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HEALTH INNOVATION AND COMMERCIALIZATION ECOSYSTEMS AND PUBLIC HEALTH EMERGENCY RESPONSE SYSTEMS

Craig Scott and Jennifer Zwicker

SUMMARY

The COVID-19 pandemic demonstrates how vital it is for the Alberta government to incorporate precision health (PH) planning into its public health ecosystem. Public health shocks demand quick thinking, rapid adaptation and good decision-making driven by data. PH offers all that and more, and not just in health care. In ordinary times, PH tailors diagnosis and treatment to an individual patient's needs. When a crisis arises, PH focuses on assessing risks to provide targeted interventions and treatments to larger populations.

A crisis is unfolding around us and it's revealing gaps in areas outside public health, such as education, community services and the travel and financial industries. The multidisciplinary focus of PH data, and the innovation and commercialization (I&C) systems accompanying it, could support social services as they respond to COVID-19. For example, demographic information about the housing needs of vulnerable populations could guide targeted funding for people who rely on caregivers for their daily living needs.

This communiqué makes two important recommendations about the current health crisis. It's being published along with a paper on the barriers to a home-grown PH I&C system and how the public and private sectors should tear those barriers down.

Currently, there is a lack of co-ordination in the areas of innovation networks, facilitating discovery, governance and decision-making, and risk and procurement

- all of which hinder the establishment of a PH I&C system. This situation exists because there is no mandated organization for PH I&C. If, for example, there were a formal process in which social services stakeholders could contribute to health policy discussions, sourcing recommendations and acting on them would take less time.

The first recommendation is that, a provincial governance structure for PH I&C should be established, so policy leaders from the I&C ecosystem can co-ordinate their efforts and co-operate in their work. This structure would increase the ability to streamline responses by combining resources, drafting policies, reducing duplication and building new partnerships. Second, the government should create incentives to promote greater collaboration in that ecosystem. Right now, there is a stand-off between academia and government/research funders because the latter are focused on seeing the dollars go to specific health-care issues.

PH I&C invites economic diversification, research into new technologies and fresh investment, offering potential for growth at a time Alberta desperately needs it. With a PH I&C structure in place, Alberta would be able to provide significant benefits to individuals requiring care in normal times, and the province would also be out in front on public health policy in times of crisis. A well-co-ordinated PH public health model would improve Alberta's ability to respond swiftly and creatively when a public health emergency like COVID-19 strikes.

INTRODUCTION

Precision health (PH) offers more than the pursuit of personalized, genomic-based medicine. While individual, micro-level PH technologies are well understood and widely marketed, this field holds promise beyond these science fiction, futuristic medicines. Larger, macro-level public health applications, such as those needed during a response to a pandemic, are also a staple of PH. As a subsector within health care, it is easy to forget that this is an interdisciplinary endeavour, spanning all sources of individualized information.

Innovations in technology and data analytics are rapidly changing the consumption patterns for the health sector. Wearables now track health information, big data analytics is growing rapidly and molecular techniques unlock new applications for studying ‘omics data (genomics, proteomics, metabolomics), which all fuel PH I&C to better predict health outcomes and risks (Feero 2017, 1842–43; Khoury, Iademarco and Riley 2016, 398–401). These medical applications are not the only PH area experiencing growth across the globe. Health and social services delivery are becoming increasingly interconnected. At the same time, these systems are demanding greater amounts of information in an effort to introduce PH. However, these shifts raise concerns about the readiness of our institutions, financiers, governments, industries, health-care providers and more, to accept and facilitate such a change.

It can be difficult to systematically plan for such an all-encompassing sector. Many countries around the world are adopting “innovation ecosystem” approaches to their health systems in response to this informational change. These networks identify priorities and provide structure to planning decisions for the sector. Innovation ecosystems aim to combine strengths and policies from a variety of stakeholders across government, industry and academia.

As the global response to the novel coronavirus pandemic (SARS-CoV-2) has demonstrated, there is a need for co-ordinated response across our societies. The same capacities that would facilitate PH innovation and commercialization (I&C) are beneficial to a public health emergency response. This benefit is in addition to the fact that innovations coming from this sector are also leading the medical response to this pandemic.

This communiqué summarizes findings from a SPP research paper that describes stakeholder perspectives on the PH ecosystem in Alberta and discusses the implications of novel PH approaches, their impact on I&C, and how this industry’s growth benefits public health emergency response systems.

WHAT IS PRECISION HEALTH?

Health interventions, treatments and policies affect people differently.¹ PH uses a multitude of individual-level data with innovative products and processes to study how health-care systems can provide “the right treatment to the right patient at the right time” (Haldorsen 2003). Ineffective treatments can be incredibly costly to both patients (such as reduced quality of life from negative side effects) and the health-care system (such as financial costs

¹ Patient heterogeneity is the term used to describe differences between individuals (de Leon 2012, 153–164).

of wasteful tests and services). PH aims to increase treatment effectiveness by using new technologies and individual characteristics to create more targeted, personalized solutions.²

Although it is often touted as a new discipline, PH is the successor to other initiatives with similar mandates, philosophy and methodologies. This terminology is derived from precision/stratified/personalized medicine, genomics and individualized care (Akdis and Ballas 2016, 1359–61). “Precision health” nomenclature is intentionally broader than its predecessors are because as mentioned above, PH encompasses more than just medicine or genomics.

With the explosion of bio-molecular medical technologies and genomics information, it is easy to overlook some important individual information. PH integrates all aspects of health, including social factors. I&C in this space uniquely combines data sources that are not commonly used within a health context such as social, economic and legal data. Innovations that integrate broader datasets and social factors in health policy analysis are changing the traditional approaches to health care (Prasser et al. 2018, e57–65).

Since PH data sources extend beyond health and medical information, data linkage projects from existing non-health sources are leading to improved policy development across a variety of domains (Glasgow, Kwan and Matlock 2018, 183–85). Integrating these data can shift toward a wellness-driven approach instead of a medically driven approach. By understanding a wider range of information about a person, PH is more representative of a personalized health approach.

WHAT IS A HEALTH INNOVATION AND COMMERCIALIZATION ECOSYSTEM?

An I&C ecosystem is the environment in which relevant stakeholders interact and the processes in place that facilitate those interactions. Each stakeholder has a different interest or role in the I&C process. Also, not all stakeholders carry equal weight, as certain groups would be largely impacted and heavily invested, while others are more indirectly involved. As I&C is often framed as a continuum from concept-to-commercialized, there are differences in the timing of stakeholders’ engagement in an innovation. Certain organizations, such as R&D funders, would have a large stake in the earlier stages of I&C, and others, such as knowledge users/adopters, would have a stake much later. Mapping the main components of an innovation ecosystem is a useful exercise to identify the players and their respective functions.

The triple helix of innovation model is one of the longest-standing tools for mapping an innovation ecosystem. Etzkowitz and Leydesdorff (1995) characterize an I&C ecosystem as containing three main components: industry, government relations and academia (universities). Each one has a broadly defined role: industry to build upon research from universities and produce commercial goods; governments to regulate markets and fund research; and academia to conduct research and increase technical capacity through

² Leroy Hood’s P4-medicine encapsulates the four principles that drive precision-based initiatives: predictive, preventative, personalized and participatory (Hood 2013, 1–9).

education. This simple model is helpful to understand more complex roles, such as university technology transfer offices, which often are involved in more than one of these interactions.

Health I&C ecosystems differ from other sectors in the degree of complexity and sheer number of affected stakeholders. Part of this stems from the fact that health innovation is not like innovation in other sectors. Evaluation metrics for innovation in most sectors are primarily based in economics and business,³ whereas health outcomes are an essential social implication of health I&C. This means that health innovation is never truly separated from the principle that it should improve a person's health. By that principle, many other parties are involved in the health I&C landscape, such as social agencies, health-care service providers, patient advocacy groups, environmental organizations and more. The other driver of the complexity in health I&C systems is the number of stakeholders that must complete multiple roles. Looking at organizations like Alberta Health Services, it becomes clear there are multiple (sometimes competing) priorities that must be considered.

A robust I&C ecosystem offers the opportunity to diversify the Alberta economy by developing technology, attracting investment and expanding health capacity beyond the health-care system. Health I&C planning involves policy capacity far beyond the boundaries of health alone, such as tax/fiscal policy, public-private partnerships, entrepreneurship, social service agencies and regulatory bodies. A recent research paper describing different perspectives on the I&C ecosystem in Alberta highlighted specific challenges around facilitating discovery, innovation networks, governance and decision-making, and risk and procurement (Scott et al. 2020). The World Health Organization's Innovation Working Group (2016) recognizes that to address these types of complexities, an "integrated innovation" approach is required – that is, a co-ordinated effort of scientific, business and social sectors.⁴ It is important to note that the benefits of providing better care are not limited to one type of sector. Simultaneous to improving health outcomes, other fields such as health and economic-focused entities experience benefits. For example, forgone economic productivity and labour as a result of the coronavirus pandemic would be reduced by the introduction of a vaccine. By over-emphasizing any one perspective without thinking of the bigger picture, societal outcomes will not be maximized.

PRECISION HEALTH CHANGES INNOVATION AND COMMERCIALIZATION ECOSYSTEMS

While the broader health I&C requires policy capacity in a wide variety of fields, the PH I&C takes that even further. This extends beyond the planning of R&D funding, economic decisions toward commercialization projects and balancing risk in the procurement of health innovations. PH requires a co-ordinated effort to provide additional sources of individualized information about a person. Data gathered from health-care providers,

³ Innovations' success measurements in economics and business are dependent on outputs like employment, economic profit, intellectual property, academic outputs (publications, grants, etc.) and industry sales growth (Smith 2005).

⁴ The World Health Innovation Working Group is comprised of scholars and policy-makers who "catalyze initiation and enable the scaling of innovations across technological, social, financial, policy and business domains. The group continues to pursue leadership in supporting collaborative efforts among multiple stakeholders."

private for-profit companies, social service companies/ministries and taxation agencies may all contribute to the wealth of information available to researchers in this industry.

Combining a variety of individual information (using different methods and techniques) is essential for health I&C, as policy analytics continues to play a bigger role in policy development (de Marchi, Lucertini and Tsoukiàs 2016, 23–37). However, the integration of these new data sources introduces more complexity to the PH I&C ecosystem. With new stakeholders, data-sharing agreements and organizational interactions comes a new set of policy challenges. One such challenge is that in a siloed PH I&C ecosystem where costs are primarily borne by one stakeholder, but benefits are diffuse across society, the likelihood of sub-optimal I&C is high. This is market failure as a result of the nature of PH that governments should look to correct.

PUBLIC HEALTH RESPONSE SYSTEMS AFFECTED BY PRECISION HEALTH

“If precision medicine is about the individual patient in front of us, precision public health is essentially about implementing the right intervention at the right time, every time to the right population” (Khoury 2018). Having a well-co-ordinated PH ecosystem can improve our public health emergency response. More clearly, assisting the PH industry would increase the efficiency of the entire I&C process, which now includes precision public health instruments that add value to emergency response. These instruments are created from individualized information and technologies that improve public health intervention effectiveness by stratifying risks among different populations within society (Bilkey et al. 2019).

This pandemic has exposed holes in institutions outside of public health such as in the education system, community services, financial sector and travel industry. A quick scan of the federal government’s public health crisis supports would reveal that many of the responses to this health crisis are socially provided benefits. Given the multidisciplinary nature of PH data, policy-makers can integrate findings from a multitude of platforms relevant to the administration of these benefits. For example, using administrative data like housing demographic information in combination with caregiving health data could be beneficial for targeted funding responses to vulnerable populations that rely on caregiving for daily living. PH I&C is a two-way street that can assist public health officials and policy-makers in identifying the channels and windows of opportunity to support individuals in their time of need.

By creating platforms to bring together a variety of relevant stakeholders in a co-ordinated fashion, there would be a reduced lag time for sourcing recommendations from stakeholders and the ability to enact them. Formalizing the process whereby social services are regularly contributing to the health system I&C policy discussions would strengthen relationships across the I&C ecosystem. These relationships prove beneficial in times of crisis.

WHERE TO FROM HERE?

Alongside this communiqué, we have released a research paper that identifies policy barriers and challenges to PH I&C in Alberta (Scott et al. 2020). While these recommendations are high level, they provide a starting place for developing policy capacity for this sector. The two most relevant recommendations from this paper to the SARS-CoV-2 response are to establish a provincial governance structure for PH I&C that brings together policy leaders from our I&C ecosystem and to incentivize greater collaboration among new and existing ecosystem players. By working toward these two goals, Alberta will not only position itself to improve its economic diversification through health I&C but will create new relationships to collaborate on future public policies.

Having capacity within these PH systems is critical to a number of processes in the coming months. PH I&C in this area could create novel ways to respond to public health concerns. In a crisis like the one in which we find ourselves, there are opportunities to break silos. Embedding other areas of society into Alberta's health-care dialogue is a form of horizontal co-ordination among the PH I&C that may prove to have long-standing benefits which extend long after the coronavirus pandemic is behind us.

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