Public Health and Learning Health Systems White Paper

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Key takeaways

- The concept of a Learning Health System (LHS) is gaining recognition in Canada but has been mostly applied to health service delivery. Public health should be a key part of any LHS.

- At its heart, a LHS is about aligning data, research, incentives, and culture to support rapid learning and continuous improvement.

- With its long history of data-driven methods, engaging communities, focus on social determinants and relationships to non-health sector partners, public health can contribute much to the LHS approach. Moreover, the involvement of public health is essential if health systems are to improve the health of the population as a whole and reduce health inequities across groups.

- COVID-19 has shown how collaboration between public health and the healthcare system, combined with rapid data sharing, can prevent disease, preserve health system capacity, and save lives. Greater sharing of data between healthcare and public health organizations would be of mutual benefit.

- Key components of a LHS that integrates public health include disease surveillance, common analytic platforms, rapid learning and change management, research and knowledge translation, collaborative partnerships, and community engagement. Learnings from this system need to be inclusive of community priorities and be patient, family and community-centered in their design.

- The LHS is an opportunity to place data, rapid learning, and quality improvement at the heart of health systems. By engaging in these discussions, public health can contribute to thinking on LHS, reaffirm the importance of learning in its own mission, and carve out a role as health systems move to integrate health and social care and address systemic issues in health and society.

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1. Introduction

The concept of a Learning Health System (LHS) is gaining recognition in many countries, including Canada. At its heart, a LHS is about aligning data, research, incentives, and culture to support rapid learning and continuous improvement to improve health. Despite the growing popularity of the concept, little attention has been paid to the role of public health in such a system.

The purpose of this white paper is to explore how public health can both contribute to and benefit from a LHS approach. It will discuss the strengths and weaknesses of a LHS approach and how a learning public health system might develop in Canada. Barriers and enablers will be outlined, along with key elements to consider in an integrated LHS. The goal is to invite closer collaboration between public health and healthcare actors, with an eye to building a better, more resilient health system built on data and rapid learning. Issues such as how a LHS would be structured or organized are beyond the scope of this paper and are best dealt with at the local level, with broad input from stakeholders.

2. The Learning Health System

2.1. What is a LHS?

Briefly, a LHS is one in which data (clinical and non-clinical) are leveraged to rapidly identify and address issues in the health system and broader societal sectors outside of health, resulting in better care and improved health at lower cost. The origins of the LHS concept stem from:

1. Recognition of the need to better harness data produced and stored in varied sectors of the health system;
2. Need to integrate best evidence more rapidly into practices and organizations; and
3. Desire to use the above to drive improvement in quality and outcome.

One of the earliest conceptions of the LHS comes from the Institute of Medicine (IOM), which introduced the term in the early 2000s and later defined it as:

> *A system in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the care process, patients and families as active participants in all elements, and new knowledge is captured as an integral by-product of the care experience.*[1]

Similar definitions have been proposed, all arguing for the importance of using data to drive continuous improvement within health systems.[2,3,4] Others note the need to move beyond data to include performance measurement, foresight and continuous improvement for effective governance of health systems.[5] Data plays a foundational role in these articulations of the LHS.

Note that the original IOM definition was focused on *healthcare,* not health systems. The IOM envisioned a fusion of health services research, quality and clinical decision making, whereby

the outcomes of every clinical encounter would add to a real-time body of data that could be mined to support clinical decision-making and improve care experience. The shift to *health* systems was added later and not included in the original framing; this explains why the original definition does not talk about populations and why public health was largely left out of early articulations.

2.2. Strengths and shortcomings

The concept of a LHS concept has understandable appeal. Using data and evidence to quickly address health system issues in a cycle of continuous improvement seems a sensible strategy. Moreover, with advances in health informatics, we are at the point where it is possible (though not easy) to merge and analyze data sets across multiple healthcare providers and sectors to identify gaps in service delivery and policies needed to address health system challenges.

However, the LHS literature has several shortcomings. For the purposes of this white paper, two key weaknesses are: (1) public health is not a focus, which means important components critical to population health are not represented; and (2) the literature is not well adapted to the Canadian context, where our publicly funded systems and jurisdictional complexities differ from the US context in which the concept arose.

First, the emphasis of the LHS literature has been on healthcare and not on population health. In the IOM framing and later definitions, it was clinical interventions delivered one by one that were the target of learning. Yet, there is a need to learn rapidly about interventions delivered at the population level – housing, water safety, walkability of cities – that are the unique focus of public health systems that aim to intervene on the social and ecological determinants of health. A LHS needs to be about more than just an efficient healthcare system – it needs to be about better health outcomes for people.

Furthermore, the original IOM workshop report focused on healthcare services.[6] While healthcare is essential, the omission of other sectors is a major gap. Health is about more than just clinical encounters. As the COVID-19 pandemic has shown, many health inequities are fundamentally driven by social factors.[7] The brunt of the pandemic has been borne by those with low incomes, those in marginalized and racialized communities, essential workers, and other populations that are clearly impacted by the social determinants of health. Such inequities can only be addressed through population and public health approaches that address the structural levers outside of the health sector. A public health perspective is essential if we are to build a LHS that protects not just individuals but also communities and whole populations.

Second, the LHS literature tends to be US-centric and does not necessarily translate well to publicly funded health systems such as Canada's. As Menear et al. note:

> *The Learning Health System concept has emerged primarily within the complex, largely privately funded United States healthcare context, which differs*

significantly from other systems internationally. [...] Given these contextual differences, there is a need to clarify how the LHS concept applies in Canada and other jurisdictions sharing similar health systems characteristics.[8]

The framework they develop provides a starting point for exploring how the LHS concept could apply in Canada, with LHS outcomes, processes, and foundational pillars linked together. Such explorations will need to account for the enormous complexity in how healthcare is organized, delivered, and financed across Canadian provinces and territories. At the same time, they will need to address the role public health systems can play – something that has largely been neglected in discussions relating to implementing a learning health system in Canada.

3. Bringing in Public Health

3.1. Why a public health perspective?

Public health is based on the three P's: disease **prevention,** health **protection,** and health **promotion.** Its focus is on the whole population and is grounded in a population health approach that includes the health status of populations, the interactions between social, biological, cultural and environmental determinants of health and health equity.[9] Public health can be also defined in terms of essential public health functions, which need to be considered when discussing a LHS. These include health protection, disease and injury prevention, population health assessment and health surveillance, health promotion, and emergency preparedness and response.

Public health practice has long been premised on data-driven approaches such as epidemiology. Examples are abundant and well-known: community health status assessments, surveillance, communicable disease reporting and numerous other public health functions rely on the systematic collection, aggregation, analysis, and evaluation of health data. Public health agencies perform these functions at multiple levels: local, provincial/territorial, and federal.

Public health also has a longstanding and deep engagement with and commitment to understanding the broader determinants of health and assessing and reducing health inequities. In keeping with a "Health in All Policies" approach,[10] public health works with many sectors to facilitate intersectoral action on social and environmental determinants of health and health equity. Examples of such public health practice include working closely with municipalities and school boards (e.g., community water fluoridation, school nutrition policies), enforcement work in the food sector, and policy and legislation such as the Smoke Free Ontario Act in tobacco control.[11]

Thus, public health as an approach already manifests and exemplifies components of a LHS, and recent interest in the concept arguably brings healthcare systems closer to the ways of thinking and forms of practice that are long established in public health. Learning health systems have much to learn from the history, practices, and values of public health.

A public health perspective places a strong emphasis on equity and SDOH, which are a key to identifying remediable issues. It also is oriented to population health, which is identified as a key focus of LHS's. SDOH-based interventions (e.g., policies to address food insecurity, housing, and employment) illustrate the importance of looking upstream when tackling health outcomes. Finally, the payoff for public health interventions is typically measured in months or years—a contrast to the short time horizons of most clinical interventions.

Public health brings additional assets to a learning health system in that it has close ties to the communities it serves, understands community health needs and has relationships with a broad array of local agencies within and outside of health and which provide programs and services to diverse populations. In Ontario, Public Health Units (PHUs) have well established roles within municipalities and are legislatively accountable to boards of health so are clearly responsive to local needs. Additionally, they are required to oversee, report, and adhere to a series of provincially set public health standards.

All of the above elements provide a strong foundation for participation in a learning health system. Public health is perhaps better suited to engagement within a LHS as it is and has been a data driven enterprise focused on population health and reducing health inequities. Therefore, committing to key elements of the LHS is congruent with public health's mission and vision which is not as straightforward in the case of the healthcare system. Indeed, it may be posited that a LHS without public health is only half a system.

3.2. What role can public health play?

As demonstrated in the previous section, public health can bring significant assets to build a viable and thriving learning health system. As a LHS is premised on leveraging data to facilitate evidence informed analysis, evaluation, and adaptation of population health interventions to local contexts, the extensive data held by PHUs and the epidemiological expertise in analyzing, reporting, communicating, and acting upon the data to improve population health would be an invaluable contribution to the LHS. No other sector has the legal mandate, incorporated into standards, to capture such data. The LHS will facilitate the sharing of data through quality feedback cycles to improve system performance. Public health can bring its many partnerships and local community presence and knowledge of communities to ensure that priority programs and services address local needs.

Furthermore, public health brings experienced executive leadership, in the form of Medical Officers of Health (MOHs) and Boards of Health who can serve as change agents and help move the healthcare sector more upstream in its attention and interventions, attending more to primary prevention and equity. In Ontario, PHUs work closely with local Boards of Health and MOHs develop strong relationships with municipal leaders, which is a notable strength when addressing local health issues.

Public health organizations bring significant expertise in program evaluation and evidence synthesis to the table with a particular focus on the equity impacts of population level policies

and programs. Additionally, they are well positioned to better measure and analyze health system performance (including organization, resourcing, and governance). As Bernstein et al. note, "greater engagement by public health in the LHC will ensure that a public health perspective is integrated into the development of a national-scale LHS, public health concerns are adequately addressed, and public health agencies can benefit fully from participation."[2] This will need to be expanded to include initiatives involving broader societal actors to address issues rooted in the social determinants of health.

3.3 What can LHS contribute to public health?

The LHS perspective provides an opportunity for public health to better connect their data collection and analysis capacities, programs, and other interventions to other sectors in the health system to improve population health. The LHS provides a platform wherein a true health system rather than simply a healthcare system, can be implemented, evaluated, refined, and improved on a continual basis driven by real time data and integration of evidence informed practices.

The LHS model also provides an opportunity for public health to influence the strategy of healthcare partners as they reorient to population-based approaches to inform planning and delivery of services. It can also open avenues of data, knowledge and information for functions that are mission critical to public health functions, for example by partnering with healthcare providers (acute and primary care) who possess patient-level data that can give public health a more comprehensive and timely picture of a community or population's health status. Such data integration serves not only the LHS as a whole but also, from a public health lens, allows for data-informed policy to be developed to address health inequities and system-level gaps.

A LHS that integrates public health would provide the basis for a more effective response to community health threats such as future pandemics, as integrated data systems would facilitate testing, tracing, and vaccination. An enhanced data infrastructure would expand the scope of public health practice and support community readiness, resilience, and recovery.

Looking back at the pandemic, we see instances where entire health systems were woefully unprepared in their information systems and have struggled to catch up. Lack of equity data has had unintended consequences on historically marginalized groups, making the pandemic worse for these groups. These information gaps could be addressed, in part, by asking the question "What would be needed to make public health a learning health system?"

3.3. Mutual benefits

There are clear mutual benefits to public health and health services in a LHS. As the healthcare sector increasingly takes a population-based approach it has much to learn from public health. Similarly, as the healthcare sector increases the sophistication with which it collects and analyzes data, there is much to gain for public health. The combined strengths of both sectors augur well for opportunities to harness the impressive power of big data analytics, machine

learning and artificial intelligence. These latter two innovations will likely play an increasing role across the health sector in the coming decades and a LHS is one of the most promising models to harness the potential benefits of these technologies while ensuring that these tools also attend to inequities. This will also foster investments in research and provide the opportunity to generate and apply knowledge created from the LHS.

Public health systems research has historically been underfunded in comparison to healthcare systems despite several calls for an agenda to address this deficiency. There may be great potential for learning from health services research that could benefit public health to address gaps and develop a systems view of workforce needs. Similarly, research related to how the public health system is organized, funded, and governed would present opportunities for cross-learning between health services and public health. There is also an opportunity to strengthen linkages between healthcare providers, public health actors, and academia to identify joint priorities of interest as part of an integrated LHS.[12] Sample projects include metrics for assessing system performance, innovative financing models, and comparative studies on leadership and governance of different systems.

Creating a LHS will require investments in technology, data, and workforce development; collaboration between the healthcare and public health sectors would provide opportunities for joint planning and resource pooling. There will be a need for programming and data science skills in both sectors, which a collaborative approach could help address.

Bernstein et al. summarize the advantages of the LHS for public health and primary care in particular. They write:

> *Primary care and public health share the same goal of ensuring health, yet they function largely independently. Primary care is focused on individual health and rarely considers the greater population health impact of aggregate health data.* The LHS's potential to change the way the public health workforce engages with clinical care partners, through mutual support for its development, *also has the possibility to change the way public health addresses problems—through a more holistic approach.[2]*

Experience during COVID-19 shows that such a holistic approach is possible. In the face of a global pandemic and the need to quickly respond to rapidly changing conditions, traditional silos between public health and healthcare started to break down, allowing for data sharing, regional planning, and mass vaccinations (see box 1). Now that these connections have been made, the time is ripe to develop a LHS that integrates health system, public health, and social sector data to better support the health of all.

Box 1: Collaboration during COVID-19

> The pandemic has shown how collaboration between public health, healthcare, and other sectors can lead to more coordinated responses that serve to protect health and save lives. In Ontario, for example:
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> - Sharing of population and public health data, facilitated by Public Health Ontario, allowed monitoring of COVID-19 cases and their spread across the province in near real-time.
> - Combined with clinical and health system data, this allowed hospitals and PHUs to proactively plan for and respond to changing case counts.
> - Collaboration between PHUs, municipalities, and healthcare providers was key to local vaccination campaigns, with PHUs planning vaccine rollouts, municipalities providing vaccination venues, and healthcare organizations staffing those events.

4. Integrating PH and LHS

4.1. Key components

Taking the above into consideration, the following key components should be considered when integrating public health and LHS approaches:

1. An effective surveillance system to identify issues early on, both at the individual and population level.
2. Technological infrastructure and shared data platforms to support the collection and sharing of health data across partners and sectors.
3. Organizational processes to rapidly design, pilot, assess, and improve on innovative solutions to health system challenges.
4. A shared understanding of the purpose and goals of a LHS, why change/innovation is needed, as well as the values underlying its implementation.
5. A structure to ensure that the perspectives of key stakeholders—including public health—are represented in the LHS approach.
6. Supports to translate and disseminate knowledge broadly, within and outside of the organization.
7. An explicit commitment to evaluating and addressing health inequities.

4.2. Barriers

A significant barrier to the LHS is the longstanding distance between public health and the healthcare system.[13] Public health has often stated that the healthcare system is held in thrall by the "Tyranny of the Acute" and close affiliation or integration of public health and the healthcare system will threaten the independence and unique mission of public health. Public

health practitioners are also wary, based on past experience, where integration with the health service delivery system led to a loss of funding. Arguably these concerns predate the possibilities that modern data analytics and the LHS bring to the discussion as public health has substantially more experience in using data to improve population health.

Currently, there is a dearth of trained personnel to meet the data analytic demands of the LHS. Furthermore, there is not a robust digital infrastructure to support the LHS. There will be much work required to create data sharing and transfer agreements to permit agencies and organizations to work together. The benefits of a LHS should provide a significant incentive for these to be worked out building on current best practices and laws in data protection and data governance.

Ensuring that communities are engaged and have a voice in the LHS is a key challenge, as is ensuring that data protection practices are in place and understood by the population. The close linkages that some PHUs have with their local communities (as is the case in Ontario, for example) can help drive this.

A final, not inconsiderable barrier is funding. In Canada, health service delivery is still based predominantly on a fee-for-service approach, and even bundled payment is based on individual patients. Similarly, public health is funded based on a set of proscribed duties that do not include LHS activities.

The business case for the LHS must demonstrate the value for investment. The literature on LHS suggests that cost savings will likely be realized through more efficient services as well a shift upstream to address preventative care and social determinants of health. Here, public health has a major role to play as its core activities focus precisely on disease prevention, health protection, and health promotion at the population level. Investing in a LHS with a strong role for public health is likely to yield a strong return on investment in the form of reduced burden on healthcare services downstream.

4.3. Enablers

The creation of a LHS will require committed leadership, sound governance, and community buy-in. Given that both public health and the healthcare system are highly valued by their communities, it is likely to be supported should leaders of organizations commit to the transformation. Engaging with health system and public health leaders is an important first step towards creating a high-functioning LHS.

COVID-19 has highlighted the crucial role of public health. The pandemic has shown how collaboration between public health and healthcare systems, combined with real-time data and rapid learning, can save lives, protect health, and preserve health system capacity. The time is ripe to build further connections between public health and healthcare systems.

There will need to be investments in digital infrastructure and connectivity in order to harness the capabilities of the LHS. Many of these investments, such as interoperable health information systems, are already under development. Other enablers include:

- Highly trained professionals, including those with skills related to computing and data science and those able to link clinical and public health worlds.
- System-level supports to enable bringing together of data and knowledge from healthcare and public health systems.
- Sustainable funding to enable local LHS's to reach their full potential.

5. Conclusion

The LHS approach is an opportunity to place data, learning, and quality improvement at the heart of health systems. To build an effective LHS, public health perspectives can and must be integrated into the system. A public health lens focuses attention on the whole population, with particular attention to equity, social determinants of health, and population-level measures. With its long history of using data to inform policy, public health is well-positioned to contribute to conceptual thinking on the topic.

At the same time, a LHS approach brings potential benefits to public health, such as greater sharing of data and access to real-time clinical data to support population health surveillance. Recognizing the longstanding separation between public health and healthcare systems, it will take committed leadership and broad stakeholder engagement to generate buy-in for an integrated public health LHS approach. In our view, this is worth pursuing. By participating in LHS discussions, public health can both contribute to the concept and carve out a role for itself as health systems evolve. Doing so will go a long way to ensuring that our health systems can adapt and learn quickly when faced with future pandemics and other health threats.

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