Canada Health Infoway

Inforoute Santé du Canada

Connected Health Information in Canada: A Benefits Evaluation Study

April 2018

Gartner.

Contents

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Executive Summary

Today, a majority of clinicians have access to connected health information about the patients they care for. Over the past several years, the availability and adoption of connected health information for Canadians has steadily increased. Connected health information is available in all provinces and territories, and, as of 2017, the pan-Canadian average iEHR availability reached 94.6%. Further, as of January 2017, an estimated 301,000 health care professionals (60% of potential users) were accessing one or more sources for patient information in an iEHR, and 85% of primary care physicians were using Electronic Medical Records (EMRs).

Infoway commissioned this study to better understand the quantitative and qualitative benefits of connected health information. The study identifies a number of quantitative connected health information benefits:

- Reduces duplication of diagnostic testing

- Enables more effective use of inpatient settings

- Drives more effective use of emergency departments

- Results in more effective ambulatory interactions

> "An interoperable Electronic Health Record (iEHR) is a secure, consolidated record of an individual's health history and care, designed to facilitate authorized information sharing across the care continuum."

It also identifies a number of other benefits for which there is strong evidence, but no quantitative evidence as yet.

Connected health information currently contributes approximately $1B worth of health care system value which can be captured and reallocated every year. It also saves the equivalent of 25 lifetimes of patient time per year, and the equivalent working hours of 2,227 providers. Current economic productivity gains made possible by connected health information are roughly $189M per year.

Health System Value	Current Benefits	$1B in health system value per year, equivalent to 5.6M ED visits or 155K hospital stays
	Benefits at Full Adoption	$3.9B in health system value per year, equivalent to 21.6M ED visits or 595K hospital stays

Patient Time Savings	Current Benefits	18M total hours per year, equivalent to 25 lifetimes
	Benefits at Full Adoption	76M total hours per year, equivalent to 106 lifetimes

Provider Time Savings	Current Benefits	5.9M total hours per year, equivalent to annual working hours for 2,227 providers
	Benefits at Full Adoption	15M total hours per year, equivalent to annual working hours for 5,633 providers

Economic Productivity Gains	Current Benefits	$189M in economic productivity per year, equivalent to returning 2,578 Canadians to the economy
	Benefits at Full Adoption	$732M in economic productivity per year, equivalent to returning 9,982 Canadians to the economy

Research conducted by Infoway and Gartner has identified a number of success factors critical to achieving and enhancing the value delivered by connected health information:

- Governance and leadership

- Workflow integration

- Point-of-care system integration

- Data quality and effective data sharing

- Change management

- Usability

The health care system in Canada is already achieving substantial value from access to, and use of, connected health information. With leadership, planning, and a focus on execution and benefits realization, the health care system will continue to reap further benefits in enhanced health outcomes for patients, providers, and the population as a whole.

Connected Health Information in Canada: A Benefits Evaluation Study
April 2018

1.0 Background and Context

1.1 National Approach to Connecting Health Information

The Canadian health care system includes a diverse group of professionals and organizations; family doctors, specialists working in hospitals and community clinics, pharmacies and diagnostic test facilities, to name a few. When Canadians receive care across the system our information has frequently become fragmented, leading to efficiency, quality, and safety issues due to disconnected care. Connecting health information has been an important foundation for improving the system and health care for Canadians.

Canada Health Infoway (Infoway) brings a pan-Canadian focus on improving the patient experience and health of populations, thus unlocking value for the health care system. Infoway is an independent, not-for-profit organization funded by the federal government and governed by its Members, who are the 14 federal, provincial and territorial Deputy Ministers of Health.

Infoway's early investments in digital health were made around 'foundational' elements, and included infostructure and core clinical systems. These core systems store information electronically, including client and provider demographics, diagnostic images and reports in hospitals, profiles of dispensed drugs, laboratory test results, and clinical reports or immunizations. This set of information constitutes the individual components of an interoperable electronic health record (iEHR) system. Each Canadian province and territory has implemented such a system.[1]

In addition to the iEHR investments, provinces and territories, regional health delivery organizations, hospitals, clinics, and ancillary health care partners have been deploying a range of technologies that support collecting, and providing access to, health information across the continuum of care. These organizations have invested in applications and processes that allow a wide range of stakeholders to access health information gathered from a number of sources both from within their point of care systems and using portals, messaging, and other means.

For the purposes of this study, the information exchanged using iEHRs, as well as the complementary solutions for sharing information between providers and organizations, will be referred to as connected health information.

Client Demographics   Diagnostic Imaging Repository   Lab Information Systems

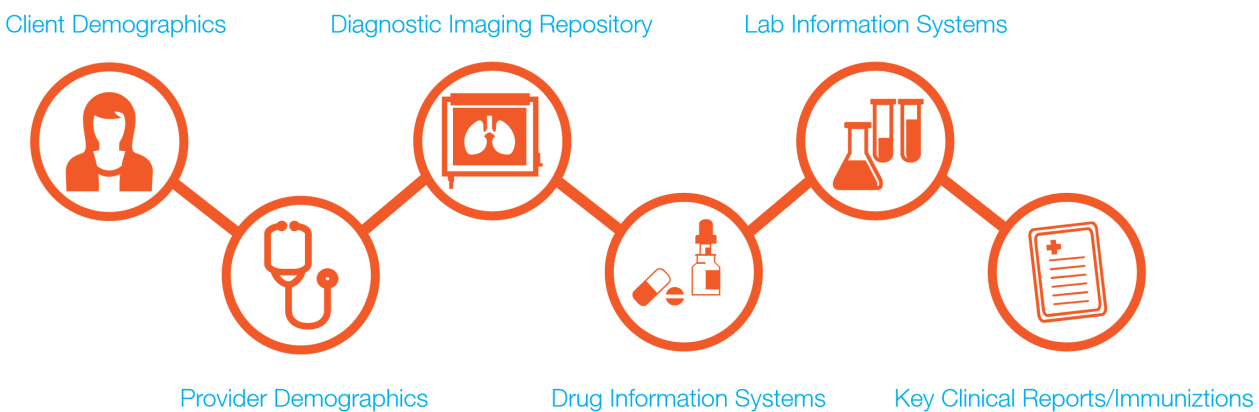Provider Demographics   Drug Information Systems   Key Clinical Reports/Immuniztions

Figure 1. Components of the Infoway Interoperable EHR

Early in its mandate, Infoway developed an EHR Blueprint (later updated as a Digital Health Blueprint) to describe the vision for connected health information and align decision makers on the best use of new and existing technologies.[2] To enable the continued adoption and use of the iEHR and other electronic systems that digitize and connect patients' health information across the care continuum, Infoway has provided leadership in the areas of privacy, security, solution architecture, standards, interoperability, clinical engagement, change management, evaluation, and the effective use of emerging technologies. This includes collaboration forums, conferences, and committees that bring together different stakeholders from across jurisdictions to establish common, best practice approaches to privacy, interoperability, and standards development. Other aspects of this leadership include national certification programs of health technologies that support adherence to standards, and promote information exchange and interoperability on a technical level. All of the above efforts have served, and will continue to serve, as important means by which to accelerate the availability of connected health information about patients for clinicians when they need it.

1.2   Study Objectives

Today, a majority of clinicians have access to connected health information about their patients. This has been made possible through foundational investments over the last two decades in digitizing and sharing information across the care continuum. Health Systems in Canada are now transitioning from creating the platform for digitization and sharing of patient information to making the highest and best use of these capabilities to enhance outcomes, optimize the patient experience, and focus on population health and wellness. To this end, there is a need to better understand the impact of the foundational investments that paved the way for connecting patient information so that the appropriate efforts can be directed to accelerate and optimize the electronic sharing of patient information and maximize value.

Previous pan-Canadian benefits evaluation studies by Infoway focused on benefits derived from particular digital health technologies,[3] such as ambulatory Electronic Medical Records (EMRs), physician office EMRs, telehealth and telehomecare, drug information systems, and diagnostic imaging. Infoway engaged Gartner to assess the value, effects, and benefits derived from connected health information across the Canadian health care system as a system using a standardized methodology[4].

2.0 Connected Health Information Landscape in Canada

Infoway tracks each jurisdiction's progress on availability of data in each of the six core EHR components individually (i.e., client and provider demographics, diagnostic imaging in hospitals, profiles of dispensed drugs, laboratory test results and clinical reports or immunizations), then uses the average of these values to represent the jurisdiction's overall EHR availability. Based on these numbers, the pan-Canadian average iEHR availability is 94.6 per cent as of March 31, 2017, and has been increasing steadily from year to year.[5]

There has been significant growth in clinicians' access to connected health information over the past decade. As of January 2017, an estimated 301,000 health care professionals (more than half of all potential users) were accessing one or more sources for patient information in the iEHR (e.g., laboratory tests, diagnostic imaging, clinical reports, prescription information). Access to this information was either through regional systems or jurisdictional viewers that provide connected health information on patients (Figure 1). Of these, more than 162,000 were actively accessing two or more clinical information sources through either viewers or integrated point-of-care systems. This is a significant increase from 2006, when less than 20,000 health care professionals (less than 4% of estimated potential users) were actively accessing this information (Figure 2). The next 10 years saw a flurry of activity in connecting health information by all other jurisdictions, resulting in the significant growth of active iEHR users.

Jurisdictions have also been focusing in recent years on extending access to connected health information from acute care settings to community and long-term care settings. In addition, efforts have continued to extend the completeness and quality of the information making up the iEHRs as well as other solutions to give clinicians the information they need for patient care. Jurisdictions are now also turning their attention and investments toward increasing the utilization of these powerful information resources in order to transform care management and delivery processes. This is being done to increase access, enhance quality of care, enhance population health outcomes, and manage costs.

A similar growth trajectory has taken place with Infoway funding digitization of physician office and ambulatory clinics in Canada. In 2006, when digital health activities were just beginning in Canada, less than one quarter (24%) of primary care physicians were using EMRs.[6]
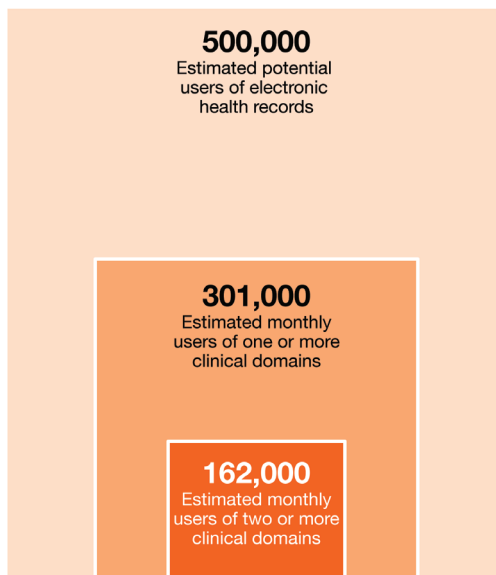

Figure 2. Active and estimated potential monthly users of electronic health records in 2017

By 2017, EMR use had grown to 85% of primary care physicians.[7] Investments in hospital information systems, pharmacy systems, and other provincial and regional infrastructure have similarly created conditions for successfully connecting health information.

Recent national surveys provide additional evidence of the increased availability of and access to connected health information.

- In 2017, approximately 42% of nurses and primary care physicians reported having access to provincial/territorial information systems.[7,8] In addition, 64% of primary care physicians reported they electronically receive hospital visit discharge information about their patients.[7]

- In 2016, about 61% of pharmacists reported having access to electronic drug information for patients. In addition, 44% of pharmacists reported having access to patient's laboratory test results, an increase from just 24% who had access in 2014.[9,10]

Overall, access to connected health information in Canada is moving from the deployment phase to mainstream adoption. The rapid increase in adoption is partially attributed to the integration of iEHR data into point-of-care systems in hospitals and clinics over recent years. Health care practitioners and leaders report that this integration is allowing providers to incorporate iEHR data into clinical workflows.[1]

Connected health information is currently accessed through integration with clinical systems such as EMRs, hospital information systems and pharmacy management systems or through standalone, web-enabled viewers. Integration with clinical systems allows connected health information to be incorporated into a patient's electronic record at the point of care with minimal disruption to a clinician's workflow. A standalone viewer allows a clinician to access connected health information for a patient, by launching a separate application, which often has additional steps such as entering login credentials and passwords, along with other privacy/security measures, followed by a patient search to locate relevant information. In some jurisdictions, the gap between integrated access and standalone viewers is bridged using single sign-on and context management. This is a more efficient way of integrating access to connected health information into a clinician's workflow.

Figure 3. Electronic health record active monthly user growth from 2006 to 2017

Future adoption tracking will go beyond simply measuring the number of active users with integrated access to connected health information to also measure the richness of information and functionality available to them. In addition, based on the experiences of Alberta and PEI (the two provinces with the longest history of iEHR availability, and the highest adoption rates), it is expected that adoption will increase as other provinces and territories have time to mature clinical workflow processes and change user perceptions toward using connected health information as a standard of care.

Canada is well positioned relative to its international peers with respect to storing and managing patient information, exchange of radiology results/images, and synchronous telehealth capabilities as recognized in an OECD comparative study.[11] However, a significant amount of progress remains to be made both in providing access to new functionality and data sources, and in incorporating the available features and information into standard practices.

3.0 Benefits

3.1 Study Methodology and Approach

Gartner applied the Infoway Benefits Evaluation framework (see Figure 4) and a standardized methodology for valuing national effects of digital health[12] to identify and evaluate the overall qualitative and quantitative benefits that are, and can be, achieved from access to, and use of, connected health information.
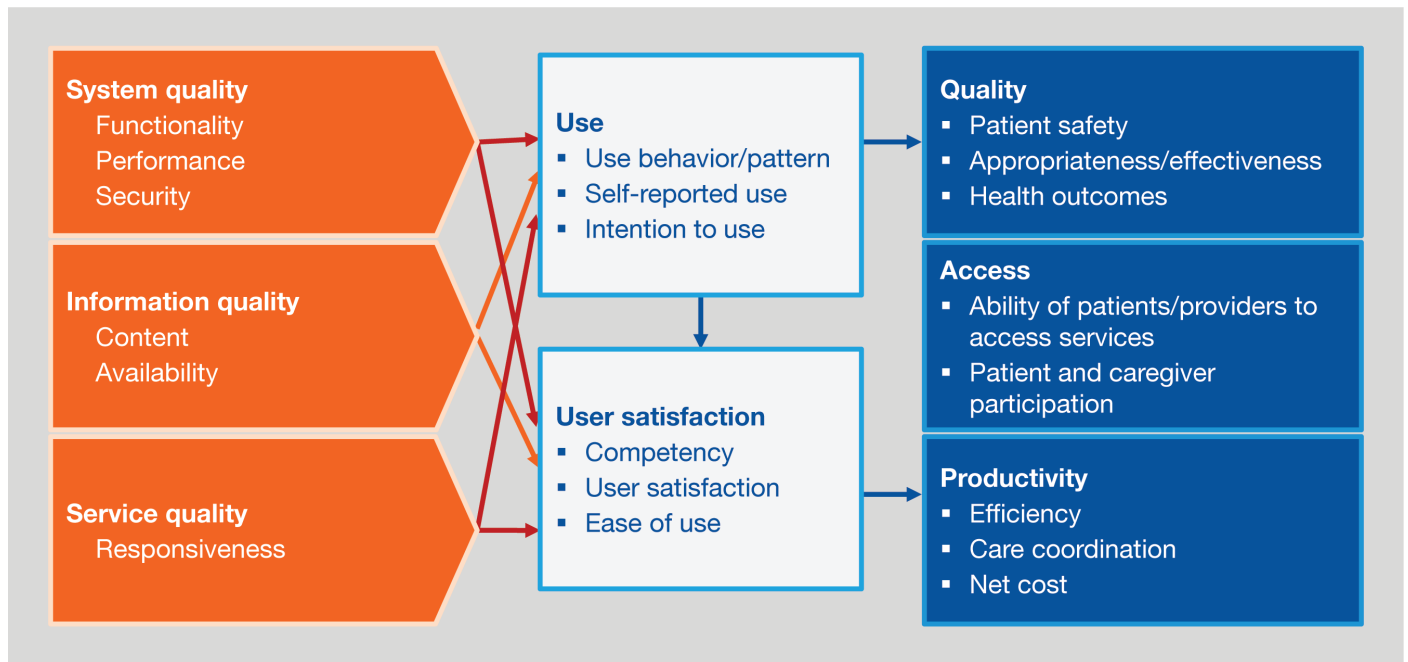
Figure 4. Infoway Benefits Evaluation Framework

The study included development and refinement of a series of hypotheses through:

- Reviewing a wide set of information sources to develop the hypotheses

- Validation of the hypotheses

- Modelling the benefits

- Iterative validation of the model, input data, and the benefits through expert review

- Literature Review
- Canada Health Infoway Reports
- Project Evaluations
- Secondary Research
- Key Informative Interviews

- Gartner Research
- Gartner Consulting
- Infoway Working Group
- Advisory Panel

Development of Hypotheses

Validation of Hypotheses

**Modelling of Benefits**

Validation of Model & Benefits

An economic benefits estimate model based on evidence to extrapolate national impacts of connected health information across Canada

- Leveraging: *Valuing national effects of digital health investments: An applied Method*
- Available Canadian National Data
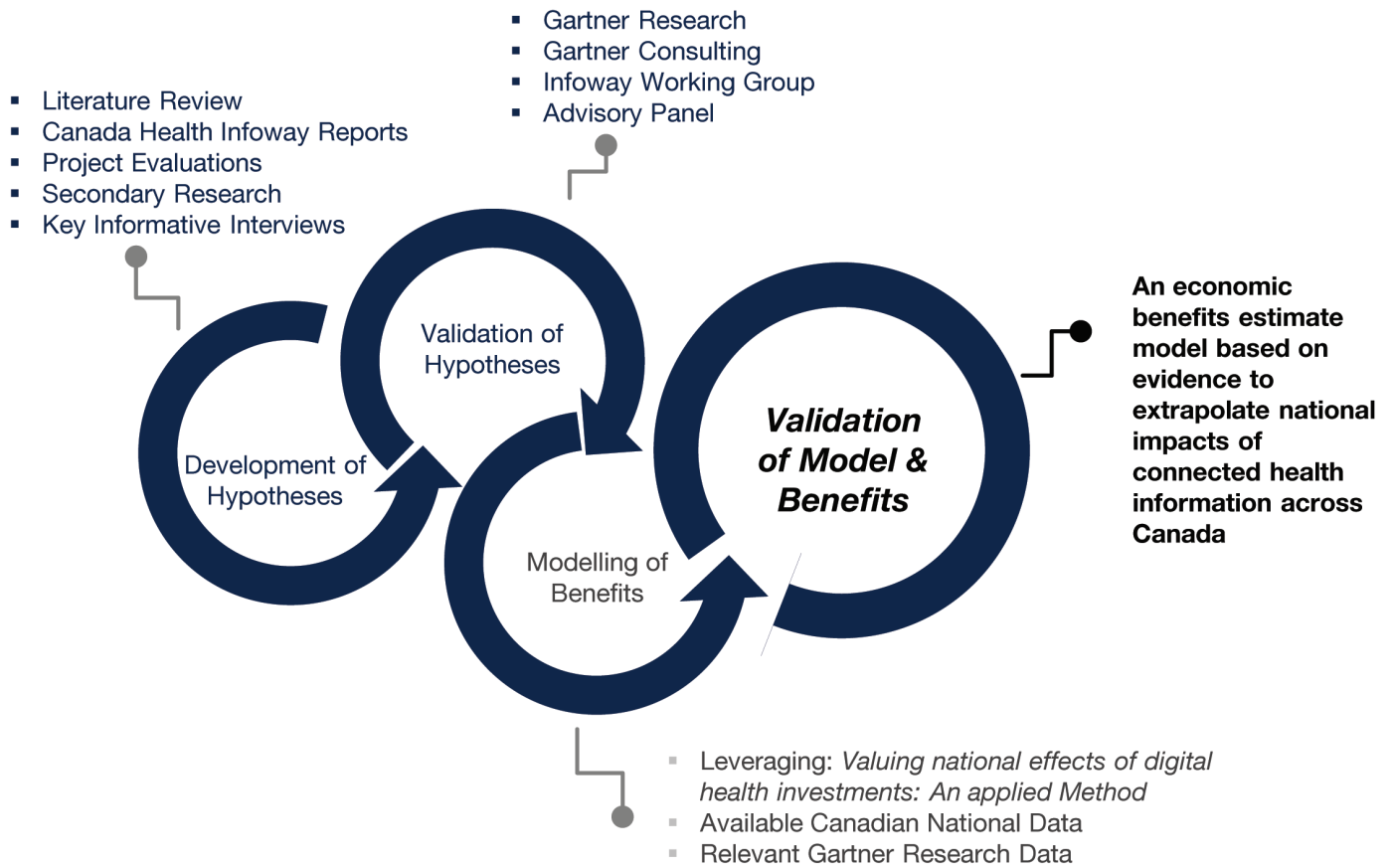- Relevant Gartner Research Data

Figure 5: Study Methodology Summary

The sources of information, which drove the development of the initial hypotheses, and the subsequent analysis and modelling, include:

- Key informant interviews commissioned by Infoway and conducted in the first half of 2017. The interviews solicited input from 27 key informants representing a variety of health care stakeholders (clinicians, administrators, digital health implementers, decision makers and government representatives) on the impact and future of iEHR in Canada. Infoway will publish more detailed findings of this research separately.

- Published research on connected health information captured through a literature review commissioned by Infoway, carried out by researchers from the Institute of Health Policy, Management, & Evaluation in the first half of 2017. The review, which included 137 articles, focused on the adoption, use, and impact of connected health information in Canada and other comparable countries and regions around the world. This literature review will also be published by Infoway.

- Review of Gartner research and engagement of Gartner Research Analysts.

- Publicly available reports published by Infoway, including previous benefits evaluation studies.[13]

- Secondary research and national surveys and healthcare data from sources such as the Canadian Institute for Health Information (CIHI).

The Gartner team developed an initial list of hypotheses based on the information available and by applying Infoway's benefits evaluation framework. An initial set of 20 hypotheses included access, quality and productivity benefits derived from the use of connected health information. The hypotheses were iteratively narrowed down, with input and direction from the Infoway Steering Committee and Working Group, and the Advisory Panel, to identify a number of benefits that could be quantitatively modelled (see Figure 5). The list of hypotheses was refined and validated based on the availability of evidence to model the benefits. Where evidence was available, hypotheses were categorized as quantitative or qualitative. Some hypotheses were excluded since they had been quantitatively addressed in previous national studies. Quantitative benefits have been modelled to identify financial benefits and potential time saving benefits. A number of qualitative benefits are also described based on findings in the literature and in reports from practitioners.

Initial Hypotheses Presented to Infoway

- Reducing duplication of lab and imaging tests
- Enhancing timeliness of access to laboratory testing and imaging results
- Increasing adherence to evidence-based guidelines
- Reducing the duration of visits to the emergency department
- Reducing the number of admissions from the emergency department
- Reducing the number of admissions to emergency departments by repeat users
- Reducing hospital readmission rates
- Reducing inpatient average length of stay
- Optimizing encounters through electronic notification
- Enhancing effectiveness of Public Health surveillance and intervention
- Reducing medical errors
- Supporting more effective encounters through reduced time to more complete and more accurate information
- Increasing Chronic Illness Medication Adherence
- Optimizing scope of practice
- Enhancing effectiveness of referrals
- Enhancing communication and coordination among providers at different health care organizations
- Enhancing patient engagement
- Optimizing disease specific encounters
- Enhancing end of life care
- Enhancing system performance through enhanced completeness, accuracy, and timeliness of health care data

Hypotheses Reviewed with Advisory Panel

- Increasing appropriate utilization for diagnostic testing
- Enhancing timeliness of test results
- Improving provider efficiency before, during, and after primary and specialty care interactions
- Reducing time and cost, and increasing satisfaction for patients before, during, and after primary and specialty care interactions
- Reducing the duration of visits to the emergency department
- Reducing the number of visits to emergency departments
- Reducing hospital readmission rates
- Reducing inpatient average length of stay
- Reducing the number of admissions from the emergency department
- Enhancing effectiveness of Public Health surveillance and intervention
- Optimizing scope of practice
- Enhancing planning and coordination of complex and chronic conditions (e.g., end of life, diabetes, congestive heart failure, chronic obstructive pulmonary disease)
- Increasing access to care by underserved communities and regions

Hypotheses Supported by Quantitative Evidence

- Reducing duplication of laboratory tests in ambulatory care
- Reducing of duplication of laboratory tests in emergency departments
- Reducing of duplicate diagnostic imaging tests in ambulatory care
- Reducing of duplicate diagnostic imaging tests in emergency departments
- More effective ambulatory interactions
- Reducing the duration of visits to the emergency department
- Reducing the percentage of visits to the emergency department
- Reducing the percentage of hospital admissions from the emergency department
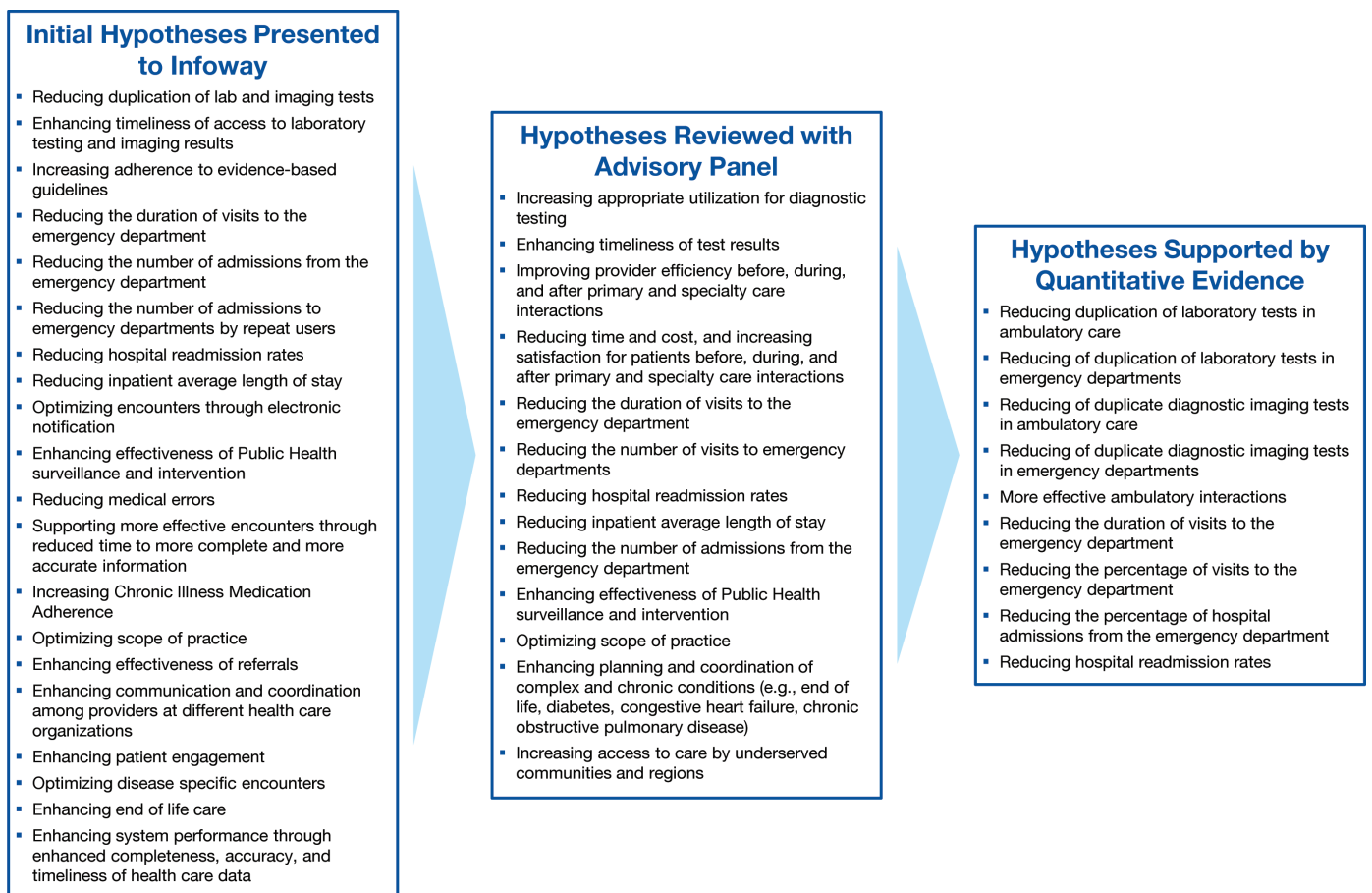- Reducing hospital readmission rates

Figure 6: Hypothesis Iteration Throughout the Study

The results reported here rely on a number of studies conducted within the last seven years. The Technical Appendix highlights a small number of limitations and other considerations to the findings based on the quality of the studies, the availability of evidence, and its applicability to the Canadian context. These include:

- The overall benefits presented in this study are likely conservative. Some initially hypothesized benefits were removed due to lack of available data.

- Benefits have been calculated independently of each other. The possibility that one type of benefits may have an impact on another benefit area has not been considered.

- Modelling inputs were derived from the literature review. However, due to the emerging nature of available evidence related to connected health information, the available evidence from this review did not grade evidence quality, nor was all evidence drawn from a Canadian context. The Advisory Panel supported selection of the most appropriate evidence to apply.

- The study reports benefits from an aggregated Canadian perspective. Regional nuances and differences across jurisdictions may impact the extent to which benefits can be realized.

- Where there was conflicting evidence or evidence from non-Canadian contexts, the Advisory Panel provided input on a case-by-case basis as to the usability of that evidence in this study.

- It is likely that, in the future, the potential for benefits realization will increase in two instances: first, as solutions are enhanced with new features and functionality; and second, as these solutions are more fully integrated into point of care systems and into standard, or expected, clinical practices.

3.2   Benefits Summary

The study reports on both estimated current benefits, based on current levels of adoption of connected health information, and also on the benefits at full adoption assuming an aspirational 100% adoption and use by all potential users in-scope for any given benefit.

Infoway estimates regarding user penetration were used to estimate the current adoption of connected health information. Depending on the care setting, current adoption and use is estimated to be between 22% and 42% of the total potential use. The actual data and sources of that data for each benefit are included in the model and the Technical Appendix.

The hypothesis-driven approach described above yielded a number of estimated quantitative benefits that can be grouped into four key areas as follows:

Health System Value	Current Benefits	$1B in health system value per year, equivalent to 5.6M ED visits or 155K hospital stays
	Benefits at Full Adoption	$3.9B in health system value per year, equivalent to 21.6M ED visits or 595K hospital stays

Patient Time Savings	Current Benefits	18M total hours per year, equivalent to 25 lifetimes
	Benefits at Full Adoption	76M total hours per year, equivalent to 106 lifetimes

Provider Time Savings	Current Benefits	5.9M total hours per year, equivalent to annual working hours for 2,227 providers
	Benefits at Full Adoption	15M total hours per year, equivalent to annual working hours for 5,633 providers

Economic Productivity Gains	Current Benefits	$189M in economic productivity per year, equivalent to returning 2,578 Canadians to the economy
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Connected Health Information in Canada: A Benefits Evaluation Study
April 2018

These four groups of benefits are derived from changes in the way that care is managed and delivered in a number of areas as follows.

Reduced Duplication of Diagnostic Testing

Laboratory tests and diagnostic imaging tests play an important role in the clinical decision-making process. As care providers look at a multitude of information sources to arrive at care decisions, these tests form an important data point upon which to discount or justify further examination or treatment directions.

The research uncovered evidence that the use of connected health information reduces the incidence of both laboratory tests and diagnostic imaging tests, the community setting and in hospitals, and specifically in emergency departments.

Reduced Duplication of Laboratory Tests

Benefit Type   Quality   Access   Productivity

There is strong evidence that when clinical decision-makers in ambulatory or emergency department (ED) settings have access to patient information that exists outside of their local hospital information system, ambulatory EMR, or laboratory information system, there is a reduction in the number of duplicate laboratory tests performed.

Illustrative example: A new patient arrives at an ED complaining about dizziness and shortness of breath. The ED physician refers to the patient's record and notices that, during a recent visit to a primary care physician, the primary care physician ordered a full blood count, the results of which were recently made available. Accordingly, the ED physician avoids ordering a new full blood count test.

Current Benefits

In ambulatory care settings, connected health information reduces duplicate laboratory tests and generates $72.7M in health system value that can be reallocated. Patients are given back a total of 1.86M hours, contributing $49.5M in economic productivity every year.

In emergency department settings, connected health information reduces duplicate laboratory tests and generates $9.0M in health system value that can be reallocated every year.

Benefits at Full Adoption

In ambulatory care settings, connected health information reduces duplicate laboratory tests and generates up to $173.0M in health system value that can be reallocated. Patients are given back up to a total of 4.44M hours, contributing up to $117.9M in economic productivity every year.

In emergency department settings, connected health information reduces duplicate laboratory tests and generates up to $40.16M in health system value that can be reallocated every year.

Reduced Duplication of Diagnostic Imaging Tests

Benefit Type | Quality | | Access | | Productivity |

Diagnostic imaging tests, like laboratory tests, play an important role in the clinical decision-making process. In some cases, repeated testing is required to assess a person's condition over time. However, in other cases, diagnostic images are ordered in the absence of easy access to prior test results.

There is strong evidence that access to, and use of, connected health information enables clinicians in both ambulatory and ED settings to reduce the number of duplicate diagnostic imaging tests performed.

Illustrative example: A patient presents at the ED following a slip and fall accident complaining of wrist pain. Following an X-ray, the patient is told they have suffered a serious sprain, but no fracture, and is prescribed a course of treatment involving pain medication and immobilizing the wrist. The patient, suffering discomfort in their wrist a week later, goes to their primary care doctor requesting a follow-up X-ray. The patient's primary care physician pulls up the patient's record, including the diagnostic images and additional information about the ED visit. The physician uses this information, in the context of the patient's ongoing complaints, to assess the patient's condition without the need to order additional X-rays.

Current Benefits

In ambulatory care settings, connected health information reduces duplicate diagnostic imaging tests and generates $6.7M in health system value that can be reallocated. Patients are given back a total of 140K hours, contributing $2.9M in economic productivity every year.

In emergency department settings, connected health information reduces duplicate diagnostic imaging tests and generates $19.5M in health system value that can be reallocated every year.

Benefits at Full Adoption

In ambulatory care settings, connected health information reduces duplicate diagnostic imaging tests and generates up to $15.97M in health system value that can be reallocated. Patients are given back up to a total of 334K hours, contributing up to $6.9M in economic productivity every year.

In emergency department settings, connected health information reduces duplicate diagnostic imaging tests and generates up to $86.5M in health system value that can be reallocated every year.

More Effective Use of Inpatient Settings

Benefit Type   **Quality**   **Access**   **Productivity**

The ability of inpatient facilities in Canada to meet demand is being tested in the face of an aging and growing Canadian population, with an accompanying rise in the incidence of chronic diseases. Inpatient acute care is one of the highest cost and most scarce care venues. Evidence points to two ways that access to, and use of, connected health information decreases the use of inpatient beds.

Studies show that organizations with access to connected health information experience reduced numbers of admissions from the emergency department to inpatient care. Access to information allows care providers to determine whether a patient is experiencing something anomalous that needs to be treated in an inpatient setting, or whether the patient's care can be appropriately addressed in a different setting.

Additionally, studies show that regions with access to connected health information report significantly fewer 30-day post-discharge readmissions. The outpatient care team is better informed, and can take proactive steps to ensure supportive care in the community. Care providers are more able to address issues in an outpatient setting when they have better information about the events that occurred in the inpatient setting including information about post-discharge medications.

While the study found quantitative evidence to support benefits occurring due to reduced ED admissions and acute care readmissions, practitioners reported in the Infoway key informant interviews that there are additional benefits which accrue from more effective care in the inpatient setting, and in transitions to and from long-term care. Further study is required to identify and quantify these additional potential benefits.

Illustrative example: A patient is admitted for surgery to an acute care facility. Following a successful surgery and a multi-day inpatient recovery, the patient is discharged with a strict set of guidelines for post-operative care. The patient informs their family doctor — who is able to see a full view of the patient's record consisting of all tests, procedures, and medication prescribed — and periodically reaches out to ask the doctor questions about their recovery between scheduled follow-ups with relevant specialists. When the patient begins to experience some surgery-related discomfort, the issue is addressed proactively and without the need for readmission to the hospital.

Current Benefits

By reducing patient admissions from the ED, connected health information generates $334.95M in health system value that can be reallocated, giving back patients a total of 8.5M hours, saving providers a total of 33K hours, and contributing $68.7M in economic productivity every year.

By reducing hospital readmissions, connected health information generates $198.29M in health system value that can be reallocated, giving patients back a total of 5.1M hours, saving providers a total of 19K hours, and contributing $40.7M in economic productivity every year.

Benefits at Full Adoption

By reducing patient admissions from the ED, connected health information generates up to $1.49B in health system value that can be reallocated, giving back patients up to a total of 37.9M hours, saving providers up to a total of 145K hours, and contributing up to $305.5M in economic productivity every year.

By reducing hospital readmissions, connected health information generates up to $881.3M in health system value that can be reallocated, giving patients back up to a total of 22.5M hours, saving providers up to a total of 86K hours, and contributing up to $180.9M in economic productivity every year.

More Effective Use of the Emergency Department

Benefit Type   **Quality**   **Access**   **Productivity**

Most emergency departments see a diverse patient population with a wide range of health concerns and care needs. The availability of connected health information promotes the effective use of EDs in a number of ways including providing comprehensive patient histories, which enable better collaboration and coordination of care. Connected health information also enhances capacity by enabling providers to exchange information for more efficient decision making and greater productivity.

Illustrative example: A patient receiving home-based care experiences worrying symptoms. The patient phones the after-hours number for their team-based care clinic and explains their symptoms. The on-call physician reviews the patient's records, medication, test results, as well as interactions the patient has had with different providers. Using this information, the physician develops a care plan that prevents the episode from escalating, while avoiding a patient visit to the ED.

Current Benefits

By reducing ED visit duration, connected health information generates $48.1M in health system value that can be reallocated, giving back patients a total of 0.7M hours, saving providers a total of 108K hours, and contributing $8.0M in economic productivity every year.

By reducing number of ED visits, connected health information generates $114.6M in health system value that can be reallocated, giving patients back a total of 1.7M hours, saving providers a total of 259K hours, and contributing $19.1M in economic productivity every year.

Benefits at Full Adoption

By reducing ED visit duration, connected health information generates $213.94M in health system value that can be reallocated, giving back patients up to a total of 3.2M hours, saving providers up to a total of 483K hours, and contributing up to $35.7M in economic productivity every year.

By reducing number of ED visits, connected health information generates up to $509.3M in health system value that can be reallocated, giving patients back up to a total of 7.6M hours, saving providers up to a total of 1.1M hours, and contributing up to $85.1M in economic productivity every year.

More Effective Ambulatory Interactions

Benefit Type   Quality   Access   Productivity

Ambulatory interactions are more effective when providers and patients have access to connected health information. When providers have access to patient history, context, diagnostic information, they have the opportunity to assemble the right care teams and adequately prepare for their interactions with patients. When the right information is available to patients, caregivers, and other providers after interactions, it can enable appropriate transitions and ongoing care, and encourage active patient engagement and compliance.

Providers report productivity and efficiency gains due to less time wasted finding information, fewer rescheduled appointments, and more effective use of diagnostics and other resources. However, much of the evidence is qualitative and cannot be used to quantify benefits in the same way as the other hypothesis statements in the study.

Illustrative example: A patient is referred to a specialist by their primary care physician. Prior to the patient's visit, the specialist accesses the referral and reviews patient information in the EHR. The specialist accesses all relevant patient information, including prior tests and medical visits potentially related to the cause of the referral. This allows her to determine that this is an appropriate referral, and what further information she needs for the consultation. The result is a more effective and efficient encounter for both the patient and the physician.

Some of the related qualitative benefits found in the literature include:

44%	Reduction in number of encounters where patient time was wasted[14]
23%	Reduction in number of encounters where clinician time was wasted[14]
70%	Percentage of survey respondents who indicated an EHR viewer enhanced care coordination[15]
61%	Percentage of survey respondents who indicated an EHR viewer improved productivity[15]
69%	Reduction in the number of specialist physician encounters where clinicians were forced to proceed with incomplete information[14]
78%	Percentage of respondents that indicated remote access to connected health information enhanced consultations, referrals, and handoffs[16]

In addition, there are a number of monetary and time-saving benefits that can be inferred from the research:

Current Benefits

In ambulatory care settings, connected health information generates $217.8M in health system value that can be reallocated, giving providers a total of 5.43M hours every year due to less time spent on retrieving information.

Benefits at Full Adoption

In ambulatory care settings, connected health information can generate up to $518.5M in health system value that can be reallocated, saving providers up to a total of 12.9M hours every year due to less time spent on retrieving information.

4.0 Applications of Connected Health Information

Practitioners across Canada are using connected health information to work together in new and different ways to achieve more effective outcomes for their patients and for the health care system. There are emerging areas in which Canadian practitioners, patients, and their caregivers are experiencing real and visible benefits which include:

- More effective outpatient interactions
- More effective care coordination and collaboration
- Efficiency and effectiveness in information retrieval
- Greater ability to leverage full scope of practice

More Effective Outpatient Interactions

One of the key types of benefits reported by both practitioners and patients is more effective outpatient interactions. Connected health information made available through regional EHRs and their integration with EMRs (ambulatory care systems) helps ensure that the necessary diagnostic reports and medical histories are readily available to the care provider and care team prior to and during the encounter. This enables more meaningful encounters, with fewer follow-ups, and less need for repeated testing and delays in developing treatment plans while waiting for test results.

In many regions the use of connected health information solutions is rapidly becoming part of the expected standard of care.

> Quality of care is just as much about seeing the full picture of the patient's situation as it is about taking action, and connected health information enables that understanding:
>
> "Just being able to look back and say, 'Yes this particular value that I'm seeing does have a historical pattern — it's not out of the ordinary for this patient', so I don't need to rush and admit them to hospital, say, or do a procedure."
>
> Ontario Emergency Physician

> Patients report more positive experiences with their care providers, and greater adherence to the care guidance they receive due to connected health information:
>
> "I feel like a person, not just a number on someone's chart" and "If you have an accident or call an ambulance, all your information is right there. It's available and it's straightforward, and very helpful. I look back to it periodically to remind me when I started medication."
>
> Elderly Female Patient

Efficiency and Effectiveness in Information Retrieval

Practitioners report that the systems which provide connected health information offer significant productivity gains. They report that having the right information at their fingertips increases personal productivity and enables better focus on care planning. They also report that there is an overall productivity gain achieved through the reallocation of ancillary or support staff that previously tracked down files and reports within their practices, as well as from external care providers, laboratories, and clinics.

Specialists report that access to connected health information has reduced their need to call family doctors' offices purely for information purposes significantly. They still call family doctors to talk to them about care planning and follow-up, but rarely purely for information purposes. These benefits are being experienced widely in provinces and territories across Canada.

> Connected health information allows providers to spend their time on activities that yield the greatest benefits for patients:
>
> The EHR "cuts down on a lot of the searching and hunting and gathering that we do for information, and it allows me to focus more on the management plan for the patient rather than trying to understand what happened."
>
> **Ontario Primary Care Physician**

> A Quebec physician reports that access to connected health information has transformed the way they work. People don't look for each other to get the information; the information is easily accessible in the system. Whereas previously people would interrupt her many times during the day, she now does not usually get interrupted during her clinic, because it is easy for individuals to get the information they need.
>
> **A Quebec Physician**

> A Northwest Territories health care leader reports that electronic medical records currently cover 85% of the population, and by the end of 2017 the electronic medical record will be deployed to everyone. In the NWT, there are two principle applications, the outpatient EMR and the hospital-based clinical information system. In the past, people in smaller centres have had access to less services and information, and the current and emerging situation, where the two systems will be knit together, provides great equity as the information is available across the entire system, not just in larger centres. He reports as well that it is far more efficient, and arguably more effective. The approach is patient-centric and that the systems can support all the indices of quality care.
>
> **A Northwest Territories Health Care Leader**

More Effective Care Coordination and Collaboration

Care providers have indicated that use of connected health information enhances coordination of care, transitions of care, and collaboration among care providers.

Accessing connected health information allows for effective planning and communication among providers as the patient moves from one care setting to another, and from one care team to another. Its effective usage also enables communication across care venues and providers of what has been found, what has been done, and what plans have been put in place. Within team, connected health information reduces the overhead of team interaction while enhancing collaboration.

> In Ontario, one of the uses of ClinicalConnect, the regional clinical viewer, is to speed referral into a program for the treatment of early psychosis. In the months after, a community provider was trained on using connected health information, no patient wait was longer than two days from referral to initiation of services for a region's Early Psychosis Entrance Program:
>
> "We regularly work with hospitals to coordinate care for patients coming from an admission who have experienced a first episode of psychosis… ClinicalConnect (the regional clinical viewer) allows me to access information from a client's most recent admission and also any historical hospitalizations. Previously, I had to request this from medical records at the hospital and this could take a week or more and may not always be the complete picture. With ClinicalConnect I can receive a referral, access all the needed information and potentially have them assigned to a worker on the same day."
>
> **Ontario Mental Health Professional**

In addition to supporting transitions of care and care coordination, access to connected health information supports collaboration among a team of health providers, by facilitating timely access to patient information and communication within the team. Experienced clinicians and caregivers also use the connected health information to infer what has transpired, to confirm that with patients, and develop proactive plans.

> Connected health information provides a longitudinal view that enables insights not otherwise possible:
>
> "The patients can have seamless care… a patient that has maybe troubling or difficult-to-diagnose conditions, and maybe they've been in and out of emergency, they've seen specialists, there's been lots of tests and all of a sudden realize 'hey, this is not an osteoporosis thing, this is not a frail elderly thing. This is actually multiple myeloma.' And because of all the trending, all the information… it pops up. Whereas a silo application, if you're not looking at all the information, you're not able to make a good decision, and people get treated episodically."
>
> Alberta Registered Nurse

> In Alberta, connected health information has enabled the development of a program which allows pharmacists affiliated with primary care facilities to observe when a patient has been discharged, and manage that panel of patients by being informed when a patient has been discharged, plan appropriate interventions, and inform the primary care doctor of the discharged, what meds the patient left with, and a plan for reconciliation and advisory encounter at home or at the clinic.

Optimized Scope of Practice

Access to a wide range of connected health information empowers various provider groups to work closer to the limits of the scope of their practice, procedures, actions, and processes that are permitted in keeping with the terms of their professional license.

> Connected health information leads to faster decisions more effective medical decision making by all providers:
>
> "Nurses have immediate access" to health information, and "can efficiently deal with problems, and some never even get to me. So patients are getting what they need without having to come see me. That's helpful for everybody."
>
> Saskatchewan Rehab Physician

> When connected health information contributes to an enhanced scope of practice, providers are more efficient, and collaborate on more important issues:
>
> "When we started, physicians were always stopped… when you looked in the hallways usually you would see nurses, clerks waiting for the physicians going out of the room. But now you don't see that anymore… it changed the relationship because there's less direct interaction, and it's for a different reason. When it happens, it's for something more important."
>
> Quebec Oncology Physician

> Pharmacists are now more likely to have access to patient lab results (44%), and of those that do, 85% say access allows them to provide better or much better quality of care.
>
> 2016 National Survey of Canadian Community Pharmacists Use of Digital Health

5.0 Critical Success Factors for Achieving Benefits from Connected Health Information

Research conducted by Infoway and Gartner has identified a number of critical success factors to be considered in achieving and enhancing the value delivered by connected health information.

Governance and Leadership

Effective governance is an important tool in aligning efforts across connected health information domains to avoid the negative impacts caused by health care system 'silos'. Strong governance also promotes ownership and buy-in over key decisions, which, in turn, promotes adoption and use of the implemented systems to connect health information and achieve the benefits described in this study. Key components to be included are a clear process for prioritizing efforts, standards definition, data ownership and sharing. Effective data governance supports the protection and appropriate use of patient data. One of the largest challenges is creating and sustaining processes and their buy-in across the broad range of autonomous but interdependent organizations — regional health authorities, hospitals, clinics, private practitioners, community health clinics, pharmacies, and laboratories.

Influential leadership with a vision for the advancement of health system interests through the use of connected health information can drive increased adoption and use of existing systems. Previous Gartner studies for Infoway have shown that engaging leadership to seize opportunities and take calculated and managed risks, to drive implementations and operations, is key to adoption and effective use of connected health information solutions.

Key attributes for the executive leader are:

- A broad vision with a bias for action

- A positive attitude toward risk-taking

- The ability to work within regulatory constraints yet still drive the changes required to achieve outcomes and benefits

Leaders need to demand more and better measures and data about the overall outcomes and benefits delivered by connected health information, and need to use these to plan for ongoing optimization and enhancement.

Leadership is required to build coalitions and consensus, and then drive top-down decision making necessary to deliver the desired outcomes.

Workflow Integration

Integration of clinical systems that connect health information directly within clinical workflows has been shown to greatly enhance utilization.

Designing workflows that include the use of connected health information is important. Organizations and users cannot be expected to be aware of the potential benefits to be achieved or how to achieve them with just the provision of a new tool, or access to an additional set of data. Embedding the solution within processes and workflows promotes the acceptance of connected health information as standard practice, and helps mitigate resistance to change.

Point-of-Care System Integration

Integrating the connected information into the systems that are used daily to review histories, document care and place orders is a prerequisite to the achievement of the projected potential benefits.

The evidence shows that adoption of processes and tools is much lower if they require extra steps — no matter how small the additional effort is.

This includes technical integration and interoperability (for example, the use of single sign-on technologies to avoid multiple logons), and contextual and functional integration (for example, displaying contextually-relevant information from different clinical systems and having the connected health information available within existing local point-of-care systems.

Data Quality and Effective Data Sharing

The timeliness, reliability, and availability of the data from information systems informs the extent to which users depend on it. Ensuring the requisite standards, specifications, privacy safeguards, processes, and underlying infrastructure are in place for data quality will positively impact the use of connected health information systems. These standards should also account for the semantic interoperability of structured data so that it can be interacted with, aggregated, analysed, and updated dynamically by authorized users.

There is a tension between the need for a complete record and the ability to utilize partial information to enhance the effectiveness and efficiencies of encounters. More study is required to determine how practitioners use information resources which have high fidelity, but are known to be incomplete.

Change Management

The most successful organizations engage their key stakeholders to identify meaningful operational outcomes which support an overall vision. The end-user population must be willing, prepared, and competent in the use of digital health solutions for optimal value to be achieved. This includes ensuring users have the necessary skills and training, as well as ensuring the appropriate organizational culture shifts have taken place. To make this a reality, dedicated change management strategies that leverage peer-to-peer promotion of connected health information (e.g., champions, super users) are essential. Additionally, developing feedback loops that capture and incorporate user feedback into governance and decision making will help drive meaningful use of available information. Infoway's Change Management Framework[17] has been effectively applied in connected health information projects across Canada.

Research shows organizations need to expand outcomes and benefits beyond health care delivery organizations, providers, and administrators, to include consideration of increasing consumer expectations and capabilities to access and use information, and to plan and manage their health. Sustained effort in change management is required to expand adoption and optimize value to consumers.

Usability

User expectations of form factors, user interfaces, and the general user experience are evolving more quickly than ever before, necessitating more responsive design and development. Hardware and software technologies that are perceived to be outdated or unusable will experience a slower path to adoption than those that aren't. Anticipating this reality of user expectations, and architecting governance, system development, and operations accordingly will promote usability.

6.0 Looking Forward

The health care system in Canada is already achieving substantial value from access to, and use of, connected health information. With leadership, planning, and a focus on execution and benefits realization, the health care system will continue to reap further benefits in enhanced health outcomes for patients, providers and the population as a whole.

In addition to the current and potential benefits identified in this study, the foundation has been built over the last decade upon which further progress can be achieved. Emerging solutions such as on-line appointment scheduling, e-consult, and e-referral ensure that the right kinds of appointments are scheduled for patients and caregivers. In addition, a national platform for e-prescribing, downstream patient access to their medical record information, and growth in other e-services to support clinical and administrative functions represent just some of the possibilities that can be made tangible on account of the investments made to date.

There are three emerging areas for expanding the impact that connected health information can have on patients, providers, and the health care system at large:

1. Accelerating patient access and ultimately patient-generated data in the EHR. With new consumer-oriented medical and wellness technologies being released on a regular basis, patients are being empowered to take a more active role in the management of their health than ever before. However, legislation, policies, and approaches within Canadian jurisdictions that facilitate the capture and use of that data in a meaningful way are still emerging. Taking swift action to understand this emerging area will help the health care system stay current, as well as prevent providers from becoming overwhelmed by patient-generated data.

Art of the Possible: A diabetic patient uses wearable devices to track fitness levels, heart rate, sleep quality, and blood glucose levels. Due to progress made in technical capabilities and policy, that information is automatically captured, aggregated, and processed within the patient record as meaningful data that informs care and proactively identifies issues.

2. Predictive analytics. Predictive analytics, involves using broad data analysis modelling tools and techniques to anticipate and take action to leverage or mitigate future outcomes. Connected health information can provide the foundational data which can be used to predict outcomes and to develop care and management plans both at the individual patient level and from a health care system perspective. Predictive analytics applied to connected health information in compliance with Privacy law and respect of patient privacy, could drive financial, access, and outcomes benefits in individual experience and outcomes, population health, decision support, public health, and health system planning.

Art of the Possible: Using data provided by the range of connected health information systems, a public health agency applies advanced analytics techniques to predict changes in morbidity rates for chronic diseases, to identify risk factors, and develop plans to change provider and patient behaviours to mitigate those risks.

3. Engaging innovative partnerships to leverage connected health information. Few organizations have the in-depth skills and knowledge required to make most effective use of the data that they capture and manage. And even fewer have the skills, relationships, financial capability to develop the relationships, acquire external data sources, and conduct the powerful analysis that will likely be possible from combining connected health information from multiple sources. It will be necessary for these organizations to participate in health care information sharing networks or ecosystems.

Finally, this study has identified a number of key benefits that could potentially be substantiated by further research. The study identified a large number of benefits that were noted in the research and also through interviews and consultations with health care leaders and practitioners, for which there is no conclusive evidence. These include areas such as quality of care, public health benefits, optimized scope of practice, and care coordination. Further research is required to validate and enhance the benefits identified in this study, develop evidence to support or deny the anecdotal and unsubstantiated claims in the existing research, and identify and evaluate the impacts of new and emerging uses of connected health information just emerging or not yet seen in the Canadian context.

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