Understanding Innovation in the Ontario Health System: A Scoping Review and Survey of Ontario Healthcare Providers

by

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Abstract

There is growing interest in understanding how innovation processes can address current health system challenges. Healthcare constantly needs to adapt, learn, and develop to meet the needs of the elaborate healthcare environment; thus, innovation is increasingly seen as a critical capability for healthcare organizations to accommodate these needs. Understanding the dynamics of innovation in healthcare is not only essential to healthcare professionals but also for policymakers who tend to use innovation policy to stimulate efficiency and contain costs related to healthcare services.

Knowledge about innovation in healthcare is scarce, and many studies on innovation in healthcare have focused on specific technologies and specific policies or stakeholders. There are also enduring studies focused on conceptualizing the spread and implementation of innovations. This research addressed the gap related to the understanding of innovation and the social factors that shape cohesion in multiparty innovation in healthcare. This was achieved by contributing theoretical and empirical insights into the hidden features of contextual and social complexity which impact divergent thinking between healthcare professionals and provincial policymakers.

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List of Acronyms

AI	Artificial Intelligence
AM	Additive manufacturing
AVR	Augmented/Virtual Reality
BC	Blockchain
BPM	Business Process Management
CAS	Complex Adaptive Systems
CME	Continuing medical education
CPD	Continuing Professional Development
DOI	Diffusion of Innovation
EHR	Electronic Health Record
EPOC	The Cochrane Effective Practice and Organization of Care Group
ET	Emerging Technology
FHIR	Fast Healthcare Interoperability Resources
GT	Grounded Theory
GTM	Grounded Theory Method
HeRO	Heart Rate Observation
HIE	Health Information Exchanges
HIT	Health Information Technology
HL7	Health Level Seven International
ICU	Intensive care unit
IOM	The Institute of Medicine
IoT	Internet of Things
MOH	Ministry of Health
OBIO	The Ontario Bioscience Innovation Organization
OECD	Organization for Economic Co-operation and Development
OR	Operating Room
PA	Predictive Analytics

RCPSC	The Royal College of Physicians and Surgeons of Canada
R&D	Research & Development
RP	Rapid prototyping
SLR	Scoping Literature Review
UNDP	United Nations Development Programme
VR	Virtual Reality

Chapter 1. Introduction

Several researchers have attempted to define innovation in the healthcare sector. However, there has been no consensus on how innovation is understood or conceptualized (Ouellet et al., 2018). Innovation is essential to transforming health systems and is extremely important in quality-of-care delivery. Thus, without a contextual understanding of innovation, it is extremely challenging to 'transform successful health systems. Several factors have been reported to influence innovation in health systems (Binz & Truffer, 2017). These factors include the interplay of individuals and institutions that fund innovation, continuity of stewardship, ability and desire to seize opportunities, and contextual characteristics such as path-dependency and supportive divergent thinking of new policies, new knowledge and novel technologies (Balabanova et al., 2012).

The disconnect between these factors, especially the coordination of divergent thinking between healthcare experts and policymakers regarding how innovation is perceived, can be problematic when it translates to understanding and implementation within the health systems (Lee et al., 2003). Relationships between policymakers and healthcare experts can be tense and may be conflicted by differing motivations and priorities. However, understanding and applying the appropriate engagement methodology of innovation and incorporating these perspectives in a meaningful and robust way (Chojecki et al., 2015) can improve implementation (Snowdon & Cohen, 2011) and narrow the variations of how innovation is perceived across health systems (Kleinert & Horton, 2013).

Despite the significant attention directed toward the adoption, diffusion, and barriers of healthcare innovation in Canada (MacNeil et al., 2019) and a range of countries internationally (Keown et al., 2014),

an understanding of innovation and the social factors that shape cohesion in multiparty innovation projects remains nascent. In particular, this gap in literature suggests the need to direct increased attention toward how the socio-political context shapes the conduct of innovation.

This thesis aims to address this gap by contributing theoretical and empirical insights into the hidden contextual and social complexity features that impact divergent thinking between healthcare professionals and provincial policy administrators. This will be attained by creating a framework that explicitly defines how ideas that initiate innovation can be supported through a lateral and bottom-up culture between healthcare professionals and policy administrators. Such a framework would have several benefits: first, it would improve the health system innovation framework as a policy tool - in that an improved contextual understanding would guide healthcare professionals and provincial administrators in their search for coordinated interactions between a focal innovation and its context. Second, explicit consideration of contexts would, thus, increase the understanding of individual case studies and provide a basis for classification, generalization, and transfer of findings, which is of key importance for innovation-based policy-making. Finally, by acknowledging that context structures are not static but change over time, stakeholders can identify particularly workable or non-workable opportunities for transformative innovation.

1.1 Problem Statement

Health systems in Ontario are facing the combined challenge of balancing innovation policy that is "pushed" on them while also having to manage and deliver day-to-day care delivery. In addition, provincial policymakers are regularly isolated from the everyday aspects of healthcare delivery, resulting

in the development of innovation policies that do not always reflect the healthcare system's goals and needs (Yi, 2019).

A “silo-ed” health system (Buchman et al., 2018) and silos between the departments that fund innovation and those that regulate it (Ponka, 2017) mean that new health technologies, procedures and regulations can be “pushed” onto health systems without an understanding of their usefulness and receptiveness from the healthcare sector (Lehoux et al., 2014). As a result, innovations that might improve healthcare delivery may be ignored while other technologies are developed (McCarthy et al., 2018) that do not enhance healthcare or service delivery in Ontario. These challenges create a pressing need for system-level thinking and system-level transformation, including better linkages between policymakers and health sector experts (XIA & LEE, 2014). To achieve this, provinces should be innovative and create the right conditions for understanding innovation within and across systems. This means encouraging, aligning, and managing partnerships and communication between stakeholders involved along the innovation pathway. It also means recognizing the processes and structures that can support and accelerate innovation. This thesis examines how innovation is understood in the province of Ontario. It explores the role of provincial management processes, the specific support that dedicated organizations for innovation can provide, and the strategies the province can adopt to facilitate the knowledge base of healthcare professionals.

1.2 Research Purpose and Motivation

This thesis aims to present the conceptual underpinnings of innovation and gain a better understanding of how innovation is conceptualized and applied in Ontario's provincial health system. This study seeks to identify the challenges of provincial interdependencies in the innovation process by looking at leadership

behaviour, organizational climate, and strategies that influence innovation in provincial healthcare systems. Innovation in the healthcare sector has long been criticized for its failure to fulfill expectations of higher efficiency and better service (Collier, 2018) & (Ouellet, Robert; Doig, Anne; Fritz, Bradley; Pugsley, 2018). The study will provide a framework for understanding innovation processes in a provincial context through representative surveys and interviews to better understand how healthcare professionals and providers interpret innovation. The framework can be utilized by stakeholders such as policymakers and healthcare professionals involved with innovation.

Additionally, the research is motivated by the need to develop a dedicated framework and a methodology that helps us better understand innovation and its implementation in the provincial health system. The outcome of this exhaustive research will be a conceptual model and propositions that illustrate the conceptualization of innovation within the health systems of the provinces. This will be implemented by concentrating on two guiding concepts for transformation: integration and collaboration. I will apply these to the central question: "How is innovation understood by health experts and health administrators in Ontario."

1.3 Research Question

The Oslo guidelines (OECD, 2018) posit that innovation is not a linear, sequential process but involves many interactions and feedback in knowledge creation and use. The guidelines further opine that innovation is based on a learning process that draws on multiple inputs and requires ongoing problem-solving. Therefore, the systems perspective of innovation calls for multidisciplinary and interdisciplinary approaches to examine the interdependencies among actors, the uncertainty of outcomes, and the path-

dependent and evolutionary features of systems that are complex and non-linear in their responses to policy intervention. As a result, innovation can effectively improve healthcare delivery when there is a better linkage between policymakers and health sector experts. This may involve:

- Stimulating system-level thinking
- Aligning bottom-up application of innovation
- Promoting collaborative interaction
- The lateral approach of applying appropriate engagement methodology of innovation
- Encouraging distributed leadership

Arundel et al. (2016) suggest that an inclusive innovation process has essential benefits in supporting advanced innovation methods and reducing failures such as abandoned and underperforming innovation. This hypothesis implies that a common understanding of the innovation system benefits individual actors and the system overall. Understanding the roles and interactions of all the stakeholders in the system allows an individual stakeholder to capitalize on other players' strengths and take advantage of opportunities. This resulting increased alignment generally enhances the system's performance.

The innovation process is complex and multi-dimensional, with innovation in the healthcare industry having unique challenges. Any attempt to understand the healthcare innovation process should begin with an in-depth analysis of its challenges. Several studies suggest that it is difficult to change the behaviour of clinicians (Gupta et al., 2017), current medical practices, and healthcare organizations (Hill et al., 2020); (Weng et al., 2013). Adopting healthcare innovations is often regulated by laws, making changes more laborious as well (Länsisalmi et al., 2006). This and the clinicians' tendencies to protect their autonomy

and reputation can promote a culture of blame and secrecy that inhibits organizational learning and the generation of innovation (Huntington et al., 2000).

Overall, the aim of the study is to determine how innovation is understood and perceived within the health system of the provinces. Several research questions have been created to achieve this objective and ensure the collection of all relevant data. These questions will help to ensure that the study will be comprehensive while providing an in-depth analysis of the understanding of innovation. Hence, the research questions are:

RQ1: How do health experts and administrators understand and perceive innovation in Ontario?

RQ2: Which factors influence the healthcare sector innovation process, including how innovation is driven?

RQ3: Where do the ideas for innovation come from?

RQ4: How is the integration of different types of health information technology (e.g. EHRs, AI) into Ontario's healthcare system decided?

1.4 Research Approach

Understanding contextual and practical problems are common within grounded theory (GT). GT is a systematic set of techniques and procedures that enable researchers to identify concepts and build theory from qualitative data(Corbin & Strauss, 2014). More specifically, GT is concerned with psychosocial processes of behaviour and seeks to identify and explain how and why people behave in certain ways in similar and different contexts (Charmaz, 2016). When applying grounded theory to a problem domain, the proposition is that knowledge and understanding of the domain and solutions are attained when

qualitative data to develop concepts and scientific rigour is achieved (Singh & Estefan, 2018). The Grounded Theory approach to innovation encourages practitioner-based insights and inputs. Multiple sources of data are embraced and engaged in a recursive sense-making process. In practice, the con to GT is that it helps to understand, design, and utilize real-world knowledge about health concerns. Applying GT to understand healthcare problems enables a research activity to focus on the problem's domain and the knowledge base of scientific foundations, experience, and expertise that informs the research (Foley & Timonen, 2015); (Gupta et al., 2017). The approach of this thesis involves using methods based on GT precepts to answer the research questions and carry out the research.

The process illustrated in Figure 1 below is a logical structure for understanding innovation and solving knowledge and practical problems (Wieringa, 2009) associated with innovation (Ovretveit, 2010); (Heinen et al., 2019). The process consists of four phases: problem investigation, solution design, solution validation and solution implementation. In the problem investigation phase, a researcher seeks information about and obtains an understanding of the given problem domain to describe the problem. In the solution design phase, the researcher develops a plan for a solution and ensures the plan aligns with the research.

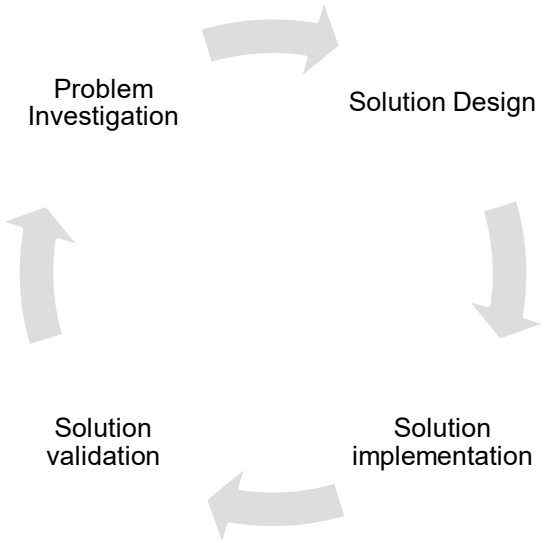


Figure 1: The Logical Structure to Understand Innovation (Wieringa, 2009)

In solution validation, the researcher assesses the specified solution to ensure it meets the research goals as closely as possible when implemented. Finally, the researcher applies solutions based on research documents and survey answers in the solution implementation phase.

1.5 Thesis Contributions

Healthcare and health systems constantly need to adapt, develop and innovate to meet the challenging needs of patients and stakeholders. To meet these needs, innovation is increasingly seen as a critical capability for healthcare organizations (Savory & Fortune, 2015); (Exton, 2010). Understanding the changing aspects of innovation in healthcare is not only of interest to social and medical professionals but also for policymakers interested in using innovation policy to spur efficiency and contain costs related to healthcare services. However, knowledge about innovation in the healthcare domain is scarce, and an understanding of innovation and the social factors that shape cohesion in multiparty innovation projects remains nascent (Collier, 2018). Many studies on innovation in healthcare are focused on single

technologies (Consoli & Mina, 2009), specific policies (e.g., financing and public procurement) (Cappellaro et al., 2011); (Sorenson & Kanavos, 2011), or actors, e.g., physicians (Chatterji et al., 2008), patients (Oliveira et al., 2015), and entrepreneurs (Exton, 2010). Continuing research has also focused on conceptualizing the spread and implementation of innovations(May, 2013b). Implementing innovations in highly regulated healthcare requires bridging social and cognitive barriers of medical professions (Kyratsis et al., 2014). Innovation processes are intricate and non-linear and require broader and subtle system transformations (Lehoux et al., 2009). Finally, we argue that the broader socio-economic contexts of innovation processes and conditions for implementation in healthcare need to be better understood.

Consequently, this research has brought to bear the challenges healthcare professionals and administrators face when innovation is pushed on the health system. It does so by describing the current state of research in the healthcare domain. Accordingly, the contributions of this research include major and minor contributions.

1.5.1 Publications

The articles listed below have been published or submitted for publication as follows:

- An Agent-Based Framework for Healthcare Teamwork has been published in ICISS '19: Proceedings of the 2nd International Conference on Information Science and Systems. March 2019
- Connectivity Patterns for Supporting BPM in Healthcare has been published in FICC 2018: Advances in Information and Communication Networks, pp 697–703.
- The impact of health information technology on Team-based communication: A systematic review (to be submitted)

1.6 Thesis Organization

The remainder of this study is structured in the following manner:

Chapter Two: Scoping Literature Review - discusses the fundamental concepts of innovation, understanding and technologies in healthcare. The review highlights the innovation paradigm and presents emerging characteristics, implementation services, models, and issues related to understanding innovation in the healthcare system. The chapter also discusses how healthcare is a complex system, and the pursuit of innovation within the system should be thoroughly coordinated with healthcare professionals and the management of healthcare institutions.

Chapter Three is a Proposed framework that outlines the strategies to be applied during the innovation journey in the general context of the health system. Before the journey, the need for innovation and potential interventions should be carefully assessed by involving all clinical stakeholders with clear implementation leadership. Interventions should be need-oriented, user-centred, and adaptable to changing circumstances.

Chapter Four: Methodology - provides a detailed description of the method used in this thesis. As described in Section 1.2, this thesis addresses contextual problems enabling provincial policymakers to use data-driven evidence to successfully coordinate their activities to innovate. Since knowledge and the ability to understand practical issues, such as the contextual perspective of healthcare to innovate, are two mutually nested problems common with grounded theory (GT), a methodology based on the principles of GT was considered the method for this thesis.

Chapter Five: Results of the Survey - is an overview of the survey and some specific themes within the health system that influence the understanding and implementation of innovations.

Chapter Six: Discussion – outlines the argument that innovation is characterized by a high complexity that requires unorthodox thinking that should be socially accepted to succeed.

Chapter Seven: Lessons Learned - depicts the lessons learned from the understanding and implementation of innovation in healthcare. The chapter posits that the growing understanding of innovation as a process of activities is raising new challenges for healthcare.

Chapter Eight: Conclusion & Future Work summarizes this doctoral thesis. It also discusses the study's limitations and recommends avenues of exploration for future research on this topic.

Chapter 2. Scoping Literature Review

This chapter is a scoping literature review (SLR) that includes a thematic analysis. We emphasize how an exercise of this sort may enhance the result of innovation, making them more useful to policymakers, practitioners and service users. The ultimate goal of the SLR was to develop a framework that proposes stages and opportunities to understand innovation. The review was adapted from Arksey and O'Malley, with changes allowing for broader inclusion, iterative analysis, and more efficient implementation (Arksey & O'Malley, 2005). The review involves six steps: identifying potential studies, screening studies for inclusion, and conducting thematic analysis, with collation and reporting of the findings of the method. The scoping review was also selected to address the broad, complex and exploratory research questions that span the diverse health system sector. This approach provided the flexibility needed to include a variety of studies, including grey literature (which is especially relevant to health system innovation and policy research) and studies of varying quality (O'Brien et al., 2016).

Literature from the scoping review was used to guide and develop The Framework of Health IT Innovation in Chapter 3. This was developed by first analyzing and integrating emergent concepts related to innovation processes and resources from themes and theme categories, as well as domain knowledge in health informatics. The thematic analysis is attached in **Appendix H – Thematic Analysis**. The SLR provided a better grasp of the literature specific to innovation in healthcare and helped identify key priorities for understanding innovation and knowledge gaps that call for scholarly attention. Key studies of the SLRs are discussed below.

2.1 Innovation in Healthcare

Although definitions of innovation abound, most definitions of innovation highlight new approaches or products that result in meaningful improvements - these can include the generation, development or implementation of new or better ideas that produce policies, products, strategies, services, procedures, models, or other solutions that add value over the status quo, such as social or economic value (Blomqvist & Colin, 2016). Applied to the healthcare sector, the definition encompasses a broad range of innovative practices, from minor incremental improvements (Chen, 2012) to disruptive or transformative innovations that completely alter or replace processes or services. For example, Telemedicine, also known as virtual care, provides access to medical providers through video conferencing, improving access to healthcare and reducing the burden on hospitals and clinics (Cannavacciuolo et al., 2023).

Contextual factors, health systems features, institutions within health systems, and the adopting entities within these institutions jointly interact to impact the receptivity of health systems to innovations, as well as the speed and scale of their adoption and diffusion (Atun et al., 2010). Though the theoretical concept of transformational innovations in healthcare has been verified in case studies(Fischer, 2016); (Weberg, 2012), little is known about the prevalence of transformative innovations or the relative outcomes of transformative and incremental innovations.

Atun (2012) defines innovations in health systems as referring to new medicines, diagnostics, health technologies, new ideas, practices, objects, or institutional arrangements perceived as novel by an individual or institution (Atun, 2012). Dzau and Balatbat (2018) infer innovation is crucial for improving health outcomes in high-income countries (Dzau & Balatbat, 2018). The Canadian Advisory Panel on Healthcare Innovation (the Naylor Panel) defines innovation as those that “generate value in terms of

quality and safety of care, administrative efficiency, the patient experience and patient outcomes." Alternatively, The Ontario Bioscience Innovation Organization (OBIO) (OBIO, 2013) describes innovation as a new technology, technique, process, model, or other solution that adds value and provides a meaningful benefit over the status quo. They caution that when innovation is limited to healthcare, two things should be considered: innovation requires openness and an appetite for risk, and its adoption should be monitored and evaluated to ensure it meets fiscal and health outcomes. Appetite for risk is the level of risk the health system is willing to accept while pursuing its objectives for innovation and before any action is determined to be necessary in order to reduce the risk (Martens & Rittenberg, 2012).

Gieske et al. (2016) distinguished between three aspects of innovative capacity that can be used to evaluate the innovative capacity of public sector organizations: connective capacity (involves connecting arrangements such as institutions, stakeholders and approaches), ambidextrous capacity (Huang & Li, 2017) - (the ability of healthcare to create sustainable capacity in a dual context, by balancing resource exploration, also referred to as disruptive innovation), and learning capacity (the ability to sequence ideas). Other critical findings include: (a) public sector innovativeness is about balancing between exploration and exploitation (e.g., innovation and improvement within and between organizations); and (b) the innovative capacity of public organizations can be improved if a multifaceted approach takes into consideration the building blocks of public innovation processes.

For this study, the definition by Omachonu and Einspruch (2010) on "Healthcare innovation is utilized. This is defined as introducing a new concept, idea, service, process, or product to improve treatment, diagnosis, education, outreach, prevention and research, with the long-term goals of improving quality, safety, outcomes, efficiency and costs". This definition of innovation captures innovation's three most

vital characteristics: novelty, application component, and (c) an intended benefit. In line with the definition, innovations in healthcare organizations typically involve new services, new ways of working, and/or new technologies (Omachonu & Einspruch, 2010).

These varied definitions underscore that healthcare innovation should not be confused with invention in general, the creation of new technologies in particular, or merely about obtaining a new idea. Instead, these definitions suggest that innovation is an activity defined more by intent and calls for a more integrative view in which various innovation system perspectives stop being implemented in parallel and start interacting in more engaged and reciprocal ways toward an integrative agenda (Weber & Truffer, 2017).

2.1.1 The Innovation Lifecycle

There is no agreement in the literature about defining the concept of innovation (Hartley et al., 2013). To avoid conflating innovation with creativity, several scholars posit that innovation involves not only the generation but also the practical realization of new and creative ideas (Lindsay et al., 2018). Hence, innovation can be defined again as a complex and iterative process through which problems are defined; new ideas are developed and combined; prototypes and pilots are designed, tested, and redesigned; and new solutions are implemented, diffused, and problematized (Hartley et al., 2013). Figure 2 depicts the different analytical phases of the innovation cycle.

A comprehensive understanding of the innovation lifecycle can provide a better direction for innovation policies in healthcare (Tao et al., 2010). The life cycle is the main essence that characterizes innovation and includes the period from its emergence to its end. The end is not a complete depletion of the lifespan of innovation but innovative ageing resulting from new innovative solutions created with better techno-

economic indicators and higher efficiency. They, in turn, lead to decision-making about terminating the life of the innovation. Innovation doesn't happen by chance (Kitzmiller et al., 2019). Instead, a predictable five-step "innovation lifecycle" can govern the innovation process in the healthcare setting. Understanding this lifecycle can help healthcare innovate more rapidly and effectively. The innovation lifecycle is comprised of the following five stages:

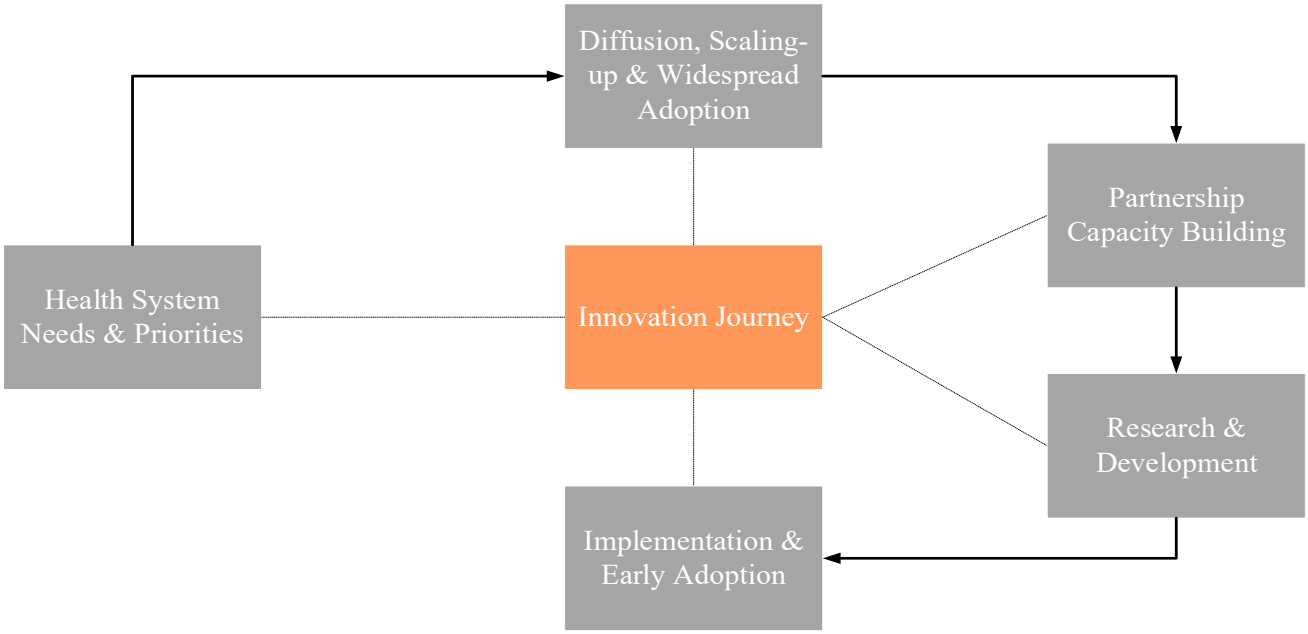


Figure 2: Innovation lifecycle – Towards Ontario Health Innovation Strategy (2015)

Stage 1: Health System Needs And Priorities

Canada has a credible standing in clinical trials, health services research, and evidence-based medicine but is less successful at implementing technical and other innovations into practice (MacNeil et al., 2019). A national advisory panel on healthcare innovation observed that "organizations across Canada are finding it difficult to introduce, sustain and scale up their innovations in the healthcare system"(Advisory Panel

on Healthcare Innovation, 2015). Some factors may include policy gaps, such as jurisdictional issues in the provision of health care across the country (Council, 2015) and the inadequate prioritization of system needs and emphasis on projects that do not transform promising and valuable healthcare innovations and technologies nationally (Snowdon et al. 2011) have been identified as contributing to the less successful implementation of innovation.

The innovation lifecycle begins with identifying the healthcare system's needs, priorities, problems, or opportunities(Anderson et al., 2014). As an initial stage, the organization will define the vision and objectives, identify available resources, and establish the scope of the project. The system needs, priorities or problem definition is not typically a difficult stage, but it's an important one to get right (Hartley et al., 2013). If skipped or not done thoroughly, it can cause problems later. The healthcare system may focus on a grassroots problem or tackle a strategic, institutional challenge (MacNeil et al., 2019).

Stage 2: Pilot, Diffusion, Scaling up & Adoption

After harvesting the best ideas and priorities, the organization needs to build and test a mockup or functional prototype of innovation. To succeed in the pilot phase, innovators need to develop a clear set of metrics and avoid moving "goalposts." Failures in the pilot stage can be a form of success and a learning opportunity.

After a successful pilot, the organization can often face a substantial adoption barrier. In a perfect world, new ideas would be easily and broadly adopted with little or no resistance. However, people are often reluctant to embrace change and innovation in real life. Adoption resistance is common in large, siloed organizations and less common in smaller or hierarchical organizations (Patsiotis et al., 2013). Leadership

support, additional funding, training, change management and communication can help close the substantial adoption barrier. Engaging stakeholders early on can make all the difference in successfully improving the perception of innovation (MacNeil et al., 2019).

Step 3: Partnership and Capacity Building

Partnership is fundamental to the implementation mechanism of innovation (Regan et al., 2017). These collaborative mechanisms, in all their great diversity, have led to a voluminous literature and a lively debate on their role and relevance (Ward et al., 2018). Their potential has been recognized by the Organization for Economic Co-operation and Development (OECD) and other international development organizations (e.g. UNDP). Developing partnerships that can genuinely feed into the innovation design process and influencing how healthcare policies and programmes are implemented can be complex (Hawkes et al., 2016). For example, Emory Healthcare in Atlanta partnered with Verizon to test 5G-powered healthcare devices, including connected ambulances, medical imaging and remote physical therapy (Drees, 2020). The partnership involved the launch of a 5G ultra-wideband network within Emory Healthcare Innovation Lab.

Significant efforts should be made to build a solid strategic capacity (Hawkes et al., 2016). Partnerships should acquire a critical mass by ensuring the commitment of the main healthcare services and government agencies concerned, strong participation from healthcare professionals, and an unchallenged representation from civil society. Accountability and transparency should be exemplary, and performances should be monitored and appropriately assessed. Partnerships should build a strong analytical capacity and have access to critical information (Hawkes et al., 2016). Partnerships across the policy levels, mainly

those with a rich track record of health engagement and communication with government partners, can influence the establishment of policy goals and objectives (Ward et al., 2018). Such partnerships thus can endeavor to become an integral part of both policy design and delivery processes.

Step 4: Research and Development (R&D)

R&D has been the bedrock of progress in global health. Many innovators treat R&D as the stage of innovation where an idea or discovery is translated into a product that addresses a health need. The result should be a safe, effective product that is appropriate, affordable, acceptable, and accessible to those who need it most. Overall, expanding investments into healthcare R&D leads to the improvement of health service technologies, which not only improves the quality of health services but also stimulates related healthcare activities (Salman et al., 2020).

Step 5: Implementation and Early Adoption

In this stage, the adoption process consists of a sequence the potential adopter passes through before acceptance of innovation. According to Talukder (2012), the perceptions of innovation by relevant decision-makers in the organization can affect their propensity to adopt an innovation. The perceived net benefits, including economic incentives the innovation offers, substantially affect organizational adaptation (Cappellaro et al., 2011). Other innovation characteristics that influence organizational adoption decisions include compatibility, complexity, observability, trialability and perceived uncertainty (Rogers, 2002). An innovation can only be considered a success when the innovation is adopted by the organization and integrated into the organization, and the adopters demonstrate commitment by continuing

to use the innovation over a period of time (Kitzmiller et al., 2019). Adoption is defined as the decision by the adopter to make full use of innovation as the best course of action (Mohammadi et al., 2018).

In the implementation stage, the organization can decide to purchase and make use of the innovation". This organizational adoption decision is only the beginning of the implementation of innovation because the acceptance of innovation within the organization now becomes essential.

The innovation journey aligns well with the concept of the value proposition within a healthcare setting (Porter et al., 2016). The goal of value proposition creation is to comprehend how healthcare can potentially generate value for a specific set of processes and to plainly and distinctly articulate why the health system should acquire a good or service to capture incremental value(Marzorati & Pravettoni, 2017). Well-developed value propositions can result in positive business outcomes as they can help retain customers, increase profits, and help reduce healthcare costs (Porter et al., 2016).

2.2 Characteristics of Practical Innovation in Healthcare

Innovation, clinical guidelines, and new procedures are " mechanisms " that should meet certain criteria to make health systems attractive and promote improvements(Øvretveit, 2011). Specific characteristics of innovation (e.g., compatibility with existing norms and values, the opportunity to try them out or a clear and easily accessible format) can positively influence clinical professionals' adoption when they are involved in the development of an innovation or the proposition of change. Offering healthcare professionals the opportunity to adapt change to their situation also promotes implementation. As emphasized by the OECD innovation strategy, better measurement of innovation and its impact on inclusiveness and sustainability is key to fulfilling the promise of better-coordinated innovation policies in the digital era (OECD, 2018). However, policymaking is still mostly focused on what innovation is

easier to pursue (Rivard et al., 2020). Therefore, there is a pressing need to capture how ideas are developed and how they can transform organizations and the fabric of society.

Several scientific literature and evidence-based clinical practice guidelines reviewed have proposed several features to help care providers and policymakers make optimal decisions for successful innovation (Binz & Truffer, 2017); (Weng et al., 2013). These features are shown in Figure 3 below.

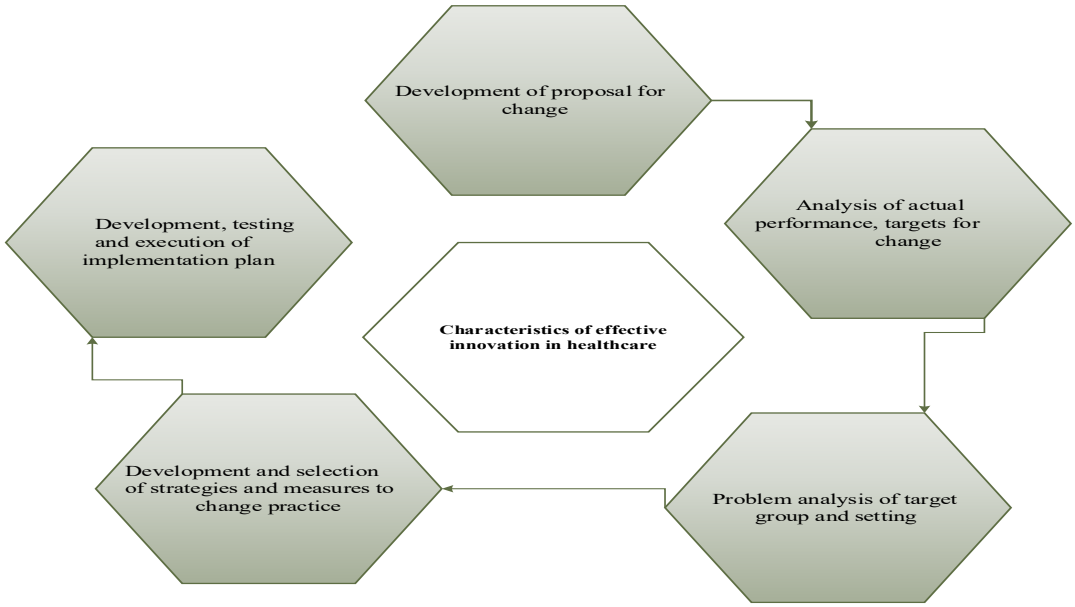


Figure 3: Characteristics of Effective Innovation (OECD, 2018)

2.2.1 Development of Proposition for Change

An initial step in applying innovation or new procedures is developing or formulating a concrete proposition for improving patient care. Innovation in the healthcare domain is rarely impulsively pursued since it is frequently inaccessible by users in regular practice and/or unclear about precisely what performance is expected (Rotter et al., 2012). Therefore, implementing an innovation should start with a detailed description of the improvements to be pursued and the changes in behaviour desired (Ostrovsky

& Barnett, 2014). These terms are preferably concrete, ambitious, and feasible within the implementation setting (Anderson et al., 2014). In defining a proposal, features of the innovation that are important for its ultimate adoption by the clinical system should be considered. Different types of patient care improvements require different change proposals (OECD, 2018). An example by Grol and Wensing (2020) states that innovation in clinical decision-making requires clear evidence presented as summaries of the scientific literature or evidence-based guidelines.

2.2.2 Assessment of Actual Performance

Before commencing the implementation of an innovation, actual care provided should be assessed, and the following concerns accounted for:

- What type of care is given?
- Is the care provided in line with the proposal for innovation, and to what extent?
- What are the most important deviations from the proposed way of working?
- Which aspects of the proposed performance have been implemented and which have not?

Most propositions for innovation include a variety of specific recommendations for optimal performance. Some of these may have been adopted, and others probably not. An efficient method is to mainly concentrate on the most important deviations from the specified recommendations and on those issues where change is possible and can lead to better patient care outcomes. Since a system can address only a few targets simultaneously, it is vital to select the most relevant ones. A detailed examination of the actual performance in practice and deviations from the desired care will also help create a sense of urgency in the target audience – a feeling that care provision should be improved and a feeling of responsibility for that change.

Various theories highlight the importance of insight into the discrepancy between optimal and actual performance as a motivator of innovation. Most care providers overestimate the quality of their work and are usually surprised when they see the “ facts, ” the actual metrics describing their performance (Davis et al., 2006). For a reasonable evaluation of actual performance that may inspire innovation, one needs:

- indicators to measure actual performance reliably and validly - preferably employing an efficient process used in the development of such indicators (OECD, 2018)
- reliable methods for collecting performance data
- acceptable, understandable, and motivational feedback, which encourages participation in the process of improving patient care for healthcare professionals
- to formulate concrete targets for change.

2.2.3 Developing Improvement Strategies

By linking the factors described in the previous stages with relevant, cost-effective measures, strategies for improving patient care may be developed, selected, and tested on the entire or part of the healthcare sector for which innovation is initiated(Powell et al., 2012). Different phases of the implementation process usually require different strategies, such as:

- Dissemination: increasing interest and understanding of innovation - encouraging a positive attitude and a willingness to coordinate activities (Mohammadi et al., 2018).
- Implementation: encouraging the adoption of innovation and ensuring that the recommended performance becomes a part of daily routines (Regan et al., 2017).

Several studies identify increasing strategies that can be used when introducing innovation and changes. Examples include developing local protocols, audits and feedback, reminders, computer-supported

decision-making, patient education, financial incentives or sanctions, organizational measures, redesigning care processes, and disease management systems. The OECD and The Cochrane Effective Practice and Organization of Care Group (EPOC) have categorized these strategies into: interventions directed at individuals or groups of health professionals (for instance, continuing medical education (CME) or professional development (CPD), outreach visits, audit and feedback, or reminders, opinion leaders);

- financial interventions, such as incentives or disincentives, directed at care providers and patients;
- organizational interventions (structural measures and interventions directed at organizational changes);
- the establishment of laws and formal regulations.

This classification does little justice to the reality of introducing innovation into care practice and new developments in this area. Given the practice realities of several influential factors, a set of methods and measures that link well to these factors is essential to the success of innovation and change strategy (Arundel et al., 2019). A mix of activities is usually selected in line with the results of the diagnostic analysis, and new measures and strategies may be conceived and tested on a small scale. In practice, a balance should be reached between the possibility, on the one hand, of achieving the desired effects and, on the other hand, the amount of money, time, effort, and personal commitment invested and the disruption the innovation may cause (Anderson et al., 2014).

2.2.4 Development, Testing and Execution of Implementation Strategy

Developing an implementation plan necessitates focusing on effective dissemination (to stimulate interest and promote sufficient knowledge about the guideline) and encouraging its acceptance (i.e., to foster a positive attitude and willingness to bring about real behavioural change). Such dissemination processes promote implementation and integration into regular working routines and care processes. Various strategies and measures may be effective in different phases of the innovation process. In planning innovation activities, it is helpful to consider the following points:

- Start on a limited scale with a small number of motivated professionals, teams, or institutions. The implementation plan and the various interventions may be tested for suitability and feasibility and modified or adjusted in light of this experience.
- Plan according to the different phases of the change process: what should still be done to inform interest-specific subgroups? What should be done to overcome resistance? What is needed to incorporate a change into existing care processes?
- Establish at what level interventions and measures can best be planned. This will differ for national programs, institution-directed programs, ward or team projects, and projects aimed at local groups or practices.
- Involve the target group: it is critically important to engage this group in developing innovation or protocol and/or analyzing implementation problems. Representatives of the target group can play an important part in designing and testing the implementation plan. They may often know what is possible and can think creatively about suitable interventions.

- Plan activities over time: develop and distribute a timetable and a logical sequence of the planned activities.
- Distribute tasks, procedures, and responsibilities: issues such as who does what, where, and who checks it has been done should be clearly established.
- Build the implementation plan into the existing structures and channels for contacting or training the target group.
- Identify the plan's long-term aims; these are used to guide an ongoing evaluation.
- Plan for and identify adequate structures, resources, and personnel - depending on whether it is a small-scale ward, practice implementation project or a large-scale implementation project, it will need the appropriate resources and suitable expertise.
- Finally, attend to the organizational culture in the setting in which the implementation is to take place. Clear leadership, good collaboration between professionals and a culture where continuous learning and care improvement can occur are desirable; they most often represent a prerequisite to achieving change.

2.2.5 Implementation of Innovation in Healthcare Practices

Understanding and assessing the implementation of healthcare interventions in practice is an important problem for healthcare managers and policy-makers (Choi & Chang, 2009) and also increasingly for healthcare professionals and others who should put them into operation beyond formal clinical settings (Shippee et al., 2012). The planned innovation should be integrated with regular practice routines and embedded in the organizational processes to prevent relapse and arrive at the stage of " normalization (May et al., 2009). When implementing an innovation or new routine is no longer actively supported by a

project or an improvement team, the chance of relapse is considerable (Choi & Chang, 2009). To ensure innovation's sustainability, specific measures are needed – for example, additional resources, new skilled staff, health information technology, or system changes (May, 2013). Alternatively, specific parts of the implementation program can be continued structurally. For example, continuous monitoring of the proposed new performance or regular training on the new behaviour may be required.

2.3 Problem Analysis of Targets for Innovation

When examining the context in which innovation is to take place, the characteristics of the health system, and the factors stimulating and hampering change, healthcare professionals argue that understanding how innovations (such as new policies, new knowledge and novel technologies) can be effectively introduced in health systems and how these innovations interact with health system variables to influence health outcomes is essential (Hulscher et al., 2013). The aspects that determine whether the implementation of an innovation is successful or not are many and varied. Success factors may be connected to the setting in which one wants to implement the innovation, the relationship between individuals within the setting, the goals of the implementation, the actual care provision proposed, the professionals who will have to carry out the innovation, the patients who will have to cooperate with the implementation, the resources available, and the organizational or structural conditions for its effective introduction (Øvretveit, 1999). In this regard, I carried out a scoping literature review of the contextual artifacts involved in pursuing innovation. The SR identified and situated the innovation processes (modelling, checking, analysis and enactment) that provide an in-depth understanding of innovation.

The SLR also focused on exploring key aspects of innovation that influence its effectiveness and improve coordination and collaboration. To ensure that a substantial collection of literature related to innovation was captured, I generated these initial research questions to guide the search:

1. How is innovation perceived and conceptualized by health experts and health administrators in Ontario?
2. Which factors influence the Ontario healthcare sector innovation process, including how innovation is driven?
3. How is the integration of emerging technologies into the Ontario healthcare system decided?

2.3.1 Identifying Relevant Studies

Arksey and O'Malley (2005) suggest that a broad definition of keywords for search terms should be embraced to gather a 'wide coverage' of accessible literature. To this end, key search terms and concepts were developed to capture literature on innovation regarding the Ontario healthcare system. A university librarian who is a subject specialist in search strings was consulted. Their input helped refine key search terms and identify databases most likely to produce the results sought. Search techniques included search tools such as innovation subject headings and Boolean operators to narrow, widen and combine literature searches.

I utilized the framework developed by van Olmen et al. to address the following: What kind of research has been conducted on innovation in healthcare? Where has this research been conducted? What types of challenges have been documented? To what extent does the process of innovation vary across countries? Ultimately, a better grasp of the literature could help identify key priorities for implementing innovation and knowledge gaps that call for scholarly attention (van Olmen et al., 2010). The review was well-suited

to describe what is known about innovation in the healthcare system and identify key lessons and knowledge gaps. Table 1 outlines the key search terms used to guide the search.

Table 1: Key search terms

Search Terms
▪ (innovation AND health systems OR health IT OR information technology AND *technology*
▪ (“innovation in the healthcare system” OR “innovation in healthcare”) AND (“health information technology" OR “health*IT” OR “health* information technolog*” OR “medical information technology*)
▪ W/15 innovation AND healthcare OR health IT OR information technology
▪ ("innovation in the healthcare system" OR "innovation in healthcare") AND ("health information technology" OR "health*IT" OR "health* information technolog*" OR "medical information technology*)
▪ ("innovation in the Ontario health system" OR "healthcare innovation ") AND ("health system technology" OR "health*IT" OR "health* information technolog*" OR "medical information technology*)
▪ title-abs-key ((innovat*W/3 transformation*) AND ("health*IT" OR "health* information technolog*" OR "medical information technology*"))

The search strings in Table 1 were used with the desire to accumulate citations up to and including the year 2022. In addition, three search strategies were used to enable us to obtain the primary articles to use in answering the research questions. In addition, each search strategy sought articles from peer-reviewed sources to ensure quality among articles.

In the first strategy, key concepts were identified and converted into Boolean logical queries and used as the basis for the preliminary search strings. Major databases in information systems, health systems design, and innovation that address the perception of innovation in the healthcare system were identified.

These were IEEE Xplore, PubMed, Scopus, and Springer Link. Google Scholar was also included to help identify articles not covered in the four scientific databases that contain the searched topics.

The second strategy concentrated on supplementing the database search by employing a search based on key scholars in the field. Citations were reviewed by title and abstract during the screening process. Overall, the period covered by the searches ranged from 2010 to 2022. This period was chosen for pragmatic reasons to limit the number of citations that would have to be reviewed and based on the assumption that additional important references would be identified by snowball searching.

The Prisma Flow Diagram

PRISMA is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses (Heinen et al., 2019). PRISMA primarily focuses on the reporting of reviews evaluating the effects of interventions but can also be used as a basis for reporting systematic reviews with objectives other than evaluating interventions (e.g. evaluating aetiology, prevalence, diagnosis or prognosis) (Li, Jeffs, Barwick, & Stevens, 2018).

The final search strategy focused on using strategic search terms that aided in accumulating relevant journal articles on different innovation and Health Information Technology artifacts. The outcome of the search strategy is shown in the Prisma flow diagram in Figure 4. The flow diagram below depicts the flow of information through the different phases of the scoping review. It maps out the number of records identified, included and excluded and the reasons for exclusions.

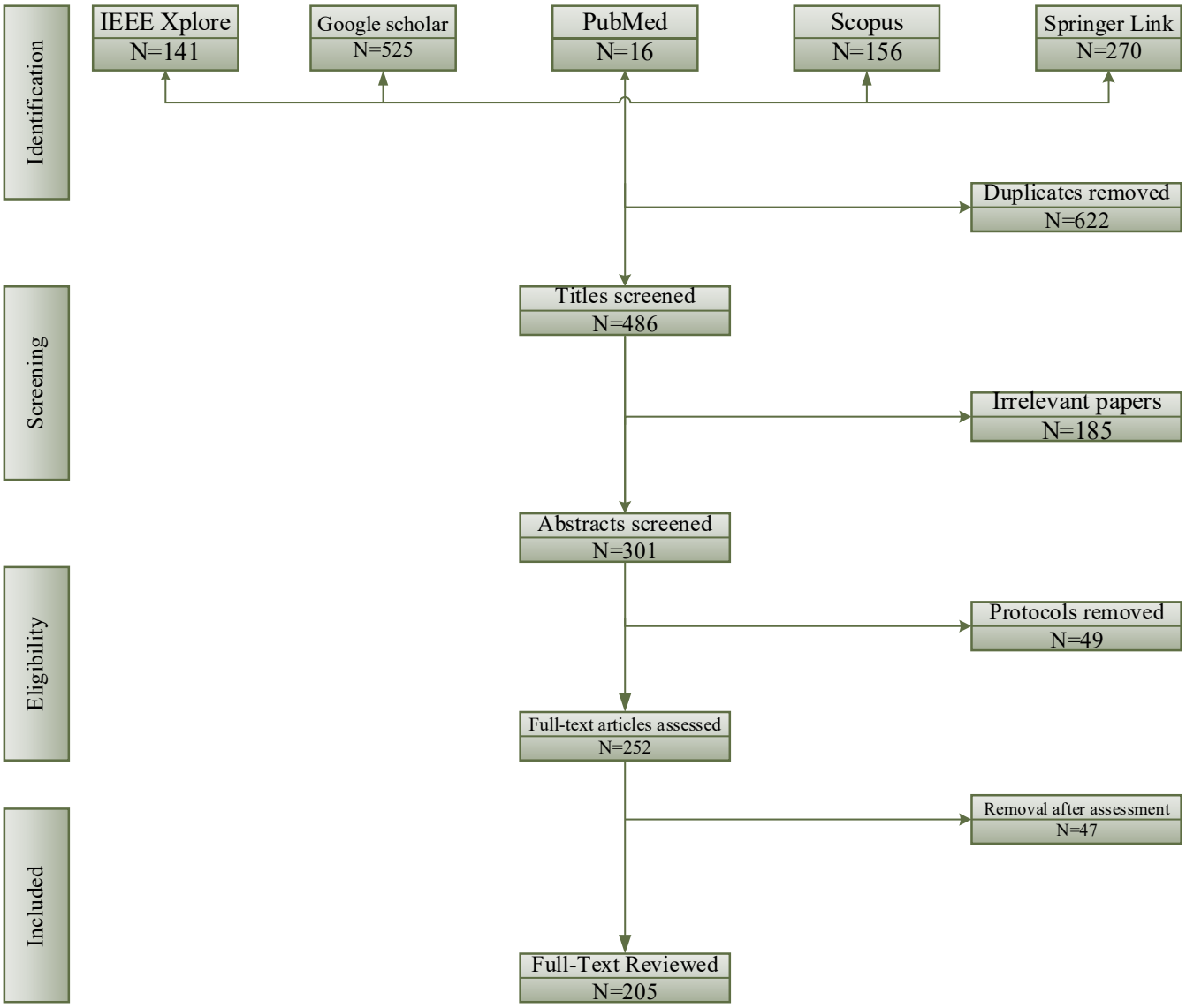


Figure 4: Prisma Flow Diagram

2.3.2 Exclusion and Inclusion Criteria

The following criteria were considered to select and exclude an article from the review. Studies were disregarded if they were (a) not written in English, (b) journal articles, dissertations, or protocols deemed irrelevant and (c) published before 2010

The inclusion criteria involved the following: (i) studies that describe the implementation of innovation in the healthcare system, (ii) original research studies published in peer-reviewed journals, (iii) empirically investigated preferences for healthcare systems, (iv) journals on emerging technologies in healthcare, (v) conference papers which may or may not be peer-reviewed and landmark empirical studies that are determined to be methodologically rigorous and have a direct relationship with the concept of innovation, and (vi) report on health system innovation, perception, needs and challenges. "Needs" refers to the understanding of innovation by a healthcare professional and policymakers that are deemed necessary to improve and implement the functioning of health systems, and "challenges" refers to "emerging and enduring problems that threaten the functioning, performance or sustainability of innovation in the health systems." After excluding duplicates, two reviewers independently screened the abstracts against inclusion and exclusion criteria, and where needed, the full article was retrieved to resolve disagreements. Finally, one of the reviewers read all articles that met the inclusion criteria to ascertain whether they addressed the study's aim.

2.3.3 Data Collection and Charting

To better facilitate analysis, data were extracted into an interactive Excel workbook and categorized according to: (1) the citation of the article (authors, title, year, affiliation of the first author); (2) details regarding the nature and scope of the article (type of article, objectives, country studied, respondents, area of interest, target population); (3) verbatim excerpts describing innovation and healthcare systems reported in the article. I also extracted all the reported understanding of innovation for each article and used a single category to classify each perception following van Olmen and colleagues' framework (Josefien van Olmen, Bart Criel et al., 2010). In each category, we developed subcategories to identify the specific

perceptions defined by the authors. The coding plan was refined inductively and through discussions with the reviewers. The goal was to categorize the understanding of innovation close to the authors' explanation while relying on van Olmen and colleagues' framework to retain consistency. Finally, the tabulation of quantitative analysis within the interactive workbook supported the mixture of both narrative and statistical data.

I examined the health systems in several countries and classified the articles pertaining to innovation, system thinking, emerging technologies, governance, and leadership. For the objectives of this paper, I only included articles that could be classified based on health systems and emerging technologies. First, I established how innovation was conceptualized among healthcare professionals. The assumption was that frequently discussed perceptions in the literature might indicate significant system-level priorities. Second, I performed a qualitative analysis of the verbatim content extracted from the articles once the Excel file roles were sorted. Indeed, the review enabled me to structure the complex and somewhat fragmented issues surrounding innovations in health systems. The presentation of the findings is structured around the analytical framework, clarifying the perception of innovation and the most regularly reported challenges in health systems in other countries.

2.3.4 General Characteristics of the Scoping Reviews

The general analysis of the articles included in this SR is reported in Table 2. The articles included were published from 2010 to 2022, with 75% (226/301) published from 2010. Journal articles (93%; 280/301) and conference proceedings 5% (15/301) comprised the majority of documents included in the review.

Most of the articles addressed innovation and health systems, making up 35% (105/301) and 28% (85/301) of the studies. The use of scoping reviews in innovation as termed in the sector—has increased in recent

years, with 35% (38/301) published after 2010. The topics examined in the reviews ranged from the understanding of health systems to the perception of innovation. The topics investigated were generally broad in nature, such as 'what is known about innovation in the Ontario health system.

Table 2: General Analysis of the Scoping Literature Review		
Characteristics	Number (n=301)	Percentage (%)
Publication year		
2010-2015	226	75%
2016-2020	63	21%
2021-2022	12	4%
Publication Type		
Journal articles	280	93%
Conference proceeding	15	5%
Thesis dissertation	1	0.3%
Government research report	5	2%
Sector		
Health system	85	28%
Health	16	5%
Innovation	105	35%
Health Information technology	35	12%
Emerging technologies	45	15%
Health and social sciences	15	5%
Healthcare themes		
Innovation	115	38%
Health system	95	32%
Emerging technologies	35	12%
Collaboration	22	7%
Context	15	5%
Governance and leadership	19	6%
Articles and Other Sources		
Reporting in article	65	22%
Cited, another source	15	5%

Table 2: General Analysis of the Scoping Review

2.3.5 Collating, Summarizing and Reporting the Results

An analytical approach was used to combine descriptive statistics (i.e., distribution of frequencies) and qualitative content analysis to obtain an in-depth grasp of what is known about the understanding of innovation. For each article, I analyzed all the components that define the conceptualization and understanding of innovation in the healthcare system. The goal was to report and illustrate the understanding of innovation as closely as possible, as the authors described. Five organizational contextual features that illustrate the conceptualization of innovation gathered from various studies are outlined below. These are the most common contextual determinants relevant to multiple levels of health system innovation. Whether a study listed determinants related to innovation or provided a detailed description, it is evident from the definitions that conceptualization is a multifaceted term incorporating multiple healthcare system levels. Braithwaite et al. (2018) argue that the influence of implementation success regarding innovation cannot be assessed without examining the impact of the broader health system in which these factors are situated. The literature proposes that the relationship between system components is of greater importance than the individual features (Braithwaite et al., 2018). This is mainly applicable when introducing an initiative within healthcare that is characterized by an infinite sequence of care activities, events, interactions and outcomes (Braithwaite et al., 2018).

2.3.6 Collaboration

As was described in section 2.3.5, innovation is driven by an interprofessional endeavour wherein stakeholders are committed to meeting a set of social, ethical, economic, and environmental principles, values and requirements when they design, implement and use socio-technical solutions to address the

needs and challenges of health systems sustainably." Interprofessional collaboration occurs when two or more professions work together to achieve common goals. It is often used to solve various problems and complex issues (Green & Johnson, 2015). Collaboration allows participants to achieve together more than they can individually, serve larger groups of people, and grow on individual and organizational levels. The relationship of collaboration comprises a commitment to a definition of shared interactions, a jointly developed structure and shared responsibility, mutual authority and accountability for success, and sharing of resources and rewards (Eikey et al., 2015). Collaborative interactions that occur within and external to the organization are essential for carrying out implementation plans related to innovation (Li et al., 2018). To drive healthcare innovation, stakeholders need to think differently about managing and improving patient care for collaborative care delivery. Collaboration is an intricate and robust system of actors, technologies and processes that cannot be achieved by concentrating on individual aspects of the health system; instead, stakeholders need to develop collaborative competencies that will enable them to manage collaboration from a systems perspective (Kuziemsky, 2018)

2.3.7 Knowledge and Information Sharing

Knowledge and information need to be shared in all directions, vertically and horizontally, for the efficiency of the health system (van Olmen et al., 2010). This urges communication, sharing results, and assessing constraints to the health system. A range of health information systems may contribute to the production, analysis, propagation, and use of reliable and timely health information by decision-makers and practitioners at different health system levels, both regularly and in emergencies. Literature suggests that organizations that inspire knowledge sharing within and beyond the organizational boundaries are more likely to develop innovations and enhance their performance (Howell & Annansingh, 2013). As

work processes become more interdependent, individuals, teams, and organizations should systematically break through‘ knowledge silos’ and recombine various skills and knowledge assets to continuously innovate processes and practices (Wang & Noe, 2010). Knowledge sharing is vital for making such collaborative flows effective, allowing innovators to acquire new information and stimuli for exploring external ideas and exploiting internal knowledge.

2.3.8 Leadership and Governance

This feature of leadership and governance refers to Ontario’s role in health policy and its relations with actors whose activities impact innovation and healthcare delivery. Leadership provides the extent to which healthcare gives direction and effectively communicates the vision to align people with it; protects the health system from external threats; clarifies the roles and responsibilities of various actors; manages conflict internally and externally; motivates and inspires health workers (and other stakeholders) by satisfying their basic human needs to sustain their focus on the health development vision (Kirigia & Kirigia, 2011) Governance, on the other hand, entails the process by which decisions are made and implemented within the health system. It involves setting goals, creating policies, and overseeing the performance of the health system(Buttigieg, 2019). Leadership and governance imply both political and technical actions since competing demands for limited resources need to be reconciled, especially the implementation of technologies within the health system (Lehoux et al., 2019). For example, health policymakers should respond to increasing patient expectations, more multicultural environments, reforms, or a changing private sector. Effective leadership and governance seek to foster strategic policy frameworks, which may necessitate effective oversight, regulation, accountability, visible funding mechanisms and patient and community empowerment (Øvretveit et al., 2012); (Chee et al., 2013).

2.3.9 Context

The health system is affected by contextual factors that call for responsiveness and adaptation to social, technological, political, regulatory, cultural and environmental changes over time. Literature suggests that to understand the dynamics of the perception of innovation, conceptualizations of context require to be transformed into practical assessment methods (Fulop & Robert, 2014). For example, Li et al. (2018) argue that the ability to intervene upon contextual factors is dependent on an ability to measure them. Context denotes the "why" and "when" of change and concerns itself both with influence from the outer context (such as the prevailing social-political environment) and influences internal to the focal organization under study (for example, its resources, capabilities, structure, culture and politics) (Fulop & Robert, 2014).

2.4 System-Level Implementation Reported Across Select Countries

This thesis reviewed articles involving health systems in matured and developing countries to better understand how innovation is perceived and implemented. We analyzed 205 articles, mainly on the implementation of innovation. The papers cited pertained chiefly to collaboration, context, leadership and governance, emerging technologies, etc. Our analysis is aligned with the analytical framework adapted from van Olmen et al. (2010). Several articles support the view that collaboration, context, knowledge, and information sharing are core elements of innovation strategy and form the basis for understanding innovation. As described in the papers, the implementation of innovation is that not all countries, particularly those with weak leadership and governance structures, can afford to collaborate on a needed process to support innovation strategy. Additionally, the inability to adequately coordinate and share

information in some health systems may have caused the failure to implement any innovation strategy, even if resources are made available (van Olmen et al., 2010).

Table 3 is a matrix of the implementation of innovation within select health systems based on van Olmen et al. (2010) framework. It shows that the more frequently supported elements of viable implementation processes across superior health systems belong to five categories: collaboration (14%), knowledge and information sharing (18%), leadership and governance (11%), context 16% and emerging technologies (15%). Studies also indicate that principles and values (10%) are highly supported in less mature countries. Not much research has reported on the implementation of innovation within the category of strategic governance (7%). Our analysis reported nine implementation categories in roughly comparable proportions to better understand innovation. Principles and values and emerging technologies present a different pattern. Up to 28% of the articles reported in countries with a low implementation of innovation referred to principles and values essential in the innovation process. This may signify that more mature health systems involve collaboration and context, whereas less mature health systems depend upon their principles and values.

	Low Imp. Rate		*Med. Imp. Rate*		*High Imp. Rate*		*Very high Imp. Rate*		*Total*	
Category of perception	No	%	No	%	No	%	No	%	No	%
Collaboration	2	7	5	12	8	11	13	21	28	14
Context	5	17	8	19	9	13	10	16	32	16
Health IT	2	7	6	14	11	15	11	18	30	15
Knowledge and information sharing	4	14	8	19	15	21	9	15	36	18
Leadership and governance	3	10	3	7	9	13	8	13	23	11
Responsibility	2	7	6	14	8	11	6	10	22	11
Principles and values	8	28	4	9	5	7	3	5	20	10
Strategic Policies and governance	3	10	3	7	6	8	2	3	14	7
Total	29	100	43	100	71	100	62	100	205	100

Table 3: System-Level Implementation Reported Across Health Systems.

2.4.1 Health Information Technology (HIT) and Their Impact on Health Systems

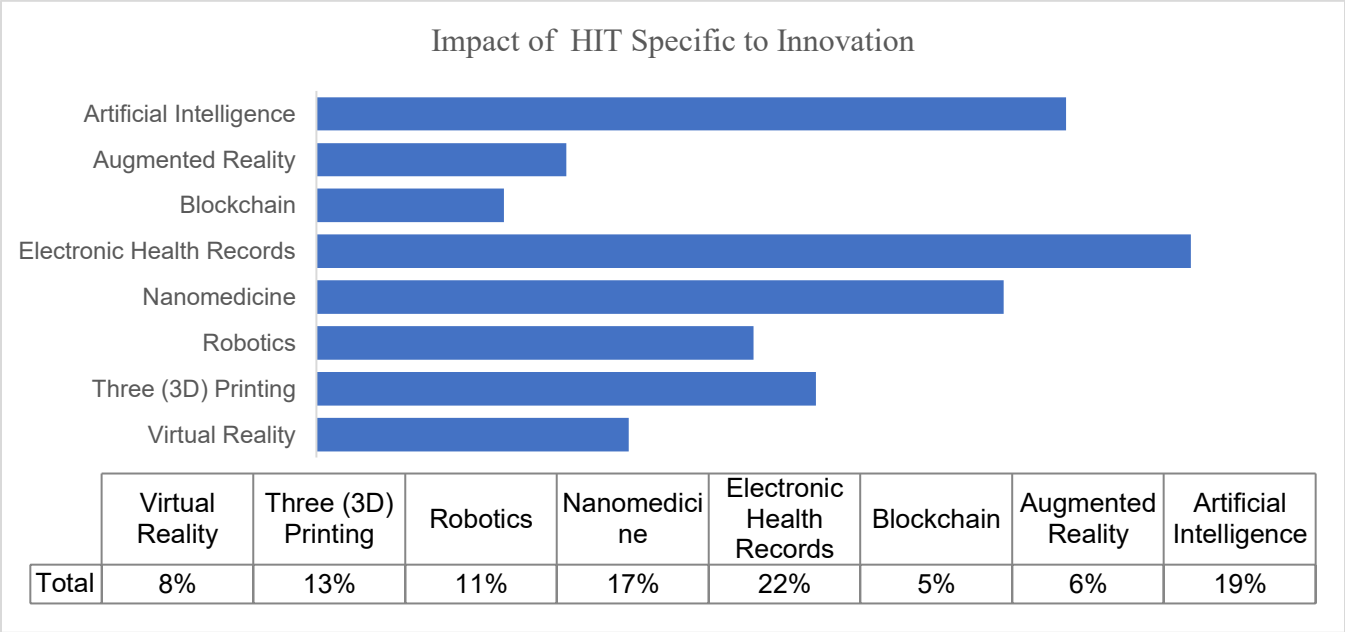
HIT includes existing and novel technologies that continue to emerge in healthcare. Novel technology is a term generally used to describe a new technology. However, it may also refer to the continuing development of existing technology and can have slightly different meanings when used in other areas, such as media, business, science, or education (König et al., 2021). The term commonly refers to technologies that are currently being developed or are expected to be available within the next five to ten years.

Novel technology has become a topic of increasing relevance in academia, news articles, policymaking and healthcare during recent decades (Rotolo et al., 2015). Although there is no generally accepted definition of novel technologies, the term has been associated with 'radically' new or 'disruptive' and relatively fast-developing but still nascent scientific-technological developments that may have prominent economic, environmental or social impacts (Li et al., 2018). For a better understanding of technologies (new and existing) in healthcare, we have classified them as Health IT

Health Information Technology is a critical resource within the healthcare domain(Sun & Qu, 2015). In the current era of digital health, technology is not seen simply as a "resource" but as an integrated part of the foundation of healthcare institutions and the broader health system(Hesse et al., 2021). In particular, advanced healthcare technology allows for scaling a personalized health journey for patients – unlocking patient care. From the foundation of electronic health records digitally storing patient data and their constant advancements to increase the interoperability of data storage and transmission among healthcare providers to establish an open line of communication between patients and providers, emerging technologies continue to put the patient first (Nguyen et al., 2014). Having resources specific to a patient's

health and allowing for ease of communication to efficiently and effectively map out care are a few examples of how the health system embodies patient care through innovation.

Figure 6 outlines the impact of health information technologies on health systems. Table 4 shows that artificial intelligence is an existing technology with a very high impact, causing advancements to shift with future demands and becoming an important base for emerging technology in healthcare. Use cases are growing immensely due to the efficiency of artificial intelligence in customized care. Analysis of the articles reviewed showed that artificial intelligence has a very high impact of 19% among properly managed health systems and a low impact of 5% among poorly managed health systems. In addition, several articles posit that intelligent health systems are already piloting or adopting artificial intelligence, enabling fluid interactions between health systems and machines (Magrabi et al., 2019). Figure 6 shows that electronic health records and AI are two health technologies with very high impacts of 19% and 22%, respectively.



	Virtual Reality	Three (3D) Printing	Robotics	Nanomedicine	Electronic Health Records	Blockchain	Augmented Reality	Artificial Intelligence
Total	8%	13%	11%	17%	22%	5%	6%	19%

Figure 5: HIT Specific to Innovation

Several studies argue that technology has become an inextricable part of innovation (Reddy et al., 2019); (Thimbleby, 2013). Rapid investments in the latest technology in healthcare and scientific innovation based on a collaborative interaction with health systems are positioned to disrupt healthcare further. AI impacts on healthcare organizations are immense, and it ranges from robot-assisted surgery virtual nursing assistance to administrative workflow assistants (Reddy et al., 2019). AI and other emerging technologies in healthcare are helping to improve patient data analysis to recognize infection patterns or highlight at-risk patients (Hesse et al., 2021). Finally, the studies identified many examples where emerging technology has a real impact on health systems.

Additionally, Robots, an emerging technology in healthcare, can substitute or imitate human actions for precise surgery or aid physical therapy to regain muscle movement (Mois & Beer, 2020). According to extracts of the articles reviewed, robotics has a very high impact of 11%. The stakes of innovation and emerging technology in healthcare are high, and "getting it right" will require new ways of innovating

with ecosystem partners and third-party organizers (König et al., 2021). Outside of electronic health records, AI and robotics can help simplify communication between healthcare providers and payers, ultimately delivering faster patient treatment plans, optimizing care, and increasing patient outcomes and success (Reddy et al., 2019).

	Low Impact		Med. Impact		High Impact		Very high Impact		Total	
Category of HIT	No	%	No	%	No	%	No	%	No	%
Health Information Technology										
Artificial intelligence	2	5	9	20	11	19	12	19	34	17
Augmented Reality	2	5	4	9	3	5	4	6	13	6
Virtual Reality	3	8	4	9	4	7	5	8	16	8
Blockchain	6	15	6	14	9	16	3	5	24	12
Electronic health records	15	38	10	23	10	18	14	22	49	24
3D Printing	5	13	2	5	9	16	8	13	24	12
Nanomedicine	4	10	6	14	5	9	11	17	26	13
Robotics	3	8	3	7	6	11	7	11	19	9
Total	40	100	44	100	57	100	64	100	205	100
Coordination and collaboration										
Information Production	14	30	10	24	10	23	18	24	52	25
Information Availability	9	20	11	27	14	32	15	20	49	24
Information Analysis & Sharing	11	24	10	24	9	20	21	28	51	25
Information Use	7	15	5	12	4	9	12	16	28	14
Information Systems	5	11	5	12	7	16	8	11	25	12
Total	46	100	41	100	44	100	74	100	205	100

Table 4: Impact of HIT Specific to Innovation

More than a third of the studies examined indicated that an innovation process that encourages consistent collaboration and clear communication between stakeholders of health systems would benefit all parties involved (Lindsay et al., 2018). In addition, new technology in healthcare enables this critical collaboration between stakeholders, allowing for proper value-based healthcare. Table 4 shows that collaboration is core to successfully implementing innovation in a health system. An increasing body of

literature demonstrates that interprofessional collaboration improves healthcare quality and safety. The table illustrates that overall, information production 25%, information analysis and sharing (25%) and information availability (24%) have a very high impact on innovation and provide the basis for partnerships between healthcare professionals and policymakers to come together to identify productive conditions for innovation and collaboration across multi-disciplinary teams(Lindsay et al., 2018). The articles establish that these components are fundamental for successful innovation. This may reflect that more properly developed health systems operate a larger supply of services, while less mature health systems depend upon developing a qualified workforce.

2.5 Model for Understanding Innovation in Healthcare

Health systems are increasingly complex and have faced difficulties finding solutions to emerging care needs(Chaves et al., 2021). This fact has promoted reflection, change, and restructuration in large healthcare corporations' traditional management style, which seeks to incorporate in their business model elements that are more flexible and interactive in connection with recent challenges and current healthcare trends. Promoting a creative and innovative culture in health organizations to allow the stakeholders to find solutions focused on healthcare systems' real needs is one of the most important elements in responding to emergent challenges. According to Golash-Boza et al. (2012), a useful model for understanding the complex issues associated with innovation in healthcare systems is conceptualized on five interrelated processes: generation, context, creativity, knowledge repositories, and innovative ideas. The model in Figure 6 states that the generation process involves strategies that lead to the creation and initial pilot testing of an innovative clinical or service delivery idea. Innovative ideas are the products of

creative minds. Consistent with the belief that complex systems are embedded within one another, the minds of the individuals who work within the healthcare system are also complex adaptive systems. Considering its intricate nature, the mind has a remarkable capacity to connect and rearrange knowledge to generate new and valuable ideas. A creative connection among experts is critical to innovation (Keown et al., 2014). The processes, structures, and patterns associated with innovation in other industries support a creative generation of ideas that are better than healthcare (Golash‐Boza et al., 2012).

Context refers to the structure, corporate culture, history, and political context shaping how ideas for change have to proceed (Fulop & Robert, 2014). This perspective sensitizes us to the need that an organization simultaneously considers the context, process, and content of innovation. Context draws on the importance of paying attention to collaboration. However, it suffers because the ways actors interact with and mobilize aspects of context are again underplayed as a crucial mediating force in current contexts (Fulop & Robert, 2014). Organizations with solid and receptive context are seen as "ready" for change and can rapidly adopt innovative concepts to meet the challenges they experience.

On the other hand, organizations with low receptive context might lack the ability to coordinate and the will or ability to implement ideas that derive change (Allen & Currie, 2011). This is due to the lack of understanding about the vital role of context in an organization, unwillingness, and lack of skill in making it more receptive can hinder the relatively slow and uneven adoption of innovation in healthcare (The Health Foundation, 2010). Discussing a practical assessment of the risks associated with a new way of doing things should accompany all attempts to implement and spread innovation.

Creativity, defined as the use of the imagination or original ideas to develop new and useful ideas—is critical for human adaptation in a complex and dynamic environment such as healthcare (Binnewies &

Wörnlein, 2011). Several research studies have shown that the presence of a positive effect increases the possibility that new and useful ideas will be developed (Zhou & Hoever, 2014). Positive impact can lead to higher creativity because it activates cognition and increases cognitive flexibility (De Dreu et al., 2008). While adaptation and creative thinking are mostly considered in developing innovative ideas, a further enhancement of the concept also occurs during internal implementation within the organization and as the idea spreads across organizations (Anderson et al., 2014).

Information is an input to the innovation process (Amar & Juneja, 2008). Hence, organizations need information, which is typically a derivative of data, to bring about innovation successfully. Knowledge is built from information (Un & Rodríguez, 2018). Without knowledge, innovation is unlikely. New knowledge is the seed from which innovation arises, and the key to whether knowledge can lead to innovation resides in how "fresh" the knowledge is and the context that is being applied (Bledow et al., 2013). The healthcare system is embedded in larger societal, industrial, and political systems that influence the pace and spread of innovation. While there are many links among all these co-evolving systems, the flow of knowledge is critical to innovation (Kannampallil et al., 2011).

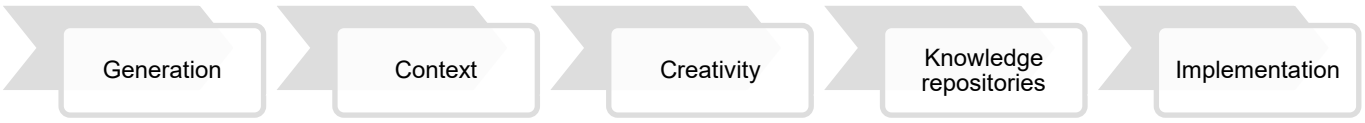


Figure 6: Model of Innovation Development

2.5.1 Collaborative Climate for Innovation

Anderson et al. (2014) identified four collaborative factors that are crucial and facilitative of innovation. These factors are vision, participative safety, task orientation, and support for innovation. Innovation is enhanced if :

- vision is understandable, valued, and accepted by strategic members of the organization,
- healthcare members perceive they can propose new ideas and solutions without being judged or criticized
- there is evidence of a collaborative environment between healthcare professionals and policymakers (Anderson & West, 1998).

This theory has been widely applied in collaborative innovation research and has received support from primary and, recently, meta-analytic studies (Hülsheger et al., 2009).

2.5.2 Ambidexterity Theory

Organizational scholars have reasoned that innovation is the result of both individual factors (e.g., cognitive abilities, personality, and motivation) and contextual factors (e.g., work characteristics and leadership) (Hammond et al., 2011). Many of the studies that have examined contextual predictors of innovation have focused on understanding the healthcare system, the perception of healthcare professionals on the impending innovation, and the influence of directors or organizational leaders(Hammond et al., 2011); (Zacher & Rosing, 2015); (Eisenbeiss et al., 2008). Bledow et al. (2010) advocated the ambidexterity theory to describe the methods for handling competing demands at multiple organizational levels to successfully innovate. Ambidexterity denotes “the ability of a complex and adaptive system to manage and meet conflicting demands by engaging in fundamentally different activities” (Bledow et al., 2013). Regarding the integration of activities, Eisenbeiss et al. (2008) differentiate between self-regulatory processes on the one hand and active management and advocate that both are required and essential for the integration of activities performed by subsystems or at different points in time. Several supporting studies have been published for the key precepts autonomy for the new

venture, access to the assets of the core business, and a shared ambition for growth that unifies core and explore business) of ambidexterity theory (Anderson et al., 2014); (Zacher & Rosing, 2015); (Bledow et al., 2009), and this perspective, therefore, holds the most notable potential for leadership and collaborative effects on innovation processes.

2.5.3 Management Proactiveness in the Innovation Process

The effectiveness of the health system in developing and implementing innovation is a function of various factors, such as the internal and environmental characteristics of the organization and the flow between the healthcare organizations and the environment that comprises policymakers (Grol & Wensing, 2020). Healthcare innovation is considered a deliberate process for improvement and thus has to be designed into the organizational system. Management has to take a proactive stance on innovation for it to occur. Management should engage with policymakers – a process that can be unpredictable and complex if a strategic plan is not implemented or if no systematic thinking is invested in the innovation. Engagement with policymakers in the innovation process, in general, and innovation diffusion, in particular, should be assessed in the context of constructive engagement. From a theoretical perspective, evaluating the effect of policymakers can be projected to aid in simplifying the innovation process so that it produces outcomes and decisions that are more likely to lead to successful innovation and diffusion. Accordingly, a structured engagement process should be integral to the innovation process. A clear plan for communication and engagement with key policymakers is necessary ex-ante as a condition for successful innovation.

2.5.4 Involving Healthcare Professionals in the Innovation Plan

It is difficult for external observers such as provincial policymakers to understand a given setting in advance fully; therefore, it is important to involve representatives of the healthcare system in the analysis of the problem, the selection of strategies to accomplish the change, and in developing a plan for its introduction (Hill et al., 2020). According to Grol et al. (2020), this can be done through interviews or group meetings. Healthcare professionals within the system should be asked, among other questions, what kind of activities and measures are attainable, will be accepted, and are likely to work best (Grol & Wensing, 2020). The involvement of certain representatives or key individuals from the healthcare institutions in actually introducing the implementation should also be discussed. Usually, the implementation targets, that is, those for whom the implementation has consequences, are much greater than initially imagined. Often, implementation affects not only clinicians but also patients, the management or directors of the institution, colleague care providers, insurers, politicians, and policymakers. A list of all those individuals and organizations involved in one form or another is desirable. This list would include those who can take stock of the bottlenecks in the implementation and for whom a separate strategy should be developed and introduced. The involvement of directors, top management, key figures in the institutions, and professional groups in implementing improvements is also seen as critical when introducing changes in healthcare (Wensing et al., 2013). A healthcare professional may initiate an improvement, but it depends on the organization's top management whether a culture is created that changes will be accepted and whether specific improvements will be introduced constructively.

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2.6 Healthcare as a Complex System

Complexity theory is a theoretical perspective on systems behaviour and change, starting from the assumption that the healthcare domain has become increasingly complex and that it is vital to observe and improve systems in their entirety instead of focusing on separate parts or components(Kannampallil et al., 2011). The theory suggests that a complex healthcare system has more to offer when considering leadership and organizational development in healthcare. It may challenge "taken-for-granted assumptions" and prompt people to think less linearly. In its simplest terms, a complex system is a way of thinking about and analyzing things by recognizing complexity, patterns, and interrelationships rather than focusing on cause and effect (Martin, 2018). The most commonly recommended advantage of this approach when thinking about innovation is it can:

- challenge assumptions
- focus on relationships rather than simple cause-and-effect models
- be applied in a variety of contexts
- provide a framework for categorizing and analyzing knowledge and agents
- suggest new possibilities for change
- provide a complete picture of forces affecting change

Healthcare is constantly changing, and complex adaptive systems thinking challenges some assumptions that policymakers, researchers, and planners may take for granted when interpreting innovation(Weberg, 2012). These assumptions state:

- that each observed effect has an observable cause

- even the most complex issues can be comprehended by breaking down the whole into smaller parts and analyzing it
- If we analyze past actions sufficiently, it will help predict future events.

The Institute of Medicine (Medicine, 2010) states that the pressing and well-established concerns common to all healthcare sectors that impact quality are system inefficiencies, increasing complexity, and an ever-expanding evidence gap. Leaders and policymakers will need to identify and understand the complexity of the healthcare system to find innovative improvement solutions and avoid managing this rising complexity with outdated linear solutions (Martin, 2018); (Lipsitz, 2012). Impactful leadership is a vital component of success, and its role is recognized as a significant factor for attaining improved performance and optimizing health improvements. The phrases complex adaptive systems, complexity science, complexity theory, and complex evolving systems are often used interchangeably. Several theorists suggest that complex adaptive systems thinking is a subset of complexity theory or vice versa (The Health Foundation, 2010).

2.7 Relationships Fundamental to Understanding the System

The conduct of a complex system develops from the interaction among the various agents involved (Martin, 2018). The noticeable outcomes are more than just the summation of the components. For example, a group of highly competent professionals with poor interactions will likely not provide as good an outcome as the same skilled individuals with better relationships (Anderson et al., 2014). Rossi et al. (2010) describe "generative relationships," in which the interactions among complex system components produce new, valuable, and unpredictable capabilities that are not inherent in any of the components

working alone. New and innovative ideas can emerge from unpredictable corners of a complex system that fosters diverse relationships between parties within and outside the system (Lehoux et al., 2009).

2.8 New Technologies Penetrating Healthcare

A novel technology lacks a consensus on what classifies it as "new." It is a relative term because one may see technology as new, while others may not notice it similarly. New technology in healthcare is one that holds the promise of creating an innovative engine and is trans-industrial (Agarwal et al., 2020). New healthcare technologies cannot be fully exploited without a clinical team to shape the therapeutic response, something hospitals have been able to do over the years with their multidisciplinary clinical workforce. How hospitals and policymakers respond to these emerging technologies will help determine whether hospitals remain at the center of the Ontario healthcare system. Some

HIT in healthcare include nanotechnology/nanomedicine, biotechnology, cloud computing, Internet of things, augmented/virtual reality, GPS, RFID, voice search, chatbots, social media, blockchain, personalized medicine, biometrics, electronic health records, wearable computing devices, drones, robotics, and artificial intelligence. The following examples of the emerging technologies stand out (Li et al., 2018).

2.8.1 Artificial Intelligence

Artificial Intelligence (AI) is a field of computer science that is permeating the healthcare system (Magrabi et al., 2019); (Bini, 2018). AI has been around for decades and brings a paradigm shift to healthcare, powered by the increasing availability of healthcare data and rapid progress of analytics techniques. The advantages of AI have been extensively discussed in the medical literature(Dilsizian & Siegel, 2014). AI

is concerned with designing systems to do things that would require the intelligence of humans. Today, artificial intelligence is shorthand for any task a machine can perform just as well as, if not better than, humans. AI technologies are now increasingly being adopted in many public sector areas, such as education, social interventions, and healthcare. AI in healthcare refers to applying AI technology in diagnosing and treating patients. AI is being used in healthcare to review mammograms, monitor early-stage heart disease, and enable accurate decision-making among medical practitioners.

AI aims to mimic human cognitive functions such as reasoning and decision-making, vision and language, knowledge representation, complex task processing and communication (Sadiku et al., 2019). Today, AI is already used in medicine in several other areas, such as decision support systems, laboratory information systems, robotic surgical systems, therapy, and reducing human error (König et al., 2021).

3D Printing (3DP): (also known as additive manufacturing (AM) or rapid prototyping (RP), was invented by Charles Hull in the early 1980s (Hornick, 2017). Since then, it has been used in manufacturing, automotive, electronics, aviation, aerospace, consumer products, education, entertainment, medicine, space missions, the military, and chemical and jewelry industries (Jordan, 2019). It is a technology perfectly tailored for the healthcare industry. It offers a range of precision healthcare solutions, including tissue and organ fabrication, creation of customized prosthetics, implants, anatomical models, drug delivery, testing, and clinical practice (Jung et al., 2019). The benefits of 3DP in healthcare include the customization and personalization of medical products, drugs, and equipment, as well as cost-effectiveness, increased productivity, the democratization of design and manufacturing, and enhanced collaboration (Jordan, 2019). Hospitals could potentially create items on demand, significantly altering the healthcare supply chain.

Augmented reality (AR): Augmented reality (AR) supplements the real world with virtual objects, such that virtual objects appear to coexist in the same space as the real world (Zhou, Duh & Billinghurst, 2008). It has the potential to provide robust, contextual, and situated learning experiences and aid the exploration of the complex interconnections seen in information in the real world (Zhu et al., 2014). In clinical care, AR provides doctors with an internal view of the patient without requiring invasive procedures (De Paolis et al., 2008).

Virtual Reality: Virtual reality (VR) is a highly interactive, computer-based multimedia environment in which the user becomes a participant in a computer-generated world. For example, surgical students can use virtual overlays of the circulatory system to help direct them during procedures. Billing agents can use "smart glasses" to see patient insurance and billing information while away from their computers. It can help reduce the anxiety a patient feels before and after surgery. It can be used to train surgeons in a realistic and low-risk simulated environment. In addition, it offers therapeutic potential and rehabilitation for acute pain and anxiety disorders (Brunet-Gouet et al., 2016).

Nanomedicine: a marriage of nanotechnology and medicine, is replacing nanotechnology in the fight against unmet diseases. Nanotechnology is the science of small things or the manipulation of matter on an atomic or molecular scale. Nanomedicine is the medical application of nanotechnology to diagnose, manage, and treat disease (Phua et al., 2021). It is regarded as one of the most promising technologies of the 21st century. It seeks to manufacture drugs and other products that are packaged into nanoscale systems for improved delivery. Cancer treatment is the most prominent area of nanomedical research and drug approvals (van der Meel et al., 2019). The application of nanomedicine, particularly in cancer

treatment, promises to impact healthcare profoundly. Medications can be more efficiently delivered to the site of action using nanotechnology (Pelaz et al., 2017).

Robotics: This deals with the design, construction, operation, and application of robots. Robots are becoming integral to the healthcare toolkit (Cresswell et al., 2018). For example, imagine a robot drawing a patient's blood with no mistakes and no pain. Robots play an important role in healthcare as they can improve diagnosis, reduce medical errors, and improve healthcare delivery's overall quality and effectiveness (Mois & Beer, 2020). They contain a promise to address significant healthcare issues in surgery, diagnostics, prosthetics, physical and mental therapy, monitoring, and support. Robots have the potential to assist healthcare providers in daily caregiving tasks. Transport, telemedicine, and service robots in healthcare promise to create a new level of quality healthcare by providing experts to patients (Huston, 2013). A wide range of robots is developed to serve different purposes within the healthcare environment. This results in various kinds of healthcare robots such as surgical robots, logistics robots, disinfectant robots, cleaning robots, pill robots, laboratory robots, rehabilitation robots, nursing robots, telepresence robots, therapy robots, assistive robots, robotic prosthetic limbs, diagnostics robots, and many other types (Cresswell et al., 2018).

Blockchain: This technology consists of a shared or distributed database that maintains a growing list of transactions called blocks (Zaidan et al., 2018). With blockchain (BC), transaction records are stored and distributed across all network participants rather than at a central location. Blockchain in health care will be in clinical trial records, regulatory compliance, and medical records. The technology can help medical practitioners make better and more accurate diagnoses and prescribe more effective treatments. BC aims to give patients and their providers one-stop access to their entire medical history across all providers.

Blockchain can securely, privately and comprehensively track patient health records. It makes electronic medical records more efficient, disintermediated, and secure. It also makes health information exchanges (HIE) more secure, efficient, and interoperable (Sadiku et al., 2019). The emerging technologies presented above can be applied to every aspect of healthcare.

2.9 Summary

This scoping literature review enabled the understanding of what is involved in demonstrating the knowledge of innovation. The review highlights the innovation paradigm and presents novel characteristics, implementation services, models, and issues related to understanding innovation in the healthcare system. I discussed how healthcare is a complex system, and the pursuit of innovation within the system should be thoroughly coordinated with healthcare professionals or the management of healthcare institutions. Finally, I further discussed that challenges and requirements to innovate could be resolved through ambidexterity, which denotes "the ability of a complex and adaptive system to manage and meet conflicting needs by engaging in fundamentally coordinated activities. Finally, we introduced several technologies currently available in healthcare – these are classified under the banner "health information technology (HIT)."

Chapter 3 The Framework of Health IT Innovation

This chapter presents the framework for understanding innovation in the health system. As stated in Chapter 2, the framework was developed through an interdisciplinary approach and specific to the health system. While the framework is designed to discuss health technology innovation, it goes beyond a particular technology in healthcare – that is, not any specific technology. The framework offers a procedure of theorization based on the grounded theory method(Jabareen, 2009). Theorization is a method that aims to relate several elements or ideas into a coherent system capable of explaining relevant phenomena or observations(Meza et al., 2023). The advantages of the framework are its flexibility, capacity for modification, and emphasis on understanding instead of prediction.

To develop the framework, literature from the review was coded for words, phrases and meanings that represented elements pertinent to the understanding of innovation. No pre-existing framework was imposed on the data, but full-text articles that spanned a range of publication types were robustly interpreted for drivers and enablers of innovation. Final themes were then grouped into categories and used to develop the framework (Appendix H – Thematic Analysis).

The framework includes strategies to be applied before and during the innovation process, targeting the healthcare setting by involving all stakeholders (healthcare professionals, policymakers, etc.), assessing healthcare adaptability, facilitating the implementation process, and maintaining a vital feedback culture. Healthcare provides an exceptional setting for implementing innovation. Thus, the framework is informative and extended as a general theory to discuss the cumulative understanding of innovation.

Implementation of innovation in healthcare should involve a thorough pre-implementation assessment of the system's need for innovation and its readiness to change(Flessa & Huebner, 2021). Involvement of all

stakeholders, transparent communication, continuous interaction in an equal atmosphere, and clearly defined leadership roles are essential to innovation (Koomans & Hilders, 2016). The framework can guide healthcare providers with concrete, evidence-based steps for understanding innovation.

3.1 Important System Characteristics of Healthcare

Diffused through the segments of the healthcare system are certain generic characteristics appropriate to understanding innovation (Haldane et al., 2021). These include the independence of the medical profession and the various specialties and the individual practitioner, the dominance of medical institutions within the health system, and the tendency of advanced technology and associated values to influence the elements of the system.

Diffusion of Innovation (DOI) serves as the theoretical lens because this theory considers clinical team members' needs, motivation, values and goals, skills, learning style, and networks as core components influencing the understanding and adoption of new practices (Venkatesh et al., 2003). The theory has proven useful for understanding and adopting innovation in healthcare. The robustness of this theory derives from the many disciplines and fields of study in which diffusion has been studied (Doolin, 2004). The global richness of these studies and the variety of new ideas, practices, programs, and technologies that have been the objects of diffusion research make the theory valuable (Dearing, 2009).

Multiple interacting factors can also influence the understanding and implementation of innovations, ranging from new technologies to novel service delivery models and health policies. Therefore, a broader analysis of the context, health system elements, institutions, adoption systems, problem perception and innovation characteristics will enable a better understanding of innovation when introduced into health systems (Zhang et al., 2015).

3.1.1 Independence of Healthcare Practice

The organization of medical practice as a critical element within the health system has received considerable attention (Whyle & Olivier, 2021); (Snowdon, 2020). Three aspects of healthcare are considered relevant to an understanding of innovation. First is the independence of the medical profession. Here, the central issue is not only independence legitimately granted for the technical performance of the practice of medicine but also the ability of the profession to demand self-governance involving nontechnical matters as they relate to the organization of the practice itself (Whyle & Olivier, 2021). The extent to which this independence is manifest is significant for the success of any fundamental system change (innovation) in the delivery of services. Second, the profession may be viewed as a loose amalgamation of various professional specialties with different objectives and approaches delicately held together under a common name at a particular time (Snowdon, 2020). This conceptualization contrasts with the traditional medical profession view as a static and relatively homogeneous community whose members share values, roles, and interests (Gupta et al., 2017). Although the two concepts are complementary, the former has several implications for understanding innovation within the health system. It is important to remember that the profession is not simply a receptacle that receives or opposes innovation. The concept of an underlying dynamic involving shifting power struggles and various emerging disciplines within healthcare suggests that innovation has utility beyond simply providing healthcare and may indicate why certain innovations are accepted more readily than others (McConnell, 2011).

Third, at the level of the practitioner, the nature of the task and the type of psychological orientation needed to perform can affect the healthcare professional's approach to innovation. This is best illustrated

by Miller's concept of "clinical mentality." Miller (1971) argues that “the clinician, guided by the demand for action but dependent on science as yet incomplete, develops an experiential approach to learning. Thus, the clinician can only act based on what he experiences, and if his activities seem to get results, he resists change based on statistical or abstract considerations”(Miller, 1971).

3.1.2 Authority of Medical Institutions

The second characteristic of the system for understanding innovation is the authority of recognized healthcare institutions (i.e., institutions characterized by dominance, structure, and definite predetermined goals) in delivering health services. As the dominant institution, the hospital acts increasingly as the most crucial repository of medical skills through which the available technologies are presented to the stakeholders. Such recognized institutions may be viewed as intermediate between the source of the innovation and the eventual utilization of such innovation by medical practitioners. This rise raises the question of the proper dependent variable in the study of innovation and the appropriate unit of analysis in a medical setting. Rogers and Shoemaker (1971) provide insight into the process involved when they posit a two-phase innovation process in formal organizations. The first phase requires someone in authority to decide to implement innovation within the organization. The second phase involves acceptance or rejection of the innovation by those within the organization who are affected (Rogers and Shoemaker, 1971). The increased dominance of administration within such organizations is associated with the rise of medical organizations such as hospitals in delivering health services. This dominance is based on the need to coordinate an increasingly complex array of nonroutine functions (Eikey et al., 2015). One implication of this development relative to innovation is that, for all practical purposes, administration represents the decision unit within such organizations. Although empirical data are not available to assess

all the implications, several points are important to note. First, since most administrators are not medical experts, decisions within such organizations that relate to technical matters require a high degree of participation by professionals themselves. As suggested by Kuziemsky (2018), collaboration and participation are essential ingredients in facilitating the linkage between the decision to implement and the "decision to adopt"(Kuziemsky, 2018). Second, while the administrator traditionally has deferred to the medical profession, he is under increasing pressure to pursue goals of greater cost efficiency and stakeholder responsiveness (Sun & Qu, 2015). These are in potential conflict with the more technically oriented goals of the medical sector and will probably affect the relative pace with which subsequent technological innovations are implemented within the organization.

3.1.3 Technological Demands of the Health System

The advancement of remarkably sophisticated technologies has been fundamental to the growth of medical institutions (Sadiku et al., 2019). Differentiating technologies vis-'a-vis their goals and resources has implications for the ability of the system to adapt to changing environmental demands and its openness to various types of innovation (Agarwal et al., 2020). As technologies have become more sophisticated and based on an increasingly esoteric body of knowledge, the system has become increasingly self-limiting and self-controlling, organized around a dynamic involving its technological requirements and processes(Ostrovsky & Barnett, 2014). This dynamic predisposes the system to accept or reject certain types of innovations quite independently of environmental demands (Atun, 2012). A second consideration affecting the system's accessibility to particular technological innovation is the propensity for action by the provider and the consumer of health services. In part, this reflects a cultural bias against a passive

response and a solid need to "do something" in most situations of uncertainty(Keown et al., 2014). This tendency to active intervention, coupled with the system's dynamic involving its technological requirements, favours certain types of innovation. Examples are the rapid adoption of organ transplants (Mao & Mooney, 2015) and AI (Wang & Preininger, 2019).

3.2 Layers of the Framework

Divergent views exist in literature on the drivers for understanding innovation in healthcare (Akenroye, 2012). Research shows that organizations tend to initiate and implement new ideas in unplanned manners (Knudsen & Roman, 2004). This has encouraged studies into the interaction between the innovation process and healthcare outcomes (Cluley et al., 2022). According to Shah et al. (2022), the uptake of innovation should be systematically reviewed for successful understanding and management. Interestingly, innovation in the health sector has taken a broader approach to embracing not only the work of clinicians but also that of other supporting agencies, patients, and regulatory units (Gelijns et al., 2001). Understanding innovation and its drivers can differ among organizations since there are dissimilarities in business scope and objectives (Omachonu & Einspruch, 2010). For example, there are differences in how organizations with contrasting strategic orientations view the factors influencing innovation (Blumentritt and Danis, 2006). This implies that drivers of innovation might be at variance across organizations and sectors. Although there are many dimensions of strategic behaviour, the focus on innovation can be driven by a substantial body of empirical and theoretical work highlighting its increasingly critical role as a source of sustainable competitive advantage.

Studies show that innovation can be understood via different frameworks of health service delivery (Akenroye, 2012). Based on this background, the study developed a framework through an interdisciplinary approach (i.e. drawing appropriately from several disciplines or fields of expertise within healthcare to redefine the understanding of innovation outside of normal boundaries and reach solutions based on a new understanding of complex situations) (Petri, 2010). The framework articulates intervening variables that drive innovation in healthcare. The emergent variables of Collaborative strategies, Data Management, Governance and labour force and Interoperability result from a thematic analysis of literature from the scoping review (Appendix H – Thematic Analysis). If the concept of healthcare innovation can be simplified, then it may become more accessible for health policymakers and practitioners to evaluate, adopt and procure services in ways that realistically recognize and give priority to valuable healthcare innovation (Segarra-Oña et al., 2020). Figure 7 illustrates the proposed framework detailing the required components for achieving innovation.

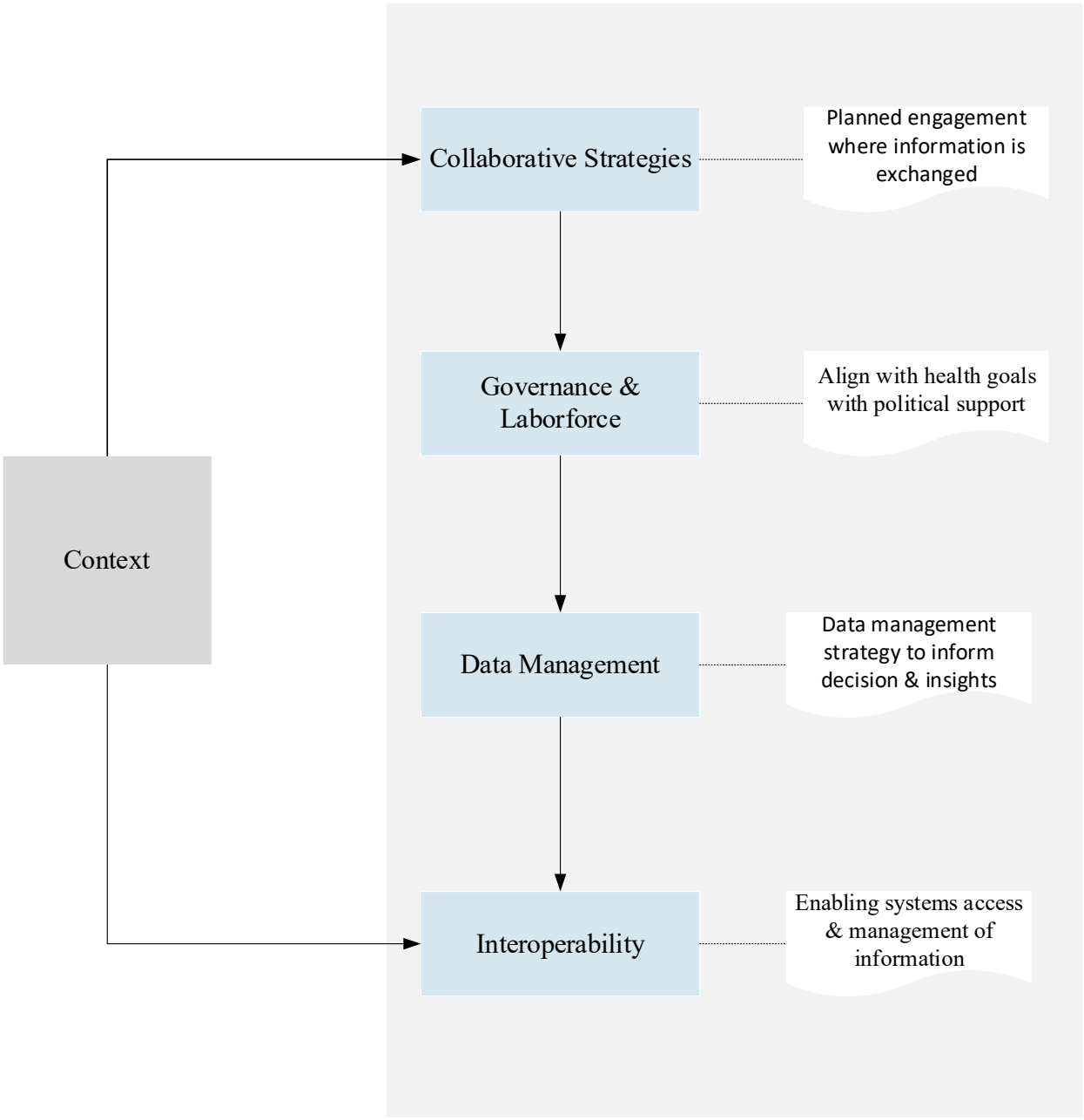

Figure 7:Framework of Health IT Innovation

3.2.1 Collaborative Strategies

The search for innovative solutions in healthcare has been prompted by efforts to meet the growing demands of patients in a situation characterized by scarce public resources and attempts to break policy deadlocks arising from endeavours to tackle unruly problems(Mina et al., 2014).

Hierarchical strategies, for example, authorize a small group of influential decision-makers in the provinces to define the need for health systems and find appropriate solutions (Torfing, 2019). The strength of this approach is that public leaders can deploy existing procedures and knowledge in designing clear and swift solutions, and they have the power to mobilize the organization's resources and competencies to ensure the implementation of innovative solutions (Torfing, 2019). However, the problem with the hierarchical approach is that solutions devised by appointed leaders and professionals might be off target because the decision makers rely too much on their own ideas and in-house resources and thus fail to benefit from the knowledge sharing and mutual learning that arise from interaction with relevant and affected actors within the health systems (Fulop & Robert, 2014).

Collaborative strategies compensate for the fundamental weakness of hierarchical strategies by engaging many relevant stakeholders to define the problem and its solution (Lindsay et al., 2018). Collaborative strategies facilitate the exchange of knowledge, competencies and ideas between relevant and affected actors. Thus, they stimulate mutual learning processes that may improve the understanding of the problem or challenge at hand and extend the range of creative ideas about how to solve it (Torfing, 2019). Collaboration also tends to enable the integration of ideas into proper solutions, the selection of the most promising ones, the building and testing of prototypes, the assessment and sharing of risks and benefits, the creation of joint commitment to the implementation of new solutions; the mobilization of resources;

and the diffusion of innovative ideas through the recruitment of a large number of ambassadors(Hartley et al., 2013).

Recognizing collaboration as a potential driver of innovation involves understanding what collaboration entails (Kuziemsky, 2018). A clear definition of collaboration is vital because it is often wrongly associated with creating unanimous consent(Hartley et al., 2013). This is unrealistic in terms of how collaboration functions in practice. Collaboration is the process through which two or more actors collectively manage differences to define common problems and develop joint solutions based on provisional agreements that may coexist with disagreement and dissent (Eikey et al., 2015). Moreover, the definition allows the productive role of difference and conflict in creative processes, including innovation.

3.2.2 Governance and Laborforce

The governance and professional capacity of the health system are crucial to offering the leadership and accountability required for a robust innovation process (Bamford-Wade & Moss, 2010); (Gilson & Daire, 2011). In this perspective, the clinical workforce is combined with governance to reflect the highly integrated relationship between management and leadership to foster innovation. Governance and Laborforce is defined as the strategic leadership and oversight of a health system that ensures the policy and regulatory environment of health systems guard privacy, security, stewardship and accountability (Huntington et al., 2000).

Current policies and governance frameworks lag significantly behind technology development, creating substantive challenges in advancing health systems. Barriers include the inconsistent use of standards (e.g. FHIR, HL7), inconsistent application of policies, siloed health information systems, digital platforms and

technologies that are not interoperable, and IT systems that do not interface or work together(MacNeil et al., 2019). As healthcare evolves, leaders can expect to experience employee and professional pushback as digital competencies are required, clinician roles change, and the lack of appropriate organization and system-wide digital health strategy. Pushback may also come from a lack of expertise or experience in technology leadership, rigid organizational structures and policy settings, or traditional funding models that are not equipped to manage health in a technological healthcare environment. A clear and well-defined health strategy focused on transforming care requires governance structures and tools to support and incentivize progress toward a robust health system (Gilson & Daire, 2011).

Healthcare requires unique governance structures and workplace environments to transform current care delivery models toward technology-enabled care approaches that mobilize and meaningfully engage patients (Gilson & Daire, 2011). For example, the rise of genomics, digital medicine, and AI are all changing the healthcare landscape, and with new technologies, there is a need for a new type of Laborforce (Mathews et al., 2022). Genomics and other technologies can potentially transform care delivery models, therapeutics, diagnostics, and precision medicines (Hassan et al., 2021). The opportunity these new technologies offer can only achieve value if the workforce has the knowledge and competency to adopt new technologies into practice (Barton, 2013).

3.2.3 Data Management

Healthcare institutions yield big data, information and knowledge in real-time from all clinical activities (Chen et al., 2020). Because healthcare data serves as the foundation on which best practices can be developed, and critical clinical decisions are made, there is a need for a healthcare framework that can utilize an efficient data management strategy (Naqishbandi & Ayyanathan, 2020). A data management

strategy is fundamental to health systems (Hassan et al., 2021) and important to drive the innovation process in healthcare (Dash et al., 2019).

Data traditionally regarded as 'health' data requires a management strategy to distill knowledge from these data to intervene in the broadest possible range of technological activities to encourage and generate a better understanding of health system innovation (Issa et al., 2014). For big data to offer value to health systems, it should be captured and analyzed effectively to translate it into knowledge, information, and insights (Nijjer et al., 2020). In healthcare, the term data typically refers to large quantities of electronic health records, administrative claims, and clinical trial data, including data collected from smartphone applications, wearable devices, social media, and personal genomics services. (Hernandez & Zhang, 2017) Data management allows systems to leverage data to learn what technology is required, where transformation is needed, and under what conditions the best outcomes can be achieved (Hassan et al., 2021). Data management tracks data across the care journey to enable innovators and healthcare teams to understand care delivery strategy and enhance innovation. A data management strategy not only strengthens health system performance but, most importantly, underpins and makes the transformation toward proactive health systems where patients are supported and encouraged to manage their health and wellness (Nijjer et al., 2020). Data management tools and algorithms also examine program-level outcomes to inform innovation decisions and determine what technology suits the health system. For example, in response to neonatologist feedback, a University of Virginia (UVA) interdisciplinary team (neonatology, cardiology, statistics, biomedical engineering) used data from a heart rate analysis to create a monitor to visualize the algorithm, heart rate observation (HeRO) and refine technology functions

(Griffin & Moorman, 2001). This helped to discriminate neonatal sepsis and sepsis-like illness (Griffin & Moorman, 2001).

3.2.4 Interoperability

Technology is an inherent part of a complex health system where invasive and sophisticated care is required (Gillman et al., 2016). As such, effective and safe integration of technology into the physical environment is critical. Integrated technologies are those with connected information systems components, including audio, visual and x-ray video that should communicate with each other (Vukmirović et al., 2018). However, many healthcare organizations have outdated information systems that are often created for different uses and may not merge or integrate with other technologies(Bygstad & Henfridsson, 2013). Having the proper foundation through hardware or software is a vital feature of a highly interoperable system (Ullah et al., 2017). A sustainable health information system is one that has the technical capability to integrate with other technologies to enhance the strategic use of information (Mouttham et al., 2012). The term health information system(s) (HIS) refers to the collection, storage, management, processing and transmission of information within the health sector(Moucheraud et al., 2017)

Interoperability, as one of the drivers of innovation, enables different information systems, devices and applications to access, exchange, integrate and cooperatively use data in a coordinated manner within and across the health system. Health data exchange architectures, application interfaces and standards enable data to be accessed and shared appropriately and securely across the complete spectrum of care, within all applicable settings and with relevant stakeholders.

As healthcare delivery moves from a single-provider setting to collaborative care delivery with multiple providers, information types and technologies, innovators need to expand their perspective of interoperability (Ullah et al., 2017). They need to consider the people, technology and clinical processes as part of interoperability. Interoperable computer systems are not beneficial if the people using the systems and the business processes they engage in are not interoperable with the technology (Raghupathi & Raghupathi, 2014).

Interoperability features enable democratizing and supporting data exchange, allowing the providers to work with that health data and share it with appropriate stakeholders when and where needed(Mouttham et al., 2012). Most importantly, interoperability facilitates using analytic tools to transform data into knowledge and insights to support and enable patient engagement and self-management of health and wellness. Interoperability overcomes the two challenges related to data exchange — the lack of structure or standard terminologies in the content of exchanged data and the lack of functionality within and across EHR platforms. According to the Healthcare Information and Management Systems Society (HIMSS), health interoperability has four levels:

- Structural Interoperability: Defines the format, syntax, and organization of data exchange, including at the data field level for interpretation. It describes the flow of data and information that is automated and integrated across multiple and varied data sources, data reporting and access functions, data center structure, data integrity, and information exchange across multiple and various platforms (Sreenivasan, M., & Chacko, 2021), (Hammami et al., 2014).
- Semantic Interoperability: Provides for common underlying models and codification of the data, including the use of data elements with standardized definitions from publicly available value sets and

coding vocabularies, providing shared understanding and meaning to the user (Ullah et al., 2017) (Snowdon, 2020)

- Organizational Interoperability: This includes governance, policy, social, legal, and organizational considerations to facilitate the secure, seamless, and timely communication and use of data within and between organizations, entities, and individuals. These components enable shared consent, trust and integrated end-user processes and workflows (Gavrilov et al., 2020).
- Foundational interoperability establishes the interconnectivity requirement for one system or application to communicate data securely to and receive data from another system. It is defined as the exchange of data at the individual and consumer level, which is accessible across clinical, social and community settings (Sreenivasan & Chacko, 2021)

3.3 Summary

My proposed framework outlines strategies to be applied during the innovation journey in the general context of the health system. The framework encourages implementing modern digital technology in healthcare. Before the journey, the need for innovation and potential interventions should be carefully assessed by involving all clinical stakeholders with a clear understanding of the details of innovation and knowledge leadership. Interventions should be needs-oriented, user-centred, and adaptable to changing circumstances. During the innovation and implementation process, a clinical team and knowledge experts with a strong understanding of innovation should ensure transparent, inclusive, and motivating staff communication regarding the project and continuous feedback through leaders of healthcare.

Chapter 4. Methodology

This chapter is a detailed description of the method used in this thesis. As described in Section 1.2, this thesis addresses contextual problems enabling provincial policymakers to use data-driven evidence to successfully coordinate their activities to innovate. Since knowledge and the ability to understand practical issues, such as the contextual perspective of healthcare to innovate, are two mutually nested problems common with grounded theory (GT), a methodology based on the principles of GT is appropriate for addressing this phenomenon.

4.1. Research Design and Data Collection

The research received approval from the University of Ottawa Research Ethics Board. A qualitative methodological approach was employed to allow participants to openly share their understanding of innovation. Two types of participants were engaged in the study – healthcare professionals and provincial policymakers.

To understand the ways in which healthcare professionals understand innovation using GT principles, insights into the members' perceptions of their knowledge of innovation can be gained. This is because some GT principles cannot be judged through observation but require a reflective stance and are better studied through understanding the individual's perception and knowledge of innovation. Moreover, the individual's perception of the other's action or of the inter-individual interaction will shape the individual's understanding. Therefore, I decided to use individuals' accounts of their knowledge of innovation through interviews and questionnaires. After obtaining informed consent, a semi-structured interview and questionnaires focused on healthcare professionals' understanding or knowledge of

innovation. The interview guide was designed based on the literature on innovation and comprised the following topics: 1. Experiences during the innovation process; 2. Communication with other professionals; 3. Collaboration; 4. Task sharing and responsibilities (Pype et al., 2015). Additionally, thematic analysis was used to identify themes in the data collected.

4.2 Appropriateness of the GT Method to the Thesis

The issues arising from the objectives of the study and literature are expressed as "how and "what" type research questions that are designed to understand innovation in the healthcare system better, thus, prompting the adoption of the grounded theory method (Tai & Ajjawi, 2016). This methodology is appropriate when very little is known about a phenomenon (Bristowe et al., 2015). The aim is to gather an understanding that uncovers a process inherent to the substantive area of inquiry (Chun Tie et al., 2019). Grounded Theory is one of the inductive research methods most suited to the understanding of a construct and "theory-driven empirical research" (Singh & Estefan, 2018). It "lets the researcher understand a theoretical account of a topic's general features (Dixon et al., 2017) while grounding the account in empirical observations or data"(Charmaz, 2016).

The emphasis of the GT on understanding a concept such as innovation not only shows the rigour involved in collecting and generalizing data but also provides researchers with guidelines, advice, and perspectives regarding its use to ensure the rigour of the research contribution(Charmaz, 2016). GT helps understand and utilize real-world knowledge about health concerns. In practice, GT enables one to see health patterns in groups, communities, and populations and predict health and practice concerns in healthcare(Singh & Estefan, 2018). Charmaz, (2016) asserted that grounded theory is "useful for research in areas where there

are major gaps in understanding a phenomenon and where a new perspective might be beneficial". Policymakers and healthcare professionals need new knowledge to address the challenges of meeting society's dynamic healthcare needs. Studies using GT can generate new knowledge about healthcare derived from fundamental interactions with patients and other key aspects of clinical practice. A GT is constructed by understanding participants' experiences and interpreting how participants make sense of their perceptions and actions (Charmaz, 2016).

4.3. The Case Study Approach

A single-case study method (Yin, 2013) focusing on individual healthcare professionals across several hospitals in Eastern and southern Ontario was utilized to better understand innovation and how it is perceived and applied in the healthcare system. According to Yin (2003), a single case study is better when the researcher wants to study a person or a group of people.

This case study method is relevant to GT as it aids in observing how effective and efficient a theory solves a defined problem. The method proves more helpful when the phenomenon investigated is challenging to study outside its natural setting and when the researched concepts and variables are difficult to understand (Boer et al., 2015), which, in this case, is how innovation is initiated in the healthcare domain. Using a case study method allows an in-depth study of a particular research problem, often by narrowing down a broad field of research into easily researchable parts. Thus, examining real-life scenarios is possible using case studies since they provide opportunities to apply concepts and theories and the extension of methodologies(Yin & Campbell, 2009). Accordingly, a case study can examine real-life instances of the cycle of innovation activities described in Chapter 1, and hence the examination of the links and

relationships between coordination with policymakers achieved objectives and accomplished outcomes. The case study method aids in generalizing the result of an intensive study of a single unit across a more extensive set of units. As such, multiple-case studies, which are repeated experiments, ensure that replication corroborates, qualifies and/or extends the study's findings and facilitates generalization (Yin & Campbell, 2009). This aligns well with the demonstration and evaluation activities of the innovation process model. A case study relies on multiple sources of evidence. The evidence, which is either quantitative, qualitative or both, obtained from the data in a case can support or revise the evidence from successive cases, iteratively evolving and expanding generalization.

Using this case study method allowed me to look at the case organization holistically and check whether innovation is practical in the healthcare sector. It also enabled me to verify whether the innovation process is collaborative. The unit of analysis of the case study is the healthcare organization, which is demonstrated to have initiated the study. This unit of analysis is in line with the mandate of understanding innovation in a health system. The learning derived from this case study is foundational and may give rise to a future research study.

4.3.1 Case Selection

Prevention and control measures implemented in response to the COVID-19 pandemic changed how individuals and organizations in Ontario interacted with each other. In an effort to slow the spread of COVID-19, residents of Ontario limited their contact with people outside their households. Businesses shifted from in-person to online interactions, and social interactions became physically distanced.

Given that the objective of this study was to broaden our understanding of innovation in the health system, the restrictions posed by COVID made it unlikely that a representative case or a typical, average case

organization would be the richest source of understanding (Flyvbjerg, 2006). Engagement with healthcare practitioners based on digital contact became the most appropriate to obtain the best information about innovation. Engaging practitioners with an in-depth understanding of how innovation works from healthcare institutions was especially good in a similar sense to what Parshuram & Berta (2020) described as a positive practice environment for innovation - one where the priority of innovation is articulated across all major organizational functions, and where the commitment is visible throughout. With a history of relevant initiatives, doctors and nurses from several clinical institutions across Ontario were engaged.

4.3.2 Sample

Healthcare is an integrated system that hosts many innovation-related relationships or functions (Stake, 1995). Hence, this case study has many participants (e.g., nurses, doctors, project managers, other disciplines, etc.) who had to be sampled. A purposeful sampling technique was used to select participants who met the study criteria because they could inform the perception of innovation from specific and diverse viewpoints (Creswell, 2018). Purposeful sampling is widely used in qualitative research to identify and select information-rich cases for the effective use of limited resources (Palinkas et al., 2015). This involves identifying and selecting individuals or groups of individuals who are especially knowledgeable about or experienced with innovation (Wolfswinkel et al., 2013).

The sample involved Fifteen participants (nurses, doctors and stakeholders) as subunits from various vantage points at several healthcare institutions, including frontline practitioners, managers and policy analysts. The sample was also diverse with respect to medical education and other professional work experiences. The breakdown of the participants is displayed in Figure 8. To understand how innovation is

conceptualized in the health system, every participant had to have worked in the province of Ontario (Neiterman & Bourgeault, 2015) and be diverse in their backgrounds.

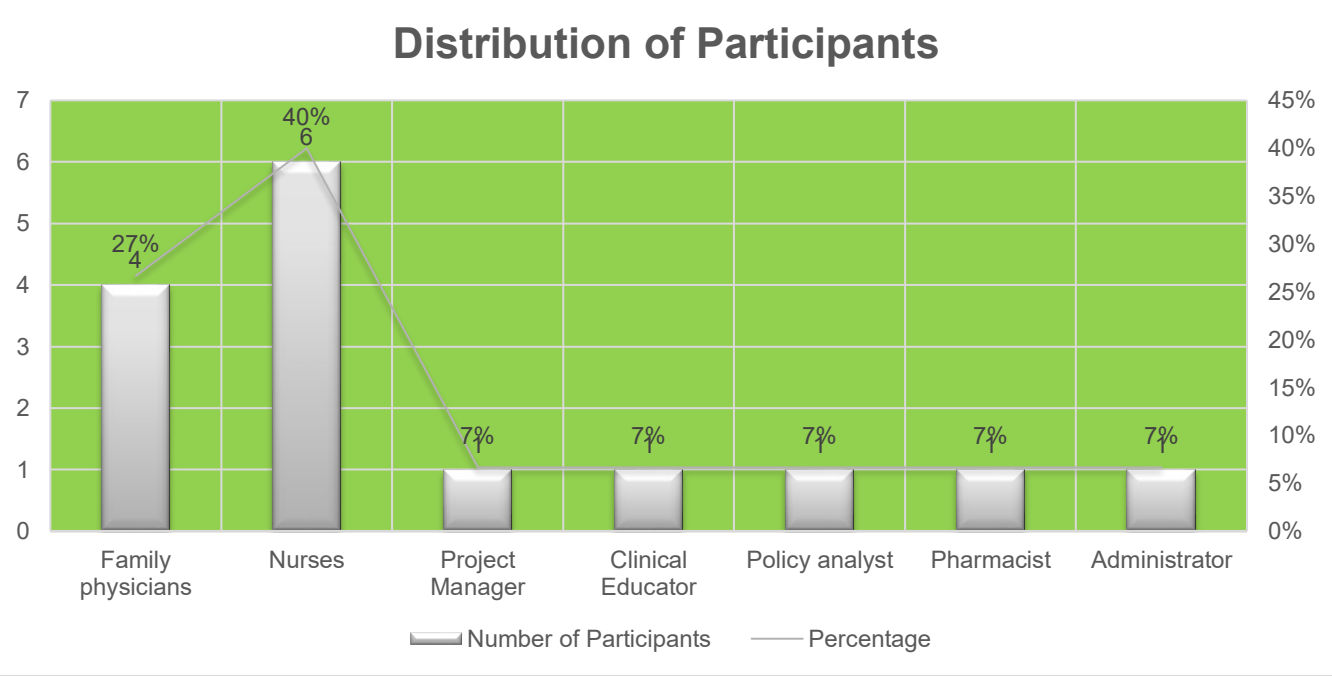

Figure 8: Participants & specialization

The participants provided different perspectives in the survey: Figure 9 shows that 27% of the survey respondents were family physicians, 40% were nurses and project manager, a clinical educator and policy analyst, an administrator and a pharmacist all represented 7% of the participants.

Stake (1995) states that data from a sample of more than ten participants is unmanageable and unnecessary, while less than four may not be enough, especially when there are no pre-existing theories about the concept being studied. The sample size exceeded what Stake recommends, primarily to make provisions for attrition or incomplete interview data sets and to ensure a comprehensive description of the case/organization and data saturation. Data saturation was achieved, with the total number of individuals being fifteen.

4.3.3 Recruitment

Participants were recruited through physical contact with healthcare professionals at several clinical institutions, and snowballing was used. A snowball technique is used when research participants are asked to assist in identifying other potential participants who meet the sample criteria and are information-rich (Ridder, 2014a). Information-rich individuals are those from whom the researcher is likely to learn a lot about the topic or phenomenon of primary interest (Patton, 1990).

Based on the research objectives, I decided which participants were best suited to provide a range of perspectives about innovation in the health system. Variation in the sample was emphasized to maximize learning (Crowe et al., 2011a). Several nurses and doctors from different medical institutions were recruited to participate in the research. The purpose and approach to the research process were outlined to prospective participants, along with my contact information as the researcher. The recruitment information letter shown in Appendix A and a consent form in Appendix B were handed out at these meetings. An email (see Appendix A) was sent to key individuals in specific roles at other levels of the organization. Participants were asked to suggest names and facilitate referrals to individuals who met the sample criteria (Crowe et al., 2011b).

4.3.4 Characteristics of Study Participants

Fifteen participants met the inclusion criteria. There were more men (n=9) than women (n=6). Participants were selected from across Ontario to provide a range of perspectives about innovation in the health system. The participants' recall of their experiences in a highly technologically dependent environment was integral to the study. Table 5 exhibits the description of the participants.

	Participant	Gender	Occupation	Location	Interviewed	Questionnaire
1	PAH50010	Male	Family Physician	London, Ontario	No	Yes
2	PAH50011	Male	Nurse	Ottawa	No	Yes
3	PAH50013	Female	Family Physician	St. Catharines	No	Yes
4	PAH50014	Male	Clinical Educator	Kingston, ON	No	Yes
5	PAH50015	Female	Nurse	St. Catharines	No	Yes
6	PAH50016	Female	Nurse	St. Catharines	No	Yes
7	PAH50017	Male	Project management	Ottawa	Yes	No
8	PAH50018	Male	Nurse	Ottawa	No	Yes
9	PAH50019	Male	Family Physician	St. Catharines	No	Yes
10	PAH50020	Male	Family Physician	St. Catharines	No	Yes
11	PAH50021	Female	Pharmacist	Hamilton	No	Yes
12	PAH50022	Female	Nurse	Ottawa	No	Yes
13	PAH50023	Male	Policy Analyst	Toronto, ON	No	Yes
14	PAH50039	Male	Hospital administrator	Toronto, ON	No	Yes
15	PAH50040	Female	Nurse	Toronto, ON	No	Yes

Table 5: Data of participants (n=15)

4.3.5 Participants and Data Collection

Based on the restrictions posed by the COVID-19 virus, most participants opted for the questionnaire component of the study or an interview via Zoom meeting. Interviews lasted about 60 minutes and were recorded on audiotape. The questions for the interview were mainly derived from the scoping review, analysis of policy documents, and government reports on innovation. An overall summary of the main points was developed using the contact summary form in Appendix A. In addition, essential guides or queries for the subsequent encounter or interview were flagged, and preliminary coding of themes in a column became part of the broader inductive analytic process at the later stage.

The rest of the data was collected through a questionnaire. After fifteen questionnaires had been received and analyzed, no new information was found to contribute significantly to the descriptions of the experiences. The interview and questionnaires involved experiences from physicians, nurses and a researcher. The interview guide (Appendix G), based on the conceptual framework that anchored the research, was utilized for the interview (Ridder, 2014b). Additionally, questionnaires involving questions inspired by the Oslo Manual guidelines of 2018 for conceptualizing and measuring innovation were also used. The questionnaire allowed participants to share information that was relevant to them. This added to the richness of data gathered and analyzed. Given the limited literature on the systems perspectives that call for developing innovation policies to co-ordinate divergent thinking that serves broad societal objectives in the healthcare sector (OECD, 2018), the questionnaire was designed to draw extensively on recent experience for understanding innovation in the healthcare sector (Arundel & Bloch, 2016) and on cognitive testing with healthcare managers.

Healthcare professionals and provincial officials were chosen based on their role in the innovation process. There were three primary forms of data collection: semi-structured interviews, surveys, and review of documents. Each stage of the interview or review of documents informed the subsequent steps.

4.3.6 Documents Review

Formal and informal documents were reviewed to understand the organization's context and assess how interviewees perceive innovation. Data were collected by reviewing journals and clinical documents. These included annual reports (for the overall public and specific ones on innovation initiatives for Ontario Healthcare), strategic plans (corporate and Professional Practice), project reports and presentations,

survey results, specific policies and procedures (e.g., Nursing Performance Appraisal process, and media articles. Most of the documents were available online; additional documents of interest were identified at various steps through discussions with the participants (Crowe et al., 2011b). When reviewing the documents, notes were taken of key ideas of relevance to this study. These notes formed the basis of analysis for this aspect of the research.

4.4 Data Analysis

The data analysis was inductive, iterative, and informed by the literature and semi-structured interview guides. This philosophical orientation is compatible with the view that qualitative case study approaches are based on the belief that knowledge can be constructed (Goffin et al., 2019). The data analysis involved two steps—a deductive approach based on literature and an inductive approach based on the interview and survey answers.

Step 1, deductive approach: The GT principles on performing data coding were adhered to. The answers to the survey were searched for excerpts where GT principles could be identified. These excerpts were coded according to the GT principles. The audio recording of the interview was read and transcribed to ensure accuracy. Inductive coding of the data from the interview and document sources did not start with a pre-established list of codes; instead, the codes emerged from the data. Specific steps included: (i) reading answers to the questionnaires and making margin notes; (ii) reading the transcripts, making margin notes (iii) reviewing the margin notes to identify/label emerging codes; (iv) re-reading the transcripts and highlighting according to these codes; (v) summarizing the code to determine specific themes (vi)

reviewing the themes and re-assessing the coded data to ensure they all belong together, and (vii) naming and defining the themes (Clarke & Braun, 2018).

Step 2, inductive approach: Fragments extracted from the interview and survey questionnaire and coded per GT principles were considered as units of analysis for understanding innovation (Graneheim & Lundman, 2004). Per the GT principle, meaningful units were identified, abstracted and labelled with a code. These codes were subsequently sorted into categories. The researcher engaged in a process of reflection and detailed review during the analysis and referred back to the original survey transcripts regularly. Qualitative data analysis software, NVivo 10, was used to manage and analyze the transcripts (Crowe et al., 2011b). The interview and questionnaires were analyzed as two separate datasets, though an overlapping of thematic codes ensued.

4.4.1 Qualitative Data Analysis Technique

Qualitative data are usually in the form of words rather than numbers and deal with meanings. These data types are generally a source of well-grounded, rich descriptions and explanations of processes derived from identifiable local contexts (Miles & Huberman, 1994). Conceptually, qualitative data support understanding behaviours from a participant's perspective, e.g., how they perceive and understand their social realities and, hence, how they act within the social domain. Therefore, qualitative data proves more suitable for evaluating innovation than quantitative data, as qualitative data offers more insights into healthcare professionals' perceptions and understanding of innovation. Methods employed to collect qualitative data are through participant interviews and questionnaires. The data are analyzed using descriptions provided by participants and are reported in the participants' language (Minichiello, Aroni,

& Minichiello, 1990). Hence, information derived from qualitative data collected from healthcare professionals in the case study on innovation is vital. This qualitative data focuses on the ability of healthcare professionals to exhibit their understanding of innovation.

Consequently, to derive insight from the data collected, I apply thematic analysis as a qualitative data analysis method to identify and understand the participants' perceptions of innovation. Thematic analysis, a method for identifying, analyzing and reporting themes within data, offers an accessible and theoretically flexible approach to analyzing qualitative data (Mills et al., 2010). I used inductive coding to derive themes from the collected qualitative data (Miles & Huberman, 1994). The themes derived through thematic analysis are idea categories provided by participants during the interview. The application of thematic analysis enables identifying and reporting the experiences, meanings, and reality of healthcare professionals' interactions and involvement with innovation. The application of thematic analysis also allows for answering the practical problems (understanding and knowledge of innovation)

4.5 Rigour of the Study

The Lincoln and Guba (2011) criteria used to establish the rigour of this study included credibility, transferability, dependability and confirmability. Credibility was reached by recruiting and interviewing participants who met the inclusion criteria and were able to describe their experiences of innovation when dependent upon technologies for healthcare (Carnevale, 2002). Credibility refers to the believability of the study's results or the extent to which the researcher genuinely conveys the participants' experiences and perspectives (Carnevale, 2002). Transferability or 'fittingness' was established by providing rich, in-depth descriptions depicting the participants' lived experiences. Transferability refers to the degree to which the findings reflect the experiences of individuals in other similar settings or contexts (Carnevale,

2002). Dependability or auditability was demonstrated by having another researcher follow the study process without reaching contradictory findings (Lincoln & Guba, 2011). Confirmability was achieved through the researchers' use of audit trails to demonstrate the thought processes associated with the descriptions. Confirmability is the assurance that data was collected and analyzed to minimize any distortion of the participants' views (Carnevale, 2002). A systematic and detailed record of the data collection and analysis process was maintained so that a third party or reader could confirm that they would arrive at the same conclusions. Specifically, four categories of records were kept (Shenton, 2004): (i) raw data (e.g. transcription of interviews; (ii) data reduction and analysis products (e.g. contact summary forms, excel document with survey data; (iii) process notes (e.g. journal and memos and notes from debriefings with supervisor and thesis committee); and (iv) data reconstruction and synthesis products (e.g. analytical matrices, table or flow charts and drafts of thesis). A final technique that applies to ensuring credibility, transferability and confirmability is the reflexive journal, which is used to record a variety of information about the self and the method (Connelly, 2016).

4.5.1 Triangulation

Triangulation was conducted first through corroborative evidence from the survey and document review to shed light on a theme or perspective (Creswell, John, 2018). Besides data triangulation from the interview, surveys and documents were essential data sources that clarified the given themes. In the context of this qualitative case study approach, the purpose of triangulations was to achieve a more complete data set (Shih, 1998) and, therefore, a more complete portrayal of the phenomenon of innovation.

4.6 Ethical Considerations

Research ethics approval was obtained from the University of Ottawa. The ethical protocol of the ethics board was strictly adhered to throughout the research process. These included the five major ethical considerations: (i) access to participants, (ii) obtaining informed consent, (iii) privacy and confidentiality, (iv) concerns about risk, and (v) reciprocity (Sutherns et al., 2014).

4.6.1 Access to Participants

Participants were accessed through the awareness strategies outlined earlier. Contact information was displayed in Appendix B, the consent letter, so that prospective participants could get in touch voluntarily. Snowballing technique was used to recruit participants. Initial contact was made to explain the purpose of the study, gain consent and organize an interview time and place.

4.6.2 Obtaining Informed Consent

Informed consent was obtained from each interview (Appendix B). At the organizational level, permission was obtained from senior representatives at several hospitals about the identification of their hospital during and/or after the completion of the research.

4.6.3 Privacy and Confidentiality

Participants were given the option of being interviewed at their work location or a place of their convenience. Participants were informed that audiotaping and transcriptions were for research purposes only. Alpha-numeric code numbers were used to identify participants. Interview notes and consent forms were separated from the data files. The data comprised of the journal and all audiotapes and transcriptions

(soft and hard copies) are stored in a locked cabinet in my supervisors' office at the University of Ottawa and destroyed by a secure shredding service five years after the thesis defence. All email communication about the research was handled separately through my University of Ottawa email address. Desktop computers, laptops, electronic data files and storage devices were all password protected. In the report, quotes have been selected carefully to avoid inadvertently identifying the participant(s).

4.6.4 Concerns about Risk

Risks associated with this study were not more significant than those in everyday practice (TCPS, 2013). It is possible that the interviews could present some emotional triggers for participants, especially for healthcare professionals. Participants were assured that every effort was made to minimize risks by ensuring that the session lasted a maximum of 60 minutes for each meeting by scheduling the sessions at a time convenient to me.

4.6.5 Reciprocity

The participants' insights, time, and expertise contributed significantly to this research process. The opportunity for joint learning and creating new knowledge was mutually beneficial for the researcher and participants. No financial compensation was awarded to participants. Participants were also informed they were under no obligation to participate. If participants chose to participate, they could withdraw from the study at any time or refuse to answer any questions without suffering any negative consequences. (Appendix B).

4.7 Summary

Case studies are a ubiquitous component of qualitative research used to answer many different questions. In this chapter, the GT, a qualitative methodology, was selected because Innovation is complex and has to be explored in depth within its context (Creswell, 2013). In addition, the GT fosters a good investigative analysis, which can contribute to a tailored approach to understanding innovations.

Chapter 5. Results of the Survey

This section presents the findings of the study in the context of the research questions. The primary purpose is to use the data collected to answer the research question. The findings are primarily descriptive and focus on the perceptions of healthcare professionals to understand innovation. Commonalities and themes (Appendix-I Excerpts of Participants' Responses) that arose from the interviews were interpreted and used to drive conclusions.

5.1 Results and Materials

A demographics section was not required for the survey. Such questions were considered personal and tedious for the respondents who did not want their age, race, ethnicity, gender, marital status, income, education, and employment disclosed. The survey was also anonymous and did not collect identifying data. Questions included multiple-choice and open-text responses. The survey was inputted into the Survey Monkey platform, and the researcher addressed all technical issues. The uOttawa Research Ethics Board approved the study.

There was a 36% (15/42) response rate for the survey. Descriptions of participating respondents are presented in Table 5. Most specialists are family physicians with access to most technology in their healthcare facilities. Answers from participants were used to answer the research questions. 64% of the respondents were neutral about top-down innovation being driven by government policy in Ontario. 64% of respondents disagree that innovation culture at the provincial level is supportive and includes professional clinical staff. In addition, 100% of respondents agree that an inclusive innovation culture can

result in better innovation outcomes, and 100% agree that leadership can provide valuable support for innovation within the healthcare system.

Additionally, 100% of respondents were neutral on the premise that bottom-up innovation can include the active involvement of staff throughout the clinical hierarchy. When asked about collaboration, 36% of respondents maintained a neutral stance that collaboration was involved in initiating innovation, and many section staff were involved in developing innovation projects. 73% of respondents agreed that open communication, a positive work atmosphere, a clear sense of direction and strategic vision are factors that drive innovation in healthcare. In addition, 36% of respondents agreed that there is an inherent disconnect between provincial policymakers and healthcare experts as it relates to the implementation of innovation in healthcare. In addition, 100% of respondents agreed that obstacles to innovation involved the lack of resources, a supportive culture for innovation, risks and resistance from academic and professional staff.

5.2 Feasibility and Impact on the Health System

A majority of the respondents agreed that the evolving understanding of innovation as a process of activities raises new challenges for healthcare professionals. Although innovation is commonly regarded as the outcome of a process of activities, these are by no means always succeeding in a linear shape but involve several feedback loops to be feasible. Hence, typical activities and steps are common for many innovation programs. However, the uncertainty of achieving results and finishing an activity with the required quality forces innovators to provide feedback between the activities to improve the final solution. These challenges are expressed in the increasing complexity of innovations, which are also determined by the complexity of the surrounding conditions in healthcare.

In this Grounded Theory analysis, I used intuition and knowledge to assemble the data into thematic categories (Appendix I). Finally, I decomposed each category into multiple items (attributes) using content analysis to derive the themes from the data. The survey reveals five (5) themes reflecting the core experience of understanding innovation based on answers provided by healthcare professionals. The themes are discussed below.

5.3 eConsult

Electronic consultation (eConsult) is a promising innovation for improving access to specialty care(Oseran & Wasfy, 2019). eConsults offers a rapid, direct, and documented communication pathway for consultation between primary care and specialists. It (eConsult) is an asynchronous communication between healthcare providers within a shared electronic health record (EHR) or secure Web-based platform(Vimalananda et al., 2015). Referring providers send a consultation request to specialists, who can respond by answering the consult question, requesting more information, and scheduling a specialist appointment. eConsults have been adopted at an increasing number of US academic centers, private healthcare settings, and internationally(Vimalananda et al., 2020).

Respondents agreed that an innovation such as eConsults has to be supported by the right values, behaviours and processes to have a meaningful impact. A well-defined innovation process is an essential first step in building a culture of innovation. To this end, respondents disagree that the innovation culture within the healthcare system is entirely supportive and involves healthcare professionals (doctors, nurses) and management. A respondent emphasized that "innovation, which is a top-down process, often doesn't involve professionals working in healthcare until the end stages, and participation in that innovation is often voluntary and uncompensated work." The respondent agreed that eConsults is an excellent platform,

yet a specialist still has to log into a separate platform, upload all patients' information individually, put it back into the EMR and finally download it to a desktop. The respondent stated that while eConsult is helpful to specialist practice, adding another login and not involving "already existing processes or computer program is prohibitive to using it." Figure 9 provides a summary of the perspectives of the respondents based on the survey questions.

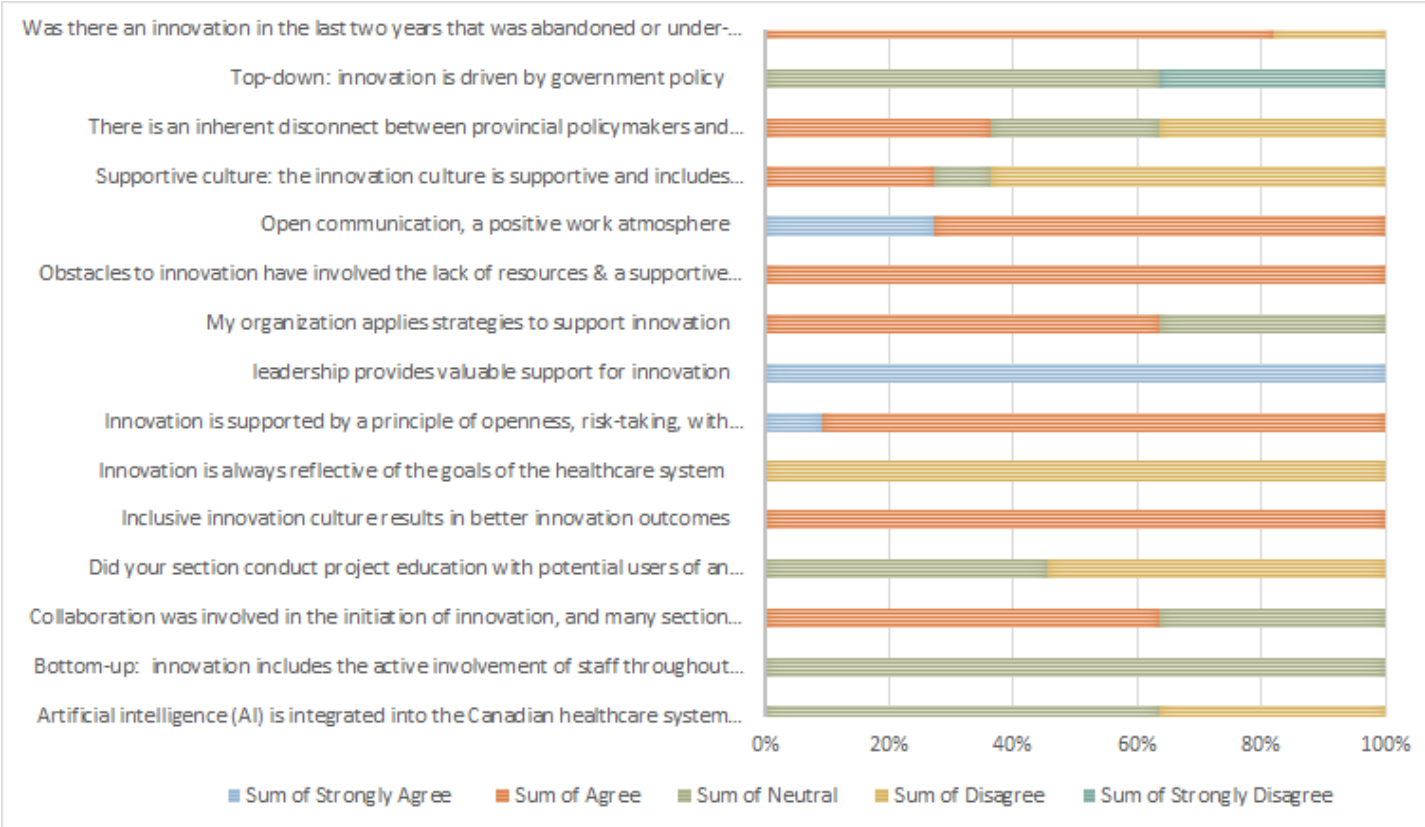

Figure 9: Participants' Perspectives on the Factors of Innovation

eConsult is one of the most promising innovations piloted in Canada to improve access to specialist care(Vimalananda et al., 2020). It is a model of asynchronous communication that allows primary care providers (e.g. family physicians and nurse practitioners) to electronically consult with specialists

regarding their patients' medical issues in a wide range of areas, including psychiatry, dermatology, geriatrics, pediatrics, cardiology, oncology, palliative care, sports medicine and clinical pharmacy(Oseran & Wasfy, 2019). This case challenges the underlying assumption that innovation has always involved healthcare practitioners. "The most common way specialists initially heard about the eConsult service was through another specialist." While most respondents found eConsult a feasible way to improve access to specialist care, several respondents also offered suggestions to improve the platform, including enhanced formatting and a facilitated way to enclose educational resources with the consult. Several respondents recommended implementing an eConsult app for phones and tablets. Several respondents supported integrating the service into electronic medical records (EMRs).

eConsult has been identified by respondents as a priority by the provincial governments of Ontario, Quebec, Manitoba and Newfoundland and Labrador and by several professional associations, including the Quebec College of Family Physicians and the Association of Registered Nurses of Newfoundland and Labrador. Hence, there seems to be momentum in fostering eConsult in Canada, with four provinces actively involved and currently at different phases of the innovation process (i.e. assessing, developing, preparing and implementing plans to do so).

5.4 eReferrals

Electronic referral (eReferral) systems have been designed to improve wait times and efficiency by electronically standardizing information and communication within the referral process(Azamar-Alonso et al., 2019). These systems would allow physicians to communicate asynchronously, reduce the number of unnecessary referrals that clog wait lists, provide a record of the patient's journey through the referral system, and lead to more efficient visits(Liddy et al., 2015).

The referral process is termed as transferring (including sharing) the responsibility of patient care from the referring provider to another physician or provider, so that it also includes the transfer back of patient care at an appropriate time(Naseriasl et al., 2015). According to Liddy (2015), electronic referrals allude to the automation of the referral process in which appointments and other information regarding the consultation are transferred between two or more healthcare providers. Like the referral process in healthcare, eReferral was seen as an innovation that healthcare providers would use to communicate effectively with consultants, specialists, and patients at all stages of the healthcare process(Liddy et al., 2015). In Canada, while there has been increasing adoption of electronic medical records (EMR) within primary care(Schoen et al., 2012), little is known about the current state of eConsultation and eReferral in Canada(Liddy et al., 2015). According to a respondent, their "region tried to implement eReferral (i.e. referring a patient from a toolbar in the EMR rather than the use of a fax to clinics); however, there were barriers to getting enough clinics onboard."

This leads to the research question of where do the ideas for innovation come from. While most respondents were neutral on this question, few believe the idea is usually at the provincial level, where healthcare professionals are rarely involved. For example, through a partnership with the Canadian Foundation of Healthcare Improvement, the Royal College of Physicians and Surgeons of Canada (RCPSC), the College of Family Physicians of Canada (CFPC), and Canada Health Infoway, seven provinces: BC, Alberta, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland and Labrador have established eConsult services provincially or in some regions. These involve different technology platforms, workflows and remuneration policies.

Currently, referrals to a specialist by a primary care provider are initiated in the following way. The primary care provider selects the most appropriate specialist and forwards the patient's relevant information, usually by fax. Several specialists may share a central intake, and others may have individual processes that the primary care provider should know about and be able to access. The specialist reviews

the patient's file triages for urgency and schedules an appointment. Ideally, the process is expected to keep primary care providers and patients in the loop, but this is often not the case.

eReferral services, on the other hand, can simplify the referral process and have been viewed to reduce wait times and improve referral tracking. Other benefits include an organized directory of providers and specialties, clinical pathways, and a centralized triage system for identifying a referral's urgency, completeness and appropriateness. Figure 10 depicts the eReferral process.

To use an eReferral system, specialists and primary care providers should have health information systems that can be linked through a shared EMR or an independent eReferral platform. This is important for usability, as systems designed for single specialties or requiring manual data entry are burdensome for primary care providers and a barrier to use. The diagram below is an example of the eReferral process.

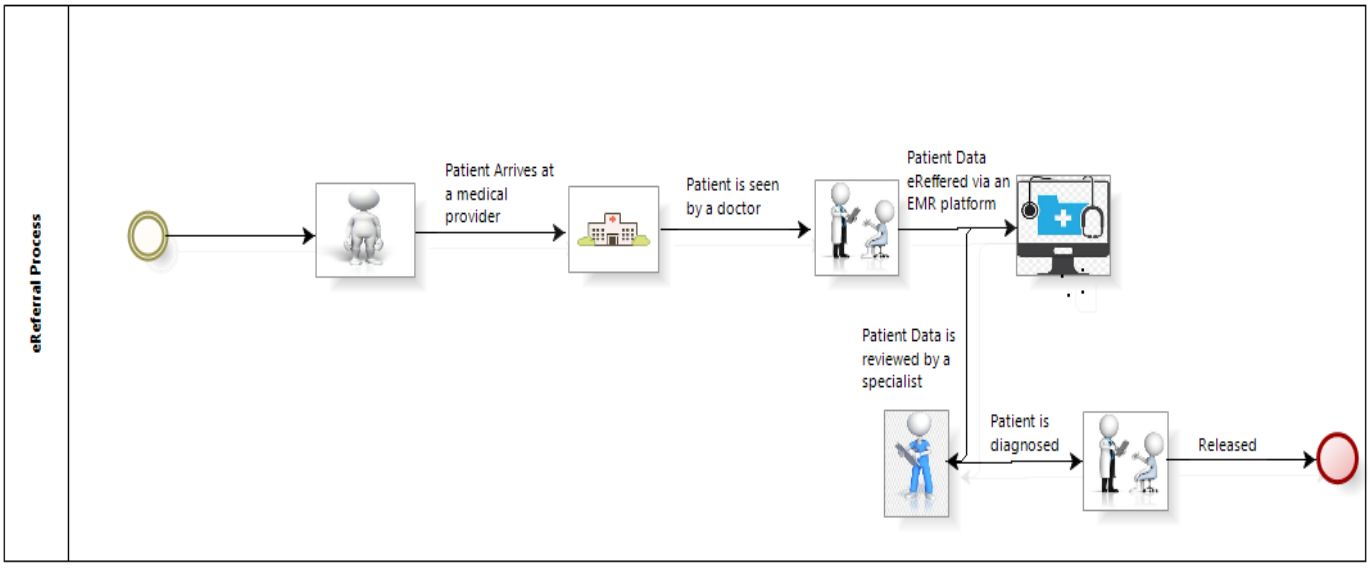

Figure 10: eReferral Process

Healthcare professionals and patients should be empowered to influence the design, implementation and evaluation strategies of eReferral platforms and services. This will ensure that these innovations are implemented in a way that serves them optimally. In addition, an eReferral platform embedded with a machine learning algorithm will identify relevant information in data and potentially help doctors make quicker, more accurate diagnoses. Machine learning is particularly valuable because it can help healthcare professionals make sense of the massive amounts of healthcare data generated daily within electronic health records. Using machine learning in healthcare, like machine learning algorithms, can help healthcare find patterns and insights that would be impossible to find manually. These services need a robust evaluation and quality improvement strategy that is shared with others to improve understanding of the benefits, risks and potential unintended consequences of these innovative service-delivery models.

5.5 Integration

Integration is one of the main factors frequently argued during discussions with participants to impact innovation. To improve patient outcomes, integrated care interventions encourage linkages among professionals and services across the healthcare continuum. For example, a respondent added that despite the increased effort to integrate care better, there is considerable variability in their success, and relatively little is known about the factors associated with successful implementation across healthcare. In addition, 100% of respondents believe integration is core to understanding and implementing innovation. Evaluations of successful integrated care programs show no single approach to integration; there are cases of bottom-up initiatives and top-down structural change (Holterman et al., 2020). Hence, integration needs

to be supported by policy and leaders' action while ensuring that initiatives are context-specific, implemented from the bottom-up, and focused on the health system (Evans et al., 2016).

The figures below were taken from the Ministry of Ontario's health administrative databases. They show the locations of physician networks (Stukel et al., 2013) in Ontario and the primary healthcare concentration zones within the physician networks. Physician networks have been shown to integrate primary, secondary, tertiary care & community care (Stukel et al., 2013). Physician networks are a way of linking patients to a single usual care provider and then assigning a provider's patients to a network based on previous utilization patterns. For example, figure 12 depicts the locations of multispecialty physician networks in the capital Region of Ontario. For each network, the large green cross represents the location of the largest hospital, and small grey dots indicate the locations of other hospitals. Each network has either one provider hub or an aggregation of provider hubs linked by straight lines to the largest hospital, resulting in "spiders." Satellite networks are represented by dotted lines between provider clusters and the centroid of their respective provider hubs. Figure 11-15 depict the map of the neighbourhoods of some regions in Ontario.

Integrating these large physician groups within Ontario will foster collaboration among technology, professionals and services across the health system continuum to improve patient outcomes. Hence, I surmise that this "natural" model of physician organization reflects how primary care physicians, specialists, and hospitals practise together to care for a defined population. Such a structure would require more accurate technology and professional integration to facilitate care. These interconnections are especially important when implementing innovation to overcome system fragmentation.

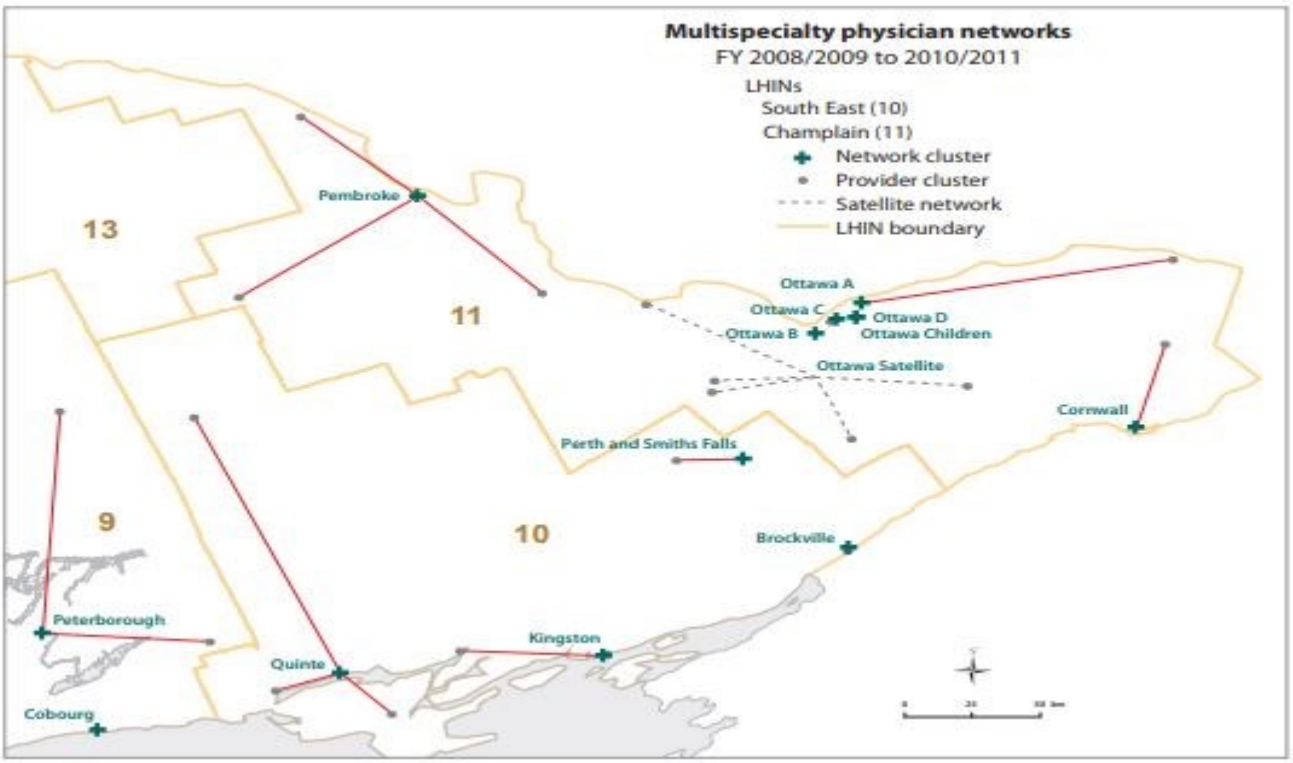

Figure 11:multispecialty Physician Networks in the Kingston and Ottawa areas (Ontario Ministry of Health satellite image 2011)

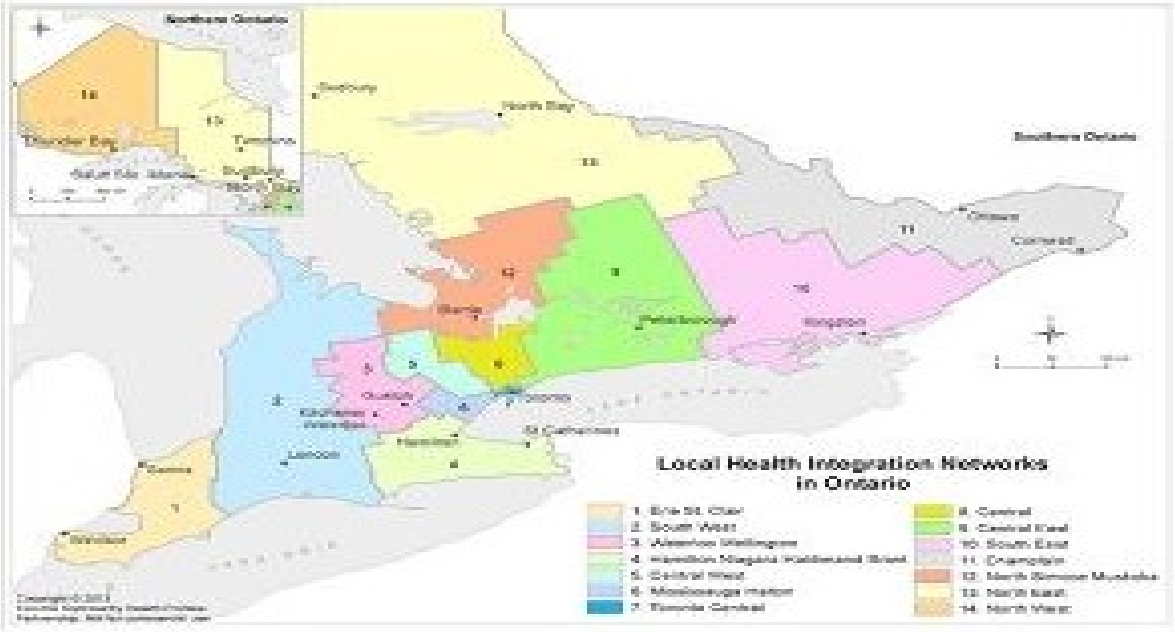

Figure 12: Integration Networks in Ontario (Ontario Ministry of Health satellite image 2011)

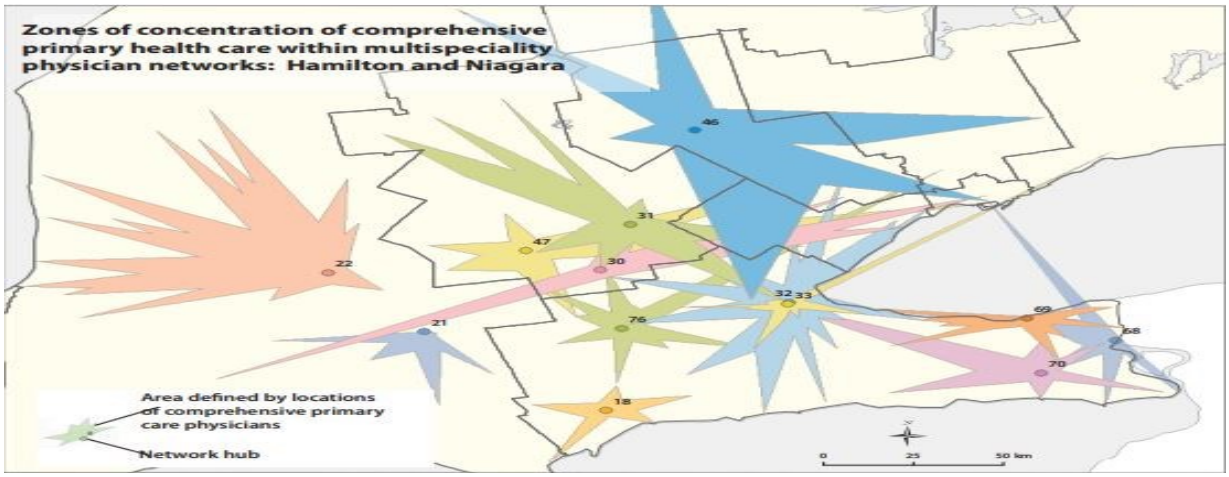

Figure 13: Zones of concentration of comprehensive primary healthcare (Ontario Ministry of Health satellite image 2011)

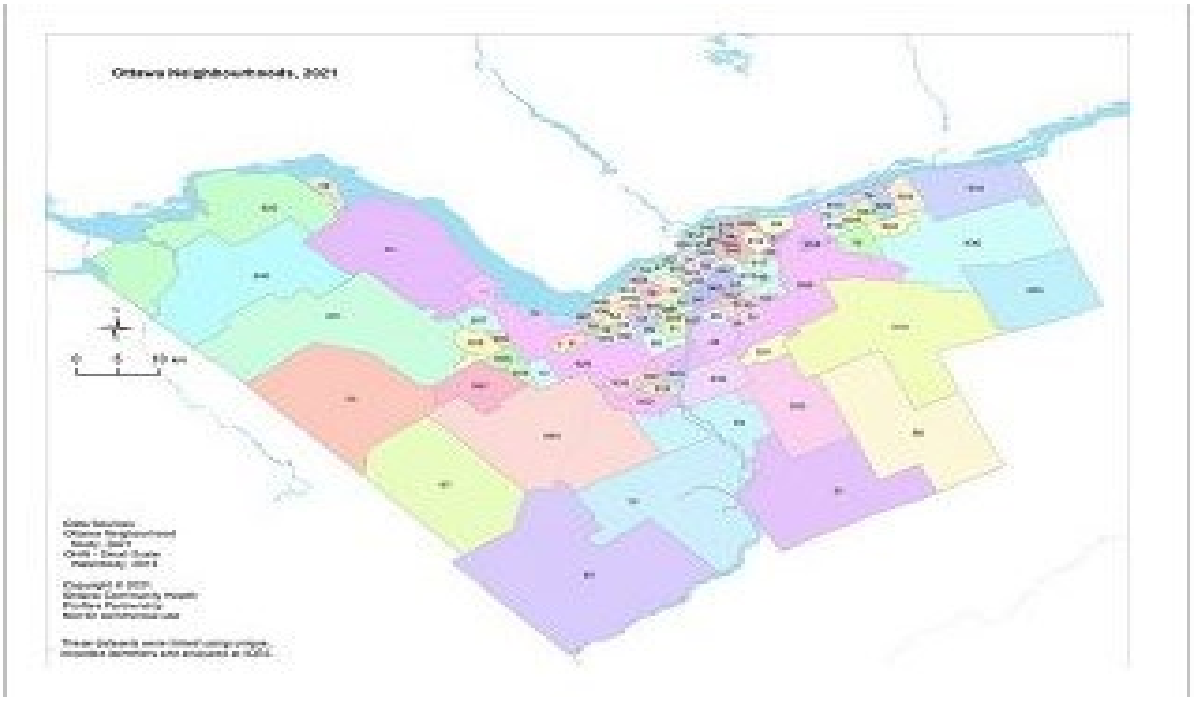

Figure 14: Ottawa Neighborhood Multispecialty Networks (Ontario Ministry of Health satellite image 2011)

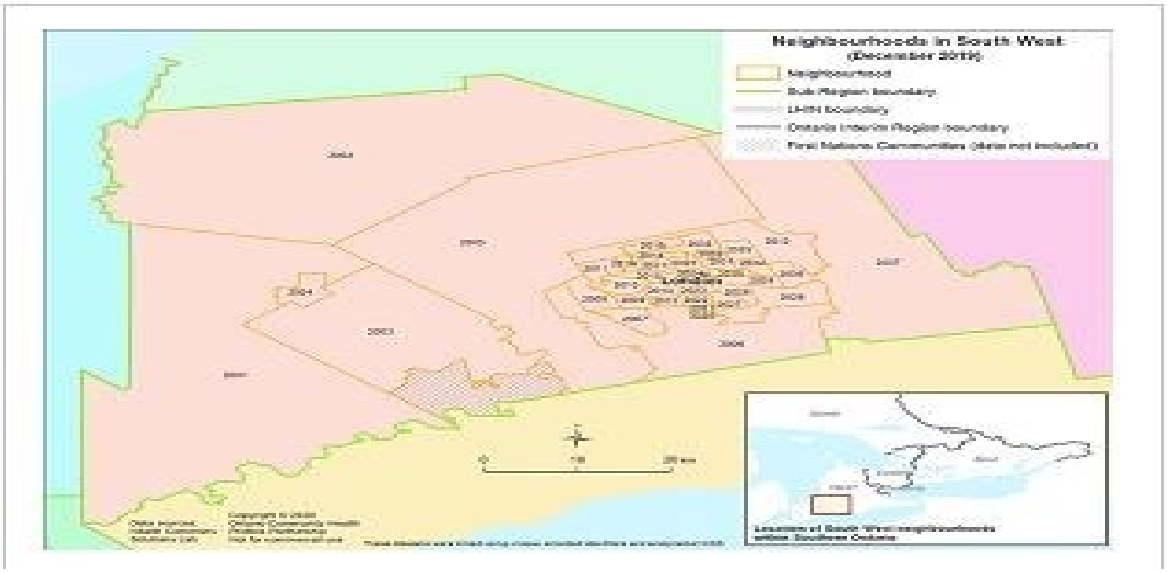

Figure 15: Multispecialty Networks of Southwest Ontario (Ontario Ministry of Health satellite image 2011)

5.5.1 Importance of Integration

Ontario health services are complex systems (Grudniewicz et al., 2018) that policy rhetoric often fails to acknowledge (Hoare et al., 2019). They argue that the system suffers coordination problems, inter-collaboration, and communication between providers (Lanham et al., 2013). In addition, successful and sustained physician networks also contain challenges rooted in technological uncertainties, ambiguous healthcare signals and embryonic competitive structures (Tao et al., 2010). Hence, effectively integrating technology and professionals into the time-pressured and high-risk healthcare environments is critical to innovation. Integration challenge is acute in healthcare, which is ripe with opportunity and a common target for innovation. Integration can empower innovation in healthcare; more importantly, technology integration has implications for direct patient care, efficiency, throughput, patient safety, teamwork, communication, and the perception of care (Bayramzadeh & Aghaei, 2021). It has become central to remaining responsive and agile in this changing landscape (Tinetti ME, Fried TR, 2012).

Integrated health systems are widely considered to provide superior performance in terms of quality and safety due to effective communication and standardized protocols. Integration can make healthcare units patient-centric and well-connected. With integrated patient records or EHRs, healthcare units can aid personnel in viewing the health status of their patients, identify gaps in care, and devise a strategy that aligns with patient needs. It promotes greater control and coordination throughout the entire continuum. Integration can also enhance efficiency and network performance. Different healthcare settings can be combined to ensure a hassle-free patient experience. By enabling supreme consistency across all areas of information and data management systems, integration systems can eliminate the dispersed and siloed nature of applications and data to extract insights on time, thereby saving millions of lives (MacNeil et al., 2019).

5.5.2 Improvements in Patient and Clinician Interaction

The survey outcome suggests that physicians believe that a viable integration of the system within the specialty locations will facilitate the creation of deeper patient relationships and encourage a greater personalization of care. Patients will receive the new system positively while noting that their providers are more attentive to their health. With the patient's permission, the providers will use the data accessible across the various components of the system to educate the patient about their intent for a regimen to enhance the likelihood of the patient following the guidance.

5.5.3 Improvements in Information Sharing

The integration of records can help to provide all care providers with access to all information generated for a patient across different care environments. This will enhance cooperation and communication among all included clinicians, internal and external, to the main hospitals across Ontario.

Family physicians emphasize the importance of more complete patient histories, which help reduce information processing tasks and duplicate tests because the physicians can determine what services were previously provided, view old lab results, and access documentation from the community and hospital physicians. In addition, local or community physicians would be able to track their patients in receiving more specialized care from the hospitals, contributing to a more robust physician-patient relationship because of their more comprehensive understanding of the care patients receive across the continuum of care.

5.5.4 Technology Integration

Technology integration is a commonly overlooked yet critical area (Bayramzadeh & Aghaei, 2021). For example, the association with the high-stakes nature of the patient condition and subsequent required technical innovations have made intensive care units (ICUs) and operating rooms (ORs) highly complex environments. In addition, eReferrals and eConsult services are multispecialty physician services that require integration. Any disruptions or interruptions to workflow and services can negatively impact the health system and threaten patient welfare on various levels. Thus, maintaining an efficient workflow under extreme conditions is vital for patient safety (Petrosoniak et al., 2019).

The current healthcare system is focused on acute care and is poorly aligned with the needs of patients. Integrating rural community physicians within the system offers hope for decreasing the rural/urban

disparity in care. More physicians may elect to practice in rural areas if an HIE is in place to link them to the more advanced medical cases and technologies of urban hospitals. Essentially, the use of information systems enables the customization of care to better suit the needs of each patient. This system represents a model for more efficient use of resources and management of information to improve the delivery and quality of care.

5.6 Interdependencies

Understanding innovation in a complex health system cannot be achieved by analyzing its parts independently (Holland, 1996). The interdependencies among the components of the system are critical to understanding innovation and system behaviour (Cilliers, 1998). The term interdependency is used here as an overarching phrase for collaboration, coordination, interactions and partnerships among parts of the healthcare system. Interdependencies are the structures and processes through which people interact, exchange information and interpret observations. Innovation is influenced by patterns of interdependencies (Kelso, 1995). Recognizing interdependencies among the individuals in an innovation initiative is vital for understanding how the initiative might evolve (Grudniewicz et al., 2018). Interventions that consider interdependencies have been shown to be more effective than interventions that do not (Leykum et al., 2010). Interdependencies influence how individuals organize to accomplish tasks and how they use and share information (Lanham et al., 2012). Interdependencies among healthcare stakeholders underlie innovation and influence performance. The degree of connectedness or interrelatedness among project team members can impact the uptake of an intervention.

The relationship between healthcare professionals and policymakers was the primary interdependency of interest in this case. In a departure from traditional adherence studies, this intervention did not focus on

medications but on the understanding and implementation of innovation based on a communication pathway between health professionals and policy-makers. I surmise that strengthening the relationship between health professionals and policy-makers with a novel communication channel can lead to additional and unanticipated positive results.

5.7 Summary

Analysis of the survey provided an ideal opportunity to deepen the understanding of innovation within the healthcare system. It shows that understanding innovation in a complex health system cannot be achieved by analyzing its parts independently. The interdependencies among the parts of the system and between the system and its environment are critical to understanding innovation and system behaviour. The evolving understanding of innovation as a process of activities raises new challenges. Though innovation is generally regarded as the outcome of a process of activities, these are by no means always succeeding in linear or top-down shape but involve several feedback loops.

Chapter 6. Discussion

The thesis argues that innovation is characterized by a high complexity that requires unorthodox thinking that should be socially accepted to succeed. Hence, to adequately understand innovation in the complex healthcare environment, an explicit conceptual framework that conceptually groups the key themes that delineate the features of innovation is critical. Moreover, because innovation occurs within the complex healthcare system, a theoretically informed framework provides a powerful tool to help conceptualize and understand these complexities. There is sufficient evidence drawn from the survey that healthcare professionals persistently seek knowledge that contributes to a better understanding of innovation approaches, specifically, why some efforts to implement evidence-based innovation succeed while others fail. This study responds to these calls and has identified additional embedded factors that enable a better understanding of innovation. These factors, which range from context to governance and health policies, are discussed below.

6.1 Context

Context is an influential component in understanding innovation (Dopson et al., 2008). It is considered the central construct in conceptual frameworks (Parshuram & Berta, 2020) for understanding innovation. It has been argued that the dominant factor in clinical effectiveness, practice development and successful outcome achievement (for example) is context – that is, how things are done around healthcare. I argue that context needs to be understood if meaningful and lasting change is to be achieved. Adopting humanistic values of individual self-worth and potential for self-understanding means that attempts to

change an organization's culture need to view the staff resource as central to such a strategy. Thus, the culture at individual, team and organizational levels creates the context for practice.

A knowledge-generating organization such as healthcare relies on the interaction between explicit knowledge and tacit knowledge (Mccormack & Rgn, 2002) to understand and implement innovation. Provincial policymakers need to develop ways of translating tacit knowledge into explicit knowledge without relying on traditional management procedures. Leadership and developing processes for continuous feedback on performance are crucial to such an endeavour. Innovative organizations require the full participation of workers, a stable workforce that can build trusting relationships, adequate technological support and inter-organizational networking.

Healthcare is a complex adaptive system, meaning that the system's performance and behaviour changes over time cannot be entirely understood by simply knowing about the individual components. Recognizing the effort devoted to understanding the dimensionality of the situational factors that affect innovation is essential. Situational factors include interdependent actors, networks, and institutions contributing to innovations in specific socio-technical regimes. Thus, context is vital to legitimizing the result of policy-making and strategies toward innovation broadly and not toward particular needs that would affect another function (Bergek et al., 2015).

6.2 Barriers and Policy Implementation

The study identified a variety of potential obstructions or barriers that can hinder innovation in the health system. These include poor communication, top-down dictates, workplace politics, a culture of risk aversion, and inadequate competencies in risk management and change management. Understanding innovation as a process of activities raises new challenges to healthcare. Though innovation is frequently

regarded as the outcome of a process of activities, these are by no means always succeeding in a linear or top-down shape but involve several feedback loops. Hence, disregarding feedback loops and collaboration with healthcare professionals at the system level can cause significant challenges to the innovation process. Another challenge to innovation is the nebulous specifics for legislation clearly outlining who is responsible for the data integrity of the medical record. That is, whoever maintains the data can utilize the data and can also be held accountable for actions based on erroneous data. A further factor that impacts innovation is the malpractice implications regarding the activities of the physician or medical personnel who services the patient based on the data in the organizational EMR or a jointly populated EHR.

The challenges of policy implementation in the health system were also clearly identified as a key health system weakness. For example, existing experience of health policy implementation has demonstrated that new policies have generated unexpected and sometimes adverse outcomes (Blomqvist & Colin, 2016). Policy implementation approaches that recognize these complex realities entail considerable local-level decision-making to be responsive to complex local needs, problems and circumstances (Hawkes et al., 2016). Innovation requires dynamic interventions based on decision-making at the clinical level to change people's behaviour (Rossi et al., 2010). Rather than command and control leadership, those at national and provincial levels should adopt policy implementation approaches that support and enable distributed leadership, that is, leadership across the health system.

Effective interventions, therefore, cannot all be standardized and routinized, for example, through clinical algorithms. Many require interaction with the broader community about the circumstances generating health needs and cross-sectoral action to tackle the root causes of barriers to innovation. Developing these

interventions and managing the networks of actors involved in implementing them requires clinical-level decision-making.

6.3 Leadership and Governance

One of the main factors frequently argued to impact innovation is leadership and governance. These are critical entry-point in strengthening health systems (Lebrasseur et al., 2002). Both management and leadership are important in health system development; however, more comprehensive experience suggests that the complex demands of bringing about change within health systems require leadership (Carter et al., 2013).

Governance is defined as policy guidance for the whole health system, coordination between actors, regulation of different functions, levels, and actors in the system, an optimal allocation of resources, and accountability toward all stakeholders (van Olmen et al., 2010). Although many actors influence governance, the province has a central role in ensuring equity, efficiency and sustainability of the health system. This requires a strong capacity at the Ministry of Health (MOH) and its decentralized structures. The health system is accountable to the population at all levels, from the individual provider toward the patient and from the MOH to the overall population.

The thesis argues that leadership is not an indulgence to pursue; instead, it's a vital aspect of strengthening the health system. There are two main reasons why leadership matters to current Ontario health system improvement and development initiatives. First, new efforts to enhance the health system, such as re-engineering patient care, introducing health initiatives or improving quality assurance, should recognize the complexity of policy implementation and the leadership it demands. Second, leadership is needed to

transform the health system's existing organizational structures and culture and to translate new policies into routine working processes.

6.4 Model for Understanding Innovation

The survey's analyses revealed that healthcare begins with recognizing and acknowledging that the governance frameworks and solutions of current health systems are no longer effective or adequate for future health systems (Benedict, 2015). Healthcare has focused predominantly on automating today's health systems, including digital enterprise infrastructure such as Electronic Medical Records (EMR) (Vayena et al., 2018). While these electronic infrastructures have been significant, efforts, to date, have not examined the transformation of care delivery to consumer-focused care. Adequately understanding innovation and its components can facilitate the transformation of care delivery. To this end, explicit conceptual models, frameworks, and taxonomies are needed to help practitioners manage key contextual factors influencing innovation. An important element of assessing and improving healthcare is a logical model that outlines the knowledge by which contextual factors drive innovation outcomes. The model below provides the components required to understand innovation.

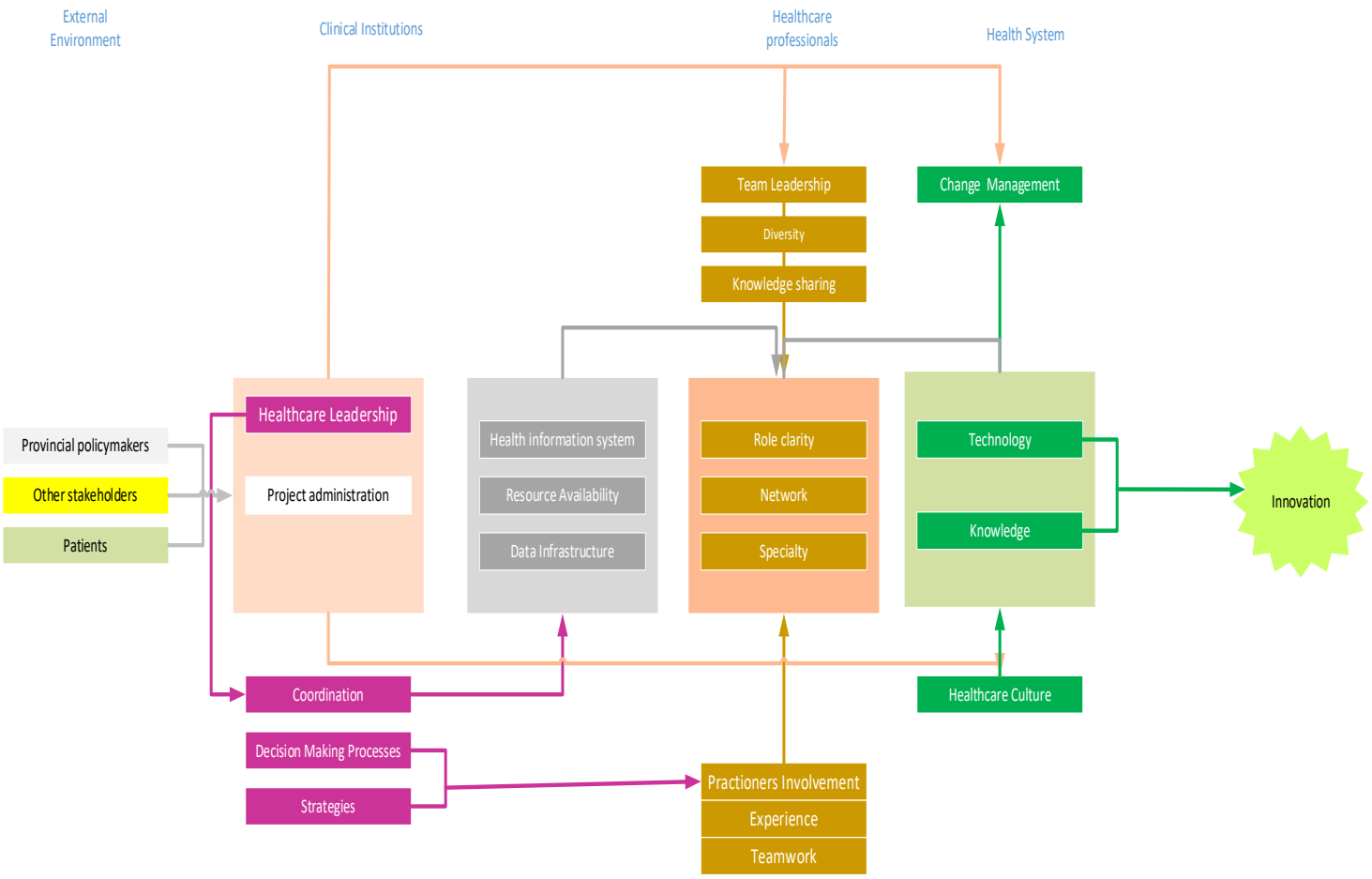

Figure 16:Model for Understanding Innovation

The model in Figure 16 shows that the core contextual features that include the external environment, clinical institutions, healthcare professionals, and the health system should be considered to get a better knowledge of innovation. These contextual features are organized based on the level of the healthcare system in which they are believed to operate, including the health system (green), clinical institutions (purple), and healthcare professionals levels (brown). In addition, factors relating to aspects of technology and knowledge (green) or characteristics such as leadership and teamwork team (brown) are identified as existing across system levels.

The model also depicts that leadership influences the success of innovation in healthcare. Leadership is a pervasive and essential theme throughout healthcare (Kaplan et al., 2012). Senior leadership directly impacts the required innovation strategy at the clinical level and guides resources and investment to support improvement. Leadership also sets the tone for effective project teams and health system leadership. Team leadership is important in a successful team functioning, and health system leadership is critical in establishing a culture supportive of innovation within the health system, developing capability and encouraging staff motivation to improve. Factors relating to technology support and knowledge are hypothesized to influence health system success. A system is a product of its parts and their interrelationships; any effort to better understand the context-sensitive nature of innovation requires attention to the interconnections among all contextual factors (Parsons, 2007).

6.5 Summary

The lack of unified theory has been noted as a significant gap and a critical challenge in understanding innovation in the health system(Samhan, 2015). Drawing insights from the survey, the study engaged this stated concern and sought to understand the desirability of the unified theory. Primarily, our findings also revealed no unified theory of innovation. Instead, it has been examined distinctly around a discrete set of issues related to change, people, policy-making, and technology in different healthcare organizations. This has resulted in diverse antecedents (around change, stakeholders, practice, and technology), varied conceptualizations and examinations of innovation, and different outcomes and strategies to understand how innovation is perceived. For example, innovation might result from a technological change in a large healthcare institution, but in a smaller setting, innovation might be driven primarily by physician-related issues only.

Chapter 7 Lessons Learned and Implications of the Research

This section discusses some key lessons learned. These lessons were gleaned from answers to the survey questionnaire and data from studies on innovation. Data and responses from the survey were organized by categories that ensured key information was not missed and helped to focus the discussion.

7.1 The Valued Knowledge of Innovation

Answers from the interviews demonstrated a growing interest in understanding how innovation processes can address current health system challenges. Healthcare constantly needs to adapt, learn, and develop to meet the needs of the elaborate healthcare environment; thus, innovation is increasingly seen as a critical capability for healthcare organizations to accommodate these needs. Understanding the dynamics of innovation in healthcare is not only essential to healthcare professionals but also for policymakers who tend to use innovation policy to stimulate efficiency and contain costs related to healthcare services.

Knowledge about innovation in healthcare is scarce (Øvretveit et al., 2012), and many studies on innovation in healthcare have focused on specific technologies and specific policies or stakeholders, e.g. physicians and patients (Oliveira et al., 2015). There are also enduring studies focused on conceptualizing the spread and implementation of innovations (May, 2013a). Innovation processes are complex and non-linear, requiring broader and more subtle system transformations (Lehoux et al., 2009). Therefore, implementing innovations in highly complex health systems requires bridging social and cognitive barriers of medical professionals and policymakers. Considering the above, I argue that the broader contexts of innovation processes and conditions for implementing and developing healthcare innovation need to be better understood.

7.2 Structure and Functional Dynamics

The fourth edition of the Oslo Manual (OECD/Eurostat, 2018) provides a universal definition of innovation that applies to this research. The value of using the Oslo Manual's broad definition of innovation is that it captures all types of innovation and, consequently, a comprehensive range of outcomes. It is a relatively simple matter for surveys to include questions to identify incremental and transformative innovation and hence support analysis of the inputs and strategies required for innovations of varying novelty and impacts.

Healthcare innovation can be characterized as implementing new or improved products – goods or services, processes, marketing methods or business models, policies, or organizational structures (OECD/Eurostat, 2018). Healthcare innovation aims to improve measurable healthcare indicators, including quality, health disparities, effectiveness, patient-centeredness, safety and timeliness, leading to better health outcomes. Health systems are complex adaptive systems (Essén & Lindblad, 2013) comprising interdependent actors (networks) whose activities contribute to the overall function of developing, diffusing and utilizing innovations (Carlsson & Stankiewicz, 1991) within the healthcare sector under the influence of institutional arrangements. Stakeholders in Health systems are individuals or organizations contributing directly or indirectly to healthcare innovation (Oliveira et al., 2015). Stakeholders sharing similar interests can self-organize in formal or informal networks to achieve common goals, such as sharing knowledge and experience or supporting institutional change (e.g. professional or patient organizations). Institutions can be regulative (e.g. laws and regulations), normative (e.g. practice guidelines), or cultural cognitive (e.g. common belief and product codes) (Scott, 2008).

7.3 Implication on Health Systems

New health technologies, referred to as the "application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve health problems and improve quality of lives," have exerted growing pressure on health system governance, raised significant social and ethical concerns and threatened the sustainability of health systems. As a result, healthcare professionals have increasingly voiced concerns about the uncoordinated diffusion of new medical technologies as "enormous challenges and needs confronting healthcare systems today that make the governance of innovation extremely complex." Given the complex policy issues raised by new health technologies, one may wonder why health services and policy researchers have not yet sought to synthesize what is known about system-level challenges that innovations should attend to in the first place. Health systems should be understood as open systems wherein interactions and shifting equilibriums occur(Fineberg, 2012). For adequate service delivery to unfold, "leadership and governance" should make available the right set of "resources," which include human resources, finances, infrastructure and supplies, knowledge and information systems. These key components should also adapt to shifting population needs and contexts and align with a set of values and principles.

7.4 Implications for Theory and Future Research

Two conclusions are drawn from evidence obtained from the survey and external research papers. The first is that in circumstances where the outcomes of transformation are less predictable (uncertainty) and where these activities involve many stakeholders and boundaries (communication complexity), empirical evidence shows that operational flexibility becomes more significant to the successful practice of innovation than formalization and control mechanisms. The second conclusion is that emphasizing

monitoring instruments on outputs (efficiency in process performance) and not outcomes (effectiveness, achievement of goals) can lead to insufficient knowledge and ceremonial performance of innovation. However, these arguments should not be perceived as rejecting process control mechanisms or conventional project management methods. In fact, the paper questions only the emphasis on process understanding and collaboration and proposes that these should be improved by embedding systemic constructs (causal connectedness). The responses from the survey expressed exactly that: not the absence of rigorous control but the complementarity of control with instruments that will provide more flexibility is required in contemporary innovation in healthcare.

7.5 Summary

This chapter discussed the lessons learned from the understanding and implementation of innovation in healthcare. The paper posits that the growing understanding of innovation as a process of activities is raising new challenges to healthcare. Although innovation is commonly regarded as the outcome of a process of activities, these are by no means consistently successful in linear or top-down form but involve many coordinated parts. Evidence shows that activities and steps are common for many innovation projects; however, the uncertainty of achieving results and completing a project with the required quality forces innovators to coordinate between the activities to improve the final solution.

Chapter 8 Conclusion and Future Work

This chapter summarizes the contributions of this doctoral research. I also discuss the study's limitations and recommend avenues of exploration for future research on this topic.

8.1 Contributions

This thesis offers an analytical and methodological approach to understanding innovation in the health system that involves introducing and integrating various forms of technology to support patient care. Technology is an inherent part of a complex health system where invasive and sophisticated care is required (Gillman et al., 2016). As such, effective and collaborative diffusion of technology into the physical environment of healthcare is critical. The motivation for the contributions is well summarized by the issues raised by Lehoux et al. (2014) “A “silo-ed” health system and silos between the departments that fund innovation and those that regulate it mean that new health technologies, procedures and regulations can be “pushed” onto health systems without an understanding of their usefulness or receptiveness from the healthcare sector. The current “patchwork of innovation policies” does not sufficiently address the innovation process. As a result, innovations that might improve healthcare delivery may be ignored while other technologies that do not enhance healthcare or service delivery for Ontario are developed. These challenges create a pressing need for system-level thinking and system-level transformation, including better linkages between policymakers and health sector experts. The contributions provide contextual solutions to these challenges to improve the understanding and implementation of innovation.

Innovation theory has been widely applied and deemed useful as a lens to re-think and re-frame a range of problems in healthcare (Tsasis et al., 2012). However, due to a lack of empirical evidence, its value in informing the design and implementation of healthcare initiatives and policies has been uncertain. Knowledge about innovation in healthcare is scarce (Øvretveit et al., 2012), and many studies on innovation in healthcare have focused on specific technologies and specific policies or stakeholders, e.g. physicians and patients (Oliveira et al., 2015).

This thesis builds on the existing literature by operationalizing innovation concepts to examine and understand the real-world implementation of innovation in the health system. The results provide preliminary evidence regarding understanding the dynamics of healthcare innovation, which is essential to healthcare professionals and policymakers who tend to use innovation policy to inspire efficiency and contain costs related to healthcare services. Many innovation studies encourage the use of flexible, bottom-up approaches to implement, lead, and evaluate healthcare initiatives and policies (Edgren & Barnard, 2012). This study supports this advice and highlights, particularly for integrated care policies, the importance of identifying core 'consistent elements' and developing feedback mechanisms to ensure knowledge and learning move upward and beyond policy control.

Secondly, the thesis presents a conceptual framework for understanding innovation in the health system by proposing a framework based on an interdisciplinary approach (i.e. drawing appropriately from several disciplines or fields of expertise within healthcare to redefine the understanding of innovation outside of normal boundaries and reach solutions based on a better understanding of complex situations). The framework articulates intervening variables that drive innovation in healthcare. Understanding and leveraging these factors determines the degree to which innovation can be disseminated within an

organization (Greenhalgh et al., 2004). A potential drawback of approaches to innovation that follow a solution-centric or technology-push path is that they may not capture all of the contextual dependencies and subtleties in relationships between various stakeholders, end-users and beneficiaries of the innovation, particularly when they are affected by factors that may be continually changing. This framework is extended as a general theory to discuss the cumulative understanding of innovation. The framework is also informative in that it frames the creation of a specific solution to a particular problem domain.

8.2 Answers to Research Questions

The thesis contributions and answers from the survey helped answer the four research questions raised in Section 1.2 as follows:

> *RQ1: How is innovation perceived and conceptualized by health experts and health administrators in Ontario?*

The discussion on the problem investigation in Chapter 2 showed that the current understanding of innovation is limited. Respondents argued that several components should interact within the healthcare environment to better understand and implement innovation. Respondents believe that interdependency is a key component of innovation. Healthcare experts perceived and conceptualized innovation as a process that facilitates social and technological change.

> *RQ2: Which factors influence the healthcare sector innovation process, including how innovation is driven?*

While most respondents were neutral on the factors influencing innovation, few argued that innovation is controlled from the top of the provincial chain. An example is the eConsult platform. This case challenges the underlying assumption that innovation has involved healthcare practitioners. The most common way

specialists initially heard about the eConsult service was through another specialist. While most respondents found eConsult a feasible way to improve access to specialist care, several respondents also offered suggestions to improve the platform, including enhanced formatting and a facilitated way to enclose educational resources with the consult.

RQ3: Where do the ideas for innovation come from?

While most respondents were neutral on this question, few believe the idea is usually at the provincial level, where healthcare professionals are rarely involved. For example, through a partnership with the Canadian Foundation of Healthcare Improvement, the Royal College of Physicians and Surgeons of Canada (RCPSC), the College of Family Physicians of Canada (CFPC), and Canada Health Infoway, seven provinces: BC, Alberta, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland and Labrador have established eConsult services provincially or in some regions. These involve different technology platforms, workflows and remuneration policies.

RQ4: How is the integration of different types of health information technology (e.g. EHRs, AI) into Ontario's healthcare system decided?

Integration is one of the main factors agreed by respondents to impact innovation. Respondents say integrated care interventions encourage linkages among professionals and services across the healthcare continuum to improve patient outcomes. For example, a respondent added that despite the increased effort to integrate care better, there is considerable variability in their success, and relatively little is known about the factors associated with successful implementation across healthcare. Regarding AI, respondents believe that the integration of the technology is decided at the policy level.

8.3 Limitations of the Research

It is evident that this research has made significant progress in the direction of high-quality knowledge of innovation; nonetheless, several research limitations may still require attention. The first limitation of this doctoral research was social distancing resulting from the COVID-19 virus. Most participants opted to provide answers to the survey instead of being interviewed in person or at their place of work. Secondly, Because I took an exploratory, in-depth, qualitative approach, a small number of the survey was examined. As such, while the insights gained might be transferable to similar contexts, they may not generalize to dissimilar ones. Therefore, to obtain the level of detail required, I selected healthcare professionals who were highly familiar with the concept of innovation.

8.4 Future Work

While the study identified significant theorization of the issues around understanding health system innovation, technology and interaction, it also revealed several fruitful areas of inquiry that need the attention of future researchers.

The Health System Itself: Aspects of the health system revealed that a system is to be understood as a set of interacting or interdependent entities forming an integrated whole. Traditionally, health systems have been composed of silos that create barriers between professions and organizations (Kharicha et al., 2005). There is a growing need to address this phenomenon and apply different theoretical discourses.

Decision Stages of Innovation: Research is required to assess issues related to defined stages in the innovation process, both for healthcare professionals and healthcare. The critical question is how factors such as attributes of innovation, characteristics of personnel, organizational structure, control processes, and context fit together within the innovation process. Are all variables equally crucial at all stages, or are

some variables primary factors early in the innovation process and others in subsequent stages? Are the directions of the observed relationships consistent, or do they vary by stages of the innovation process? Answers to these questions are particularly relevant to the development of intervention strategies, which are needed to provide the basis for more effective utilization of scientific information for understanding innovation.

Conceptual framework. A broader conceptual framework is needed to bring together relevant variables that affect innovation by healthcare professionals and healthcare organizations. This framework is particularly important in accounting for the organizational setting of clinical practice adoption processes, such as hospitals as the decision unit and physicians as the final adoption unit.

Electronic Data Interchange (EDI): Attention needs to be given to information channels so that the various communication channels may be specified in each stage of the decision-making process and the transfer of information. EDI is the computer-to-computer interchange of clinical documents in a standard electronic format between health systems and professionals. Greater attention needs to be given to the pattern of communication within healthcare and the effects of different patterns at various stages of the innovation process.

Longitudinal evaluation. Variables affecting innovation by healthcare professionals and healthcare itself need to be subjected to longitudinal assessment. This analysis will provide insight into causal relationships associated with innovation so that transformation strategies can be engaged based on rational choice rather than advocacy.

8.5. Conclusions

Evidence from the interviews suggests that Ontario's potential to create healthcare innovation is insufficiently exploited due to several mutually supporting restrictive mechanisms. By not systematically evaluating unmet clinical needs among healthcare professionals and patients, their ability to contribute to new, improved solutions remains untapped. In addition, a lack of understanding among healthcare management and policymakers of the uncertainties involved in innovation and the need to involve external parties with critical competencies can be a reason for the lack of a unified innovation strategy across healthcare and between academia, healthcare, and policymakers.

Developing a unified innovation practice could be strengthened by providing easily accessible digital platforms for knowledge development and diffusion. For example, a joint healthcare innovation strategy for academia and healthcare may enhance the inclusion of more competence fields for co-creating holistic healthcare innovations. Dismantling the linear way of innovation and encouraging flexible, bottom-up approaches are necessary to implement, lead, and foster healthcare initiatives and policies for healthcare innovation and opportunities for intra- and collaborative acumen in healthcare. In addition, A framework that summarizes and conceptually groups key themes to delineate key features of innovation should be adapted to create a more enabling environment for innovation. A systematic encouragement of healthcare professionals and patients needs articulation on both the demand and supply side is necessary for value-based healthcare. These findings have implications for designing effective provincial innovation policy by addressing identified restrictive mechanisms.

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Appendices

Appendix A: Sample contact email

Dear _____

Our research on innovation will help healthcare systems improve on the disconnect of how innovation is perceived between healthcare experts and provincial policymakers. To do this, this study, which is done as part of my Ph.D in Digital Transformation and Innovation at the University of Ottawa, will develop a theoretical framework that explains how the interactions between healthcare professionals and policy administrators can be amenable. The significance and outcome of this research would help provide the provincial health system with an innovation framework that can be used as a policy tool to encourage open communication, maintain a clear sense of direction and strategic vision, and establish a strong link between leadership actions and innovation.

The study will seek to identify how innovation occurs and is perceived: where the ideas come from, what methods are used by policymakers to support the development of the idea into an innovation, and how knowledge can be coordinated to foster innovation. These issues focus on collaboration processes, sharing knowledge, developing and implementing innovation and whether or not innovation is a 'top-down' process driven by policymakers or a lateral process based on coordination with healthcare experts, middle management, and front-line staff. The framework will allow reasoning about these relationships and measure compliance and performance using indicators.

The involvement we will require from you in this project is a series of meetings to:

a) Describe the extent to which innovation is strategically considered
b) Understand the interplay of conceptualization and social factors that shape innovation
c) Identify how the actors combine knowledge and legitimacy to new configurations and technologies
d) Solicit information on the perception of innovation, such as supportive and inclusive or a top-down process.
e) Validate the theoretical framework based on its usefulness in the introduction of new technologies.

Each meeting session would be for a maximum of 60 minutes. The sessions would take place via Zoom or at your workplace at a time convenient for you. If you are interested in participating or have questions or comments about the study, please get in touch with Amos Harris.

Thank you for your consideration and best regards

Appendix B – Consent letter

Title of the study: Understanding Innovation in the Ontario Health System: A Scoping Review and Survey of Ontario Healthcare Providers

Name of researcher:
Amos Harris, Doctoral Candidate Digital Transformation and Innovation, School of Electrical Engineering and Computer Science, University of Ottawa.
The project is being conducted independently from the organizations and agencies from which participants may be recruited.

Supervisors:
Prof. Craig Kuziemsky, Telfer School of Management, University of Ottawa. Phone: 613-562-5800 ext.6947, e-mail: kuziemsky@telfer.uottawa.ca, Kuziemskyc@macewan.ca
Prof. Pascal Fallavollita, Interdisciplinary School of Health Sciences, University of Ottawa. Phone: 613-562-5800 ext.3478, e-mail: pfallavo@uottawa.ca

Invitation to Participate: I am invited to participate in the above-mentioned research study conducted by doctoral candidate Amos Harris of the School of Electrical Engineering and Computer Science, University of Ottawa. Amos Harris is under the supervision of Prof. Craig Kuziemsky from the Telfer School of Management and Prof. Pascal Fallavollita from the Interdisciplinary School of Health Sciences, both at the University of Ottawa.

Purpose of the Study: The purpose of the study is to present the conceptual underpinnings of innovation and gain a better understanding of the dynamics of how innovation is conceptualized and applied in the provincial health system of Ontario. The study will seek to identify how innovation is initiated, where do the ideas come from, the methods used by policymakers to support the development of the idea into an innovation, and the barriers to health system innovation. The study will look at leadership behaviours, organizational climate, and strategies that influence innovation in the provincial healthcare system.

Participation: My participation will consist of two sets of meetings during the project's duration, each lasting not more than 60 minutes. The first set of meetings aims to provide a narrative of the extent to which innovation is strategically considered and conceptualized. The researcher will describe the concept of innovation and specify how it can be activated in an organization.
The researcher will provide participants with questionnaires on a series of questions focused on innovation and the methods used by management and policymakers to initiate innovation. The questionnaires will be answered anonymously. The identity of each participant will be safeguarded through codes or a combination of numbers and letters. In addition, the codes will be assigned to each participant to protect their identity and privacy.
I would describe how innovation projects work and provide information on developing and implementing innovation and whether or not innovation is a ‘top-down’ process driven by government policy or a ‘bottom-up’ or collaborative process involving middle management and healthcare experts.

I understand that the interviews will be audio-recorded, and I will have the opportunity to review my transcripts during the second meeting and make the necessary corrections. I will also have the opportunity to return any comments or feedback on my transcripts via email within two weeks if I am absent from the meeting. All edits, additions, and omissions made to the interview transcript will be documented.

Risk: Beyond the time needed to participate in this study, there are no known risks associated with my participation in this study greater than those I might encounter in everyday life. I have received assurance from the researcher that every effort will be made to minimize these risks by ensuring that the session lasts a maximum of 60 minutes for each meeting session by scheduling the sessions at a time convenient to me.
Benefits: My participation in this study will provide the researcher with experimental data that can be used to provide evidence of how innovation occurs - where do the ideas come from, what methods are used by policymakers to support the development of the idea into an innovation, and what are the barriers to health system innovation as it relates to transformation. The information provided would enable priority areas of focus and opportunities for continuous translation of innovation.

Confidentiality and anonymity: I have received assurance from the researcher that the information I will share will remain strictly confidential by communicating the study results in an aggregated manner (e.g., "half of the participants found that clinicians had no input in the development of innovation policies"). I understand that the contents will be used only for the improvement of innovation programs.

Anonymity: My anonymity will be protected by not recording my name or any identifiable information. If needed, data may be tagged with non-traceable numeric IDs.

Conservation of data: The data collected will be kept in a secure manner that will be accessed only by the researchers. The data will be kept by one of the supervisors for a period of 5 years in case of an audit.
Voluntary Participation: I am under no obligation to participate, and if I choose to participate, I can withdraw from the study at any time and/or refuse to answer any questions without suffering any negative consequences. If I choose to withdraw, all data gathered until the time of withdrawal will be removed.

Acceptance: I, (Name of participant) _____, having read and understood the above text and having had the possibility to ask and receive complementary information on the study, agree to participate in this study. If I have any questions about the study, I may contact the researcher or his supervisors. If I have any questions regarding the ethical conduct of this study, I may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room154, Ottawa, ON K1N 6N5.
Tel. :(613)562-5387
Email: ethics@uottawa.ca
There are two copies of the consent form, one of which is mine to keep.

Participant's signature :	(Signature)	Date:	(Date)
Researcher's signature:	(Signature)	Date:	(Date)

Appendix C – Meeting session protocol

Reminder on the use of this protocol: The activities in this protocol are to be followed in the order described below for each Key Informant. The time allocated for each meeting session is a maximum of 60 minutes. However, the time estimated for each meeting session may change from one Key Informant to another; this should be allowed, and Key Informants should not be rushed.

1. Consent form: At the first meeting with the participant, he/she is presented with the consent form and given a chance to ask any question or clarification before signing.
   1.1. If the participant declines to sign the consent form, thank him/her and end the meeting session.
   1.2. If the participant signs the consent form, continue the meeting session.

2. Meetings on innovation: The researcher would describe the concept of innovation. This includes:
   2.1. The definition of innovation
   2.2. The concept of innovation in the context of healthcare
   2.3. How innovation is perceived in the provincial health system
   The Key Informant would describe:
   2.4. How innovation is initiated
   2.5. The methods and culture that drive innovation
   2.6. whether or not innovation is a 'top-down' process driven by government policy or a 'bottom-up' or collaborative process that involves middle management and healthcare experts.
   2.7. The understanding and impact of the integration of artificial intelligence in the healthcare system

3. Meetings on the framework Validation: The researcher will present the theoretical framework. The participant will then be asked to anonymously answer pre-defined questions about his/her perception of innovation (See Appendix D).
   3.1. Questionnaire (20 minutes): The participant is given the "Questionnaire for Key Informant on process Validation" document and asked to answer the questions provided. Remind the participant that he/she can refuse to answer any question with which he/she is uncomfortable.
   3.2. The researcher should answer any question that the participant may have about the questionnaire or its individual questions.
   3.3. Conclusion. The researcher collects the "Questionnaire for participant on process Validation" documents from the participant and thanks the participant for his/her time.

Appendix D – Questionnaire for Participant on Innovation Culture and Leadership

Participant # _____

This questionnaire is to be answered anonymously. Please do NOT write in your name, but DO write your participant number. This project is being conducted independently from the organizations and agencies from which participants may be recruited.

All questions below should be answered based on the discussion of innovation in the healthcare system. Please do NOT base your answers on previous knowledge or expected features. To obtain accurate responses on innovation activities, a series of questions focused on how innovation occurs: where do the ideas come from, what methods are used by policymakers to initiate the development of the idea into an innovation, defined in terms of its "expected impacts on your section are listed below:

For each question below, circle the answer that best matches your opinion.

Question 1

Innovation is defined as introducing a new concept, idea, service, process, or product to improve treatment, diagnosis, education, outreach, prevention, research, and the long-term goals of enhancing the quality, safety, and outcomes efficiency and costs. Given this definition, would you say **this definition aligns with your perspective of innovation**?

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 2

Supportive culture: the innovation culture is supportive and includes professional clinical staff and the use of several advanced methods for innovating.
Given this definition, would you say **the culture of innovation is supportive**?

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 3

Top-down: innovation is driven by government policy at the provincial level and does not include clinical management and staff.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 4

Intuitiveness: would you agree that an inclusive innovation culture results in better innovation outcomes.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 5

Leadership: An essential component of leadership is establishing an organizational culture supportive of innovation. Given this definition, would you say **leadership** provides valuable support **for innovation?**

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 6

Innovation is supported by a principle of openness, risk-taking, learning, communication, and feedback.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 7

Bottom-up: innovation includes the active involvement of staff throughout the clinical hierarchy: encouraging new relationships, collaboration, learning and the sharing of knowledge, supporting people to take risks, and celebrating achievements.
Given this definition, would you say **bottom-up is actively fostered?**

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 8

My organization applies strategies to support innovation, such as using diverse information sources and methods for developing innovation, such as trial and error testing and user involvement in the design of services.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 9

Was there an innovation in the last two years that was abandoned or under-performed? Would you agree the original purpose of this abandonment/under-performance was (lack of various resources, risks, and resistance from staff)?

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 10

In the past two years, obstacles to innovation have involved lack of resources, lack of a supportive culture for innovation, risks and resistance from academic and professional staff, etc.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 11
Collaboration was involved in the initiation of innovation, and many section staff were involved in developing innovation.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 12
Open communication, a positive work atmosphere, and establishing a clear sense of direction and strategic vision are factors that drive innovation in your sector.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 13
The disconnect of how innovation is understood and rationalized between healthcare experts, healthcare providers, and policymakers can be problematic when it translates into a difference of opinion related to the value of the transformation.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Question 14
Design thinking: As part of developing innovation in the last two years, did your section conduct project user or focus groups with potential users of an innovation

Strongly Agree Agree Neutral Disagree Strongly Disagree

THANK YOU FOR YOUR PARTICIPATION!

Appendix E – Questionnaire for participants on the perception of innovation

Participant # _____

This questionnaire is to be answered anonymously. Please, do NOT write in your name, but DO write your participant number.

All questions below should be answered based on your perception of innovation and its impact on healthcare. Please base your answers on your experience of innovation in the healthcare domain.

Please be as concise and brief as possible.

Question 1

What describes your responsibilities?

Question 2

How do you perceive innovation in the context of healthcare?

Question 3

How would you describe the disconnect between provincial policymakers and healthcare experts as it relates to the implementation of innovation in healthcare?

Question 4

Do you believe that innovation not always reflective of the goals and needs of the healthcare system is pushed on healthcare staff?

Yes No

Question 5

If you answered “yes” to question 1, could you please briefly describe how

Question 6

If you answered “no” to question 1, could you briefly state why?

Question 7

Can you suggest the potential initiation of innovation in the healthcare system?

Question 8

The adoption of Artificial Intelligence has become a global race, and many countries are investing significant amounts of money into AI research and development – how would you describe Artificial Intelligence?

Question 9

The integration of artificial intelligence (AI) into the Ontario healthcare system is seen as a significant strategy to contain rising healthcare costs, support clinical decision-making, manage chronic disease burden and support our ageing population – how is integration decided?

Question 10

As part of the strategy of integrating innovation in the last two years, did your section

A. conduct project user or focus groups with potential users of an innovation",
   Yes No

B. test the 'ease of use of a planned innovation on a sample of potential users",
   Yes No

C. run a test pilot of the innovation" and
   Yes No

D. run post-implementation studies to identify or solve problems with an innovation".

Yes No

Appendix F: Source of Participants

Title of the study: Understanding Innovation in the Ontario Health System: A Scoping Review and Survey of Ontario Healthcare Providers

Name of researcher:
Amos Harris, Doctoral Candidate Digital Transformation, School of Electrical Engineering and Computer Science, University of Ottawa.

Supervisors:
Prof. Craig Kuziemsky, Telfer School of Management, University of Ottawa. Phone: 613-562-5800 ext.6947, e-mail: kuziemsky@telfer.uottawa.ca, Kuziemskyc@macewan.ca
Prof. Pascal Fallavollita, Interdisciplinary School of Health Sciences, University of Ottawa. Phone: 613-562-5800 ext.3478, e-mail: pfallavo@uottawa.ca

Sourcing participants: participants or respondents of this research will represent our target audience, which will effectively provide us with the feedback and answers we seek. The anticipated participants are considered to have general and specialist knowledge of the innovation process. Also, the participants to be recruited will be individuals holding management positions, considered as subject matter experts or decision-makers on policy development and implementation of innovation. In addition, they will be involved in creating or using indicators used to measure compliance with innovation.

How participants will be recruited: An email describing the research and its potential benefits to the respective provincial agencies and hospitals will be sent to contact persons responsible for innovation in agencies and hospitals in Ontario. The Executive Director of selected hospitals in Ontario will act as our contact and will be authorized to send this email on our behalf.

Recruiting Location: The goal is to recruit 30 participants in Ontario that indicate interest in the study. The study targets six nurses, doctors, provincial policymakers, hospital administrators, and IT staff members. Anticipated locations are:

- Department of Surgery – University of Ottawa
- Ottawa General Hospital
- Ontario Ministry of Health

Rationale for intended participants: The rationale for the intended number of participants is to obtain a better mix of professionals that will help me to better understand how innovation is conceptualized and perceived in the provincial health system. Moreover, qualitative analyses and typically the grounded theory suggest the recruitment of 15 – 30 participants. Due to COVID-19, the sample size of 30

participants is large enough to obtain enough data to sufficiently describe the research phenomenon, address the research questions, and attain saturation.

Participant rewards and incentives: Participants will not be directly compensated for their involvement in the project. However, the results from the project would provide participants with the knowledge of innovation projects that are often shaped by entrenched differences between vested stakeholders and groups who seek to inscribe their unique interests and meanings into an IT object. This understanding can be used by participants in relation to their expertise, which would lead to a situation where the perspectives and interpretations regarding change can become more and more cohesive and less fragmented.

Appendix G – Interview Guide

Introduction

1. Greetings
   1.1 Introduction of the Principal Investigator
   1.2 This interview is being conducted to get your input about implementing innovation. I am especially interested in your perception and understanding of innovation.
   1.3 This project is being conducted independently of your organization/agency.
   1.4 If it is okay with you, I will be audio recording our conversation. The purpose is to get all the details of the conversation. I assure you that all your comments will remain confidential. I will compile a report containing all participants' comments without reference to individuals. If you agree to this interview and the audio recording, please sign this consent form."
   1.5 If the participant refuses to sign the consent form, thank him/her and end the meeting.
   1.6 If the participant signs the consent form, continue the meeting session.

Confidentiality

2. All information collected during the course of this project will be kept safe and secret.

3. Study identifiers
   3.1 The principal investigator will not use your name or any other identifying information, and any information that you provide will only be used for research purposes.
   3.1 Participants are reminded that they can refuse to answer any question with which they are uncomfortable.

Interview guide

4 The PI will describe the concept of innovation, including its definition and then ask the following questions:
   4.1 How do you perceive innovation in the context of healthcare
   4.2 Would you please describe how innovation is initiated in your organization
   4.3 How involved are you with the introduction of innovation in your organization
   4.4 How would you describe artificial intelligence
   4.5 How do you consider the integration of artificial intelligence (AI) into the Ontario healthcare system
   4.6 Describe the methods and culture that drive innovation in your organizations
   4.7 Do you agree that innovation is a 'top-down' process driven by government policy or a 'bottom-up' or collaborative process that involves middle management and healthcare experts?
   4.8 How will you describe the disconnect between provincial policymakers and healthcare experts as it relates to the implementation of innovation in healthcare?

4.9 Questionnaires are emailed to participants.

5 Meeting 2 - Process Validation

Participants will not be obligated to attend the second meeting. The decision to participate will be voluntary and based on a participant's availability.

5.1 Participants are provided with the transcribed version of their answers to validate for clarity and accuracy of the data collected.

5.2 Participants are presented with a theoretical framework of innovation by the PI based on answers provided on the questionnaire.

5.3 The PI answers any question that the participant may have about the questionnaire or its individual questions.

Conclusion/closing statement:

Thank you for sharing your perception and understanding of innovation in the Ontario health sector. In keeping with the consent agreement, the personal and confidential information you provided will not inadvertently or advertently be disclosed. For more accurate data collection, the participants' responses will be transcribed using qualitative data analysis (QDA) software and or manually transcribed by the researcher and emailed to participants for clarity and accuracy of the data collected. Any correction or update on data collected will be effected appropriately.

Appendix H – Thematic Analysis

Title of Journals	Authors	Publication	Category	First Pass (focused Theme)	Second Pass (Perceived Theme)	Chosen Theme
A Swiss Health Care Professionals' Perspective on the Meaning of Interprofessional Collaboration in Health Care of People with MS—A Focus Group Study	(Schmid et al., 2021)	International journal of environmental research and public health	Interprofessional Collaboration	The ability of healthcare professionals to work together and contribute to primary healthcare.	Work together and understand	Collaboration
Collaboration and trust in healthcare innovation: The eDiaMoND case study	(Jirotka et al., 2005)	Computer Supported Cooperative Work (CSCW)	Collaboration and Trust	The collaboration of clinical partners can provide a detailed understanding of work practice	collaboration of clinical partners	Collaboration
The impact of collaboration strategy in the field of innovation on the effectiveness of organizational structure of healthcare institutions	(Grynko et al., 2020)	"Knowledge and Performance Management"	Collaboration strategy	A Collaboration strategy can foster collaboration and implement activities that promote the exchange of information and skills.	Exchange of information and skills	Collaboration
Going far together: Healthcare collaborations for innovation and improvement in Canada.	(Verma et al., 2013)	International Journal of Healthcare Management	Shared Information	Collaboration increases linkages and the sharing of information across communication channels for improvement	sharing of information across communication channels	Communication channels
Collaboration for continuous innovation: routines for knowledge integration in healthcare	(Markowski & Dabhilkar, 2016)	International Journal of Technology Management	Specialists Collaboration	Collaboration between specialists entails combining "their core knowledge with crucial insights in other areas when they test and probe and adjust their initial solutions	combining " core knowledge with crucial insights	Collaboration
E-Health innovations, collaboration, and healthcare disparities: developing criteria for culturally competent evaluation.	(Bacigalupe et al., 2013)	Families, Systems, & Health	Partners Collaboration	Collaboration between users and creators and partners and creators includes sending suggestions about message content	sending suggestions about message content	Collaboration
Innovation in healthcare, innovation in law: Does the law support interprofessional collaboration in Canadian health systems	(Ries, 2016)	Osgoode Hall LJ	Team-based Collaboration	Collaboration in health care describes a model of practice in which multiple health professionals work together in a team-based approach to patient care.	Multiple health professionals working together	Collaboration
A model and typology of collaboration between professionals in healthcare organizations	(D'Amour et al., 2008)	BMC health services research	Professionals collaboration	Collaboration is based on the premise that professionals want to work together to provide better care. At the same time	professionals want to work together	Collaboration
Interprofessional, learner-driven collaboration for innovative solutions to healthcare delivery in student-run clinics	(K. Chen et al., 2020)	Journal of Interprofessional Care	Institutional collaboration	Information exchange and collaboration between clinics and professionals are inefficiently facilitated by the existing platform	information exchange and collaboration	Collaboration
Improving population health through collaboration and innovation	(S. Green et al., 2014)	Population Health Management	Coordination	Sharing information among health care providers across settings to improve care coordination, avoid duplication of services, and reduce medical errors;	Information sharing	Sharing
Collaboration for clinical innovation: a nursing and engineering alliance for better patient care	(Andrews et al., 2020)	Journal of Research in Nursing	Interprofessional Collaboration	Collaboration demonstrates the benefits of a multidisciplinary team for generating a specification and reaching an effective design	Sustainability and Transformation Partnerships	Partnerships

				with Sustainability and Transformation Partnerships.		
Knowledge translation in tri-sectoral collaborations: an exploration of perceptions of academia, industry and healthcare collaborations in innovation adoption	(Ii et al., 2018)	Health Policy	Interprofessional Collaboration	Collaboration has the potential to combine knowledge management, capacity building and linkages between varied professional groups	linkages between varied professional groups	Collaboration
Sustaining innovation: Collaboration models for a complex world	(MacGregor, et al.,2012)	Springer New York	Interprofessional Collaboration	collaboration enables different groups to work together fruitfully over the long term to overcome multiple, often competing, agendas	work together fruitfully over the long term	Collaboration
Implementation of Innovative attitudes and behaviour in primary health care by means of strategic communication: a 7-year follow-up	(Morténius et al., 2012)	Journal of Evaluation in Clinical Practice	Professional Collaboration	Strategic communication established by communication channels plays an important role in creating innovative attitudes and behaviour among primary care professionals.	Creating innovative attitudes and behaviour among primary care professionals.	Communication channels
Value capture practices in cross-sectoral innovation collaboration in healthcare	(Alalääkkölä et al., 2021)	The International Society for Professional Innovation Management (ISPIM)	Interprofessional Collaboration	collaboration necessitates embracing different motivations, goals, and ways of operating – including those related to value capturing and interactions of public-sector organizations and clients	capturing and interactions of public-sector organizations and clients	Interactions
Enabling communication and cooperation in bio-nanosensor networks: toward innovative healthcare solutions	(Agoulmine et al., 2012)	IEEE Wireless Communications	Interprofessional Collaboration	With communication capabilities, NMs can exchange information and collaborate to enhance functionalities.	Information exchange and collaboration	Collaboration
Collaboration in Health Care	(Morley et al., 2017)	Journal of medical imaging and radiation sciences	Interprofessional Collaboration	collaboration demonstrates improved sharing of evidence-based practices between professions, improved decision-making, and increased innovation	improved sharing of evidence-based practices between professions	Sharing
Data interoperability and multimedia content management in e-health systems	(Masud et al., 2012)	IEEE Transactions on Information Technology in Biomedicine	Multimedia content	Exchange health data to provide better services to the patients. Data interoperability is required to exchange heterogeneous data among Health service providers.	Exchange health data to provide better services to patients	Exchange
Digital health and the state of interoperable electronic health records	(Shull, 2019)	JMIR medical informatics	HIT	A well-known lack of interoperable electronic health records & other technology makes implementing remote patient monitoring products extremely complex	lack of interoperable electronic health records & other technology	Interoperability
Integrated care with digital health innovation: pressing challenges	(Pant et al., 2022) .	Journal of Integrated Care	Digital health	In the context of digital health and integrated care, interoperability can be understood as different health information systems or software applications ability to communicate and exchange information consistently and effectively.	Different health information systems or software applications ability to communicate	Interoperability
The Emergence and Dynamics of Electronic Health Records–A Longitudinal Case Analysis of Multi-Sided Platforms	(Stegemann & Gersch, 2021)	Proceedings of the 54th Hawaii International Conference on System Sciences |	Digital health	Interoperability is an essential precondition for exchanging data. The digital platform should be able to achieve	A precondition for exchanging data	Interoperability

from an Interoperability Perspective				direct network effects through standards and interfaces.		
Interoperability opportunities and challenges in linking mhealth applications and eRecord systems: Botswana as an exemplar	(Ndlovu et al., 2021)	BMC medical informatics and decision making	Mhealth	Interoperability utilizes standards, interfaces and protocols to connect systems using appropriate techniques, methodologies and legislation.	Standards, interfaces and protocols to connect systems	Systems connection
Designing interoperable healthcare services based on fast healthcare interoperability resources: Literature review	(Nan & Xu, 2023)	JMIR Medical Informatics	Health system	It is critical to improving interoperability—that is, 'the ability of health information systems to work together within and across organization boundaries in order to advance effective delivery of healthcare.	Health information systems work together within and across organizational boundaries.	Work together
A Framework for eHealth Interoperability Management	(Katehakis & Kouroubali, 2019)	Journal of Strategic Innovation and Sustainability	Digital health	The aim of interoperability with regard to EHR exchanges is to allow for the consistent processing of information in a way that the recipient can meaningfully interpret communicated information.	Processing of information consistently in a way that the recipient can meaningfully interpret communicated information	Communicate information
Electronic health records, interoperability and patient safety in health systems of high-income countries: a systematic review protocol	(E. Li et al., 2021)	BMJ open	Health system	The lack of interoperability is often cited as one of the many significant shortcomings for the ability of health technology to work together.	Significant shortcomings for the ability of health technology to work together	Technology working together
Healthcare IT Transformation: Bridging Innovation, Integration, Interoperability, and Analytics	(Dodd, 2016)	CRC Press	HIT	Introducing new approaches to meet the challenges of integration, scale, and event through coordination of information systems, linkage coordination, and health ecosystem security, privacy, and consent.	Meet the challenges of integration through coordination information system linkage.	System linkage
Understanding health information technology adoption: A synthesis of literature from an activity perspective	(Sun & Qu, 2015)	Information Systems Frontiers	HIT	Collaborative use of the system among professionals at clinics and pharmacies	collaborative use of the system	Collaboration
Establishing a multidisciplinary initiative for interoperable electronic health record innovations at an academic medical center	(Kawamoto et al., 2021)	JAMIA open	Health system	Healthcare Interoperability allows digital innovations to be seamlessly integrated through standard application programming interfaces (APIs)	Seamlessly integrated through standard application programming interfaces	Integrated
Transformational leadership and shared governance: an action study ANITA	(Bamford-Wade & Moss, 2010)	Journal of Nursing Management	Leadership	Working synchronically with the workforce for the fundamental transformation or rethinking of structures, processes, values and ideals for something better.	rethinking of structures, processes, values and ideals for something better	Governance
Analysing Health Systems To Make Them Stronger	(Ye et al., 2019)	Studies in Health Services Organisation & Policy	Health system	Governance, the policy guidance to the whole HS, coordination between actors and regulation of different functions, levels and workforce in the system	Policy guidance to the whole HS	Guidance
Building integrated, adaptive and responsive healthcare systems – lessons from paramedicine in Ontario, Canada	(Allana et al., 2022)	BMC Health Services Research	Health system	Develop guidance, legal and regulatory allowances for ongoing local experimentation	guidance, legal and regulatory allowances for experimentation	Guidance

The essence of governance in health development	(Kirigia & Kirigia, 2011)	International Archives of Medicine	Health development	Governance and workforce in health development are critically important for the achievement of health goals.	Critically important for the achievement of the health goals.	Governance
Leadership and governance within the South African health system	(Gilson & Daire, 2011)	South African Health Review	Health system	Governance is needed to transform the existing organizational structures and culture of the public health system in particular and translate new policies into routine ways of doing business within the system.	Transform the existing organizational structures and culture of the public health system.	Governance
Digital Health: A Framework for Healthcare Transformation	(Snowdon, 2020)	HIMSS	Digital health	Governance and workforce is the vision and system-level strategy to guide the implementation of digital health across global health systems. Governance ensures the policy and regulatory environment of health systems guards privacy.	Vision & system-level strategy	Governance
Governance in health workforce: how do we improve on the concept? A network-based, stakeholder-driven approach	(Lim & Lin, 2021)	Human resources for health	Health system	Governance drives adaptability, resiliency and efficiency within the health system, ultimately spearheading progress toward people-centred care and universal health coverage	Spearheading & people-centred care	Governance
Human resource governance: what does governance mean for the health workforce in low- and middle-income countries?	(A. D. Kaplan et al., 2013)	Human resources for health	Health system	Governance provides strategic vision and direction to define priorities and expected roles of health system actors.	Strategic vision and direction to define priorities and expected roles of the health system	Governance
Improving health workforce governance: the role of multi-stakeholder coordination mechanisms and human resources for health units in ministries of health	(Martineau et al., 2022)	Human resources for health	Health system	Governance includes rules (both formal and informal), roles and responsibilities for collective action and decision-making in a system with diverse stakeholders.	Collective action & decision-making	Decision-making
Health workforce governance in Italy	(Vicarelli & Pavolini, 2015)	Health policy	Health policy	Fostering close cooperation among a wide range of stakeholders, including associations of not only professionals but also citizens	Close cooperation among a wide range of stakeholders	Governance
Big data: the next frontier for innovation in therapeutics and healthcare	(Issa et al., 2014)	Expert review of clinical pharmacology	Data & Analytics	Utilizing data management and strategies can improve the efficiency of research and clinical trials, identify and develop new effective medicines quickly and shape new ideas for physicians to meet the promise of personalized medicine.	Develop new effective medicines and shape new ideas	Data Management
Requirements of Health Data Management Systems for Biomedical Care and Research: Scoping Review	(Ismail et al., 2020)	Journal of medical Internet research	Data & Analytics	Improving the quality of patient care and enhancing the data access ability in real-time, thereby creating a diverse set of health technology	Enhancing data access ability in real-time	Data Management
New emerging capabilities for managing data-driven innovation in healthcare: the role of digital platforms	(Pietronudo et al., 2022)	European journal of innovation management	Data & Analytics	Data-driven digital platform can revolutionize established practices in healthcare, accelerate research and innovation and overcome challenges related to healthcare data.	Accelerate research and innovation	Data Management strategy

Big data management in healthcare: Adoption challenges and implications	(Chen et al., 2020)	International journal of information management	Data & Analytics	Data management tools and methodologies can improve operational and strategic capabilities.	Improve operational and strategic capabilities	Data Management
Big Data in Healthcare Management: A Review of Literature	(Castiglione et al., 2013)	Seventh International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing	Health data	Easy and quick management of all aspects of data regarding a patient, not necessarily medical.	Management of all aspects of data	Data Management
Multi-sided platform and data-driven care research	(Fürstenau et al., 2021)	Electronic markets	Health data	digital multi-sided platforms improve intersectoral and interprofessional collaboration among diverse stakeholder groups, with an emphasis on data	Intersectoral and interprofessional collaboration	Collaboration
POSB319 Predictive Analytic Techniques and Big Data for Improved Health Outcomes in the Context of Value-Based Health Care and Coverage Decisions: A Scoping Review	(Miracolo et al., 2022)	Value in health	Health system	Data management & analytics techniques allow the analysis of large digital data, together with increasing research for the adoption of technological tools.	Analysis of large digital data,	Data Management & Analytics
Disrupting health care through big data and predictive analytics	(Rose & Burgin, 2014)	Managed Care Outlook	Health system	Demonstrates a measurable and positive impact on health plans by analyzing data for new advancements in technologies.	Managing data for new advancements in technologies	Data Management
Using predictive analytics and big data to optimize pharmaceutical outcomes	(Hernandez & Zhang, 2017)	American Journal of health-system pharmacy	Health system	Predictive analytics that leverages big data will become an indispensable tool for clinicians in mapping interventions and improving patient outcomes.	Mapping interventions	Data Management
Connected Health Innovation: Data Access Challenges in the Interface of AI Companies and Hospitals	(Kemppainen et al., 2019)	Technology Innovation Management Review	Health Data	Strategy that assumes data availability as a central part of network orchestration to drive innovation	Network orchestration,	Data Management

Appendix-I Excerpts of Participants' Response

Question	**First Pass (Focused Codes)** Excerpts from participants	**Second Pass (Perceived Theme)**	**Chosen Theme**
How do health experts and administrators understand and perceive innovation in Ontario?	Using new technologies and ideas to make healthcare more efficient (e.g. e-Referrals)	New technologies and ideas	New ideas
Suggest the potential initiation of innovation in the healthcare system	Innovation initiation happens in both top-down and bottom processes in healthcare	Both top-down and bottom processes in healthcare	Top-down
Is the innovation culture within the healthcare system supportive and entails the involvement of healthcare professionals	Top-down innovation often doesn't involve people in healthcare until the end stages and doesn't account for practitioners' viewpoints (e.g. eConsult)	Non-practitioners' point of view (e.g. eConsult)	eConsult
Which factors influence the healthcare sector innovation process, including how innovation is driven?	Innovation is controlled from the top of the provincial chain & challenges the assumption that innovation has involved healthcare practitioners.	Innovation is controlled from the top.	Top-down
How is the integration of health information technology (e.g. AI) into Ontario's healthcare system decided?	Integrated care interventions encourage linkages among professionals and technology – e.g. eReferrals and eConsult are multispecialty physician services that require integration.	eReferrals and eConsult require integration.	eReferrals
Open communication, a positive work atmosphere, and establishing a clear sense of direction and strategic vision are factors that drive innovation in your sector.	Agreed: a positive work atmosphere, establishing a clear sense of direction and strategic vision	Positive work atmosphere and strategic vision	Communication
How would you describe Design thinking in health system innovation?	A problem-solving approach characterized by the empathetic lens through which designers integrate the perspectives of end-users and key stakeholders during the entire process of developing solutions	Problem-solving characterized by empathetic lens	Problem-solving
Where do the ideas for innovation come from?	The ideas are usually at the provincial level, where healthcare professionals are rarely involved.	Healthcare professionals are rarely involved.	Top-down
How is innovation perceived and conceptualized by health experts and health administrators in Ontario?	Interdependency is a key component that helps-conceptualize innovation as a process that facilitates social and technological change.	Interdependency and the facilitation of social and technological change.	Interdependency
Would you describe Collaboration as a driver of innovation at the clinical level?	Collaboration sparks innovation in healthcare. Everyone brings unique knowledge and skills and embraces differences to birth new ideas by blending unique viewpoints.	Embracing differences to birth new ideas by blending unique viewpoints	Collaboration
What would be described as obstacles to innovation?	The lack of resources, supportive culture and resistance from academic and professional staff.	Lack of a supportive culture and resistance	Resistance
Do you perceive leadership as an essential component of innovation?	Leadership is an integral component of innovation – it establishes a culture supportive of innovation.	Establishes a culture supportive of innovation.	Supportive culture
Was there an innovation in the last two years that was abandoned or under-performed? Would you agree the original purpose of this abandonment/under-performance was (lack of various resources, risks, and resistance from staff)?	Agreed: our region tried to implement eReferral (being able to easily refer from a toolbar in our EMR rather than faxing to clinics); however, there were barriers to getting enough clinics onboard to refer to, so this is no longer used in our practice.	Implement of eReferral	eReferral
As part of the strategy of integrating innovation in the last two years, did your section conduct project user or focus groups with potential users of an innovation	Neutral, but integrating technology within the health system solves inefficiencies. Technology integration can improve the patient experience, enhance communication, and enable better data analytics,	Integrating technology solves inefficiencies.	Integration & technology