THE WALLED GARDENS OF HEALTHCARE

A Systemic Analysis Of the Quanti-viable Future

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Author's Declaration

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Abstract

Connected health for a seamless care experience for health-seekers

The disruption to healthcare caused due to the bottom-up adoption of mobile technologies has brought forth signals of health seekers managing their own health. Propelling this movement forward is the consumer technology sector's growing interest in health care. By realizing an unmet need for health management tools, direct-to-consumer technology products and services are targeted at those who prefer to supervise their own health. However, their efforts have had limited success in integrating with the actual needs of the health care providers or physicians that rely on clinical data for diagnosis and disease management. Adding to this, there is an increasing demand for systems that can connect clinical data with extra clinical data platforms to bridge the continuity gaps in patient care.

This research uses Brenda Dervin's sense making methodology as a framework for introspection into the current system and extrospection of the emergent environment for the drivers of this change in the health data landscape. Through a systemic analysis, current challenges and barriers that limit the integration of extra clinical platforms with clinical platforms have been brought forth to highlight points of intervention. Foresight tools and methodologies have been employed to explore future strategies, within the areas of opportunities that can be utilized to bridge the currently disconnected worlds of health data. Through expert interviews and literature reviews, the aim was to identify key stakeholders and analyze their needs to build criteria and determine the success of these future strategies. The two-pronged approach is a means to base the design interventions and maximize the impact of strategies built around the principle of holistic experience of care for health seekers and patients.

By identifying the scope and the scale of the current health data landscape, criteria for the design of the connected health system was based on the existing principles of the Canada Health Act; allowing them to be grounded on the Canadian values of equality and solidarity, simultaneously calling for a reflection needed to expand and revolutionize the present scope. The strategic recommendations aim at instilling tolerance and a culture of innovation; devising comprehensive incentive models for physician-provider compensation that allow for the successful implementation of out-patient strategies; and formation of a digital health governance model through the creation of a unique digital health identity. The design principles and strategic recommendations are proposed to bridge the disconnected health data worlds and provide a seamless care experience to health seekers and patients.

Keywords
digital divide, interoperability, health data platforms, extra-clinical data, clinical data, systems analysis, foresight, quantifiable data, digital health, connected health

Acknowledgements & Dedication

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Dedication
Through this MRP, I pay homage to the memories of the time spent with my two grandfathers, The Communist & The Capitalist, who in their death made me understand the importance of self-managing care, foresight, and health.

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Preface

An Apple a day ...

"... an utterly insignificant little blue-green planet whose ape-descended life forms are so amazingly primitive that they still think digital watches are a pretty neat idea." - (Adams, 1980)

The initial spark for the project was the researcher's superficial interest in obtaining an Apple watch. After the failure to procure one due to affordability issues, arising out of maintaining a graduate student experience, the researcher instead decided to explore other low hanging fruits. However, before eventually giving up her quest for a quantifiable existence, the researcher in conjunction with Lindsay Roxon, a fellow student at OCAD University, realized an expanding market for wearable devices and fitness monitoring mobile applications. Large consumer technology companies were venturing into healthcare (Farr & Oreskovic, 2015) by targeting their platforms and products to measure wellness and health related data.

Furthering this interest in the topic were reports, published by, the Institute for the Future - Booting up mobile health from medical mainframe to distributed intelligence (Liebhold, Maguire & Townsend, 2009) and The Future of Science, Technology, and Well-being 2020 (Institute for the Future, 2010) that formed the basis of looking at the future of digital health. The researcher's professional work with various stakeholders from the healthcare sector led to the awareness of a developing need for successful outpatient strategies for disease management. As a means of not spiraling out of control, the researcher on the guidance and support from her academic supervisor, Helen Kerr, chose to minimize the scope. These boundaries were defined over a dinner table discussion with family members, who also happen to be primary care physicians across North America, who informed the researcher about the drawbacks of existing Electronic Medical Record (EMR) platforms (see lexicon) and the pains they experience dealing with technology while catering to the needs of their patients.

Over the course of the project, the researcher realized that, although there are signals in the Canadian healthcare environment about empowering patients and shifting the burden of care to the health seeker (see lexicon), this change like most things in health care, is going to be slow and incremental. Hence, the need for the two-pronged approach, with one aspect looking at the current systemic barriers while the environmental scan helps inform about the necessity for a transformation from the current perspective and looking at the future.

The researcher would like to acknowledge the fact from the onset of the report that the Canadian health care system, unlike many others in the world, strives to tirelessly work towards the betterment of its people and all the stakeholders in the system. The research, though originally envisioned out of the researchers shallow needs and hypochondriac subsistence, has evolved, much like the researcher, to embrace the complex world of health data and disease management; realizing a system working towards overhauling their outlook for innovation and design, at the same time placing the patients and health-seekers needs at the forefront of their strategic decisions.

Foreward

A journey into
abductive sense making

"… the human, a body-mind-heart-spirit living in a time-space, moving from the past, in a present, to a future, anchored in material conditions; yet at the same time with an assumed capacity to sense make abstractions, dreams, memories, plans, ambitions, fantasies, stories, pretenses that can both transcend time-space and last beyond specific moments in time-space. This portrait of the human subject… mandates positing as possible fodder for sense-making not only thoughts and ideas, observations and understandings, but emotions, and feelings, dreams and visions, pretenses and illusions, connections, and disconnections." (Dervin 2003)

Sense making is an action-based process of building connections among people, places, and events by constructing a hypothesis grounded in evidence and integrated experiences of the world-view; in an effort to act effectively on the foreseen path. (Dervin, 2003) (Klein, Moon & Hoffman, 2006) (Kolko, 2010) As a communicative framework, the sense-making journey enables the subjects and the researchers to reflect on the purpose and motivations for their research.

In an effort to effectively hypothesize and then synthesize the information, the framework that was applied for the purpose of this research was Dervin's Sense-making Methodology (SMM). Developed by Brenda Dervin, the sense making practice encompasses a meta-theory, methodology, and a series of research techniques (Dervin, 2003). SMM allows design researchers a rigorous and descriptive method for interviewing and discerning experience patterns while also mapping to a theoretical framework that guides analysis of participant data and assessment of its meaning. It is a highly explored social sciences method for understanding human experiences with technology, services and information practices in learning,

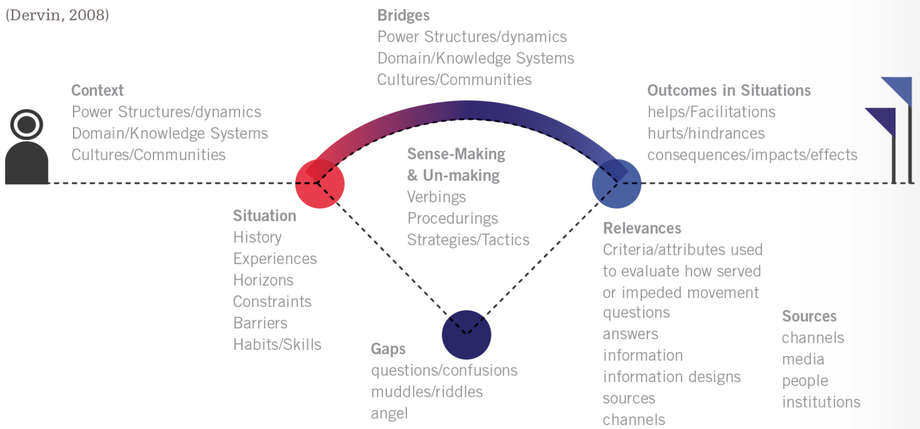


Fig.01 | Brenda Dervin's Sense making Methodology Sources - (Cheuk & Dervin, 2011) (Dervin, 2008)

self-informing, and understanding another's life world experience. The distinctiveness of this practice in experience research arises from its research base that supports both a methodology (the framework and philosophy) and the use of a collection of techniques for its implementation in the field. (Jones, 2013)

Through the interpretive nature of the SMM process, the project investigates the approach to inferring data, problem solving, and understanding the collective experiences of the different stakeholders towards an envisioned outcome. As an experiential inquiry into the connected health landscape, knowledge-seeking methods and expert interviews were combined with analysis methods, providing a framework to address the research problem through health seekers' and patients' experiences within the system, the information, and the resources, while navigating complexity. The research used the SMM methodology in the analysis and the synthesis process to assess:

The rationalities of health-seekers' and patients' experiences with existing information or systems

The manner in which stakeholders such as experts in the realm of extra clinical data platforms, clinical data platforms, and policy development would be interviewed as a means to understand their experiences.

The way in which all system actors construct and communicate their experiences

Since human experiences (Dervin, 2003) are constantly in flux, Dervin's SMM aims to understand, holistically and authentically, all aspects of an individual's journey towards their goals. In a health-seeker's or a patient's context, it is illustrative of the various barriers, gaps, and challenges faced by them, while pursuing their health or seeking the treatment for an ailment or a condition, within the existing system (Jones, 2013).

The consequence of using this sense-making methodology was to arrive at a meaningful understanding and to empathize with all the actors involved in the existing system in a bid to provide 'a structure for the rigorous inquiry into the actual experience of a person in a situation' (Dervin, 1999). Over the course of the research, numerous methods along with cross methodologies were employed as a way of creating coherent rationalities, framing research theories, and connecting the various hypotheses (Jones, 2013). For the purpose of this research, these methodologies not only helped with data collection, but also to set a context for reflection on the purpose, stakeholder motivations, and significance of the issues. The combination of all the methodologies helped support the analysis of the complex problem situation (Dervin, 1993). The analysis of the connected health system looked into three major fields of patient and health-seeker experience

Situation
Understanding the current problem embedded within the system

Gaps
The breaks in the current experience and existing information needs along with the drivers of change

Outcome
Goals or what the user hopes to achieve

The evaluation of the situation, the gap, and the outcome are three essential elements of the development of this research inquiry. The situation refers to the context of understanding the present conditions that led to the events or the eventual breakdown in the system. The gap is a reference to the research problem and the existing mental models, comprehended in this research through the systemic analysis, environmental scan and the process of interviewing representative stakeholders.

The outcome refers to the goals or what the user, in this case, patient or health-seeker, aims to achieve through a connected health data system. The bridge, to understanding the situation that led to the gaps, is through the methodology of sense making, which the research takes towards reaching a goal. (Jones, 2013)

Approaching this research question as a design problem led this exploration through an iterative, unique, rational and poignant journey through the complexity of the healthcare system. Applying the sense-making methodology from hypothesis to synthesis assisted in the researcher empathizing with her own subjectivity while, simultaneously, attempting to understand the experiences of those involved in the intricacies of the functioning of the system. The process of framing and reframing the situation, as a whole, steered the research towards constructing coherent interpretations of the stakeholders' novel experiences. To that end, the sense-making design synthesis process aided the development of the research capability and to build empathy towards another person's perspective. (Kolko, 2010)

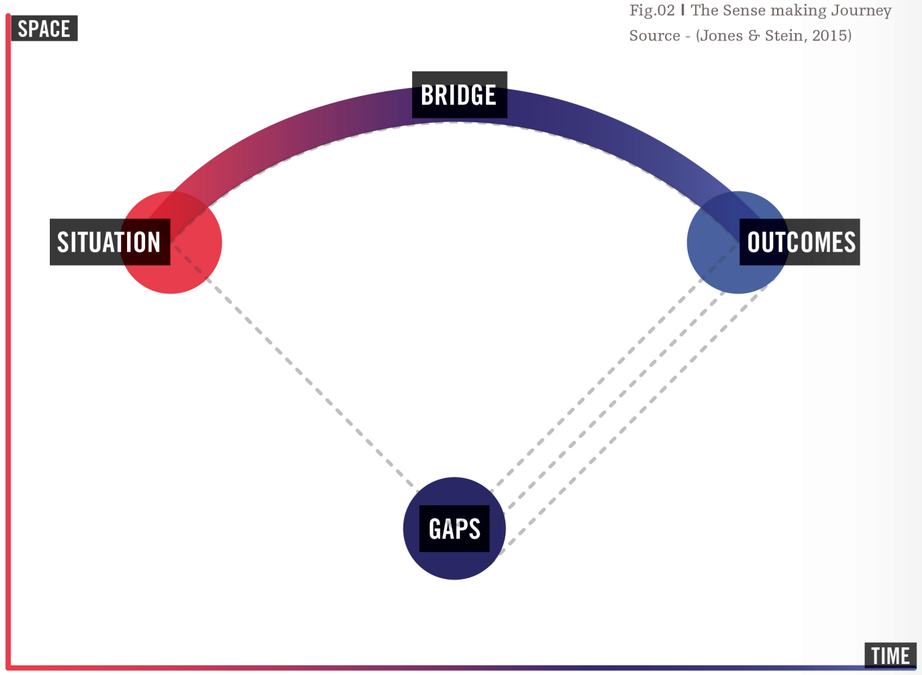


Fig.02 I The Sense making Journey
Source - (Jones & Stein, 2015)

Lexicon

The research vocabulary

Health Data Platforms
For the purpose of this research, a health data platform refers to both clinical data platforms and extra-clinical data platforms. The term health data refers to data collected, managed, and analyzed from patient reported outcomes and clinically reported outcomes.

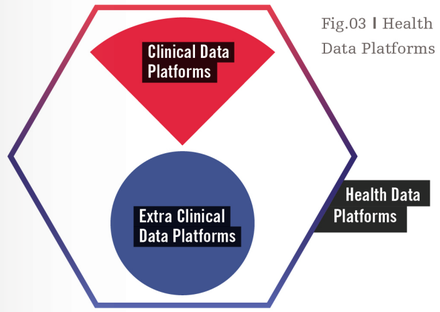


Fig.03 I Health Data Platforms

Clinical Data Platforms
This signifies clinically reported outcomes, and is the principle source for most medical and health related information; health care providers or practitioners gather this data either during regular and ongoing patient care; or as a part of a formal clinical trial program. Clinical data could be classified into six major types: Electronic health records, Administrative data, Claims data, Disease registries, Health surveys, and Clinical trial data. (Healthdata.gov, 2015)

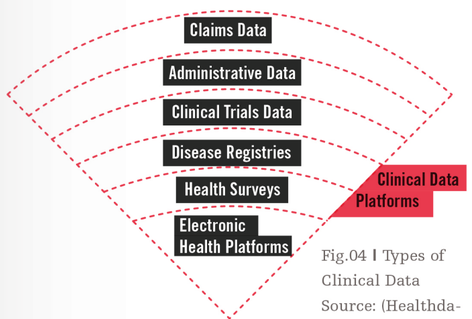


Fig.04 I Types of Clinical Data
Source: (Healthdata.gov, 2015)

Electronic Health Information
Electronic Health Information falls into three categories (Guides.lib.uw.edu, 2015):

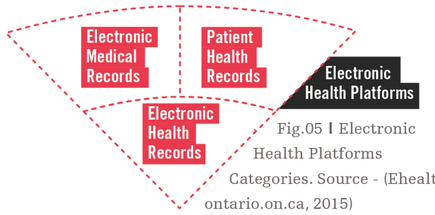


Fig.05 I Electronic Health Platforms Categories. Source - (Ehealthontario.on.ca, 2015)

Electronic Medical Records (EMRs)
The richest form of electronic clinical data, it is usually collected at the point of care largely at a medical facility, hospital, clinic, and practice. This data may include administrative and demographic information, diagnosis, treatment plans, prescription drugs, laboratory tests, hospitalization, patient insurance, or other information. This data is not usually accessible to independent researchers that have no affiliation with healthcare provider organizations. (Ehealthontario.on.ca, 2015)

Electronic Health Records (EHRs)
Combines an individual's information registered with health care providers (family doctor, specialist, health care team) and the provincial health care plan. Efforts are underway, in Ontario, for EHRs to include data from hospital information systems, community care clinics, and other providers as well. (Ehealthontario.on.ca, 2015)

Personal Health Records (PHRs)
The records that patients and health-seekers can access enabling them to maintain a record of their appointments, email correspondence with health care providers, information about medications, and any interaction with online patient groups. (Ehealthontario.on.ca, 2015)

Extra Clinical Data
An important factor in health and wellness management, currently, extra clinical data includes the data reported by patients, outside the patient-clinician experience. This data may be recorded by patients and health seekers in their communities and homes, or via survey, mobile platforms or via wearable devices (Dwivedi, 2015). Alternatively, this data could also include outcomes reported by health seekers from consumer technology platforms like JawBone, FitBit, or Apple Health (MaRS, 2015).

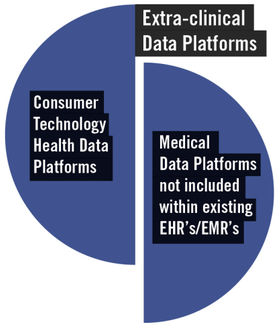


Fig.06 | Types of Extra-clinical Data Platforms

Through the course of the research, the definition has evolved to include all health-related data collected in non-clinical settings like home, work and the variety of clinical data from disease management and monitoring platforms that are currently not integrated into existing EMR platforms. A fundamental characteristic of extra clinical data is the patient's or health-seeker's essential role in management, tracking or monitoring of their health and wellness related activities.

Health-seeker
Health-seeker is often a term used in the context of Internet users who seek health-related information online. In this perspective, 'health seekers' are a broad spectrum of web consumers that are patients, patients' friends or relatives, caregivers, e-patients, and citizens in general, searching for information on health topics. They differ from 'health consumers' who are patients, family caregivers, and citizens, essentially customers of the healthcare services. (Higgins et al., 2011)

For the purpose of this research project, the expression Health-seeker borrows the empathetic interpretation, expressed in Peter Jones' book – Design for Care, of a person's journey towards well-being, their outlook towards health management and their motivation to achieve optimal health, regardless of them suffering from a disease. (Hart et al., 2009) This research considers the action of health seeking as a natural quest and a fundamental human need as a means to offer an unbiased and a person-centered viewpoint of the healthcare system (Jones, 2013).

Patient
While a person, applying self-care strategies to attain a health standard subjective to their individual needs (Jones, 2013), remains a health-seeker throughout the course of his or her lifespan, they only become a patient at the onset of a disease. The usage of the phrase health-seeker, over patients, for the users of the healthcare system, in this research, is a viewpoint to express the 'impersonal convenience' (Hart et al., 2009) of the prevalent 'disease care model' (Hart et al., 2009). In this report, the usage of 'patient(s)' is a reference to any person, in a clinical context, feeling any symptoms of a disease or ailment; or suffering from a medical condition that is chronic or acute.

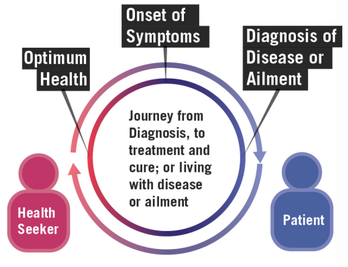


Fig.07 | Health seeking journey Source: (Higgins et al., 2011) (Jones, 2013)

Person-Centered Care Approach
A consequence of a health system that is equitable and aware of the needs of its stakeholders by empathizing with health seekers and patients using the health and social services. In a person-centered system, health seekers or patients are seen as equal partners in planning, developing, and monitoring care to make sure it meets their needs. A system designed on the principles of these human-centered values places the needs of its people and their families at the center of decisions as experts, working alongside professionals to get the best outcome. (Health Innovation Network, 2015) (Sepucha, Uzogarra, & O'Connor, 2008).

A system built on the principles of this approach does not necessarily involve giving its people whatever they want or only providing information. Rather it is about considering the social determinants that drive people's desires, values, family situations, circumstances, and lifestyles. A person-centered system sees health-seekers and patients as individuals, working together to develop appropriate solutions. (Institute for Healthcare Improvement, 2016) (Gill, 2013)

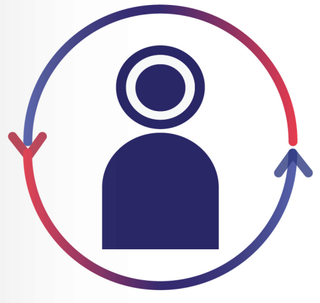


Fig.08 | Person Centered Approach

Episodic and Continuous Care Model
Refers to two distinct types of care delivery models in health care systems:

Episodic care model
In an episodic care model, an emphasis is given to the treatment of urgent and persistent symptom(s), resulting in physician-patient encounters occurring as isolated events. Since disease or illnesses are considered as a one-off event, the result could be disintegrated care. The care cycle is complete when the symptoms subside; however, the process of care starts again when the symptoms arise again.

Continuous care model
This model emphasizes monitoring an individual's health condition over time and analyzes physiological symptoms comprehensively along with mental, behavioural, environmental, and social aspects of health. In a continuous care model the patient-physician interaction is more tailored to an individual's need; with health and disease or ailment not considered discrete events. Being longitudinal and multifaceted, the focus is on the continuum of care. (Hussey, Sorbero, Mehrotra, Liu & Damberg, 2009) (Wibberly, 2015)

Introduction To The Research

The Quantifiable Health Revolution

"The relationship between citizens and health providers is evolving … The era of passive consumers of health services has been overtaken by a new paradigm of people-powered healthcare." (Khayat, 2015)

The disruption to healthcare caused due to the bottom-up adoption of mobile technologies has brought forth signals of health seekers managing their own health (Liebhold, Maguire & Townsend, 2009). Propelling this movement forward is the growing interest
of the technology sector in health care (Kocher & Roberts, 2014) (Davies, 2015) (Farr & Oreskovic, 2015). By realizing, an unmet need for health management tools, direct-to-consumer technology companies are targeting products and services to those that prefer to supervise their own health (z, Shell & Leitch, 2011) (PwC, 2015).
Yet, despite the societal acceptance of these tools and the need for growing outpatient strategies, as a means to manage rising costs, combined with the burden of aging population, the healthcare sector is relatively cautious and measured in adopting these changes. With health care institutions not being the locus point of this change and patients or health seekers lacking the support or the access to proper functional systems that can assist them in their health management (Frommeyer, 2015), there is a rising tension between existing policies and the individual adoption of digital related behavioural practices.

The challenge ahead for consumer technology companies to be acceptable, in the medical space, is a big one, largely due to the fact that most consumer health data platforms are not diverting their efforts to the actual needs of the health care providers or physicians that rely on clinical data for diagnosis and disease management (Sullivan, 2014). Adding to this, there is an increasing demand for systems that can connect clinical data with extra clinical data platforms to bridge the continuity gaps in patient care for chronic and acute disease management. (Canadian Institute for Health Information - Health Quality Ontario, 2013), (Clinicians.org, 2015), (Williams, 2009).

Fig.09 I The evolving symbol of people-powered revolution propelled by the Bottom-up Adoption of Mobile technology
Source - (Salles, 2016)

This research is an introspection of the current system of the connected health landscape and an extrospection into the emergent environment for the drivers of this change in the health data landscape. The two-pronged approach is a means to base the design interventions on the principles of holistic experience of care.

What are the existing systemic barriers in bridging health data platforms that limit a seamless experience of care for health-seekers and patients?

Using systems thinking, the research seeks to underline current challenges that limit the interoperability between extra clinical and clinical data platforms as a means to discover points of intervention. The aim is to examine the current barriers, insights into the system and criteria for an integrated health data systems design. The hope for this research is to lay the groundwork for a larger discussion that enables key stakeholders, in the healthcare space, by giving them measurement tools and connections.

How might the evolution of connected health affect the experience of care for health seekers?

The project employs foresight tools and methodologies to explore the drivers of change arising from the connected health data landscape. The aim is to come up with strategies that can be utilized to bridge the currently disconnected worlds of clinical and extra clinical platforms.
After an extensive environmental scan, the resulting design solutions were placed at points of intervention, established through the systemic analysis, as means to maximize the impact of strategies built around the principle of a seamless experience of care for health seekers.

Fig.10 I Disconnected Worlds of Clinical and Extra Clinical Data
Source - (MyHealth - MaRS, 2015)

What future strategies could be employed to bridge the disconnected health data worlds and provide quality care to health seekers?

The hope for this research is to lay the groundwork for a larger discussion that empowers key stakeholders, in the healthcare space, by giving them measurement tools and connections. With rising healthcare costs and the increasing burden of an aging population(Fig.10), the aim is for this research to bring about a cross-industry awareness in a bid to propel the systemic development of health data platforms. Bridging of this information gap will also help prepare the Canadian health care system to embrace future possibilities of creating a more comprehensive approach to healthcare delivery, with a keen eye on potential challenges down the road.

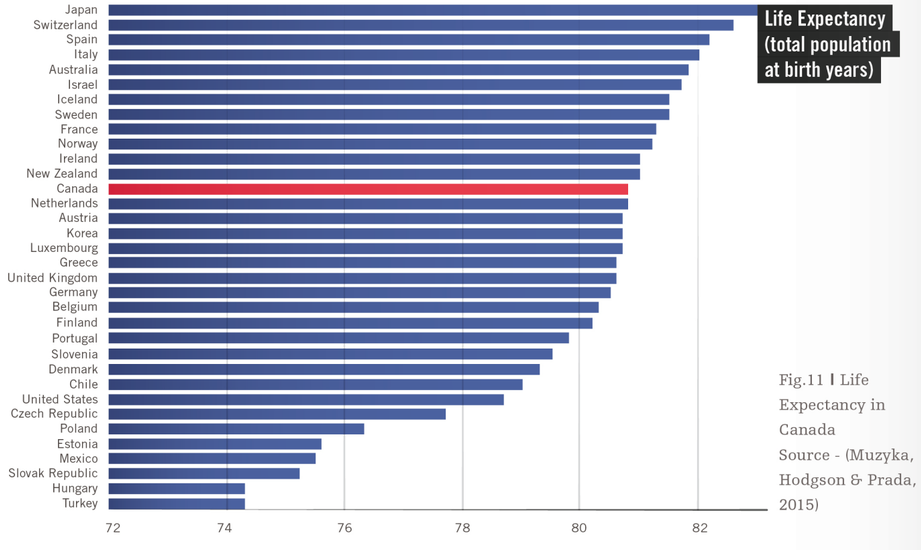


Fig.11 | Life Expectancy in Canada
Source - (Muzyka, Hodgson & Prada, 2015)

Research Question

How might we create a seamless experience of care for health-seekers & patients by bridging the gap between extra clinical and clinical data platforms?

Research Methodology

Introspection & Extrospection Of the
Connected Health System

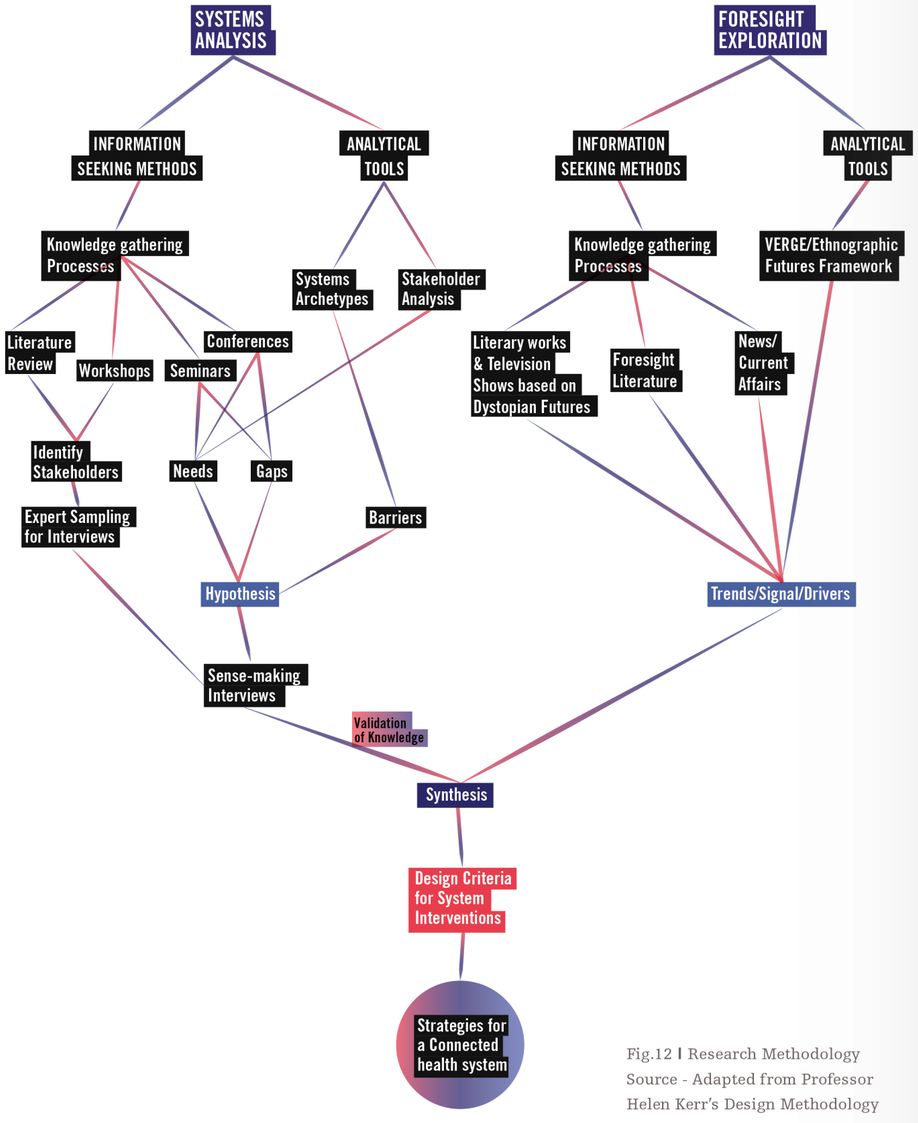


Fig.12 | Research Methodology
Source - Adapted from Professor
Helen Kerr's Design Methodology

"Method is the absolute, unique, supreme, infinite force, which no object can resist; it is the tendency of reason to find itself again, to recognize itself in every object." - (Marx, Proudhon, Engels & Quelch, 1910)

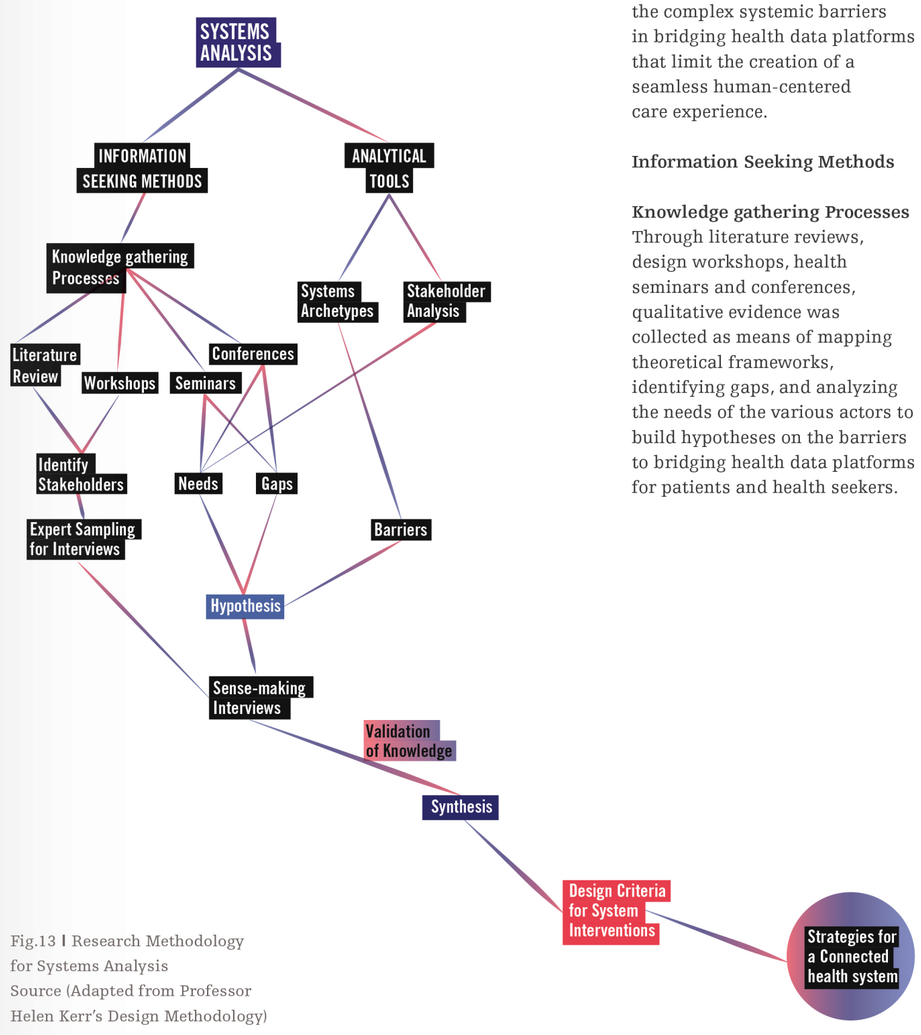


Fig.13 | Research Methodology
for Systems Analysis
Source (Adapted from Professor
Helen Kerr's Design Methodology)

For a comprehensive evaluation of the system, information seeking methods and analytical tools were employed to explore the complex systemic barriers in bridging health data platforms that limit the creation of a seamless human-centered care experience.

Information Seeking Methods

Knowledge gathering Processes
Through literature reviews, design workshops, health seminars and conferences, qualitative evidence was collected as means of mapping theoretical frameworks, identifying gaps, and analyzing the needs of the various actors to build hypotheses on the barriers to bridging health data platforms for patients and health seekers.

Semi-structured Interviews with Experts

List of Experts (Appendix A - Page 142)

One to one interviews were conducted with stakeholders from consumer technology companies, that use extra clinical data platforms, and technology companies, that deal with clinical data platforms, to understand the current barriers they face that limits them from bridging data platforms towards a more integrated system. To learn more about the current landscape and policies, which are, in place to connect health data, interviews were sought with policy specialists and researchers working within the healthcare sector.

Basing the interviews on Brenda Dervin's sense-making methodology (SMM) provided a rich source of qualitative experiential data; by helping investigate people's collective understanding of the current landscape, goals, mental models, and interpretation of knowledge (Jones, 2013). This neutral questioning technique (Appendix E - Page 147) for the interviews helped in validating hypotheses generated through knowledge gathering techniques, discovering gaps in the communication experience, and locating authentic situations of the discontinuities in the system. Eventually, these empathetic SMM interviews with experts assisted in undertaking a more co-creative and communicative approach towards problem-solving (Jones, 2015).

Analytical Tools

Systems Archetypes

Archetypes, arising from the Greek word 'archetypos' meaning first of its kind (Senge, 1994), are the structures that produce common patterns of problematic actions in systems and organizations (Braun, 2002, Meadows & Wright, 2008). By flagging these activities, archetypes could serve as tools for diagnosis and foresight. Visualizations of the systemic relationships and situations as archetypal feedbacks (balancing or reinforcing) help challenge stakeholders to consider the virtues of fundamental solutions "by making time an explicit variable in decision-making" (Braun, 2002).

Through the report, hypotheses and theories have been represented in verbal and graphical format, demonstrating and capturing only the key elements of the systems. Analyzing the archetypes that exist in the current health data system could help stakeholders and organizations gather insights to avoid these "traps". In addition, identification of these signposts could prepare stakeholders to avoid unintended and undesirable consequences and prepare them beforehand to turn them into opportunities (Meadows & Wright, 2008).

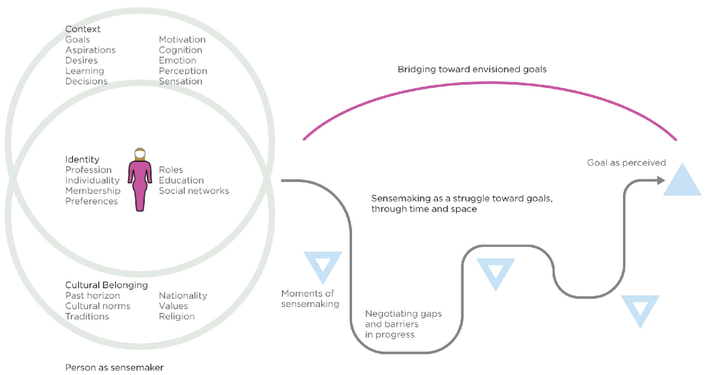


Fig.14 | A User's Experiential Sense making journey towards intended outcomes Source (Jones, 2013)

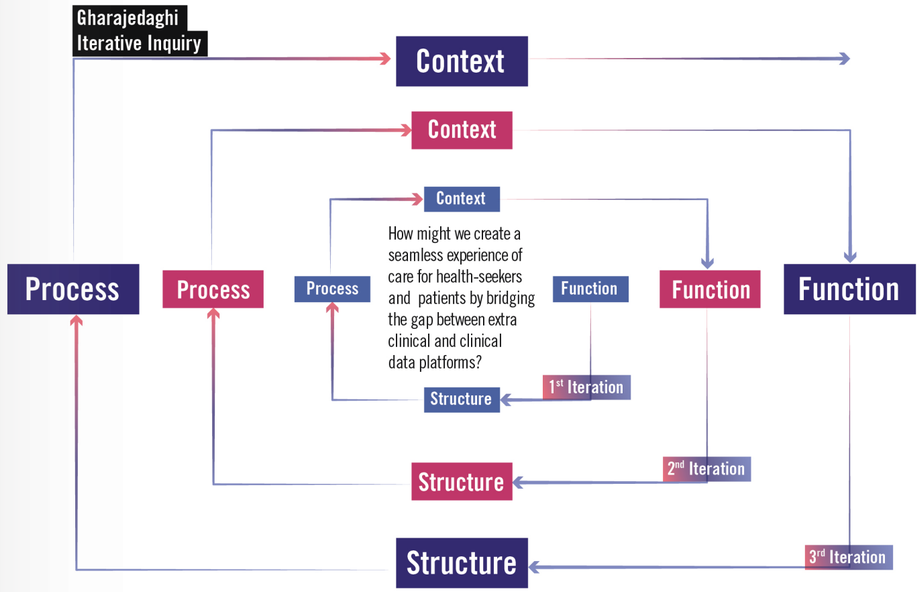
Gharajedaghi's Iterative Inquiry

Jamshed Gharajedaghi's iterative process of Inquiry aims to understand complexity by repeating the structure, function, and process in a given context to interpret hypothesis and interrelationships between members. (Gharajedaghi, 1999)

> At each level of the system, four aspects are analyzed
> 1. Structure: Who belongs in the system?
> 2. Function: What does it do?
> 3. Process: How does it work?
> 4. Context: What is the larger containing system?

Subsequent iterations would help breakdown validity of these hypotheses and understand a system as a whole. (Appendix C: Page 145)

Fig.15 | Iterative Inquiry Process to Understand Complexities Holistically Source - (Gharajedaghi, 1999)



Stakeholder Analysis

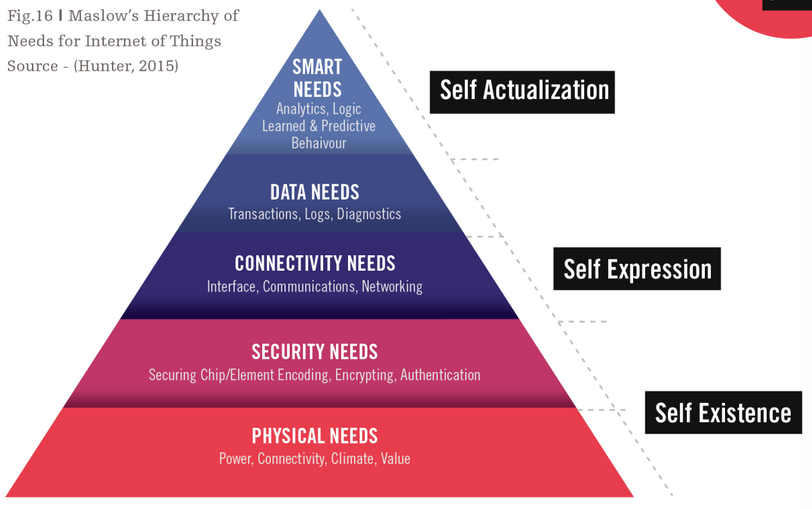
Stakeholder analysis is a combination of breaking down a complex system into its constituent elements, mapping the various key players within a given system and ranking the priority of the influence of their corresponding inter-related needs. The outcome of the process is to enable the stakeholders to base concrete decisions on 'social engineering' and deductive understanding of the relative impact of one variable need on other. (Saaty, 1990)

Stakeholder Mapping

Stakeholder mapping (Appendix B: Page 144) is a human-centered design based evaluation to understanding the key stakeholders, their origins, and the incentives behind their needs. Grounded in research, a collaborative process of dialogue and deliberation, Stakeholder mapping is the first step in understanding the numerous perspectives to establish fundamental interrelationships between people and their objectives within the context of a larger system (Saaty, 1990).

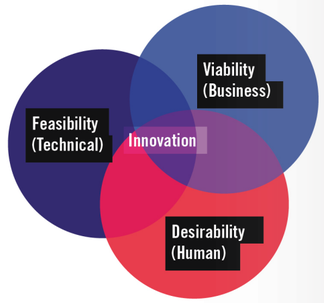
Hierarchy of Needs
Hierarchy of Needs (Appendix B: Page 144) is an output derived from stakeholder mapping. The process of correlating the needs of the various stakeholders, established through the stakeholder mapping and then placing them in the order of influence to visualize areas of opportunities and insights into the system to place an intervention. Priorities and concerns of the key stakeholders, problem elements, and internal dynamics are then classified, grouped, and arranged into different levels for synthesis. The needs hierarchies can be linear, ascending or descending but always interacting and reacting to the complexity of a system (Saaty, 1990).

Fig.16 | Maslow's Hierarchy of Needs for Internet of Things
Source - (Hunter, 2015)



Design Criteria
The principles (The Bridge: Page 105) that would assist in decision-making and help define where an intervention would be most effective and successful. These tools assist in the evaluation of the final recommended strategies. (Perelman, Barrett & Paradis, 1996) The design choices for a successful intervention, for a product, service, or design, would be defined based on the implementation on the three pillars of viability, feasibility, and desirability.

Fig.17 | Desirability, Viability, & Feasibility Model for Innovation
Source - (Dubberly, 2001)



Foresight tools and methodologies were employed to explore future strategies, within the areas of opportunities that can be utilized to bridge the currently disconnected worlds of health data. Current trends in the health technology landscape were determined through a vigorous environmental scan of the connected health system. The criteria identified through the systemic analysis helped determine the rate of success of the future strategies.

Information Seeking Methods

Knowledge gathering Processes
Literature reviews, health seminars, wearable technology conferences, literary works, feature films, and television shows based on dystopian futures helped in gathering indicators of change to analyze emerging developments in the healthcare, digital health, and consumer technology sector.

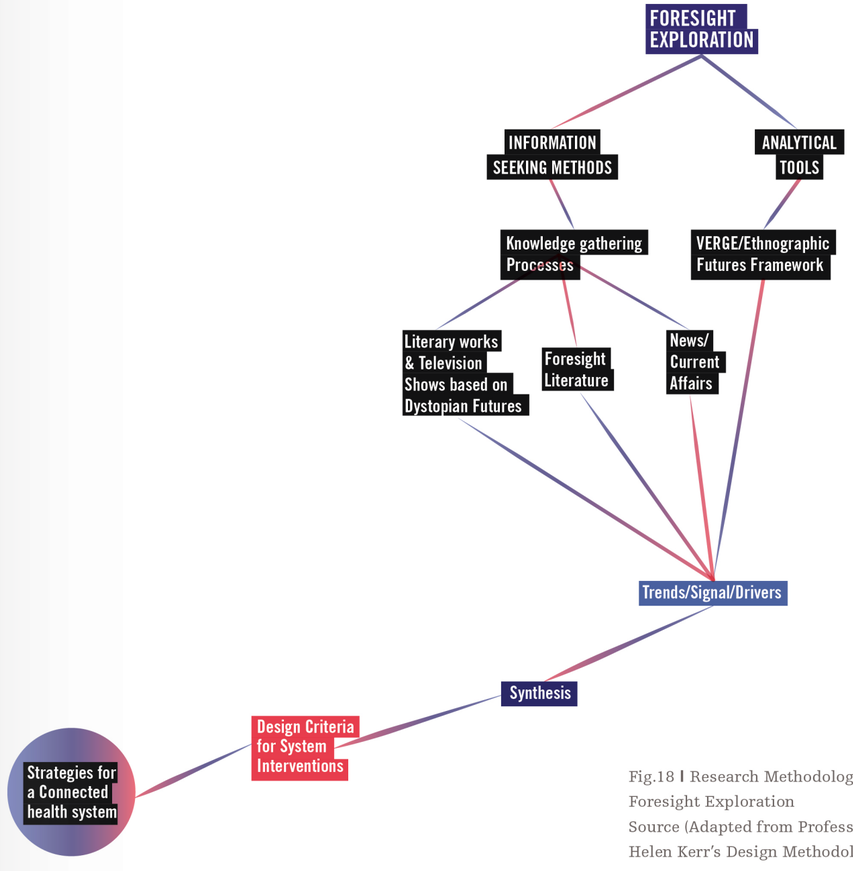


Fig.18 | Research Methodology for Foresight Exploration
Source (Adapted from Professor Helen Kerr's Design Methodology)

Analytical Tools

Verge/Ethnographic Futures Framework
This frame is used to explore the changes in the world and is known by futurists in the US as “Verge”, while practitioners in the UK know it as the “Ethnographic Futures Framework/EFF.” Developed by Dr. Richard Lum, Michele Bowman, and Wendy Shultz, Verge was originally intended as an alternative taxonomy to STEEP+V for environmental scanning. Now, however, the taxonomy has evolved into a general practice framework that can be utilized at practically every stage of foresight. The Verge domains Define, Relate, Connect, Create, Consume, and Destroy (Appendix F: Page 149) are used to organize an environmental scanning effort. These domains function as research areas, within which researchers track weak signals. (Dudevoir, 2014) (Lum, 2013) (Schultz, 2010) (Vision Foresight Strategy, 2014)

Strategic Recommendations
Multiple strategic directions were visualized which were then continually and iteratively reviewed and analyzed. The strategic solutions (The Outcomes - Page 109) were tested in relation to the design principles for their performance indicators to measure their effectiveness in providing a holistic experience of care for health seekers and patients.

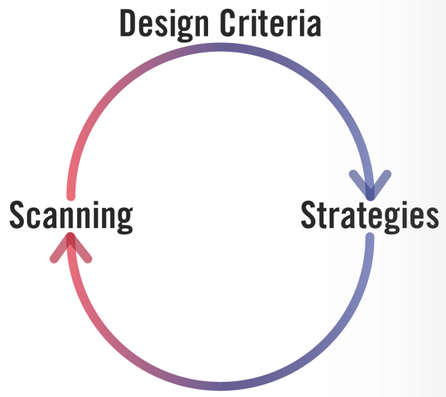
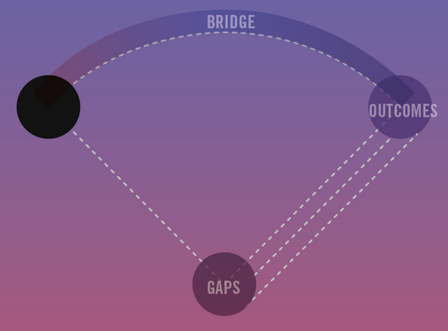


Fig.19 | From Scanning, to Strategy Development Process
Source (Adapted from Candy & Stein, 2014)

THE
SITUATION



Background

The Digital Divide in Healthcare

"As far as integrating non-clinical with clinical data, I still see a giant Great Wall of China exists between those two disciplines. Nobody is doing it and nobody is even trying because the hurdles are so high. It is a lost cause for so many tech start-ups. If you bet any part of your company strategy on opening up of regulatory controlled data then you are risking your entire company. Therefore, you would not do that. The risk is unknowable and uncharacterizable. So, nobody does it." – (Moffat, 2015)

An expression to imply closed platforms (Eisenmann, Parker & Van Alstyne, n.d.), walled gardens ("Walled Gardens", 2015), are reflective of exclusive information systems where a service provider has control over applications (Paterson, 2012), content, and media; restricting users the appropriate amount of access to non-approved applications or content (Memetic, 2012). This is in contrast to an open platform, where consumers have unhindered access to applications, content, and much more (Smith, 2009). This research draws from the metaphor (Andrew, 2008) of this intensely fertile space for health platforms, within the larger healthcare ecosystem, that has been closely protected for patient safety and privacy with access only given to a few.

Within the healthcare ecosystem, space for health data platforms is flourishing. This is visible through the massive investments in health information technology and a favorable environment for foreign investment in digital health start-ups, with local governments providing financial stimulus for innovation, in the technology and healthcare sector (Garewal, 2015). Examples of these are visible in provinces like British Columbia with Vancouver's Interface Health Society running the IHX Challenge for health tech startups (Interface Health, 2015) and Ontario-based MaRS hosting the HealthKick conference (HealthKick, 2015). Furthermore, the government has created a conducive environment for non–resident investors through additional incentives like the reformation of Section 116 of the Income Tax Act (Gucciardo & Clark, 2010), that formerly curtailed investment in Canadian firms, and a new startup visa (Lewis, 2013) (Czikk, 2013), that entices companies to establish themselves within the Canadian borders (Garewal, 2015).

However, these blossoming gardens have been cordoned off from one of their primary stakeholders, with patients and health–seekers, being granted limited admission to this space unless through the designated entry and exit points such as an electronic access to their medical summary or chart (Pcmag.com, 2015) (Rozenblum et al., 2011). Added to this, the creation of this wall, has resulted in the stratification of information systems with patients or health-seekers and sometimes even physicians navigating the

Fig.20 | Lack of Interoperability between clinical and extra clinical platforms
Source (Kim, 2015)

complex realm of institutional silos resulting in status quo and an inhabitable environment for any kind of innovation in healthcare. (Gobry, 2013)

Nevertheless, these barriers, that have been erected, serve a larger purpose, as they are essential to provide protection, privacy, and safety for the same primary stakeholders. With healthcare organizations and research agencies procuring, gathering, and storing patient health and medical data in digital format, policy mandate initiatives require analysis of health data archives in such a way that an individual's privacy and confidentiality rights are not compromised (O'Keefe & Rubin, 2015). This pursuit to find a balance between allowing the use of health and medical data for research, while protecting confidentiality combined with the lack of proper knowledge dissemination systems and the absence of information standardization mechanisms, have made the integration of clinical platforms, operating within different institutions and practice, a hurdle to people-powered health reforms.

> *The biggest issue in the health care system is the sharing of patient data and information between the hospitals or clinics they have visited. A patient died in Ottawa because we did not have access to the imaging results done in another hospital. If I had that information on his file, I could have saved his life.*
>
> Confidential quote from a family care physician MD CCFP, 2014)

The integration of extra clinical data with clinical data platforms serves a useful purpose at a systemic level, particularly for health-seekers and patients. The human body moves along a spectrum from health to disease converting a health-seeker to a patient over time. The fallacy of the notion that health and illness have a demarcated boundary, with one starting where the other ends, results in a diagnosis only when sufficient symptoms arise, which is usually when the disease or the condition has already affected the individual (Brewster, 2014). The idea of being able to diagnose ailments, before the onset of symptoms, using these easily available quantifiable tools like wearable technologies and mobile apps would help prepare for and prevent diseases, better in the long run, at an individual and societal level. Furthermore, at a systemic level, it could help the healthcare sector achieve characteristics of a complex adaptive system (Morgan, 1986), through data-driven preventative health and disease management allowing the system to evolve with the growing complexity of illnesses and lifestyle changes of the surrounding environment (Reeves, Levin & Ueda, 2016).

Understanding the intricacies of bridging the clinical with extra clinical data platforms primarily requires an internal evaluation of the social system it exists within currently. It is essential to focus greater efforts on addressing the need for immediate action on this design challenge, particularly, while in other business sectors, walled gardens frustrate consumers. In healthcare, these could end up causing immeasurable harm to those at the center of the system - the patients (Kim, 2015)

Current Landscape

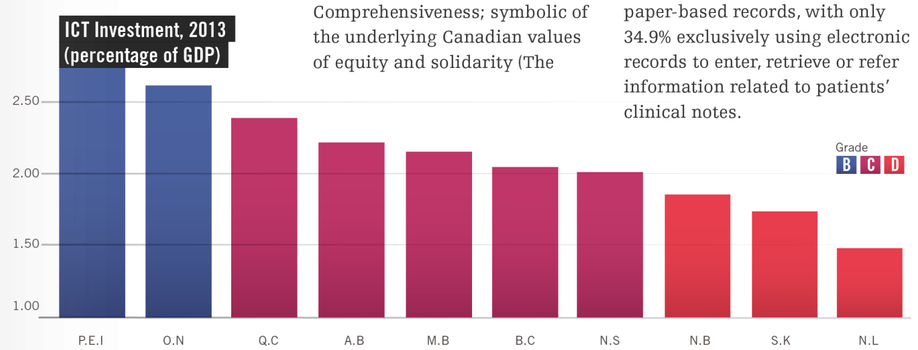
An overview of the connected health system

"When you talk about the two platforms, the clinical one has its own challenges of not being inter-connected. The non-clinical ones … what is happening on the consumer and the patient's side is a wild west right now." - (Dwivedi, 2015)

A socialized healthcare system, such as Canada's national health insurance program, usually referred to as "Medicare", is aimed at certifying reasonable access to medically necessary hospital and physician services, on a prepaid basis to all citizens (Health Canada, 2016). Instead of a single national plan, the program is composed of 13 interlocking provincial and territorial health insurance plans. Though fragmented by province and type of care, they share certain common features. Most primary and emergency care is free for residents, whereas some specialty care, prescription drugs, long-term and in-home care, is not covered extensively by the Canada Health Act (Garewal, 2015). The Canadian health care system has been framed on the governing principles of Universality, Portability, Public administration, Accessibility, Comprehensiveness; symbolic of the underlying Canadian values of equity and solidarity (The Society, the Individual, and Medicine component of the University of Ottawa Medical Curriculum, 2016).

However, this publicly funded medical system with universal coverage, while making healthcare more accessible and affordable for citizens, has also managed to leave large 'care gaps' in treatment (Montague, 2004) (Garewal, 2015). Healthcare is a service industry stuck in the antiquated model (The Conference Board of Canada, 2013) of 1960's, where dated technologies like fax machines and paper medical records are still widespread (National Physician Survey, 2014), with patients often being sent home with instructions printed on paper which can be lost or misinterpreted (Nowak, 2015). The digital gulf is most evident in healthcare with the statistics from a Canada wide physician survey conducted in 2014, reflecting, 48.4% of physicians still use a combination of electronic medical records and paper-based records, with only 34.9% exclusively using electronic records to enter, retrieve or refer information related to patients' clinical notes.

Fig.21 | Ontario's second place ranking among provincial adoption of ICT (Information & communication Technology) Source (Statistics Canada: The Conference Board of Canada, 2013)



The rapid pace of advancements in medicine, science, and technology is inversely proportional to the rate of adoption of basic information technology tools in healthcare. This contradiction has resulted in existing information not appropriately translated into practice through the application of new technology. The healthcare sector not only lacks preparedness towards emerging trends in technology adoption but also lacks systemic planning to manage the current challenges. Cumbersome processes like patient handoffs, waste of resources due to double testing and loss of information between primary care physicians, and secondary and tertiary care providers have made the delivery of care overly complex and uncoordinated, particularly for those managing chronic conditions. These operational silos have led to communication breakdowns, affecting the quality of care; in a sector that, in its essence, should ensure a health seeker's access to appropriate care and protection from all harm. (Institute of Medicine, 2001)

Report Card - Health		
Rank	Country	Grade
1	Japan	A
2	Switzerland	A
3	Italy	A
4	Norway	B
5	Finland	B
6	Sweden	B
7	France	B
8	Australia	B
9	Germany	B
10	Canada	B
11	Netherlands	B
12	Belgium	C
13	Austria	C
14	U.K.	C
15	Ireland	D
16	Denmark	D
17	U.S.	D

Fig.22 | "B" grade to Canada's health care system. Source (Muzyka, Hodgson & Prada, 2015)

To be able to modernize the delivery of care, the "socialized medical" (Laric, Pitta & Katsanis, 2009) system needs to fight existing outdated physical infrastructures, service models, labour incentives, and information flows (Muzyka, Hodgson & Prada, 2015). Added to that, Canada lags behind in adopting innovative information and communication technological tools (The Conference Board of Canada, 2013) with the debate on progress curtailed mainly to protect privacy needs. The digital gap gets even wider in the healthcare data space with data standards, data commons and data sharing that are behind the times, along with a lacking capability to understand, standardize, enhance, and store basic medical data in an actionable format (Frommeyer, 2015).

However, this digital rift has given rise to plenty of niches for consumer technology companies to address current insufficiencies with new products and technologies (Garewal, 2015). Globally, the proliferation of new medical devices being developed and brought to market every year is increasing, with projected estimates that the international market demand for these devices will reach US$440 billion by 2018 (Ontario Health Innovation Council, 2014) (Episcom 2013). According to Rock Health, a major player in the field of health sector funding in the US, venture capitalists poured a record $2.3 billion into digital health companies in the first half of 2014 (Bailey, 2014) (Bernaert, 2015). In comparison to other Canadian provinces, Ontario ranked second, in the adoption of information and communication technology (The Conference Board of Canada, 2013), and is home to nearly half of Canada's 800 - 1,000 health-related technology startups, as estimated by the business accelerator MaRS (Nowak, 2015). Even the previously popular smartphone pioneer based in Ontario, BlackBerry has its eyes on the healthcare sector as it transforms its core business from a consumer hardware vendor to an enterprise-focused software and services provider. (Nowak, 2015)

Fig.23 | Landscape of Extra-clinical data platforms
Source Read from Top to Bottom, Left to Right (AIRO, 2016) (SeamlessMD, 2016) (Bant, 2016) (Forahealthyme, 2016) (Muse: the brain-sensing headband, 2016) (Figure 1, 2016)

For health-seekers, the smartphones and wearable technologies have empowered them with tools to control, access, and self-manage health and treatments by providing a platform to collect health data, such as blood pressure, medical records and lifestyle-related behaviours including fitness regimes and food intake, physical activity, early diagnostics and treatment compliance. Two-thirds of nurses and about 80 percent of doctors use personal smartphones in the course of their work (Nowak, 2015). Yet, only 16.6% physicians, within Ontario, recommend mobile apps to patients (National Physicians Survey, 2014). Despite, patients becoming more than just 'passive recipients' of treatments (Champagne, Hung & Leclerc, 2015) these platforms are yet to prove their value as a "medical instrument" for the physicians and all healthcare workers (Bernaert, 2015).

The signals of change are visible globally. In developing countries like South Africa, where mobile technology is leveraged for HIV/AIDS and TB prevention through phone-based counseling and text-message supported self-testing (Bernaert, 2015). In India, family doctors use Whats app to consult patients (Dhar, 2015). In Ontario mobile technological innovations, are advancing the shift towards a connected and decentralized, community-based healthcare system (MacIntosh, 2015). It is estimated that 70% of treatment delays or unexpected events resulting in death or serious injury (Nowak, 2015) are the consequence of communication breakdowns; leveraging mobile technologies for consultations, diagnosis and monitoring chronic and acute conditions would help to move away from the traditional model of episodic care (See Lexicon) (Bar, Pisani & Weber, 2007).

Over the past few years, Ontario has been home to an increasing number of health-related platforms and technologies catering to the need of health-seekers, patients, physicians, and care providers; with clinical trials underway for a variety of chronic, acute care and mental health treatment, disease management, and communication platforms. For patients suffering from chronic and acute conditions, platforms like Bant (Bant, 2016) for Diabetes management engages adolescents to record data and improve self-management. Others like ForaHealthyMe (Forahealthyme, 2016) and Loop (Healthcare Human Factors, 2016) encourage communication between care teams and patients.

A number of platforms are directed towards Healthcare organizations and clinicians such Seamless MD, that enables hospitals to educate, engage, and monitor patients through surgery (SeamlessMD, 2016). Figure1 (Figure 1, 2016) employs crowdsourcing for diagnosis by allowing doctors or medically trained personnel to share images of diseases and injuries with other doctors.

For Health-seekers, a wide range of options being catered to assist them in managing their physical and mental health related issues. Cogniciti (Cogniciti, 2016) provides brain health assessment by measuring the different cognitive factors for the early detection of dementia while Muse - wearable head sensor (Muse: the brain sensing headband, 2016) assists in the management of anxiety and other stress-related health issues. (Garewal, 2015) However, fitness trackers, wearable technologies, and health monitoring application platforms may be camouflaging themselves as lifestyle and wellness products, for health-seekers, to avoid the regulatory hurdles of the FDA in America and Health Canada in Canada. Some believe that by evading the challenge to be integrated with more medical grade platforms, they are doing more harm than good by only catering to the healthy population segment that is a smaller segment compared to those that might need it for managing serious conditions (Budds, 2015) (Steenhuysen, 2015). However, the trend seems to be shifting as a new surge of smart platforms, are venturing into chronic disease management and gradually shifting from mere trials to business opportunities. (Steenhuysen, 2015).

The few examples listed above reflect how the social and financial impetus provided to the extra-clinical platforms and technologies has created a thriving landscape for health-technology companies, across the country. The increasing financial burden of hospitalization, segmented markets and the coverage restrictions of public health insurance, has led to a greater emphasis on digital health solutions, diagnostics, and technology over the integration of the distinct EHR platforms (Garewal, 2015). However, to make care more accessible to the public, through home care based solutions like remote monitoring, diagnostic applications or Tele-health would require the seamless assimilation of these digital health platforms with the existing clinical platforms like the Electronic Health Records.

According to Britnell, every country in the world, aspires to provide satisfactory care, improve quality, while managing financial viability. The biggest hurdle they face has been in the form of transformation being only achievable through continuity and consistency. Currently, most health systems are struggling to employ value-based care that improves outcomes, by integrating technology in their processes to make care more efficient, and empower patients. Yet, providing this transformational change has not had a high success rate, and only limited incremental improvements. (Britnell, 2015)

As an antidote to this fragmentation, the most discussed concept in healthcare transformation presently is sustainable integration – combining information technology with existing health systems in a way that is financially viable, and effortlessly adopted by care providers and patients to improve long-term outcomes and quality of care. However, this integration faces severe resistance from Healthcare organizations, as it requires, a change in demands of work, incentives, and regulations under which they presently operate. As Britnell states, most healthcare organizations focus on patchwork solutions rather than re-inventing their business models. A more reactive approach to health care delivery has led these organizations to, concentrate their efforts on immediate problems over long-term ones, thereby functioning like disease-curing machines focusing only on the treatment of symptoms and diseases rather than holistically looking at an individual's health. For the change to be visible across the system, would require these healthcare organizations to break away from their institutional silos and culture focused on the transactional approach towards incremental improvements instead, take the onus of large-scale transformation on themselves. (Britnell, 2015).

First X ray made in public. Hand of the famed anatomist, Albert von Kölliker, made during Roentgen's initial lecture before the Würzburg Physical Medical Society on January 23, 1896.

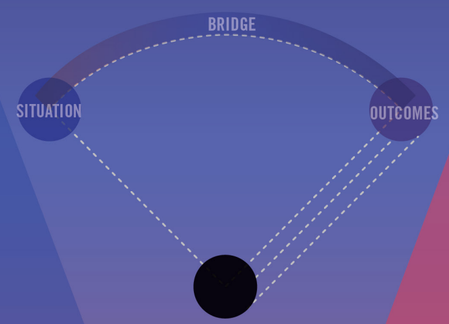
Fig.24 | Experimental use of X-Ray in 1896. Source (Assmus, 1995)

For this large-scale transformation to be successful would require the process of health-technological appropriation by care providers to go from mere adoption to embedding it in their daily practice (Bar, Pisani & Weber, 2007). With constant mobility and seamless connectivity, many health seekers are coming to their physicians with fitness measurements from their wearable devices, conflicting information on the web and treatment plans discussed on their social media groups such as online patient networks PatientsLikeMe.

With a substantial number of consumer technology companies venturing into medical grade platforms (Steenhuysen, 2015) (CBS News, 2014), there is an increasing need to integrate the large quantity of data generated from traditional devices like diabetes monitors and heart rate monitors with non-traditional devices like wearable and health monitoring applications on the phone to electronic medical records. While technology is not a source of apprehension for those venturing into the digital health landscape, the lack of product market fit arising due to the barriers to integration with the legacy systems in healthcare is a big cause for concern (Kubick, 2012). Added to this, whether a small family practice or a large healthcare organization, all are struggling to manage the multitudes of software systems that lack interoperability in speaking to each other.
(Kim, 2015)

A connected system that integrates clinical systems with extra clinical systems could soon become a useful approach for research and eventually a clinically relevant instrument (Champagne, Hung & Leclerc, 2015). Such was the case with X-ray's when they were first used in an experimental and investigative manner, with pictures of the patients being taken with many different conditions. (Howell, 1995) Indications of its application only became evident once the social system in which it was embedded adapted through "the harmonization of traditional health care organizations' policies and practices with the needs and practices of people, patients" (Liebhold, Maguire & Townsend, 2009).

With the increasing level of complexity of diseases and the ever-growing range of available tools, the healthcare system needs to find a way to package sustainable solutions to assist care providers, healthcare workers, health seekers and patients in navigating this environment. (Champagne, Hung & Leclerc, 2015)



THE
GAPS

What are the existing systemic barriers in bridging health data platforms that limit a seamless experience of care for health seekers and patients?

&

How might the evolution of a connected health system affect the experience of care for health seekers and patients?

Mapping Systemic Barriers & Signals Of Change

The journey from hypothesis to synthesis

"Truth is found neither in the thesis nor the antithesis, but in an emergent synthesis which reconciles the two." - (Hegel, n.d.)

Once the research question had been framed, a hypothesis map of the current systemic barriers and emerging trends was constructed; based on the knowledge gathered from literature reviews, digital health workshops, seminars, and conferences. Analytical tools like systems archetypes and stakeholder analysis helped establish stakeholders at all levels in the system.

The analytical tools also provided a context to evaluate the needs and the values of stakeholders to define the sampling pool for the sense-making interviews with the experts in the field. Through these sense-making interviews, experts shared their knowledge of the current system, the existing gaps, and needs as well as their vision for a connected health system. The excerpts from these interviews presented the validation required for many fundamental barriers identified in the hypothesis systems map.

Using the *Verge* scan, or the Ethnographic Futures Framework, the point of impact across people and human systems, including cultural points, was highlighted using key experiences from a human-centered perspective. The goal of the trend scanning exercise was to determine the critical uncertainties or the gaps that could have an impact on how the strategies would play out in the future and which strategic considerations should be contemplated before rolling out the strategies. The question was further broken down into the *Verge* domains to comprehensively analyze the points of impact across the system.

Based on the validation and the knowledge gained from the interviews and the signals gathered from the environmental scan, multiple iterations of the map were created, for the purpose of the synthesis, which formed the basis to delve deeper into the systemic analysis.

The Hypothesis and the Synthesis maps have been visualized in such a way as to give a holistic representation of the signals of change and the factors that limit the integration of patient-reported outcomes with clinically based outcomes. The map, a visual representation of the research, takes a two-pronged approach to assessing these barriers and the signals; by focusing on the scope or the subject matter through the Areas of Influence (read vertically) and the scale through the Sphere of Origination (read horizontally). The Sphere of Origination takes a social systems overview by analyzing the different systemic levels, from an individual (Micro), organizational (Meso), regulatory (Macro), to the societal (Meta) sphere, from which these barriers surface. From a systems perspective, considering the Area of Influence assisted in evaluating the sectors that are affected due to the challenges arising at different levels of the system. Since this research is situated at the intersection of healthcare, health technology, and the consumer technology sector, as a means to look at barriers holistically it was pertinent to examine the influence of the barriers in each sector and the impact of changes on the Healthcare system, digital health, and the consumer technology sector. As a means to streamline the analysis, the usage of the term barrier envelopes all the gaps, limitations or challenges while the term trends encompasses all change signals visualized in the synthesis and hypothesis map, which can then be located at the intersection of the Sphere of Origination and the Area of Influence.

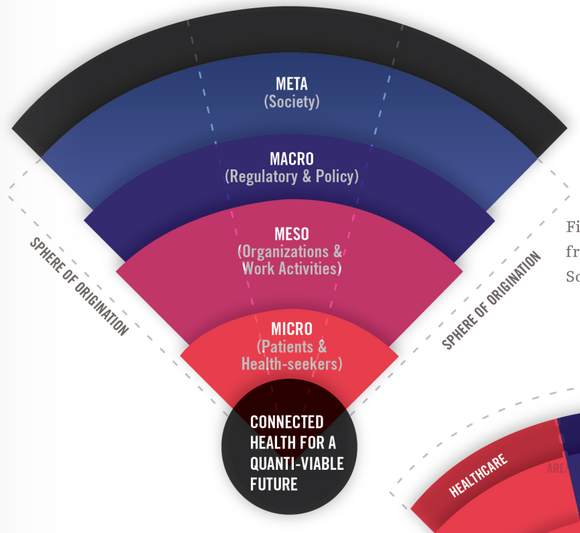


Fig.25 | Sphere of Influence adapted from the Social Systems Approach Source (Jones & Stein, 2015)

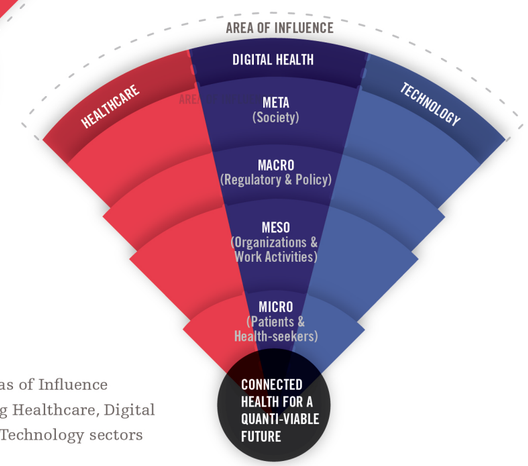


Fig.26 | Areas of Influence representing Healthcare, Digital Health and Technology sectors

Hypothesis Map – Barrier Mapping

Through a systemic analysis, assumptions about the barriers that limit the interoperability between clinical and extra clinical data platforms were formed. These assumptions were then validated through expert interviews, analytical and knowledge-gathering processes to reveal the recurring themes. This working model of the barriers map was then synthesized (Page 36) with the trends map (Page 34) to holistically analyze the challenges and the signals of change in the landscape of connected health.

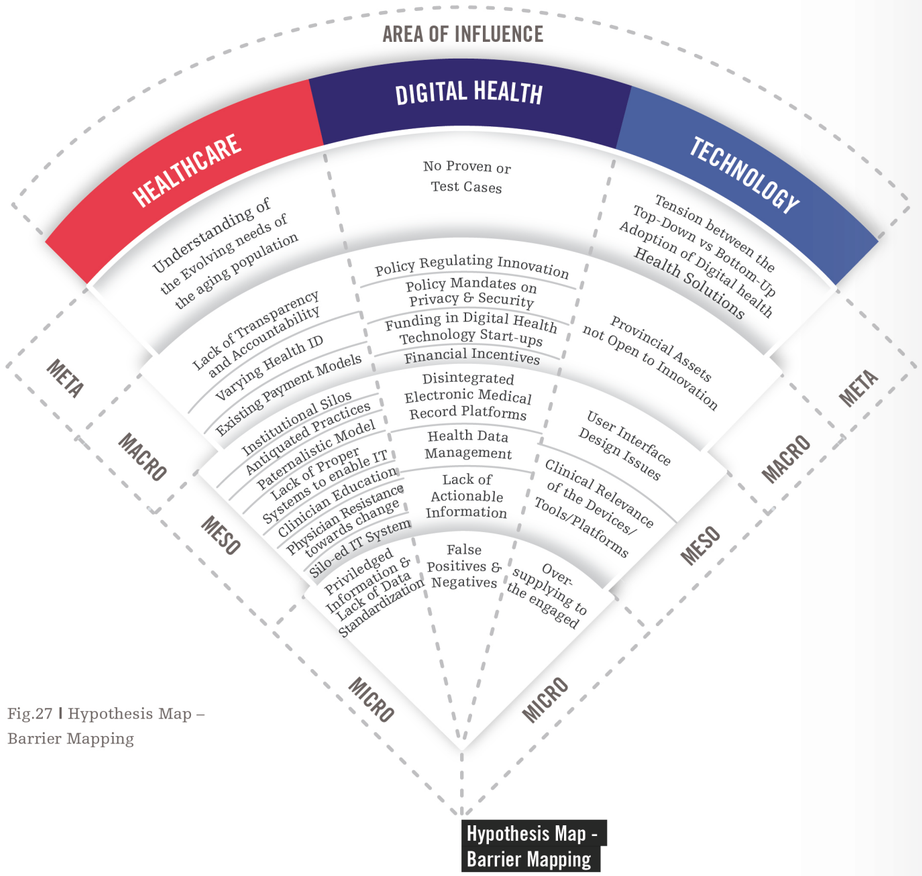


Fig.27 | Hypothesis Map – Barrier Mapping

Hypothesis Map – Trend Mapping

Signals of change at all levels in the system that could have an influence on the connected health landscape were explored through an environmental scan using the Ethnographic Futures Framework. These trends were then mapped based on their point of origin and the area where they would most likely have the maximum influence. This working model of the trends map was then synthesized (Page 36) with the barriers map (Page 33) to holistically analyze the challenges and the signals of change in the landscape of connected health.

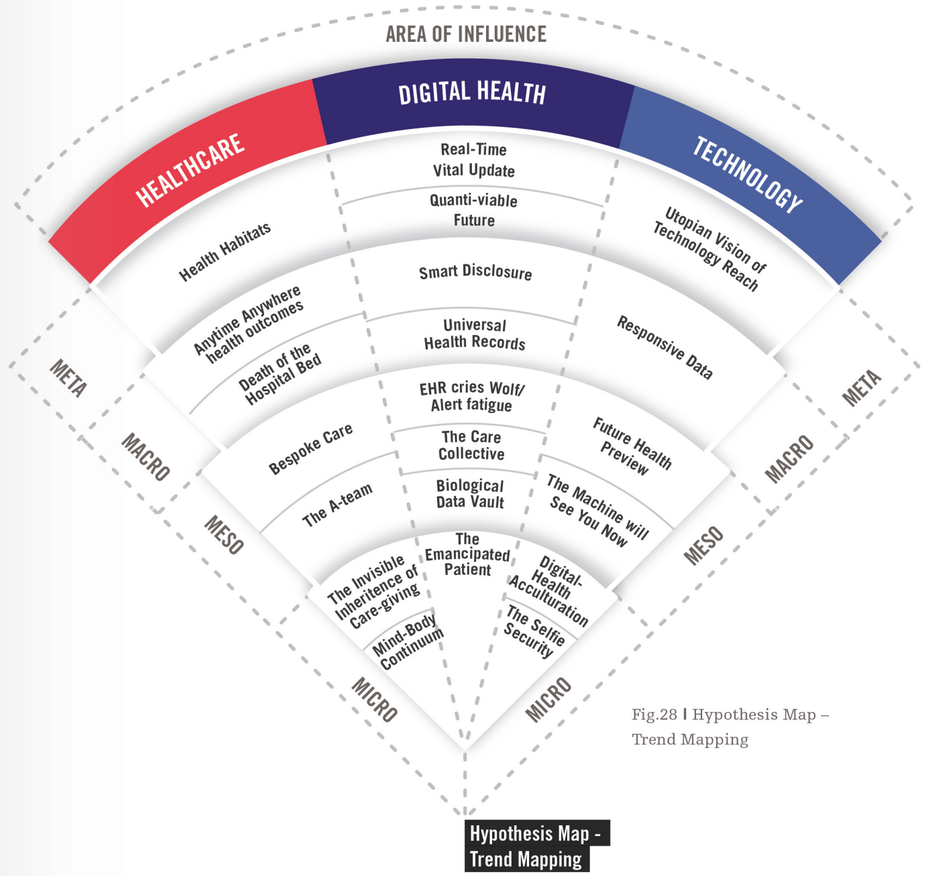


Fig.28 | Hypothesis Map – Trend Mapping

Synthesis Map – Barrier & Trend Mapping

The synthesis map integrates all the recurring themes and assumptions from the Barrier (Page 33) and Trends mapping (Page 34) to reveal the insights and foresight about the landscape of connected health.

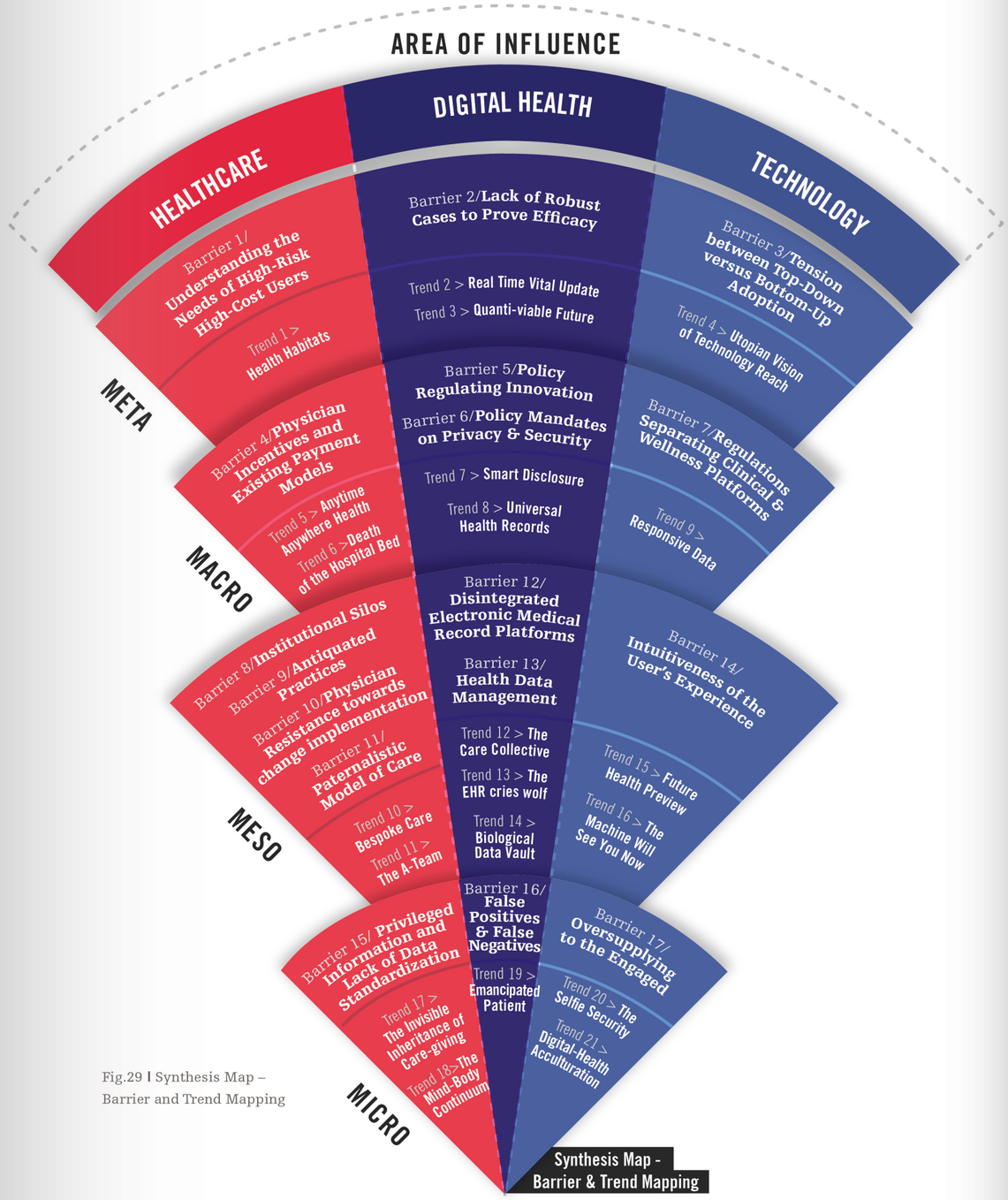


Fig.29 | Synthesis Map – Barrier and Trend Mapping

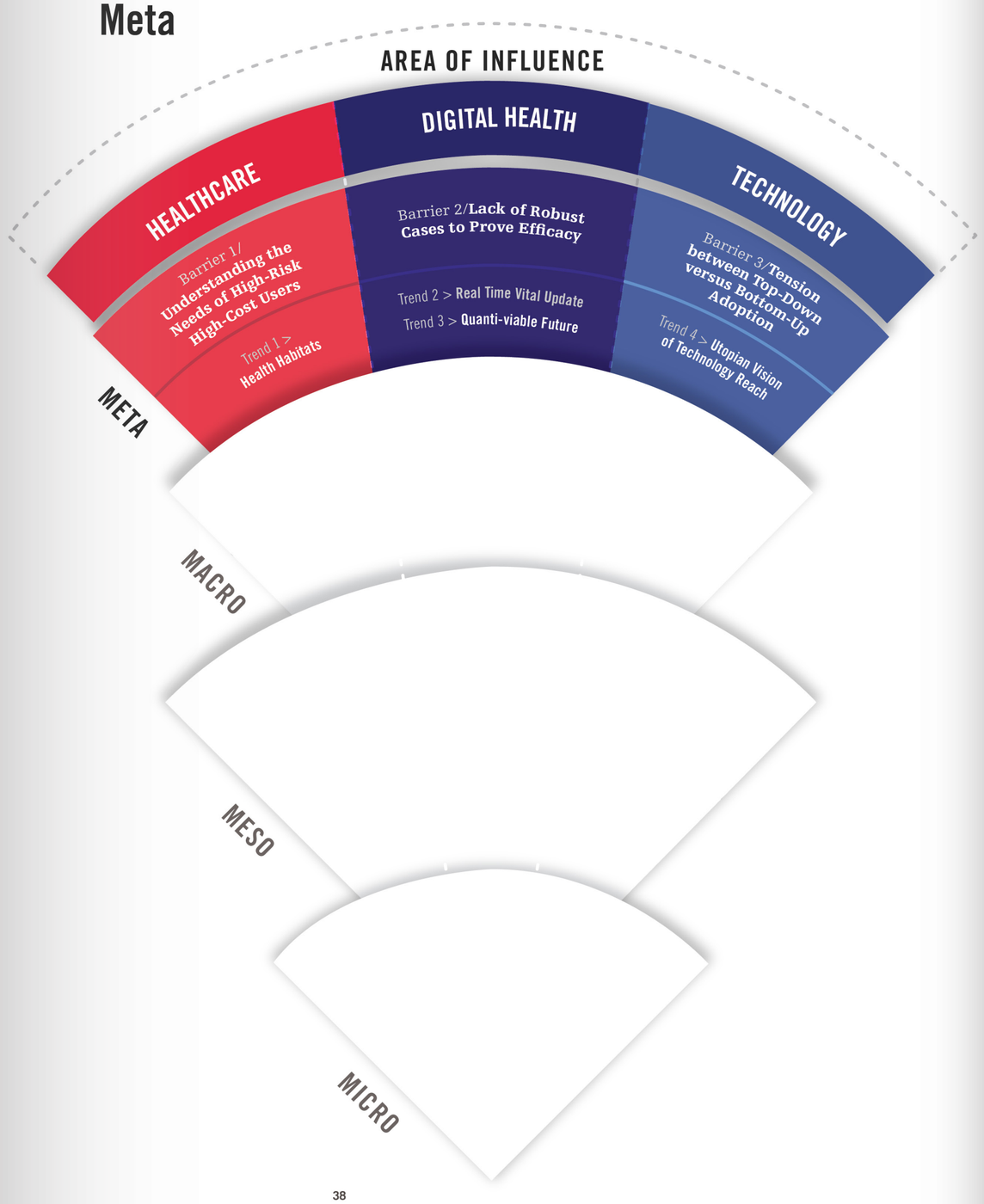
The Introspection & Extrospection

Framing the Problem

In the absolute reason all these ideas... are equally simple, and general.... In fact, we attain knowledge only by a sort of scaffolding of our ideas. But truth in itself is independent of these dialectical symbols and freed from the combinations of our minds.

- (Marx & McLellan, 1977)

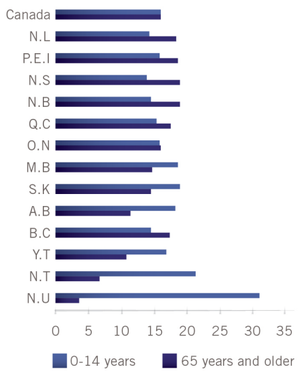
Meta



Barrier 1/**Understanding the Needs of High-Risk High-Cost Users**

"The big reason why caring for the top five percent is so expensive is that they get admitted to hospital. That's true for adults and kids. Hospital care is the most expensive type of health care … at least some of the five percent get admitted to hospital because they don't get adequate home care. Improving that could prevent hospitalization and save a lot of money. The patients that make up the five percent have illnesses that are vastly different from one another; each will have a different fix." – Canadian Medical Association Journal (Wodchis, Austin & Henry, 2016)

Fig.30 | Population comparison, aged 0-14 & 65 + in Canada
Source (Statistics Canada, 2015)



According to a recent report by the Canadian Medical Association journal, more than $30 billion in annual health expenditures, representing 75% of total government health care spending could be attributed to individual costs. One-third of high-cost users (individuals with the highest 5% of costs) in 2009 remained in this category in the subsequent 2 years. Most spending among high-cost users was for institutional care, in contrast to lower-cost users, among whom spending was predominantly for ambulatory care services. Costs were far more concentrated among children than among older adults. The most common reasons for hospital admissions among high-cost users were chronic diseases, infections, acute events, and palliative care. Although high health care costs were concentrated in a small minority of the population, these related to a diverse set of patient health care needs that were incurred in a wide array of health care settings. (Wodchis, Austin & Henry, 2016)

According to Statistics Canada data projections, seniors' aged 65+ will comprise one-fifth of the Canadian population by the year 2024. In response, most provinces are creating more home-based health services to contain the inflated costs of caring for the aged. However, improving the sustainability of the health care system, through better management of high-cost users, requires a better understanding of these users' clinical requirements and an analysis of the current strategies for vastly different needs of the high-cost populations. (Wodchis, Austin & Henry, 2016)

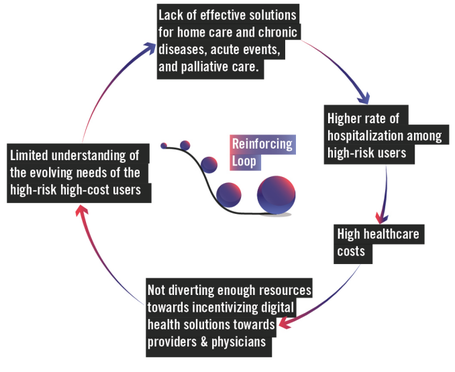


Fig.31 | Understanding of the Needs of the High-Risk High-Cost Users
Source - Adapted from Braun, 2002)

Trend 1 > Health Habitats

The future of medical tourism would be nations that not only provide quick and affordable treatment but also the ones that have a repository of medical stories, research capabilities and access to specialized technology helping bring in more patients and investors to generate revenue for their national health.

Trend Description
While the last decade was defined by those nations that provided quality healthcare at a lower cost, this new trend brings the shift as quality healthcare would be defined by nations that not only provide affordable care, have research and medical innovation capabilities but also view health from a holistic standpoint. A large factor would be for governments to incentivize outside investment in healthcare, for the creation of these health habitats as new medical proving grounds. Countries like Australia, Sweden, and Canada are constantly featured high among the most liveable countries, primarily due to the access its citizens have to government funded health care programs but also their reputation as medical research hubs. This trend could also be a way to attract research talent and investment in regions. Although, these countries face strict competition from their Asian counterparts in terms of costs, their distinguishable edge lies in reduced risk due to strong legal structures that protect patients. A huge incentive for governments to look into building themselves as health habitats would be the access to alternate revenue streams for their publicly funded healthcare. (Barnes, Levy & Lutz; Purdy & Fam, 2015)

> *…while the previous trend in medical tourism was built on low cost, the new one will focus on the value that consumers place on coordinated research & care systems.*
> - (Barnes, Levy & Lutz, 2015)

Signals
Provincial governments across Canada send patients, which cannot be diagnosed or treated in a timely manner, abroad. British Columbia (BC) government has signalled interest in creating BC as a medical tourism destination for other Canadians and foreign travellers, to tap into the potential of health system revenues. Examples would be patients considering bariatric surgery with the wait time estimated at over 5 years and the Saskatchewan government sending patients to BC to reduce surgical wait list time. Companies like Cambie Surgery Centre, Canadian Health Care International Corp and International Healthcare Providers make phone or online arrangements for international patients travelling for medical care to Canada providing services at drastically lower costs as compared to the US.

Extrapolation
Besides improvement in wait times, Canada becomes a research hub with investment funding opportunities arising due to its reputation as a Health research habitat. The patients from abroad, visiting as part of medical tourism, generate new revenue streams leading to added investment in follow-up care for citizens and seamless patient health information flow across borders. Additional product offerings that incentivize patients who are willing to travel for medical procedures.

Counter Trends
Liability risks arising due to complications of a procedure in a foreign country may require the patient to work through the host country's legal systems. Risks and liabilities of providing medical tourism insurance. Provincial policies for publicly insured travel for health care abroad.

Departure Question
How might connected health be used as a tool for collaboration and faster care delivery to make Canada a health research hub?

Design Principles
Universality & Comprehensiveness

Implications for
Meta + Healthcare Sector

Using wearable or extra clinical platforms as tools to collect and gather patient-reported outcomes for those suffering from chronic conditions like diabetes that requires constant treatment monitoring may further help in the quest to develop cost-effective outpatient strategies. Although the data analytics for these devices is still at a very nascent stage, the possibilities of discovering previously mysterious signs of ailments before the onset of symptoms could be a huge leap in disease management (Steenhuysen, 2015).

A strongly connected health data system would help ease dialogue and monitoring needed by providers, health professionals, unions, and particularly the high-risk high-cost users. Providing value and customizable care for individual health seekers, through usage of these collaborative tools and new market opportunities, may also result in faster delivery powered by the large-scale influx of investment from patients and providers.

Conceiving robust digital health strategies over stop gap solutions for the evolving needs of this high-risk high-cost population group would help prepare for more home care services with the healthcare system preventing high costs due to hospitalization. (Wodchis, Austin & Henry, 2016)

Supporting patients to become self-reliant in managing their health and wellness helps address the increasing cost and challenges facing the Canadian Healthcare system due to aging populations. The patient reported outcomes, derived from the extra clinical platforms and devices, could become tools to manage health data and generate insights about behavioral and disease management patterns for health related research, eventually, helping to keep individuals outside the walls of the hospitals.

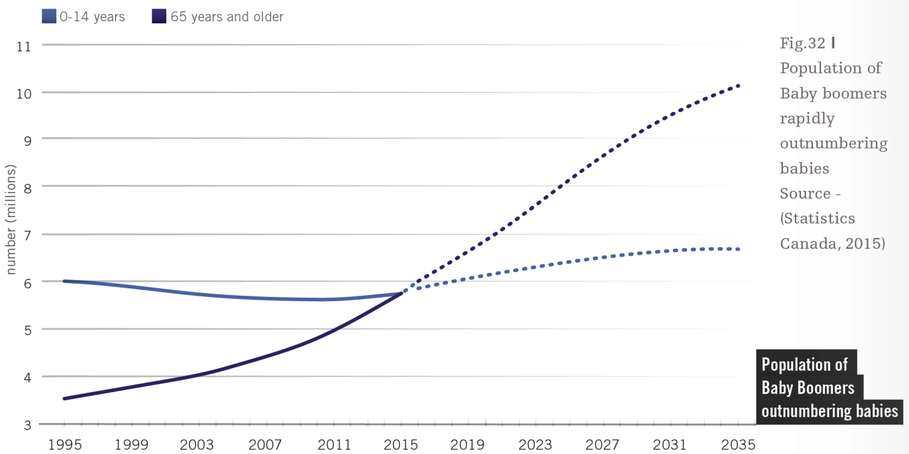


Fig.32 | Population of Baby boomers rapidly outnumbering babies
Source - (Statistics Canada, 2015)

Barrier 2/**Lack of Robust Cases to Prove Efficacy**

"Taking baby steps and that is by proving efficacy. … learn what it is and prove it and then we will be able to do this, in a way, of theoretically thinking something but proving impact. The big challenge is that what everybody says sounds great but it's not real till we prove it." - (Dwivedi, 2015)

Ontario is the testing ground for a variety of start-ups and technology companies, working in the space of creating novel tools for managing connected and distributed care through their digital health offerings (MacIntosh, 2015). A variety of these platforms, straddle both the clinical and the extra clinical side, by involving the physicians and the provider by integrating data from patient reported outcomes with clinical outcomes. These platforms and devices not only provide value for those with chronic conditions but also venture into the space of creating a communication bridge between physicians and patients for treatment and disease management. (Husain, 2015) Yet, despite there being a variety of test cases, the connected health data landscape still seems to lack successful precedents or a well-tested case for the integration of data from extra clinical platforms with clinical platforms. (Koh, 2015)

As much as capturing the data from patient reported platforms has benefits, the challenge the integration of health data platforms is facing right now is in finding a way to demonstrate the utility to a specific patient population (Key Informant, 2015). Augmenting this gap is a lack of substantially supported research. This could provide a healthy rationale behind making the case for patient-reported data to become an additional support tool that is valuable for clinicians, eventually helping them achieve clinical outcomes that are more effective. (Koh, 2015) However, this value does not need to be recognized in the form of a compelling need for clinical purposes only. A successfully integrated platform requires having a viable business model that would make sense for all the parties involved. (Koh, 2015)

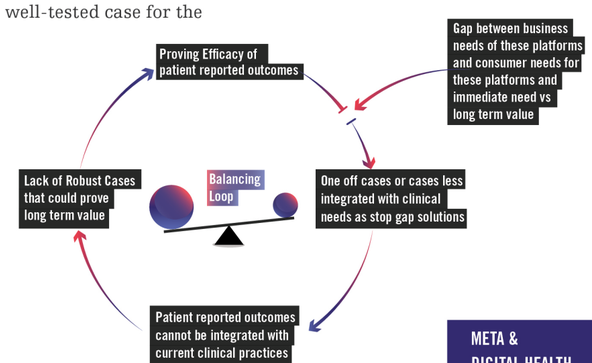


Fig.33 | A Balancing Loop signifying the lack of robust cases to prove efficacy
Source - Adapted from Braun, 2002)

Trend 2 > Real Time Vital Update

Emerging technology solutions that not only provide instant health data checks but also power health seekers by assisting them in proactively managing their health. For physicians, data-driven diagnosis (Moffat, 2015) tools could help monitor and encourage patients to bring about behavioural change or even assist them in medical procedures.

Trend Description
Technology disruption in healthcare has found beneficiaries in consumers, patients, and physicians alike, by providing solutions to life-threatening problems efficiently and effectively. The wearable, ingestible and sensory technological innovations are not only valuable for monitoring patient fitness and initiating behavioural change interventions but are being used to communicate patients vital measurement mid-surgery hence resulting in saving lives instantaneously. Now more than ever health seekers are open to utilizing these systems with 70% of people receptive to using toilet sensors, prescription bottle sensors, or even swallowing health monitors (Fisher, 2013). This trend when adopted in emergencies or in developing countries could help connect doctors with patients to solve urgent fundamental problems without requiring significant financial investments. (Lechner, 2015) (Intel, 2013)

> *Erica Kochi, the co-founder of UNICEF Innovation, has talked of wearables which are "not just nice to have, but that people need to have...*
>
> - (Forrest, 2015)

Signals
Low-tech wearables, like the multi-coloured arm measuring tape which shows a child's nutrition intake; the Embrace infant warmer – a sleeping bag containing a wax-like substance to help prematurely born babies regulate their temperature; Vivi, a wearable that pops over one eye to instantly deliver patient vitals and supplementary materials to doctors mid-operation. Google glass assisting in surgeries in developing countries with the help from doctors in the US. Nano technology and ingestible monitoring systems foreseeing health issues.

Extrapolation
Medical devices synchronized with the phone could reach out to doctors anywhere in the world offering consultation fitting into the larger trend of anytime, anywhere health. Augmented reality based platforms are the next domain for innovation in healthcare. Eventually, wearable devices will utilize their superpowers for good, particularly, in developing countries.

Counter Trends
Ensuring consent for wearable data collection; Privacy violation due to unauthorised collection of medical data from those using these devices.

Departure Question
How might real time data streaming from these emerging technologies connect with clinical data platforms to help physicians and health seekers be equal partners in providing a seamless experience of care?

Design Principles
Portability and Accessibility

Trend 3 > Quanti-viable Future

An existence made of data that is collectable, readable, and changeable. Despite being functional by providing insights into behaviours and physiology, these devices clearly lack a value proposition when it comes to understanding the medical validity of the collected data.

Trend Description
Once the domain of early adopters, sensors, and wearables, are now increasingly the new accessory of middle-income demographics monitoring their everyday existence. Despite being enablers for quantifying health related information and powered with the ability to measure physiological data, that could help advance health interventions outside a traditional health setting; the data from these technologies is hardly considered usable in a clinical setting. Added to that, the process of gathering data comes down to the matter of convenience and keeping people motivated to be constantly armed with these devices. Although it has been successful in making its user more active than usual, one of the short-term problems for trackers is that they are not actually reliable enough to be medically useful to manage chronic conditions (Rosenblum, 2015). The sorts of measurements from these commercial technology products tend to only focus on vague metrics that could just as easily be inferred from a short interview or basic examination. Resulting in the growing debate about the validity and value of this data. Furthermore, there is a lack of understanding whether all this data gathering is indeed about health management and medical advances; or does it only serve the purpose of demystifying previously unknown intricate functionalities of our body. (Petersen, 2015), (Thomsen,2015)

> *Tracking behaviours, just seven years ago were the strangest thing you could think of to do, have gone mainstream*
>
> - Quantified Self founder Gary Wolf

Signals
Advertised as health and wellness brands, health-related consumer technology like FitBit & Apple watch never guarantee weight loss to users. Devices like Fitbit have not been clinically validated to perform at the same standards for reliability that the U.S. Food and Drug Administration uses for medical devices, such as the traditional blood pressure cuff in a doctor's office. Consumer wearables are marketed under the FDA's less rigorous "wellness-focused" rubric. (Rosenblum, 2015) Besides hardware issues, the user reviews point to them having questionable utility in terms of accuracy of data gathered.

Extrapolation
Living in a future made of connected devices that assist humans to move seamlessly, eventually, individuals becoming slaves to these devices due to the diminishing ability to think on their own. The data from these devices will be the property of employers, government, and law enforcement agencies. Rather than provide the benefit of freedom of monitoring health on the go, they might end up restricting and barring it. The simplicity of this seamless existence, although alluring, brings with it a no holds access to our lives ultimately managing to blur the lines between private and public.

Counter Trends
Big Brother is watching; Quantifiable Future

Departure Question
How might viable data be generated, from consumer technology platforms, so that when it is connected with clinical data platforms it provides actionable information to health seekers?

Design Principles
Universality and Comprehensiveness

Implications for
Meta + Digital Health Sector

The data from these emerging technologies has been largely extra clinical and is not considered accurate by care providers to deliver diagnosis or treatment. Nevertheless, technology companies have been successful in using these devices to generate useful insights about consumer behaviours and needs. For the healthcare sector, these emerging technologies have managed to relocate diagnosis from a healthcare setting to anytime anyplace and hence reshaped the relationship between care providers and health seekers.

For the data, from these health-technology platforms, to be worthwhile, would require it to be valuable to care providers and health-seekers alike. A major challenge ahead for these consumer products is to connect and provide meaningful information to those who are apathetic rather than the ones already engaged. Although, research and resource investments are underway for a variety of digital health platforms, an understanding has to be created to develop an appetite for taking risks, as there might be many bad gambles before finally getting the right one. (Dwivedi, 2015) Thus, continuous pilot projects need to be undertaken, around usability in the medical landscape; the consideration for patient needs and for the facilitation of better healthcare from the health-seekers, patients, clinicians, providers, to the policy designers.

The effectiveness of the patient-reported outcomes into the clinical practice of primary care physicians and specialists would allow for its validation in diagnosis, treatment planning or goal setting for a patient or health-seeker. This substantiation in the form of a well-demonstrated and researched case, could assist in establishing the value for health data integration as the absence of a robust case would result in the lack of evidence-based value that is crucial to propelling policy frameworks towards the integration of the health data system. Hence, by establishing long-term value through a scalable model, the re-evaluation of the policies around the adoption of patient reported outcomes in the clinical practice would be facilitated (Taylor, 2015). Eventually, the tangibility of the outcomes would generate value, resulting in increased approval and need for speedy clinical adoption (Moffat, 2015)

Barrier 3/**Tension between Top-Down versus Bottom-Up Adoption**

"There are real gaps. Some leadership, both, from top down and from the grassroots up to make a compelling case why this linkage would be beneficial that would require every stakeholder patient, caregivers, researchers, health care professionals, busy clinicians who couldn't really care much about the research value of that data, at least not immediately." (Husain, 2015)

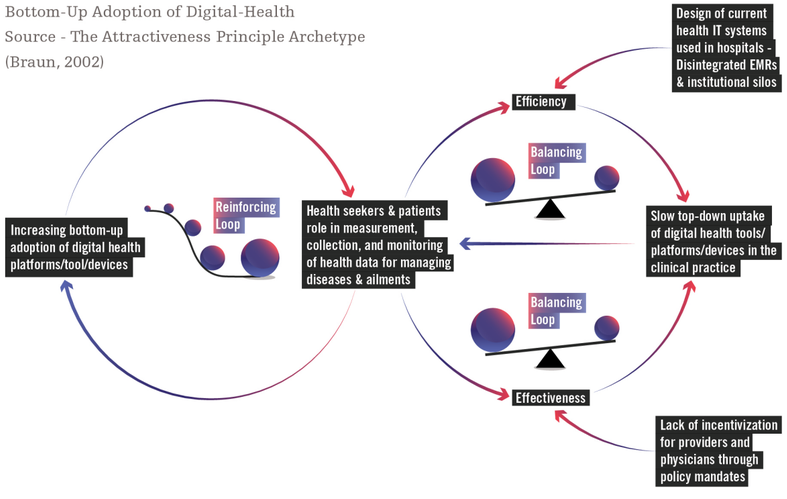
On a global scale, there has been an expanding market for consumer health monitoring and wellness based mobile technologies with a rapid pace of adoption by patients and health-seekers to self-manage their health (introduction to this research - Page 9). This grassroots propelled adoption is not only something visible in developed countries but the ones pioneering this movement are individuals in the developing countries. Like every other country, Canadian healthcare system has embraced a variety of self-monitoring devices and platforms (Husain, 2015), through small pilot projects for Asthma, pulmonary functions, and Diabetes being tested by clinical care teams. However, most decision makers are skeptical about the clinical applicability of these tools to inform care, to intervene or preempt patient hospitalization and emergency room services. (Key Informant, 2015)

In Canada, the uptake from the provincial or institutional level is happening sporadically; with the existing systems certainly not designed in a way for it to happen, cohesively (Key Informant, 2015). A large factor for the cautious adoption has been due to the fact that instead of coming top-down from the institutions themselves the spread, of mobile technologies as health monitoring tools, is coming from bottom up with the patients using it to supplementing their care with or without the recognition of healthcare providers and clinicians. (Liebhold, Maguire & Townsend, 2009)

The disruptive impact of patients using mobile health technologies with or without physician recommendation has led to the rethinking of the model of delivery of care using high-cost medical technologies and the need for outpatient strategies. This resistance to implementation of new technology stems from a few basic factors. One is about physician resistance to the deployment of new technologies en masse arising due to the lack of physician incentivization from a policy standpoint, and a dearth of proven cases that help understand how to include them in their practice. (Howell, 1995) (Liebhold, Maguire & Townsend, 2009)

The current environment in healthcare has led to the belief that this is a patient driven need, which has resulted in most healthcare providers, and policy specialists viewing it as a budding concern not requiring immediate action. Though the uptake of mobile health technologies stems from the ground level up, for it to be an effective tool for managing health and to be clinically relevant, would require a collective momentum building by strong leadership from the top level (Husain, 2015)

Fig.34 | The tension between Top-down & Bottom-Up Adoption of Digital-Health
Source - The Attractiveness Principle Archetype (Braun, 2002)



Trend 4 > Utopian Vision of Technology Reach

The growing tension between providing these smart devices and health platforms to those that are interested versus those that actually need it yet lack the interest or the technical capabilities to use these digital health platforms.

Trend Description
The increasing number of smart devices and digital platforms, for those interested in health data monitoring, generate millions in revenue. However, the question remains if, these digital health products are indeed reaching those that need it the most or lack the interest or technical capability of managing these smart devices. The user base, for which these devices can be most useful for, are either the developing countries - financially incapable of affording them or the aging population - lacking the technical knowledge or the interest to learn how to use these devices. Added to this, the user interface competencies of these devices are not suitable for those with vision problems or the aging demographic. On the physician's side, the usage patterns are highly alarming bringing to forefront this disconnect between reality and projected vision of technology reach.

> *Whether the barrier is doctor buy-in or patient compliance, guiding or advocating any pattern of adoption will take a nuanced understanding of the desired users and their motivations.*
>
> - Avery et al., 2010

Signals
According to 2014 National Physician Survey, 82.9% physicians reported that they do not recommend health-related mobile apps to their patients while 50.7% physicians disclosed they themselves did not use any mobile apps for their practice. One-third of the U.S. consumers who have owned these devices stopped using them within six months of receiving it. A recent MIT Technology Review story found doctors from a number of specialties unsure about what to do with the data many of their fitness tracking patients are bringing them.

Extrapolation
A digital divide with an, even more, fertile landscape of fitness and wellness related platforms and devices for the interested while those that need it either do not bother or financially incapable of reaching it.

Counter Trends
Privacy and consent laws, oversupplying to the engaged

Departure Question
How might bridging health data platforms make the utopian vision of technology reach a reality as a means to create a seamless experience of care?

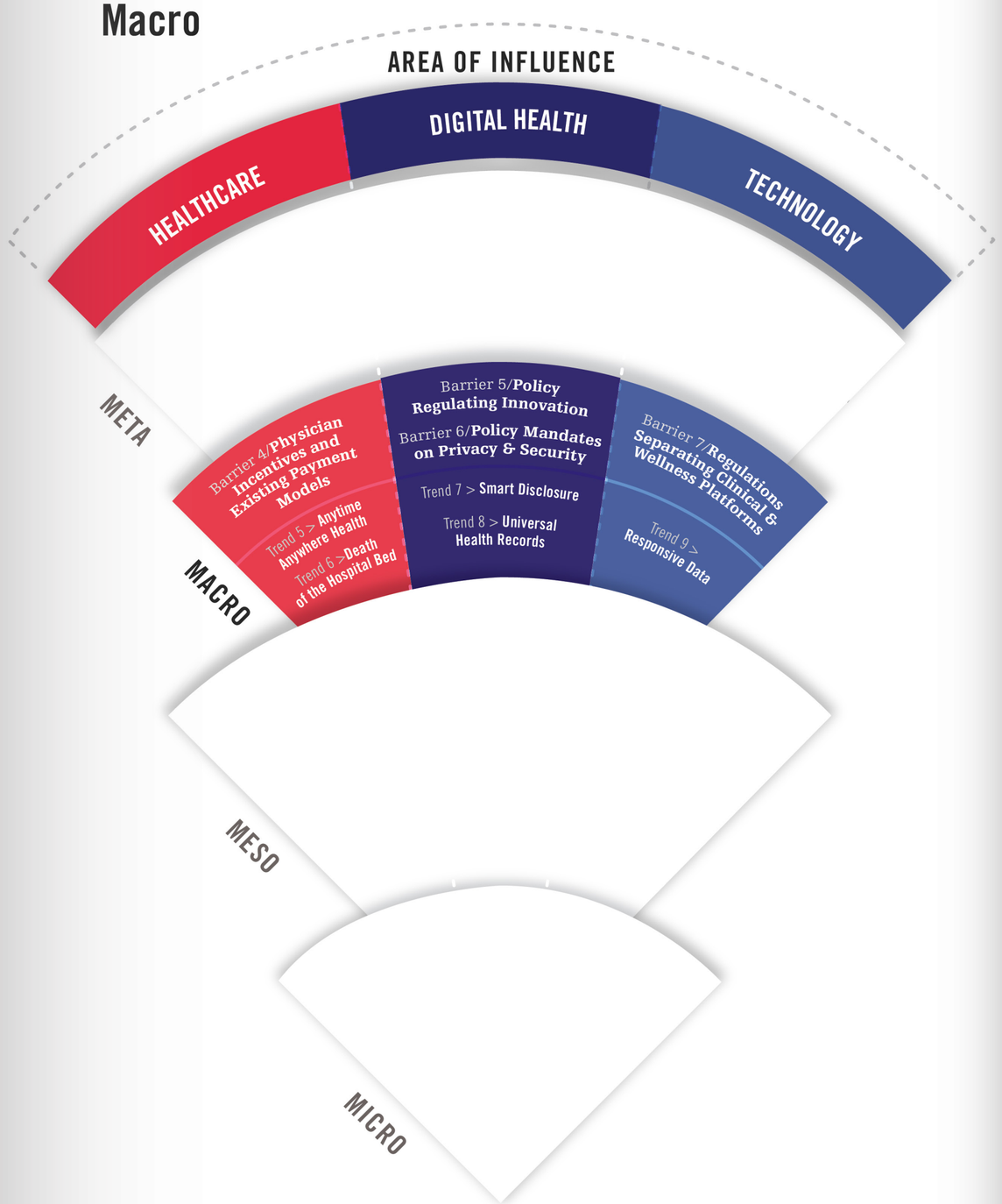
Design Principles
Universality & Accessibility

Implications for
Meta + Technology Sector

The healthcare system struggles considerably with ongoing and effective data collection for treatment purposes. For technology companies, understanding their user base would help build strategies to connect with those who need it the most, in turn, assisting them in positively validating their prized inventions. Linking patient-reported outcomes with clinical data platforms could be a powerful opportunity to efficiently and longitudinally provide for the needs of the patients and health seekers across the system. (Husain, 2015)

Healthcare, at the end of the day, is a service industry catering to the taxpayers who are its customers. Involving the patients and empowering them with tools that could make them active participants in managing their health through access to seamless services could bring about the much-needed shift in transforming the current system. (Muzyka, Hodgson & Prada, 2015)

Macro



Barrier 4/**Physician Incentives and Existing Payment Models**

"Until you try to fix the policy and get health-care providers to care more about quality and cost, people aren't going to move as quickly about it ... " – Joshua Liu, Seamless MD (Nowak, 2015)

In Canada, the fee-for-service model pays most physicians based on each service they provide. This paid by the transaction (Rakowski, 2012) based approach caters to providing more accessible care is comparatively easier to manage and enforce and focuses on the number of patients rather than the quality of care. In Ontario, particularly, the payment practice based on patient volume per doctor has helped in higher physician retention and enrollment, team-based treatment, and drastic reduction of health-seekers that are not in the care of family doctors. Yet, this payment approach has led to major accountability gaps and little emphasis has been paid to monitoring physician performance, affecting the overall objective of the system. (Conference Board of Canada, 2014)

With the exception of the United States, Canada's expenditure on its publically funded health care program is more than that of its close comparators - Australia, the Netherlands, New Zealand, Sweden, and the United Kingdom. Yet, Canadian health-seekers and patients rate their experience poorly due to the longer wait time for pressing clinical conditions and lack of seamless access to care. The Canadian taxpayers' investment in the current system does not seem to reflect the necessary return of their money, due to the little to no cost transparency, system performance, and quality of health outcomes. (Rakowski, 2012)

Despite, this, growing understanding of the symbiotic relationship between funding and quality, the current funding models are still financed based on volume, with very little incentives for healthcare providers to adopt digital health technologies that could help improve communication and coordination between care providers and patients or health-seekers, eventually improving outcomes. Joshua Liu, the co-founder & CEO of SeamlessMD - a digital health company in Canada, points out that the current model of requiring a healthcare professional for doing everything is not scalable. Digital startups are not being used to their full advantage to provide safe and efficient care (Liu, 2014).

In contrast, the performance mandates for Affordable Care Act, in the US, has led to a shift in their funding model from fee-for-service for patient hospitalization to a more value-based payment structure by penalizing providers for patient readmission. (Steenhuysen, 2015) Although the medical system in the US is hardly one to emulate (Fig.22 – Page 25), the key force driving digital adoption, there has been the aggressive push for value-based healthcare, providing financial incentives to doctors and hospitals to keep large patient groups healthy and out of the hospital. In the U.S, the imposition of the pay-for-performance guidelines has led to massive investments, trials, and adoption of new digital solutions in the fear of losing money. (Liu, 2014)

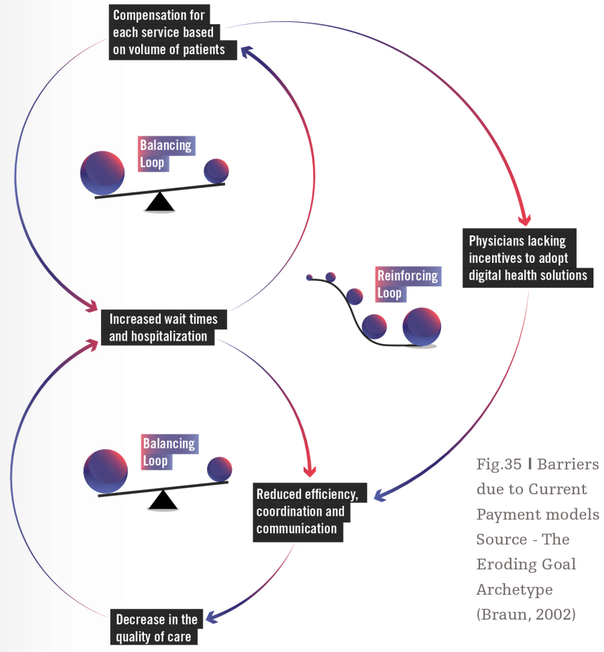


Fig.35 | Barriers due to Current Payment models Source - The Eroding Goal Archetype (Braun, 2002)

Trend 5 > Anytime Anywhere Health

Mobile health platforms have made consumers rethink the role of place in health management, generating new expectations for health in the home, the workplace, and the community.

Trend Description
Mobile platforms are spearheading the movement to practice health management at any place, resulting in the collapse of the bricks and mortars healthcare framework and expanding points of care. In the banking and financial sector, mobile and distributed platforms like ATMs and the web not only expanded service touch points but also helped reinvent the business model of how services are delivered to the users. (Liebhold, Maguire & Townsend, 2009) This rethinking of distributed platforms is not only limited to having touch points for healthcare delivery at convenient locations but also the ease of access to one's health management options. Mobile EHRs, wearable and ingestible devices will reduce the need to visit hospitals and physicians resulting in the creation of an ecosystem of service delivery solutions that enable health seekers to achieve health outcomes where they live, work, or play. (Mars, 2015)

> *72% of those surveyed would be willing to see a doctor via video conference for non-urgent appointments*
>
> - Intel Corporation, 2013

Signals
Ingestible monitors by Proteus Biomedical that sense and record when a patient takes one or more microchip-enabled drugs using electric charge generated by the patient's stomach acid. The wearables revolution with apple watch and Fitbit providing constant monitoring of consumers physiological data. Heal, Doctor on Demand, Pager in the US and Equinoxe Virtual Clinic, Canada offering patient-driven video-based physician appointments. In Canada, British Columbia is the only province with a code for doctors being paid their standard fee for the virtual consultation. ('White Coat, Black Art', 2015)

Extrapolation
Health ATMs located everywhere that get real-time information transmitted from wearable devices and connect to physicians in case of emergency; Electronic ICU's where physicians and nurses reach out to home-based patients via a remote command-and-control center.

Counter Trends
Stricter Privacy Policy; Hackers of these health data platforms; Remote meetings where attention drifts off; Lack of personal connection between patients and doctors combined with the struggle to share treatments and understand symptoms visually across this virtual divide.

Departure Question
How might bridging the gap between the clinical and extra clinical health data platforms assist in providing anytime, any place access to health for health seekers and patients?

Design Principles
Portability

Trend 6 > Death of the Hospital Bed

Emerging technologies, increasing costs and the misutilization of hospitalizations have made the physical structure of a hospital an archaic and an obsolete model.

Trend Description
The changing demographics of a vastly aging population has highlighted a desire to care for the elderly at home bringing to attention the growing pains of hospitals aiming towards comprehensive outpatient strategies. Coupled with that, maintaining a hospital infrastructure drains investments and solutions like increasing the number of physicians and diverting academic research funding to balance operational costs not being viable alternative strategies. The lack of traditional hospital structures in developing countries has revealed innovative ways of making care accessible while being financially feasible. According to a survey by Intel Corporation, 57% people surveyed felt that traditional hospitals would be obsolete in the future (Intel, 2013). Emergent technologies are also assisting in building a more fluid health care system and helping to shift the mindset of hospitals being a locus point of change.

> *Care must occur at home as the default model*
>
> - Eric Dishman, Intel Global Manager of Health and Life Sciences

Signals
Mobile Healthcare, At-Home care for Elderly, Openness of people in emerging markets such as Brazil, China, and India of using health monitoring technologies more than those in technologically advanced economies like Japan and the US.

Extrapolation
Community & family care health service model; My personal space for care; Home - A constant reminder of death & dying

Counter Trends
App-skepticism; Hospitals for hypochondriacs; Everyone is a doctor

Departure Question
How might the disintegration of the antiquated hospital structure create a more conducive environment for bridging the gap between consumer technology platforms for seamless self-managed care?

Design Principles
Public Administration

Implications for
Macro + Healthcare Sector

With current privacy regulations acting as a major roadblock to accessing healthcare at convenient places, integrating EHR's/EMR's would be the initial hurdle to cross. For data from the various medical platforms to be meaningful for medical analysis would require care providers to have a frame of reference and usage of standardized terminology, which is understood by health-seekers and care providers alike. Technology serves as a conduit to making self-managed care more easily accessible, with people being equally involved in their health and disease management. Shifting the burden of care entirely from hospitals to technological interventions is probably not the complete solution to the problem of increasing costs on the healthcare system.

The experience, of various countries, with a single pay model (Rakowski, 2012) (Conference Board of Canada, 2014), reveals that each model has certain advantages and disadvantages based on the environment where they are applied. For the Canadian healthcare system, getting closer to the right blend for each context would be a better approach. (Conference Board of Canada, 2014) The combination of different pay structures would help minimize drawbacks of each model by focusing on amplifying the benefits of each. Eventually, by encouraging quality over the financial value and aligning the motivations of doctors, patients, and health seekers could facilitate in the seamless delivery of care through these easily accessible tools. (Conference Board of Canada, 2014) (Rakowski, 2012) These improved outcomes could help build a sustainable healthcare system.

Barrier 5/**Policy Regulating Innovation**

"Innovation is you are doing something in a time where not everything is proven out … you can go back a different path, retrench from the path, might take a different path. The challenge we are facing right now, is that if the policies allow us to innovate? Innovations are not a sure thing. It is a bet. You have to place many bad bets before you get a right bet. Investments are happening, policy decisions will be changed; it is going to take a lot of time and money. What we need is a tolerance for guessing." - (Dwivedi, 2015)

The increasing mobility is empowering people to use technology, in unique ways, paving the path for facilitating a culture of innovation in most sectors and organizations. Despite its size, strength, and investment involved, for a long time in most nations, healthcare sector was considered unappealing and impermeable to technology innovators – "*the entrepreneurial equivalent of Siberia*" (Kocher & Roberts, 2014). Creating a conducive environment for innovation led to greater focus on the need for a systemic overhaul of current policies and practices to shift from high investment based fixed technology to lightweight technologies requiring low financial capital. (Liebhold, Maguire & Townsend, 2009)

For many years, Canadian entrepreneurs cited a lack of resources in the country's venture capital industry, which is younger than its American counterpart. Limited resources for start-ups, caused companies to address immediate needs instead of long-term impending issues, early exits or premature product launches, and greater difficulty in attracting a talented workforce. (Unknown source) However, the exceptional rate of mobile health technology adoptions and growth of the sector resulted in the creation of a more favorable environment for digital health start-ups and foreign investment with provincial governments across Canada investing heavily in technology sector, particularly health technology, as a means to tackle the impending signals of change (Garewal, 2015).

Yet, Canada lags behind in adopting innovative technologies in it's healthcare practices, with sub-par strategies by providers to incentivize their adoption (Muzyka, Hodgson, & Prada, 2015) Part of the problem stems from some platforms on the clinical side, mainly provincial assets not open to innovation, even to the people working on them from the inside like researchers and clinicians. (Dwivedi, 2015) This, brings to focus the fact that, currently, in healthcare organizations there is more talk of innovation and less action (Frommeyer, 2015)

Healthcare is an industry reticent to taking risks, which is, a pre-requisite to building a culture of innovation. There is a sense that one wrong step will set it back by several years. However, this political risk of failure is costing the system immense value, which could be gained by integrating data platforms. (Moffat, 2015)

Due to the investment involved in technology companies venturing into healthcare, there is a pressure to cater to short-term needs over long-term ones. By not acting on time for the current needs of the system, the technology companies take big risks. As each innovation wave will result in, bigger disruptors replacing old ones, with more data produced forcing the healthcare, technology, and digital health sectors to either tackle the existing incompetence by creating value for all stakeholders or become irrelevant in the future. (Kocher & Roberts, 2014)

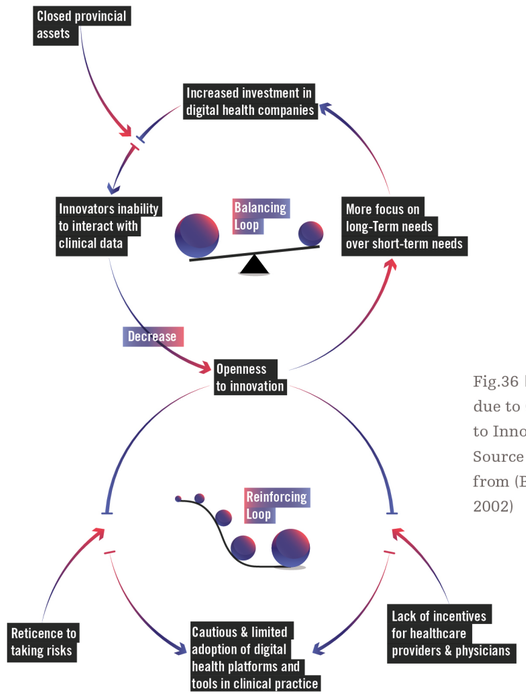


Fig.36 | Barriers due to Openness to Innovation Source - Adapted from (Braun, 2002)

Barrier 6/**Policy Mandates on Privacy & Security**

"… a lot of energy and time has gone into keeping it separate. You have to understand that the system is built this way by design, to separate the two spheres." (Husain, 2015)

Among the major obstacles blocking the adoption and the use of even basic digital health platforms and tools along with limiting the integration of patient-reported outcomes with clinical outcomes, are the concerns about privacy and security infringements. The current policy mandates around privacy and security issues have resulted in substantial confinement of progress in healthcare, that could help speed processes, inform protocol, reduce the workload of clinicians and healthcare workers, increase the necessary communication and coordination among the different physicians and specialists; eventually helping to improve health outcomes. (Muzyka, Hodgson & Prada, 2015)

$500
The value (in US$) of an individual's health-care dossier, in the black market. Exceeding that of credit card information. (Nowak, 2015)

However, these concerns about privacy and security cannot be assumed as being baseless and are, in fact, a valid threat to patient safety. According to a recent report by Blackberry, the value of an individual's health-care dossier, in the black market, is about $500 (U.S.) exceeding that of credit card information; with a review of more than half of the Canadian healthcare organizations revealing that cases of mobile device data breach has increased drastically in the last year. (Nowak, 2015) These hacks are now becoming more common, with a recent case in a Los Angeles hospital, where their computer network was held hostage by hackers, who infiltrated and disabled it until a ransom of 40 Bitcoin ($17,000 US) was paid (Barrett, 2016). Although, there was no evidence of any patient data being compromised; patient care was affected, as there were emergency room delays, ER patients had to be diverted to other hospitals; and all registrations and medical records had to be processed manually on paper. (O'Neil, 2016) The facility was also without access to email, digital patient records, and some internet connected medical devices.

In Canada, every province has it's own healthcare legislation, with each province setting up their own privacy legal guidelines and standards. The involvement and application of regulations, by the Canadian federal government, are only in the cases where the provincial laws do not reflect federal standards arising from the substantial differences in the way various provinces approach health information privacy. The privacy laws are monitored and enforced by data protection authorities called Privacy Commissioners, who have the authority to issue rulings and penalties with some violation judgments and issues resolved by courts. Laws regulating

commerce, healthcare, and other sectors are interpreted and enforced by Information and Privacy Commissioners at the federal and provincial levels. The role of the federal Commissioner is to administer commercial activities while that of the provincial Commissioner is to oversee provincial government territories including health care. This segregation into domains to monitor activities and regulate standards on different levels has led to a high-level of oversight in terms of privacy awareness among government and corporate employees. (Hassan, 2016)

Although, provincial laws are mostly consistent with each other, in primary healthcare related issues, some vast differences exist such as in initiatives that cross provincial jurisdictional boundaries, cloud information management solutions, Telehealth for home care, and mobile health applications. (Hassan, 2016) This integration of health data problems and the corresponding privacy and security concerns can be seen as a complex wicked problem (Buchanan, 1992), in itself. For the integration of health data platforms, the security and privacy compliance issues can be further broken down into a few different aspects – Health Data Ownership, Health Data Access, Health Data Sharing, and Health Data residency.

Health Data Ownership

One of the most controversial and debatable issues remains that of health data ownership, with a variety of viewpoints stating whether the patients (Koh, 2015), the physicians (The Canadian Medical Protective Association, 2016) or the Ministry of Health in Ontario (Moffat, 2015) in fact, own the data. According to Ontario's privacy commissioner, the patient records belong to the patient, with service providers and doctors as custodians (Arellano, 2016). However, the Supreme Court of Canada (McInerney v. MacDonald, 1992), established through one of its rulings that although physicians own the physical medical record, patients have a general right of access to the information in their record.

Health Data Access

Currently, the integration of health data platforms is not encouraged by the policy frameworks, with general professional policy directives discouraging integration due to the concerns around data quality and questions about access issues to prevent data corruption of the medical records. Jerry Koh states that even if there was a legislation that would encourage integration, currently, there are no proven cases to substantiate issues around patients' access to the data. This makes the problem particularly nuanced. As noted by Ian Hunter, systems architect with Microsoft Health Vault, finding ways to make data access less complicated as a means to collect and track information, while delivering it back to providers and physicians in a secure and private way requires going through necessary and appropriate consent process which make data accessibility issues extremely challenging. (Hunter, 2015)

The privacy legislation, in most provinces, actively discourages hosting this level and kind of health data unless there is a clarity regarding what and how it will be used. It is important to understand that, for a patient or a health seekers' entire medical record to be accessible to extra clinical solution providers high levels of security measures from their end, would be required making it extremely difficult for them to provide an integrative service to patient and health-seekers in a cost effective manner. (Koh, 2015) Additionally, the current business model of either tapping into a data provider's system one at a time, or downloading local copies of each data source, coupled with the risks of maintaining privacy and security compliance complicates the problem further (Kubick, 2012).

Health Data Sharing

Related to the data access issues are the privacy and security issues around understanding the sharing of health data. For the two health data realms to be integrated, it would require a comprehensive understanding of what aspects of or components would be shared and with whom. The problem gets particularly complex with questions around what records would be shared, who would be responsible for sharing it, and the authentication required for everyone with whom the data would be shared. This results, in some complicated security issues, which require high-level technological skills and investment. This could eventually increase the cost of the solutions or eliminate those

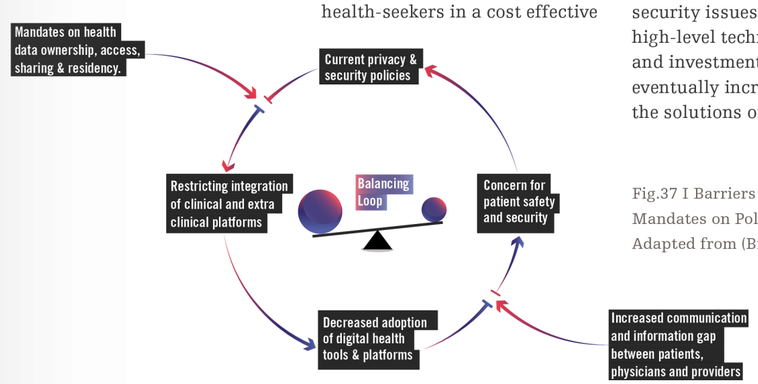


Fig.37 I Barriers due to Policy Mandates on Policy and Security Adapted from (Braun, 2002)

who might need it the most but lack the skills to manage these security hurdles. (Hunter, 2015) In Ontario, the privacy mandates warn against physicians and healthcare providers to communicate with patients on social networking sites or integrating non-clinical sites into clinical practices. Although this stems from protecting patients or maintaining the sanctity of the patient-physician-provider relationship, it ends up setting the tone for distrust, wariness, and caution around the future of integrating the two health data realms (Husain, 2015). However, focusing on privacy protection has not stopped multiple third parties from aggregating health data and making the data and insights available (Champagne, Hung & Leclerc, 2015), even though, the reticence around integrating it with clinical data costs a vast amount in terms of potential benefit for the healthcare sector. (Moffat, 2015)

> *All Canadian provinces, with the exception of British Columbia and Nova Scotia, allow health data to reside in the United States.*
>
> (Hassan, 2015)

Health Data Residency
During the process of knowledge gathering, one of the major insights into the significant discrepancies between perception and reality of privacy enforcement of the Ontario's PHIPA - Privacy Health Information Protection Act (Cavoukian & Grant, 2004) came to light through an article published by Waël Hassan. Hassan states that all Canadian provinces, with the exception of British Columbia and Nova Scotia, allow health data to reside in the United States (Hassan, 2015). More specifically, British Columbia and Nova Scotia do not allow their residents' health data to be stored in the US, even when the data is encrypted and have laws requiring government organizations to use servers located in Canada for personal information, mainly because of concerns about US privacy laws and surveillance (Hassan, 2016).

Therefore, the distrust of US-based computing by many Canadian privacy experts, based on their policies of sharing personal information with other corporations and national security agencies is misplaced. Rather than focusing on limiting the integration and toughening the privacy laws there should be federal laws similar to that for HIPAA, of the United States, that protects the privacy of all across jurisdictions.

Trend 7 > Smart Disclosure

Built on the principles of Privacy by Design and Access by Design (Mars, 2015) as a way to help health seekers have access to their data eventually allowing them to meaningfully share it with those belonging to their circle of care.

Trend Description
The debate of privacy versus security needs continues, with people volunteering private health information in a bid to understand their ailments that could eventually result in health care research advancements. A lot of progress in the technology sector has also been constrained due to policies focussing only on privacy needs of individual health seekers. (Muzyka, Hodgson & Prada, 2015) It has also increased the dependency of the healthcare system on dated technologies like fax machines and pagers that are hardly symbols of a modern healthcare system. The need of the hour is to accommodate this willingness of people to share their health information through appropriate security measures.

> *Majority of people (84%) would be willing to share their personal health information to advance and lower costs in the health care system.*
>
> - Intel Corporation, 2013

Signals
Online Banking platforms basing their customer interaction on safety by adding multiple levels of security barriers, while, also considering their user's privacy needs.

Canadian Citizen and Immigration portal uses multiple levels of security while not breaching any privacy laws. It allows individuals to share personal information with government representatives while also letting them nominate other members to control and view their online profile.

Extrapolation
A unified portal, powered by Ontario Health Insurance Plan, designed on the principles of smart disclosure helps connect patients with all the stakeholders from their care circle. Patients will finally have the ability to share their health related information when needed with those involved in their care, resulting in better disease management and measurable outcomes. This unified portal also is a boon to researchers with them having access to patient data that could help in innovative breakthroughs in healthcare.

Counter Trends
Oversharing economy; Higher physician liability; Patients crying wolf

Departure Question
How might policies that focus on smart disclosures help bridge the health data divide to create a more person-centred experience of care?

Design Principles
Public Administration & Accessibility

Trend 8 > Universal Health Records

The shift of patient records from being organization-centric to being more patient focussed, by aiming to build an inclusive platform for everyone involved in disease management and integrating information from different medical record platforms.

Trend Description
This trend forms its basis in the movement for the unification of different electronic medical platforms, in an effort, to provide information exchange between the different physicians, specialists, nurses, care providers and patients. Creation of this integrated platform, for all health related information, could help patients manage their disease, effectively, as well as form a communication channel for all those involved in care. This centralized database should operate in such a way that, allows care providers to synchronize and update information real time, so as to communicate treatment options to all care partners (Rowley, 2015). A universal health record will help resolve a number of problems flooding health care like physician group connectivity by connecting health data from ER department, hospitals and physicians practice about a patient's co-morbidities arising from multiple chronic and acute conditions along with drug interactions. For quality care outcomes, this information exchange needs to be meaningfully designed not for physician or practice needs only but in a more patient-centric manner.

> *"Health information exchange (the verb) has been the goal of health IT, now that we have moved into the "post-EHR adoption" era of healthcare."*
> - (Rowley, 2015)

Signals
The Health Information Technology for Economic and Clinical Health (HITECH) Act, enacted as part of the American Recovery and Reinvestment Act of 2009, which set up the EHR Incentive Program, included the creation of regional "community" Health Information Exchanges (HIEs), where everyone could come to share data about patients (Rowley, 2015). In the U.S, collaboration between the department of Veterans Affairs and Kaiser Permanente, an integrated managed care association, have a pilot program to share health records between their systems VistA and HealthConnect, respectively. This software called 'CONNECT' uses Nationwide Health Information Network standards and governance for health information exchanges to be compatible with other exchanges, being set up throughout the country. (Mearian, 2015)

Extrapolation
Global Health Records - With globalization and rise of the global citizens these records would not only be limited to a single province or country rather be accessed by a patient for his health care needs in any part of the world.

Counter Trends
Closed API's – no open source compatible program interface; Privacy restriction; Organizational silos; Cloud information traffic jam

Departure Question
How might the creation of universal health records bridge the health data divide between clinical and extra clinical data platforms to create a holistic care experience for health seekers and patients?

Design Principles
Universality & Public Administration

Implications for Macro + Digital Health Sector

Current privacy policies have created barriers towards the adoption of basic tools to share information, which in turn has curtailed efforts to improve outcomes that could accelerate procedures and enhance efficiency. For bridging the gap in health data, it is important, that the policy creates a stronger security framework while at the same time giving the patients the access and freedom to share information to provide a more person-centred approach. For health seekers' holistic care experience, before extra clinical data platforms are integrated with clinical platforms, the first step would require the integration of different medical record platforms with each other. However, the obstacles between healthcare, technology, and digital health sectors are slowly crumbling, with policy mandates like connecting GTA (eHealth Ontario, 2014), working towards linking the different electronic medical records in Ontario, a first step in the right direction that could fix other mandates and policy issues (Dwivedi, 2015).

Until these platforms are accessible, barriers will continue to exist for innovators to interact with clinical data. However, as Prateek Dwivedi, puts it, *"It's not a negative thing. One of two things will happen. Either the extra-clinical data platforms will be built by innovators from the outside, or, the inside. There is no right or wrong answer here. You just have to create a safe environment for innovation to exist. We would argue that it should be open to the free market, and you can look at it going, well what is the motivation of the free market? And that just needs to be resolved and that absolutely is a policy decision."*

However, some privacy and security measures that exist are not that prohibitive if the digital health companies decide to work with policy experts. They might have certain cumbersome security measures and access might be guaranteed only to a certain people, but these policies actually exist to manage the integration of platforms as in the financial sector (Dwivedi, 2015). There might be several hurdles that need to be crossed but the tremendous benefit and value of connecting health data platforms to make them closely integrated with one another and more accessible to patients supersedes all the drawbacks. (Moffat, 2015) Once interoperability between existing EMR platforms is achieved opening up the provincial assets through policy innovation is the next step (Dwivedi, 2015) and, of course, having an adventurous government (Moffat, 2015) would be an added bonus.

Barrier 7/**Regulations Separating Clinical & Wellness Platforms**

"And the reason is that it opens us. Once you are inside the regulatory environment, you are much more significantly constrained to what you can do and say and your marketing materials and your manufacturing and, even, aspects of your business are heavily scrutinized by regulatory bodies. Integrating with an EMR and EHR we are aware it might come down the road but it' something we are actively avoiding right now. If someone were to ask us we would probably say no." - (Moffat, 2015)

Technology companies, particularly consumer technology companies in the space of health data platforms providing solutions to patients and health-seekers that would like to self-manage care, prefer to intentionally avoid the clinical or health label. This not only helps them avert the elevated scrutiny from regulatory authorities but also offers them the freedom to make certain business decisions and market their materials to a wide-ranging group of consumers. Avoiding any certification for clinical validity protects them from implications arising from the data collected through their platforms or devices, as it does not fall within the purview of medical data, allowing them to focus specifically on consumer health seekers.

To avoid any unwarranted attention from regulatory authorities, technology companies prefer not to venture into the health data landscape and are candid about their value proposition of not providing any medical services for clinical use. (Moffat, 2015) Hence, they seek to only target health seekers by providing them a medium for measuring their physiological data for wellness goals, which need not have any clinical applicability unless they have a diagnostic element or software associated with it. Their apprehensions about avoiding the clinical and medical label are not completely baseless. In recent months, the American fitness-monitoring device giant Fitbit has been served with a number of lawsuits. A recent nationwide class action from consumers in California, Colorado, and Wisconsin is suing them for fraud and misrepresentation. This comes in response to Fitbit advertising its heart monitors as the most accurate wrist-worn wireless tracking devices in the market, targeting it to athletes and those with certain health conditions, who monitor their heart rate essentially to manage their health and medical conditions. (Nationwide class action lawsuit against Fitbit, Inc., 2016; Lieff Cabraser Heimann & Bernstein, LLP, 2016)

Additionally, regulatory requirements for medical devices are well established worldwide. However, new technologies like wearable devices, operate in the regulatory and privacy grey areas. With these internet connected devices and platforms designed to capture personal data, transmitting it for analysis and sharing they become more prone to malware and other security or privacy issues with little responsibility established for issues related to information in the wrong hands. (Salah, MacIntosh & Rajakulendran, 2014). (Metz, 2013)

Trend 9 > Responsive Data

Real-time clinical data synthesis will not only give meaning to the content generated but would also improve the distribution of information to those without access to the internet and wearable devices, bringing about a change in the model of care delivery.

Trend Description
One of the barriers holding back technology breakthroughs in healthcare has been the lack of access to shareable and actionable information. In spite of having developed and perfected the art of data storing, data has largely been the domain of those skilled enough to decipher it. For health-seekers to transition into empowered users would require these evolving data structures to be able to create meanings, insights, and incentives for those using it to support their healthcare decision-making. Access to real-time data synthesis would not only help health seekers but also care providers as a means to communicate about prevention and treatment options, test interventions in a language that is easily understandable by all as well as enable them to verify the information the patients are exposed to. (Avery et al., 2010) For health data platforms and other wearable devices, users having access to usable information would make these products indispensable and relevant to more consumers. (Liebhold, Maguire & Townsend, 2009).

> *"There is a lot of data being gathered. That's not enough, it's really about coming up with applications that make data actionable."*
>
> - Ed Martin, Interim Director at University of California, School of Medicine.

Signals
Data Provenance, the process of tracking and computing data derived as it moves through the system being used at a hospital in Toronto to monitor premature babies in a neonatal intensive care unit to help predict the onset of illness. An automated communications process called Remote telemetry has been operational in a US hospital to measure data collected at remote or inaccessible points and transmitted to receiving equipment. (PSFK, 2015); (IBM, 2015)

Extrapolation
The access to this vast information is extremely powerful. Before placing this vast amount of information in the hands of those that need it the most would require some kind of filtration and training about how to use this information for those not used to this kind of data dump.

Counter Trends
Stricter privacy laws barring and inhibiting use of this actionable information

Departure Question
How might connected health assist in making medical information actionable and responsive for a seamless experience of care for health-seekers?

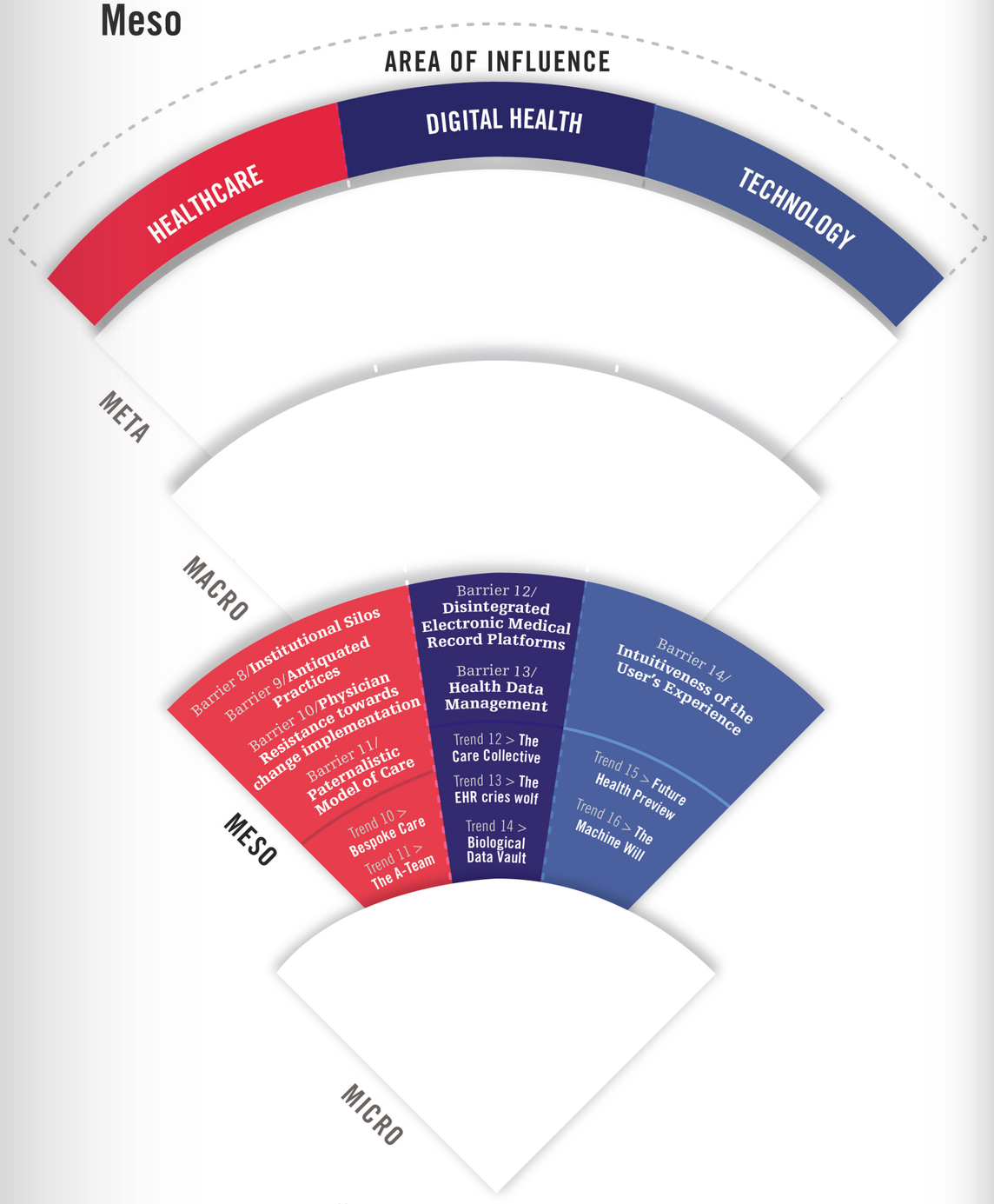
Design Principles
Comprehensiveness

Implications for
Macro + Technology

As evidenced from a variety of case studies from around the world (Current Landscape – Page 24), the use of these non-traditional clinical devices has helped physicians manage and deliver care outside the traditional setting of a clinic (Salah, MacIntosh & Rajakulendran, 2014). However, in a medical setting, these devices and platforms need to be reliable enough to provide vital information along with providing information accurately and be dependable to deliver care when required. Integrating data from various data platforms to create a seamless experience would only be successful if this information is conveyed in a more human centered way to those who need it. To be clinically viable they need regulatory approval to provide precise medical information catering to the needs of patients, providers, and physicians that regular fitness monitoring devices are not reliable enough to convey. (Salah, MacIntosh & Rajakulendran, 2014).

For technology companies, by integrating their devices and platforms with medical records could be an approach to remaining future relevant while at the same time would provide value to those who need it the most. In such a case, crossing the regulatory hurdles would be a small price to pay for influencing more people and building a business with an impact.

Meso



Barrier 8/**Institutional Silos**

"I think there is a lot of attention being paid to the new technology. Clinicians can't sit in their silos and engage the way they have been ... Clinicians have traditionally worked in the clinical domains that are siloed, where they look at clinically reported outcomes and what we are seeing is we believe that patient-reported outcomes will be an important factor in healthcare." – (Dwivedi, 2015)

Although, called a system there are occasions when the Canadian Healthcare sector functions less than the sum of all its moving parts. The sector runs within its multiple silos whether in reference to multiple provincial models, physician payment models, systemic cultural issues, or the disintegrated technology systems. (Deveau, 2013)

The stratification starts from the top with the healthcare system split into 13 provincial and territorial jurisdictions, along with federal health directives, carrying with it challenges of multiple governance systems at play, within the various jurisdictions managing policies and functioning at their own pace. This is visible in the difficulty faced while scaling innovations without being cost intensive. (Deveau, 2013) The fragmentation based on the provincial and functional boundaries results in a further lack of collaboration at the institutional level with providers, clinicians, and administrators. Furthermore, the lack of incentives from the policy level has resulted in healthcare institutions not having enough incentives or resources to work with one another. (Koh, 2015)

> *"IT is just a tool; automating broken service-delivery processes only gets you more efficient broken processes."*
>
> - (Porter & Lee, 2013)

Although systemic, the silo mentality affects the way healthcare technology has been structured within the province and even within the hospitals, particularly with the introduction of Electronic Medical Records. Within the healthcare system in North America, particularly Ontario, the disintegrated EMRs resulted in further stratification of the IT systems affecting the expenditure and outcomes eventually hindering the delivery of quality care. (Porter & Lee, 2013)

Information technology in health care functions within a silo-ed system divided into departments, locations, services, and types of health data. If health data platforms were integrated within the way the current IT system functions, it would add another layer of complexity rather than support the delivery of comprehensive care.

To provide a more integrated health care delivery through the connected health data platforms would require the assimilation of the different departments, locations, services, types of health data and the organization of it around patient needs. (Porter & Lee, 2013)

Furthermore, patients seeking treatment for their conditions and maladies should not be burdened even more due to the information silos. (Muzyka, Hodgson & Prada, 2015) Providing efficient and effective care in a system where the whole had been broken down into little fragments that do not connect with each other is not a sustainable way of providing care (Deveau, 2013). Unifying these silos in the health information system would provide patients with access to seamless care services that cater to their physical and emotional needs.

Barrier 9/**Antiquated Practices**

"… our system is not really built for this … This is a challenge to the system as it's currently built. The clinical response from healthcare providers has been structured in a certain way. We are used to being paged, we are used to receiving faxes and all the old systems and we've figured out how to accommodate those." - (Husain, 2015)

Despite, the "rise of extreme mobility" (Liebhold, Maguire & Townsend, 2009), the healthcare sector, particularly in Canada and the United States, has managed to stay trapped in the archaic model from the 1960s (Muzyka, Hodgson & Prada, 2015). Besides being plagued with rampant inefficiencies, it is expensive. The total spending on health care in Canada amounted to an estimated US$206 billion (Purdy, 2015) or 11.3 percent of gross domestic product (GDP). It is forecasted that the spending will rise by an average of 4.5 percent a year in 2014-2018, to US$ 464.3 billion (Purdy, 2015).

> *"Mediocre tactics employed by healthcare providers and the current policy frameworks have throttled the use and deployment of new technologies."*
>
> (Muzyka, Hodgson & Prada, 2015).

The bureaucracy attached to this sector has resulted in slow-moving adoption of new technologies; this is the only remaining sector still using fax machines and paper slips as a means of communication (Barry, 2015) (Muzyka, Hodgson & Prada, 2015). A primary cause of frustrations for consumer digital health technology companies venturing into healthcare has not been the fit of their product or the platform with the consumer market but rather the efforts required to fit their technology with the existing antiquated practices and legacy systems in healthcare. (Kim, 2015)

The health care system's functional operations, particularly in the context of using information and communication tools that could help improve performance outcomes, are not aligned in a way that can help it achieve even a minimum viable model of efficiency and effectiveness. The paradox of the situation lies in the fact that Canada is trying to deliver modern health care services while being a slow adopter of innovative technologies that could enhance the quality of health care services and improve the health and quality of life of Canadians. The use of outdated systems and practices stems from the lack of proper physical infrastructures, service delivery models, provider incentives, current education models of the physicians, labour contracts, and the flow of information, to name but a few. (Muzyka, Hodgson & Prada, 2015)Besides, the privacy needs superseding security concerns, the lack of integration of existing EMRs has resulted in impediments to the uptake of even basic tools that could help form an information sharing and communication link between patients, physicians, and providers.

Furthermore, adoption of digital health tools cannot only be blamed on the obsolete physical structures. The antiquated practices are reflective of the current state of medical and clinical educational curriculum of physicians and surgeons in Ontario that does not train physicians or provide physicians with a practice of using, analyzing and generating insights from the data collected from the digital health tools. Hence, basing the evidence of how even the current medical records, in spite of being a replacement of paper records, don't in actuality address issues related to how a physician might want to analyze data, draw insights from it or use it as an evidence to inform patient treatment and care. As Jerry Koh states, as long as the current state of physician and clinician education does not change, they will continue to hold an outmoded view of shaping the practice of physicians.

$206 billion

The total estimated spending (US$) on health care in Canada is at 11.3 percent of gross domestic product (GDP). (Purdy, 2015).

$464.3 billion

Estimated Forecast that the spending (US$) will rise by an average of 4.5 percent a year in 2014-2018. (Purdy, 2015).

Barrier 10/**Physician Resistance towards change implementation**

"This requires a new equilibrium with a new set of tools and that is a real change for many people; and it's a behavioral change. The right influences have to be able to encompass both social, behavioral, and system incentives to promote this change and those are not there. At every level the incentives etc. are not there to provide this kind of care, which is not direct contact care." - (Husain, 2015)

The generalization that the Canadian healthcare system is resistant to change would not be a stretch. Considering 48.4% of physicians still use a combination of electronic medical records and paper-based records to enter and refer information related to patients clinical notes (National Physician Survey, 2014), along with the clinics and pharmacies still being the most active users of fax machines. (Berkow, 2015) However, this resistance to change stems from the fact that the clinicians are not used to informing patient care based on health data outcomes. In addition, for clinicians to consider using data from patient reported outcomes would require additional training and effective integration into their existing processes and systems. (Key Informant, 2015)

To understand this problem, from the standpoint of healthcare professionals, brings to focus the lack of motivations that could propel the investment of their time in using the patient reported outcomes to inform care. (Koh, 2015) Besides, lacking structural incentives there is a scarcity of financial or practice motivations for healthcare providers to look at outcomes which are not clinically proven. (Koh, 2015) In spite of physicians being trained to understand patient behavioural, verbal, and physiological symptoms in a clinical setting, there are no medical precedents or any formal guidance regarding usage of data from patient reported tools and platforms. Hence, even if there were steps in the direction of integrating health data platforms, they would largely arise from a physician's own initiative, practice, and time. (Koh, 2015)

However, this problem is not unique to Canada; the emphasis on changing behaviours and incentivizing physicians is part of a larger systemic issue. The problem of incentivizing physicians arises from three main issues: organizational myopia, transactional reform trumping transformation, and the emotional power of the change over the technical prowess. Most healthcare organizations tend to be under the impression that they are working in the right direction considering the modest support they get from the government and the health system in which they operate. The current nature of the healthcare system can be defined as transactional or "*doing things better*" rather than transformational or "*doing better things*" (Britnell, 2015) The risk averse (Moffat, 2015) nature of the healthcare system believes doing small changes rather than holding individuals, organizations, or systems responsible for transformational change will produce better care and value. That is what makes this problem simple to state yet immensely difficult to implement in action.

48.4%
physicians still use a combination of electronic medical records and paper-based records to enter and refer information related to a patients' clinical notes. (National Physician Survey, 2014)

Barrier 11/**Paternalistic Model of Care**

" … Hippocrates, regarded as the "father of medicine," … was also the father of medical paternalism: he made no secret of how he viewed the relationship between doctor and patient, writing that physicians should conceal "most things from the patient" including " the patient's future or present condition." Hippocrates felt strongly for medical formulas to be kept secret from patients and that knowledge had to be compartmentalized to physicians." - (Topol, 2015)

A health seeker's or patient's role and involvement have become a constant theme in medicine for a more person-centred approach to care (Sandman & Munthe, 2010) (Murphy, 2008) resulting in the need for a shift to a physician-patient relationship dynamics that is more anti-paternalistic in nature. (Miller & Wertheimer, 2007) The culture of paternalism in healthcare stems from the way the philosophy is embedded within the healthcare organizations and the education system. Historically, the expression paternalistic had negative associations (Buchanan, 2008) and was used in the context of themes surrounding authority and subservience (Loignon & Boudreault-Fournier, 2012)

However, for physicians who have spent years perfecting their medical expertise, the term paternalism refers to the compassionate and humane approach they adopted over the course of their practice, as they believed their patients requested and needed it (Loignon & Boudreault-Fournier, 2012).

A common relationship and communication approach of physicians, with their patients/health-seekers during an interaction; for certain patient groups,particularly, physicians needed to actively take this authoritative role. This top-down approach to care has assisted them in fulfilling their duties more effectively.

The doctor-patient relationship in healthcare has (always) been a paternalistic approach where doctors assume that they know what patients need. (Muzyka, Hodgson & Prada, 2015) The lack of interest of physicians with digital health tools stems from this paternalistic approach where professionals 'do things to' people (Health.org.uk, 2013) (Coulter, 2011) (Tritter & Koivusalo, 2013)

Trend 10 > Bespoke Care

The movement to adapt treatment based on an individual's genetic makeup and physiology in an effort to make receiving care more effective and efficient.

Trend Description
The advancement in personalized medicine has led healthcare into a new era of so-called mass customization (Barnes, Levy & Lutz, 2015). Direct to consumer DNA testing kits, like 23&me, have made patients more curious about their biology as a means to prevent long-term investment in disease management. Added to this, the accessibility and affordability of retail-based genetic testing services could prove to be an extremely powerful resource to base treatments and care plans on. Analyzing an individuals inherited conditions, drug responses and traits before the occurrence of certain physiological systems would not only mean huge breakthroughs in preventative care but customizing care based on needs could help decrease costs of unnecessary medical procedures.

> *66% of people say they would prefer a care regimen that is designed specifically for them based on their genetic profile or biology.*
> - Intel Corporation, 2013

Signals
The increase in the number of mobile apps, like Health Kit, that help users monitor physiological data. Patients choice for elective surgery and personalized care regime came to foray through Angelina Jolie's New York times opinion editorial explaining her decision to opt for preventative surgery after genetic tests indicated her at risk for Ovarian and Breast cancer (Jolie Pitt, 2015). Affordability of 23&me genetic testing services (Ramsey, 2015).

Extrapolation
A detailed analysis of a patient's symptoms, genetic behaviours, and risk factors will give a more holistic view of the ailments and health-seekers needs in a bid to provide more alternative care options and preventative solutions.

Counter Trends
Patient the healthcare expert; Hypochondriacs everywhere; Genetic discrimination (Zhang, 2016)

Departure Question
How might bridging connected health platforms provide a tailor-made experience of care for health seekers?

Design Principles
Comprehensiveness

Trend 11 > The A-Team

The future of care delivery is veering away from the paternalistic siloed model, where professionals 'do things to' people (Health.org.uk, 2013), to a care delivery model consisting of integrated practice teams looking at health with a more holistic lens.

Trend Description
For the patient the journey from the time of diagnosis to end of treatment is mired with painful experiences made worse due to the complexity of a system that shuttles you from one physician to another for different aspects of treatment. Added to that co-morbidities and chronic ailments make the journey, even more, turbulent due to the lack of any interaction and scattered information platforms between the different care providers, testing labs and physicians. This disjointed approach is not only a cause of inconvenience to patients but also increases costs for care providers and government spending on healthcare, due to the duplication or unrequited treatments. (PwC, 2010) An integrated approach (Porter & Lee, 2013) to the delivery of care consisting of a team of care providers that includes experts in clinical aspects like general practitioners & specialists as well as non-clinical aspects like family members & health systems navigators is one step in the right direction. This integrated team would not only assist the patient to manage the disease by building trust and a circle of care but also make them feel less of an unnecessary burden that needs to be handed off to the next one in the assembly line.

> *The hardest part of health care reform will be to get doctors to give up their autonomy.*
>
> - Robert Pearl

Signals
Various care providers including University Health Network, Toronto, testing Integrated Practice Units/Care; Interoperable Electronic Health Records—an important focus of new laws in the US. Verily, previously known as GoogleX, experiments with technology to deal with health and diseases, by bringing together multi-disciplinary teams consisting of chemists, engineers, doctors and behavioral scientists, as partners in understanding health as a means to prevent, detect, and manage disease.

Extrapolation
Care teams co-ordinating, managing and helping patients navigate the system would reduce the frustrations of the patient. Creation of universal health records that would keep all patient team members on the same page regarding disease management.

Counter Trends
Closed API's; Physician as the expert

Departure Question
How might interoperable health data platforms help involve all health partners to provide a holistic care delivery experience to patients?

Design Principles
Public Administration & Comprehensiveness

Implications for Meso + Healthcare Sector

Aligning physician incentives with the system outcomes could bring about this shift from the paternalistic culture of prescriptive care of patients (Snowden, Shell & Leitch, 2011) to one where health professionals would become support partners in care that could empower patients. Additional benefits would be the substantial cost savings associated with reduced hospitalization. The integration of digital health platforms could shift the physician-patient relationship to evolve into one that is defined by collaboration, negotiation, and dialogue, rather than a top-down approach.

An important consideration behind building these integrated care teams would be making the different electronic health records interoperable. Connecting these currently disintegrated platforms will make information exchange easier as all health partners can be updated real-time about the course of treatment. Personalizing care for individual needs would come at a cost for health seekers with corporation offering these services charging a hefty fee. In addition, the responsibility of care will shift from the physician to the health-seeker. It will be important for the health care system to offer customized care services to manage costs and provide it as per requirement in an effort not cause hysteria. For better outcomes, access to a health seeker's genetic history, and drug interaction information on a single platform viewable by all those involved in care could make patients more responsible for their own preventative health and treatment management.

The integration of health data platforms would further require physicians and healthcare professionals to shift their approach from 'do things to' or "doctor knows best" culture (Health.org.uk, 2013) (Coulter, 2011) (Tritter & Koivusalo, 2013) to one, that makes patients active participants in their health decisions. (Snowden, Shell & Leitch, 2011). The shift to technology would also reduce the burden on the care of their health services.

However, the introduction of self-management tools has allowed patients to be able to not only record and access their own health but also be more responsible for their own treatments, medications and to achieve better outcomes. To be able to think of patient reported outcomes, as a new data set, that could help clinicians with an opportunity to inform their patient care, would require a massive shift in behaviours and protocols. (Key Informant, 2015) The focus on the integration of technologies ultimately focuses on the weakest link or the least common denominator that is confronting the antiquated pillars of the Canadian healthcare system. To forge ahead of the problems facing healthcare would require addressing the health data problems and how to leverage the existing data from patient reported outcomes and clinical outcomes in a novel manner. (Frommeyer, 2015) Eventually, smart data would help break down the century-old industrial health model and dismantle the antiquated frameworks at play. (Liebhold, Maguire & Townsend, 2009

Barrier 12/**Disintegrated Electronic Medical Record Platforms**

"My family doctor never got all the information, especially with the test and everything … I just wish there was a system that somebody could type in my name and everything was all there, so everyone could be on the same page." - Female Breast Cancer Interviewee (CanIMPACT, 2015)

34.9%
physicians exclusively use electronic medical records to retrieve a patient's clinical notes (National Physicians Survey, 2014)

72%
Physicians, among those that still use paper records, do not plan to use electronic records for the next 2 years (National Physicians Survey, 2014)

6%
primary physicians, allowed sharing of patient records with other clinicians, however, that is dependant on provider and provincial policies. (Conference Board of Canada, 2006)

The medical record has historically been a paper file of the entire medical history of the patient, which resided in the doctor's office (Etzioni, 1999). Since, its introduction the usage of Electronic Medical Records has more than doubled from 23% to 56%, from 2006-2012, (CBC, 2013) (Canada Health Infoway, 2013 & Pricewaterhouse Coopers LLP).

The introduction of EMRs was identified as critical to improving quality of care (Manca, 2015), and to preventing duplicate diagnosis, or medical errors (Canadian Medical Association, 2014) some of those arising from the indecipherable and illegible handwriting of physicians, (Caplan, 2007); it also helped save the Canadian Healthcare system $1.3 billion (CBC, 2013) (Canada Health Infoway, 2013 & Pricewaterhouse Coopers LLP). Even though, the jury is still out, if EMRs, in fact, improve physician-patient relationship and communication (Chrones, 2015) (Greiver, 2015); the one issue where there is substantial agreement from all parties, involved in the healthcare system, is the need and the value of their integration. (Snowden, Shell & Leitch, 2011); (Husain, 2015; Moffat, 2015; (Dwivedi, 2015)

A big challenge for the Healthcare system in Ontario is that, at the moment, EMRs, whether belonging to family practices or hospitals, are not integrated with one other and a lot of other health data sets like lab data, drug data, and across the health system (CanImpact 2015). However, this does not arise from any technical interoperability issue between EMRs as they all have Health Level-7 (Hl7.org, 2016) capability, which is the international standards that define the ability for clinical and administrative data transfer between software applications used by various healthcare providers. The EMR systems are disparate, even in primary health care; due to a variety of EMR vendors being used by different healthcare institutions and practices. Bringing back to focus issues surrounding power, autonomy, incentives, and most importantly the data model that each institution uses.

Among the developed OECD Countries (Organisation for Economic Co-operation and Development) Canada has the worst primary care access to EMR technology. (Snowden, Shell & Leitch, 2011) (Conference Board of Canada, 2006) Added to this only 34.9% physicians exclusively use electronic medical records to retrieve a patient's clinical notes. Among those physicians still using paper records, 72% do not plan to use electronic records in the next 2 years (National Physicians Survey, 2014). The problem gets more complicated with only 6% (Conference Board of Canada, 2006) primary physicians, dependent on provider and provincial policies, allowed sharing of patient records with other clinicians. This problem makes providing quality care, particularly, to those suffering from life threatening conditions, like Cancer, a very difficult task.

Besides cost issues, many physicians find the typing of information very time consuming (National Physicians Survey, 2014) with many usability (Smelcer, Miller-Jacobs & Kantrovich, 2009) and user experience concerns. (Chrones, 2015) *"It also goes to the user experience making the future of seamless EMR integration likely a long way off". The reality is that many EMR systems are not designed like that so even if the devices are being designed that way; if the rest of the systems are going to be that way that is not necessarily the case."* (Key Informant, 2015)

> *"I use one software program in the acute care hospital, a different program in the cancer agency that does not communicate with the one in the hospital, and a third one in the radiation oncology department … then primary care providers use one of the six different programs …"*
> General Practitioner in Oncology, states (CanIMPACT, 2015)

Before a step in the direction of bridging patient reported outcomes with clinical outcomes will be taken, there must be interoperability between the multiple vendors which, in itself, is going to be a very difficult as an implementation exercise. In addition, existing clinical systems like EMRs need to be designed for future use and in such a way that they are able to integrate with extra clinical systems (Key Informant, 2015). Bridging the EMRs would require a shift in the organizational culture to build a culture of innovation and transparency so that patients and health seekers can actively be involved in their health decisions and management. The integration of patient-reported outcomes with clinically based outcomes would make health seekers, patients, and caregivers more

pro-active health decision makers bringing about a shift in the physicians-caregiver-patient relationship. (Snowden, Shell & Leitch, 2011)

However, some healthcare institutions are utilizing technology, taking small steps in the direction of founding relationships with their patients, who want to be actively participating in their own care to ensure safety and accuracy of their care. An example of this is Sunnybrook Hospital in Toronto that gave all patients complete access to their medical records online through their in-house patient portal MyChart. (Taylor, 2012)

> *Why do we have a gazillion different EMRs? Why couldn't there just be one EMR system?"*
>
> - (Koh, 2015)

The delay in integrating EMRs could have been prevented if the government had enforced a mandate when the funding for the shift to electronic medical records was provided in the first place. (Dwivedi, 2015) However, eHealth Ontario is currently working on a health strategy 2.0 to support the needs of patients foremost health action plan. Although an integrated system would be still a work in progress, they are trying to make some of their data available easily for viewers, so that health seekers and patients would be able to view the data in a repository (Ehealthontario .on.ca, 2016). EMR interoperability is also being resolved and extended, across Ontario, through initiatives such as the CGTA - Central Toronto and Greater Toronto, CSWO - Southwest Ontario and CNEO - North East Ontario region (Dwivedi, 2015) (Husain, 2015) (Koh, 2015) (Taylor, 2015). The CGTA initiative, which constitutes a majority of institutions in Ontario, is close to 100% integration of all its hospitals). "*Therefore, once the interoperability is there it still has to be opened up for innovation and that is the next step.*" (Dwivedi, 2015)

However slow, there are some great efforts towards the integration (Dwivedi, 2015) and a few examples of successful integration in other provinces causing acknowledgment to include patient-reported outcomes in the clinical space. The work ahead is not easy with "*barriers, like system barriers and regulatory barriers, that need to be systematically worked out and overcome*" (Husain, 2015) before understanding the best practice principles of bridging extra clinical platforms with clinical platforms.

Barrier 13/**Health Data Management**

"The challenge of big data, in healthcare, is that it matters. In healthcare, it matters there is a lot of data to get through and if you cannot guarantee if it is accurate or high quality then the data you have is giving you wrong conclusions. So rather than big data, it is about having the right data. And the right data is not about measuring everything but the things that will provide impact and you keep growing. … I think the biggest thing is how are we going to deal with this deluge of data." - (Dwivedi, 2015)

The lack of integration of electronic medical records has resulted in each healthcare institution, with the exception of one or two provinces and jurisdictions, maintaining their own copy of a patient's medical records. As Jerry Koh states, for certain patients or health-seekers, obtaining treatment from different physicians and healthcare providers, the problem exacerbates even further as different health data would be residing with different professionals and institutions. (Koh, 2015) (CanImpact, 2015) For patient reported outcomes to be integrated in a meaningful way, understanding how this data would not only be collected and analyzed but also how will it be managed and used is imperative.

The data in a clinical context is still recorded in an unstructured format. That is very different from the way it is recorded by the extra clinical data platforms; thereby making the data not readily available for analysis. (Kubick, 2012) Bringing forth the problem that there is still a need to understand how to harness this data in a useful format. Currently, there is no clear understanding and demonstration to purposefully and quantifiably use the volume of data generated from patient reported outcomes for clinical viability. (Key Informant, 2015)

In the case, that patient reported outcomes are integrated with clinical data, the responsibility for healthcare providers and professionals' increases. To effectively use this data would require additional medical expertise that currently is not available. There needs to be a collective understanding about how and when the response would be generated for the patient, once the patient has in fact transferred their information they might be expecting a response. A lack of communication at the physicians end at this point would make the situation worse.

However straightforward the technology might be for integration, creating a system that effectively, safely, and responsibly transfers information from these linkages; while at the same time makes sure that the quality of data is useful enough for someone to effectively receive, analyze, and respond to it on time, is an essential consideration. (Husain, 2015) (Koh, 2015)

Trend 12 > The Care Collective

Based on the principles of integrative care, the trend aims to look into how information can be collected, synchronized, modified, shared, and communicated as the patient navigates the health care system before, during, and after the onset of an ailment or disease.

Trend Description
This trend finds it's roots in integrating the past, present and future medical stories and treatments; accessible as a means to support shared decision-making for all those involved in care. (PwC's Health Research Institute, 2010) The application of this trend would ease the process of information and knowledge transference and translation between the patient and the various care providers as the information gets updated realtime. Founded on the objective of building a comprehensive patient profile, the adoption of integrative care practices, largely depends on the successful integration of various medical records used by care providers. Consolidating the different medical record platforms would not only improve physician efficiency by connecting patient medical history with treatment plans but also prevent duplication and multiple testing. From the patient perspective, it would increase safety and quality of care, eventually, improving tangible outcomes for health care system.

> *40% of health leaders surveyed by PwC acknowledged that handoffs among clinicians were difficult or very difficult.*
>
> - PwC, 2015)

Signals
In the US, interoperable EHRs is the focus of a lot of new laws with the government providing incentives to those that comply with its Health Information Technology for Economic and Clinical Health Act and penalizing those that not adhere with it's new standards with Medicare reducing reimbursements to those who do not adopt or are late in adopting electronic health records (EHRs). Integrated managed care organizations like Kaiser Permanente provides its patients electronic health tracking of all their health related information,like prescriptions and lab tests results, in one place through the duration of their care assisting patients to self manage their care.

Extrapolation
All health related information is updated real-time while doctors are diagnosing or lab tests are being performed. This real-time input of information would inform care providers of certain anomalies to spot and track immediately. Reducing the stress related to delays and wait times in the course of disease management, an added boon for patients.

Counter Trends
Tighter privacy laws over security laws; Increased hacking of health information; Patients not giving enough information to secure their online health related information

Departure Question
How might integrating all health related information from the various data platforms make for a seamless experience of care for health-seekers and patients?

Design Principles
Portability & Accessibility

Trend 13 > The EHR cries wolf

The technology created to warn doctors of impending danger to their patients could be actually the one putting the patients in danger, with doctors getting overwhelmed with the incessant alarms from their medical records platforms that they inadvertently might be letting them ignore emergencies.

Trend Description
Coined as alarm fatigue, it is the exhaustion caused due to excessive and misleading alerts from medical device and platforms, primarily put in place to save patient lives. A technological and health hazard in hospitals, with physicians and nurses, becoming immune to these sounds, eventually, resulting in them overlooking or delaying treatment. User experience limitations, like the variations of different alarm sounds, do not effectively distinguish urgent needs over ones that do not require immediate action. While there is an acknowledgment of the problems associated with this alert fatigue, there is not much being done in action. Adding to the confusion is the lack of standardization of alarm sounds, between device manufacturers, making it difficult for health workers to triage their response to alerts. With the movement for the integration of a variety of external clinical platforms into electronic medical records, could bombard physicians with an overload of information as well as sounds. These automated alerts, though designed to prevent errors and prevent potential hazards to patient lives, could create a false sense of security doing more damage than good. (Quartz, 2015); (Rosenblum, 2015); (Doyle, 2015)

> *Addressing alarm fatigue is like opening Pandora's box, there are so many different arms to the problem.*
>
> - Maria Cvach, nurse lead of the alarm committee at Johns Hopkins Hospital in Baltimore, Maryland.

Signals
A 12-day alarm system analysis at Johns Hopkins indicated there were an average 350 alerts per bed per day. In one intensive care unit, the average was 771 alerts per bed per day. Tens of thousands of alerts may signal throughout a hospital each day, according to The Joint Commission, the organization that accredits American hospitals. 85%–90% of these alerts are false or nuisance alarms, indicating conditions that do not require clinical intervention.

Extrapolation
An alarm that just would not stop ringing. Consistently monitored fitness related data being sent to doctors with their multiple devices constantly beeping with alerts. Patients crying Wolf, sending false alarms, resulting in health workers not responding or delaying to respond.

Counter Trends
Giving doctors control to disable alarms; multiple platforms personalizing sounds specific to their products

Departure Question
How might smart alerts be created once the health data platforms are integrated with one another?

Design Principles
Comprehensiveness and Public Administration

Trend 14 > Biological Data Vault

Curating data from wearable and mobile health technological platforms as means of creating a repository of biological data for current and future purpose of research and eventually to utilize it for comprehensive health management (Quartz, 2015).

Trend Description
Understanding the afterlife of the data that is collected from these mobile and wearable health data platforms requires an extensive process of choosing, managing, clustering, extracting, and documenting of biological data. Due to fast paced development in research, technical and genetic capabilities has given rise to more such databases that preserve and accumulate a person's biological and genetic profile. On the individual level, this biocuration could help to develop a database of health information. At an organizational level, the task is challenging, as not only would healthcare, digital health, and technology companies be held responsible for protecting this information but also to ensure the authenticity and quality of the data collected. This trend has also led to the creation of professions like Biocurators whose only purpose is to maintain the libraries of biological data and those that protect it from being harmed or misused. (Curry et al., 2010); (Mitchell et al,. 2015); (Quartz, 2015)

> *"The exponential growth in the amount of biological data means that revolutionary measures are needed for data management, analysis, and accessibility."*
>
> Howe et al., 2008

Signals
Qualcomm Life's 2net platform, that uses a cloud-based system to capture, transmit, and aggregate biometric data from medical devices and sensors giving access to health care providers, family caregivers, and patients.

Extrapolation
Biological data exchange where biological data is bartered for products and services. An extensive library consisting of biological information informing research, product development and even disease management.

Counter Trends
Privacy laws; Policies that protect sharing of information to parties interested in biological data, More individual stake in protection of Data Vault.

Departure Question
How might effective curation of biological data help provide a seamless experience of care for health seekers and patients?

Design Principles
Public Administration & Comprehensiveness

Implications for Meso + Digital Health Sector

For a seamless experience of care, information needs to be constantly adapted at the same time as it is being exchanged and updated as the patient navigates through various care providers to be accurate and current. (PwC Health Research Institute, 2010) The subject of alarm management will likely take on increasing urgency in coming years, as new technologies are brought to market and integrated with clinical data platforms. From a physicians standpoint for them to be held accountable to provide quality and safe care, they would first need to understand how to use this data and to trust it (Dwivedi, 2015) before they take on the added responsibility of cautiously reviewing and responding to the information (Husain, 2015). The information collected from all health data platforms being aggregated at a single place would help for better communication between patients, researchers, and care providers. The interoperability between health platforms would play a huge role in determining where and how this information is stored and utilized.

Information technology is a powerful tool (Porter & Lee, 2013), and once the economic and political pressure (Liebhold, Maguire & Townsend, 2009) would compel healthcare organizations to integrate patient reported outcomes with clinical outcomes, the medical information flow seamlessly and organize the delivery of care around health-seeker's needs. The system for integration of patient reported outcomes and clinical outcomes needs to be devised cautiously and thoughtfully, so that the new linkage created would not result in even bigger actual or perceived gaps. (Dwivedi, 2015) For physicians, the need would be to establish data management standards so that they are able to ask the right questions from all the big data (Saunderson, 2015) generated in a bid to provide the right answers.

An integrated EMR gives a comprehensive view, by not only providing a patient's or health-seeker's medical history but also a context to clinician and physicians, something that is difficult for a person to carry with them or remember every time they interact with their physician. (Dwivedi, 2015) At a population level, the data collected could help analyze the health of a population and develop better preventative strategies. (Moffat, 2015) The optimal information would help break down the silos in healthcare by providing easy, accessible knowledge sharing and ability to transfer a patients records, diagnostic imaging, consultant reports, emergency care; and even help manage referrals, and appointments, eventually empowering practitioners and facilitating better care.

It is an extremely challenging proposition to merge and combine all the data into a single research platform, particularly since the content, context, and structure of the data generated from different extra clinical and clinical sources in extremely heterogeneous. (Kubick, 2012) The incremental movement towards a more integrated electronic medical record could help in the evolution of data standards and systems, however the road ahead for data included from patient reported platforms to be meaningful in a clinical context is going to be time-consuming and complex (Kubick, 2012). Having a clear understanding of managing big data in the right way would help to make information actionable, eventually bringing about a shift in the delivery of care (Liebhold, Maguire & Townsend, 2009) as "the amount of things you can learn from it, the effectiveness of the treatment and learning about the research … there are tremendous benefits. So truly paying for effectiveness rather than paying for volume which is the holy grail of healthcare." (Koh, 2015)

Barrier 14/**Intuitiveness of the User's Experience**

"It has to be usable. Something people can easily use and it needs to be intuitive. I think we still have a challenge with that because of the complexity of information and the volume of information stored in the systems reflecting it back in a way that is meaningful and usable for anyone other than the clinicians is still a challenge." (Hunter, 2015)

One key fact that has been re-iterated through existing research and expert interviews is that the current technology is fairly sophisticated and not a problem that could limit the integration, in fact it will evolve if the system develops a need to integrate the two health data platforms. (Dwivedi, 2015) (Koh, 2015) (Hunter, 2015) However, making sure this technology is simple and intuitive for the benefit of all those who use it while also providing meaningful ways of connecting with the user and at the same time making the platform secure and safe for the users, clinicians and providers sets a high bar for user experience design.

For the system to be valuable, it will need to cater to the requirements of the key beneficiaries of such a system including the elderly, youth, those suffering from chronic conditions and those providing the care to this vast and distinct user group. For each user in this system to be able to extract maximum benefit of an integrated system would require different ways of using the system to meet different needs. For example, elderly patients with little digital experience would need the user experience to be less complicated for them to adopt it to manage their care or communicate with their care provider, or would require security functions put in place that allows only their care givers to access information without misusing their information. For the system would have to be able to collect, and track information in a meaningful way for them to be providing care. Going through the appropriate consent processes so that the system is private and secure makes the pathway to integration seem extremely challenging. (Hunter, 2015)

The current platforms present differing levels of challenges with respect to information burden, disorganization, design usability, access to information, user education and directions to use, and information management, making it not appealing enough to cater to needs of key user beneficiaries, for example the physicians and the patients (Walter & Tung, 2002). 36.4% of physicians find using electronic medical platforms extremely time consuming, resulting in the lack of adoption. All the issues, above, would inform the design, adoption, usability, security, and navigational concerns (Walter & Tung, 2002) for the system that would be dealing with complex concepts (Hunter, 2015).

To add to the existing user experience issues, sharing medical records or part of medical records with care givers of other specialist or physicians involved in the care would require intricate security protocols that would require more investment in technology and higher levels of knowledge for using information systems. Eventually, this might result in, the elimination of a large number of patient groups, from participating, that could benefit from an integrated system the most. (Hunter, 2015)

36.4%
of physicians find using electronic medical platforms extremely time consuming, resulting in the lack of adoption.

Trend 15 > Future Health Preview

Health simulation tools for cumulatively understanding physiological and behavioural factors that help health-seekers interpret their individual biology to find ways to prevent and prepare for what their body has in store for them.

Trend Description
The advancements in genetic research and nanotechnology combined with virtual reality and 3D imaging will bring new ways of simulating, diagnosing, and treating diseases and ailments. The growing acceptance of the fact that the body doesn't just suddenly go from a state of health to disease, would also bring about a shift in the way healthcare currently functions as doctors usually don't start diagnosis and treatment till the onset of visible symptoms which usually occurs at a later stage in the lifecycle of a disease. (Brewster, 2014) By using the variety of technological resources at our disposal, prevention, and diagnosis of epidemics and outbreaks can happen at an individual as well as a community level (PSFK, 2015). Not only would this lead to the achievement of new milestones in public health prevention (Liebhold, Maguire & Townsend, 2009), pharmaceutical development (Avery et al., 2010) but even in the development of the practice of health care practitioners. By helping them rehearse and train for treatment and procedure options, they could correct mistakes, which might cause long-term damage to their patients and even their individual practice. Eventually, making them better at preventing and treating diseases.

> *To offer better care, the HCPs of the future may have to diversify their service offerings and prescribe experiences instead of medications.*
>
> - (Idea Couture, 2015)

Signals
Simulation of hospital rooms. Google X Nanoparticles that when consumed flow through the bloodstream to detect signals and accumulate on a wristband to report findings of deteriorating health like cancer cells. A Virtual Dissection table with touch screen shaped like a human body on a stretcher lets medical students explore, dissect and understand the body's parts and systems (Choi, 2015)

Extrapolation
Surgeons becoming better at preventing death and increasing life spans. Expensive 3D/virtual technology has led pharmaceutical companies visualizing health related outbreaks and releasing simulations at a heavy cost for those interested. Also, resulted in drugs being launched before a disease affects anyone; causing mass hysteria about injecting oneself with treatment, eventually, weakening the immune system.

Counter Trends
3D/virtual technology being used for unlawful activities could affect laws that could limit usage of these technologies. Access to 3D/virtual technology resource available to those that can afford it like pharmaceutical companies.

Departure Question
How might connected clinical data platforms be powered with tools to predict, prevent, and diagnose diseases before the onset of symptoms?

Design Principles
Comprehensiveness.

Trend 16 > The Machine Will See You Now

The disruption in healthcare due to the developments of artificial intelligence (AI) aiding diagnosis. However, whether artificial intelligence in would be a boon or a disadvantage in improving quality and efficiency, in healthcare, still needs to be proven.

Trend Description
Artificially intelligent tools and platforms give the ability to use computer-aided tools to weigh in symptoms and causes from a variety of unstructured data sources and could provide better diagnosis, feedback, guidance, and support to patients and assist physicians in providing better care. With research suggesting that healthcare providers and consumers would spend an estimated 6 billion dollars, every year by 2021, on AI-based tools would completely change the landscape of differential diagnosis. AI tools could help physicians and care providers analyze an individual's social determinants, familial, and medical history by powering through the tons of information hidden in all the unstructured data from different health platforms. In addition, it would help ease the burden of work, mitigate anchoring bias, reduce mistakes, and aid healthcare workers in decision making. However, it still remains to be seen how AI technology will match human needs, gather, administer, and apply data to reveal new knowledge; while at the same time understanding different languages and accents.

> *Robots won't steal doctors' jobs, but they will spare overworked docs some of the dangerous fatigue that can lead to mistakes. They're stressed, they've got a million different things they're looking at, so [there's] stuff they might have missed.*
>
> - (Captain, 2016)

Signals
Computer-aided diagnosis and treatment being tested in 16 cancer institutes working with IBM's Watson Health artificial intelligence venture (Cohn, 2013) Investments in virtual personal assistants by Google, Amazon, and Apple. (Hernandez, 2014) (Wilson, 2015). In Brazil and India, machines are being used in primary care. (Cohn, 2013)

Extrapolation
Artificial intelligence easing doctors workload and providing quality care to patients by extracting data from all sources to give a person's comprehensive medical history. Artificial technology will allow quicker and dependable diagnosis of diseases and ailments helping patients and health seekers self identify symptoms before they emerge and manage treatments without assistance from physicians.

Counter Trends
Artificially Intelligent Robots replacing doctors, physicians, and healthcare workers in the medical workforce.

Departure Question
How might the automation of medicine assist health care workers and providers to make the care experience seamless for health seekers and patients?

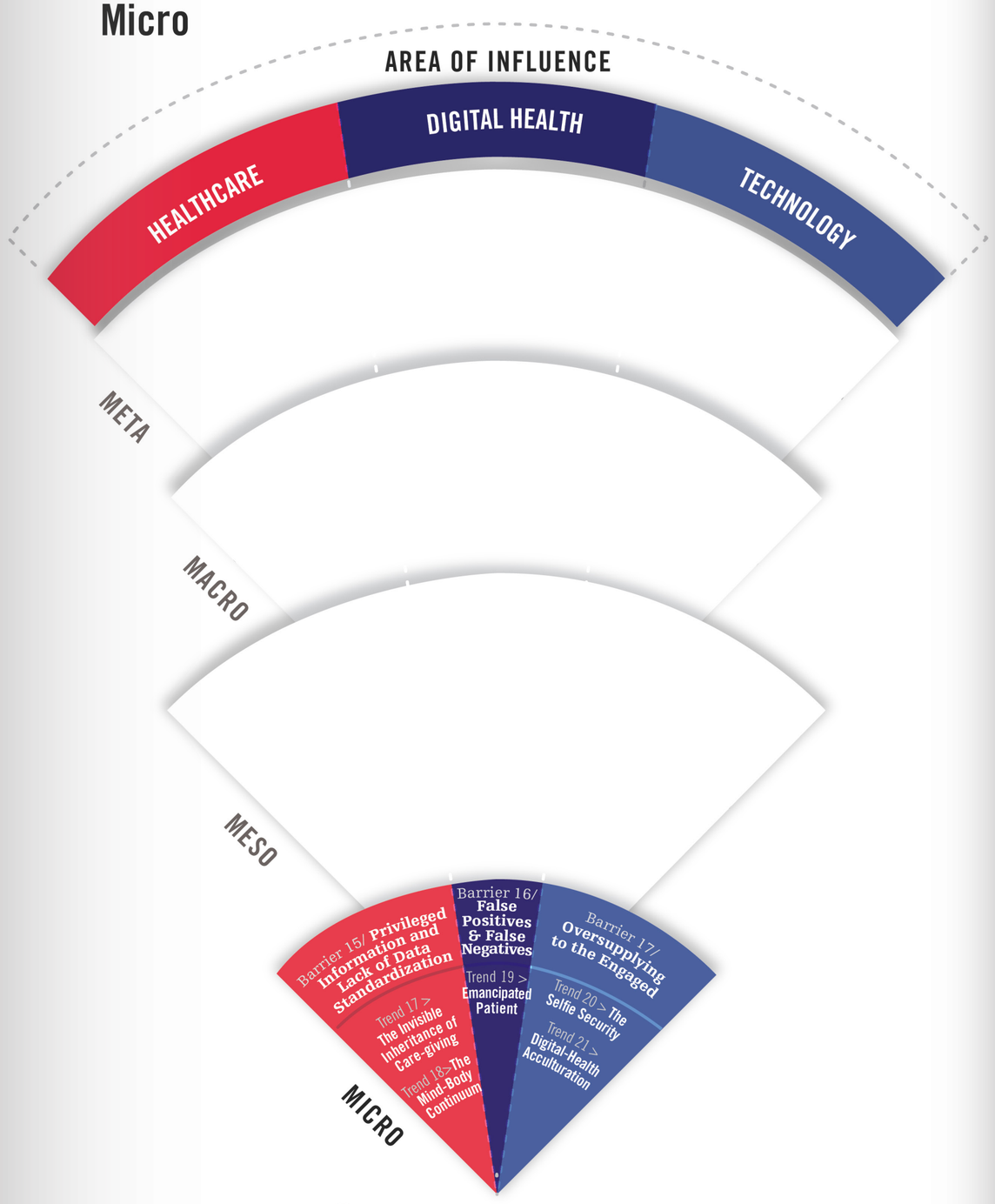
Design Principles
Portability and Comprehensiveness

Implications for
Meso + Technology Sector

An integrated system would adapt to the different health seeker groups to be able to collect information responding to differing care needs better than the current system. (Hunter, 2015) A large part of having a seamless experience of care is keeping patients out of the hospital. The access to technology that allows health seekers to manage their own health before the onset of symptoms would further reduce the burden on the system. Also, for the successful integration of patient and clinically reported outcomes would require iterative process of user testing, with clinicians, care givers and patients, in order, to solve user experience issues. (Moffat, 2015)

The front end user experience problems can be mitigated if designers, researchers, and developers collaborate, while evolving it; iterating on it and over time building a system that caters to the needs of all and provides useful and relevant solutions. The approach to designing this system would require focusing on understanding the context in which the technology is used and dropped rather than just focusing on early adopters to effectively engage those that need it the most. Garnering awareness and knowledge of human factors to develop effective interactive solutions between humans and computers (Husain, 2015) would result in a system that provides a person centered approach to care.

Micro



Barrier 15/**Privileged Information and Lack of Data Standardization**

"Defining most forms of medical knowledge as privileged information for the health care provider [has been] defended as a necessary consequence of the increasingly technical nature of medical care." - (Howell, 1995)

As Joel Howell writes, the unexpected side effect of technology introduction in healthcare led to control of a patient's health related information by the healthcare professionals or providers (Howell, 1995). However, with the bottom up adoption, mobile health technologies are becoming tools for patients to reclaim their right to be privy to their medical health related information. Privileged information, a reflection of the archaic nature of healthcare, has led to health information and data being collected, gathered, and used in a format not well understood by a majority of health seekers and patients, resulting in difficulty of information dissemination. There are many nuances in the way data gets recorded in a clinical setting, that is still not standardized. For an integrated health data system, the barriers are two-fold: the lack of uniformity of information entry of health data standards and a requirement of a nuanced understanding of utilizing the data. (Koh, 2015)

For physicians, the current lack of standardization of data makes information dissemination for care and treatment an immensely up-hill task. Currently, in Canada and the healthcare sector in most countries, health related data with respect to data standards, data commons, and data sharing, are dated with the sector facing some strong challenges to finding new ways to analyze, standardize, harness, and even manage the existing health data (Frommeyer, 2015). Even the data from existing EMR platforms is not standardized and in an unstructured format, with each provider and practice having their own standards of managing, collecting, and using this data. (CanImpact, 2015)

An integrated health data system would require a collective agreement about the type of health data standardization, and even an understanding about what aspects of the data would be standardized, for it to be clinically relevant. Added to this, a homogeneous health data structure would be useful only if it is done across the jurisdictional boundaries, which requires acceptance from organizational and a governmental standpoint. Only when there is a shift in the way data is collected, structured and regulated would it be possible to export and import health data across an integrated data system and for it to be utilized and exported in a way that provides a seamless experience of care. (Key Informant, 2015)

From the patients' perspective, the barriers arise from clinicians or care providers, as they are not privy to the language of the information communication and hence cannot take informed decisions regarding their own health management affairs. Their dependency on extra clinical tools helps them breakdown this information. However, these extra clinical tools or platforms lack clinical relevance that could allow patients to make better decisions about their care and health management. On one hand, the physiological and behavioral health data collected from extra clinical platforms has no frame of reference for a meaningful medical analysis. (Saunderson, 2015) Even if the onus reverts to the patients or health seekers to integrate into a system of their choice, there are limited information standards in terms of data standards or even interfacing standards currently in place in Canada. (Koh, 2015)

In the US and Europe, and to a very limited extent in Canada, the Blue Button plus initiative allows mobile apps to leverage data standards as a way to help patients track and manage their disease. (Koh, 2015) However, the information standards to be put in place would require a motivation from the organizational and policy standpoint. (Koh, 2015) The different conventions of the physician care provider, and the patient interaction combined with the different tools and standards used in the clinical setting are at odds with each other to provide quality care to the health-seekers and patients. (Husain, 2015)

Trend 17 > The Invisible Inheritance of Care-giving

Usually the most over looked person in the process of disease management is the family caregiver navigating a demanding system, providing support and going through the process with the patient physically and emotionally.

Trend Description
The circle of care forms the biggest source of support for those suffering from a disease or ailment. With a vast amount of aging population and the tenacity of diseases growing stronger, the role of this unpaid relative or a family member in the process is demanding made worse due to the lack of proper support systems in place. The care partner depending on the disease or ailment is usually the connector managing and communicating with family care physicians, home care agency, nursing care-giver, specialists, hospitals, insurance companies, financial institutions, professional, social, and community members all at the same time. The financial and emotional demands of this job bring to attention the need for systems that can be put in place as a way to care for those caring. (Ziegler, 2015)

> *Treatment is something that you do. When you've completed your task, that's it, you're done. If it's a patient that's involved, it's somebody else's concern after that. Care of course is a continuum.*
>
> - White Coat, Black Art: Falling through the cracks, 2015

Signals
Rise of patient networks like PatientsLikeMe and other health community groups. Health applications in FitBit & Apple watch have an option that allows the sharing of fitness data with friends and community. Loop, a platform created by healthcare human factors in Toronto, allows cancer patients and all those involved in their care to connect with each other through a secure e-portal.

Extrapolation
Government supported care network frameworks based on the ethos of communication and collaboration have lead to the development of policies, which allow the joint custody of medical records. This has led interoperable health platforms to allow dual user logins and connecting with care providers.

Counter Trends
Baby Boomers aging, Expensive nature of access to nurses and external care givers by patients.

Departure Question
How might bridging health data platforms ease the burden to assist care-givers and those bearing the invisible inheritance of caregiving in providing better care for patients or family members suffering from a disease or ailment?

Design Principles
Accessibility

Trend 18 > The Mind-Body Continuum

Visualizing the mind and the body as one and constantly iterating on one or the other to achieve a minimum viable model of well being.

Trend Description
Health seekers are becoming more conscious that their stressful desk-bound existence makes them prone to chronic conditions and psychological ailments. As an approach to balance the long-term effects of their daily grind, health-seekers are making small shifts in their physicality, lifestyle, and behaviours. This transformational view of well-being sees the mind-body functionality as symbiotic and hence augmenting one or the other; making the attainment of optimum level of well-being their top priority. The shift driven at an individual level, largely due to the advancements and accessibility of consumer technology, sees little support from care providers. This has led the health and wellness industry to expand its domain to include environments, fashion and food choices as means of incrementally improving the concept of health and wellbeing. (Maxwell, 2015) (LiveScience, 2015).

> *Participating in a weekly group hike in the country not only improves circulation but as a social activity might do more for the heart (and the brain) than exercise has done alone. As the evidence for the health impacts of our everyday choices accumulates, managing these choices will become ever more challenging*
>
> (Idea Couture, 2015)

Signals
Using smartphones for monitoring behaviours and patterns, bottled and juiced meals, paleo diets, power yoga, super food kale being part of our daily diet, clothes that enhance people's moods and memory all these symbolize the incremental shift towards a quest to attain a mind-body continuum. Hospitals collaborating with Fortune 500 companies to maintain workforce.

Extrapolation
These small changes to one's daily existence would result in extending lifespans, with health- seekers eventually delaying the process of aging, due to the improvement in their quality of life. Technological advances combined with the increasing knowledge of health and well-being is helping people find new ways to approach personalized health profiling leading to the emergence of a new, dynamic wellness industry that can be accessed and managed by individuals.

Counter Trends
Technology dependence making minds slower and lifestyle less active. Lifestyle and wellness related products & service being treated as fads with no value

Departure Question
How might the interoperable health data platforms help individuals achieve a mind-body continuum of care?

Design Principles
Comprehensiveness

Implications for
Micro + Healthcare Sector

To visualize the mind and body as one, in terms of, treating diseases and ailments will require patient medical records to include an individuals' comprehensive history and treatments with access and control to all parties from physicians, providers, the patient and even care givers. With the lack of proper support systems and connected platforms for those caring for the sick, communication is one of the biggest pain-points for these caregivers. A large aspect of easing the caregivers' burden would be for the integrated system to provide effective support, communication, and collaboration through a care network. The digital nature of this care network needs to be interoperable with various clinical data platforms as a way to build a strong alliance between care givers and care providers by enabling all those involved in the care to be on the same page regarding care planning.

However, the integrated health data system would not only require the linkages to be user friendly but would need delineation from a health care provider's point of view to be clear so that there is an awareness regarding the correct conventions for operating such systems. (Husain, 2015) The data cannot be dumped into the existing EMRs not only because the physicians would be faced with a flood of data that might not be useful to them and they would not know what to do with it, but also the data would need to be manipulated so that physicians could work with it in a clinical setting. The consideration for system designers, of this integrated system, would be to think about how to prevent data loss while at the same time meaningfully utilize data to inform and prevent unwanted medical care. (Key Informant, 2015)

In terms of a user experience design, the connected health data system should be able to integrate into the daily fabric of the patients and health seekers lives. (Dwivedi, 2015) The sharing or combining of the patient reported outcomes to be clinically relevant would require standardization of data and terminologies within the different contexts of where it is recorded. (Kubick, 2012) The possibility of interoperability between clinical and extra clinical platforms would need to find ways of mapping the different terminologies and finding ways of linking different clinical models. However, a single system with global standards would be hard to achieve.

The need for "common semantics and common ways of modeling patient data" (Kubick, 2012) between the two different worlds of health data would allow information collecting and sharing seamless for everyone involved in care. The standardization that integrates patient reported outcomes with the clinical data would make treatment more effective by reducing errors and enhancing productivity resulting in better outcomes and an efficient work force. (Muzyka, Hodgson & Prada, 2015) The consistent flow of verbal, written or collected information would make this knowledge effective (Kubick, 2012) and build a more transparent and accountable health system with a keen eye on the objective, functioning and output (Muzyka, Hodgson & Prada, 2015).

Barrier 16/**False Positives and False Negatives**

""If we monitor every single heartbeat, we are bound to see abnormal rhythms emerge in all of us at least a couple times a day. This does not mean that, everyone has cardiac dysrhythmia and should get pacemakers… we need to be able to understand the difference between the causation, correlation, and irrelevance of data when studying certain conditions. We should not let data guide us blindly down questionable rabbit holes. Instead we should ask intelligent questions of the data to determine possible health implications" (Saunderson, 2015)

Powered by digital health tools, patients and health seekers are not only taking control of their health but also diagnosing themselves through these new platforms and tools that result in health seekers, at times, over analyzing information that is insignificant while some ignoring that might be significant. (Saunderson, 2015) This phenomenon is referred to in medicine as false positives or false negatives, where an incorrect recording of health data results in an assumption of presence or absence of a disease even if in reality the opposite is true. Although, this occurrence stands true for both wellness and medical grade devices, products and platforms, the ease of access of tools that are at an intersection of wellness and health poses a more urgent need to focus efforts on settling their clinical validation claims. (Russo, Goparaju, & Bianchi, 2015)

The wellness space, in which extra clinical platforms currently have an impact, send inconsistent information to health seekers regarding their possible medical relevance leading the users of these platforms to derive meaning of the outputs. This would result in two distinct scenarios due to the mismatch of reality with the data output. At times, health seekers might report information by over estimating the reading of their data on their wellness devices, enabling people who are paranoid and obsessed with the meaning of data creating hypochondriacs in the process. (Rubin & Baddeley, 1989) (Saunderson, 2015) The second scenario could lead to people over estimating the therapeutic power of their health platforms causing a placebo effect (Silberman, 2009) with health seekers and patients living in the fallacy of the curative prowess of these solutions and taking risks with their health. (Saunderson, 2015)

Trend 19 > Emancipated Patient

Health seekers, propelled by the ease of access to over the counter health and wellness based consumer technology, are slowly shifting to a more self-managed care model.

Trend Description
With health technology platforms, targeting diagnostic tools to overzealous early adopters, access to health information is now in the hands of health seekers. Providing tools to consumers as a means to manage their own health has resulted in the shift with the health seekers being responsible for their own health. Additionally, it has also brought about a change in the model of care delivery from a single setting, controlled by the physicians, into multiple settings, managed at the discretion of health seekers. (Liebhold, Maguire & Townsend, 2009). This transfer of power to a more patient managed model of care is beneficial for the health care system too as it reduces the burden on health services and moves away from health being only the domain of experts. (Health.org.uk, 2013)

> *More than half of people (53%) would trust a test they personally administered as much or more than if that same test was performed by a doctor*
>
> (Intel., 2013)

Signals
Over the counter diagnostic consumer technology products expanding their offerings from Pregnancy and Diabetes testing to monitoring daily steps, heart rate, blood pressure monitor, ovulation, menstrual cycles, sleep patterns etc.

Extrapolation
Health insurance policy giving the health seeker choice to pick a device of their preference as a way to manage, monitor and decipher all their physiological, mental, emotional and biological data. This health data would be sent to the care providers, only in case of emergency, determined by systems set up in the platform.

Counter Trends
Over flooding of consumer technology market with platforms with the same value proposition. Longer waiting times in hospitals and clinics could increase costs of these over the counter products and services from consumer technology.

Departure Question
How might we connect health data platforms to make the patient more emancipated?

Design Principles
Comprehensiveness & Portability

Implications for Micro + Digital Health Sector

An empowered patient will not be a burden on the system eventually reducing the amount of investment in healthcare. The important factor to consider would be to empower, especially, those health seekers who lack the technological knowledge or the proper incentives to manage their care. However, a key design consideration would be to build solutions around how to settle the inconsistent messages from health seekers and patients to rationally manage and navigate the outputs for the connected health system. (Russo, Goparaju, & Bianchi, 2015)

The false negatives and false positives bring to focus the clinical relevance of the digital health tools and the financial investment that needs to be considered to make them accurate and technically robust to minimize false outputs. (Russo, Goparaju, & Bianchi, 2015) The wide reach and the high stakes at play is a cue for the need to prioritize medical validation efforts, so that they meet the clinical standards of the physicians and minimize potential risks while maximizing benefits for health seekers and patients. (Russo, Goparaju, & Bianchi, 2015)

Barrier 17/**Oversupplying to the Engaged** (Institute for the Future, 2010)

""In the sense the challenge is not necessarily to help the health-seekers although that is important. The much bigger challenge in public health interventions is to motivate people who are not health seekers. That is the biggest low hanging fruit… If you talk to public health administrators the problem they face is so staggering compared to 'should I walk 700 or 10,000 steps with my FitBit?'. So, how do we prevent these people with Diabetes from dying to ending up in hospital every week? These are not health seekers we are talking about. How do we get data from those who would really benefit from these lifestyle interventions, in a way, that helps them to improve their lifestyles? So health seekers are, in my perspective, our entire market, they are a small minority for propagation, they are highly motivated and great and we need to help them. However, helping people go from 1 to 5, rather, than 11 to 12. It's identifying and helping those people." (Moffat, 2015)

A lot of the bottom up adoption of digital health tools, particularly in the extra clinical data landscape, is due to the desire and demand of early adopters that yearn for or can afford to procure them. (Moffat, 2015) Added to this, there are those that are probably reticent to adopting these technologies (Moffat, 2015) and who might need it the most particularly due to the lack of knowledge of how these technologies work. There is a visible gap in the digital health market between those that are accepting of extra clinical technologies and probably need it less than those that avoid these technologies who probably need it the most. (Saunderson, 2015)

The enticement of a connected health data platform is more for health seeker groups that need it the least. To express this point, in a survey of wearable device users in the US, 75% described themselves as "early adopters of technology", 48% were younger than 35 years, and 29% reportedly earn more than $100, 000 annually. (Patel, Asch & Volpp, 2015). This, highlights the challenge that lies ahead for connecting health data platforms would be to engage the older, the less affluent or the least technologically savvy, so that it can provide value to those that need it the most.

75% * described themselves as "early adopters of technology"

48% * were younger than 35 years

29% * reportedly earn more than $100, 000 annually.

* In a survey of wearable device users in the US.

Trend 20 > The Selfie Security

Once limited to James Bond movies, the human body has taken over as a more secure way to login to the online domain. With eye tracking, hand gestures, fingerprinting. Soon parts of the one's body will be serving, as an additional safety measure catering to the increasing security related needs of consumers.

Trend Description
Symbols, alphabets, and numbers hardly seem like a robust way of securing information from hackers and protecting us from a possible security breach. With our expanding digital existence, greater security is the need of the hour. However, the thin line separating us from a hacking threat is usually a complicated password left to the behest of our dwindling memory, likely to betray us at anytime. The recent trend of, mobile phones using, fingerprints as a security layer has brought forth the idea of using basic human body functions like voice control, hand gestures, eye tracking to serve the purpose of not only protecting information but also to help power smoother interactions.

Using the human body as a protective shield from digital attacks, also guarantees swift transactions, which could be an allure to younger demographics that prefer less time-consuming ways of connecting with services. (PSFK, 2015)

> *All of us want a payment experience that is safe as well as simple, not one or the other. We want to identify people for who they are, not what they remember.*
>
> Ajay Bhalla, MasterCard's President of Enterprise Security Solutions.

Signals
Mobile and financial space are the ones largely exploring this trend with Apple pay already using fingerprints as a means to confirm transactions. MasterCard allows people to shop for their groceries and verifies the transaction through an app sending a notification for a forward-facing picture (selfie). In India, ICICI Bank introduced voice recognition software to authenticate customers based on speech patterns that act as a password; in place of card numbers, PINs or security questions to contact their call centre.

Extrapolation
DNA and physiological attributes to help unlock and protect information digitally. Creation of synthetic voice software to mask a customer and hack the account.

Counter Trends
Offline password, Hacking body controls.

Departure Question
How might the healthcare system use these emerging trends in digital security to mitigate privacy concerns and create a more intuitive and fluid experience of care?

Design Principles
Accessibility

Trend 21 > Digital-Health Acculturation

Increasing bottom up adoption of mobile technologies for medical compliance and treatment management is causing an incremental integration of the fast-paced world of consumer technology with the still antiquated healthcare domain.

Trend Description
The digital health revolution brought about the blending of two very distinct cultures. On one side is the technology sector that releases a new product prototype as frequently as possible and, on the other hand, healthcare where fax machines are still a medium of communication. This misconfiguration, between the conflicting pace of innovation adoption between the two sectors, combined with a struggle for control over daily user adoption practices has resulted in a digital health divide. The mobile health sector has been introspective of this gap and the power dynamics between the two cultures. For any innovation to be effective in the current system, both technology and healthcare sector must adapt to each other's needs while tackling their conflicting culture. This growing realization to meet at a middle ground, for long-term adoption of services and practices, could result in digital health platforms and devices to be embedded in the social, cultural and political behaviours of patients, physicians and care providers. (Ledger & McCafrey, 2014); (Castells, 2006); (Dhar, 2015)

> *"... social development today is determined by the ability to establish a synergistic interaction between technological innovation and human values..."*
> - (Bar, Pisani & Weber, 2007)

Signals
In India, healthcare practitioners receive patient's investigative lab reports on mobile-based messenger platforms like Whatsapp. (Dhar, 2015) The successful examples of appropriation include the use of cell phones for the purpose of improved health outcomes in less developed countries like South Africa, where the Cell Life project utilized cell phones to monitor HIV treatment in patients (Liebhold, Maguire & Townsend, 2009)

Extrapolation
Just as mobile phones penetrated our daily existence, mobile health apps govern our daily existence from the food we eat to our current state of mind with a button that allows the physicians to approve our choices or suggest alternative treatments. For the physicians, it eases workload as patients with minor ailments maintain contact through digital platforms resulting in them concentrating more on chronic and acute patients.

Counter Trends
Failure of digital health start-ups, consumers giving up on wearable devices 6 months after buying them

Departure Question
How might the digital health acculturation of technology and healthcare sector allow the creation of a seamless care experience of health seekers and patients?

Design Principles
Universality

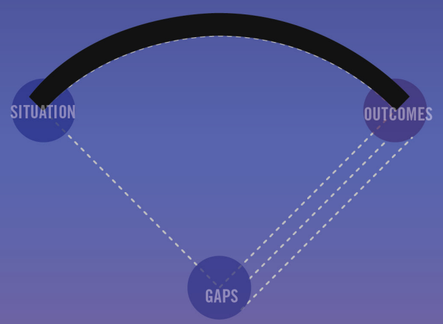
Implications for Micro + Technology Sector

Financial industries have always served as a testing ground for prototyping innovations. In the healthcare sector, where security is such a huge concern, privacy and security related trends could be used to authenticate patient health records. The patient can use biometrics or physiological functions to access their health information and share with those that will play an equal role in their care.

For a seamless experience of care, the connected health data platform needs to intervene by reaching the uninterested, rather than supplying the engaged (Institute for the Future, 2010). That in itself is a big challenge. Also, a uniform adoption and integration of technology into the everyday practice of patients and care providers would require not only technical interoperability but also cultural interoperability, with physician approval spearheading this movement.

Designing a system that reaches a wide population range may begin with those that adapt to new tools, technologies and services swiftly, regardless of whether the these tools actually provide some physiological or behavioural or emotional benefit to an individuals health and wellness. A portion of the population will neglect or might be predisposed to avoid these new tools for health management, despite needing it the most and that could hinder the expansion and utility of the connected health data system. (Institute for the Future, 2010)

THE
BRIDGE



Design Principles

Success Criteria For A Connected Health System

The Canada Health Act, serving Canadians since 1984 (Flood & Choudhry, 2002), forms the basis on which the design principles of a connected Health Data System have been formed. Basing the design criteria on the existing principles of Universality, Portability, Public administration, Accessibility, and Comprehensiveness; allows them to be grounded in their adherence to the Canadian values of equality and solidarity, and at the same time calls for the reflection needed to expand and revolutionize the present scope. (The Society, the Individual, and Medicine component of the University of Ottawa Medical Curriculum, 2002)

The criteria recommendations mentioned below which underly the principles, are framed to reflect the needs of contemporary society (Flood & Choudhry, 2002) and overcome the systemic barriers to designing a connected health system for a seamless experience of care for all it's citizens.

Universality

For visible outcomes, the reach of the Connected Health Data system should

1. Be expanded to all its users, particularly the uninterested, the high-risk high-cost users, as well as the early adopters to provide equitable care.

2. Overcome the barriers to enrollment by creating relationship centered-care through normalization of the conversation (Dwivedi, 2015) between care providers and patients and a more intuitive user experience (Moffat, 2015) (Hunter, 2015).

Portability

The coverage of the Connected Health Data system should

1. Allow the health seekers and patients anytime, anywhere care; even outside a clinical setting and at a place of their convenience.
2. Not be disruptive and fit in the daily fabric (Dwivedi, 2015) of health seekers' and patients' lives.

Public Administration

The governance and funding of the Connected Health Data system should

1. Place Emphasis on Accountability and Trust
2. Build a culture of innovation at all levels of the system by building "plug and play" system interoperability - with some aspects open to change and able to work with other health platforms. (Taylor, 2015)
3. Be cost effective rather than cost intensive.

Accessibility

Reasonable access of the Connected Health Data system should be granted by

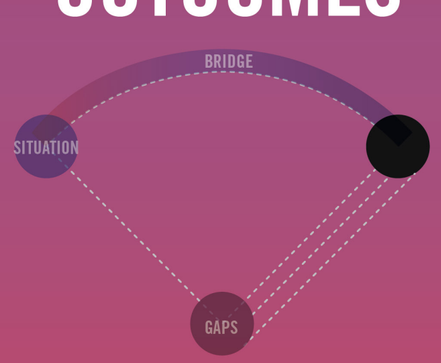
1. Considering privacy rights for all stakeholders involved in care, by maintaining high level of security.
2. Demarking Boundaries for a shared expectation of the experience of care.
3. Identifying the level of integration. For example, a copy of patient records versus real time access versus synchronizing records that would be provided to all stakeholders.

Comprehensiveness

To be effective and expansive in it's approach, the Connected Health system should

1. Take a person-centered approach to care by focusing on open communication between all those involved in care.
2. Encompass the person as a whole by incorporating a holistic view of a person's medical history that includes physical, mental, and emotional health.
3. Focus on the quality over quantity of health data by addressing the right data at the right time.

THE OUTCOMES



What future strategies could be employed to bridge the disconnected health data worlds and provide quality care to health seekers?

Strategic Recommendations

Pathways for a Connected Health Landscape

"In health care, the overarching goal for providers, as well as for every other stakeholder, must be improving value for patients, where value is defined as the health outcomes achieved that matter to patients relative to the cost of achieving those outcomes. Improving value requires either improving one or more outcomes without raising costs or lowering costs without compromising outcomes, or both. Failure to improve value means, well, failure." - (Porter & Lee, 2013)

The internal and the external analysis of the connected health system helped generate strategic directions for the design of the system. The impact of each recommendation was tested in co-relation with the design principles and needs of the future. (Van Der Heijden, 2000) Testing the strategic recommendations against the design criteria helped understand the influence of the strategies to create a seamless and holistic experience of care for health seekers. The performance and fit of strategies was deliberated based on four success measures: (Van Der Heijden, 2000)

I. The Financial Performance, was expressed, qualitatively, by analyzing the uniqueness, investment involved with respect to the value that would be generated for all the stakeholders

II. The Risk Performance of the strategies was assessed based on the systemic investigation and design criteria. By assessing the threats, allowed factoring in leading indicators that could affect the implementation of these strategies in the future.

III. A key criterion was to evaluate the Strategic Fit of the recommendations with the current competencies, to efficiently utilize as well as minimize the time and resources invested in it.

IV. Since the Cultural Fit in healthcare is a key obstacle to significant changes, strategies were measured, factored in ways to minimize change activities. The strategies that were deemed cultural unfit were reanalyzed through visualizing alternate combinations that would allow for it to be successfully implemented.

The strategies were then tested based on the design principles evaluated through the systemic analysis. Since these recommendations are more iterative and flexible, implementation considerations were also highlighted to manage the attainment of these outcomes.

Instilling Tolerance & A Culture Of Innovation

Strategic Recommendation - Option 1

"... fix the clinical side and brace the innovation. There are not going to be two platforms but they are just going to extend the platform and brace the innovation, I think that's probably a better way to look at it." - (Dwivedi, 2015)

Dependent on the successful integration of the electronic medical records, the next step would be to open certain provincial clinical assets on a smaller scale to the extra clinical platforms and assess the viability of the integration. Pilot testing and building it around opening communication lines before integrating the data would be the first step in the demonstration of the power of the linkage.

This demonstration would help prove efficacy and make a case to build policies and invest time, money and resources around integrating patient reported outcomes with clinical outcomes.

Considerations

Primarily, requires integration of the existing Electronic Medical Record platforms.

Open-mindedness to failure of the demonstrations, and yet re-starting rather than giving up.

The scale to which these tools would be expanded.

May require first evaluating it as a communication platform rather than comprehensive medical records platform.

May also be tested first as an information dissemination tool to test its capability.

Testing and clarifying types of integration and the pipeline.

Defining the scale to which this tool can be, or will be, expanded.

Describing the roles and responsibilities of those involved in the care using this platform.

Incrementally expanding and scaling the pilot platform first with high-risk high cost users, then with patients suffering from chronic and acute condition; to build it specifically for their needs, rather than the health seekers and early adopters.

Evaluate various levels of security and privacy protocols.

Require understanding attitudes and behaviours of physicians and providers towards opening their data and medical notes to extra medical world.

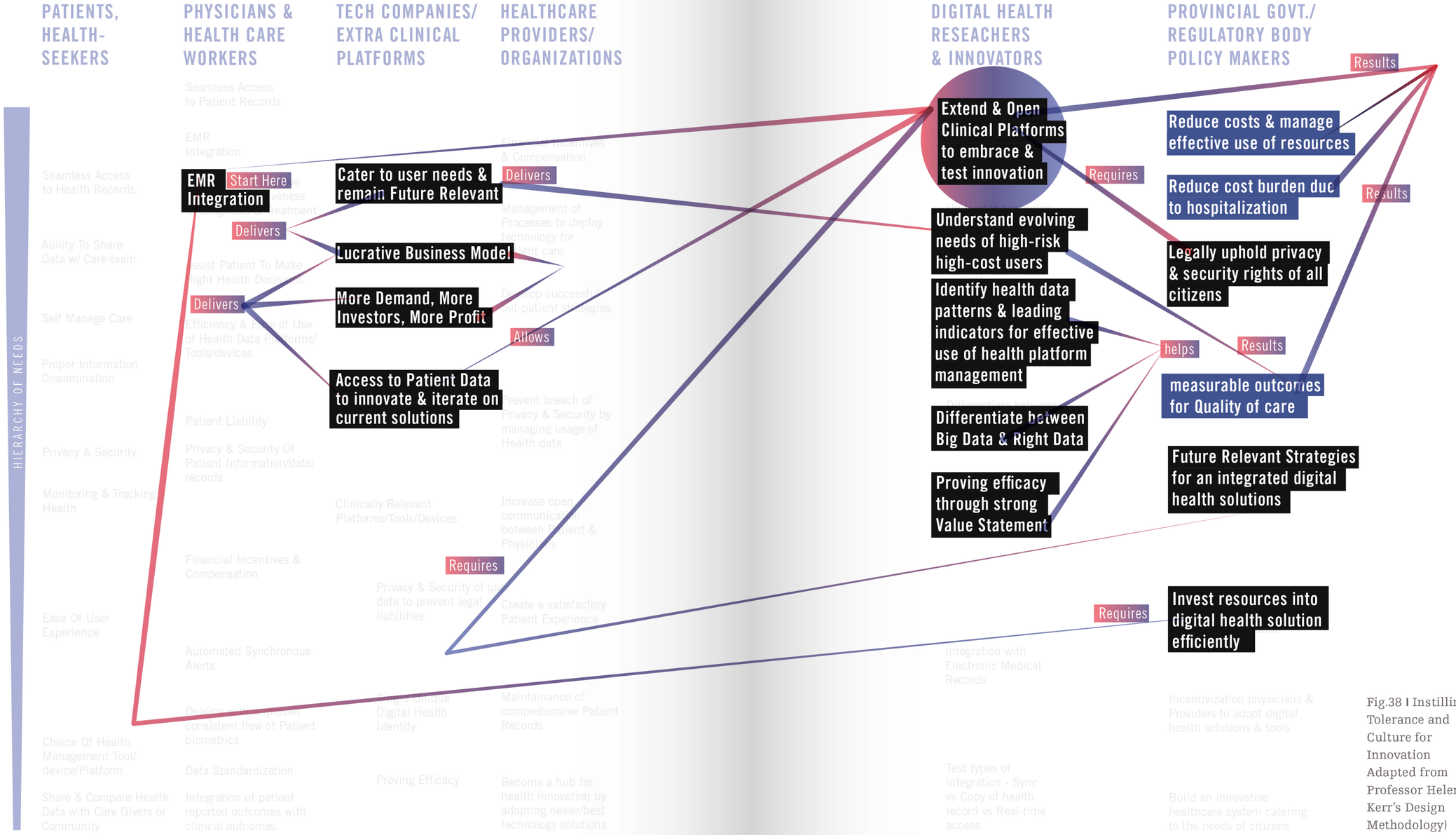


Fig.38 | Instilling Tolerance and Culture for Innovation Adapted from Professor Helen Kerr's Design Methodology)

Incentivize To Digitize

Strategic Recommendation - Option 2

"... importantly practice incentive for them to want to do it.... So every time someone tries to do this it will be from their initiative, mostly from their own practice, own time to do this." (Koh, 2015)

To drive the adoption of digital health solutions by physicians and providers, create payment incentives and compensation models that consider comprehensive out patient strategies. As a strategic recommendation, this direction would allow the integration of patient reported outcomes with clinical outcomes to be culturally acceptable for the healthcare workers. Incentivizing physicians and providers would also allow them to support patients that would adopt digital health practices to manage their care. The new equilibrium for the adoption of these digital health platforms would also bring about a change of attitudes to patient managed care.

Considerations

Provide tangible and intangible benefits to both physicians and providers for the adoption of digital health based solutions across institutions, care levels, and specialties.

Incentives and compensation models should divert financial and time efficient resources as a means of cross industry collaboration for the uniform adoption of digital-health solutions.

Focus should be on the patient-physicians-provider relationship, by delivering them more outcome-based information (Porter & Lee, 2013).

May require first evaluating it as a communication platform rather than a comprehensive medical record platform.

Clarifying types of integration within the connected health system such as physicians access to edit each others notes or would access be limited to just viewing records or would it be a tool to build interpersonal communication between care teams.

Defining the pipeline of the integration and clarifying roles and responsibilities.

Evaluate responsibilities and liability issues that might arise due to an implementation that emphasizes on outpatient strategies for patient care.

Requires training and guidance to physicians and providers on care that is not direct contact care; along with ways to analyze health data from patient reported platforms and tools.

May require understanding attitudes and behaviours of physicians and providers towards opening their data and medical notes to extra medical world.

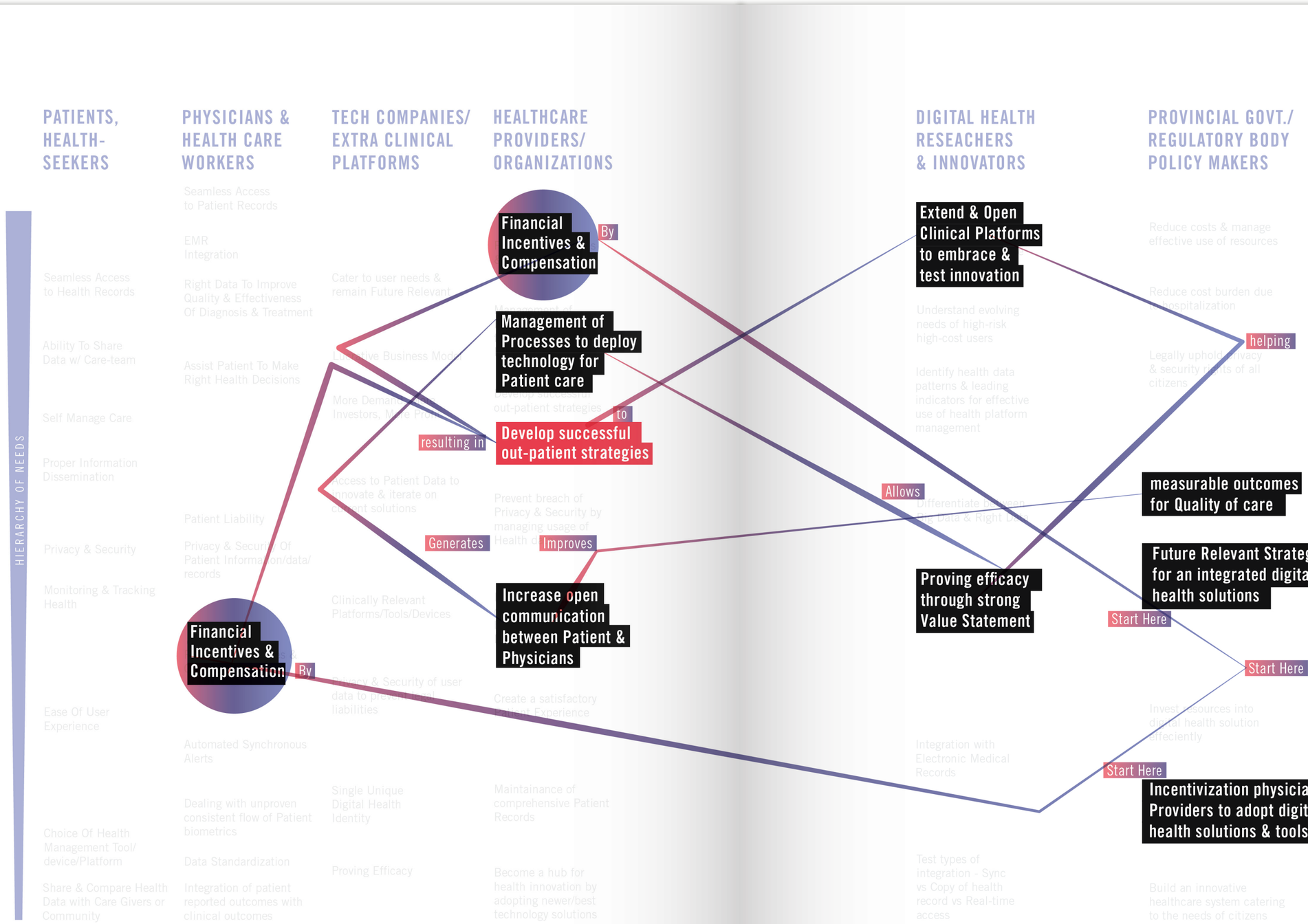


Fig.39 I Incentivize to Digitize Adapted from Professor Helen Kerr's Design Methodology)

e-Health Governance

Strategic Recommendation - Option 3

"I think the key to the entire success of the program is the holistic healthcare record that has lifetime view and this is where the value is because you can change the provinces, you can change cities, you can change countries. You certainly change physicians, healthcare providers but to have a single record that represents a lifetime of information that can track your health, knows all the information from anything you've being diagnosed with, to all the procedures you've had done, to the medication you've had over time." – (Hunter, 2015)

Visualizing the design of the connected health system as a single platform would first require the management of the medical records through a consistent digital identity for every citizen. These digital identities should be unique, lasting the lifetime of a citizen or health –seeker. Assigning digital identities to each citizen would not only assist in managing information from clinical and extra clinical platforms separately on a single platform but would also help identify health indicators, based federally and provincially, along with assistance in matching patient records.

The connected health system would allow users to login using their unique identification number to access and store their medical records; and securely and safely map records to patient and care teams accessible to them at point of care.

Considerations

Allow the platform accessible through the single unique identity to

Include data of a patient's comprehensive medical history be it physiological, psychological, behavioural, clinical or non clinical with access to all parties involved in care (Porter & Lee, 2013) inclusive of healthcare providers, care givers, lab investigations, and complimentary alternative medicine specialists.

Be based on principles of Privacy By Design, Access By Design, and Secure Exchange of health data (MaRS, 2015).

Data aggregation should be based around patient conditions and treatments rather than institutional silos. (Porter & Lee, 2013).

Include templates for data standards and medical terminology to normalize the conversation during the patient care.

Make medical records accessible to all the people involved in care.

Pilot test as a communication, information dissemination, as well as an appointment scheduling platform.

Focus on the user experience of the different patient types and clinician needs.

Allow patients and teams to measure care outcomes.

May require comprehensive training and guidance to patients, providers, and physicians on the usage of the platform.

Clarify types of integration of the connected health system – would physicians have access to edit each other's notes, or would they have access to records. or would it be a tool to build interpersonal communication between care teams.

Define the pipeline of the integrations and clarify roles and responsibilities.

Incrementally expand and scale the pilot platform first with high-risk high cost users, then with patients chronic and acute condition; to build it specifically for their needs, rather than the health seekers and early adopters.

Evaluate various levels of security and privacy protocols.

Requires understanding of the attitudes and behaviours of physicians and providers towards opening their data and medical notes to extra medical world.

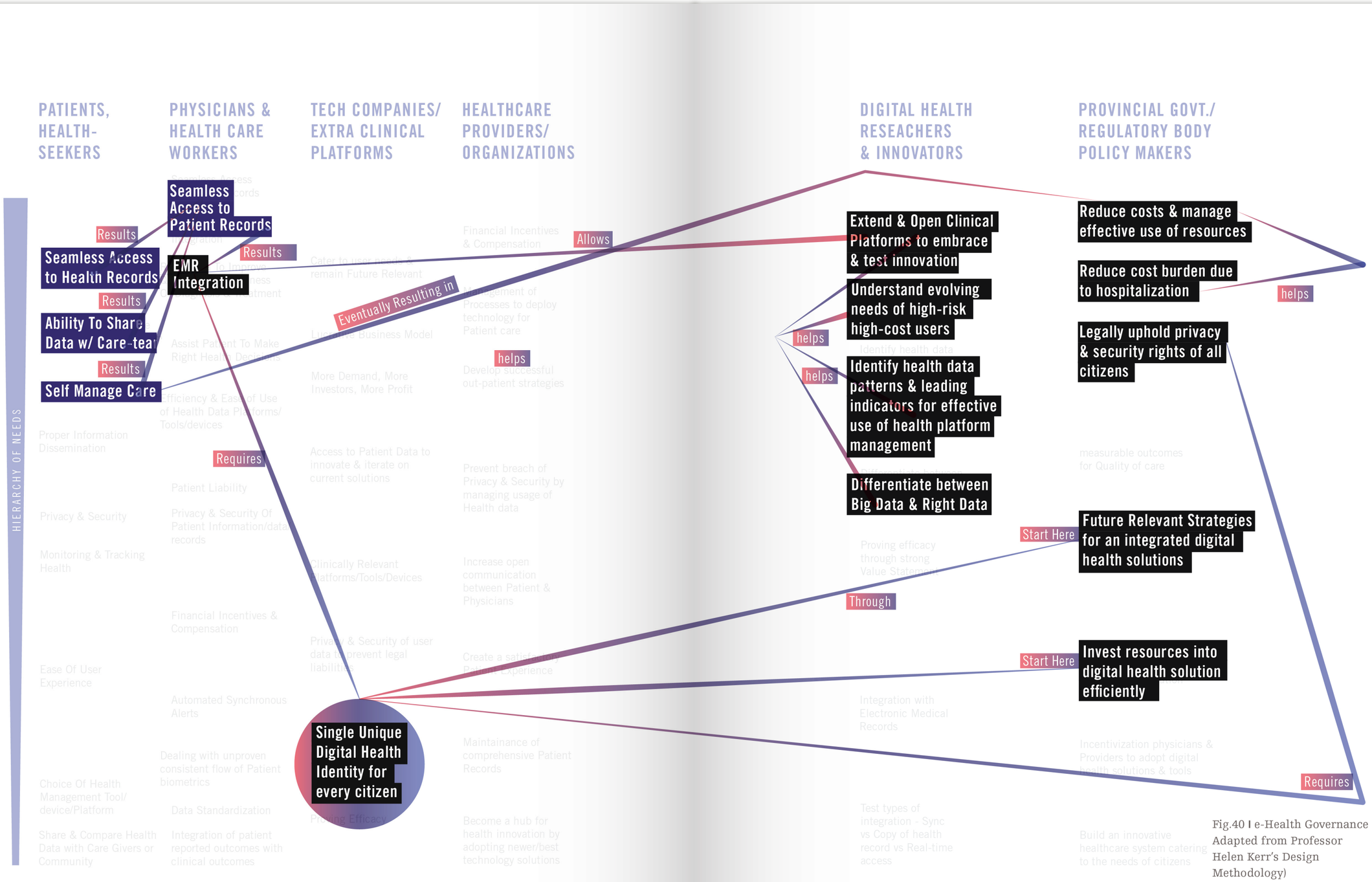


Fig.40 I e-Health Governance Adapted from Professor Helen Kerr's Design Methodology)

Conclusion

Insights about the value for the system

"Can you do without integrating platforms? Yes. It is just not efficient. You lose track of people once they leave your institution. Without integrating platforms, you can only do it some much." - (Dwivedi, 2015)

P ropelled by the increasing demand by patients and health seekers for systems that can connect clinical data with extra clinical data platforms, this research project set out to explore the connected health landscape as a means to bridge the continuity gaps in patient care. Using Brenda Dervin's sense making methodology as a framework for introspection and extrospection of the health data landscape brought forth the realization that the demand for a seamless health experience is not only from patients and health seekers, but is also an immediate need from the physicians' and providers' perspective. The systems analysis helped in developing an understanding of the current challenges and barriers that limit the integration of extra clinical platforms with clinical platforms, eventually, helping highlight points of intervention. Through expert interviews and literature reviews, key stakeholders and their needs were classified to build criteria that would determine the success of the future strategies.

The foresight exploration provided a platform to explore future strategies, within the areas of opportunities that can be utilized to bridge the currently disconnected worlds of health data. The two-pronged approach towards this research assisted in basing the design interventions built around the principle of holistic experience of care for health seekers and patients to maximize the impact of strategies.

Through the identification of the barriers and trends, classified based on their scope and scale, design principles for the connected health system were proposed. Establishing the design criteria on the existing principles of Canada Health Act allowed them to be grounded in the Canadian values of equality and solidarity, simultaneously, calling for a reflection needed to expand and revolutionize the present scope.

The strategic recommendations, as formulated, aim to instill tolerance and a culture of innovation; to develop comprehensive incentive models for physician-provider compensation that allows for the successful implementation of outpatient strategies; and to formulate a digital health governance model through the creation of a unique digital health identity. The design principles and strategic recommendations aspire to bridge the disconnected health data worlds and provide a seamless care experience to health seekers and patients. A connected health system would allow for the decentralization of care eventually creating and demonstrating the value for all stakeholders in the healthcare, digital health, and technology sectors, and at every level in the ecosystem.

At the societal level, integrating platforms could help develop better preventative strategies and assist in testing the effectiveness of treatments, particularly in the public health domain. This evidence-based approach to public health administration could result in better outcomes for all citizens. Added to this, there is an enhanced opportunity to understand the needs of citizens, their individual lifestyle choices, and testing the efficacy of treatments by using the wealth of data generated from a connected health data system. The data would not only help benefit citizens by identifying patterns and providing customized care, but would, also help inform research which in turn could support best practices for care providers to treat diseases and conditions before the onset of symptoms.

From a governmental and policy standpoint, better performance measurements derived through empowering citizens with self-care capabilities could help reduce costs dramatically by preventing duplication of treatment and help to make informed decisions in a time efficient manner that could make citizens healthier and improve the experience of health seeking. In addition, it would allow regulatory and governmental bodies to focus on the effective allocation of existing resources. Having data as an indicator of public health allows for the opportunity to manage non-urgent care outside clinics, aids investment, resources, and energy towards those who really could benefit from the treatment.

However, the most value will be generated from an organizational standpoint for healthcare, digital health and technology organizations. For researchers, the insights generated through the access to this previously restricted wealth of data from patient reported outcomes, integrated from different platforms, would allow for research based validation about patients' response to treatment and clinician's care practice. By recognizing biological markers and mental health indicators from the data collected, researchers could assist clinicians to provide effective diagnosis, and help customize treatments for certain patient groups.

Physicians can diagnose better with more information, particularly information reported on lifestyle, behavioral, and mental factors through this connected platform, which may be more reliable than a patient's self-reported experience. The patient reported medical data

from extra clinical platforms could help with faster diagnosis, treatment planning, and placing interventions where they would be the most effective, thereby augmenting and improving the delivery of care. The data-driven diagnosis could help inform trends early on in the course of a disease, making opportunities for primary and secondary prevention. Additionally, an integrated and connected health system could help physicians start a dialogue with their patients on clinically adjacent solutions for chronic diseases, such as Diabetes, which have a wellness aspect to disease management and inform effective and timely interventions. The patient reported outcomes could help prevent post-surgical hospital readmissions by getting ahead of complications and issues before a patient is discharged.

Creating value for the health system could also benefit digital health and technology companies venturing into the healthcare ecosystem. The data generated through the connected health platforms and tools allows the creation of new customer segments in hospitals and governments using them, allowing them to reach out to a wider customer base that could eventually help them expand their business outcomes.

At an individual patient or health seeker level, this allows for the efficient management of chronic and acute conditions for "High-risk High-Cost Users". The medical data analytics could give feedback about patient needs, and physical and mental health conditions outside a clinical setting. The self-monitoring devices could also help engage certain patients' groups extensively and inform care teams about the correlation between a patient's lifestyle choices and disease progression and management.

Information from patient reported outcomes could assist in bridging the communication gap between physicians and patients as it allows them to validate and verify the quality of life and stress indicators. A connected health system could hence improve the experience of health seeking through open communication between Care providers, patients, and health Seekers. An integrated health platform could become a tool to engage, facilitate, and manage change in behaviours; provide support in managing diseases and navigating the intricacies of a health system.

To conclude, the integration of extra clinical and clinical platforms could eventually result in "Healthier people. Healthier lives. A Healthier system that saves money… Everybody is Happier." (Dwivedi, 2015).

Next Steps

Taking it forward

The research approach was to take a step back to analyze and identify the barriers and trends within the connected health landscape and classify them based on their scope and scale, before designing digital solutions for specific ailments, conditions, and domains. The strategic recommendations, as formulated, aimed to instill tolerance and a culture of innovation; developing comprehensive incentive models for physician-provider compensation that allows for the successful implementation of outpatient strategies; and formation of a digital health governance model through the creation of a unique digital health identity.

As a starting point, the design principles and strategic recommendations can be tested to demonstrate their value within the public health and community-based care domain. Furthermore, to prove the efficacy of decentralization of care through digital solutions, they could be tested through nurse-led or community-based initiatives among patients with conditions like Tuberculosis (TB) and the Human Immunodeficiency Virus (HIV) that require stringent and regimented medication protocols. The ongoing efforts in Ontario to connect the disintegrated electronic medical record platforms could be expanded further to include patients and empower them in the management of their health through access to medical records. Extending the electronic medical record platforms to include a patient's or health seeker's comprehensive medical history, chronicling physiological, mental, or emotional parameters would allow for the analysis of disease and ailments from a more holistic lens.

To test this further the electronic health platforms should first open and extend a part of the system to patients as a communication platform to bring the entire care team, inclusive of, patients, care providers, caregivers, and physicians on the same page regarding care planning, treatment, and long-term care management. Testing it, initially, as a communication platform, would assist in building a minimum viable model of the connected health system. This would not only provide the necessary validation of the value of the system but would also allow policy makers to understand the strengths, weaknesses, opportunities, and threats before designing regulations and strategies.

The insights gained from the research were aimed to produce an output that is provocative and relevant to other experts in the field. Besides the personal learning associated for the researcher, the aim of this research is to provide all stakeholders, working in the space of human-technology interaction in health care, an opportunity to reflect on their organization's current practices and the existing landscape of digital health.

The researcher hopes that this study lays the groundwork for user interface, service, and user experience design for digital health solutions. Post the completion of this project, a service design blueprint – GIGA-map will be developed by the researcher to visually support and enhance the understanding of the systemic barriers, environmental factors, and areas of opportunity as a basis to allow organizations working in the digital health landscape to create a more person-centered design approach to digital health solutions.

This research document aims to serve as a human-centered design framework for organizations working in the space of healthcare, digital health, and consumer technology to effectively bridge continuity gaps by building digital health solutions that improve the future delivery and design of health platforms in Ontario and beyond.

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Moffat, G. (2015). Expert Interview. Interaxon. (Moffat, 2015)

Taylor, P. (2015). Expert Interview. Phone (Taylor, 2015)

Appendices

Appendix A
Experts Interviewed

(Alphabetically arranged based on their last names)

Prateek Dwivedi
Healthcare Product Builder
Prateek Dwivedi is a digital health technology lead for MaRS Discovery Districts and runs the Cancer informatics program at the University Health Network (UHN). His work with UHN Cancer Informatics program at Princess Margaret Cancer Centre is largely around building new informatics platforms based on strategies for capturing outcomes at the point of care. At the MaRS Discovery District, he runs a digital health practice for innovators, where he mentors entrepreneurs, who are running new health technology companies. Prateek Dwivedi's contribution in the analysis has been attributed as (Dwivedi, 2015).

Dr. Amna. F. Husain
Associate Professor, University of Toronto
Research Lead & Family Physician practicing in Palliative Care
Dr. Husain is a family physician practicing at the Temmy Latner Centre for Palliative care; one of Canada's largest palliative care organizations affiliated with Mount Sinai Hospital, alongside her work at the University of Toronto in the department of family and community medicine. A majority of her practice is in home palliative care and inpatient consultation with a focus on coordination of care for patients in the community. In her research, she has been working on innovative models and tools for collaborative care delivery, with many organizations and health care professionals across settings and organizations. An output of that currently evaluated in the form of an online clinical collaboration tool. Dr. Husain's contribution in the analysis has been attributed as (Husain, 2015).

Ian Hunter
Senior Solutions Architect, Microsoft
Ian Hunter is a Senior Solutions Architect, with Microsoft, the world's largest information technology company. His specific degree of focus is the Healthcare sector and his expertise lies in building systems insulations for Healthcare based technology. Ian Hunter's contribution in the analysis has been attributed as (Hunter, 2015).

Jerry Koh
Manager, Solutions Lab, MaRS
Jerry Koh's work as manager of Solutions Lab, at MaRS Discovery District - a registered non-profit charity whose mission is to improve lives and prosperity of Canadians through innovation, is to help startups, entrepreneurs, and innovators overcome systemic barriers in the form of policies, industry standards or protocols, market structures and forces. An essential part of his work deals with addressing the systemic barriers by employing the use of systems design, design thinking, capacity, and movement building as a means of supporting innovation, particularly, in Health Technology, Life sciences, and Clean Technology along with work and learning. Jerry Koh's contribution in the analysis has been attributed as (Koh, 2015).

Dr. Graeme Moffat
Director Scientific & Regulatory Affairs
Interaxon | Brain Sensing Technologies
Dr. Moffat supervises the clinical and scientific research along with managing regulatory affairs and relationships at Interaxon, the parent company behind the wearable brain sensing technology for consumer use – Muse headbands. Dr. Moffat's contribution in the analysis has been attributed as (Moffat, 2015).

Patricia Sullivan-Taylor
Strategic Advisor, Health System Performance at Health Quality Ontario
Patricia Sullivan-Taylor is the Strategic Advisor for multiple strategic projects on the health system performance at Health Quality Ontario. Health Quality Ontario publicly reports on the health of Ontarians and of the Ontario health care system. Patricia Sullivan-Taylor's contribution in the analysis has been attributed as (Taylor, 2015).

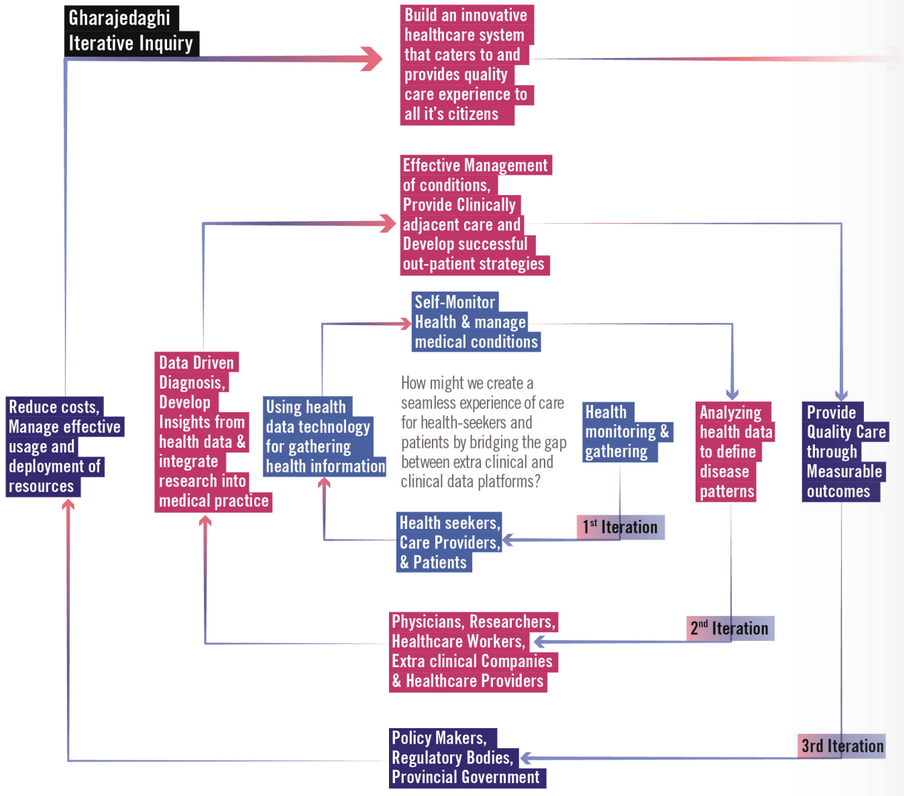
To ensure confidentiality of the responses from certain experts, their contribution in the analysis has been attributed as (Key Informant, Year) or (Confidential source, Year) as a means to mitigate any risk to their privacy through the identification of personal identifiers.

Appendix B
Stakeholder Analysis
(Stakeholder Mapping & Hierarchy of Needs)

HIERARCHY OF NEEDS

PATIENTS, HEALTH SEEKER	PHYSICIANS & HEALTH CARE WORKERS	EXTRA CLINICAL TECH PLATFORM CO.	HEALTH CARE PROVIDERS	RESEACHERS	PROVINCIAL GOVT. /POLICY MAKERS
	Seamless Access to Patient Records				
	EMR Integration		Financial Incentives & Compensation	Extend & Open Clinical Platforms to embrace & test innovation	Reduce costs & manage effective use of resources
Seamless Access to Health Records	Right Data To Improve Quality & Effectiveness Of Diagnosis & Treatment	Cater to user needs & remain Future Relevant	Management of Processes to Deploy tech. for Patient care	Understand evolving needs of high-risk high-cost users	Reduce cost burden due to hospitalization
Ability To Share Data w/ Care-team	Assist Patient To Make Right Health Decisions	Lucrative Business Model	Develop successful out-patient strategies	Identify health data patterns & leading indicators for effective use of health platform management	Legally uphold privacy & security rights of all citizens
Self Manage Care	Efficiency & Ease of Use of Health Data Platforms/ Tools/devices	More Demand More Investors More Profit			
Proper Information Dissemination	Patient Liability	Access to Patient Data to innovate & iterate on current solutions	Prevent breach of Privacy & Security by managing Health data use	Differentiate btw Big Data & Right Data	measurable outcomes for Quality of care
Privacy & Security	Privacy & Security Of Patient Information/ data/records			Proving efficacy through strong Value Statement	Future Relevant Strategies for an integrated digital health solutions
Monitoring & Tracking Health		Clinically Relevant Platforms/Tools/ Devices	Increase open communication btw. Patient & Physicians		
	Financial Incentives & Compensation				
Ease Of User Experience		Privacy & Security of user data to prevent legal liabilities	Create a satisfactory Patient Experience		Invest resources into digital health solution effeciently
	Automated Synchronous Alerts			Integration with EMRs	
		Single Unique Digital Health Identity	Maintainance of comprehensive Patient Records		Incentivization physicians & Providers to adopt digital health solutions & tools
Choice Of Health Management Tool/device/ Platform	Dealing w/ unproven consistent flow of Patient biometrics			Test types of integration - Sync vs Copy of health record vs Real-time access	
Share & Compare Health Data w/ Care Givers or Community	Data Standardization	Proving Efficacy	Become a hub for health innovation by adopting newer/best tech. solutions		Build an innovative healthcare system catering to the needs of citizens
	Integration of patient reported outcomes w/ clinical outcomes				

Appendix C
Gharajedaghi's Iterative Inquiry



Appendix D
Systemic Value & Success Stories

Insights into the needs for a Connected Health System

SYSTEM LEVEL	VALUE TO THE SYSTEM	CASE STUDIES OF SUCCESSFUL INTERVENTIONS			
META	• Better Preventative Health Management & Effectiveness of the Treatment.				Estonia Digital Governance UK. GOV Bio-Diaspora
MACRO	• Reduce financial burden • Effective allocation of existing Resources			Alberta Government myHealth Ontario	
MESO	• Insights to help integrate Research into Practice. • Data Driven Diagnosis • Clinically Adjacent Care • Minimize Post Surgical Readmissions • More Customers, Better Business For Digital Health Companies.		Odense University Hospital Philips, RelayHealth, Sales Force, Kaiser Permenente , Omada Health, Meditech		
MICRO	• Management of patients with Chronic and Acute conditions or the High-risk High-Cost Users • Improved Experience of Health - Seeking through open communication between Care providers, patients, and Health Seekers.	Blue Button Plus			

Figure 41: Systemic Values & Success Stories
Sources: (Dwivedi, 2015), (Koh, 2015), (Hunter, 2015), (Husain, 2015), (MacIntosh et al., 2014) (Moffat, 2015), & (Taylor, 2015)

Appendix E
Sense making interview Questions

Interview Questions for Interviewees in the Health Data Technology Sector

This interview has 4 parts

PART I: PARTICIPANT INFORMATION
I would like to start this interview by requesting you to please state
o Your name
o Name of the organization you are involved with
o Description of what your organization does
I would like to remind you again that these personal identifiers would be kept confidential unless, you give me explicit permission to use these in the final report.

PART II: UNDERSTANDING THE CURRENT SITUATION
o What business need did your organization feel that led it to venture into the health data platforms sector?
o What are the current health platforms and clinical/extra-clinical systems that your organization is working towards?
o How does your platform fit as an intervention in the current health-seekers journey?
o Can your platforms be categorized as a clinical data platform or extra-clinical data platform?
o Are they directed more towards patients/health seekers or health care providers/workers?
o How does your health data platform integrate with current clinical data platforms?
o How does your data platform assist the patients and health seekers? In what way is it fulfilling the need of the patients and health seekers?
o From your professional perspective, which aspects of connecting health data systems and platforms are concerning?

PART III: UNDERSTANDING THE NEEDS & GAPS
o What seems to be missing in the system, which could help make extra clinical and clinical data interoperable?
o What do you need that you do not have available that could help you make systems interoperable with other clinical/extra-clinical data systems?
o As an organization, working in the health data technology systems, what are the challenges you come across in making systems interoperable?
o What are the barriers in the current healthcare system that, limit you from connecting your data with other clinical/extra clinical data platforms?

PART IV: UNDERSTANDING THE CRITERIA
o Are there services and organizations that are assisting you currently, in connecting your health platform with clinical platforms?
o What have you seen that could help bridge the two disconnected health data platforms?
o How will integrating health data platforms help the patients and health seekers?
o What are the current ways in which your organization is working towards integrating with other clinical/extra-clinical data systems?
o How will connecting the two health data platforms help your organization?
o How do you see your organization changing the delivery of care for patients?
o What are the benchmarks for the design of a connected health data system for patients and doctors to create a seamless experience of care?

Section 5: Interview Questions for Healthcare Policy Specialists

This interview has 4 parts

PART I: PARTICIPANT INFORMATION
I would like to start this interview by requesting you to please state
o Your name
o Name of the organization you are involved with
o Description of what your organization does
I would like to remind you again that these personal identifiers would be kept confidential unless you give me explicit permission to use these in the final report.

PART II: UNDERSTANDING THE CURRENT SITUATION
o Currently, does the health care system have a requirement for the two data platforms to be interoperable?
o If yes, what purpose will interoperability of the two data platforms serve in the larger system?
o In your experience by making the two systems interoperable does it fulfill the need of the patients/health seekers or health care providers/workers? And how does it do so?
o To your knowledge, what are the current ways in which extra clinical data platforms are being integrated with clinical data platforms to provide value to health seekers?
o What aspects of connecting health data systems and platforms are concerning?

PART III: UNDERSTANDING THE NEEDS & GAPS
o What is missing in the system, which could help make interoperability of extra clinical and clinical data platforms, valuable to health-seekers?
o Do the current policy framework support the unification of the two health data worlds?
o What kind of backing, do clinical and extra clinical data platforms need, from a policy standpoint, to become interoperable?
o With the lack of interoperability between existing EMR platforms, what does the integration of extra clinical platforms with clinical platforms look like? What are the barriers in the current healthcare system that, limit connecting health data platforms with one another?

PART IV: UNDERSTANDING THE CRITERIA
o Are there services and tools currently in place to assist in bridging the two disconnected platforms of health data?
o In your practice, have you considered next steps in the direction of bridging the two data platforms to provide quality care what should they be?
o What are the current ways in which your organization is working towards integrating clinical and extra-clinical data systems?
o How will integrating health data platforms help the patients and health seekers?
o How will connecting clinical data with extra clinical data platforms help physicians, nurses, and care providers?
o What are the benchmarks for the design of a connected health data system for patients and doctors to create a seamless experience of care?

Appendix F
Environmental Scan Framework

Goal: By the year 2030, how might the landscape of digital health data platforms evolve? How might this evolution of digital health data platforms affect the experience of care for health seekers?

Trend Name	Snappy Title
VERGE Domain	**Define** What new concepts, paradigms, and ideas will emerge and assist us in making sense of the health- tech world? **Relate** What social structures and relationships will link people and organizations in the health-tech world? **Connect** How will health-tech connect people, places, and things? **Create** What are the processes through which we will design health-tech products and services? **Consume** How will we be acquiring and utilizing the health technological products and services available to us? **Destroy** What resources, values, or systems would the health technological products and services be eradicating? How will they misuse the available resources?
Trend Summary	One sentence that describes the essence.
Trend Description	Elaborate on the trend and its characteristics: – what is it, and what does it affect?
Signals	What evidences are there that this is happening? Describe the phenomena, events, or developments, and references to papers or other material that makes you think this is happening.
Industry(s)	Law, Foresight, Advertising, etc.
Counter-Trends	Is there an opposite trend that we should track? These might modify the strength or counter balance of this force
Extrapolation	What would this trend look like 5 -10 years, or 20 years out?
Implications/ Relevance	What effect does this have; why would one care? You may elect to ask questions as placeholders
Departure Question	Based on the implication of the trend, what does it mean for the MRP topic.
Design Principles	What criteria's/needs does it meet?

Figure 42: Trend Scanning Structure Sources - Adapted from (Candy & Stein, 2014); (Lum, 2013) (Schultz, 2010)