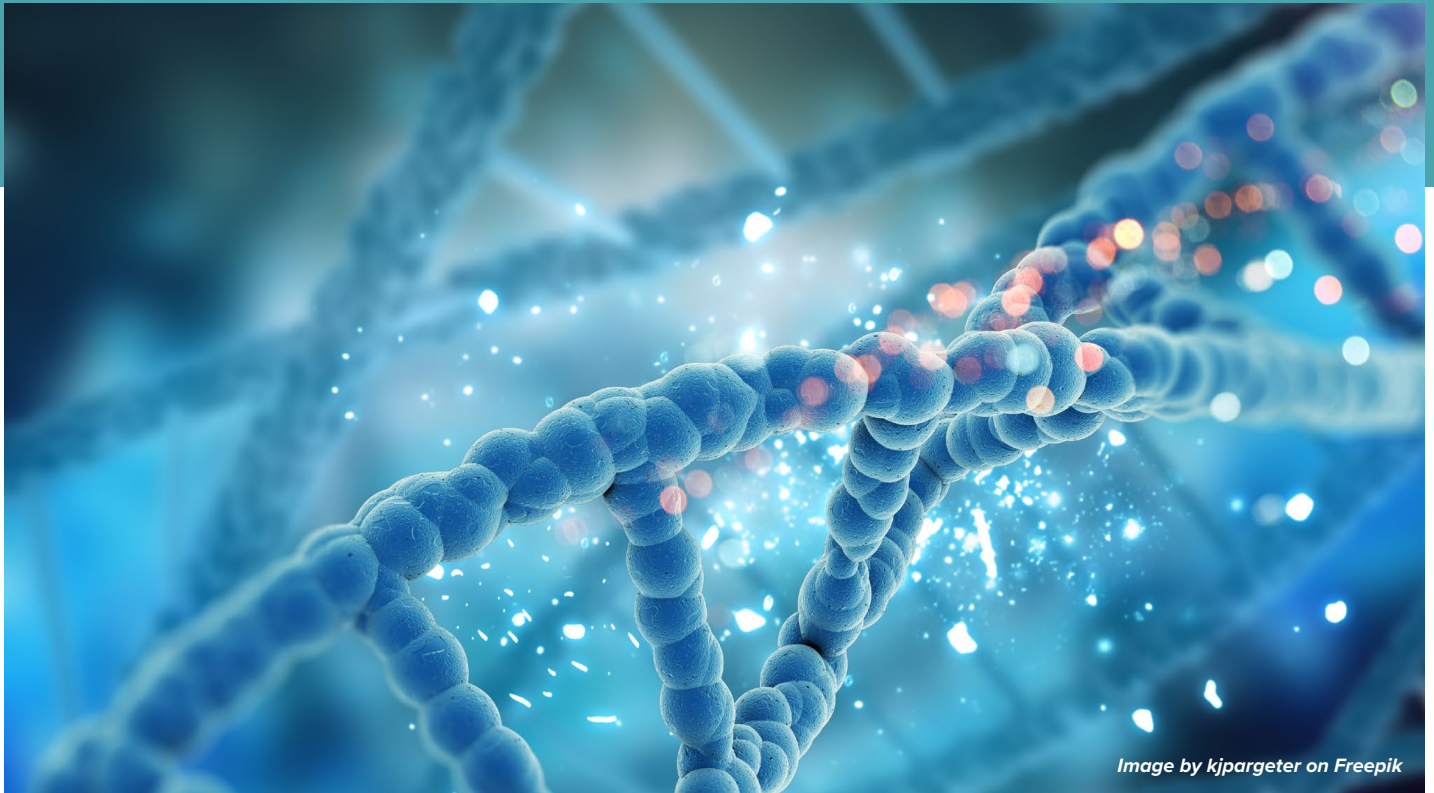


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THE ERA OF GENOMIC MEDICINE

Better understanding of the genetic basis of disease has also led to a new era of genomic medicine. Genomic medicine, or genome-based testing, can be defined as the use of laboratory-based biomarkers that measure the expression, function and regulation of genes and gene products to aid healthcare decision making and scientific discovery. Genome-based tests have already become commonplace in oncology and there is expected to be an exponential growth in new tests and test approaches across a number of therapeutic areas in coming years.

Genomic medicine has already improved patient health outcomes through predicting who may benefit (or not be harmed) from therapy, and helping clinical decisions through better prognosis and diagnosis of disease. However, genomic medicine harbors a number of additional potential benefits including:

- **Better patient and care provider experiences** – Reducing the need for referrals and other diagnostic tests, and improving time to diagnosis. Improving the state of readiness across Canada will lead to equitable care and access.
- **Better science and economic growth** – Aiding scientific discovery and clinical trial enrollment, creating commercial and investment opportunities as well as future-proofing Canada’s healthcare workforce.
- **Healthcare efficiency** – Genomic medicine creates opportunities to reduce healthcare costs while creating the necessary infrastructure for delivering 21st century care.
- **Equitable access to care** – Readiness at a provincial level ensures equitable access to care across Canada and within provinces, including between academic and community settings. Standards for readiness also create opportunities for collaboration across provinces.

Genome-based testing is a unique health technology in this regard. And like other disruptive technologies, will require a shift in traditional models of delivering and financing healthcare.

IS CANADA READY?

To better understand Canada’s state of readiness, a group of international experts identified necessary conditions for policymakers and healthcare administrators that were required for their healthcare systems to be “ready” for genomic medicine¹.

These conditions fell into three categories:

1. **Infrastructure** – Health and human resource infrastructure that includes communities of practice, resource planning and a digital infrastructure (informatics).
2. **Operations** – The ability to evaluate and coordinate, and implement testing at a health system level including an entry point for innovation, an evaluative function, a model for coordinating service, and support for care provider awareness and patient navigation.
3. **Healthcare environment** – The larger healthcare infrastructure supports required are in place, including necessary approaches to financing, integrating innovation, education and training patients and providers, and regulating testing to ensure quality care.

An open-access, peer-reviewed report can be found here: <https://bit.ly/43p46W4>



Eleven essential conditions were then mapped to Canada's four largest provinces as well as Nova Scotia, the largest province in Canada's Atlantic region.

Assessing the state of progress for each of these regions revealed varying states of readiness for genomic medicine. Important gaps that will need to be addressed in Canada's future include:

- **Improving Informatics** – Is essential for test development, interpretation, and clinical decision support. Ensuring adequate integration of test results into electronic health records will also provide a key resource for real-world monitoring, disease management, quality assessment and assurance, and financing. Most provinces still lack sufficient data integration.
- **Evaluation/Health Technology Assessment (HTA)** – Fit for purpose HTA will be needed to identify high-value testing. Most provinces lack evaluative processes that adhere to HTA principles of timeliness, transparency, and engagement.
- **Navigational Tools** – Effective delivery of genetic testing requires navigation tools for patients and the public including referral guidelines, a test directory, eligibility criteria, tools/ education for ordering genetic testing, and a care clinic directory. Some of the provinces are working on these navigational resources.
- **Financing Approach** – Most provinces lack dedicated funding to facilitate rapid onboarding or a funding formula that supports test development and proficiency testing. The current reliance on the private sector to fund test development may be counterproductive as priorities are influenced by who is paying, rather than unmet need, equity, or efficiency.
- **Engagement** – High performing health systems require broad engagement of those impacted by testing. These include the patients, administrators, IT professionals, implementation and genome scientists, public and private sector innovators and others (scientists, legal and ethics experts, professional organizations, bioethicists, regulators).

In Canada, only two provinces, Alberta and Quebec have created more of the necessary conditions for readiness, largely in part to the earlier establishment of single, laboratory service organizations and programs that provide the necessary infrastructure for coordination and planning as well as necessary operational conditions. The opposite is true in Ontario, which is challenged with much higher levels of demand for service, a complex web of formal evaluative processes, and until recently, a highly decentralized health system.

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¹ Husereau D, Villalba E, Muthu V, et al. Progress toward health system readiness for genome-based testing in Canada. *Curr Oncol.* 2023 Jun 1;30(6):5379-5394. (Open Access available at: <https://www.mdpi.com/1718-7729/30/6/408>)



Don Husereau is an Adjunct Professor of Medicine at The University of Ottawa. He does freelance health care research, and works with private and public sector life sciences organizations to help them understand the value of health technology and its implications for health and innovation policy.

Attend the **23rd Annual Healthcare Summit** where Don Husereau will be moderating a panel entitled **“Diagnostic State of Readiness Project/Precision Medicine/Companion Diagnostics and How our Healthcare System Needs to Prepare for This Evolving Landscape“**. This panel will describe what conditions are necessary for equitable access to advanced innovative testing, how major Canadian provinces are doing, and what more needs to be done in the coming years to benefit patients. To register for the summit in Vancouver, BC on October 3-4 please go to www.healthcaresummit.ca.

The 80% Problem: Leveraging Data to Achieve Health Equity



According to research, more than 80% of a person's health status is dependent on social determinants of health, such as where they live and work, the air they breathe, their modes of transportation, access to clean water, and whether they use tobacco or other drugs. Yet not everyone has equitable access to the same critical resources, high-quality healthcare, or opportunities for wellbeing.

In 2022, Canada spent \$331 billion on healthcare¹ and ranked second-to-last in overall health outcomes, specifically in equity, among 11 high-income nations.² More spending does not mean better health, and part of that correlates to the 80% problem. Canada also has an aging population with increasing chronic conditions or comorbidities. Without addressing health inequities and incorporating social determinants of health into patient care, Canada has an uphill battle to becoming a healthier nation.

Health inequity is entrenched and systemic in healthcare worldwide, not just in Canada. Global organizations are publicly recognizing the importance of addressing health inequity. In fact, “advancing health equity” has become the fifth element of International Healthcare Improvement’s (IHI’s) quintuple aim,³ and, the World Economic Forum also has identified health equity as a key initiative.⁴ Inequity is a long-standing challenge entrenched in healthcare, but the world became more aware of its implications as a result of the COVID-19 pandemic.

We must use this momentum and the visibility of these inequities to advance health equity. Just as technology has improved so many other parts of our lives, it could also advance health equity. Now is our time to eliminate any barriers to the tools, resources, opportunities, and knowledge we need to be as healthy as possible.

Technology and data are at the heart of advancing health equity. People, whether as patients, caregivers, community leaders, or public health officials, need clean, usable, trustworthy data to take meaningful action. We need to understand social determinants of health along with information from research, operations, and community risks to advance health equity. A patient’s physical environment, health-related behaviours, and economic factors make a profound difference on their health status.



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At an individual level, technology ideally can provide caregivers with a holistic view of a patient’s health through a single, longitudinal health record. This enables them to address all aspects of a person’s condition including non-clinical factors. At a community level, technology can support leaders with a full picture of their population’s health status and

risk factors. With better information, they can more effectively reach and treat different segments of the population, direct appropriate and needed resources, programming, and interventions equitably, and create policies that lead to health justice.

Technology, though, comes with its own challenges in equity. We're already seeing AI and ML being used in healthcare delivery organizations, and their use is only going to expand. AI and ML models are only as good as the data they ingest, and healthcare data is inherently biased. Therefore, it becomes even more important for us to be thoughtful and intentional with how, when, where, and why these models are deployed. AI and ML could be game changers as we look to solve caregiver burnout, workforce shortages, supply chain disruptions, rising costs, and even health inequities. This is only true if these tools do not further exacerbate the biases and inequities that exist today.

In short, with more data and better information, we have an incredible opportunity to create a better healthcare system that improves lives and the experience for patients, caregivers, and communities around the world regardless of economic status or geography. It will take all of us working together to advance health equity to achieve health justice. Let's take action now.

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⁴ <https://www.weforum.org/agenda/2023/04/world-health-day-healthcare-trends/>



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AI and GPT: Catalyzing the Fifth Industrial Revolution

– A shift from AI tools to AI partners will establish the ‘cognitive age’.



GPT SUMMARY: *The Fifth Industrial Revolution (5IR) is anticipated to follow the Fourth Industrial Revolution (4IR) and is characterized by a cognitive partnership between AI and humanity. The 4IR, marked by transformative technologies like AI and robotics, has reshaped various aspects of our lives. However, the emergence of advanced AI models like GPT has paved the way for the 5IR. GPT models demonstrate an impressive ability to generate human-like text and have found applications in diverse fields. In the 5IR, AI will no longer be mere tools but will become partners, augmenting human cognitive abilities and ushering in a new era of societal evolution. The advent of GPT models and similar advancements may serve as the catalyst for this cognitive revolution.*



The narrative of human history is deeply interwoven with the influence of technological advancements. Each industrial revolution so far has drastically shifted the contours of our society, introducing mechanization, mass production, and digitization, and redefining the norms of human existence. We are currently living in the era of the Fourth Industrial Revolution (4IR), a transformative phase where the physical, digital, and biological worlds are integrating in unprecedented ways.

While we grapple with the 4IR, we should also anticipate the future evolution of our society. The current surge in AI technology, particularly with powerful models like GPT, suggests that we may be on the cusp of a new era – the Fifth Industrial Revolution (5IR). The distinctive characteristic of the 5IR could be its ‘cognitive’ nature, wherein AI and humanity enter a new dynamic of collaboration. This concept has been presented in the [literature](#), but the emergence of large language models (LLMs) and GPT have become catalysts for this transformation in ways that have been unexpected.

THE FOURTH INDUSTRIAL REVOLUTION (4IR)

The Fourth Industrial Revolution encompasses transformative technologies like Artificial Intelligence (AI), Internet of Things (IoT), robotics, 3D printing, genetic engineering, quantum computing, and more. These technologies, converging the physical, digital, and biological realms, hold immense potential for both growth and disruption.

4IR represents a systemic transformation across all sectors and industries, profoundly affecting politics, culture, and the global economy. It is reshaping our lifestyle, work, and interpersonal relationships. Furthermore, it is pushing the envelope of human capabilities, enabling us to edit the human genome and construct intelligent machines that surpass human performance in various complex tasks.

THE EMERGENCE OF A COGNITIVE FIFTH INDUSTRIAL REVOLUTION (5IR) – AI AND GPT AT THE FOREFRONT

As we continue to traverse the landscape of the 4IR, it's crucial to envision what lies beyond. While it's still in the realm of speculation, the potential harbinger of the 5IR could be the continued evolution of AI, specifically technologies like the GPT models.

GPT and its successors embody a new era of AI models that utilize machine learning to comprehend and generate text that mirrors human communication. They demonstrate a remarkable ability to simulate human conversation, compose detailed essays, create poetry, and even write code. These models are elevating human productivity and creativity in various domains, from customer service to content creation.

In the anticipated 5IR, these AI technologies won't just be tools, but partners in a cognitive revolution. This new dynamic will not be about machines replacing humans, but rather about AI augmenting human cognitive abilities, leading to a paradigm shift in how we perceive and interact with artificial intelligence. The 5IR could truly mark the advent of a cognitive age, where the synergy of human and artificial intelligence shapes a new era of societal evolution. The touchpoint of this transformation very well may be the advent of LLMs and GPT models.

As we enter the realm of the Fifth Industrial Revolution, a significant transformation is taking place – the advent of the cognitive age, where human intelligence and artificial intelligence intertwine. The rise of advanced AI models like GPT has sparked incredible possibilities, revealing the potential for collaboration and synergy between humans and machines. This cognitive revolution holds the promise of unlocking new levels of creativity, innovation, and problem-solving that surpass individual capacities.



However, it also becomes a revolution in responsibility. We must navigate the ethical complexities to ensure that as technology and human cognition intersect, we shape a future that uplifts and empowers humanity forging a path towards optimized coexistence, where the brilliance of human ingenuity converges with the vast potential of artificial intelligence.

By: John Nosta | *Innovation Theorist; President, NOSTALAB*

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John is the founder of NOSTALAB – an innovation think tank recognized globally for an inspired vision of transformation. He’s currently ranked as one of the leading global influencers in innovation and technology and well established as one of the top global strategic and creative thinkers. He is also one the most popular speakers around the globe presenting his vibrant and insightful perspective on the future on innovation. His focus is on guiding companies, NGOs, and governments through the dynamics of exponential change and the diffusion of innovation into complex systems, particularly in technology, AI and GPT. www.nostalab.com

John will be the opening keynote speaker at the **23rd Annual Healthcare Summit in Vancouver (October 3 - 4, 2023)**. The Summit will embrace change, turn problems into potential, and chart the future in healthcare. If you care deeply about the current and future state of healthcare, this is the event to attend. Follow [@HlthcareSumm](https://twitter.com/HlthcareSumm) on Twitter to learn more and for event news and announcements. You can register now for the summit at www.healthcaresummit.ca.

The Fastest Path to Early Wins in Data Sharing for Critical Public Health Applications Using Privacy-Enhancing Technologies (PETs)



During the COVID-19 pandemic, consortium efforts from public-health authorities and their partners in academia, industry, healthcare, research institutes, and sequencing centres have created a virtual flood of viral genomic sequence data. The Canadian COVID Genomics Network ([CanCOGeN](#)), the COVID-19 Genomics UK Consortium ([COG-UK](#)) are examples of national consortia that were forged in response to the pandemic to increase sequencing and bioinformatics capacity in public health and to leverage Next Generation Sequencing (NGS) for rapid genomic based infectious disease surveillance. Genomic sequence data is information rich. However, the data needs to be interpreted with the use of contextual information at case and sample level (e.g. demographic, clinical, and laboratory) and at population level (e.g. epidemiological, public health policy, travel measures).

Despite these positive data sharing efforts to date, a generalizable, secure, and efficient computing infrastructure and governance framework for real-time data sharing to enable scientific research and data analysis remains an unsolved challenge. [A recent report](#) describing the lag in SARS-CoV-2 genome submissions to Global Initiative on Sharing All Influenza Data (GISAID) demonstrates international struggles to share data at scale and in a timely manner. [The lag time](#), defined as the time between the specimen collection and data submission, ranged from ten days to almost a year and a half among the GISAID's participating countries. Such a wide distribution of lag times exemplifies the technological and logistical challenges countries face. These challenges result in opportunity costs associated with early interventions that would reduce the cost of intervention and save lives. The SARS-CoV-2 virus evolves too quickly and emerging Variants of Concern transmit too rapidly to detect and control with lag times on this scale.

While pathogen genomic data is generally considered to be non-identifying, the associated contextual data and the potential of amplifying the human host genetic sequences during sample processing are personal and potentially sensitive. The global debate concerning the trade-offs between privacy, individual freedom and public good has never been as intense and consequential as it has been during the COVID-19 pandemic. That said, the debate is not new. Consider human superspreaders: One of the most famous cases is that of Mary Mallon, also known as [“Typhoid Mary”](#). Ms. Mallon, a cook having contracted asymptomatic typhoid, spent thirty years incarcerated in a forced quarantine. What are the hypothetical consequences of identifying an asymptomatic and unvaccinated healthcare worker who infected the elderly in a senior care home where many of those elderly patients died as a result of the infection? Genomic epidemiology through open data sharing can be a powerful tool to help epidemiologists identify human superspreaders. Decision-makers within healthcare, and perhaps more importantly, those in the political realm, are tasked with difficult choices at an unprecedented scale.

Health research directly contributes to achieving the [United Nations' Sustainable Development Goal 3](#): to ensure healthy lives and promote well-being for all at all ages. In addition, access to health data can help reduce inequalities and support sound policymaking. Individuals and their communities may have wide-ranging and potentially conflicting priorities regarding the type of benefits anticipated from public health data. One may look to Indonesia's decision to withhold samples of avian influenza virus A (H5N1) from the World Health Organization as evidence of how a state might perceive little benefit to sharing data to the benefit of wealthier nations at the cost to developing nations. The [Nagoya Protocol](#) (NP), a legal framework under the Convention on Biological Diversity (CBD), formalizes the principle of fair and equitable sharing of benefits arising from biological diversity. Whether NP would inhibit rapid responses by restricting access to pathogen data is an ongoing debate. The international treaties that include intra-State (between governments and communities) benefit-sharing obligations such as [ITPGR](#) regard benefit-sharing as a dialogic process geared towards consensus building, a long-term process of engagement in good faith among multiple actors to establish a partnership.

Data pipeline sharing digital assets for benefit sharing should mirror this process. [GO FAIR initiative](#) under the FAIR Data Principles is a practical guide aimed at implementing the four key pillars of the FAIR Data principles (Findable, Accessible, Interoperable, and Reusable).

What is certain is that the urgency of data availability will need to be balanced with privacy concerns. Healthcare providers must manifest a meaningful, trust-building, and speedy implementation of appropriate information technologies (IT) for data sharing that are grounded on a respect for individual rights. Our collective well-being and global health depend on it. Public health organizations, each operating with its own unique politics, incentive/financial structures, and compliance requirements, will need a coordinated vision for the implementation of real-time pathogen genomics data sharing. Novel genomic tools to help decision-makers must consider the public health-specific context. A public health “playbook” for a federated genomic data sharing platform can include a customized technical architecture that maps the needs of public health organizations to governance-enhancing tools powered by today’s technologies. Opportunities exist for public health organizations to advance “[precision public health](#)” by adopting genomic sequencing and open data through highly curated, but interoperable, genomics data sharing. We can create bespoke solutions that embrace the best tradeoff for each jurisdiction. [Privacy-enhancing technologies \(PETs\)](#), backed by national statistical organizations such as the [United Nations Statistics Division](#), are examples of this.

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In Submission for Data Stewardship and the Secure Sharing of Data, International Seminar on Official Statistics, The UN Statistics Division.

<https://unstats.un.org/bigdata/events/2022/data-stewardship/>

Attend the **23rd Annual Healthcare Summit** on October 3-4, 2023 (in Vancouver, BC) and our panel on Privacy Enhancing Technologies (PETs). **Soyean Kim** will be one of our panelists along with other expert speakers. Register at www.healthcaresummit.ca.

Collaborative Innovation: Working Together to Think Differently



Better access to health services, better health outcomes and more sustainable health systems for all Canadians isn't a dream. For generations the development, delivery and evolution of health services have been geographically compartmentalized, provider-centric and resistant to evolution in a world where adaptation and evolution are the foundations of survival. What is blocking Canada's health systems from evolving like many other social and economic systems? Mindset.

Two foundational concepts can change the paradigm for health innovation:

1. **We are all ‘on the same team’** when it comes to improving health systems. Regardless of geography, age or demographics: Canadians need better health services.
2. **By working together** across geographies, disciplines and roles we can solve some of the most pressing challenges in our health systems.

DIGITAL has been at the forefront of delivering digital solutions to some of healthcare’s biggest challenges. The approach we take is simple and demanding and it works.

We bring together Canadian industry, academia, innovators, community and government to work together to develop and deploy digital solutions to wicked problems. While this approach may sound simple - it isn’t. Collaborative innovation demands every individual and organization to absorb perspectives on issues that might be different from their own and work with others to develop solutions together, better than any single organization could on its own.

Here are a few examples of what our model has produced:

BREAKING DOWN GEOGRAPHIC BARRIERS

Ultrasound is crucial to early diagnosis of ailments from heart conditions and prenatal risks, to lung abnormalities. However, traditional ultrasound devices are large and usually limited to urban centers, making them inaccessible to citizens living in remote, rural or Indigenous communities. In B.C., only 5% of physicians are trained to interpret scans, resulting in approximately 40% of patients not having timely access to ultrasound services.

A collaborative innovation team, led by [Providence Health Care](#), [revolutionized ultrasound access](#) through the leveraging of existing ultrasound technology into a highly integrated and functional point-of-care ultrasound social network accessible to B.C. and Canada’s broader healthcare workforce. The result has meant ultrasound access for over 90 communities from [Haida Gwaii](#) to [Salt Spring Island](#).

AI DRIVES IMPROVED ACCESS

Challenges in access to x-ray services became especially acute during COVID-19 where lead time in receiving formal radiology reports, along with accurate identification of abnormalities in the lung, compounded to risking late or incorrect patient diagnoses. [XrAI](#), a solution that uses artificial intelligence to identify lung abnormalities on chest x-rays in real-time, enabled clinicians on the frontline in emergency rooms and rural hospitals to better identify COVID-19 and other lung-related illnesses.

Developed by [Synthesis Health](#) in collaboration with numerous healthcare organizations and physicians, XrAI has now been deployed in B.C. via Vancouver Coastal Health to serve over 1.25 million patients, representing 25% of the province's population. Deployments across Canada – through the Ahtahkakoop Cree Nation, Peter Ballantyne Cree Nation, Onion Lake Cree Nation and the B.C. First Nations Health Authority – have also been completed in [seven Indigenous communities](#).

THE WORLD IS KEEN TO ADOPT CANADIAN HEALTH TECHNOLOGIES

In 2019, the World Health Organization (WHO) identified its [Top Ten Threats to Global Health](#), listing antimicrobial resistance (AMR) as #5 noting overuse and misuse of antibiotics and similar treatments has created a wave of bacteria, viruses, fungi and parasites resistant to traditional antibiotics. AMR currently kills 5 million people around the world annually and is estimated to kill up to 10 million by 2050.

[Firstline Clinical](#), joined by health authorities from Alberta, Nova Scotia, Saskatchewan and others, took on the challenge to address AMR by building upon Firstline's clinical decision support application to create a [global clinical knowledge network](#) for infectious diseases. The application makes expert guidance instantly accessible on mobile devices to frontline healthcare providers anywhere on the planet, even in resource-limited nations with limited connectivity.

In December 2022, the WHO recognized this technology as a material step in addressing AMR by [partnering with Firstline](#) to distribute the solution. The platform is now being deployed in over 100 countries and being used in all United Nations peacekeeping operations, marking one of the largest adoptions of Canadian health technology in history.



THINKING DIFFERENTLY

The best ideas are often crafted when we push ourselves to think bigger and differently. Working together across industry, government and academia to focus on results is creating solutions to major health challenges. The potential of what we could achieve if we worked together across the spectrum of health challenges to build and deploy solutions together better than any of us could on our own is immense ... and very possible.

By: Sue Paish | CEO, DIGITAL

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DIGITAL grows Canadian businesses through the development, adoption and deployment of Canadian-made technologies and by working with industry to develop a digitally skilled workforce to positively impact lives across our country.

We bring together businesses, academia, community and government agencies to solve some of industry and society's biggest challenges – better and faster than any single organization can do on its own. Through a powerful model that combines cross-sector collaboration, Canadian IP creation and results-based co-investment, we unlock the potential of Canadian industry to lead and succeed in the digital world.

Ahead of the curve starts here.

For more information, visit: www.digitalsupercluster.ca

We are pleased to announce that Sue Paish will be participating on both the opening and closing panels at the upcoming **23rd Annual Healthcare Summit**. Don't miss out on hearing her invaluable insights by reserving your seat today at www.healthcaresummit.ca. Early bird rates end August 15th.

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