



# SYMPOSIUM ON ARTIFICIAL INTELLIGENCE

Precision Medicine

SUMMARY REPORT

NOVEMBER 2018





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## ARTIFICIAL INTELLIGENCE: PRECISION MEDICINE

# EXECUTIVE SUMMARY

Harnessing the potential of digital technologies implies rethinking every aspect of service delivery, business models, and value creation. Artificial intelligence (AI), in particular, holds tremendous potential to empower science, improve the lives of Canadians, and transform the way we think about health, treatment and patient care. By opening new frontiers in medicine, AI is igniting patient-centric treatments based on data analytics and scientific research. Precision medicine, spurred by AI, is challenging antiquated structures and traditional ways of thinking about patient care, cultivating a technology that connects all stakeholders to integrate the patient deeply into the ecosystem for a more personalized approach to healthcare. This digital transformation will increasingly play a role in finding active therapies for incurable or difficult to cure diseases, benefiting not only the patient but also providing fundamental support for the physician and the healthcare system.

We are at an inflection point in the understanding of the enormous potential that AI represents in unlocking new knowledge held within large amounts of health and life sciences data. It can drive a new age of medical discoveries and technological innovations. Canada is uniquely positioned to lead in the creation of AI and precision medicine technologies due to its growing capabilities, diverse population and vast gene pool that represents a microcosm of the world that few countries have. These ingredients give Canada a distinct advantage in becoming a global leader in precision medicine areas.

Drawing on insights learned from a symposium aimed at better understanding AI's potential in Canada's healthcare sector, this report provides an overview of the main challenges and opportunities in the adoption of AI in precision medicine and offers 12 recommendations. Underpinning these recommendations is the understanding that to be successful, Canada must fully leverage its competitive and technological advantages and address misalignments. For example, precision medicine requires large amounts of health data to test and improve the use of digital technologies and AI applications. However, despite having established data sharing initiatives with data sets in genomics and other disease-related data, there is no common platform to accelerate research, attract investments, and spur AI in precision medicine. Canada can and must do better to maximize this potential.

It is clear that capturing the opportunities of AI and precision medicine requires the commitment of all levels of government as well as industry and research institutes. This entails working in partnership to accelerate the trajectory of this technology application across Canada. As one participant indicated, the technology exists, it is just a matter of having access to the data to spur new applications where the patient's unique characteristics are at the centre of customised treatments.

Participants at the symposium agreed that Canada is one of the leading countries in this area of innovation. Yet, while Canada has the talent and the institutions, it requires a vision to help define this new area of

medical science. Without a common vision that mobilizes protagonists in the healthcare sector, Canada faces the prospect of being a sideline observer, missing out on better health outcomes and new economic opportunities. The aim of this report is to contribute to this important conversation and help establish the foundations for a new vision and approach moving forward.

## RECOMMENDATIONS

The following 12 recommendations—drawn from discussions during the symposium—are grouped under the four themes covered during the day. The recommendations reflect the views raised by participants and the essence of their interactions and conversations. The four themes of discussion were complementary and should not be viewed in isolation. The issues raised touch on multiple dimensions, from the need for a vision to the establishment of a national data approach and the implementation of modern regulations to spur innovation in precision medicine, all of which are interconnected.

### TOWARDS A PAN-CANADIAN APPROACH TO AI APPLICATIONS IN PRECISION MEDICINE - FORM FOLLOWS FUNCTION

1. Establish a new national entity responsible for the oversight of health data that may be modelled on international best practices with the purpose of leveraging AI in precision medicine. This could entail a data trust to provide a framework of agreements between government and industry and the development of options for creating a decentralized yet accessible and compatible data platform.
2. Initiate the creation of digital platforms that will facilitate the development of pharmaceuticals and the uptake of new technologies that leverage AI and precision medicine. This entails leveraging existing coalitions' networks and public entities that have health data repositories to interconnect the current siloed databases and transition towards a pan-Canadian platform of health data.
3. Develop a strategy to coordinate efforts in precision medicine, to ensure that all actors contribute to the adoption of AI applications and innovative medical devices, highlighting the health innovation ecosystem and the needs of healthcare centres.

### TECHNOLOGY ENABLERS - FAST PACE INNOVATION

1. Empower an environment for experimentation with the right incentives to accelerate the development, commercialization, and uptake of new technologies in Canada's healthcare system (e.g., regulatory sandboxes).

2. Set priorities in the pursuit of R&D and innovation, addressing barriers and gaps in the development, demonstration and commercialization of technologies within the Canadian healthcare system.
3. Accelerate the application of digital platforms in the development of new drugs, therapeutic areas, and patient care leveraging data analytics, bio-informatics and AI in the field of precision medicine and personalized care.

## THERAPEUTIC AREAS FOR HEALTH AI AND ANALYTICS – NEW FRONTIERS OF CARE

1. Identify priority therapeutics areas that would benefit the most from the application of digital technologies, AI, and analytics, leveraging the largest data depositories across Canada. This includes the use of AI to scour existing clinical trial data and the creation of new virtual models for the treatment of specific diseases.
2. Create effective partnerships among relevant departments, namely ISED and Health Canada, industry and provinces to advance precision medicine and to set ambitious national goals such as the *National Cancer Moonshot Initiative* in the US.

## STANDARDS AND REGULATIONS – ENABLING CREATIVITY

1. Design an enabling regulatory framework that serves progress with clear standards and regulations around AI and data issues, ensuring accessibility, security, privacy, and the interoperability of high-quality data.
2. Address issues of data ownership and security while being inclusive in discussing the importance of access to personal data and its use for research and treatment. This includes implementing international best practices and using case studies to explore practical options for attaining meaningful patient consent in an AI-enabled world.
3. Bring together the top 50 thinkers and decision-makers in the field of digital health to discuss best practices and inform policymaking in adapting a regulatory framework to the needs of a rapidly changing environment.
4. Establish a regulatory framework for a pan-Canadian patient data platform where an invitation to participate is automatic, simple, and effective.

## ARTIFICIAL INTELLIGENCE: PRECISION MEDICINE

# SYMPOSIUM OVERVIEW

On June 12<sup>th</sup> and 13<sup>th</sup>, 2018, the Public Policy Forum, in partnership with the Department of Innovation, Science and Economic Development (ISED), hosted back-to-back symposia exploring the potential of artificial intelligence (AI) in key sectors of the Canadian economy. The June 13<sup>th</sup> symposium focused on *AI and Precision Medicine* (PM), while the June 12<sup>th</sup> symposium explored *AI in Automated Vehicles*. A keynote address by Alan Bernstein, president and CEO of the Canadian Institute for Advanced Research was also part of this event to highlight the importance of AI and the new world it is creating.

The symposium on AI and precision medicine offered a platform for leading thinkers and stakeholders from industry, academia and government to discuss challenges and opportunities in this domain and help inform the future course of action needed to leverage Canada's strengths in AI and precision medicine.

The four themes discussed were:

- **Towards a Pan-Canadian Approach to AI Applications in Precision Medicine – Form Follows Function:** This theme explored how to realize and scale up digital networks across Canada and discussed options for a national approach to create an interactive digital platform;
- **Technology Enablers – Fast Pace Innovation:** This theme explored how to leverage industry capabilities and anchor Canadian expertise to speed the applications of new technologies in the health space;
- **Therapeutic Areas for Health AI and Analytics – New Frontiers of Care:** This theme explored how to identify the most promising therapeutic areas to prioritize Canadian efforts in the development of AI and precision medicine solutions and strengthen domestic and global partnerships; and,
- **Standards and Regulations – Enabling Creativity:** This theme explored how to improve cross-provincial privacy and data sharing issues and the type of regulations needed to support the potential of AI in precision medicine, highlighting the importance of “out of the box modern solutions”.

This report provides an overview of the main discussions and views, covering challenges and opportunities in the adoption of AI applications in precision medicine. It also highlights recommendations aimed at informing the development of policy options and at encouraging committed partnerships in the advancement of AI and precision medicine drawn from the discussions that took place during the symposium. The symposium agenda, including questions that helped shape the discussions, are included in Appendix A and a participant list is included in Appendix B. A second report summarizes the discussion on “*AI and connected and automated vehicles*”.

## TOWARDS A PAN-CANADIAN APPROACH TO AI APPLICATIONS IN PRECISION MEDICINE – FORM FOLLOWS FUNCTION

This thematic area explored current structures within the health industry in Canada, and how Canadians and industry can fully embrace the new potential of data and digital innovations, such as AI for precision medicine. The central theme of the symposium was to explore how best to evolve within the Canadian context to enable the significant potential of AI to attain better health outcomes, scientific discoveries, and patient treatments. Capturing the potential of AI in precision medicine is a function of the ability to collect and share health data across provinces, jurisdictions and organizations. Much of the data relevant to health research arises from interactions within the health system, including encounters with physicians, pharmacists, laboratory technicians, or hospital staff. In the last decade, there has been an explosion in the volume of data and the variety of health data available. However, organizations managing access to data for research purposes in Canada are primarily regulated at the provincial level. The result is that most studies, data sets and information are kept in silos, therefore constraining macro level use of technology or digital platforms in the discovery of new treatments or in the pursuit of innovative research. As the Council of Canadian Academies indicates in its report *Accessing Health and Health-Related Data in Canada*. “For effective research with health and health related data, disparate sources of data must be brought together”<sup>1</sup>. In order to achieve these goals, it is essential that all stakeholders, including industry, research institutes and different levels of government work effectively together to ensure a fluid transition. Access to data is critical to advance AI applications and capabilities. Greater diversity and quality of data is the fuel needed for the development of AI and to expand its learning applications.

Just as a pan-Canadian health data approach must be lean and agile, so too must be the structure that balances the availability of high-quality data with privacy and security considerations. Participants noted that existing coalitions and networks have developed robust health data, and could serve as pilots for building a common vision for a more cohesive pan-Canadian governance structure. A pan-Canadian approach to health and precision medicine faces cross-cutting and horizontal issues. As such proactive government leadership is needed across all jurisdictions to drive partnerships with multiple stakeholders, including industry, hospitals, patient groups and health professionals. In addition, efforts could be made within and across jurisdictions to create common data platforms for specific therapeutic areas as a way of laying the foundations for a future national model that applies AI within the health ecosystem and begins to quantify the benefits of new applications while addressing governance, infrastructure, and security concerns<sup>2</sup>.

Participants stressed the importance to plan for these efforts with a long-term vision in mind so that a pan-Canadian approach to health data, AI and precision medicine serves to strengthen Canadian capabilities.

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<sup>1</sup> Council of Canadian Academies, *Accessing Health and Health-Related Data in Canada*, 2015, p. 144

<sup>2</sup> This is also the approach suggested by members of the BC Digital Technology supercluster.

They also insisted that the scale must be broad, including multiple provinces in any given initiative and different sub-sectors within the health system, as AI is driven by the diversity and quality of data. The discussion also highlighted that it is important to include those who are in the research community and considerations must be given to the monetization and commercialization of the data and technological applications. Additionally, the views of Canadians regarding the use of data for transformational applications in health care and its management must be considered. This is in addition to the networks of health organizations, from hospitals and public health agencies to corporations and industry associations, which all have a stake in creating a compatible and accessible data platform that “can advance AI and precision medicine, not to mention high impact discoveries”.

In order to help advance these efforts and the potential of AI in precision medicine, participants proposed three recommendations:

- Establish a new national entity responsible for the oversight of health data that may be modelled on international best practices with the purpose of leveraging AI in precision medicine. This could entail a data trust to provide a framework of agreements between government and industry and the development of options for creating a decentralized yet accessible and compatible data platform.
- Initiate the creation of a digital data platform that will facilitate the development of pharmaceuticals and the uptake of new technologies that leverage AI and precision medicine. This entails leveraging existing coalitions’ networks and public entities that have health data repositories to interconnect the current siloed databases and transition towards a pan-Canadian platform of health data.
- Develop a strategy to coordinate efforts in precision medicine, to ensure that all actors contribute to the adoption of AI applications and innovative medical devices, highlighting the health innovation ecosystem and the needs of healthcare centres.

## TECHNOLOGY ENABLERS – FAST PACE INNOVATION

In this thematic discussion, participants examined how technology serves as an enabler of better health outcomes and health innovation in Canada. With the growing volume of data, the possibility to connect multiple data sets across therapeutic areas and medical procedures, and the ability to analyze all that information in a matter of seconds, the potential of digital technologies in health holds significant promise. For example, the evolution of mobile technology to 5G networks will be an enormous enabler for telemedicine and a way to mitigate inequality in care, providing the ability to monitor patients remotely, using new AI algorithms, and reducing hospital visits significantly while delivering better-customized care. Participants see an opportunity for the government to be involved in connecting Canada’s population within this new digital fabric.

AI and big data analytics increase our ability to decipher large amounts of health data to personalize treatments based on a variety of factors, including, genomic, microbiomic and proteomic variations. Personalized medicine will increase our ability to adapt treatments and tailor drugs to address specific disease variations. During the discussions, it was stated that “AI has implications on how we design and conceive new treatments and how we can provide services to remote communities. This is really how we democratize technological applications for the benefits of all Canadians”. Furthermore, AI presents opportunities to use medical devices to monitor patients and report potential complications in real time. However, to unlock the true value of health data analytics and the new technological promise, it will be critical to ensure that multiple sizable data sets are accessible and interoperable. Greater accessibility to high quality data will fuel the potential for deep learning and the use of AI to drive new discoveries and validate or adapt therapeutic approaches. During this discussion there was a general agreement that “the effectiveness to fuel the power of AI and precision medicine to revolutionize Canada’s healthcare depends on data: its quality, accessibility, and diversity. The amount of data available drives the evolution and speed of machine learning and AI”.

Participants noted that while Canada’s healthcare system and diverse population holds tremendous potential and value with its rich data holdings, fragmentation and data silos have limited the ability to realize this potential. Participants look to governments across Canada to develop a path forward while engaging with patient groups and other communities to aid in the design process to help anticipate and mitigate any security and privacy concerns.

With the increasing importance of data and technology as an economic driver, participants stressed that the government must view infrastructure funding beyond bridges and roads and must include digital and data infrastructure as critical investments to spur economic activity and social well-being. There is a need for government to be agile when it comes to health and medical technologies and the infrastructure needed to “realize new horizons”. Participants also raised the fact that there is an opportunity for industry and government to work more closely together to ensure that Canada sets priorities to spur innovation and address barriers in the development of new technologies. The Supercluster Innovation Initiative was highlighted as a good example of collaboration and co-investment among industry, academia and government.

The discussion also alluded to the speed of change. As one participant remarked, we are not only experiencing a big data challenge but a fast data challenge – capturing large amounts of data from multiple sources, in real time, while being able to perform analytics to deliver better services. Some suggested starting with pilots on smaller, specific data sets to demonstrate early success. For example, pilots could use a rare-disease database because there is limited data for such diseases in each province, making it more manageable to connect data sets across provinces. Other pilot projects mentioned to have great potential, included using AI in the identification of markers for mental health issues and determining points of intervention, and various applications of AI in caring for the aging population. Participants also suggested

the need to connect major hospitals in Canada through a data platform to collect data and spur more investments, clinical trials and AI applications. Finally, as some participants noted, hospitals and physicians hold significant unstructured data, for example in physicians' notes that would be incredibly valuable to help guide industry in the development of new technologies and innovations. Therefore, participants suggested that governments and hospital administrations take a concerted effort to collect and open data in a way that is useful to industry and respects the privacy of patients. The effectiveness of capturing these data points will determine the speed of technological evolution and applications.

For this thematic area, participants agreed on the following three recommendations:

- Empower an environment for experimentation with the right incentives to accelerate the development, commercialization, and uptake of new technologies in Canada's healthcare system (e.g., regulatory sandboxes).
- Set priorities in the pursuit of R&D and innovation, addressing barriers and gaps in the development, demonstration and commercialization of technologies within the Canadian healthcare system.
- Accelerate the application of digital platforms in the development of new drugs, therapeutic areas, and patient care leveraging data analytics, bio-informatics and AI in the field of precision medicine and personalized care.

## THERAPEUTIC AREAS FOR HEALTH AI AND ANALYTICS – NEW FRONTIERS OF CARE

Discussions for this theme were framed around four topics that explore ways Canada can connect health data in therapeutic areas to advance AI and precision medicine within and beyond the Canadian healthcare system.

### **Genomics versus multi-omics data platform approach**

Advancing personalized medicine requires the assembly of a large array of health data that can be unique to certain diseases, or to certain patients. This can range from genetic data (genomics), proteins (proteomics), microorganisms (microbiomics), as well as real-time patient data monitoring and long-term administrative data from hospitals and other sources. Capturing the potential of personalized medicine requires the ability to collect, link, and standardize data from multiple sources.

It was restated by participants that in the current Canadian healthcare system, data is fragmented and there are more than a dozen organizations managing health data, including biobanks and genetic databases, with very little coordination across provincial and territorial jurisdictions. It was mentioned that even within provinces there is fragmentation in data collection with large hospitals using different enterprise resource planning and electronic medical record systems, making the goal of creating a pan-Canadian database a

very large and complex undertaking. Participants stressed the urgent need to act now or risk missing an opportunity to be a leading nation in this area of medical science innovation.

Participants proposed multiple perspectives regarding the most efficient and effective way forward to sort through data that exists in multiple jurisdictions across Canada, governed by different privacy rules. It was noted that there will be a significant need for data science and privacy expertise, both of which may be beyond what is currently available within government and across the health system.

It was proposed that genomics is a good starting point for precision medicine as it is the most clinically ready omics technology. Over the years, Canada has made significant investments in creating an analytical capacity related to genetics, with therapeutic areas such as cancer and cardiovascular disease that can be addressed in the short term. While this approach does not address the larger multi-omics nature of personalized medicine – the big data integration of diverse omics data which is more reflective of a person’s health—participants agreed that the focus on genomics would help determine valuable information such as the required size of data sets for statistical analysis.

In the longer term, participants indicated the need to ensure progress towards the use and accessibility of broader and multiple health data systems to help physicians better personalize treatments and to serve as a central component of innovative health research. This broader approach would enable the testing of AI solutions to identify better treatments and develop new targets for drug development. However, this would require significant coordination across multiple organizations to ensure adequate consent and data quality. This longer-term approach, given its scale, may be opposed by some organizations, but participants perceive the advantages to be greater than the potential costs. Participants suggested using health card numbers, a common standard across Canada, as the basis for the organization of data in a pan-Canadian database.

### **A pan-Canadian approach focused on therapeutic areas and domestic benefits**

During the conversations, it was emphasized that Canada has the requisite talent for “knowledge creation” but there is a gap in “knowledge for value creation” at the executive level to leverage new technologies and scale-up companies. Delivering better results requires bringing together groups and individuals who can realize the opportunities of AI in key therapeutic areas. The work carried out by the Montreal Heart Institute was frequently referenced as a model of best practice. The Institute has been successful in gathering and using omics data and translating it into commercialization opportunities. The Institute works in partnership with private and public bodies while drawing on its own data with the aim of retaining benefits within the organization as well as within Canada.

Participants suggested developing an accessible digital platform that first focusses on one therapeutic area such as cancer given the availability of data and potential for connecting multiple well-established data systems. Considering the pervasiveness of the disease and the extent of domestic and international

collaboration already occurring, there was support to take early leadership in the area of oncology. Solid relationships, partnerships, and best practices are already in place and a good model in oncology would strengthen the foundations to add other therapeutic areas later on, such as cardiac, dementia and Alzheimer's.

It was also emphasized by participants that while international collaboration is important, Canada is in a race to innovate and capture new technological opportunities. In this race, we must ensure that benefits remain in Canada and contribute to world-leading innovation capabilities in Canada. Many participants shared their concerns about the risk of losing billions of dollars to international companies that are “grafting onto the work done by Canadian companies and then extracting the benefits to their operations abroad”. Collaboration requires a fine balance to grow Canadian capabilities and executing a strategy for the effective commercialization of technologies and services in the global domain. Participants felt it is particularly important for Canada to be able to adopt an approach to data collection and use that considers innovation and value creation potential that ultimately benefits Canadians and grows our companies.

### **The role of government in advancing precision medicine**

Participants agreed that the Government of Canada has a role to play in compiling data and implementing a governance structure for a digital platform that is transparent, secure, and protects privacy. Within this structure, government and industry should define strong partnerships to accelerate the applications of new technologies in the health sector, advance precision medicine, and capitalize on new market opportunities. During discussions, participants highlighted the global potential for new patents “that can generate value in a nascent technology area”. Participants emphasized that the government needs to be part of creating the opportunity of AI in precision medicine by “promoting an environment that is conducive to innovation and risk taking but also to behavioral changes in the system so that doctors are encouraged to adopt new technologies that deliver better care and reduces costs”. The Economic Strategy Tables and the Innovation Superclusters Initiative were highlighted as important government efforts to spur collaboration and committed partnerships. It was stated that similar initiatives will need to be developed on AI and precision medicine given their potential to “revolutionize healthcare in Canada”.

Within the healthcare system, participants recommended the modernization of federal-provincial transfers so that they are “based upon measurable results and activities that help advance the applications of new technology areas in AI and precision medicine”. Participants also alluded to the need to have rapidly accessible health information and eliminate inefficiencies in the system. For example, Canadians can see a history of their financial transactions, yet they cannot access their history of medical results.

In order to address the issues and challenges identified in this thematic discussion, participants proposed two recommendations:

- Identify priority therapeutics areas that would benefit the most from the application of digital technologies, AI, and analytics, leveraging the largest data depositories across Canada. This includes the use of AI to scour existing clinical trial data and the creation of new digital models for the treatment of specific diseases.
- Create effective partnerships among relevant departments, namely ISED and Health Canada, industry and provinces to advance precision medicine and to set ambitious national goals such as the National Cancer Moonshot Initiative in the US. This program was aimed at breaking down barriers and promoting data sharing and collaboration to advance cancer prevention, treatment and care.

## STANDARDS AND REGULATIONS

Standards and regulations was a discussion theme that cut across the symposium. The following section goes into more detail about the barriers and pathways forward to improve cross provincial privacy and data sharing.

### **Regulatory Barriers to Innovation**

Stakeholders agreed that the technology is ready to be implemented; however, there is a lack of clarity on the regulatory framework and absence of policy alignment around AI and data issues. There needs to be clarification around data ownership, consent, and use. Policies on data use and data privacy are top of mind, in health and across many industries. The enactment of the European Union's General Data Protection Regulation (GDPR) has set clear rules for data privacy. The implications are being felt around the world, forcing countries and companies to examine privacy legislation and practices. In Canada, finding the right balance and determining meaningful patient consent in an AI-enabled world is an immediate challenge the health sector is facing. To ensure patients' privacy is maintained, the government needs to develop comprehensive and clear regulations surrounding data ownership. These regulations would stipulate ownership of specific components of the data and the circumstances under which it may be used. This and other legislative challenges are influenced by a series of regulatory and structural barriers within the Canadian health system. Participants raised that when developing a strategy to coordinate efforts in precision medicine, all relevant actors should contribute to promoting effective regulations and standards.

Furthermore, it was acknowledged that the current health system is unsustainable in terms of cost. New technology can provide a viable means to reduce costs and improve patients' outcomes through the use of big data and AI. In this context, participants felt that Canada should develop a framework with clear standards and regulations around AI.

The overall healthcare system in Canada is fragmented across hospitals, cities and provinces, making it seemingly impossible to link siloed data sets. Working towards a regulatory framework for AI is, therefore, a

federal/provincial challenge. Additionally, the ability to procure innovative technologies such as medical devices in Canadian hospitals is limited by a lack of broader assessments on the benefits of new technologies.

Participants underlined that commercialization timelines and adoption with the health system in Canada for medical technologies are lengthy, resulting in many start-ups commercializing abroad. As AI and other disruptive technologies gain momentum, there will be a pressing need to address the safety and cybersecurity issues around health data with clear regulations that do not hinder innovation or economic activity. Individually, each of these challenges merits attention as “it could hamper Canada’s position as a global leader”.

### **Opportunities and Solutions**

Participants were optimistic about how industry and government could collaborate and create new opportunities and solutions to address present concerns. Industry is seeking guidance and collaboration from the federal government to determine best practices for acquiring big data and determining under what circumstances it can be used and by whom, all while addressing issues of data security. As a first step, participants suggested initiating a more robust discussion about the interpretation of privacy legislation, particularly around how to get meaningful patient consent in an AI-enabled world. Participants were also looking for ways to bring clinical data and other data sources together through partnerships for a more substantial collection of data. To facilitate these opportunities, participants recommended that research funding evolve from being project-based to a systemic approach that targets national goals.

To support the development of new guidelines for digital health, participants recommended that the federal government bring together the top 50 thinkers and decision-makers in the field of digital health to discuss best practices and inform policymaking. Stakeholders should include regulators, policy makers, industry and venture capitalists.

A second proposal suggested creating “regulatory sandboxes” to accelerate the development of ground-breaking medicine, health technologies, or medical devices in which intellectual property could be commercialized and products could be sold globally. In this digital age, speed to market is critical for commercial success. However, in healthcare, the paramount principle of patient safety creates stringent regulation that slows down development. Regulatory sandboxes could be created to allow for looser regulation and rapid development under specific, controlled circumstances where there are substantial potential benefits for patients and commercialization.

### **Partnerships and Processes**

Participants stressed the urgency of acting immediately. They called on the Government of Canada to work with privacy experts across the country to consider further guidance around the interpretation and

modernization of privacy regulations. This type of initiative would include experts and consult with groups that have been tackling data protection issues in Canada and internationally, such as the [Public Population Project in Genomics and Society](#) (P3G). It is also important to hear from all stakeholders in the sector, including the provinces, researchers, privacy commissioners and ethics boards, patients and the broader public, and private sector players. Additionally, there are lessons to be learned from implementation in other jurisdictions. For instance, participants suggested that Canada consider the idea of data trusts, a framework of agreements between government and industry to stimulate the secure and mutually beneficial exchange of data, similar to the United Kingdom model. The government would work with independent institutions to encourage the creation of robust arms-length mechanisms to share public and private sector data. That would help reassure data donors that their information is being used for the collective good rather than for private profit or government surveillance, and it would give researchers and entrepreneurs access to new sources of data.

Overall, a coordinating body is required to take the lead on initiating the process and ensuring progress. However, participants agreed that while the government should have a convening role, it is the health sector that should be consulted in developing a regulatory framework around data.

The discussions in this thematic area lead to four recommendations:

- Design a creative and enabling regulatory framework that serves progress with clear standards and regulations around AI and data issues, ensuring accessibility, security, privacy, and the interoperability of high-quality data.
- Address issues of data ownership and security while being inclusive in discussing the importance of access to personal data and its use for research and treatment. This includes implementing international best practices and using case studies to explore practical options for attaining meaningful and simple patient consent in an AI-enabled world.
- Bring together the top 50 thinkers and decision-makers in the field of digital health to discuss best practices and inform policymaking in adapting a regulatory framework to the needs of a rapidly changing environment; and,
- Establish a regulatory framework for a pan-Canadian patient data platform where an invitation to participate is automatic, simple, and effective.

## CONCLUSION

AI holds great potential and is expected to be one of the major trends in healthcare in the coming years. As one participant summarized “AI is human, its evolution depends on its learning and access to data to transform any area of healthcare. Canada can solve its shortages of doctors and nurses with a robust AI system in healthcare”. The deployment of AI could serve as a viable option to alleviate many of the constraints in the health care system.

Canada is uniquely positioned to play a leading role in the AI and precision medicine due to leading expertise and entrepreneurial activity within the country. Furthermore, Canada has more readily available health records than most countries due to its universal healthcare system and centralized data collection agencies, such as the Canadian Institute for Health Information. Additionally, Canada is home to renowned research institutes that specialize in compiling databases, including the Institute for Clinical Evaluations Science.

Following discussions, participants agreed that Canada needs to develop a health data strategy that serves to advance AI and precision medicine. A data strategy for healthcare must provide structure to the collection and use of health data while also being flexible enough to support innovation and commercialization. The data strategy would establish a common digital platform to connect the largest health databases and bioinformatics centres across Canada to advance precision medicine and the use of AI in health while building strong partnerships with research institutes and entrepreneurs to extract value from the platform.

Additionally, securing public trust is a crucial element in the development and implementation of a data strategy. Forward-looking regulations and standards will be critical to success. Governments and industry will have to work together with groups and communities to advance common national goals.

The discussions held at this symposium served to explore the complexity of the issues and to comprehend the scope of the opportunities posed by AI. An aging population with increasing health costs should be an inspiring force for jurisdictions across Canada to refine regulations and policy tools to accelerate the uptake of innovative technology solutions to provide better care. It is this mindset that will ensure that Canada continues to be a global leader in innovations that matter to Canadians.

## APPENDIX A: SYMPOSIUM AGENDA

9:00 **Registration and Networking**

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9:30 **Welcome and Introduction**

Overview of Alan Bernstein's remarks from night before, setting the stage for today's discussions, and explaining the format of the day.

Moderator: [David Fransen](#), PPF Fellow

Speaker: [Aliza Lakhani](#), CEO and Regional Dean, Northeastern University Toronto

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9:50 **BREAKOUT DISCUSSIONS - Round #1**

**Group 1: Pan-Canadian AI - Industry and Networks**

Facilitator: [Martin Godbout](#), Board Chair, Genome Québec

**Group 2: Technology Enablers**

Facilitator: [Alison Paprica](#), VP, Health Strategy and Partnerships, Vector Health

**Group 3: Therapeutic Areas for Health AI - Analytics**

Facilitator: [Pieter Cullis](#), Chief Technology Officer, Molecular You

**Group 4: Standards and Regulations: How to improve cross-provincial privacy and data sharing?**

Facilitator: [Carole Piovesan](#), Lawyer and AI Lead, McCarthy Tétrault LLP

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10:50 **Break**

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11:00 **BREAKOUT DISCUSSIONS - Round #2**

**Group 4: Pan-Canadian AI - Industry and Networks**

Facilitator: [Martin Godbout](#), Board Chair, Genome Québec

**Group 1: Technology Enablers**

Facilitator: [Alison Paprica](#), VP, Health Strategy and Partnerships, Vector Health

**Group 2: Therapeutic Areas for Health AI - Analytics**

Facilitator: [Pieter Cullis](#), Chief Technology Officer, Molecular You

**Group 3: Standards and Regulations: How to improve cross-provincial privacy and data sharing?**

Facilitator: [Carole Piovesan](#), Lawyer and AI Lead, McCarthy Tétrault LLP

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12:00 **Lunch (12:00 - 13:00)**

**KEYNOTE (15-20 minutes, around 12:15 or 12:30)- Lumira Capital on Venture Capital Growth**

Speaker: [Peter van der Velden](#), Managing General Partner, Lumira Capital

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1:00

### **BREAKOUT DISCUSSIONS – Round #3**

**Group 3: Pan-Canadian AI – Industry and Networks**

Facilitator: [Martin Godbout](#), Board Chair, Genome Québec

**Group 4: Technology Enablers**

Facilitator: [Alison Paprica](#), VP, Health Strategy and Partnerships, Vector Health

**Group 1: Therapeutic Areas for Health AI – Analytics**

Facilitator: [Pieter Cullis](#), Chief Technology Officer, Molecular You

**Group 2: Standards and Regulations: How to improve cross-provincial privacy and data sharing?**

Facilitator: [Carole Piovesan](#), Lawyer and AI Lead, McCarthy Tétrault LLP

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2:00

### **BREAKOUT DISCUSSIONS – Round #4**

**Group 2: Pan-Canadian AI – Industry and Networks**

Facilitator: [Martin Godbout](#), Board Chair, Genome Québec

**Group 3: Technology Enablers**

Facilitator: [Alison Paprica](#), VP, Health Strategy and Partnerships, Vector Health

**Group 4: Therapeutic Areas for Health AI – Analytics**

Facilitator: [Pieter Cullis](#), Chief Technology Officer, Molecular You

**Group 1: Standards and Regulations: How to improve cross-provincial privacy and data sharing?**

Facilitator: [Carole Piovesan](#), Lawyer and AI Lead, McCarthy Tétrault LLP

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3:00

### **Break**

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3:15

### **Plenary**

**Each facilitator has 15 minutes to convey the key points discussed throughout the day at their table, and potentially take questions/comments from the larger group**

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4:15

### **Initial Response from Government**

Speakers: **Sheryl Groeneweg**, Director General, Manufacturing and Life Sciences Branch, Innovation, Science and Economic Development Canada (ISED)

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4:20

### **Closing Remarks, Next Steps, and Housekeeping**

Speaker: [David Fransen](#), PPF Fellow

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## APPENDIX B: PARTICIPANTS

### **Rodrigo Arancibia**

Director, Life Science Industries  
Innovation, Science and Economic  
Development Canada (ISED)

### **Ohad Arazi**

Vice-President  
TELUS Health

### **Naveed Aziz**

Chief Administrative & Scientific  
Officer  
Canada's Genomics  
Enterprise (CGEn)

### **Jonathan Butler**

Policy Analyst  
Innovation, Science and Economic  
Development Canada (ISED)

### **Pieter Cullis**

Chief Technology Officer  
Molecular You

### **Janet Dancey**

President  
Canadian Personalized Healthcare  
Innovation Network (C-PHIN) -  
Roche / Canadian Clinical Trials  
Group (CCTG)

### **Dr. Michael Duong**

Director, Evidence Generation  
Hoffmann-La Roche Ltd

### **Drew Fagan**

Fellow  
Public Policy Forum

### **David Fransen**

Fellow  
Public Policy Forum

### **Alain Gignac**

President  
Precinomics

### **Martin Godbout**

Chairman  
Génome Québec, BioQuébec,  
IRICoR

### **Peter Goodhand**

President, Ontario Institute for  
Cancer Research & Executive  
Director  
Global Alliance for Genomics and  
Health

### **Tanya Gracie**

Policy Lead  
Public Policy Forum

### **Shanon Grauer**

Counsel  
McCarthy Tétrault LLP

### **Sheryl Groeneweg**

Director General, Manufacturing  
and Life Sciences Branch  
Innovation, Science and Economic  
Development Canada (ISED)

### **Kim Harvey**

Director of Strategy, Planning and  
Architecture  
Canadian Institute for Health  
Information

### **Doug Heintzman**

MI Board Director  
MaRS Innovation

### **James Hinton**

Associate  
Bereskin & Parr LLP

### **Huda Idrees**

Founder & CEO  
Dot Health

### **Nathalie Jackson**

Sector Analyst  
Innovation, Science and Economic  
Development Canada (ISED)

### **Patricia Kosseim**

Counsel, Privacy and Data  
Management  
Co-Lead, Access Privacy  
Osler

### **Aliza Lakhani**

CEO & Regional Dean  
Northeastern University

### **Andre Leduc**

Vice-President, Government  
Relations & Policy  
Information & Technology  
Association of Canada

### **Paul Lem**

Founder & CEO  
Spartan Bioscience

### **Marc Lepage**

CEO  
Genome Canada

### **Rick Makos**

President & CEO  
Phemi

### **Alison Paprica**

Vice President, Health Strategy  
and Partnership  
Vector Health

### **Dr. Michael Phillips**

Chief Scientific Officer  
Sequence Bio

### **Carole Piovesan**

Lawyer and AI Lead  
McCarthy Tétrault LLP

### **Bill Pristanski**

Chairman of the Board  
Terry Fox Foundation

### **Ian Rae**

CEO  
Cloud-Ops Cloud Infrastructure  
and Networking Solutions

**Denise Rollin**

Project Administrator  
Public Policy Forum

**Mark Schaan**

Director General, Marketplace  
Framework Policy Brand  
Innovation, Science and Economic  
Development Canada (ISED)

**Lisa Setlakwe**

Senior Assistant Deputy Minister  
Innovation, Science and Economic  
Development Canada (ISED)

**Elissa Strome**

Executive Director, Pan-Canadian  
AI Strategy  
CIFAR

**Peter van der Velden**

Managing General Partner  
Lumira VC

**Danya Vered**

Director  
Strategy Corp

**Charles Vincent**

Director General, Automotive,  
Transportation and Digital  
Technologies Branch  
Innovation, Science and Economic  
Development Canada (ISED)

**Dr. Sarah Wickham**

Director of Privacy  
Health Infoway

**Dr. Brad Wouters**

Executive Vice President, Science  
& Research  
UHN Research

