Is there any eagerness to embrace patient portals? A study of conceptualization, implementation, adoption, and impact

by

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Abstract

Patient portals are health information technologies that allow patients to view their personal medical record, schedule appointments, and communicate with their healthcare providers. Although portals are seen as necessary tool in the delivery of patient-centered care, the implementation and subsequent adoption of these systems has demonstrated to be a challenging process. Between 2016 and 2019, Alberta Health Services (AHS) introduced a patient portal called MyChart®. The implementation of the AHS MyChart® had not been previously documented or evaluated, and so it was unclear whether the patient portal was delivering the intended outcomes. The aim of this dissertation was to generate evidence to fill this gap, so that any shortcomings could be addressed prior to province-wide implementation in Alberta. This dissertation included three studies: a study based on historical methods, which documented the development of MyChart®; a comparative case study in which several clinics were compared, and a scoping review which examined how patient portal impact is being measured. The research questions and the methods selected were linked by the overall aim of this dissertation. The analysis exposed the complexities of implementing a patient portal in a public healthcare system and the influence the various social and political factors on the development and implementation stages. Additionally, it exposed the numerous factors that have an impact on the adoption stage. Furthermore, it demonstrated that patient portals need to be considered as part of a health system transformation rather than as just a technology. The findings of this dissertation showed the need for organizational change and careful management of the individual expectations when implementing technologies that are used by different groups within a healthcare system.

Preface

This thesis is an original work by Melita Avdagovska. The studies in this dissertation have received ethics approval from the Research Ethics Board at the University of Alberta (Pro00072286 and Pro00084135) and operational approval from Alberta Health Services (OA43157, OA43158, OA43159, and OA43160).

Chapter 2 of this thesis has been published as, "M. Avdagovska, T. Stafinski, M. Ballermann, D. Menon, K. Olson, and P. Paul, Tracing the Decisions That Shaped the Development of MyChart®, an Electronic Patient Portal in Alberta, Canada: Historical Research Study," *Journal of Medical Internet Research*, 2020;22(5):e17505." I was responsible for the data collection and analysis as well as the manuscript preparation. T. Stafinski, M. Ballermann, D. Menon, K. Olson, and P. Paul supervised the data collection and the data analysis and were also involved in the manuscript preparation.

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Glossary of Terms

AH	Alberta Health
AHS	Alberta Health Services
ANP	Alberta Netcare Portal
EHR	Electronic health record
EMR	Electronic medical record
IT	Information technology
PHR	Personal health record
PoC	Proof of concept

Chapter 1: Understanding the fuss around patient portals

> *"I am convinced that my health is MY responsibility, not the physician or treatment team. They are here to advise and instruct and carry out detailed procedure that I accept. I must be convinced of the efficacy of treatment options. I am not a blind follower of absolute directions from the all-knowing care-teams. I always try to enter into a meaningful dialogue about treatment options and expected results, and I expect the treatment teams to deal with me professionally and personally."*
>
> ~Patient Study Participant

Introduction

The escalating costs of healthcare services and the increased prevalence of chronic conditions are demanding transformative changes in healthcare delivery. Considerations about these changes have focused on the advance of evidence-based health information technology innovations that have the capacity to empower patients as partners in their care, sustain evidence-based individualized care, and monitor population health(1). The most commonly used health information technologies are electronic health records (EHR), electronic medical records (EMR), personal health records (PHRs), and electronic patient portals (also referred as patient portals)(2–4). The functional benefits of these record systems are to maintain access to documents and results needed to enhance and support clinical decision making, to allow for electronic communication, to standardize administrative procedures, and to provide data for accurate reporting(3,5).

These systems are not only designed to deliver the necessary medical information to healthcare providers, but also have the capacity to deliver the identical information to the hands of patients. Providing patients with secure access to their health information has been a provincial(6–9) and national goal in Canada(10,11) that has been considered critical to the delivery of patient- and family-centered care(6–8). However, the process of delivering and providing access to the personal health record to patients has shown to be a complex undertaking. The promise to empower patients by providing a platform where they can take an active role in the maintenance and monitoring of their health records is not being realized due to issues such as variabilities in uptake, design, implementation concerns, and impact on workflow. While paper access to the medical record had always been obtainable and not seen as contentious, real-time access to the health record has been intertwined with concerns about privacy and the perceived inability of patients to understand the information in the record(12–14). However, at the same time, patient access has been associated with the empowerment of patients as partners in their care(1). These conflicting perspectives warrant a more comprehensive *insider* enquiry into the apprehensions around implementation and adoption of patient portals in order to determine the *return-on-value*(4). There is a shift in thinking about these types of technologies as it is no longer whether these systems should be implemented and adopted, but in what ways this implementation and adoption should be done(3).

The following sections provide a brief overview of the literature about patient portals. An additional overview of the literature is provided in Chapters 2, 3, and 4, specific to the objectives and aim of the undertaken studies. The overview is followed by a description of the current study motivation and research questions. This chapter concludes with an outline of the study approach and outline of this dissertation.

Patient portals – the future?

Health information technology systems such as patient portals or PHRs are considered “consumer-centric tools” that are essential to the delivery of patient-centered care(15).

Patient portals are secure websites tied to an institutional electronic health or medical record system, which are populated with a person’s lifetime health history. The information comes from various sources, including community clinics, hospitals, doctors, pharmacies, and laboratories(16). These systems not only provide access to the health record and laboratory results, but they also comprise of functions such as permitting patients to communicate with their provider, renew prescriptions, manage appointments, and receive educational resources(16).

Benefits and limitations of patient portals

Studies have shown that patient portals have the capacity to improve patient safety, are effective in educating patients about their health, decrease the number of unnecessary medical tests, decrease medication errors, decrease the number of no-show appointments, and contribute toward improved medication prescribing (17–24). According to Shetty, “the greatest area of benefit relates to the chronic disease management, where costs are typically high”(25).

Not only do patient portals allow for health information to be in one place, they have the capacity to establish better communication between patients and healthcare providers(21). Even if the patient changes to a different healthcare provider, the information will still be there, thus providing a smoother transition to the new provider(21). Portals provide a means for patients to share confidential information with their healthcare providers without having to book a face-to-face medical appointment(20).

Healthcare providers also benefit from these systems. Due to access to laboratory results, patients tend to be more organized when they come to their appointments, which leads to more effective consultation time(21). Furthermore, providers are able to deliver necessary information to patients in a quick and efficient manner. In addition, patient portals allow for enhanced provider-patient communication, contributing toward enhanced patient-provider relationships(21,26).

The benefits of patient portals to healthcare systems are related to reduction in administrative costs because duplication of redundant medical tests, and the scheduling and cancelling of appointments are prevented(21). Additionally, portals contribute toward the coordination of care by having the capacity to track and update information relevant to patient care(27).

Although evidence suggests that patient portals can have a positive impact on patient care and patient outcomes, many healthcare systems have been very slow in adopting these health technologies due to various concerns. Apprehensions have been expressed by patients and healthcare providers in terms of privacy, usage, and accessibility(21,28). Patients have expressed concerns about accessing and maintaining their personal healthcare records in a manner that is private and secure(20,29,30). As these portals are online-based tools, patient's fear that their data could be manipulated and misused by insurance companies(18), among others. Some have expressed concerns around optimal design and functionality(20). Furthermore, not all patients have access to a computer, smart phone or a tablet to access their records(31,32).

Healthcare providers (studies have focused mostly on physicians) have expressed concerns about the implementation, availability, and impact of patient portals on the patient-provider relationship. Many studies show that providers are concerned that these systems will increase their workload, without increasing remuneration(18,33–36). Furthermore, providers have expressed concerns that these types of health technologies will start replacing office visits and thus impact the traditional methods of care(37). Another practice-related concern is the absence of transparency surrounding the provider’s role and accountability with respect to patient portals and protection of patient data(21). In order for healthcare providers to accept patient portals as part of their practice, they want to see "regulated and controlled integration with the electronic health record technology, ease of use without being a burden on cost or time, and demonstrated added value to the practice of medicine"(38).

For healthcare systems, the challenge has been the upfront cost of implementing patient portals(36,38,39). The cost is related to the software purchase, hardware and networking upgrades, training and technical support, ongoing maintenance and upgrade costs, and financial incentives for providers(36,38,39). Very quickly it becomes evident that implementation is a much bigger process than just turning on the switch(40). Although studies have demonstrated some positive evidence that patient portals have the potential to contribute to cost savings, many healthcare systems and governments lack the desire to provide the necessary upfront investments without proven return on investment(4,37).

Complexities within the current research

While some studies have suggested that patient portals have the capacity to improve patient safety, are effective in educating patients about their health, can decrease the number of unnecessary medical tests and medication errors, and can contribute toward improved medication prescribing, there is very little empirical evidence establishing whether in fact this is the case(41–50). Benefits tend to be *promised and guaranteed*, but the challenge is in establishing whether these benefits are actually realized due to ambiguities related to implementation and user adoption.

Despite the positive(17,23,51) findings on quality of care from earlier systematic reviews and direct studies, current reviews appear to demonstrate mostly neutral or negative(21,28) effects from patient portals in terms of implementation and usage(52). Furthermore, there is inadequate evidence to draw conclusions about the impact of these systems on patient safety and reductions in clinical errors. The studies that have focused on patient outcomes report no benefit, which tends to be attributable to very little usage or usage only by certain socio-economic groups(53). Variability in usability is described in many studies, but information as to why this is happening is contradictory(52). Patient satisfaction tends to be higher than the satisfaction reported by healthcare providers(52). Additionally, there is very little evidence about how different health professions interact with patients through these systems(20,21,54). Regulations, guidelines, and incentives are rarely defined, and so it is not surprising that resistance to adoption by healthcare providers is high. Also, evidence on cost-effectiveness is very limited and based on small trials. Probably one of the greatest challenges in using evidence from other studies is that each record system tends to be customized to fit the needs of the healthcare system in which it is based, and therefore results must be generalized cautiously(55).

The challenge of implementation

The complexities in understanding patient portals are not only related to the evidence, but also due to the difficulties related to the process of implementation. Funding is always labelled as one of the most difficult challenges to overcome when implementing a patient portal. This is because implementation is often initiated when there are other competing priorities and when the prospect of long term support is unclear(56,57). Despite the continuing extensive research in the area of patient portals, implementation and adoption of these systems continues to be a convoluted process, which tends to impact settings and practices in different ways. Regardless of the type of setting, these systems require substantial investment of time, resources, and determination, and not all care settings have the same capacity to contribute equally, which likely contributes to contradictory results. The ways in which patient portal(s) are being implemented suggest that they are neither sustainable nor manageable. There is little exploration of the socioecological and political factors influencing implementation and most studies have explored findings only from the perspective of one group of users in a setting, rather than considering all users in that setting(56–58).

The technology is another challenge that impacts the implementation process. It is not only about purchasing the *latest* technology, but also about whether the technology can be integrated into the current network and if the data will be delivered to patients in a manner that they are able to understand and use. Usability, infrastructure, and vendor product selection play a major role in the success of the implementation and the adoption of the patient portal(59,60). The interoperability between patient portals and the institutional electronic health record systems is vital not only for patients to access their health information, but also for the seamless exchange of data necessary for the coordination of care, outcomes reporting, and public health surveillance(60).

Furthermore, the medical community has an important influence on the implementation of portals as success has been correlated to the levels of support by providers. Hence better support tends to lead to higher patient enrollment(61). Many clinicians do not believe that their patients should be looking at their health information because it might be interpreted in the wrong way(62). Without the buy-in from healthcare providers, implementation of patient portals results in disastrous and costly undertakings(62).

Ensuring privacy and security are imperative for any health information technology systems to be implemented and used. Data protection is crucial in healthcare, and thus necessitates policies and procedures that protect the data from any breaches. Katsikas et al, point out that patient portals are impacted by “people, software, hardware, procedures and data”, so any security solutions must be developed by considering the “technological infrastructure” within the “organizational framework”(63). There is an agreement that electronic records are more secure than paper because “every time a user touches the system, an automated electronic audit record is created”(64).

The socio-economic status of patients also plays a big role in the implementation and the adoption of these systems. There are two groups of patient portal users “’People Like Us’ and the ‘disempowered, disengaged and disconnected’”(32). The socio-economic barriers are rarely considered during the planning and implementation of patient portals. This has led to low user adoption by disadvantaged groups(32,65).

Also, these systems are customized to fit the needs of the health system, which makes each system unique. This is a reason why generalizability is difficult. In addition to customizability of the application which impacts intervention fidelity, there is also the behaviour of the users which represents a major source of variability. It is therefore important to internally investigate how a particular patient portal works and what elements a particular system needs to have in place to maximize utility.

Conclusion

The current literature shows that there is a continued need to understand what constitutes a successful patient portal that has the capacity to benefit all users in the system. Hence, understanding the impact of portals from the planning to the implementation and adoption stages is crucial as this technology might be a tool that could allow for better patient-centered care built on the same information.

Study motivations and research questions

The above mentioned problem statement is the motivation for this dissertation. The overall objective was to advance knowledge about patient portals. The focus was not on the technology, but on the processes that impacted the planning, implementation, and adoption stages. As this dissertation was developed based on real-world inquiry, the goal was to also generate evidence that could be used to inform and to determine the capacity for a province-wide implementation of the patient portal in Alberta. In addition, the goal was to generate evidence about the nature of a successful patient portal from the standpoints of patients, healthcare providers, and healthcare system administrators.

The following questions guided this research:

1. Why and how are patient portals conceptualized, developed, and implemented within a healthcare setting?
2. What factors influence uptake and what elements are deemed crucial for uptake and access for all end users?

As the study was exploratory in nature, three more questions were added to reflect an identified need to understand:

3. What are the intended outcomes during the conceptualizations and planning stages for patient portals?
4. How is the impact of patient portals measured, from the standpoint of the four specific dimensions (patients, population, healthcare workforce, and health system) of the Quadruple Aim Framework?
5. What components from the Benefits Evaluation Framework (as expanded by Lau et al(4)) are most commonly evaluated to measure impact?

Based on these research questions, the following work was completed: a study based on historical methods, which documented the development of MyChart®; a comparative cases study, which compared clinics that were high and low users of MyChart®; and a scoping review, which examined how patient portal impact is measured. The historical study and the comparative case study evaluated the MyChart® portal which was piloted by Alberta Health Services between 2016 and 2019, and the scoping review considered the current literature on how impact is being measured. The research questions and the corresponding methods were linked by the overall aim of this study, which was to generate evidence to fill the knowledge gap, so that any shortcomings could be addressed prior to province-wide implementation in Alberta.

Study approach and outline of dissertation

The following segment provides a brief overview of the sections of this dissertation and the methods that were used to answer each of the research questions.

Chapter Two introduces the historical study aimed at answering questions 1 and 3 (Why and how patient portals were conceptualized, developed, and implemented within a healthcare organization? What were the intended outcomes during the conceptualized and planning stages for patient portals?). A historical research approach was used because it provided a systematic way to collect and appraise historical data in order to recognize, understand, explain, and illuminate events, decision, and actions that transpired in the past. The historical study provided an opportunity to document the conceptualization, development, and implementation process of MyChart® in Alberta and to discuss this material with many individuals who played key roles in this process.

Chapter Three describes the work related to research question 2 (What factors that influence uptake and what elements are deemed crucial for uptake and access for all end users?). For this study, a qualitative comparative case study method was used, as this approach provides a way to analyze and synthesize similarities, differences, and patterns across 2 or more cases that share a common focus or goal. As data from five clinics was used, a comparison of cases provided an opportunity to learn more about factors that played a role in the uptake during a real-time patient portal implementation from the standpoint of study participants rather than from existing frameworks.

Chapter Four presents the findings from the scoping review, which focused on answering research questions 4 and 5. Given its rigour and transparency, scoping methodology results can be useful on their own or as an underpinning for further systematic reviews and clinical trials. Furthermore, the scoping review methodology was ideal in exploring a topic such as patient portals due to the inconsistencies in the current evidence, as it appropriately captures broad and ambiguous topics and approaches.

Chapter Five draws together the results of the three studies included in this dissertation and includes reflections of the relevance of this research and suggestions for future research directions.

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Chapter 2: Tracing the decisions that shaped the development of MyChart®, an electronic patient portal in Alberta, Canada: Historical research study

A version of this chapter was published as:

Avdagovska M, Stafinski T, Ballermann M, Menon D, Olson K, Paul P. Tracing the Decisions That Shaped the Development of MyChart®, an Electronic Patient Portal in Alberta, Canada: Historical Research Study. J Med Internet Res. 2020 May 26;22(5):e17505. doi: 10.2196/17505. PMID: 32452811; PMCID: PMC7284487.

Link: https://www.jmir.org/2020/5/e17505/

Abstract

Background

Understanding how health organizations decide on information technology (IT) investments is imperative to ensure successful implementation and adoption. There is a high rate of failure and a tendency to downplay the complexity of implementation progression. Alberta Health Services introduced a patient portal called MyChart®. Although MyChart® allows patients to view appointments and selected laboratory results and to communicate with their providers, its uptake varies.

Objective

The study aimed to examine the institutional decision-making processes that shaped the development and implementation of MyChart®.

Methods

A historical study was conducted based on the 7-step framework, where one engages in a rigorous archival critical analysis (including internal and external criticism) of documents and analysis of interviews. For this study, 423 primary and secondary sources were reviewed and analyzed and 10 key decision makers were interviewed.

Results

Supportive leadership, project management, focused scope, appropriate technology and vendor selection, and quick decision making were some of the facilitators that allowed for the growth of proof of concept. The planning and implementation stages did not depend much on the technology itself but on the various actors who influenced the implementation by exerting power. The main barriers were lack of awareness about the technology, proper training, buy-in from diverse system leaders, and centralized government decision making.

Conclusions

Organizational priorities and decision-making tactics influence IT investments, implementation, adoption, and outcomes. Future research could focus on improving the applicability of needs assessments and funding decisions to healthcare scenarios.

Introduction

Background

Aging populations, increased prevalence of chronic conditions, and consequent rising costs significantly challenge healthcare systems worldwide. One proposed solution to these challenges has been health information technologies (ITs) that empower patients to be partners in their care, support evidence-based, individualized care, and monitor population health(1) [1].

Understanding how health organizations decide on IT investments is imperative to ensure successful implementation and adoption. There is a high rate of failure and a tendency to downplay the complexity of implementation progression.

The literature shows that the majority of health IT investments are struggling to achieve the hoped-for improvements in quality of care and economic benefits(2–5). Furthermore, these technologies tend to run over budget because of inadequate preparation for the complexities of implementation(6,7). There is a need to understand the implementation and adoption of such technologies through a life cycle approach for the technology rather than as a decision at a single point in time. Understanding the events and actors involved in each stage of the cycle provides for better future planning for the successful implementation of IT investments such as patient portals(8). Alberta Health Services (AHS) introduced a patient portal called MyChart® through a proof of concept (PoC).

Aim and objectives

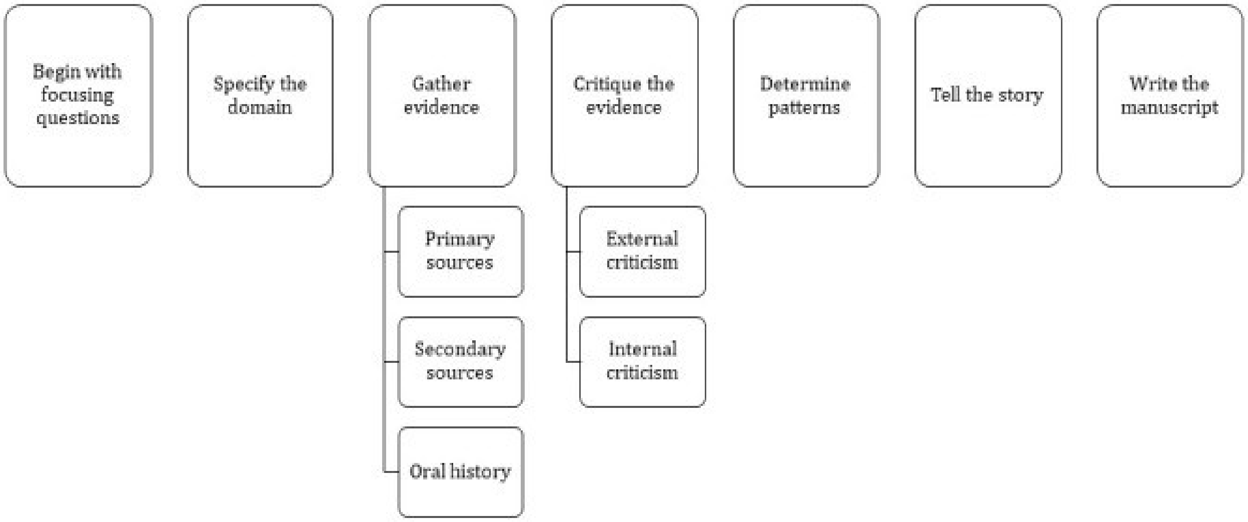
This study aimed to investigate and describe the process by which health IT, in this case, a patient portal, was introduced into the provincial health system of Alberta, Canada. The focus was on the process of decision making and the chronological timelines that led to the pilot of the patient portal, with an emphasis on the conceptualization, development, and implementation processes: need (why), process (how), decision makers (who), decision (what), setting and context (where), and timelines (when).

Methods

Study design

A historical research approach was used to trace the history of the development and implementation of a patient portal in several clinics in Alberta(9–13). Specifically, the 7-step methodology framework developed by Mason et al for studying medical information systems was used, as shown in Figure 1(9). This entails a rigorous archival critical analysis (including internal and external criticism) of numerous documents (contracts, meeting agendas and minutes, training and marketing materials, reports, decision requests, etc.), analysis of key informant interviews, and development of the narrative(9).

Figure 1: Mason et al (1997) 7-step framework



Historical research includes the methodical collection and appraisal of data to recognize, understand, explain, illuminate, and accurately reconstruct past events, actions, and decisions(10,12,13). Organizations may associate IT solutions with ***awesome potential*** and lose track of concerns and problems, resulting in repetitive regurgitation of ideas and being victims of IT fads and fashions. Mason et al pioneered a framework to describe how a solution and its identified need may be adopted when it encounters the organizational context, including the connections and roles of change agents working to mitigate resistance(9). History allows for understanding and acknowledging what has worked and what has not worked previously(9). It is important to outline that studying IT through the historical method is not about understanding the technology. It is about the connections and roles that impact how the technology is implemented and eventually used(9). The framework developed by Mason et al allows for an in-depth understanding of the organization' s current practices, how cultural and environmental conditions impacted the decisions, how the need and the problems were identified, shedding light on the resistance, the process of change, and the actors that led the change(9).

Study setting

Alberta Health (AH) is the Alberta government department accountable for ensuring the delivery of healthcare services and setting and assessing compliance with policy and legislation(14). Healthcare service delivery is funded through AHS and primary care networks (PCNs). PCNs coordinate the delivery of primary health services(15,16). AHS was established in 2008 and delivers care through 400 facilities throughout the province(17). The focus of this historical study is the MyChart® PoC that took place in Edmonton, Alberta.

Study context

Planning for a patient portal in Alberta began in the early 2000s led by AH. However, it was not until 2016 that one was introduced into the province, with the launch of a PoC study of MyChart® (AHS branding of EpicCare Ambulatory from Epic Systems, 2014 version) by AHS.

MyChart® was developed by Epic and customized to meet the needs of AHS, allowing patients to view appointments, medical test results, and medication therapies, and communicate with their providers. It is connected to the central AHS electronic medical record (EMR), named eCLINICIAN.

This study received ethics approval from the Research Ethics Board at the University of Alberta (Study ID: MS1_Pro00072286).

Search strategy

Information on the introduction of patient portals in Alberta was gathered by first identifying relevant sources. Primary sources, including oral histories (key informant interviews), are materials that provide firsthand accounts of the event of interest(18–20). Oral histories are considered a primary source, as the interviews are ***for the record*** and tend to confirm the events outlined in written documents(21). Secondary sources are reports, materials, books, or articles written on the topic of interest by people who were not directly involved(10,21). They provide additional depth and meaning to a topic(22).

The search strategy was developed to identify any sources of the development and/or implementation of a patient portal in Alberta. As the implementation of patient portals was conducted internally, government archives were searched in February 2018, and it was identified that AHS and Alberta Health maintained the sources. Requests were submitted, and the AHS project leadership agreed to provide the documents. In addition, the provincial and AHS archive departments were contacted, but the archivists found no documents on this topic. It was expected that most of the written data sources (both primary and secondary) would be internal documents; thus, an agreement was signed with AHS for document access.

In addition, a web-based search of academic electronic databases (PubMed [MEDLINE and non-MEDLINE] references and Cumulative Index of Nursing and Allied Health Literature) was conducted. The search focused on the term *Alberta patient portal* with the intent of identifying articles that had any descriptions about the development of a patient portal in Alberta.

Sampling procedure

Purposive sampling was used to recruit key informants from the AHS and AH. The names of possible participants were identified through meetings with AHS and Alberta Health representatives and a search of government directories. Both Alberta Health and AHS individuals were interviewed because of their role in planning for a patient portal. This sampling approach is common in historical studies, as the researcher requires information from individuals with firsthand knowledge of the topic under investigation. Furthermore, this approach was selected because of the representativeness and uniqueness of their experiences, not because of the generalizability of the findings(23).

Potential participants were sent an information letter and consent form, giving full details of the study. Once a contacted individual had agreed to participate, an interview was scheduled with each person individually. In total, 19 individuals were approached, and 10 agreed to participate in a semi structured interview. All data were analyzed and reported anonymously. In order to ensure that the participants' current positions were not jeopardized because of the opinions they offered, the names and specific positions of participants were kept confidential.

Data collection procedure

Selecting relevant sources

Documentary sources were considered relevant if they described any information about patient portals in Alberta. They included project management documents, scope or function documents, decision requests, presentations, organizational charts, user manuals, privacy documentation, meeting minutes and follow-ups, contracts, briefing notes, and correspondence. Also, sources that discussed electronic health records (EHRs) or EMRs systems and potential vendors were included. Sources that were not related to patient portals and/or EHRs or EMRs were excluded. A total of 423 sources were included.

Documents underwent external and internal criticism. External criticism considers the validity of the documents by confirming where the document came from and who had documented the fact that the source existed. Internal criticism looks within the data itself to try to determine truth, even considering the motives of the person providing the data(21). This process of trustworthiness and credibility was performed for each retrieved source(22,23).

Interviews

The interviews were conducted face-to-face or by telephone and were recorded and transcribed ***verbatim***. Participants were given an alphanumeric label to protect their identity. The interviews provided an opportunity to clarify various written sources and eyewitness accounts. A generic description of the positions of the key informants is presented in Table 1.

Table 1: Organizational designation of key interview participants

Organization and designation of key interview participants	
Alberta Health	• Executive-level participant 1 • Executive-level participant 2 • Executive-level participant 3 • Senior-level participant 4
Alberta Health Services	• IT senior-level participant 5 • Senior-level participant 6 • Executive-level participant 7 • Senior-level participant 8 • Senior-level participant 9 • Clinician senior-level participant 10

Each interview lasted for 45 min to 1 hour. The interview sessions began with clarification of the objective of the study, and a description of the information was sought. The interview questions and discussions focused on the need for a patient portal in Alberta, intended outcomes, facilitators, and barriers to the design and implementation processes, stakeholders, policies and legal factors, and future recommendations.

Data extraction and synthesis

The sources were numbered from 1 to 423 for ease of data extraction and referencing. Developed a data extraction form to record any information about the development and implementation processes of any patient portal in Alberta. The final form included items related to source type, date of creation, author position and affiliation, summary of source information, impact of source, possible quotes, and related sources. The primary and secondary sources were grouped by year (2005-2019) and type (planning, decision requests, agendas, minutes, presentations, contracts, scoping documents, and optimization documents). Data extraction was conducted and the interviews were transcribed. In historical research, interviews are not analyzed to develop themes but to juxtapose the insights provided by the oral interviews with the official documents. The interviews were entered into NVivo (version 11), which was used to track the analytical process through memos and notes. Interview data extraction related to events and actions was connected with patient portals. In addition, potential quotes were identified as being related to various events.

Results

Data collection overview

Figure 2 shows the number of selected primary (including interviews) and secondary sources. The following sections describe the events based on the extracted data from these sources. An overview of the Alberta Health and AHS timelines is shown in Figure 3.

Figure 2: Overview of data collection strategy

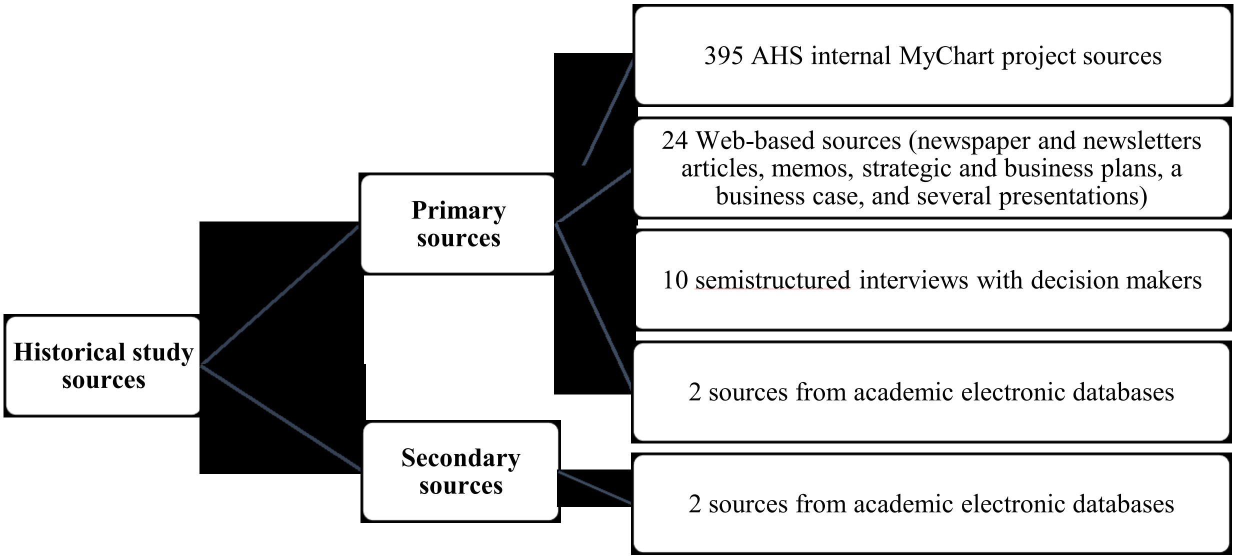
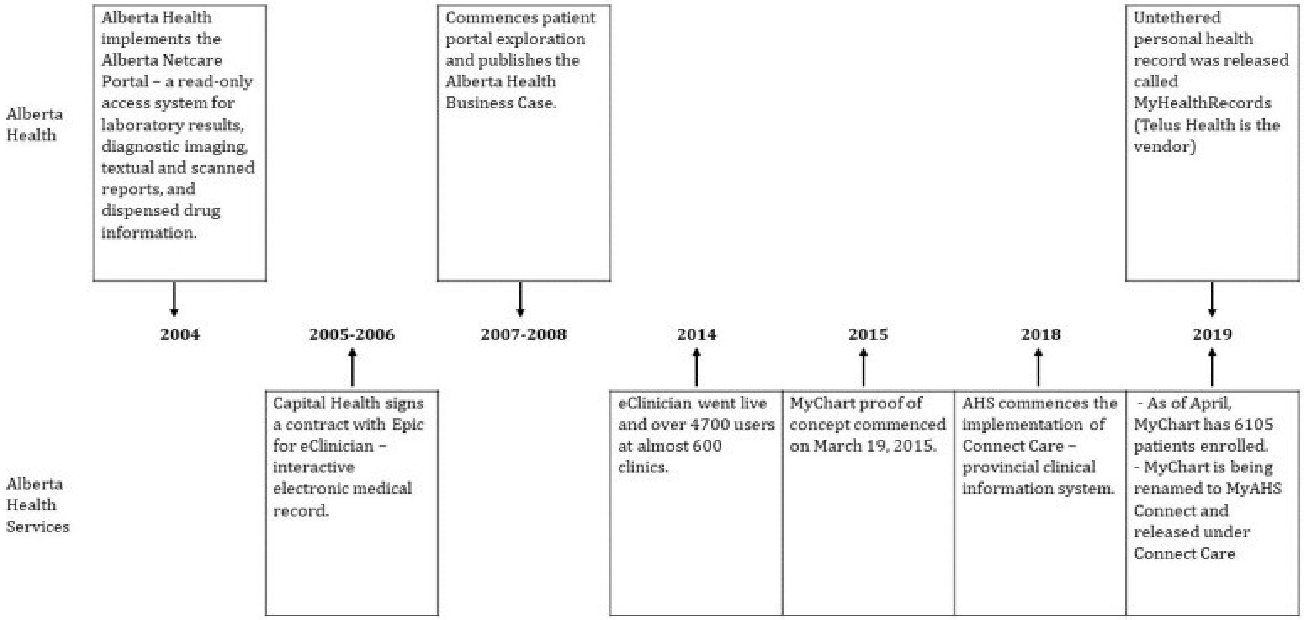


Figure 3: Timeline of the development of patient portals in Alberta



The unmet need

Before 2005

Alberta's first EMR implementation planning began in 1997 (before the creation of a single province-wide health services delivery organization) with the directive to develop and deliver a single province-wide EMR(24). This led to the implementation of the Alberta Netcare Portal (ANP) in 2004, which was a read-only access system for laboratory results, diagnostic imaging, textual and scanned reports, and dispensed drug information(25).

2005/06: Capital Health and the need for a different electronic medical records

In 2005, Capital Health (1 of the 7 regional health authorities at that time) issued a request for proposals (RFPs) for a different EMR system to replace the ANP system. Epic Systems Corporation (from now on referred to as Epic) was awarded the contract in September 2006. The new EMR system, which was developed and customized for Alberta, was called eCLINICIAN.

2007/08: The Alberta Health business case

Although Capital Health and later AHS were working on implementing eCLINICIAN, AH commenced a patient portal discovery phase based on reports from the United States about the potential for health ITs to be cost saving (business case: personal health portal [Advice to the Minister]). This led Alberta Health to develop a business case that represented the first official document produced by a government body in Alberta that described the need for patients to have access to their personal health records. In addition, patients were ***falling through the cracks***, as they were unaware of their test results or if specialist referrals were being made (AH executive-level participant 4).

Although in 2008, AH planned to have a portal deployed within a few years, this did not occur until 2019. Several executive leaders confirmed a description of events during this time when delays resulted from inappropriate planning, changes in vendors, and changes in AH leadership. In addition, individuals involved in managing the personal health record (PHR) project were not equipped with the appropriate technical knowledge as described by an interview participant:

> *So what happened was we ended up in the development mode we're not in the software business. We are not in development business.*
>
> *AH executive-level participant 1*

The portal planning undertaken by AHS during 2008 was also seen as a reason for delays:

> *I also think that the culture of AHS has worked against us because they didn't want something separate from their clinical information system. They wanted it to be something that they controlled and part of the software that they would be purchasing. I believe that that culture and that resistance was evident through the whole journey.*
>
> *AH executive-level participant 1*

It appears from the key informant interviews and documents that between 2005 and 2008, numerous activities established foundational components for a patient portal in Alberta. It is difficult to judge whether the commitment to meet the identified technology need was rushed or whether the task was more complicated than expected. It took more than 11 years for AH to finally release a PHR system in March 2019(26). During these years, an apparent or actual lack of coordination between AH and AHS resulted in tension due to their two patient portal systems appearing duplicative, being established within the same healthcare system.

2014-2019 Alberta Health Services and the race to deliver a patient portal

The delays that occurred between 2008 and 2014 were caused by the restructuring that occurred in Alberta when 12 separate health regions and 3 health boards were merged into Canada's first province-wide, fully integrated health system known as AHS. The AHS' patient portal journey was a continuation of what had been initiated by Capital Health (one of the former health regions) by its implementation of eCLINICIAN. As AHS was planning the implementation of a provincial inpatient clinical information system, eCLINICIAN was meant to serve as a bridge that would ease the gap in terms of the identified need for a provincial EMR and an interactive way for patients and healthcare providers to access information. In 2014, the eCLINICIAN Working Group, with input from various stakeholders, developed a document outlining the AHS health information–sharing prioritization principles that described the need for cost-saving measures based on patients having access to their healthcare information. In 2014, eCLINICIAN went live with over 4700 users at almost 600 clinics or sites(27). It is important to point out that the AH ANP EMR was still being used in Alberta during the implementation of eCLINICIAN.

The eCLINICIAN system was intended to support ***one person, one record,*** and had the capacity to deliver the MyChart®® patient portal through which patients could access their record, communicate with their provider, and book and cancel appointments. The MyChart® PoC, led by a clinical Working Group (MyChart® Working Group) reporting to the AHS Ambulatory Oversight Council, was planned in phases that were meant to reflect a forward-thinking plan to align with both the AH PHR and the upcoming AHS Clinical Information System.

> *As a small project team what we did is we created a Clinical Guidance Working Group it was called the MyChart® Working Group and on there we had a number of different users on board. We had physicians, nurses, allied health, from different sites and we had managers on there as well.*
>
> *AHS senior-level participant 8*

The MyChart® PoC implementation was planned as an incremental change in order to minimize resistance by clinicians and patients (eCLINICIAN prioritization principles). It was decided that at the conclusion of the PoC, the Working Group would validate the solution against physician's expectations, assess the true performance of the patient portal in a controlled environment, identify areas for improvement, identify implementation tips and traps, and lessons learned, measure key performance indicators and determine the return on investment (eCLINICIAN link—PoC scope August 21, 2015).

The results from the PoC would be used to determine any future approaches for deployment, long-term expansion, or modifications of the health IT. Thus, between 2014 and 2019, AHS planned, developed, customized, and implemented a patient portal—a process that has been characterized by intricate agenda-setting and decision-making processes. The following sections will describe the technology and what needed to be done to commence the PoC and the subsequent successful implementation and adoption.

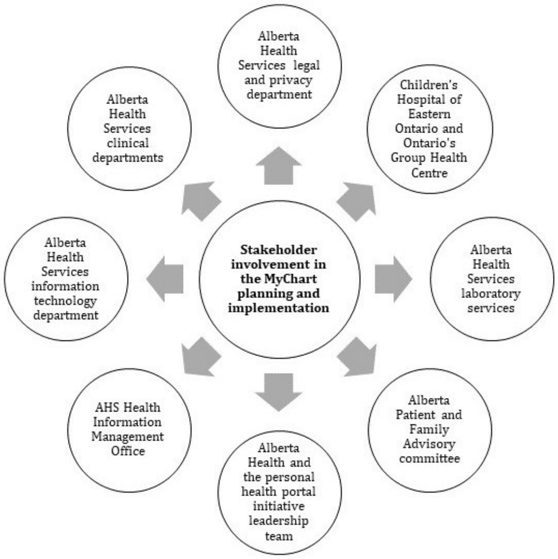
MyChart®: The change

The AHS MyChart® was a customizable Web app that offered patients easy access to their medical records via controlled access to the same eCLINICIAN medical records used by their physicians. It provides self-service functions that have the capacity to reduce administrative costs and increase patient satisfaction. It also offers various features that organizations can select to meet their identified requirements (MyChart® Recommendations: Core Features). Each function is implemented based on the need and cost.

Patients participating in the MyChart® PoC were able to view their health summaries (problem list, medications, allergies, and immunizations), laboratory and diagnostic imaging test results, previous and upcoming appointments, and letters sent from clinics they have attended. In addition, patients were able to send non-urgent messages to their healthcare team, request appointment dates and times, complete health assessment questionnaires, and enter information (i.e., vital signs or blood glucose measurements).

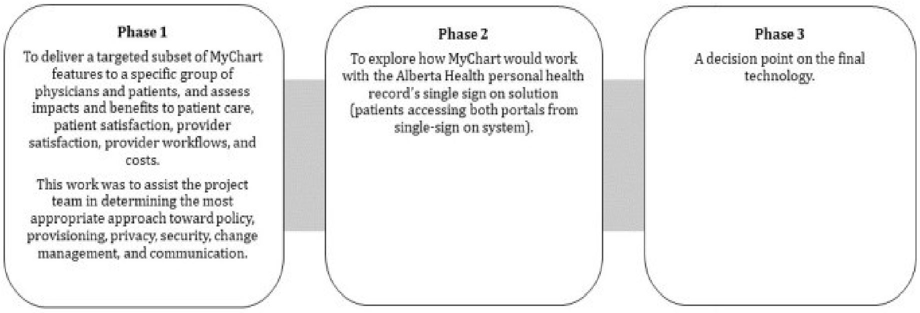
Before deciding on how the PoC will evolve and if MyChart® was the right technology, the work was precipitated by extensive engagement with various stakeholders, as described in Figure 4 (MyChart® summary report). This wide consultation process allowed the MyChart® Working Group to build credibility in the work they undertook.

Figure 4: Stakeholder involvement in the MyChart® planning and implementation



Before the PoC started, the MyChart® Working Group had to plan and consider all possible variables, tasks, and situations that might arise, and this work was guided by the Epic team (weekly status report for eCLINICIAN foundation—eCLINICIAN MyChart®). The planned PoC phases are shown in Figure 5.

Figure 5: Planned MyChart® proof of concept phases



Phase 1

To deliver a targeted subset of MyChart features to a specific group of physicians and patients, and assess impacts and benefits to patient care, patient satisfaction, provider satisfaction, provider workflows, and costs.

This work was to assist the project team in determining the most appropriate approach toward policy, provisioning, privacy, security, change management, and communication.

Phase 2

To explore how MyChart would work with the Alberta Health personal health record's single sign on solution (patients accessing both portals from single-sign on system).

Phase 3

A decision point on the final technology.

The PoC was deployed by ensuring that the best *bang for our buck* was achieved by only working with healthcare providers that were willing to be part of the study and implementing functions that were going to be utilized (MyChart® summary report). The vision for MyChart®

PoC was *better health, powered by information, supported by technology* (MyChart® monthly CIS project status report, August 2015). The estimated PoC implementation cost (more than US $873,600) was based on the cost of staff to support the PoC, and the purchase of the required software and hardware (MyChart® PoC scope, September 9, 2015). By April 22, 2015, the PoC was up and running. The initial goal was to engage 500 patients participating across clinics, with significant measurement and benefits realization activities.

Making the case for MyChart®

The launch of the MyChart® PoC required several components that were determined to be crucial for success, such as the recruitment of clinics and healthcare providers, customization of the portal, and an understanding of how MyChart® would align with the AH PHR initiative. The MyChart® Working Group established project management principles to guide them through the planning and implementation process, guided by charter principles as shown in Table 2 (eCLINICIAN: Lessons learned in context MyChart® project).

Table 2: MyChart® proof of concept charter principles

- Keep it simple
- Keep the focus on the patient
- Have clear communication with each other and with the task force group
- Let us work together, collaborate, and take joint responsibility for getting it done (no finger pointing)
- Listen to Epic! (Let us not waste time reinventing the wheel, Alberta Health Services is not all that different)

In making the case for MyChart®, the MyChart® Working Group outlined several cost-saving assumptions, such as a decrease in no-show appointments due to MyChart® reminders and the opportunity to implement Web-based scheduling. In addition, with secure messaging, there would be less need for mailing letters to patients, and fewer visits to the emergency department for non-emergent issues, as patients would have immediate access to their healthcare team. Given that patients would have access to their medical records and test results, the number of follow-up visits was also expected to decrease (eCLINICIAN MyChart® PoC).

Costs were calculated for the license fees and maintenance of the MyChart® app. For each new user who accesses MyChart® at least once, there would be an ongoing cost of US $4.05 per year (eCLINICIAN MyChart® PoC). These costs were offset by the savings realized through the avoidance of unnecessary medical visits.

The Working Group members considered the MyChart® PoC as a ***bottom up initiative*** based on the notion that clinicians had asked for their patients to have access to their medical records (MyChart® Epic care AMH, December 3, 2015). Furthermore, the process of ***customizing*** the patient portal from the American version to a version that worked within the legislation and privacy requirements in Alberta was a long process. There were many decision requests to change how the processes and functions worked, with the intent to create a system that was patient centered and would meet all legislative requirements of Alberta's Health Information Act.

Gaining support from the providers

As described by AHS senior-level participant 9,

> *because we wanted to be successful, we sort of chose a group of willing clinics and physicians who we knew were knowledgeable, that reassured us that the clinic was committed and that they were willing to help us. The Working Group didn't want to force anybody that did not want it to participate in the PoC.*
>
> *AHS senior-level participant 9*

The recruitment of participating healthcare providers was a challenging process due to the uncertainty of what a patient portal would mean for them:

> *There were some physicians who were absolutely horrified at the idea of patients being able to view their own results and their own information especially in the case where some decisions were made to release lab results immediately. They were horrified at the idea that the patient might see the results before the physician had a chance to see the result.*
>
> *AHS senior-level participant 9*

Healthcare providers were concerned because MyChart® would not replace anything but instead add to the workflow. The MyChart® Working Group wanted to ensure that the initiative would be seen as useful and necessary for the enhancement of patient-centered care. The Working Group decided that the best way to commence the PoC was to find healthcare providers who were given the autonomy to decide which patients were appropriate candidates for MyChart®. During the promotional and exploratory processes for participating clinics, the Working Group selected 5 clinics in Edmonton to participate in the PoC, as shown in Table 3, and offered the opportunity to the healthcare providers from these clinics to participate or not to participate in the PoC. As of April 2019, MyChart® was used at 10 clinics.

Table 3: MyChart® proof of concept participating clinics

- Lynnwood Family Medicine Clinic
- Alberta Health Services (AHS) Inflammatory Bowel Disease (IBD) Clinic
- AHS Kaye Edmonton Clinic (KEC)—Multiple Sclerosis
- AHS KEC—Diabetes
- AHS KEC—Rheumatology

Navigating between the two patient portals

The leading concern about the future of MyChart® and the need for a PoC hinged on processes related to deciding how the AH and the AHS patient portals were ultimately going to *work together*:

> *The AH PHR is essentially access to read-only database of health information. If you want to break it down to most basic stuff, PHR is for reviewing health information, while MyChart® is a tool for viewing health information. These are all things that the PHR can never do. It is helpful to say that they are two different things, the problem is that if the patients are coming into MyChart® and they can do all these things, why would they bother going to the PHR? That's the problem.*
>
> *AHS IT senior-level participant 5*

As the introduction of the MyChart® PoC idea, tensions between AH and AHS in terms of the portal delivery have increased, leading to a *competition-type* delivery of service, as the two systems appeared duplicative.

> *There were a lot of pull and retain, and a lot of political sensitivities given the amount of money that Alberta Health, the time and effort and money had invested in the PHR. So to get the MyChart®® pilot going, we had to escalate it up out of our zone to the IT leadership and medical leadership at AHS first. Then, we had to get permission from the deputy minister level of Alberta Health to do our pilot. We weren't allowed to advertise.*
>
> *AHS executive-level participant 7*

From the early planning days of the MyChart® PoC, it was determined that the MyChart® portal provided more functionalities than the planned PHR.

> *We knew that we could offer more complete functionality using the Epic MyChart®, basically out of the box. So the public portal that they're building, there was a lot of configuration, they had to build the software. There was a lot of configuration to that kind of thing. And then the software platform that they were building on it was no longer being supported by Microsoft. So we knew that we could surpass their functionality out of the gates in some ways using eCLINICIAN MyChart®.*
>
> *AHS executive-level participant 7*

Regardless of what was going to be decided, there was a feeling that AH has had the opportunity since 2009 to deliver a patient portal. The sentiment expressed by some participants was that money has been spent, and patients were yet to have access to their healthcare records. MyChart® was seen as a portal that had the potential to be delivered on the identified need.

> *And for clinicians and patients alike this is a real game changer. There's something that really changes the way we operate in healthcare. It takes responsibility for healthcare and it gives it to me, to the patients, they can take responsibility for their own healthcare, which in theory is everything driven by the physician and dictated by the physician in terms of why he thinks the patients need to know and understand.*
>
> *AHS senior-level participant 9*

The planning for MyChart® had to incorporate components as to how the two portals will eventually work together.

Proof of concept scope and functions

The most challenging component of the implementation process was determining the MyChart® functions, as there were many options but limited funding and personnel. Organizational policies had to be established for a help desk, customer service requests, key performance indicator report analyses, a MyChart® utilization dashboard, and a go-live strategy (Epic MyChart® project plan, February 2, 2015). There were many functionalities from which to select; therefore, the Working Group had to decide what was important during the PoC.

Then, 1 participant described:

> *we just sat down in committee meetings and went through the potential futures and whether it was feasible and useful and did we want. And that's how we kind of made our decisions.*
>
> *AHS executive-level participant 7*

The Working Group focused on developing the sign-up process and implementing the following functions: two-way communication, real-time scheduling, release of test results, proxy access, notifications, appointment scheduling, and questionnaires, as described in Table 4.

Table 4: Planning and development of functions during the MyChart® proof of concept

Function	Planning and development process
Sign up process	• The sign-up process was a source of significant grievances by patients and healthcare providers, "because we put so much security on it and made them use passwords, we made it quite complex" (AHS clinician senior-level participant 10). • A two-factor authentication process was designed to comply with privacy legislation. Some never tried to create a MyChart® account again after an unsuccessful initial attempt. • When MyChart® was first introduced, the sign up was based on a process whereby a provider would print a letter containing a MyChart® activation code, and then the patient would take it home and sign up for the account at his or her convenience. Although this process seemed simple, many patients had issues with the code, remembering to set up the account, or losing the printed paper. • There were numerous discussions on how to improve this process and make it more efficient (MyChart® activation workflows—pros and cons). • After considering the various options for sign up and soliciting advice from Epic, the MyChart® Working Group decided on an email process. • Once a provider had introduced and discussed MyChart® with the patient, and he or she agreed to sign up, the provider clicked the MyChart® status icon on the patient header in eCLINICIAN [Decision Request 11: Create option for MyChart® activation letter to be sent to patients via email]. This initiated an email containing an activation letter that was directly sent to the patient's email address documented in MyChart®. The email included general instructions about MyChart® and the patient's MyChart® activation code. The patient had to enter his or her personal healthcare number, date of birth, and activation code. • The sign-up process included attaching a label to all patients offered MyChart®, which indicated whether they were ***active*** (account used on regular or as needed basis), ***inactive*** (patient signed-up but never used), ***pending*** (a patient starts the sign-up process but does not complete it), and ***declined*** (patient declines to sign up). These labels were as a way of keeping track of patients (Decision Request 238: Add MyChart® status to patient header).

Two-way communication	• MyChart® included two-way patient-provider secure communications for nonemergent issues. This function required many modifications and decisions because it had not been tested before the PoC, and participating clinicians had expressed skepticism. It was also one of the main reasons many healthcare providers within the participating clinics decided not to participate in the PoC. Providers assumed that they would be inundated with a large number of messages, and there was no compensation plan in place to remunerate them for their time. • This function was seen as time saving not only for providers but also for patients. • To effectively evaluate the two-way communication, clinics had to decide on the message routing, and how responses would be managed, although the clinics agreed to a process, and each adapted to meet their needs. In some clinics, clinicians monitored the messages directly, whereas in other clinics, nurses or the front office staff managed messages.
Real-time appointment scheduling	• For the real-time scheduling function to be applied, participating clinicians had to enter their availability in the system, which would allow patients to select from the available slots. Once a patient selected a slot, the clinic's office would receive a message. If the booking was done incorrectly or the slot changed, the office staff would call the patient and modify the booking. • This function allowed patients to not only book appointments, but also cancel them at their convenience. Although this function was available to all clinics during the PoC, only 1 clinic (community-based family clinic) gave their patients access to real-time scheduling.
Release of test results	• Release of test results required the lengthiest deliberations because it needed to comply with the legislative requirements of the Health Information Act. • Three options were discussed: auto release (immediate release of all nonsensitive results), time-delayed auto release (some results to be released after a 7-day delay), and no release (results of sensitive tests with the potential for security and privacy concerns). • Each was explored, although Epic recommended automatically releasing as many results as possible, the MyChart® Working Group decided that results would be released after 10 days. • Patients would receive an email notification once the results were posted in MyChart®.

Proxy access	• Alberta Health Services determined that although proxy access was challenging due to the Health Information Act, this function would be piloted. • Proxy access allowed MyChart® users to permit others to access their MyChart® record by establishing a proxy relationship (e.g., parent to child, adult to elderly parent). Proxy access was seen as ***breaking new ground*** and therefore required careful monitoring and clear guidelines. "So proxy was essentially a precedent issue," as no service provided by Alberta Health Services had this available electronically (AHS IT senior-level participant 5). • When initially introduced during the PoC, proxy access was granted through a manual paper-based process that was found to be very cumbersome and time-consuming. It was later replaced by an electronic proxy access via eCLINICIAN. Another issue was that in order to receive proxy access to another patient's MyChart® account, the designated proxy had to first have their own personal MyChart® account. This was not always possible, as many family members requesting proxy access were not part of the same clinic that was on eCLINICIAN. • The Working Group established a ***shell*** MyChart® account containing no personal health information for those that have been approved proxy access to another patient's MyChart® account, but do not have their own MyChart® account (AHS IT senior-level participant 5). Although clinics found the proxy sign-up process cumbersome, the benefits of having proxy access appeared to outweigh these concerns, as patients reported positive benefits.
Questionnaires	• Although several participating clinics wanted to utilize MyChart® for questionnaires and surveys, the MyChart® Working Group decided for only 1 specialty clinic to proceed with this function. • It was agreed that if this function was deemed successful, it would be recommended for wider implementation.

Decisions on how to proceed were made collaboratively as the Working Group saw this as an opportunity to bring a patient portal in Alberta. Therefore, some functions were selected, whereas others were not. Furthermore, when the MyChart® PoC was planned, it was decided that the goal would be to offer MyChart® to about 500 patients. However, as the PoC evolved and more healthcare providers decided to participate, it became clear that the milestone of 500 patients was no longer adequate (eCLINICIAN MyChart® PoC). After considering the positive feedback to date, the AHS agreed to allow for the number of patients participating in the MyChart® PoC to increase to 5000.

Although there were a great number of anticipated challenges with bringing a patient portal in Alberta, AHS and the MyChart® Working Group concluded that not proceeding with this PoC was not an option.

Discussion

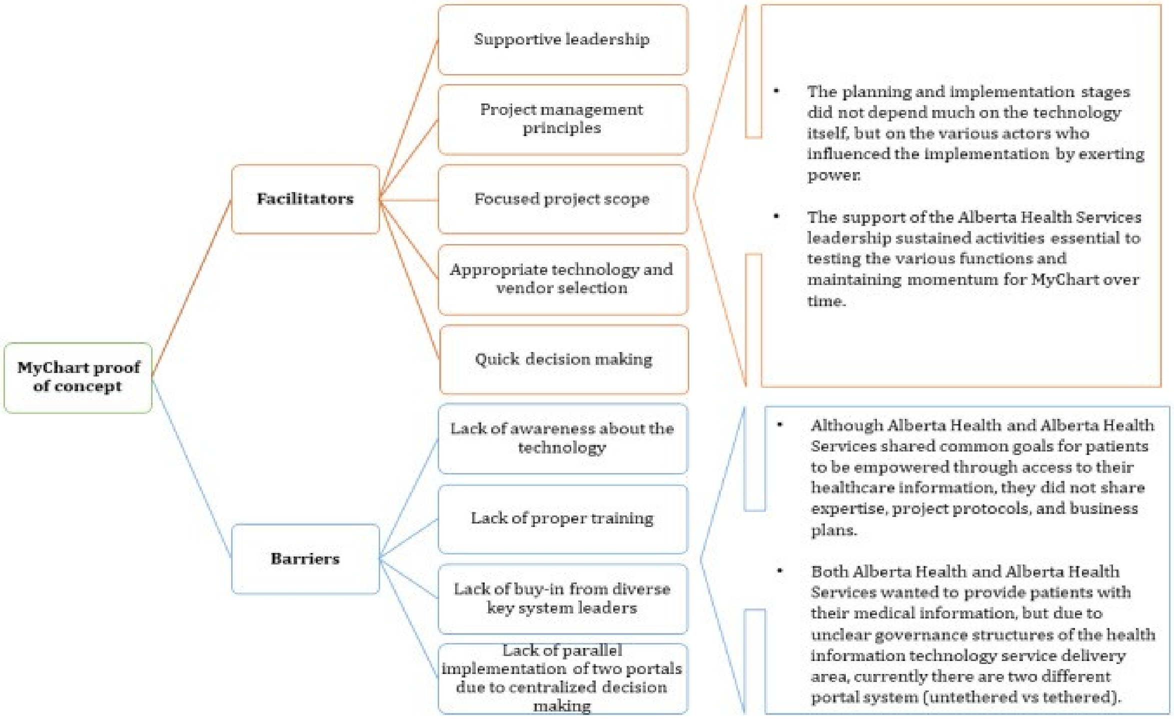
Principal findings

An overview was presented of the various environmental and contextual factors that influenced the MyChart® PoC during the planning and implementation stages. The MyChart® PoC was a complex undertaking of design transformation, adjustment, implementation and deployment, collaboration and compromise, and problem solving with the intent to learn about the necessary elements needed to ensure successful wider implementation. The PoC leadership team agreed that the "technology was the easiest part," as they focused on foundational features with very minimal customization (AHS IT senior level participant 5). The problem-solving processes were impacted by various environmental, social, and professional factors.

Despite extensive research in the area of patient portals, implementation and subsequent adoption of these systems is a convoluted process, which tends to impact settings and practices in different ways(28). This complexity is clearly shown in MyChart® PoC. Furthermore, regardless of the type of setting, these systems require a substantial investment of time, resources, and determination, and not all care settings have the same capacity to contribute equally. As the PoC proceeded, the Working Group saw a difference in the enrollment numbers between the clinics that alluded to differences in uptake.

This study aimed to determine what it took to implement a patient portal and what some of the elements were that were necessary not only for successful implementation but also for the successful adoption and optimization of the technology. The review of primary and secondary sources and insights from the interviews explicated several facilitators and barriers that affected the process, as described in Figure 6.

Figure 6: Facilitators and barriers that impacted the MyChart® proof of concept during the planning and implementation stages



- The planning and implementation stages did not depend much on the technology itself, but on the various actors who influenced the implementation by exerting power.
- The support of the Alberta Health Services leadership sustained activities essential to testing the various functions and maintaining momentum for MyChart over time.

- Although Alberta Health and Alberta Health Services shared common goals for patients to be empowered through access to their healthcare information, they did not share expertise, project protocols, and business plans.
- Both Alberta Health and Alberta Health Services wanted to provide patients with their medical information, but due to unclear governance structures of the health information technology service delivery area, currently there are two different portal system (untethered vs tethered).

<u>MyChart® proof of concept facilitators</u>

Supportive leadership and quick decision making, project management and focused project scope, and appropriate technology and vendor selection were some of the facilitators that allowed for the commencement and growth of the PoC.

Supportive leadership and quick decision making

The MyChart® Working Group comprised leaders who had the capacity to make decisions in support of making the implementation more manageable and without unnecessary delays. It was not only that the leadership was effective, but they also used real and relevant cases to make the case for the portal and garner support. These observations were also confirmed by an interview participant:

> *I found that in some way, so from concept to deployment it took us what around 6 to 8 months with MyChart®. And the reasons I think we were successful is we had strong leadership at the level of the MyChart® pilot. And there was medical leadership but also operational leadership. We explicitly had use cases. So we developed a little framework about what are you actually going to use it for, explicitly. That is very helpful and having understanding of the high level concepts. And then we were prepared to make quick and rapid decisions and live with those decisions. And we had clinical input to help us make the decisions.*
>
> *AHS executive-level participant 7*

Leadership was able to try improvements and become leaders in innovations, as they had

> *own internal executive approval to kind of go for it and try new things and create some precedent.*
>
> *AHS IT senior-level participant 5*

Furthermore, the working Group

> *had to set the stage when it came for the precedent setting stuff since they considered this project as a PoC and they were given a little bit more leeway.*
>
> *AHS IT senior-level participant 5*

> *The project leadership was able to create a pull for the technology and created an environment where the demand was greater than the supply.*
>
> *AHS IT senior-level participant 5*

The findings show that the planning and implementation stages did not depend much on the technology itself, but on the various actors who influenced the implementation by exerting power.

> *The proof of concept was ultimately a learning exercise.*
>
> *AHS IT senior-level participant 5*

As described by AHS executive level participant 7:

> *We were successful because we had strong leadership at the level of the MyChart® pilot.*

The support of the AHS leadership sustained activities essential to testing the various functions and maintaining momentum for MyChart® over time (eCLINICIAN: Lessons learned in context MyChart® project).

Project management and focused project scope

The MyChart® Working Group developed the PoC based on project management principles. These principles were upheld through various meetings and discussions. Furthermore, the Working Group developed many discussion documents to identify the most suitable scope for the MyChart® PoC. As confirmed by AHS IT senior-level participant 5:

> *first got scope, and once we got clear understanding of who is going to be involved, resources. So scope, resources, finance, and then we could build the schedule. That schedule looked at basically at half dozen clinics and we rolled out everything in a very short period of time.*

Appropriate technology and vendor selection

The MyChart® Working Group saw Epic as the necessary guide in this PoC as they possessed the skills and knowledge on how to implement this type of technology. The assumption was that Epic had done this in many different settings and they had the expertise to understand what was required and what AHS needed to do in order to have a successful PoC. The relationship with Epic was not only for the implementation of eCLINICIAN, but also for future partnerships.

> *So it wasn't really because of the former relationship with them on eCLINICIAN deployment on anything like that, it was more of a perceived ability for them to help us in the future as a partner to deploy the full Connect Care suite of options.*
>
> *AHS executive-level participant 7*

The partnership between the MyChart® Working Group and Epic has continued and grown.

MyChart® proof of concept barriers

The main barriers were lack of awareness about the technology, proper training, buy-in from diverse key system leaders, and parallel implementation of two portals due to centralized government decision making.

Lack of awareness about technology

Although the project team decided not to impose the MyChart® PoC on any clinic, various documents show that there was a substantial "lack of awareness" (AHS senior-level participant 6) about what patient portals are and what they would do.

> *There were barriers relating to communicating with the clinics and getting buy in. There was the fear that getting patients their own information would lead to increased work for the physicians in particular.*
>
> *AHS executive-level participant 7*

Therefore, there was a fear

> *that patients wouldn't be ready, would get really scared and this would cause a lot of extra work for physicians.*
>
> *AHS executive-level participant 7*

Lack of proper training

The MyChart® Working Group acknowledged that the clinic staff should have received more detailed training. Clinicians perceived MyChart® as an add-on and thus did not see training as something needed. This issue was amplified by the fact that the Working Group, due to the small funding, did not have the capacity to establish dedicated staff to assist with any technical and user issues. Although training was not deemed valuable, as the PoC progressed, clinicians and other clinic staff realized the need for proper training on how the portal works and how patients interact with the system.

Buy-in from diverse key system leaders

Buy-in was a challenge due to

> *fear that giving patients their own information would lead to increased work for the physicians in particular.*
>
> *AHS executive-level participant 7*

Furthermore, there was a lack of different key system leaders and champions. The MyChart® Working Group comprised influencers, but they needed additional leaders to expand their spheres of influence.

> *I think you need for any successful innovation you need champions both within and outside the system but within the system is absolutely critical and fundamental. If you don't have internal champions, it's not going to go anywhere. And I think you really need in most instances health clinician champions.*
>
> *AH executive-level participant 2*

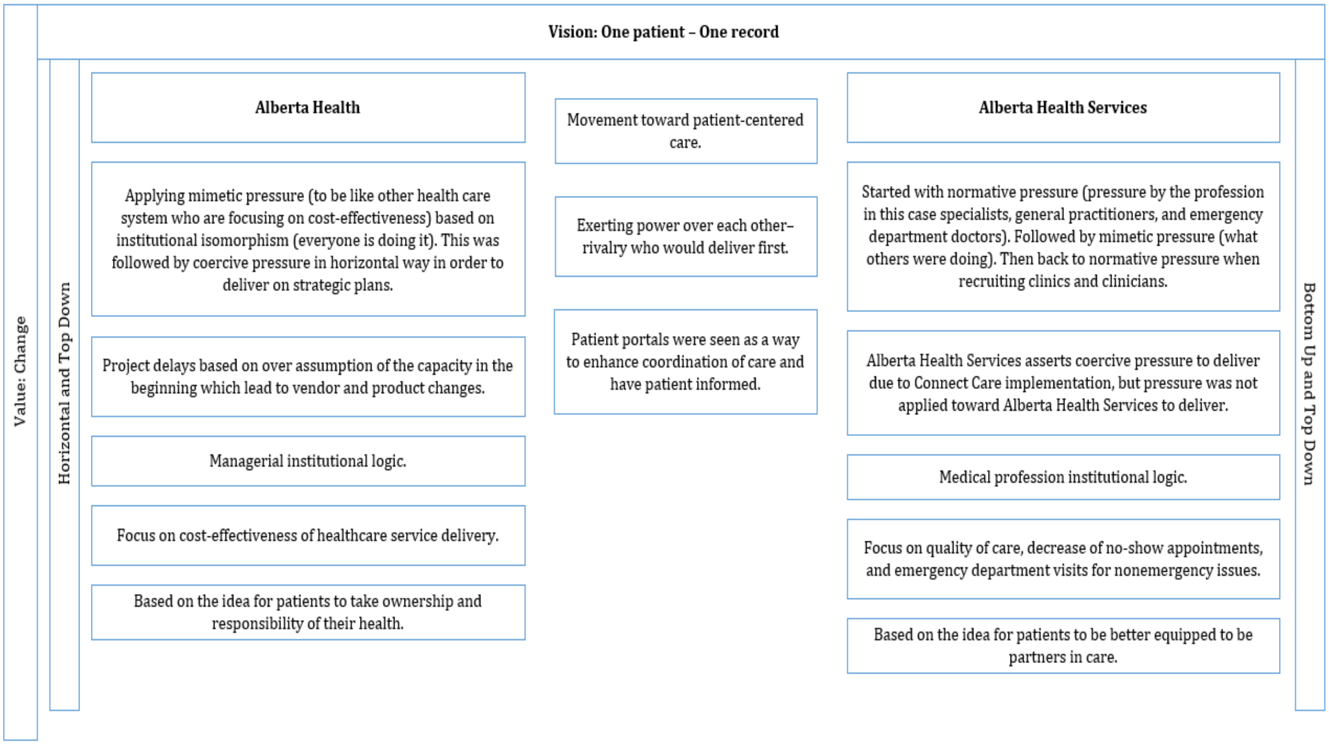
Leadership change also affected the MyChart® PoC in negative ways. There were several documents called *handover succession checklists*, which described the complex process of anytime individuals changed (Enhancement PoC eCLINICIAN portals: MyChart® and eCLINICIAN link—Handover succession checklist).

> *So when you have senior leader change in charge of a project that makes for a challenge as well in terms of transition thing.*
>
> *AHS clinician senior-level participant 10*

Parallel implementation of the two patient portals

Although AH and AHS shared common goals for patients to be empowered through access to their healthcare information, they did not share expertise, project protocols, and business plans. In addition, the two approaches described in Figure 7 show the impact of the parallel implementation of the two portals.

Figure 7: The vision to change



Applying mimetic pressure (to be like other health care system who are focusing on cost-effectiveness) based on institutional isomorphism (everyone is doing it). This was followed by coercive pressure in horizontal way in order to deliver on strategic plans.

Project delays based on over assumption of the capacity in the beginning which lead to vendor and product changes.

Managerial institutional logic.

Focus on cost-effectiveness of healthcare service delivery.

Based on the idea for patients to take ownership and responsibility of their health.

Movement toward patient-centered care.

Exerting power over each other–rivalry who would deliver first.

Patient portals were seen as a way to enhance coordination of care and have patient informed.

Started with normative pressure (pressure by the profession in this case specialists, general practitioners, and emergency department doctors). Followed by mimetic pressure (what others were doing). Then back to normative pressure when recruiting clinics and clinicians.

Alberta Health Services asserts coercive pressure to deliver due to Connect Care implementation, but pressure was not applied toward Alberta Health Services to deliver.

Medical profession institutional logic.

Focus on quality of care, decrease of no-show appointments, and emergency department visits for nonemergency issues.

Based on the idea for patients to be better equipped to be partners in care.

As described by an interview participant:

> *there are two because neither have fully developed themselves out to be the one that is preferential and two, not everyone was involved.*
>
> *AHS senior-level participant 6*

Convergence of the two portals seems to be a natural progression, described as follows:

> *Convergence has to happen. Someone somewhere eventually has to figure it out.*
>
> *AHS executive-level participant 7*

Both AH and AHS wanted to provide patients with their medical information, but due to unclear governance structures of the health IT service delivery area, currently there are two different portal systems (untethered vs tethered)(29). These bureaucratic governance complexities will continue to impact how services are planned and delivered in Alberta until there is a better governance structure(30).

The MyChart® PoC facilitators and barriers show the complexities that exist within the decisions to implement health IT within different healthcare settings.

Comparison with current literature

Several studies have focused on identifying facilitators and barriers to patient portal implementation, but only a few have touched on understanding the organizational impact(31–33). Kooij et al focused on understanding how organizational factors impact the implementation process of patient portals by focusing on several hospital settings and identified a number of facilitators and barriers(31). Their findings are similar to what was found in terms of a lack of perceived value and willingness to change by healthcare providers. These findings are also similar to those of Koivunen et al(32) and McGinn et al(33). However, these latter studies focus on understanding the facilitators and barriers from the perspectives of different stakeholders (providers, managers, IT providers, and patients), whereas the focus of this study has been on understanding the internal organizational facilitators and barriers that impact the planning and implementation stages of a patient portal system. The intent was to understand the internal drivers of change and how decisions were made to support implementation.

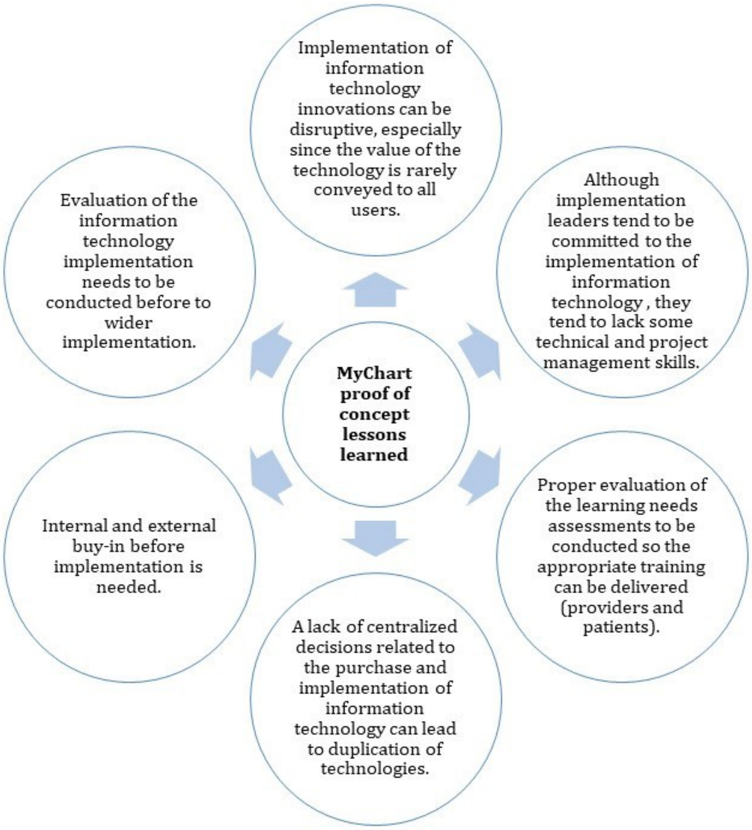
In this study, it was found that incorporating project management principles led to a more focused scope that was aligned with the limited funding. These principles (vision and mission, objectives, standards of engagement, intervention and execution, organizational alignment, and measurement and accountability) allowed the implementation team to maintain a detailed record and track progress in real time. The Working Group incorporated project management principles for each project stage (planning, development, implementation, optimization, evaluation, and adoption). Studies by Richer et al(34) and Aubry et al(35) confirm that projects that have the potential to impact organizational change provide benefit not only by incorporating project management principles but also by establishing a project management office and central decision making to improve resource allocation.

According to the US Office of the National Coordinator for Health Information Technology, the challenge of narrowing a large field of available options to a manageable number of vendors can be daunting, but it is a critical step(36). It is not only about selecting the best vendor but also selecting a vendor that is willing to make commitments to gain new business(37). In this study, the sources identified an in-depth understanding of how the vendor selection process evolved. The vendor selection was based on the perceived ability of Epic to help in the future as a partner to deploy the provincial clinical information system.

Implications and lessons learned

Although many aspects of what occurred during the MyChart® PoC processes are considered common with the implementation of health ITs, there are several features with broad implications for planning and delivering patient portals in a large public healthcare system that were evident during the MyChart® PoC in Alberta, as described in Figure 8.

Figure 8: MyChart® proof of concept lessons learned



First, the implementation of IT innovations can be disruptive, especially as the value of the technology is rarely conveyed to all users(38,39). Value, by definition, includes both costs and benefits(40). This is confirmed by several reviews(40–43). One review concluded the human element is critical to health IT implementation(42). Although these IT innovations are seen as a key component of healthcare transformation to reduce costs and improve quality, their adoption proceeds at a snail's pace(40). Furthermore, there tends to be a lack of properly selecting which IT projects are of most value(43). Selecting the right technology requires an understanding of the value that the technology has the capacity to deliver and the ability to convey that value to all end users(44,45). As the literature points out, health IT implementation should be considered as a complex intervention and that complex interventions may work best if tailored to local circumstances rather than being completely standardized(46). Second, although implementation leaders tend to be committed to the implementation of IT, they tend to lack some technical and project management skills (47). These types of implementation require appropriate skills to ensure successful utilization(46,48). Third, proper evaluation of the learning needs assessments to be conducted so that appropriate training can be delivered (providers and patients)(49–52). Quick presentations or Web-based technical training did not seem to resonate with the healthcare providers during the MyChart® PoC. Fourth, a lack of centralized decisions related to the purchase and implementation of IT can lead to duplication of technologies(47,53–55). Fifth, internal and external buy-in before implementation is needed(47,56,57). Studies have shown that without the proper buy-in from providers, patients lack information about the opportunities to access their medical records(56). Without the proper buy-in, providers and decision makers tend to doubt the usefulness of the technology(39). Sixth, evaluation of IT implementation needs to be conducted before wider implementation(58–60). Furthermore, evidence from pilots is rarely used when planning the implementation on a wide scale(59). According to Houston et al, the domain of Health Informatics is at risk for too rapid implementation as external pressures continue to promote adoption(61). Although decisions are made to invest in the purchase and implementation of patient portals, the evidence of utilization and adoption has produced mixed results(41,62,63). There is a rapid desire to implement patient portals without clear evidence that these technologies have the desired impact on the target populations in terms of effectiveness and safety(61).

The findings in this study highlight the importance of understanding internal organizational and decision-making approaches that have the capacity to hinder the planning and implementation of patient portals. It shows how organizations decide on IT investments, the intricacies of the decision processes, and factors affecting decisions at each stage to provide better future preparations for the successful implementation of technologies. Furthermore, the findings also document the effect of various social and political spheres on the development and implementation of MyChart® and identify key factors that government and healthcare organizations may wish to consider before funding IT in healthcare.

Limitations

There are several limitations to this study. First, archival information from AH to describe their patient portal development process in its entirety was not available. Second, although many efforts were made, it was not possible to interview any AHS individuals who were considered IT technical experts.

Conclusions

Implementing patient portals is a complex undertaking, as “it’s much more about the people who are using it that actually can make an impact on care” (AHS senior-level participant 6). The results of this study document the effect of various social and political spheres of influence on the development and implementation of MyChart® and identify key factors that government and healthcare organizations may wish to consider before funding IT in healthcare. This study supports decision makers in understanding and managing the necessary organizational change and managing the individual expectations when implementation technologies have different types of usage by different groups.

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Chapter 3: Study of a patient's portal implementation and uptake: A qualitative comparative case

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Abstract

Background

Giving patients access to their health information is a provincial and national goal, and it is critical to the delivery of patient-centered care. With this shift, patient portals have become more prevalent. In Alberta, the Alberta Health Services piloted a portal (MyChart®). There was a need to identify factors that promoted the use of this portal. Furthermore, it was imperative to understand why there was variability in uptake within the various clinics that participated in the pilot.

Objective

This study aims to identify potential factors that could improve the uptake of MyChart® from the perspectives of both users and nonusers at pilot sites. The focus was on factors that promoted the use of MyChart® along with related benefits and barriers to its use, with the intention that this information could be incorporated into the plan for its province-wide implementation.

Methods

A qualitative comparative case study was conducted to determine the feasibility, acceptability, and initial perceptions of users and to identify ways to increase uptake. Semi structured interviews were conducted with 56 participants (27 patients, 21 providers, 4 nonmedical staff, and 4 clinic managers) from 5 clinics. Patients were asked about the impact of MyChart® on their health and healthcare. Providers were asked about the impact on the patient-provider relationship and workflow. Managers were asked about barriers to implementation. The interviews were recorded, transcribed verbatim, and entered into NVivo. A thematic analysis was used to analyze the data.

Results

Results from a comparison of factors related to uptake of MyChart® in 5 clinics (2 clinics with high uptake, 1 with moderate uptake, 1 with low uptake, and 1 with no uptake) are reported. Some theoretical constructs in this study, such as intention to use, perceived value, similarity (novelty) of the technology, and patient health needs, were similar to findings published by other research teams. Also some new factors associated with uptake were identified, including satisfaction or dissatisfaction with the current status quo, performance expectancy, facilitating conditions, behavioral intentions, and use behavior. All these factors had an impact on the level of uptake in each setting and created different opportunities for end users.

Conclusions

There is limited research on factors that influence the uptake of patient portals. Some factors were identified that were consistent with those reported by others but also several new factors that were associated with the update of MyChart®, a new patient portal, in the studied clinics. On the basis of the results, found that a shared understanding of the technology among patients, clinicians, and managers, along with dissatisfaction with nonportal-based communications, was foundational and must be addressed for patient portals to support improvements in care.

Introduction

Background

Providing patients secure access to their health information is a provincial(1–4) and national goal in Canada(5,6), and it is considered critical to the delivery of patient- and family-centered care(1–3). Surprisingly, many portals have underperformed expectations in Canada(7) and in other jurisdictions(8,9). Although patients today have greater access to their medical information than ever before, there is a need to identify the best way to provide this information and to understand the impact of the provision of medical information to patients on the healthcare providers.

To address the issues mentioned above, the Alberta Health Services (AHS), a province-wide health delivery organization, piloted a patient portal called eCLINICIAN MyChart® (an AHS branding of EpicCare Ambulatory from Epic Systems, 2014 version) between 2016 and 2019(10). The goals of the study were to determine whether MyChart® would help patients and their families participate actively in the maintenance and monitoring of their health information and to provide information that could be used to scale up the use of MyChart® by documenting factors that both hindered and promoted MyChart® uptake.

Objectives

To accomplish this goal, data were collected from both users and nonusers at the pilot sites. The focus was on factors that promoted the use of MyChart® along with the related benefits and barriers to its use, with the intention that this information could be incorporated into the plan for its province-wide implementation. To the best of the author's knowledge, this is the first study that has considered the perspectives not only of patients and healthcare providers but also of clinic managers and nonmedical staff, such as receptionists, on the impact of patient portal uptake. The timing of data collection began before the introduction of the portal to identify expectations held by healthcare providers' practitioners and managers. This approach to data collection was used to identify previously unknown or unanticipated factors that could limit the potential of patient portals for healthcare systems, including previously obscure power dynamics among clinical leadership. Portals are likely to have systemic groups of nonusers for reasons that have not been previously articulated. This study, sought to clarify why portals can, at times, fail to achieve their transformative potential. In parallel with this work, a quantitative survey was conducted on patient views of the portal(11), and the views of the clinicians and managers presented here complement those findings.

Methods

Research question

The research question was as follows: What factors impacted the differences in uptake of the patient portal MyChart® and what elements were deemed crucial for uptake and access for all end users?

This question was developed by incorporating the principles of diffusion of innovation by Rogers(12) and the theory of technology acceptance by Davis(13). Roger's theory focuses on explaining how and why new ideas and technologies spread, whereas Davis's theory focuses on the perceived usefulness of a technology to enhance performance(12,13). By incorporating these two frameworks, various theoretical approaches were considered which were relevant when considering the uptake of a patient portal within a publicly funded healthcare system.

Ethics approval

This study received ethics approval from the Research Ethics Board at the University of Alberta (Study ID: MS6_Pro00084135) and operational approval for the clinics included in this study from AHS (OA43157, OA43158, OA43159, and OA43160).

Design

Using a qualitative comparative case study design(14–16), 56 in-depth semi structured interviews were performed with clinic managers, healthcare providers, nonmedical providers (receptionists), and patients from 5 clinics that participated in the pilot. Comparative case studies involve the analysis and synthesis of similarities, differences, and patterns across 2 or more cases that share a common focus or goal(14). In this study, each of the 5 clinics constituted a case. A comparison of cases provided an opportunity to learn more about factors that played a role in the uptake during a real-time patient portal implementation from the standpoint of study participants rather than from existing frameworks.

Study setting

Alberta, Canada, has a publicly funded and managed healthcare system based on the principles of universal access to medically necessary services. AHS(17) is the largest provider of healthcare services in Alberta, delivering care to more than 4 million people. In 2016, AHS introduced a patient portal called MyChart® that was connected to the central electronic medical record system called eCLINICIAN. This was carried out through a pilot where several self-selected clinics decided to participate; however, individual healthcare providers within the clinics were free to participate or not. MyChart® allowed patients to view appointments, medical test results, and medication therapies and to communicate with their healthcare providers through a computer or an app on a phone or tablet. It was developed by the Epic Systems Corporation (Epic) and customized to fit the needs of AHS. The pilot was led by the eCLINICIAN MyChart® Working Group, comprising physicians from both family medicine and various specialties, technology experts, policy makers, and healthcare administrators.

Following ethics approval, 5 clinics in the pilot were selected for this study based on the number of patients enrolled in MyChart® per clinic and the length of time each clinic had been using it. These clinics were considered minimal and safe users of the nonportal functionalities of the Epic product (e.g., eCLINICIAN). Three of the clinics were specialist clinics, 1 clinic was a community-based family practice clinic, and 1 clinic was a family practice clinic hosted within an AHS facility. The AHS family practice clinic was selected because although in principle they agreed to participate, they never enrolled any patients. The key features of the cases are outlined in Table 5.

Table 5: Case study characteristics

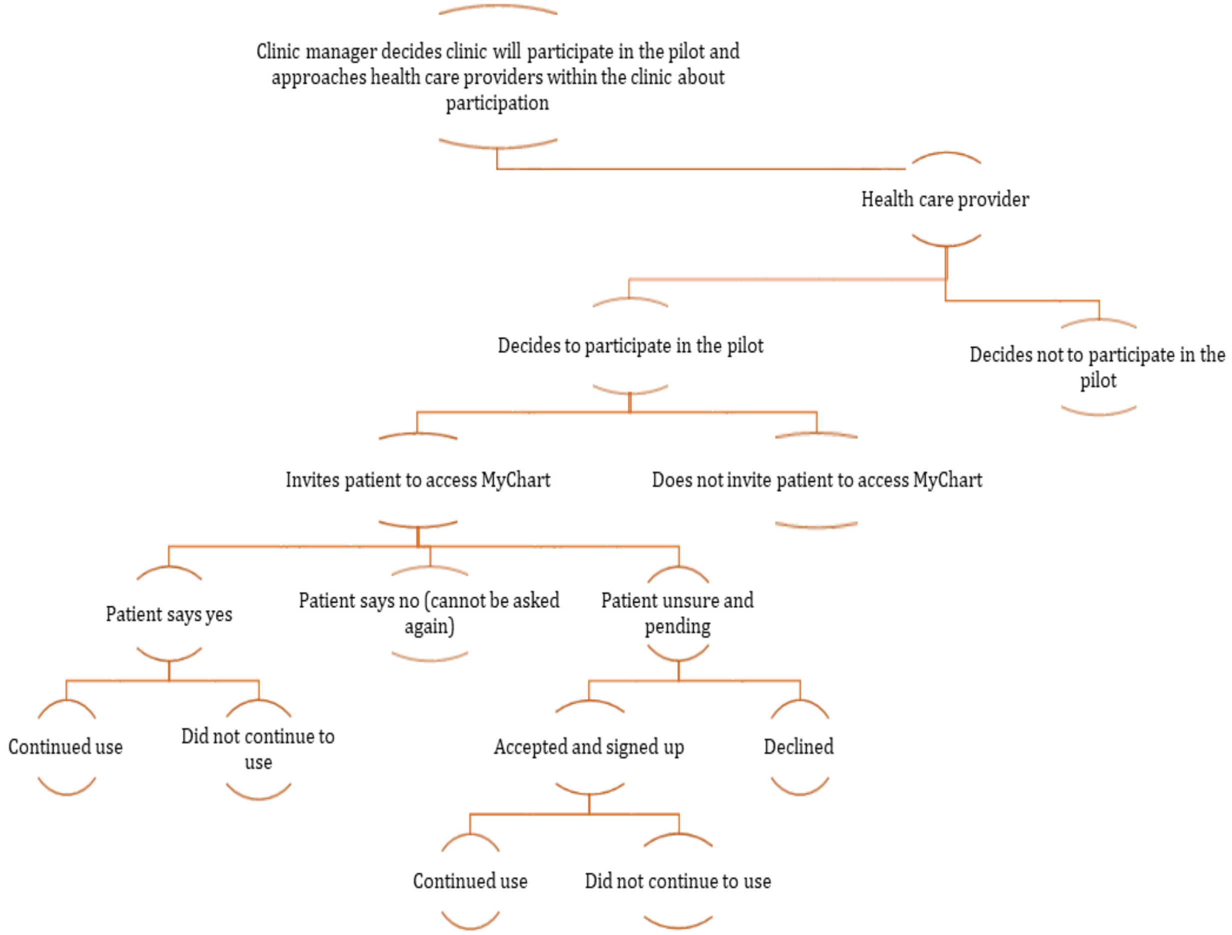
Details of the clinic	Type of setting	MyChart® patient enrollment, n[a]
Clinic 1: medium user of MyChart®	Specialty clinic in academic setting	357
Clinic 2: high user of MyChart®	Specialty clinic in academic setting	875
Clinic 3: low user of MyChart®	Specialty clinic in academic setting	172
Clinic 4: high user of MyChart®	General practice clinic in community setting	965
Clinic 5: no users of MyChart®	General practice clinic in academic setting	0

[a] As reported in April 2019.

Sample and recruitment strategy

Before deciding on the required study sample, the project team had discussions with the MyChart® project team and the staff of several clinics in the pilot to understand how its use evolved in each setting. On the basis of those conversations, a participant recruitment framework was developed (Figure 9), which was reviewed and then finalized.

Figure 9: Participant recruitment framework



On the basis of this framework, clinic managers and healthcare providers were recruited who did or did not participate in the pilot and patients who used or did not use MyChart®, including proxy users. MyChart® permits proxy access to family members who provide care to their loved ones.

Clinic managers and healthcare providers were recruited using a purposive sampling(18) approach. Each identified clinic was contacted, and an introductory meeting with the clinic manager was requested. The clinic managers invited healthcare providers (specialists, general practitioners, and/or nurses) to participate in these introductory meetings. Presentation and recruitment materials were developed, reviewed, and finalized. Meetings were conducted during which the study was described and recruitment strategies were discussed for healthcare providers and patients within each clinic. After answering any questions, a written consent was obtained from healthcare providers and other clinic staff who were willing to participate in the study. After this, interviews with clinic managers and healthcare providers were set up. During the interviews, it became apparent that only 1 clinic implemented the MyChart® web-based booking and canceling appointments function, so all 4 receptionists (nonmedical providers) in that clinic were interviewed.

Patients were recruited using a recruitment card (Appendix 1), which was handed out by healthcare providers at each clinic over a 2-week period. They had provided the card to all patients they saw during those 2 weeks. Interested patients reached out directly if they were interested in participating.

Data collection

During the scheduling of the interviews, the study was explained, questions were answered, and written consent was obtained from those who agreed to participate. The participants then completed a demographic information form and were assigned a de-identifying code used to maintain anonymity and track data. All recruited participants took part in an individual semi structured interview (conducted face-to-face or by telephone) lasting between 30 and 45 min. Notes and reflections were written immediately after each interview. The semi structured interview guides (Appendix 2) were developed, based on the research question, and then were reviewed and revised based on feedback. To determine whether the interview guides required adjustments, the recordings of the first 2 interviews per group were evaluated. No changes were made. All interviews were recorded digitally, transcribed verbatim, checked for accuracy, and then uploaded to NVivo 11 (QSR International) to facilitate analysis. Data collection and analysis occurred concurrently until no new dimensions of the participants' experiences were identified(19).

Data analysis

The data collected guided the structure of the subsequent analyses, following the principles of inductive thematic analysis(20–22). All transcripts were cleaned and each transcript was read several times, transcripts coded for key ideas related to the research question, and codes into preliminary categories. The codes were reviewed and preliminary categories across cases and participant groups were organized according to recurring and emerging themes. As is common in qualitative research, the findings were built from the data(23). The findings were then compared with those of other studies.

Several processes were undertaken to maintain the trustworthiness of the data(22), including establishing credibility by recruiting a diverse sample with different and sometimes opposing perspectives and maintaining a comprehensive audit trail in NVivo 11. To ensure transferability of the data, detailed descriptions of the sample and thick descriptions of findings were developed. Analytic rigor was enhanced through regular meetings of the research team to discuss emerging findings. As each interview was completed, all available interviews were reviewed collectively. Data saturation was reached after 25 patient and 20 healthcare provider interviews, but 2 more patients and 1 more provider were interviewed to ensure that important information was not missed. The demographic data were analyzed descriptively and added as case nodes in NVivo to explore factors associated with the adoption of MyChart®.

Results

Demographic characteristics

The plan was to recruit patients who would fit one of the following categories: user (has access to MyChart® and has used it at least once in the past 6 months), declined (offered but declined to sign up), did not continue to use (signed up but did not use), and proxy access user. During the recruitment, only 1 patient who declined was recruited. No patients who discontinued use were recruited.

One caregiver who used MyChart® under the proxy provisions and several caregivers who used the family member accounts were recruited. Table 6 shows the patient respondents' demographics and reported conditions.

Several healthcare providers were recruited who were nonusers (1 provider elected not to participate in the pilot, 1 medical resident who was not aware that MyChart® was part of the clinic where he or she was working, and 3 medical office assistants who were familiar with MyChart®; however, as a result of the implementation process for MyChart® in that particular clinic, they were not involved directly with MyChart®). The specialty physicians were endocrinologists (n=3), neurologists (n=5), and gastroenterologists (n=5). Table 7 shows the healthcare providers' and clinic managers' demographic information.

Overall, 56 participants were recruited (Table 8; to see interview codes and the demographic characteristics per participant group, see Appendices 3 and 4).

Table 6: Demographics of patient respondents and the reported conditions (n=27)

Characteristics	Value, n (%)
Gender	
Female	17 (62)
Male	10 (37)
Age (years)	
18-25	1 (3)
26-35	1 (3)
36-45	0 (0)
46-60	16 (59)
≥61	9 (33)
Marital status	
Never legally married	2 (7)
Legally married and not separated	18 (66)
Separated, but still legally married	0 (0)
Divorced	2 (7)
Common law	4 (14)
Widowed	1 (3)
Education level	
Less than high school degree	0 (0)
High school degree or equivalent	5 (18)
Some postsecondary education but no degree	7 (25)
Registered apprenticeship or other trades certificate or diploma	5 (18)
Associate degree	1 (3)
Bachelor’s degree	7 (25)
Graduate degree	0 (0)
Postgraduate degree	2 (7)
Employment status	
Employed, working ≥40 hours per week	9 (33)
Employed, working 1-39 hours per week	7 (25)

Characteristics	Value, n (%)
Not employed, looking for work	0 (0)
Not employed, not looking for work	2 (7)
Retired	4 (14)
Unable to work	3 (11)
Self-employed	2 (7)
Family income (Can $)	
<20,000 (US $14,723)	0 (0)
20,000-34,999 (US $14,723-25,765)	1 (3)
35,000-49,999 (US $25,766-34,806)	2 (7)
50,000-74,999 (US $36,807-55,210)	1 (3)
75,000-99,999 (US $55,211-73,614)	4 (14)
100,000-149,999 (US $73,615-110,422)	8 (29)
≥150,000 (US $110,423)	11 (40)
Chronic condition	
Yes[a]	23 (85)
No	4 (14)
MyChart® users	
Yes	25 (92)
No	2 (7)
And/or proxy	5 (18)

[a] Chronic conditions reported by the participants included arthritis, Barrett syndrome, bleeding disorder, breast cancer, celiac disease, chronic obstructive pulmonary disease, Crohn disease, depression or anxiety, diabetes type 1, diabetes type 2, high blood pressure, hypothyroid, inflammatory bowel syndrome, irregular heartbeat, Langerhans cell histiocytosis, multiple sclerosis, osteoporosis, prediabetes, psoriasis, relapsing-remitting multiple sclerosis, sleep apnea, systemic mastocytosis, thyroid disease, and ulcerative colitis.

Table 7: Interviewed participants per case

Interviewees	Clinic manager, n	Healthcare providers, n	Nonmedical staff, n	Patients, n	Caregiver, n
Clinic 1					
MyChart® user	1 (female)	3 (2 female and 1 male)	0	4 (female)	1 (male)
MyChart® nonuser	0	0	0	0	0
Clinic 2					
MyChart® user	1 (female)	5 (female)	0	5 (female)	N/A[a]
MyChart® nonuser	0	0	0	0	0
Clinic 3					
MyChart® user	1 (female)	4 (female)	0	4 (3 female and 1 male)	N/A
MyChart® nonuser	0	1 (male)	0	1 (male)	N/A
Clinic 4					
MyChart® user	1 (male)	2 (1 female and 1 male)	4 (female)	11 (5 female and 6 male)	N/A
MyChart® nonuser	0	5 (4 female and 1 male)	0	1 (male)	N/A
Clinic 5					
MyChart® user	0	0	0	0	N/A
MyChart® nonuser	0	1 (male)	0	0	N/A

[a] N/A: not applicable.

Themes

Coded each group of interviewees (clinic managers, healthcare providers, nonmedical staff, and patients) separately. While reviewing the transcripts and coding them, it became evident that the concerns raised by nonusers were also raised by users of MyChart®. Therefore, information collected from users and nonusers was aggregated. Table 8 shows the identified themes.

Table 8: Themes per sample group

Patients	
	Theme 1: My health, my responsibility, but I need the information to do that Theme 2: Convenience, convenience, convenience Theme 3: A few tweaks will do it Theme 4: Do not take it away
Healthcare providers	
	Theme 1: Of course we need it Theme 2: Yes, it did some good things Theme 3: Not all was great Theme 4: Consider my needs
Clinic managers	
	Theme 1: Time for some efficiency in communication Theme 2: Heard great things about it Theme 3: Heard about some issues as well Theme 4: Change is needed
Nonmedical providers	
	Theme 1: Great service for the patient Theme 2: Needs some education Theme 3: Need to maintain and expand

The themes from each sample group are described in more detail below, with direct quotations used to support the analysis.

Patients

A total of 27 patients from 4 clinics were interviewed. Four themes emerged from the interviews: (1) my health, my responsibility, but I need the information to do that; (2) convenience, convenience, convenience; (3) a few tweaks will do it; and (4) do not take it away.

Theme 1: My health, my responsibility, but I need the information to do that

When initially offered, patients were unsure what to expect from a system that would give them access to their own healthcare information—information that had been difficult to obtain previously. Furthermore, participants noted that the introduction to MyChart® was not as convincing as it might have been, thus they were unsure if there was any benefit for them.

Patients decided to enroll and use MyChart® based on their interest in being more proactive in their own health:

> *First, I am convinced that my health is MY responsibility, not the physician or treatment team. They are here to advise and instruct and carry out detailed procedure that I accept. I must be convinced of the efficacy of treatment options. I am not a blind follower of absolute directions from the all-knowing care-teams. I always try to enter into a meaningful dialogue about treatment options and expected results, and I expect the treatment teams to deal with me professionally and personally.*
>
> *[1PAT3]*

Patients noted that seeing their medical results did not cause them to be anxious or call the doctor's office more, as had been expected by their healthcare providers. Patients were genuinely surprised that the system actually maintained records of their health information. Some were surprised to learn things that they were uninformed about previously.

This theme centered on the importance of having access to credible information that "helps me look after me" (3PAT1). Having access to the information allowed patients to make more informed choices. Empowerment and comfort were also considered important:

> *It has been empowering for me and that also feel that because of it, I am burdening the system a lot less. Fewer appointments, fewer phone calls...and also I feel not just burdening the system but I'm better able to take care of myself.*
>
> *[3PAT1]*

Patients no longer accepted the modus operandi that *no news, is good news*. They wanted to know whether their results were *good* or *bad*. Having access to their medical records was seen as a necessity, as patients were already trying to collect and maintain it by requesting copies from their healthcare providers. Patients expressed frustration with the fact that patient portals exist elsewhere and regarded the process of implementation in Alberta to be slow. Overall, patients felt that they needed this information to be responsible for their own health.

Theme 2: Convenience, convenience, convenience

The term *convenience* was used to describe a missing element in healthcare and the contribution of MyChart® to solving this problem. Regardless of where the patient was, they liked being able to connect with their healthcare team through MyChart®. Just knowing that they could reach out to their healthcare provider was considered a safety net. Being able to contact their healthcare provider directly through an email system and receive prompt replies was appreciated. Patients indicated that, from their point of view, they did not abuse this system and they only sent messages when needed. Although patients did not understand all their test results, they saw the benefits of having the information and used it to frame more specific questions for their healthcare providers and to discuss treatment plans. Most of the time, the provided ranges of results were sufficient for patients to understand their results. Furthermore, some patients had been performing the same tests over the years, thus they were already aware of how to interpret their test results:

> *I may not understand everything, in fact I understand very little but this information enables me to ask a smarter question.*
>
> *[4PAT2]*

Patients wanted the same convenience in interactions with their healthcare provider as for other services such as banking and shopping. The ability to make and cancel appointments web-based was described as extremely convenient and valuable. One patient explained that “you should not have human resources doing the work that can be done with clicks” (4PAT2). Another patient described the ability to make appointments web-based as *freedom.* In addition, having the ability to fill out questionnaires before going to the appointment was seen as beneficial, as patients had the ability to take the time and carefully think about the answers. Caregivers used the information in MyChart® to monitor the health of their family members.

Patients correlated the convenience of MyChart® with cost saving, as patients were able to see their results without making unnecessary follow-up appointments, did not have to travel for a short appointment, and did not have to take time off from work, and did not have to pay for parking and/or pay to get their results printed. They saw this not only as cost savings to them but also as cost savings to the healthcare system.

Although proxy access was one of the most challenging elements to set up within MyChart®, patients noted that it was one of the most beneficial connections, especially when caring for a family member:

> *Now my father who is 90 is a different story and one of the very interesting and most important features of this is the availability we have to see dad's test results. So, I can access because you know my dad and I work together, and this is maybe kind of not how they thought this was going to work, but as a primary caregiver with my dad, I've got his user ID and password, which I set up for him anyway.*
>
> *[4PAT3]*

Patients who had provided proxy access to their accounts were cognizant of the possible issues, but they found that the benefits outweighed the risks. Patients in this study did not seem to be greatly concerned about privacy and security. They felt that this system was as secure as any other system that had their personal information:

> *Well there's a concern every time I pull out my debit card or my visa. There is a concern every time I go on Instagram. There's a concern with every single thing we do and I could choose to be paralyzed by that and not have a credit card, and not go online, not do anything. But I choose to do all those things to enjoy the benefits, I guess. It's I suppose convenience and you use reasonable care, I think. And you kind of recognize that things can be hacked into and data can be lost.*
>
> *[4PAT4]*

Theme 3: A few tweaks will do it

Although patients found MyChart® very beneficial, they also described some of the barriers that they experienced with the system. Some patients expressed concerns about their ability to understand the results, as they did not find the descriptions in MyChart® valuable at all times. Diagnostic reports were not accompanied with explanations; thus it was difficult for patients to interpret the findings. Some patients did not appreciate the fact that healthcare providers did not see them as sufficiently competent to understand the information:

> *But you know the medical professionals are God and everybody else bows before them and does whatever they say. You know they're the only ones that can interpret this stuff properly.*
>
> *[4PAT4]*

Patients expressed dissatisfaction about the inability to see the entire medical record, including the doctor's notes.

No education or training on how to use MyChart® was provided. As they did not know what their use of MyChart® would entail, some patients decided not to sign up, noting that it might take "too much time to learn the things" (4PAT11 [NU]). Patients were frustrated about the lack of access to most MyChart® functions. Patients in the clinics without the option to book web-based appointments defined this gap as a barrier:

> *I can book my flights, I can book my hotels, I can do it all on an app on my smartphone. I can book my lab, why can't I book my doctor's appointment.*
>
> *[4PAT4]*

Patients also did not understand why all their family members could not be on the system.

The sign-up and the sign-in process were barriers to some patients. One person said, "I mean I understand that they need a certain security level, I totally understand that, but it was so delicate and so picky that it often didn't work" (4PAT1). Although MyChart® was seen as a beneficial tool that enhanced the patient-provider relationship, some expressed concerns about healthcare being computerized and what that would mean for patients.

Theme 4: Do not take it away

Many of the interviewed patients expressed concerns about the possibility that MyChart® might not be continued after the pilot and said it would be like going "back to the Stone Ages" (4PAT4). They said they were not being informed on regular bases about the future of MyChart®. Furthermore, patients explained that if MyChart® was removed, they would have to go back to playing phone tag with their providers:

> *In this world where we have access to so much information and can make choices and view and control things online. My expectation is that I should be able to do that with my healthcare. And my experience is it's probably giving me better healthcare more efficiently than the old way.*
>
> *[4PAT4]*

Participants wanted to inform decision makers regarding the value of the patient portal and their wish for it to be maintained, and they had some suggestions for improvements (see Appendix 4 for additional quotes).

Healthcare providers

A total of 21 healthcare providers from 5 clinics were interviewed. Four themes emerged from the interviews: (1) of course we need it; (2) yes, it did some good things; (3) not all was great; and (4) consider my needs.

Theme 1: Of course we need it

The interviews with healthcare providers commenced by soliciting opinions about their perceptions of MyChart® and their experience of its implementation. Many expressed positive views as they saw it as a good vehicle for delivering information to patients:

> *I think it's the patient's information. And unless there's a really clear medical reason, like maybe they have severe anxiety, mental health issues, or something else that maybe they shouldn't have it. I don't see any reason why they shouldn't have that information based on pretty much real time unless there are a certain subset of things that possibly might qualify for that maybe it's a cancer diagnosis.*
>
> *[4HCP1]*

One described MyChart® as "a piece of our healthcare system that's been missing" (1HCP2). Furthermore, many providers agreed that patients had the right to their information and said portals were a great tool for that purpose. Providers thought MyChart® had a positive impact on both themselves and their patients, "I can say fairly from my patients that experience is always been positive and been positive to me" (1HCP2).

Theme 2: Yes, it did some good things

Healthcare providers described several benefits from the MyChart® for patients, “by learning about their health even and that sort of thing that they can click on into a health portal and learn about their condition or what comes up, or surgeries or whatever” (1HCP1). Providing patients with information improves patient visits. One provider said, “when you are armed with the results and armed with some of those values, it will make the patient interviews and patient visits a bit more meaningful” (4HCP2). MyChart® was seen as a secure system where everything was recorded, as even a nonuser provider stated, “everything's documented so you don't have to worry” (4HCP4 [NU]).

Providers stated that MyChart® was desirable as it reduced phone calls and provided an alternative means of communication. One of its novel functions was 2-way secure communication for nonemergency issues. This function required many modifications and decisions because it had not been tested before the pilot, and participating clinicians had expressed skepticism. It was also one of the main reasons many healthcare providers within the participating clinics decided not to participate in the pilot. Providers assumed that they would be inundated with a high number of messages, and there was no payment plan in place to remunerate them for the time required to answer these messages. As patients on MyChart® started calling the clinic less frequently to get results, healthcare providers recognized the improvement in workflow, “instead of them calling us, they’re just sending us a message through MyChart®, which is easier for us on our end” (2HCP4).

Although only 1 clinic during the pilot decided to implement the appointments function for their patients, it proved to be extremely valuable as patients could “do it at their convenience to save some calling back and forth” (4HCP1). Providing proxy access was seen as a much-needed innovation in delivering healthcare. It was a new function that was never offered in Alberta before the MyChart® pilot. Providers were positive about the approach. The most common request for proxy was for a spouse or adults caring for their elderly parents. One provider said, “the wife is the one that like keeps track of all the health information or like the different results and medications and whatnot so they’re usually the ones that email about their husband's symptoms or questions or whatnot” (2HCP1).

MyChart® did not impact workflow negatively, as was originally expected. The major benefits in terms of workflow was that it improved communication between patients and providers and that it provided a means of accessing information quickly. The work itself did not change, but there was a change in the way the work was performed. The system allowed other team members to be informed about communication and decisions.

Theme 3: Not all was great

Although there were many benefits of having MyChart® available to patients, providers expressed several concerns. Not all patients were deemed fit to have access to their healthcare information, as “too much information sometimes is not a great thing” (1HCP1). Another provider stated that “a lot of patients wouldn’t really want to know that; they’ll just want to know if they’re living or dying” (5HCP1 [NU]). Providers made decisions about which patients would be offered MyChart® and stated that sometimes they did not offer it because there was no time to do so:

> *I offer it to all although I can tell you I'm not consistent. So, I mean to offer it all but there's plenty of times when I’m rushing around in a clinic, and/or if a person has a lot of other concerns it doesn’t pop into your mind and so you’re more focused on other things during your clinic visit.*
>
> *[2HCP3]*

Healthcare providers did not want the additional work of educating and helping patients or providing technical support. One provider stated, “more physicians are annoyed with that; they’ll just stop offering that service” (1HCP3). This reluctance was based on previous experiences that technologies tend to be implemented without proper technical support or education. Providers felt that they had to *wing it* in using the system. MyChart® was perceived as potentially taking time away from medical consultations if providers had to do promotion and education. As another provider stated, “I do not have time in that time to introduce a concept that has to be done by somebody else” (3HCP5). Some providers described that they just forgot about MyChart® and did not bother with enrolling patients:

> *It's kind of forgotten sometimes and it could be the nature of the clinic. It’s a busy clinic and maybe it's just forgotten as a tool. There is one physician that does use it more so than others.*
>
> *[3HCP3 NU]*

There were no clear guidelines and expectations, thus there was hesitancy about what was the right thing to do. Healthcare providers expressed apprehension because they were unclear what MyChart® meant in terms of changes in charting practices.

Theme 4: Consider my needs

When asked about the upcoming provincial-wide implementation, healthcare providers stated that if MyChart® were continued, then it needed to reflect their needs and be established in a manner that would work within their busy schedules. It was stated that the system would need to be developed around some kind of incentives. No incentives would mean that “people won’t use it” (1HCP3) and patients would not receive the opportunity to be introduced to the portal. Policies and guidelines should be implemented about charting, proxy access, and 2-way communication. MyChart® could be incorporated as long as it did not contribute to additional workload (see Appendix 4 for additional quotes).

Clinic managers

A total of 4 clinic managers were interviewed, and 4 themes emerged from the interviews: (1) time for some efficiency, (2) heard great things about it, (3) heard about some issues as well, and (4) culture change is needed.

Theme 1: Time for some efficiency in communication

When managers were asked why they decided to be part of the pilot, they stated that it was to eliminate paper and phone calls, try an innovation, and provide new ways for patients to manage complex chronic conditions. They had positive views about portals and how portals could impact practice in a positive way. This was an important finding, as clinic managers were involved in decisions about whether to have their clinic involved in the pilot:

> *I think that you know this is going to be the future. The question is how we get there. [4CM1]*

They viewed MyChart® as a way to connect team members and assist patients and providers. They thought that the system had the capacity to improve the communication processes currently broken in the healthcare system, as patients continue to complain that they are unable to reach their providers when needed.

Theme 2: Heard great things about it

Clinic managers stated that the impact of patients seeing their medical records was seen as a facilitator to better care. Patients already search for things on the web, and MyChart® provided access to correct and legitimate information:

> *Our patients are different patients than what they were 20 or 30 years ago because they have Internet access already. They already research all.*
>
> *[2CM21]*

It is important to note that clinic managers agreed that not all patients would use MyChart® and that the system needed to accommodate this possibility. The MyChart® 2-way communication function capacity was seen as a means of establishing new ways of communication and reducing reliance on phone calls.

Theme 3: Heard about some issues as well

When the pilot started, only physicians were allowed to sign up patients to MyChart®. This led to low enrollment numbers because physicians did not have enough time to explain MyChart® to each patient. Furthermore, clinic managers described that many physicians did not participate in the pilot even though the clinic was part of the pilot. This was because of a lack of buy-in as physicians did not see MyChart® as something beneficial. One clinic manager identified the issue of control as a drawback to the use of MyChart®:

> *Physicians traditionally are so accustomed to kind of controlling everything that happens with that patient. And when the patient starts seeing the results of what they're trying to achieve. They're worried about it derailing the treatment progress and the relationship between the provider and the patient, when in fact I think the actual opposite occurs.*
>
> *[2CM21]*

Clinic managers acknowledged that they heard from the healthcare providers about patients having issues with MyChart®. The sign-up process was challenging and created grievances. Technical support was lacking, and healthcare providers had to figure out ways to help patients with the sign-up process. One of the barriers was that physicians did not take full responsibility for the 2-way communication.

Theme 4: Change is needed

Clinic managers stated that change is needed in the current provider-patient relationship. They agreed that all clinics should be able to provide it, so all patients would have the same opportunity to access their healthcare information:

> *It needs to be a normal part of the life or not, it needs to be a normal part of, more the norm than the exception.*
>
> *[1CM1]*

Furthermore, clinic managers stated that physicians need to learn how to work with innovations such as MyChart® and that these changes might not be easy in the beginning but are needed (see Appendix 4 for additional quotes).

Nonmedical staff

Only 1 clinic within the pilot opened the web-based appointment booking and canceling appointments function. For the scheduling function to be accessible, participating healthcare providers had to enter their availability in the system, which would allow patients to select from the available slots. Once a patient selects a slot, the clinic receives a message. If the booking was done incorrectly or the slot was changed, the office staff would call the patient and modify the booking. From these interviews, identified 3 themes: (1) great service for the patients, (2) needs some education, and (3) need to maintain and expand.

Theme 1: Great service for the patient

The nonmedical staff described that participants “loved booking their own appointments especially because they know (if) something happens in the middle of the night, they can go on and book for the next day if there's openings” (4NON2). If there were any issues with the appointment, then the staff would call the patient and get it all sorted out; therefore, MyChart® lightened the workload.

Theme 2: Needs some education

As not all healthcare providers participated in the pilot, some patients in a given clinic were able to make web-based appointments, whereas others could not do so. In addition, a challenge was with patients who would book many appointments, as “they can book a whole bunch of them on MyChart® in one day” (04MANON00213DEC2018).

Theme 3: Need to maintain and expand

Staff indicated that they would like more information about MyChart® so that they could assist patients better and said that they needed “more awareness and if they ask questions I can help as I can't help them much now” (4NON3) (see Appendix 4 for additional quotes).

Summary of the results

Reporting the uptake and adoption of an initial phase of a patient portal introduction among 5 healthcare clinics that were, at the outset of the introduction, judged to be clinics where high uptake would be found. In contrast, 2 clinics showed high uptake, 1 clinic showed moderate uptake, 1 clinic showed low uptake, and the last clinic was categorized as a clinic without use. Identified several factors related to the uptake of the patient portal, including satisfaction and/or dissatisfaction with the current communication tools, performance expectancy, facilitating conditions, behavioral intentions, and use behavior. All these factors had an impact on the level of uptake in each setting and created different opportunities for the end users. Table 9 summarizes the findings about each clinic.

Table 9: Impact of the MyChart® pilot on each case study

Case study	Level of usage	Satisfaction or dissatisfaction with the current communication tools	Performance expectancy	Facilitating conditions	Behavioral intention	Use behavior
Clinic 4	High user; 965 enrolled patients	Clinic considered as an innovation hub clinic; first clinic to go live within the PoC[a]; 2 family doctors and a registered nurse participated; 3 family doctors did not participate	MyChart® described as the *most rewarding* initiative; offered the web-based booking and canceling appointment function. Only clinic to do so	The registered nurse acted as the MyChart® support person	High enrollment as they offered it to almost all patients	The clinic maintained high enrollment and incorporated the frontline staff (office assistants) to be part of the process
Clinic 2	High user; 875 enrolled patients	It was described that the clinic had the *old way* and the *new way* processes	The participating providers used the technology to share medical results with their patients and decrease the number of phone calls to the clinic	Two specialists maintained the *old way* who did not participate in the PoC because of the assumption that it will increase their workload and patients will contact them all the time. Two specialists	The old way was maintained for a while, until the nurses from the nonparticipating specialists decide to start enrolling patients on MyChart®	After the nurses took on the initiative to sign up patients to MyChart®, the enrollment increased

Case study	Level of usage	Satisfaction or dissatisfaction with the current communication tools	Performance expectancy	Facilitating conditions	Behavioral intention	Use behavior
				implemented the *new way*		
Clinic 1	Medium user; 357 enrolled patients	MyChart® was brought in because of the potential for uploading forms and questionnaires that patients tend to do	The technology did not produce the identified needs as the forms on MyChart® were found to be inappropriate by the clinic	Nurses took on the active role in enrolling patients	Only offered to certain patients (medium enrollment)	The implementation process was observed by 2 other specialty clinics that enrolled in the PoC and achieved a high enrollment (1047 and 667 patients)
Clinic 3	Low user; 172 enrolled patients	The participating specialist is the clinic manager that brought MyChart® to the clinic with the intent to decrease the number of phone calls or unnecessary follow-up appointments	The portal was deemed needed because of the 2-way communication function. However, patient messages sent through MyChart® were often unanswered because of staff changes	The nurses did not actively participate in the enrollment process; other staff did not see the benefit and were unwilling to participate because of the 2-way communications function	Low enrollment, although patients expressed interest (interviewed 1 patient from this clinic who did not have access but wanted it)	MyChart® was described as an *afterthought*
Clinic 5	Nonuser; 0 enrolled patients	Although offered to participate, the staff at this academic	The technology was deemed difficult to	The clinic has patients with MyChart® because	The portal was not seen as something necessary in the	No perceived value and thus no enrolment or usage

Case study	Level of usage	Satisfaction or dissatisfaction with the current communication tools	Performance expectancy	Facilitating conditions	Behavioral intention	Use behavior
		setting family clinic decided not to	incorporate in the clinic's flow	of access provided at other clinics, but no provider from this clinic wanted to use or assist patients with the portal	delivery of healthcare services	

[a]PoC: proof of concept.

Discussion

Principal findings

In this study, dissatisfaction with current healthcare communication tools appeared to be the primary factor that drove patients' and providers' decisions to consider the use of MyChart®. Once they had made this decision, uptake was dependent on performance expectancy, which included understanding how to use the technology and valuing the additional functionality that it offered. Furthermore, although the themes emerged from the interview data, they aligned with the *theory of technology acceptance* by Davis(13) and included *perceived usefulness*, *perceived ease of use*, *barriers to ease of use*, and *future usage*(13). For example, theme 1 from the patient interviews was *my health, my responsibility, but I need the information to do that*, which correlated with *perceived usefulness*(13), as shown in Table 10.

Table 10: Themes per sample group correlating with the theory of technology acceptance

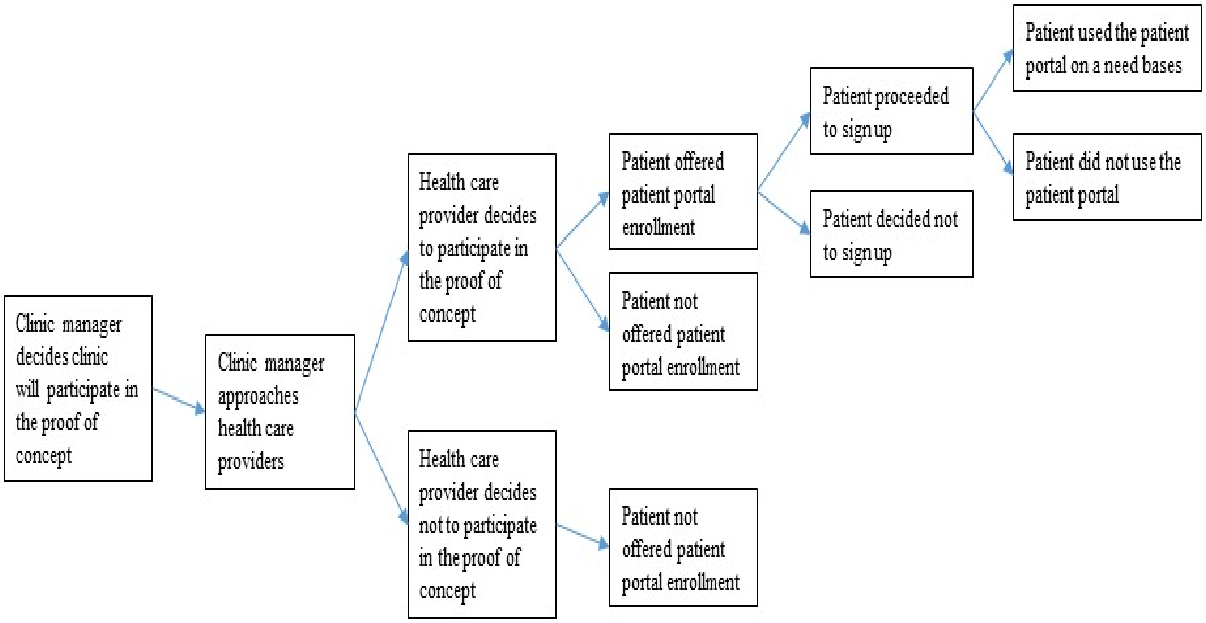
Patients	
	• Theme 1: My health, my responsibility, but I need the information to do that (perceived usefulness) • Theme 2: Convenience, convenience, convenience (perceived ease of use) • Theme 3: A few tweaks will do it (barriers to ease of use) • Theme 4: Do not take it away (future usage)
Healthcare providers	
	• Theme 1: Of course we need it (perceived usefulness) • Theme 2: Yes, it did some good things (perceived ease of use) • Theme 3: Not all was great (barriers to ease of use) • Theme 4: Consider my needs (future usage)
Clinic managers	
	• Theme 1: Time for some efficiency in communication (perceived usefulness)

	- Theme 2: Heard great things about it (perceived ease of use) - Theme 3: Heard about some issues as well (barriers to ease of use) - Theme 4: Change is needed (future usage)
Nonmedical providers	
	- Theme 1: Great service for the patient (perceived usefulness) - Theme 2: Needs some education (barriers to ease of use) - Theme 3: Need to maintain and expand (future usage)

The conditions that facilitated understanding of the technology varied across clinics. Some clinics formally designated assistance with MyChart® use to staff in their clinic. All clinics had high or medium uptake of MyChart®. In other clinics, staff decided not to offer MyChart® to some patients, which had an impact on the uptake of MyChart®. Reasons are not entirely clear and require further investigation. Some patients who understood how to use the technology and valued it became *users*, whereas others did not. The main reason for discontinuing use appeared to be the lack of an immediate healthcare concern(24).

Clinic managers were foundational to the uptake of MyChart® (Figure 10), a finding that has not been discussed in the literature to date. They made decisions about whether to present the technology to providers. The data suggest that this decision was based on an informal assessment of satisfaction with the current communication tools. Clinic managers who declined participation in the pilot indicated that their clinic patients and providers would not be interested in trying the technology. Figure 10 summarizes the impact of the clinic managers on the uptake of MyChart®.

Figure 10: Clinic managers as gatekeepers to uptake of MyChart®



The actions of the clinic managers could be observed through Roger's theory of diffusion, as they served as early adopters by assessing the advantages or disadvantages of the innovation. They determined the *perceived efficiencies*, its *compatibility* with the existing system, the *complexity*, and, ultimately, the *benefits* and unintended *consequences* of the innovation(12). Usage and enrollment depended on how patients were informed about the portal. Patients in this study reported variable understanding of the portal following the introduction by clinic staff. Similar to the study by Kim et al, a quick introduction did not appear to be valuable to patients. In this study, participating healthcare providers reported not having sufficient time to explain the portal to patients(24). In clinics with higher uptake, a short introduction became incorporated into the clinic visit workflow, which allowed for more sufficient means in enticing patients to sign up.

Knowledge about the technology was another important component that led to increased or decreased usage. Ryan et al found that patients and healthcare providers had positive views about patient portals but that older patients had less knowledge about patient portals(25). In this study, older participants reported that they took the time to learn and understand the system once they decided to enroll. Patients had to learn the system by *trial and error*. When patients were unable to navigate the sign up and authentication, the use of MyChart® became impossible. When patients accessed medical information in MyChart®, they reported becoming more active in the management of their health, which allowed them to see their health trends and identify opportunities for self-care. Patients came prepared with specific health questions because they could spend less time going over less valuable health information (e.g., lab results) and making better use of scarce time with their care provider. This finding was similar to the results reported by Dendere et al(26).

Some research teams have reported a relationship between concerns regarding privacy and technology uptake(27–35). In this study, participants did not report perceiving significant risks to having the confidentiality of their health information violated. Participants reported a sense that the health system would maintain appropriate controls and procedures to protect the security of their health information.

Although not all healthcare providers saw the *value* of patients having access to the same information, participants *championing* use of MyChart® experienced more efficient ways to connect and communicate with their patients. This finding is in contrast to the findings reported by others who have studied patient portals(26,36–39) and reported that portals increased workload. For example, Koivunen et al described the negative views of nurses about patient portals(40). The findings are consistent with the work of other research teams who reported that nurses saw patient portals as an opportunity to improve communication with patients(41,42).

Furthermore, theories of how patient portals support healthcare system transformation may not draw upon crucial empirical data. The current findings emphasize that without a shared understanding of the purpose of patient portals and some dissatisfaction with existing communication methods, uptake lags. These aspects will be crucial as patient portals introduced in real-life care settings often accompany other technologies for clinicians and managers to navigate(43).

These findings agree with Wiljer et al, who described a need for a culture shift, where access to medical records is a fundamental right of every patient(44). A shift of this magnitude could only be accomplished with broad support from policy makers, healthcare providers, health administrators, and patients. Without adequate support for patients as complete partners in the management of their health, patients would be left to take actions based on incomplete and possibly inaccurate information from untrustworthy sources. Clinically useful uptake of patient portals is an essential enabler for patients as partners in managing their health and transforming the wider health system.

Limitations

There were several limitations to this study. Patient interviews were only conducted with patients who volunteered to participate and were attending an appointment with a healthcare provider who was also participating in the study. The information provided by participants may not have been recalled accurately by them. In addition, although all efforts were made it was, unable to identify and recruit participants who did not continue to use MyChart® as there were no means to obtain information about discontinued usage. Finally, the findings should be generalized with caution to other healthcare systems and to settings that use other types of patient portals.

Conclusions

This work exposes a number of factors that have an impact on the uptake of MyChart®. This study has found that dissatisfaction with nonportal-based communications was a foundational element that likely needs to be addressed before more advanced goals can be reached, and that clinical managers were key gatekeepers in the uptake process. Once a clinic manager decided that the clinic should use the portal, the designation of a staff member to help patients become more familiar with the portal appeared to increase uptake.

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Chapter 4: How impact of patient portals is captured based on the Quadruple Aim and the Benefits Evaluation Frameworks: A scoping review

Abstract

Background

Electronic patient portals are secure websites tied to an institutional electronic health record system from which patients can view their medical information. These types of records are populated with a person's lifetime health history. Despite the continuing extensive research in this area, measuring patient portal impact continues to be a convoluted process.

Objective

To explore what is known about patient portal evaluations and provide recommendations for future endeavours. The focus was on mapping what measures are used to assess the impact of patient portals on the four specific dimensions (patient, population, healthcare workforce, and health system perspectives) of the Quadruple Aim Framework, and what components from the Benefits Evaluation (BE) Framework were most commonly evaluated to measure impact.

Methods

A scoping review was conducted using the methodological framework of Arksey and O'Malley. Reporting was guided by Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews. A systematic and comprehensive search using the OVID platform, the following databases were searched: Ovid MEDLINE® ALL, including Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Embase, and PsycINFO. CINAHL on the Ebsco platform and Web of Science were also searched for studies published between 2015 and June 2020. A systematic grey literature search was conducted using the Google search engine in Edmonton, Alberta, Canada between February 13 and February 25, 2020. A data

extraction form was developed and reviewed to categorize the literature into themes and areas of interest, which varied by study type. Two frameworks for analysis were incorporated, the Quadruple Aim and the Canada Health Infoway's Benefits Evaluation Frameworks. Extracted data were tabulated based on a coding template developed to categorize the literature into themes and areas of interest, which varied by study type and QA perspective. Furthermore, the evaluated patient portal functions were mapped onto the Benefits Evaluation Framework. A descriptive, analytical approach was used to summarize the outcomes of the studies. In addition, a list of the various terms/outcomes/variables that were used to describe 'impact' was compiled.

Results

In total, 96 studies were included for data extraction. The studies were categorized based on the Quadruple Aim dimensions, with strict adherence to the definitions for each dimension(152,153). From the patient perspective, it was determined that most evaluations focused on benefits and barriers to access, access to test results, medication adherence, condition management, medical notes, and secure messaging. From the population perspective, the evaluations focused on increase in population outreach, decrease in disparities related to access of care services, and improvement in quality of care. From the healthcare workforce perspective, the evaluations focused on impact of patients accessing medical records, impact on workflow, impact of bi-directional secure messaging, and virtual care. From the health system perspective, the evaluations focused on decrease in no-show appointments, impact on office visits and telephone calls, impact on admission and readmission rates and emergency department visits, and impact on healthcare utilization. Altogether, 77 peer-reviewed studies were mapped on the expanded version of the BE Framework. The mapping was done by sub-dimension to create a more precise representation about the areas that are currently explored when studying patient portals. Most of the studies evaluated more than one sub-dimension.

Conclusions

Despite the extensive existing research in the area of patient portals, the evidence from this scoping review suggests that impact research is available, but it lacks multidimensionality. The Quadruple Aim and the Benefits Evaluation Frameworks provided guidance in identifying the gaps in the current literature by providing a way to show how impact was assessed. This review highlights the need to appropriately plan how impact will be assessed and how the findings will be translated into effective adaptations. If the how and what are not properly planned, the generalizability of patient portals studies will continue to elude researchers and implementation teams.

Introduction/Background

Electronic patient portals are secure websites tied to an institutional electronic health record system from which patients can view their medical information. These types of records are populated with a person’s lifetime health history. The information comes from various sources, including community clinics, hospitals, physicians, pharmacies, and laboratories. Many allow patients to view appointments, medical test results, and medication therapies, and communicate with their healthcare providers through a secure platform(3,4). Although evidence suggests that implementation of patient portals can have a positive impact on patient care and patient outcomes, many health systems have been slow to adopt them due to various concerns(5–8). Patients have expressed concerns about accessing and maintaining health information in a manner that is private and secure(4,9,10). As these portals are online tools, some worry that their data could be seen by other individuals and by insurance companies(11). Others have articulated concerns around optimal design and functionality(4). Furthermore, not all patients have access to a computer, smart phone or a tablet to access their record(12).

Health care providers have conveyed concerns about implementation, availability, and impact of portals on the patient-provider relationship. Physicians continue to be concerned that portals will increase their workload, without a mechanism for remuneration in fee-for-service models(13). In addition, there are some uncertainties around physician obligations with respect to portals use(11,13–16). Providers are concerned that this type of health technology will start replacing office visits and thus have an impact on the way care is provided(17). Another practice-related concern is the absence of transparency surrounding the provider’s role and accountabilities with respect to patient portals and protection of patient data(5).

For governments, the challenge of implementation of portals has been the upfront cost of establishing an effective and efficient system(16,18,19). Furthermore, studies show that the majority of health information technology investments are struggling to achieve the anticipated benefits(20–23).

Despite the continuing extensive research in this area, implementation and adoption of these systems continues to be a convoluted process. Although various reviews(24–33) have been conducted in this area recently, none have focused on the impact of patient portals within the context of the four specific dimensions of the Quadruple Aim (QA)(1). Second, the majority of published reviews have examined one characteristic, such as engagement, barriers and facilitators, outcomes, or communication and usually emphasize patients and/or healthcare providers. Thirdly, none have looked at which patient portal functions are most commonly used to evaluate impact based on the Canada Health Infoway's Benefits Evaluation (BE) Framework (34).

Two frameworks for analysis were incorporated, the QA and the BE Frameworks. The QA framework is a modification of the established Triple Aim Framework(2) of health care improvement, which focuses on evaluating three dimensions of care: improving the health of populations, improving the patient and caregiver experience, and reducing the per capita cost of health care. The Quadruple Aim(1) adds improving the work life of providers as the fourth dimension, providing a more comprehensive approach to the evaluation of health technology. Definitions for each of the QA dimensions were used to identify measures as they related to what is considered as significant to the patient (i.e. preferences, satisfaction, communication, access, engagement, use, etc.), population (i.e. equity, access, disparities, etc.), health system (i.e. costs, utilization, etc.), and health workforce (i.e. satisfaction, workload, preferences, etc.).

The BE Framework(34) as described and expanded by Lau et al(35) was used to organize measures from peer-reviewed studies. The BE Framework was introduced in 2006 by Canada Health Infoway to determine how evaluations might be conducted to capture and measure relevant indicators. The indicators are divided into eight categories (system quality, information quality, service quality, quality, access, productivity, followed by use and use satisfaction) and twenty sub-categories. Lau et al(35) in their review of systematic reviews, added patient and provider, implementation, and change/improvement as additional categories, which were incorporated in this scoping review.

The purpose of this review was to explore what is known about patient portal evaluations and provide recommendations for future endeavours. Specifically, it addressed the following research questions:

1. *How is the impact of patient portals measured, from the standpoint of the four specific dimensions (patients, population, healthcare workforce, and health system) of the Quadruple Aim Framework?*
2. *What components from the Benefits Evaluation Framework (as expanded by Lau et al* (35)*) are most commonly evaluated to measure impact?*

Methodology

A scoping review was conducted following the five steps identified by Arksey and O'Malley's(36): identifying the relevant research question, identifying the various relevant studies in this field, selecting studies, charting the data, and collating, summarizing and reporting the results. This type of review is recognized as particularly useful for exploring topics with inconsistencies in the current evidence, as it appropriately captures broad and ambiguous topics and approaches.

In this review, *impact* was defined as the "overall effects, direct or indirect, of a policy, strategy, programme or project"(in this case, patient portals)(37).

No ethics approval was sought or required for this study as it did not involve any human subject as it was only focused on reviewing the literature.

Data sources and searches

To capture the wide array of studies that may be relevant to this topic, all study designs were included. The gray literature search was developed to capture all relevant publications, such as government and evaluation reports. Publications that study the same intervention in the same set of patients were matched and classified as a single study.

The inclusion and the exclusion criteria are described in Table 11.

Table 11: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
• Studies with any defined impact and outcomes of tethered patient portals or personal health records • Studies with relevant impact and outcomes of tethered patient portals or personal health records	• Studies without any defined impact and outcomes of tethered patient portals or personal health records • Studies with no relevant impact and outcomes of tethered patient portals or personal health records • Studies describing impact and outcomes of untethered patient portals or personal health records • Non-English language • Documents published before the year 2015 • Abstracts • Commentaries • Opinions • Articles summarizing study findings • Clinical trials and clinical trial recruitment

With support from an experienced medical information specialist, a search strategy for peer-reviewed papers was developed and tested through an iterative process. Another senior information specialist peer reviewed the strategies prior to execution using the PRESS Checklist(38). Using the OVID platform, the following databases were searched: Ovid MEDLINE® ALL, including Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Embase, and PsycINFO. CINAHL on the Ebsco platform and Web of Science were also searched. All searches were performed on June 8, 2020. Strategies utilized a combination of controlled vocabulary (e.g., “Patient Portals”, “Electronic Health Records”, “Patient Access to Records”) and keywords (e.g., “health portal”, “EHR portal”, “ehealth patient access”). Vocabulary and syntax were adjusted across databases. Specific details regarding the strategies appear in Appendix 6. After removal of all duplicates, the total remaining number of articles was 34,128. Citations retrieved via the searches of electronic databases were imported to Covidence (https://www.covidence.org/home), a Cochrane-supported software designed for conducting reviews.

A systematic grey literature search was conducted using the Google search engine in Edmonton, Alberta, Canada between February 13 and February 25, 2020. The search term *patient portal* was combined with *impact* and/or *outcome*. The first 100 hits were considered from each combination. In addition, organizational web-sites of Canada Health Infoway, Canadian Agency for Drugs and Technologies in Health (CADTH), the National Institute for Health and Care Excellence (NICE), the International Network of Agencies for Health Technology Assessment (INAHTA), and the World Health Organization (WHO) were scanned. Finally, included articles' reference lists were hand searched.

Study selection

The relevance of retrieved studies was assessed using the inclusion criteria to ensure that they related to the topic of this review. All citations by titles and abstracts were reviewed. All articles that focused on topics other than patient portals or personal health records were eliminated. This left 2,259 articles, the titles and abstracts of which were screened independently by three researchers (MA, TS, and DM) who applied the inclusion and exclusion criteria. For quality assurance, 10% of the articles were reviewed by more than one researcher. No significant discrepancies were noted.

Potentially relevant citations were then retrieved and divided among the three researchers for screening using the same inclusion and exclusion criteria. Again, for quality assurance, 10% of the papers were reviewed by more than one researcher. No significant discrepancies were noted. Studies that focused on *untethered* patient portals or personal health records, were not available in English, or were conference abstracts, unpublished dissertations, opinions, or editorials were excluded.

Ten reviews (24–33) that fit the inclusion criteria were identified. References from each of the reviews were scanned and 58 articles that met the inclusion criteria were identified. Of them, 7 were reviewed and determined to be captured in studies already included.

Data extraction

As is customary in scoping reviews, an iterative approach was used to extract data from the selected studies. A data extraction form was developed and reviewed to categorize the literature into themes and areas of interest, which varied by study type. The following elements were considered, discussed, and incorporated in the data extraction form (tabular format): author/s, title, publication date, country, type of a source, study setting, research question/s, aim/s, data collection method/s, vendor, patient portal name, patient portal functions, deployment date, end date of project, type of an evaluation, number of patients impacted, number of staff impacted, intervention, control, length of follow up, benefit area, net benefit indicators, measure/s, definition of measure/s, tool/s used to measure, results/key themes identified in the study, identified success factor/s, identified challenge factor/s, identified recommendation/s, and other considerations/thoughts/notes.

The extraction form was piloted with several sources and any identified issues were corrected.

Quality assessment

Since scoping reviews include a broad range of information sources and topics, no critical appraisal of the quality of included papers was conducted. Although there are various suggested(39) approaches for accomplishing this, there is no consensus among experts in the field on this matter.

Data analysis and synthesis

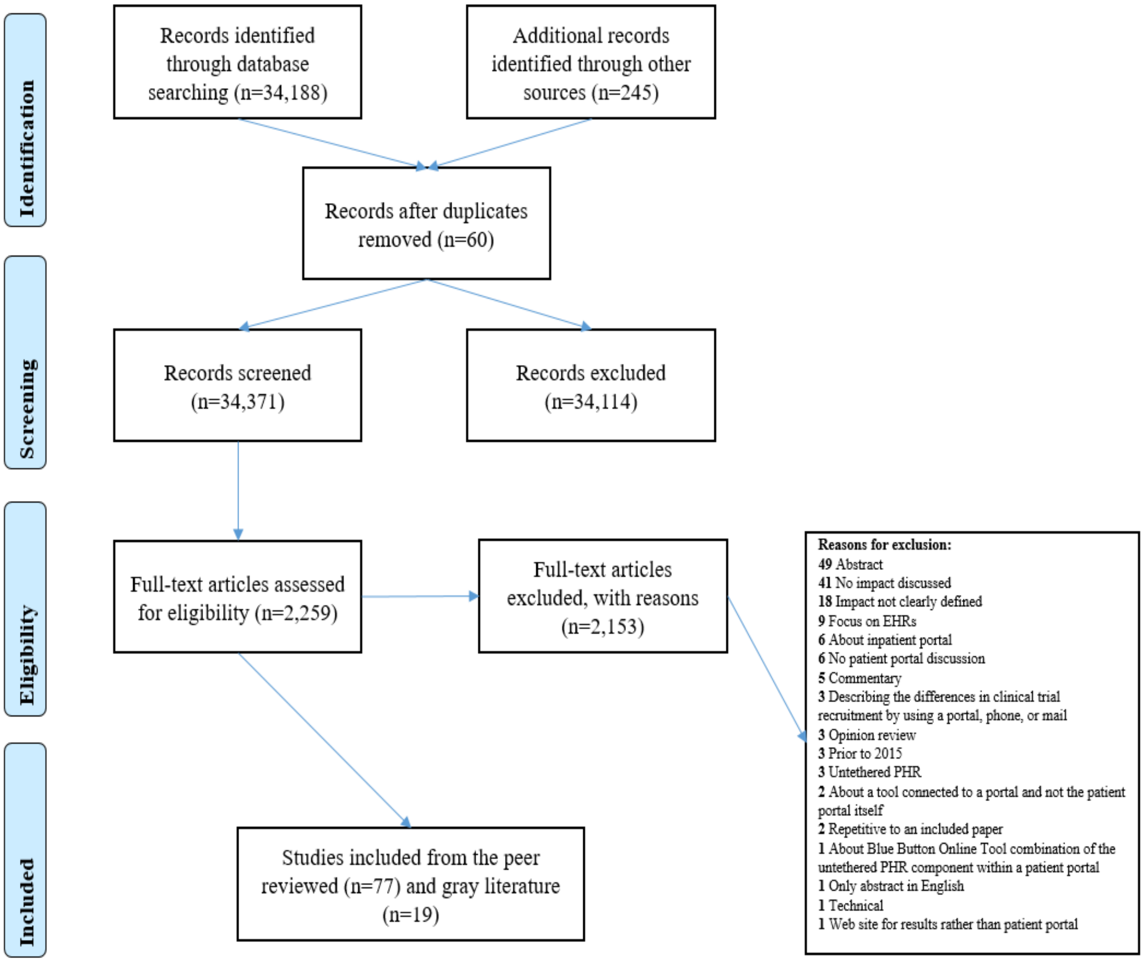
Extracted data were tabulated based on a coding template developed to categorize the literature into themes and areas of interest, which varied by study type and QA perspective. The studies were categorized based on the QA dimensions, with strict adherence to the definitions for each dimension(1,2). Furthermore, the evaluated patient portal functions were mapped onto the BE Framework(34,35). A descriptive, analytical approach was used to summarize the outcomes of the studies. In addition, a list of the various terms/outcomes/variables that were used to describe 'impact' was compiled.

Results

Results of the literature search

A total of 34,371 citations were identified through the peer-reviewed and gray literature searches. From these, 241 citations were considered for full text review. In total, 96 studies were included for data extraction. The search strategy results are described using the PRISMA flow diagram as shown in Figure 11.

Figure 11: PRISMA



Overall description of included studies

The 96 included studies employed a variety of methods ((mixed n=21, prospective n=8, qualitative n=12, RCT n=3, retrospective n=25 and survey n=27). They were conducted between 2015 and 2020 (2015 n=21; 2016 n=25; 2017 n=14; 2018 n=15; 2019 n=13; and 2020 n=8) in Australia (n=2), Canada (n=21), China (n=1), Finland (n=1), Netherlands (n=2), Norway (n=1), Spain (n=1), Sweden (n=6), United Kingdom (n=1), and United States (n=60). Although not all studies specified a clinical problem, most related to cardiology procedures and conditions, depression, PTSD, HIV, substance use disorder, anxiety, schizophrenia, neurological issues, pregnancy, and diabetes. A summary of included studies is captured in Table 12.

Thirty-two peer reviewed studies(40–71) evaluated the patient portal in general, with all available functions. Secure messaging and medical notes (OpenNotes) were the most commonly evaluated individual portal functions (eleven studies each). Five studies assessed multiple functions, such as secure messaging and refills or secure messaging and medication reminders. The gray literature studies evaluated the patient portal, in general, as their focus was on appraising various identified net benefit areas (i.e. quality, access, system use, etc.), and patient and provider satisfaction with the available functions.

Quadruple Aim Dimensions

The following sections summarize the studies according to the QA dimensions (Tables 13, 14, 15, and 16).

Patient perspective

The patient perspective was explored in 44 peer-reviewed(45,47,61,63,66,68–70,72–75,48,76–85,50,86–95,53,96–99,54–56,58,60) and 15 gray literature (100–114) studies. Several methods (mixed n=12, observational n=5, qualitative n=5, randomized controlled trial n=1, retrospective n=14, and survey n=22) were applied to gain insights from patients through surveys, interviews, focus groups, and administrative data. From the 59 studies, 35 were from the United States, 17 from Canada, 2 from the Netherlands, and one study from Australia, China, Norway, Sweden, and the United Kingdom. The studies usually explored the impact of the patient portal in, general, with only a few focusing on various portal functions, such as test results, medical notes (OpenNotes), secure messaging, and/or prescription refills.

Benefits of access

Many of the studies (61,69,106,114,77,80,82,100–104) explored patient experiences with access to patient portals and subsequently access to their own medical information. All of the studies reported that users were highly satisfied with the access, and in one study, 97% of survey respondents stated that they would definitely or probably recommend the portal to other clients and families(102).

Moll et al observed that patients considered access to information as a means of patient empowerment and involvement(50). This was also observed by Crouch et al, who found that the use of the portal was associated with significantly higher levels of patient activation and levels of patient satisfaction around timely appointments, care, and information(63). In addition, studies found that if the healthcare provider encouraged access, the likelihood of the patient enrolling and using the service was much greater(55,69,73).

Reed et al found that 9 of 10 patients believed the portal improved their health care convenience(53). In addition, access to the information allowed for better engagement of patients with providers, since they had more knowledge about their health(54). Furthermore, the information eliminated the time pressure felt during short appointments(54). A different study reported that 28% of patients/families avoided making a telephone call to a healthcare provider because they could access health information electronically(103). Convenience was also noted in the findings of another study, in which 27.2% of patients reported savings in terms of time to travel, time off work, gas and parking(56). In Graham et al, 48% of users reported avoiding a clinic visit and 2.7% avoided an emergency department visit(70). Convenience was also described due to the ability to make appointments online rather than by calling the office(111). In another study, 27.4% of patients indicated that they have used the patient portal at least once to request an appointment with a primary care provider rather than make a telephone call(106). Access to patient portal information decreased stress levels due to appointment preparedness(106). One study reported that 40% of respondents found the portal useful, as it allowed them to plan and follow up on upcoming appointments(60). In another study, 60% of respondents felt the portal had resulted in an increased sense of partnership with their health care provider, compared to 50% of respondents who felt the portal had positively impacted their relationship with their healthcare provider(114).

Although most of the studies reported positive impact due to portal access, one study found little evidence that the portal led to feelings of greater involvement in the care process, improved ability to express concerns to providers or enhanced relationships with providers, or reduced number of in-person visits(47).

Barriers to access

Several studies described patient-reported barriers to access of patient portals(60,73,113). These barriers were related to privacy, security, and technical difficulties when patients attempted to enroll or use the patient portal. Giardina et al found that 52.6% of the participants wanted portal improvements in terms of display, usability, and notifications(73). Approximately 24% of patients had higher expectations based on their idea of what functionalities a patient portal should provide, while 22% experienced usability problems(60). Another study found low user adoption was due to technical issues experienced by patients during enrollment. Patients were unwilling to spend extra time to find solutions, and eventually abandoned the creation of an account(113).

Access to tests results

The most commonly used portal function was the access to laboratory or diagnostic test results. The studies assessing this function concluded that the impact was multifaceted, providing patients with convenience, knowledge, tracking of information, decreased anxiety, and the need for fewer appointments(50,54,61,73,77,83,97,105,108,111). Visual indications were used to determine if tests results were normal or abnormal (i.e. green or red colour). Patients described lab results as the most important information for them to access. Getting real time information of lab tests before appointments led to increased awareness about personal health. A study found that availability of radiology reports online was associated with increased patient use of the system, with a likelihood ratio of 2.63(97). The rates of lab test-related anxiety were low. Another study found that 68.41% wanted access to new information the same day or after a day, while the remaining patients were willing to wait anytime between 2 weeks to 1 month, depending on the type of test(50).

Although access to test results was described as the most appreciated function, several studies found that it led to concerns. Two studies(73,77) addressed the concern of the inability for patients to completely understand the laboratory or diagnostic test results in their medical record. Both studies found that patients did not feel healthcare providers gave sufficient information when commenting on results. In Giardina et al, 63.2% of the participants reported that their physician did not include a note explaining the result(73). Most often, the medical terminology used to describe the test results led to the inability to interpret if they were normal or abnormal. The problem of not understanding results led to apprehension and anxiety until the patient was able to connect with their provider and obtain clarification(73,77). A study found that one of every six patients who had MRI or CT scans reported a clear understanding of their results when first receiving them through the portal(83). Patients wanted to receive all their results, even abnormal, but they needed more timely notifications and guidance by their provider in interpreting the them(90). However, some patients preferred that potentially concerning test results be verbally communicated by a health care professional(90).

Medication adherence

Several studies explored the correlation between patient portal use and medication adherence due to online reminders for refills and requests for prescription renewals(66,81,85,86,89,94,104,111,114). A study found that once new users were given mobile access to the portal, there was a statistically significant improvement in adherence to oral diabetes drugs and lower glycemic levels(81). These improvements were greater among patients with higher clinical need at baseline (HbA1c level >8%), and more modest but still statistically significantly better among patients with lower initial glycemic levels(81). Wright et al found that adherence to antihypertensive medications increased if patients had access to their progress notes(86). The secure messaging functions had a similar effect on the likelihood of achieving HbA1c control, as patients who only read email also had significantly ($P<0.05$) lower mean HbA1c values compared to nonusers(66). Similarly, another study observed that secure messages had the greatest impact on diabetes medical management considerations in terms of HbA1c test completed or missed therapy intervention(96).

One study found small, statistically significant, meaningful improvements in physiological measures among diabetic patients who initiated and sustained use of refills through the patient portal(94). The refills function, in combination with secure messaging, had a greater impact on HbA1c levels. Another study observed stable refill adherence over time among portal users, compared with small declines among non-users(85). Satisfaction with the refill portal function was high, as 69% would recommend the e-Refill requests to other patients, family or friends and 63% would request all or most of their prescription refills electronically(104). Furthermore, a Canada-wide survey found that when prescriptions were lost or damaged, 17% of patients decided to go without the medication(111). Consequently, portals were determined to be effective as a tool to update medication lists and had the potential to augment the existing phone-based medication update process(89).

Condition management

Patients described the portal access as a way to monitor their conditions and be more proactive in their care. The severity of the disease predisposed the level of use(55). A study that measured the acceptability and clinical outcomes of portal in parents of children with moderate or severe asthma, observed that parents used the portal as a decision-support tool that allowed for improved knowledge about the condition(68). The more severe the child's condition, the higher acceptance and usage of the portal(68). Crouch et al concluded that higher portal use was associated with positive clinical and behavioural characteristics related to management of chronic conditions(63). A study found that access to portal added value in the received care during pregnancies(69). Broman et al found portal use was effective in the postoperative care and follow up(87). Another study described that 88% of survey respondents reported that portal access allowed for better health management(114).

However, a few studies found that portal use did not enhance patient's experiences. Two thirds of persistent users responded that they did not feel the portal supports them in most lifestyle choices(55). A study observed that portal use among patients with chronic conditions enrolled in a care coordination program did not demonstrate a statistically significant improvement in self-efficacy and perception of health status(58).

Medical notes

Access to medical notes (usually referred as OpenNotes in the literature) through patient portals was another component of several studies. A study found that almost all patients described enhanced comprehension about their disease and care due to access to the clinicians' notes, as the notes refreshed their memory and clarified their understanding of visits(74). Patients reported that the medical notes eased their uncertainty, relieved anxiety, and facilitated control(74). Denneson et al found that reading OpenNotes helped 49% of patients to feel very to extremely in control of their health care(75). Another study observed that access to notes increased patient trust toward their healthcare providers(92). Notes provided a way for patients to learn about their condition, but also check for any inaccuracies, and made face-to-face time more effective(72). Higher levels of reading notes were associated with higher shared-decision making levels(78). A study observed that patients who read 4+ notes were 15% more likely to have high scores for clinician effort in helping them understand health issues and 16% more likely for clinician effort in including them in the plan of care(78). The study concluded that there was a strong correlation between shared decision making and the transparency OpenNotes provided. A similar finding was observed by Walker et al who found that transparency through notes helped patients feel more engaged in their care(79).

Caregivers found access to clinicians' notes valuable. A study found that 55% of caregivers reported reading notes helped them to remember to get the patient's tests done, and 92.3% reported reading notes helped them understand the reason for the patient's referral to a specialist(76). The same study found that caregiver access to notes had little to no negative impact on caregiver-provider relationships(76). Wolff et al found that 35.5% of caregivers viewed doctor notes because they were unable to attend the visit(98).

For a subset of patients, access to the medical notes increased their anxiety levels(74). One study found that 26% of the patents experienced stress or worry sometimes, while 8% reported often or always(75). It also reported that 18% of patients felt upset sometimes after reading their notes, compared to 8% who reported often or always. Furthermore, race and ethnicity impacted levels of access to the notes. Minorities and patients with a lower socio-economic status accessed notes in lower rates, compared to whites and high socio-economic status(93).

Secure messaging

The secure messaging function was most commonly used to request clarification, ask condition-related questions, or inform providers and/or patients about any health changes(99). Secure messages were described as a tool to recognise and decrease any gaps in care(96). A study found that secure messaging allowed for efficient bidirectional radiologist-patient communication(97). Haun et al noted that majority of the respondents used secure messaging at least once a year, and less than 15% reported never using secure messaging(88). The same study observed that patients were satisfied with secure messaging, as it provided a safe and secure communication tool that was easy to use and saved time(88). Another study found that patients reliably read messages sent by their physicians and the rate of unread messages was 3.1% at 21 days(84). Furthermore, secure messaging improved management of clinical outcomes. Petullo et al found that active secure messaging use was associated with a 0.156% lower HbA1c compared with inactive patients ($P = 0.0002$), and a 0.263% lower HbA1c compared with active nonusers

(P<0.0001)(95). Similar rates were observed by Devkota et al, in which patients who read and wrote e-mails had significantly (P<0.001) lower average HbA1c values compared to nonusers(66). A study observed that patients who used the portal, compared with nonusers, were 24% more likely to achieve blood pressure control; however, after adjusting for sociodemographic factors, this association was no longer present due to low rates of portal use among minorities and disadvantaged patients(48).

The main barrier for the use of secure messaging was the unresponsiveness of healthcare providers to the messages sent by patients, which led to increased rates of telephone calls(60).

Population perspective

Enhancing population health through decreasing disparities and elevating access to needed health services was explored in five peer-reviewed(44,115–118) and eight gray literature(100,104–106,108,111,114,119) studies. The outcomes were evaluated through various methods, including randomized controlled trials (n=2), retrospective observational (n=2), qualitative (n=1), mixed (n=6), and cross-sectional surveys (n=2). One study was from Australia, five were from the United States, and seven were from Canada. Surveys, interviews, and focus groups, in addition to EHR and portal data were the most common sources of data. The studies analyzed the capacity of patient portals to increase vaccination rates, equity in access to timely care, and population empowerment.

Increase in population outreach

The RCTs examined the effectiveness of patient portals in improving rates of influenza vaccination(115,117). Although influenza infections have the potential to lead to serious health issues and increased access to healthcare services, vaccination rates continue to be low, necessitating the need for innovative outreach interventions to remind and encourage citizens to get the shot. As EHRs deliver real-time data identification, tethered patient portals were seen to have the potential to identify unvaccinated populations and enable implementation of portal-based cost-effective interventions. Cutrona et al found a small but statistically significant improvement in completion of influenza vaccination among portal users, especially by patients who opened reminder messages sent though the portal(115). Although a very small proportion (0.3%) of patients accessed the various influenza educational materials, Szilagyi et al established a correlation between the higher number of reminders and higher vaccination rates by portal users(117). The portal reminders had a small, statistically significant effect on increasing rates among adults aged 18 to 64 years, male patients, non-Hispanic patients, and those not vaccinated in the prior 2 years.

Decrease in disparities related to access of care services

Foster et al found that there were existing disparities between patient groups related to healthcare information access in emergency departments(118). African Americans and Hispanics had the lowest portal use rates, which led to disparities in medical information access. In their retrospective study, Lyles et al reported a significant improvement in statin adherence regardless of race and ethnicity once patients increased portal use(116). The authors concluded that portal use had the potential to improve various health behaviours. Similarly, another study found that due to the ability to request and received prescription renewals through a portal, patients did not need to travel, arrange care, or take time off work, which increased medication adherence and decreased wait time (74%)(104). Another study concluded that “if only affluent, well-educated patients can access portals and understand them, then these technologies could potentially worsen health disparities", as one of the factors contributing to disparities in access were the decisions by providers to selectively offer access(100).

Improvement in quality of care

Two studies captured experiences of users who acknowledged that portals improved their quality of care and the ability to manage care due to information access(44,114). However, due to low uptake by healthcare providers, they were uninformed about the portal. Two additional studies reported that Canadians felt more engaged and active, since the portal allowed them to have more informed discussions with their doctor(111,119). Two evaluations found access to health information contributed toward easier access to services and acted as an *expansion of the standard 15 minute consultation appointment*(105,106). These studies demonstrated a readiness and willingness of patients to be more engaged in their health care. However, some apprehension was experienced, which could be elucidated by the *empowerment effect* related to online access to results and related information(108).

Healthcare workforce

Eighteen studies(40,41,82,87,120–125,42,43,46,47,49,52,57,59) and three reports(106,126,127) addressed the healthcare workforce perspective through various methods (mixed methods n=7, prospective observational n=2, qualitative n=6, and surveys n=6), with the focus on conducting formative and process evaluations. Eleven studies were conducted in the United States, five in Sweden, four in Canada, and one in China. They explored healthcare provider experience with patient access to medical records, laboratory and diagnostic results, secure messaging, and uploading of images and symptoms. To gather data, focus group/s, semi-structured interviews, and survey/s were used. Many of the studies used combination of different data collection methods.

Impact of patients accessing medical records

While healthcare providers generally agreed with the idea of patients having access to their information, they expressed concerns around patients' understanding of the information contained in the medical record, especially access to laboratory or diagnostic test results(42,43,49,57,121,125). One study reported an increase in the volume of inquiries and appointments due to patients not understanding the information. Another study found that providers had to spend more time reassuring patients after they read their record and medical notes(46). A different study found that the majority of both physicians and nurses believed medical notes were confusing for patients, which had led to worry and increased contact between providers and patients(49). With the intent to decrease patient confusion, few studies reflected on the aspect that portals had shifted how charting was done within the settings that offered access (46,52,59).

Many of the studies concluded that the healthcare workforce had a direct impact on portal adoption and utilization by patients(47,59,82,126). While paper access to the medical record had always been obtainable and not seen as contentious, real-time access had been associated with concerns about privacy and security, and had led to discontent and low uptake by providers(120,123,124).

Only one study documented increased levels of threats and violence reported by staff from patients with access to their health records(40). Staff reported that this was due to disagreement with the information in the medical record; however, the authors did not find increased incidents(40).

Impact on workflow

Another concern was the workflow impact due to portal implementation. In one study, participating providers indicated that the portal implementation did not have a negative impact on their salary, but 43% of the same participants believed that the portal increased their workload(41). Similar findings were presented by Cajander et al, as the nurses in the study described how patients called and sent messages for the same question, which led to increased workload due to duplication of services(52). Furthermore, patients came prepared with more informed questions which led to "more in-depth discussions" that took additional unplanned appointment time(52).

Another study captured the experiences of providers, who described cases in which patients contacted them for abnormalities that were clinically insignificant, therefore increasing the workload(125). Vydra et al compared provider reported time dedicated to portal-related duties with the administrative data captured by the system, as providers in their study reported spending an average of 12.5 hours per week logged into the portal; however, institutional records indicated an average of 8.2 hours per week(59).

Impact of bi-directional secure messaging

Several studies captured apprehensions of providers due to the secure messaging(122,124). In these studies, healthcare providers articulated the lack of clarity around appropriate ways to communicate via a portal as patients had expectations to receive immediate responses to their inquires(124). Lieu et al reported provider anxiety due to the lack of volume restrictions on electronic messages and their coping strategies to timing their responses to patient messages(122). Another study found messaging increased work outside normal work hours(106). A Canadian study found that providers considered to be early adopters indicated secure messaging improved the communication and interactions between themselves and their patients(106).

Virtual care

One study reported that patient portals were effective for post-operative care, as patients uploaded images instead scheduling face-to-face visits(87). In this study, surgeons reported that online and clinic visits were equally effective for 68% of patients.

Health system perspective (Reduce the per capita cost of health care)

The health system perspective was explored by 15 peer-reviewed(51,58,62,64,65,67,70,71,128–134) and 3 gray literature(111,114,135), which focused on the impact of patient portals on the potential for reducing costs. The studies varied in data collection approaches (prospective observational n=4, retrospective observational n=9, survey methods n=2, and mixed methods n=3), and the evaluated portal components (portal in general n=11, viewing laboratory results n=1, OpenNotes n=1, secure messaging n=4, appointments n=2, and care plan n=1). Fourteen studies were from the United States, and there was one from Spain, Finland, and Canada. In all studies, EHR administrative data were utilized to compare pre and post intervention inputs and outputs. In addition to the EHR, portal administrative data, workbench, interviews, charts, and tools that measured patient activation, quality of life, self-efficacy, and experience were applied. The studies explored whether implementation and subsequent adoption of a patient portal reduced costs in the evaluated areas. The included studies also explored whether patient portal use led to a decrease in 30-day all-cause readmission rates, clinical services utilization, no-show appointments, and the number of traditional encounters (office visits and telephone calls).

Decrease in no-show appointments

Studies evaluating the possible impact of patient portals on no-show appointments compared the pre-post no-show appointment rates and established that portal users had a lower rate of no-show appointments compared to non-users; however, there was no difference in appointment cancelation rates(62,64,70,128,134). Mendel et al found portal enrollment increased once the clinic staff promoted the portal as a tool for appointment reminders, which was also associated with increased patient satisfaction(128). However, once the portal started experiencing technical glitches, the decrease was maintained only for a short period of time. Zhong et al found that no-show rates for portal users were 30% less than for non-users, and frequent users of secure messaging and viewing laboratory tests functions had the largest reduction in no-show rates(62). Similar findings were captured by Graham et al, who found a 53% relative reduction in no-show appointments in the clinics that piloted a patient portal(70), and Ontario Shores Centre for Mental Health Sciences showed portal users missed 18% of total appointments compared to non-portal users, who missed 20% of total appointments(135).

Impact on office visits and telephone calls

Several studies(130–133) evaluated the impact of secure messaging on office visits, telephone rates, and hospital readmissions. These studies had similar findings regardless of the applied methodology. Dexter et al hypothesised that an increase in secure messaging use would decrease telephone call rates; however, the authors found that as messages increased so did the number of telephone calls to the clinics(130). Similarly, Bryan et al found patients who sent more messages had higher clinical and phone encounters than those who did not send any(131). This impacted the workflow and the ability of care settings to handle the influx of visits and calls. Plate et al demonstrated that if patients sent >2 messages and the clinic response rate was <75%, this significantly increased 90-day readmissions and 90-day emergency department visits(133).

Impact on admission and readmission rates and emergency department visits

Four studies(51,58,67,71) evaluated if patient portals had the capacity to decrease readmission rates, emergency department visits, and hospital admissions. Nicolas et al found a decrease in the rate of hospital admissions (5.28/10,000 per year) and 30-day all-cause readmissions (5.20/10,000 per year), while no increase in outpatient visit rates in the post-intervention period of the portal implementation(51). Similarly, Sorondo et al concluded that there was a decrease in emergency department visits by at least 21%/1000 and hospital admission rates by at least 38%/1000(58). While Nicolas et al(51) and Sorondo et al(58) found a decrease, Dumitrascu et al(67) and Griffin et al(71) concluded that portals users were associated with higher use of medical services and higher hospital readmissions.

Impact on healthcare utilization

Four studies examined whether increased portal use decreased care utilization. Leveille et al(129) could not find any correlation between viewing medical notes and the number of appointments, while Zhou et al (65) concluded that viewing laboratory test results led to increased clinic visits and telephone calls. In their study, eHealth Saskatchewan reported the number of primary care visits decreased due to patients using the portal(114). This was also found in patient self-reported surveys. In their report, Canada Health Infoway reported an increase in e-visits due to patients having access to technologies providing e-service opportunities(111).

Mapping according the Benefits Evaluation Framework

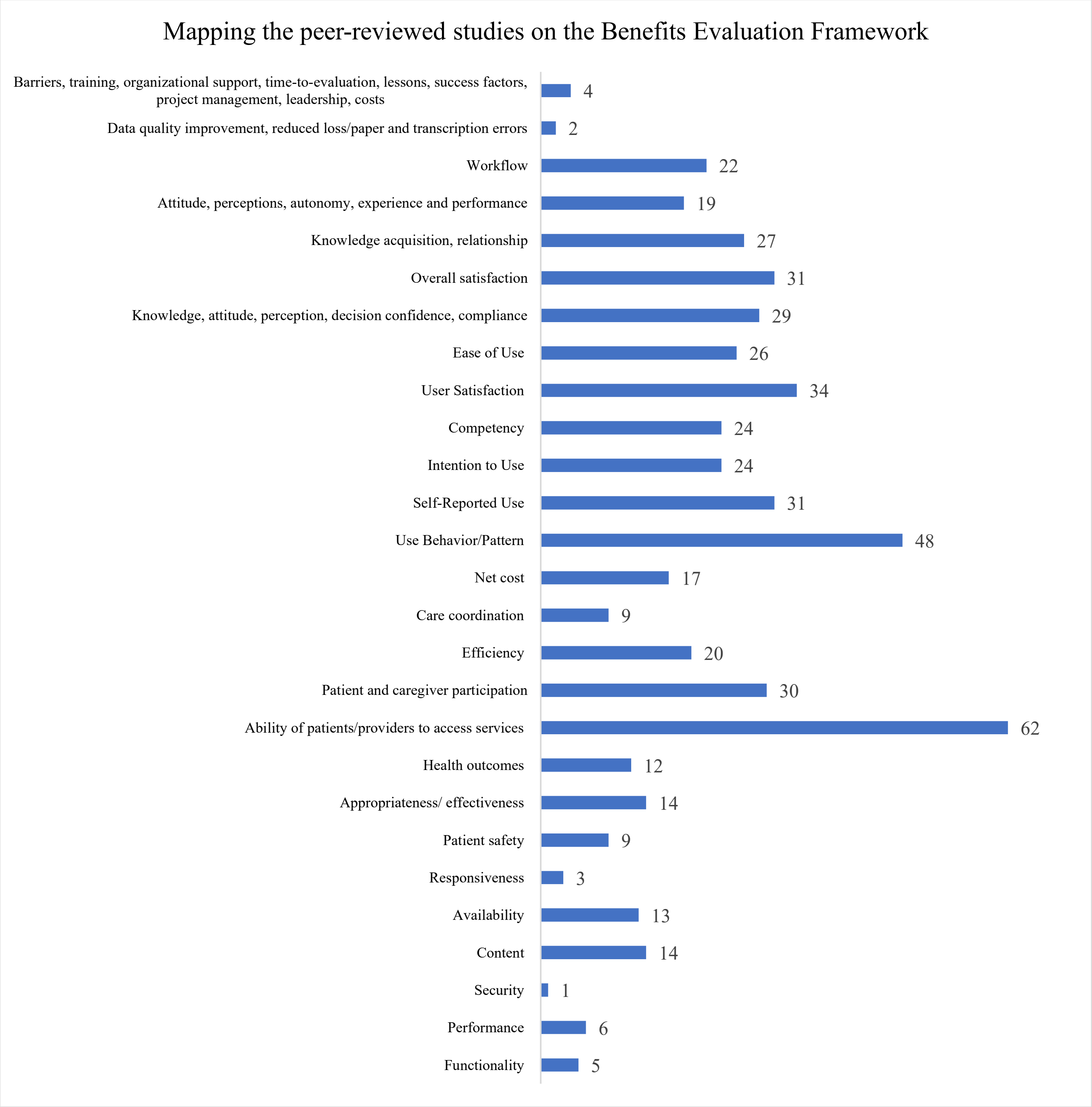
Altogether, 77 peer-reviewed studies were mapped on the expanded version of the BE Framework. The mapping was done by sub-dimension to create a more precise representation about the areas that are currently explored when studying patient portals. Most of the studies evaluated more than one sub-dimension. An overview of the number of studies per sub-dimension is shown in Figure 12. The numbers for each sub-dimension represent the number of studies that addressed the particular component.

The authors of 48 out of the 77 studies explored the 'ability of patient and providers to access services', followed by 'use behaviour/pattern'(n=48), 'user satisfaction' (n=34), 'self-reported use' (n=31), 'patient/caregiver participation' (n=30), 'knowledge, attitude, perception, decision confidence, compliance' (n=29), and 'ease of use' (n=26).

The least measured changes related to 'security' (n=1), 'data quality improvement, reduced loss/paper and transcription errors' (n=2), 'responsiveness' (n=3), 'barriers, training, organizational support, time-to-evaluation, lessons, success factors, project management, leadership, costs' (n=4), 'functionality' (n=5), and 'performance' (n=6).

Detailed mapping of each study per BE Framework sub-dimension is presented in Table 17.

Figure 12: Overview the Benefits Evaluation Framework sub-dimensions



Conclusion

As described in the sections above, the most commonly evaluated QA dimension was the patient perspective and the least evaluated was the population perspective. Although the peer-reviewed studies did not utilize the BE Framework as a directing framework, it was possible to extrapolate the studied areas and juxtapose them on the BE Framework sub-dimension.

Summary of the literature gaps and recommendations

The implementation of technologies such as patient portals is a convoluted process with ambiguous returns on investment. Frequently implementation planning is intertwined with optimism related to ‘if we offer it, they will come’; however, the current realities show that the planning and implementation stages are based on very little preparation related to visualizing the identified need for the technology and the issues that is trying to amend. Based on the results from this scoping review, several gaps in the literature were identified. For each documented gap, summary recommendations are provided on how to improve measuring impact of patient portals based on the QA and BE Frameworks.

Lack of studies with multidimensional impact evaluation strategies

Although this review was based on comprehensive inclusion criteria, there were no peer-reviewed or non-peer reviewed studies that measured impact based on all dimensions from the QA or the BE Frameworks. Even though several reports describing the use of the BE Framework were included, indicators and outcomes measured still focused on certain dimensions of the frameworks rather than most or all dimensions. From the 96 included studies, the most evaluated number of dimensions was two. In the gray literature, however, studies often evaluated three of the four dimensions. When applying the same mapping process to included studies through the extended version of the BE Framework(35), the greatest number of evaluated dimensions was 9 (123,125).

Multidimensional evaluation strategies require that research studies capture the patient experience (i.e. patient satisfaction, patient engagement, convenience of care, care plan compliance, patient-to-care team ratio, and access to care), which is related to the population experience (i.e. improved health outcomes, compliance with standards of care, insight about population health, and quality of life, while reduced complications, mortality rate, hospital admissions, and emergency department visits). As patient and population experiences are interconnected with the healthcare provider experience (i.e. reduced redundant tasks, burnout, and turnover rate while improved resource utilization, satisfaction, and provider-patient relationship), they also need to be measured, as does the health system experience (i.e. reduced cancellations, staff costs, cost per patient, costs due to readmission and emergency department visits, length of hospital stay while developing improved opportunities for reimbursements). These outcomes also fit within the BE Framework; however, measures of the impact in terms of system quality (i.e. functionality, performance, and security), information quality (i.e. content and availability), and service quality (i.e. responsiveness) need to be developed and added.

Lack of studies based on suitable methodology and sample size to evaluate patient portal technology

A substantial gap in the literature was the lack of prospective longitudinal studies with large samples. There were a few prospective studies(47,58,85) that followed patients between 7 and 12 months, but the sample sizes were small (between 20 to 94 participants). Nearly all studies that evaluated the patient perspective acknowledged that the study samples were made up of early adopters and individuals from the higher socio-economic spectrum. Study limitations were in low study response and participation rates, the lack of ethnically and racially diverse participants, and the lack of non-users (patients and providers) perspectives.

Surveys used to measure satisfaction were ‘newly-developed’ or ‘developed based on previous studies’, and thus there was little evidence of reliability and validity(136).

In addition, during the review of the included studies, there were inconsistencies between terms such as ‘indicator/s’, ‘outcome/s’, ‘measure/s’, ‘tool/s’ and ‘net benefit/s’ as they relate to measuring patient portal impact. While many studies used BE Framework terminology, the concepts were applied in different ways.

Longitudinal studies of the impact of patient portals on patients would provide more real-world data about how users of portals interact and what potentially meaningful changes are needed. These types of studies could provide evidence about cause-and-effect relationships, which remain minimally explored from the standpoint of portal use and quality of care, satisfaction, communication, and health outcomes. Size and diversity in the patient and provider samples are key to envisaging solutions that would lead to use and eventually improved value-based care. In addition, using validated surveys would ensure that the right things are measure correctly. Measuring satisfaction with technology needs to encompass elements such as preference, proficiency, and performance.

Lack of recognition and evidence utilization from organizational and health system level internal impact evaluations of patient portals

During the gray literature search, many organizational and health system patient portal evaluation reports were identified. However, when efforts were made to find the corresponding peer-reviewed publications, none were found. As these benefits evaluation reports (all from Canadian jurisdictions) measured the impact in several BE Framework dimensions, it would be helpful for these studies and their findings to be acquired through peer-reviewed journals. Such publications would provide evidence on how to evaluate patient portal impact and would be shared more extensively. Furthermore, real-world impact evaluations would guide investigators in directing research that is deemed important by organizations and systems that implement health information technologies.

Lack of operative recommendations based on study findings

Frequently, findings were not followed up by concrete recommendations as to what was needed to rectify the documented obstacles. For example, patient and provider satisfaction were considered important outcomes and measured through interviews and/or surveys; however, by stating that patients reported high satisfaction or providers reported low satisfaction, the studies did not elaborate on what the satisfaction levels meant in terms of changes or modifications. Are measures such as medium-to-high or high satisfaction enough to conclude that the evaluated patient portal was effective and should be maintained? Through this scoping review, the evidence showed that suggestions for change were based on technical or user change (i.e. accessibility or increased provider use). The current evidence warrants recommendation for changes that can be effectively implemented and evaluated, but require system change.

Lack of use of patient self-reported health outcomes

Only one study(58) reported on using a patient self-reported health outcome tool (EQ VAS). Despite studies(45,63,66,68,96) showing correlations between chronic conditions, medication adherence and use of patient portals, there is a lack of application and use of patient self-reported health outcome tools in patient portal studies that measure impact(137). Patient self-reported outcomes have the capacity to improve the quality of patient care, but they are very difficult to measure or capture through interviews. These types of outcome tools are cost-effective and can easily be integrated within the patient portal structure. As patient portals are implemented in diverse settings, use of these types of tools would provide the ability to determine the unique threshold levels and plan for patient portal intervention strategies that would be more effective and more appropriate for each setting. Measuring patient portal impact by incorporating patient self-reported health outcome tools would allow for condition-specific portal enhancements with the possibility of increased adoption and usage.

Limitations

This scoping review included some literature that was not-peer reviewed and the strength of the evidence in these studies was not evaluated. The authors did not contact any research experts to help identify other grey literature. Second, only English language articles were included, which limited the databases and search terms used. For this reason, although a large number of citations were included, some relevant articles may have been missed. Third, as customary, scoping reviews do not quantitatively synthesize the findings, and so statistical conclusions may be drawn from the results regarding effects, statistical significance or bias evaluation. Finally, study screening and selection is a subjective process. Although, high level of agreement was achieved, there was a reliance on judgment to include and exclude studies.

Conclusion

Despite the extensive and existing research in the area of patient portals, the evidence from this scoping review suggests that impact research is available, but it lacks multidimensionality. The Quadruple Aim and the Benefits Evaluation Frameworks provided guidance in identifying the gaps in the current literature by providing a way to show how impact was assessed. This review highlights the need to appropriately plan how impact will be assessed and how the findings will be translated into effective adaptations. If the how and what are not properly planned, the generalizability of patient portals studies will continue to elude researchers and implementation teams.

Table 12: Synthesis of included studies

Author/s	Title	Publication Year	Country	Study design	Aim
Agency for Healthcare Research and Quality	A National Web Conference on Effective Design and Use of Patient Portals and their Impact on Patient-Centered Care	2017	United States	Mixed method	To present evidence on the implementation of effective patient portals.
Akerstedt et al	On threats and violence for staff and patient accessible electronic health records	2018	Sweden	Survey method	To explore the possible of violence toward stuff due to patient access to their medical records.
Barrie Community Health Link	Project Review and Benefits Evaluation Final Report Consumer Health Solution for Patient and Provider Communication	2016	Canada	Mixed method	To understand the relationship with a chosen solution, the adoption of that solution, and the resulting impacts.
Brohman et al	Community Paramedicine Remote Patient Monitoring (CPRPM): Benefits Evaluation & Lessons Learned	2015	Canada	Mixed method	To describe the findings from a home-based remote patient monitoring system that transmitted data about a patient's health status from home to healthcare providers through the patient use of portal.
Bryan et al	Resource Utilization Among Portal Users Who Send Messages: A Retrospective Cohort Study	2020	United States	Retrospective method	To investigate the impact of secure messaging on office visits and telephone calls.
Bush et al	Physician Perception of the Role of the Patient Portal in Pediatric Health	2017	United States	Mixed method	To gain insights about physician perceptions regarding the importance of patient portals in the pediatric environment.
Cajander et al	Medical Records Online for Patients and Effects on the Work Environment of Nurses	2018	Sweden	Qualitative method	To gain insight in the perceptions of nurses about the impact of personal health records on their work.
Canada Health Infoway	Access to Digital Health Services 2019 Survey of Canadians Summary Report	2019	Canada	Survey method	To present the results of a survey about use and citizen interest in accessing their health information online and digitally enabled health services.

Canada Health Infoway	Annual Report 2018-2019 A new day in health care is coming.	2019	Canada	Survey method	To describe the activities undertaken by Canada Health Infoway.
Canada Health Infoway	Environmental Scan: Processes to enable adolescent access to personal health records	2016	Canada	Mixed method	To describe how adolescent access to digital health information is implemented.
Canada Health Infoway	Backgrounder - Positive Patient Experience Yields Health Care Benefits	2017	Canada	Survey method	To report the use and interest of citizens in accessing health information online.
Canada Health Infoway	Understanding the Current State of Patient Provided Digital Health Information (Know Me)	2015	Canada	Mixed method	To gain understanding about what information patients are sharing (or want to share) with their health care providers that would contribute to providers' understanding of who they are as people, beyond who they are as patients.
Canada Health Infoway	Valuing Canadians' secure access to their health information and digital health eservices	2018	Canada	Qualitative method	Synthesize outcomes generated by benefits evaluations conducted at multiple sites implementing PHRs and/or eServices in Canada, across different types of care settings.
Canada Health Infoway	Current and potential value of Canadians' secure access to their health information and digital health eServices	2017	Canada	Survey method	To describe the findings from the 2017 patient and provider surveys undertaken by Canada Health Infoway.
Children's Hospital of Eastern Ontario	Epic EHR Program MyChart® Consumer Health Solutions Benefits Evaluation Report (Pilot)	2015	Canada	Mixed method	To present the findings from the evaluation to capture and document implementation of a portal as part of an EHR system.
Chimowitz et al	Empowering Informal Caregivers with Health Information: OpenNotes as a Safety Strategy	2018	United States	Survey method	To investigate the impact of OpenNotes on caregivers.
Crotty et al	Prevalence and Risk Profile Of Unread Messages To Patients In A Patient Web Portal	2015	United States	Retrospective method	To determine the prevalence and risk of patients who do not read their secure messages.
Crouch et al	A pilot study to evaluate the magnitude of association of the use of electronic personal health records with patient activation and empowerment in HIV-infected veterans	2015	United States	Survey method	To investigate the patient characteristics, healthcare empowerment, patient activation, and satisfaction associated with access to patient portal in veterans living with HIV.

Cutrona et al	Improving Rates of Outpatient Influenza Vaccination Through EHR Portal Messages and Interactive Automated Calls: A Randomized Controlled Trial	2018	United States	Randomized Controlled trial	To examine the effectiveness of a patient portal in improving rates of influenza vaccination.
Dalal et al	Potential of an Electronic Health Record-Integrated Patient Portal for Improving Care Plan Concordance during Acute Care	2019	United States	Prospective method	To determine the levels of patient portal usage by oncology patents and their healthcare providers.
Denneson et al	Patients' Positive and Negative Responses to Reading Mental Health Clinical Notes Online	2018	United States	Survey method	To investigate the impact of OpenNotes among veterans receiving mental health care.
Devkota et al	Use of an Online Patient Portal and Glucose Control in Primary Care Patients with Diabetes	2016	United States	Retrospective method	To investigate the impact of patient portal use on the improvement of HbA1c in patients with type 2 diabetes in primary care settings.
Dexter et al	Patient-Provider Communication: Does Electronic Messaging Reduce Incoming Telephone Calls?	2016	United States	Retrospective method	To investigate the rate of secure messaging.
Dumitrascu et al	Patient portal use and hospital outcomes	2018	United States	Retrospective method	To examine the association between hospital outcomes of 30-day readmissions, inpatient
eHealth Saskatchewan	Citizen health information portal (CHIP): benefits evaluation report	2017	Canada	Mixed method	To present the findings from the evaluation to capture and document implementation of a portal as part of an EHR system.
eHealth Saskatchewan	Defining empowerment and supporting engagement Saskatchewan patients and the eHealth Saskatchewan citizen health information portal (CHIP)	2016	Canada	Mixed method	To describe the findings from a qualitative exploration about the use and access of the Saskatchewan portal.
Esch et al	Engaging patients through OpenNotes: an evaluation using mixed methods	2016	United States	Mixed method	To gain insight in the experiences of patients' viewing visit notes and the impact on the patient-provider relationship.
Federman et al	Patient and clinician perspectives on the outpatient after-visit summary: a qualitative study to inform improvements in visit summary design	2017	United States	Qualitative method	To investigate the impact of After Visit Summaries on patients.

Fiks et al	Parent-reported outcomes of a shared decision-making portal in asthma: a practice-based RCT	2015	United States	Randomized Controlled Trial	To explore the feasibility and impact of a patient portal on shared-decision making.
Fossa et al	OpenNotes and shared decision making: a growing practice in clinical transparency and how it can support patient-centered care	2018	United States	Survey method	To investigate the impact of OpenNotes on patients through a scoring system.
Foster et al	The Use of an Electronic Health Record Patient Portal to Access Diagnostic Test Results by Emergency Patients at an Academic Medical Center: Retrospective Study	2019	United States	Retrospective method	To determine the use of patient portals by patients in the emergency department.
Garry et al	Patient Experience With Notification of Radiology Results: A Comparison of Direct Communication and Patient Portal Use	2020	United States	Survey method	To evaluate the experiences of patients when receiving their radiology test results.
Gerard et al	What Patients Value About Reading Visit Notes: A Qualitative Inquiry of Patient Experiences With Their Health Information	2017	United States	Mixed method	To investigate the impact of OpenNotes on patients.
Giardina et al	Patient perceptions of receiving test results via online portals: a mixed-methods study	2018	United States	Mixed method	To explore the experiences of patients when viewing test results via patient portals.
Giardina et al	The patient portal and abnormal test results: An exploratory study of patient experiences	2015	United States	Qualitative method	To gain insight on how patient use patient portals to manage their care.
Graetz et al	Association of Mobile Patient Portal Access With Diabetes Medication Adherence and Glycemic Levels Among Adults With Diabetes	2020	United States	Retrospective method	To investigate the association between medication adherence and glycemic levels among adults with diabetes.
Graham et al	Effects of a Web-Based Patient Portal on Patient Satisfaction and Missed Appointment Rates: Survey Study	2020	Canada	Survey method	To determine the impact of a patient portal on patient satisfaction and health system usage.

Griffin et al	Patient Portals: Who uses them? What features do they use? And do they reduce hospital readmissions?	2016	United States	Retrospective method	To identify who uses patient portals and the impact of use/non-use of portals on 30-day hospital readmission.
Grossman et al	Providers' Perspectives on Sharing Health Information through Acute Care Patient Portals	2018	United States	Survey method	To assess the perceptions of providers about patients’ access, care delivery, and usefulness of patient portals.
Group Health Centre	myCARE Benefits Evaluation and Final Report	2016	Canada	Mixed method	To present the findings from the evaluation to capture and document implementation of a portal as part of an EHR system.
Grunloh et al	"Why Do They Need to Check Me?" Patient Participation Through eHealth and the Doctor-Patient Relationship: Qualitative Study	2018	Sweden	Qualitative method	To gain insight about the impact of personal healthcare records on the provider-patient relationship.
Grunloh et al	"The Record is Our Work Tool!"-Physicians' Framing of a Patient Portal in Sweden	2016	Sweden	Qualitative method	To understand the impact of personal health records system implementation on workflow.
Hanna et al	Patient perspectives on a personally controlled electronic health record used in regional Australia	2017	Australia	Qualitative method	To gain insight on patients’ experiences in accessing their personal healthcare records.
Haun et al	Large-Scale Survey Findings Inform Patients' Experiences in Using Secure Messaging to Engage in Patient-Provider Communication and Self-Care Management: A Quantitative Assessment	2015	United States	Survey method	To assess veteran patients’ experiences in using secure messaging.
Health Quality Innovation Collaborative	miDASH, Consumer Health Solution Canada Health Infoway Benefits Evaluation Health Quality Innovation Collaboration (HQIC)	2016	Canada	Mixed method	To present the findings from the evaluation to capture and document how implementation of a portal as part of an EHR system by focusing on quality of care, provider and patient caregiver interaction, and health service utilization.
Holland Bloorview	connect2care Benefits Evaluation – Results and Final Report	2016	Canada	Mixed method	To present the findings from the evaluation to capture and document implementation of a portal as part of an EHR system.
Jhamb et al	Disparities in Electronic Health Record Patient Portal Use in Nephrology Clinics	2015	United States	Retrospective method	To synthesize the rates of patient portal adoption and blood pressure control.

Johansen et al	Health Professionals' Experience with Patients Accessing Their Electronic Health Records: Results from an Online Survey	2019	United States	Survey method	To investigate the provider perceptions about patients accessing healthcare record.
Kayastha et al	Open Oncology Notes: A Qualitative Study of Oncology Patients' Experiences Reading Their Cancer Care Notes	2018	United States	Qualitative method	To understand the experiences of patients with advanced cancer and access to care notes.
King et al	Connecting Families to Their Health Record and Care Team: The Use, Utility, and Impact of a Client/Family Health Portal at a Children's Rehabilitation Hospital	2017	Canada	Prospective method	To examine the use and impact of connect2care portal.
Kummerow Broman et al	Postoperative Care Using a Secure Online Patient Portal: Changing the (Inter)Face of General Surgery	2015	United States	Prospective method	To evaluate the acceptance of an online care by using patient portal compared to a face-to-face consultation.
Leveille et al	Do Patients Who Access Clinical Information on Patient Internet Portals Have More Primary Care Visits?	2016	United States	Prospective method	To examine the relationship between primary care visits and access to patient portal information.
Lieu et al	Primary Care Physicians' Experiences With and Strategies for Managing Electronic Messages	2019	United States	Qualitative method	To gain insight in the primary care physicians' experiences with secure messaging.
Lyles et al	Refilling medications through an online patient portal: consistent improvements in adherence across racial/ethnic groups	2016	United States	Retrospective method	To evaluate longitudinal changes in statin adherence between racial/ethnic minorities by using the online refill function in patient portals.
Mafi et al	Patients learning to read their doctors' notes: the importance of reminders	2016	United States	Retrospective method	To determine the impact of patients accessing their providers' notes.
Manard et al	Patient Portal Use and Blood Pressure Control in Newly Diagnosed Hypertension	2016	United States	Retrospective method	To synthesize the rates of patient portal adoption and blood pressure control.

Nicolas et al	The impact of a comprehensive electronic patient portal on the health service use: an interrupted time-series analysis	2019	Spain	Prospective method	To investigate the impact of patient portals on healthcare utilization.
Forster et al	Maternity patients' access to their electronic medical records: use and perspectives of a patient portal	2015	Australia	Retrospective method	To investigate the perceptions of maternity patients when accessing a patient portal.
Mendel et al	Impact of health portal enrolment with email reminders at an academic rheumatology clinic	2017	United States	Survey method	To explore the impact of patient portal utilization on appointment adherence.
Millman et al	Optimizing Adherence Through Provider and Patient Messaging	2016	United States	Retrospective method	To determine the effectiveness of secure messaging on healthcare.
Moll et al	Patients' Experiences of Accessing Their Electronic Health Records: National Patient Survey in Sweden	2018	Sweden	Survey method	To gain understanding about why patients access and how they use their personal health records.
Moll et al	Oncology health-care professionals' perceived effects of patient accessible electronic health records 6 years after launch: A survey study at a major university hospital in Sweden	2019	Sweden	Survey method	To examine the impact of the implementation of a personal records system on oncology health-care professionals, 6 years after launching the system.
Ontario Shores Centre for Mental Health Sciences	Ontario Shores’ HealthCheck Patient Portal, Ontario Shores Centre for Mental Health Sciences, Benefits Evaluation Report	2016	Canada	Mixed method	To present the findings from the evaluation to capture and document implementation of a portal as part of an EHR system.
Peremislov	Patient use of the electronic communication portal in management of type 2 diabetes	2016	United States	Retrospective method	To determine the effectiveness of secure messaging on healthcare for the management of type 2 diabetes.
Petullo et al	Effect of Electronic Messaging on Glucose Control and Hospital Admissions Among Patients with Diabetes	2016	United States	Retrospective method	To determine the relationship secure messaging and HbA1c levels on emergency room visits and hospital admissions.
Pillemer et al	Direct Release of Test Results to Patients Increases Patient Engagement and Utilization of Care	2016	United States	Mixed method	To investigate the impact of patients accessing test results.

Plate et al	Utilization of an Electronic Patient Portal Following Total Joint Arthroplasty Does Not Decrease Readmissions	2019	United States	Retrospective method	To assess the impact of patient portals on patients after a total hip and total knee replacement surgeries, and if secure messaging impact healthcare utilization.
Raghu et al	Using secure messaging to update medications list in ambulatory care setting	2015	United States	Retrospective method	To understand the differences between portal users and non-users, and medication responses compared between secure messaging and over phone.
Reed et al	Portal Use Among Patients With Chronic Conditions: Patient-reported Care Experiences	2019	United States	Survey method	To examine patients with chronic conditions experiences in using a patient portal
Reed et al	Patient-initiated e-mails to providers: associations with out-of-pocket visit costs, and impact on care-seeking and health	2015	United States	Survey method	To evaluate the impact of secure messaging on patient cost and healthcare utilization.
Reicher et al	Implementation of Certified EHR, Patient Portal, and "Direct" Messaging Technology in a Radiology Environment Enhances Communication of Radiology Results to Both Referring Physicians and Patients	2016	United States	Retrospective method	To evaluate the impact of secure messaging and patient engagement.
Rief et al	Using Health Information Technology to Foster Engagement: Patients' Experiences with an Active Patient Health Record	2017	United States	Qualitative method	To examine the use and impact of HealthTrak portal for patients at risk for cardiovascular disease.
Riippa et al	A Patient Portal With Electronic Messaging: Controlled Before-and-After Study	2015	Finland	Prospective method	To assess the benefits and risks of providing secure messaging options to patients with chronic conditions.
Robinson et al	Patient perceptions and interactions with their web portal-based laboratory results	2019	Canada	Qualitative method	To explore patient’s perspectives on accessing laboratory results and the impact on their health and healthcare.
Ronda et al	Patients' Experiences with and Attitudes towards a Diabetes Patient Web Portal	2015	Netherlands	Survey method	To explore patient experiences with access to patient portals.

Saberi et al	Antiretroviral Therapy Adherence and Use of an Electronic Shared Medical Record Among People Living with HIV	2015	United States	Prospective method	To examine the impact of access and no-access to patient portal on antiretroviral therapy (ART) adherence in HIV-positive individuals.
Shah et al	Education Research: Electronic patient portal enrollment and no-show rates within a neurology resident clinic	2019	United States	Retrospective method	To explore the impact of patient portal utilization on appointment adherence in a neurology clinic.
Shah et al	Accessing personal medical records online: a means to what ends?	2015	United Kingdom	Survey method	To examine the types of patients that access their healthcare records and the impact of the access on patient cost-savings.
Shaw et al	Increasing Health Portal Utilization in Cardiac Ambulatory Patients: A Pilot Project	2017	United States	Mixed method	To developed a process in engaging patients in using a portal and increase portal utilization.
Shimada et al	Sustained Use of Patient Portal Features and Improvements in Diabetes Physiological Measures	2016	United States	Retrospective method	To examine the association between prescription refills and secure messaging for the management of type 2 diabetes.
Sieck et al	The Rules of Engagement: Perspectives on Secure Messaging From Experienced Ambulatory Patient Portal Users	2017	United States	Qualitative method	To explore the experiences of patients and providers when using secure messaging.
Sorondo et al	Patient Portal as a Tool for Enhancing Patient Experience and Improving Quality of Care in Primary Care Practices	2016	United States	Prospective method	To determine the impact of portals on patients with chronic conditions and healthcare utilization and self-care.
Szilagyi et al	Effect of Patient Portal Reminders Sent by a Health Care System on Influenza Vaccination Rates: A Randomized Clinical Trial	2020	United States	Randomized Controlled trial	To examine the effectiveness of a patient portal in improving rates of influenza vaccination.
The Social Research and Demonstration Corporation	Impacts of direct patient access to laboratory results – Final Report	2015	Canada	Mixed method	To understand how direct lab access affects patients' experience, their utilization of healthcare services, physicians' workload and their relationships with patients.
Vydra et al	Diffusion and Use of Tethered Personal Health Records in Primary Care	2015	United States	Mixed method	To investigate the use of a patient portal by healthcare providers.

Walker et al	OpenNotes After 7 Years: Patient Experiences With Ongoing Access to Their Clinicians' Outpatient Visit Notes	2019	United States	Survey method	To investigate the perceptions of patients who access their visit notes.
Wang et al	Adoption of an Electronic Patient Record Sharing Pilot Project: Cross-Sectional Survey	2020	China	Survey method	To investigate the feasibility and acceptance of a personal health records system implementation in Hong Kong.
Wildenbos et al	Older adults using a patient portal: registration and experiences, one year after implementation	2018	Netherlands	Survey method	To examine the factors among older adults that contribute and inhibit patient portal enrollment and use.
Winget et al	Electronic Release of Pathology and Radiology Results to Patients: Opinions and Experiences of Oncologists	2016	United States	Survey method	To evaluate the experiences of patients when receiving normal and abnormal test results via a patient portal.
Wolff et al	Inviting patients and care partners to read doctors' notes: OpenNotes and shared access to electronic medical records	2017	United States	Survey method	To investigate the impact of OpenNotes on patients and caregivers.
Women's College Hospital	aEPR Benefits Evaluation	2016	Canada	Mixed method	To present the findings from the evaluation to capture and document how implementation of a portal as part of an EHR system that supports improved quality of care, patient safety and clinician efficiency.
Wright et al	Sharing Physician Notes Through an Electronic Portal is Associated With Improved Medication Adherence: Quasi-Experimental Study	2015	United States	Retrospective method	To investigate the association between medical visit notes and medication adherence in primary care.
Zanaboni et al	Patient Use and Experience With Online Access to Electronic Health Records in Norway: Results From an Online Survey	2020	Norway	Survey method	To investigate who and why uses patient portals.
Zhong et al	On the effect of electronic patient portal on primary care utilization and appointment adherence	2018	United States	Retrospective method	To explore the impact of patient portal utilization on appointment adherence.

Zhong et al	Characteristics of Patients Using Different Patient Portal Functions and the Impact on Primary Care Service Utilization and Appointment Adherence: Retrospective Observational Study	2020	United States	Retrospective method	To investigate the impact of a patient portal on secure messaging, prescription refills, and outpatient appointments.
Zhou et al	Personal health record use for children and health care utilization: propensity score-matched cohort analysis	2015	United States	Retrospective method	To examine the association between patient portal use and healthcare utilization in a pediatric settings.

Table 13: Patient perspective

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Robinson et al	Canada	Qualitative method	Viewing laboratory and diagnostic results	• Semi structured interviews	• Semi structured interviews were conducted where selective coding was used, creating higher level themes/ categories. • Questions focused on use of the portal, reception of test results and changes in healthcare experience as a result of the portal. Grounded theory analysis was used as its inductive nature makes it well suited for understanding healthcare experiences.	• Patients varied in their understanding of the results. Patients stated that healthcare providers sometimes do not provide sufficient information when commenting on results. • Benefits of access to test results included convenience, fewer appointments and decreased anxiety. Some participants described increased engagement in their healthcare and positive health changes. However, patients expressed concerns about receiving alarming test results.
Moll et al	Sweden	Survey method	Patient portal in general	• Survey	• An anonymous self-completion questionnaire was designed covering different portal usage topic areas with a total of 24 questions. General questions related to the portal. • There were questions targeting experiences from accessing and using the content, information security, information needs, behavior, and information-seeking style. • The questionnaire included questions with various response options (5-point Likert scale, multiple choice, and free text form). Descriptive analysis was conducted on the responses. Reported percentages were based on those who answered each specific question.	• From the respondents, 68.41% (1737/2539) wanted access to new information same day or after a day (within 24 hours). Additionally, 19.22% (488/2539) wanted access to new information within 2 weeks, while 1.42% (36/2539) within 1 month, and 10.95% (278/2539) chose “other.” • Respondents reported that lab results were the most important information for them to access. • No statistically significant association between respondents who were working or had been working in health care and those who had not (P=.17) in terms of availability of new results. • The study found that patients considered access to information as a means to patient empowerment and involvement.
Giardina et al	United States	Mixed method	Viewing laboratory and diagnostic results	• Semi structured interviews • Structured interviews	• First semi-structured interview guide was developed which was tested with patents. Once the interview guide was enhanced, the guide was finalized as a structured interview guide for the subsequent interviews.	• From the participants, 89.5% indicated that their physician explained why the test was being ordered. Only 50.5% reported that their physician told them to check their portal for the result.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					• Structured interview assessed: participant characteristics, physician and patient actions on test results, patient perceptions of receiving results via the portal, and portal concerns and suggestions for improvement. The structured interviews had 3 open-ended questions.	• Furthermore, 63.2% of the participants reported that their physician did not include a note explaining the result. • Abnormal result (44.2%) resulted in a call than normal (15.4%) results, and 25.3% sent a secure message to their doctor regarding the test result (abnormal =32.6% and normal=19.2%). • In addition, 61.1% of the participants saw a visual cue to know if result normal or abnormal; 16.8% reported that the physician told them it was normal or abnormal; 8.4% stated they had medical knowledge to know if test normal or abnormal; and 8.4% did not know what the results meant. • From the participants, 55.8% patients with abnormal results experienced negative emotions; 21.2% patients with normal results experienced negative emotions; 50.0% of the patients did not care and no emotions when they saw the results; and 60.0% did not have any issues. • In total, 52.6% of the participants wanted portal improvements (display, usability, and notifications).
Kayastha et al	United States	Qualitative method	OpenNotes	• Semi structured interviews	• Semi structured interviews focused on how do patients with advanced cancer experience reading their own medical records. • Focused on four segments: assessing their overall experience reading notes, discussing how notes affected their cancer care experiences, having the participant read a real note with the interviewer, and, making suggestions for improvement. • Content analysis approach rooted in grounded theory was used.	• Nearly all patients described enhanced comprehension about their disease and care, because notes refreshed their memory and clarified their understanding of visits. • For a subset of patients, increased anxiety. • For others, eased uncertainty, relieved anxiety, and facilitated control. • Patients identified two areas needing improvement: the use of jargon, and repetitive information masking important updates.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Denneson et al	United States	Survey method	OpenNotes	• Survey • EHR administrative data	• The data was from the baseline survey of a longitudinal study examining a Web-based course designed to educate VHA patients on the use of OpenNotes. • Two items assessed participants' ability to take ownership of their health care (health self-efficacy). Response options range from 1, not at all, to 5, extremely. • Two items assessed participants' sense of knowledge about their health and health care (health knowledge). Response options range from 1, not at all, to 5, extremely. • Two items asked participants about how their relationship with their clinician had changed since reading their notes (patient-clinician alliance). Response options range from 1, a lot less trust, to 5, a lot more trust. Or from 1, a much worse relationship, to 5, a much better relationship. • Two survey items asked participants about negative emotional responses to reading their notes (negative emotions). Response options range from 1, never, to 5, always.	• Reading OpenNotes helped patients feel in control of their health care (49% very to extremely in control); had a little (17%) to a lot (28%) more trust in clinicians; experienced stress or worry 26% reported sometimes experienced stress or worry and 8% reported often or always; reported feeling upset after reading their notes (18% reported sometimes felt upset, and 8% reported often or always). • Patients with PTSD reported experiencing greater levels of negative emotional responses to OpenNotes. • Findings show small-to-null effects regarding associations with positive and negative responses to OpenNotes. • Although patients reported negative responses, but they also reported benefits in reading their notes.
Chimowitz et al	United States	Survey method	OpenNotes	• Survey	• The OpenNotes Safe Care Survey of patients and caregivers was conducted with the goal of measuring the impact of OpenNotes on patient and family perceptions of patient safety. • The survey focused on informal caregivers' perceptions of the impact of reading notes on ambulatory follow-up; identification of documentation errors; and relational effects such as caregiver trust in the clinician.	• Majority of caregivers reported benefits of reading notes related to ambulatory safety behaviors. Fifty-five percent reported reading notes helped them to remember to get the patient's tests done, and 92.3% reported reading notes helped them understand the reason for the patient's referral to a specialist. • Among note-reading caregivers, 53.7% trusted the clinician more, and 58.2%, reported better teamwork as a result of OpenNotes.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						• Caregiver access to notes had little to no negative implications for caregiver-provider relationships.
Fossa et al	United States	Survey method	OpenNotes	• Survey • Shared decision making tool • EHR administrative data	• A survey was conducted which included questions that measured how many notes a patient read in the previous 12 months, his/her experience with clinicians, perceived risk and benefits of OpenNotes, and measures of patient satisfaction and shared decision making. • The survey included the three-item CollaboRATE scale, which measures a patient's experience with shared-decision making. • Primary independent variable was the number of notes read by patients. • Classified patients into three categories: 1) never read a note or read a note more than 12 months ago, 2) read 1-3 notes in the past 12 months, and 3) read 4+ notes in the past 12 months.	• From the respondents, 54% had read 4+ notes, 42% read 1-3 notes, and only 4% of patients reported reading no notes. • Who read 4+ notes were 15% more likely to have top-box CollaboRATE scores for clinician effort in helping them understand health issues (p=.011); 15% more likely for clinicians listening to the things that matter most to them (p=.009); and 16% more likely for clinician effort in including them in the plan of care (p=.008). • Clear correlation between what shared decision making required and the transparency OpenNotes provided.
Gerard et al	United States	Mixed method	OpenNotes	• Survey	• A survey was conducted to evaluate a 9-item patient feedback tool linked to OpenNotes as part of a pilot quality improvement initiative.	• From the survey respondents, 98.5% indicated that the reporting tool was valuable, and 68.8% feedback reports had qualitative responses about what patients liked about reading notes and the OpenNotes patient reporting tool process. • Patients learned about their condition through the notes. Checking accuracy was deemed as important. Patients wanted some control over the decision making. • The availability of notes made face-to-face time more effective. Patients felt positive when reading notes. Patients reported that OpenNotes and the reporting

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						tool allowed for partnership and engagement, bidirectional communication and enhanced education, and importance of feedback.
King et al	Canada	Prospective method	Patient portal in general	• Survey • Focus groups • Semi-structured interviews • Patient portal administrative data	• Adopted a concurrent triangulation approach by using portal login information, a survey, and focus groups or interviews. • The survey assessed caregivers' perceptions of the utility of and satisfaction with the portal and e-messaging, and the portal's impact on client engagement and perceptions of caregiver-provider communication.	• Typical pattern was a steady level of use (2.5 times a month over an average of 9 months). • A moderate degree of perceived usefulness of and satisfaction with the portal and e-messaging features, and evidence that the portal was perceived to provide useful access to the clinical record. • Some evidence that portal access facilitated caregivers' receptions of engagement in care, but this evidence was not strong. • Little evidence that the portal led to feelings of greater involvement in the care process, improved ability to express concerns to providers or enhanced relationships with providers, or reduced number of in-person visits.
Rief et al	United States	Qualitative method	Patient portal in general	• Focus groups	• Focus group were conducted with participants from the active arm of an RCT. • The data was analyzed through qualitative "editing" approach by first developing a codebook and then coding the transcripts. • Goal was to capture the experience of using the active version of the PHR known as HealthTrak.	• Active reminders and tracking tools prompted both more frequent and improved communication with their providers. • Getting real time information of lab tests before appointments led to improved conversations with the provider. • Better engagement with the providers due to patient having more knowledge about their health. • The information eliminated the time pressure felt during short appointments. • Increased awareness about personal health.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Wolff et al	United States	Survey method	OpenNotes	• EHR administrative data • Patient portal administrative data • Survey	• EHR data was pulled for the baseline information. • At follow up, if participants viewed doctor visit notes were asked about their use and perceptions of OpenNotes. • Measures of online practices of patients and care partners were constructed from digital recordings of My Geisinger interactions for the 12-month periods before exposure to OpenNotes.	• Patients reported not viewing notes because they relied on their care partners to read the notes (18.5%), or they did not have access to a computer (16.7%). • From the care partners, 35.5% viewed doctor notes because they were unable to attend the visit. • Shared notes increased patients' confidence in addressing aspects of their health.
Wildenbos et al	Netherlands	Survey method	Patient portal in general	• Survey • Patient portal administrative data	• Registration rates for one year were collected via automated patient portal data extraction. • Patients were classified as active, declined, and expired. • An online survey in Dutch with open-ended questions collected the experiences of older adults. The survey served to gain insight in how MyChart®'s functionalities could be improved.	• From the respondents, 40% found the portal useful and it allowed them to plan and follow up on upcoming appointments. Around 8% were dissatisfied with the usefulness due to incompleteness of the information and time delays for tests to show up. • Main inhibitors were that patients had higher expectations of MyChart® based on their idea of what functionalities a patient portal should provide (24%); the unresponsiveness of physicians to messages sent by patients via MyChart® (15%); and the experienced usability problems (22%).
Reed et al	United States	Survey method	Patient portal in general	• Survey	• A patient experience survey was developed with guidance of patient panel with focus on examining patient health care experiences among patients with chronic conditions.	• Portal nonusers reported preferring in-person health care (54%) or experiencing internet access barriers to enrollment (41%). Nine of 10 patients reported that it improved health care convenience, access to health information, and integrated with in-person services. • Nearly a third of users reported the portal had improved their overall health. • Many patients who did not use the portal lacked access to a connected device.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						• Among patients who had used the portal, 90% reported ≥ 1 aspect of convenience, 92% reported ≥1 aspect of data and information usefulness, and 92% reported that using the portal integrated with their other health care experiences.
Millman et al	United States	Retrospective method	Secure messaging	• EHR administrative data	• Proprietary algorithms based on evidenced-based medicine were developed for 140 treatments across 19 major diseases. • Each gap assessment algorithm used the International Classification of Diseases, Ninth Revision, Clinical Modification codes and the presence of claims (medical and pharmacy) to identify the health care services received by the member. • Based on the algorithms, gaps in care were identified. If no such test was present, a gap in care was indicated triggering a message for that individual. If a match could be made to an appropriate physician, a message was sent to her or him as well. • For each gap in care, a new regression model was created.	• Messages notifying members of gaps in care can influence evidence-based adherence for some conditions. Messages were associated with statistically significant ($P < 0.05$) changes in utilization related to 23 evidence-based recommendations for care. • Greatest impacts observed were for messages related to diabetes medical management considerations (HbA1c test completed) or missed therapy intervention.
Shimada et al	United States	Retrospective method	Secure messaging and eRefills	• EHR administrative data • Patient portal administrative data	• Used International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes to determine type 2 diabetes diagnosis and determine patient characteristics at baseline.	• Of the cohort, 34.13% (38,113/111,686) was using Web-based refills, and 15.75% (17,592/111,686) was using secure messaging. • Small, statistically significant, and potentially meaningful improvement in physiological measures among diabetic patients who initiated and sustained use of Web-based refills or secure messaging or both via portal. • Rate of use and increase in use was greater for Web-based refills than for secure messaging.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						• Although rates of use of the refill function were higher within the population, sustained secure messaging use had a greater impact on HbA1c.
Reicher et al	United States	Retrospective method	Secure messaging	• Patient portal administrative data • Administrative data collected by an organization	• Focus was on determining interoperability between system and patient access to laboratory results.	• An average of 6.9% rate of use by patients who accessed their health data online, and about half of these patients were new users to the system. • Availability of radiology reports online was associated strongly with increased patient use of the system, with a likelihood ratio of 2.63. • Secure messaging allowed for efficient bidirectional radiologist- patient communication.
Wright et al	United States	Retrospective method	OpenNotes	• EHR administrative data • Patient portal administrative data	• To determine whether patients changed adherence status pre- and post-intervention, a four-level outcome variable was created: nonadherent to adherent, adherent to adherent, nonadherent to nonadherent, and adherent to nonadherent.	• Compared to those without access, patients invited to review notes were more adherent to antihypertensive medications (79.7% for intervention versus 75.3% for control group). • Adherence was similar among patient groups taking antihyperlipidemic agents (77.6% for intervention versus 77.3% for control group). • Demonstrated that patients who have access to their progress notes have a higher adherence rate to antihypertensive medications.
Saberi et al	United States	Prospective method	Medication	• Chart review • EHR administrative data • Medication dispensing administrative data	• The difference in refill adherence change pre- and post-portal use (for users) or before and after a randomly assigned reference date (for non-users) constituted the primary outcome measure.	• Observed stable adherence over time among portal users, compared with small declines among non-users.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Shah et al	United Kingdom	Survey method	Patient portal in general	• Survey	• Questionnaire comprised of five closed questions each followed by an open question. • The closed questions asked patients about access, making telephone calls, appointments due to results, and time and money saved. For each question, patients were required to answer 'yes 'or 'no' and, if 'yes', to estimate the number of times this had been the case. • Each of the questions were followed by an open question ask-in patients to provide examples of how they had used record access.	• Greatest savings as reported by patients related to calls to the practice and appointments with doctors. • From the participants, 13% thought that they had made extra appointments with their doctor as a result of record access. • Portal savings: 27.2% reported savings in terms of time to travel, time off work, money in terms of gas and parking. • From the participants 8.7% reported better managing own health.
Ronda et al	Netherlands	Survey method	Patient portal in general	• Survey • EHR administrative data • Clinical outcome tools	• Survey was sent to users and non-users which contained multiple choice questions about reasons for requesting a login, the usability of portal features and patient's wishes. Three questions that were scored on a 5-point Likert scale. • Collected patient data form the electronic health record, such as login frequency, age, gender, type of diabetes, treatment setting, laboratory values, comorbidity and diabetic complications. The patients were analyzed according to their login-frequency. • Compared two groups: patients who requested a login but never used it or only once ('early quitters') and patients who requested a login and used it at least two times ('persistent users'). • In addition to the survey, used several clinical measure tools: the Diabetes Treatment Satisfaction Questionnaire (DTSQ); Problem Areas in Diabetes (PAID);	• With a higher HbA1c, the odds of becoming a persistent user decreases. • Patients wanted to enroll because they were informed by their physician. • Patients who became persistent users were apparently those with a higher disease seriousness. • Insulin use was a predictor of requesting a login. • Two thirds of the persistent users responded that they did not feel the portal supports them in most lifestyle choices. • Persistent users perceived the comprehensibility of the portal more favorably than early quitters.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					Diabetes Management Self-Efficacy Scale (DMSES); and Brief Diabetes Knowledge Test (BDKT).	
Fiks et al	United States	Randomized Controlled Trial	Patient portal in general	• Survey • EHR administrative data	• To measure acceptability and clinical outcomes, families in both groups completed outcome surveys at enrollment (after randomization) and at 3 and 6 months. Feasibility of portal use was assessed by the proportion of participants in the intervention group who completed the portal survey each month, as a measure of whether families were able to complete the portal survey consistently. • Survey was distributed to parents. Survey results were tracked over time in a timeline available to families through the portal and to clinicians through the EHR. • Acceptability of asthma care was assessed by the 6-month outcomes survey by using 11 Likert-scaled questions developed by the study team with face validity. • Parents also completed the Parent Patient Activation Measure, Integrated Therapeutics Group Child Asthma Short Form and the Asthma Control Tool (ACT).	• Parents of children with moderate or severe asthma used the portal more frequently (75% were frequent users compared with 47% of parents whose child had mild persistent asthma). • Six parents felt the portal enabled them to learn more about asthma. • Value of providing decision support to families at home in addition to clinicians in the office.
Giardina et al	United States	Qualitative method	Viewing laboratory and diagnostic results	• Semi-structured interviews	• The semi-structured interviews included three sections: management of medical information, discussion of a specific abnormal test result, and test result notification preferences. • Interviews were analyzed through content analysis. Codes that conveyed similar	• The survey participants favored access to abnormal test results. Concerns were expressed due to the need for more timely notification and difficulty interpreting the relevance of a result.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					meanings or ideas were combined to form new categories.	• Notification preferences appeared to be heavily influenced by past interactions with physicians and the health care system. • Patients who received an abnormal result and didn't understand it, preferred that sensitive test results be verbally communicated by a health care professional.
Jhamb et al	United States	Retrospective method	Patient portal in general	• EHR administrative data • Patient portal administrative data	• Sociodemographic characteristics, comorbidities, clinical measurements, and laboratory values were captured. • The goal was to evaluate the correlation between sociodemographic, clinical factors and portal use.	• From the total number of patients, 39% access the portal and out of which 87% reviewed laboratory results, 85% reviewed medical information, 85% reviewed appointments, 77% reviewed medications, 65% requested medication refills, and 31% requested medical advice from their renal provider. • Portal adoption increased over time. • Borderline significant association between portal use and BP control (OR, 1.14; 95% CI, 1.00 to 1.29; P=0.05). • Portal adoption was correlated with BP control in patients with hypertension; however, in the fully adjusted model this was no longer statistically significant.
Crouch et al	United States	Survey method	Patient portal in general	• Survey • EHR administrative data • Patient portal administrative data • Patient empowerment and	• Demographics and comorbidities were collected using a self-report checklist. Patient activation was measured using the Patient Activation Measure (PAM-13). • Patient empowerment was measured with the Health Care Empowerment Inventory (HCEI), an 8-item questionnaire with Likert scale responses used to assess the following categories: informed, engaged, committed, collaborative, and tolerant of uncertainty.	• The use of portal was associated with significantly higher levels of patient activation and levels of patient satisfaction for getting timely appointments, care, and information. • The use of My HealtheVet was associated with higher levels of activation, lower plasma HIV-1 RNA, and greater ability to correctly identify CD4 counts and viral loads. • Higher use of portal use was associated with positive clinical and behavioural characteristics.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
				satisfaction tools	• Patient satisfaction was measured with the Consumer Assessment of Healthcare Providers and Systems (CAHPS), which consists of 14 items measuring three concepts: courteous and helpful office staff, provider-patient communication, and getting timely appointments, care, and information. Medication adherence was measured using the Community Programs for Clinical Research 7-day adherence measure.	
Mafi et al	United States	Retrospective method	OpenNotes	• EHR administrative data • Patient portal administrative data	• Claims and online registration records to obtain demographic and clinical data, including visit dates and ICD-9-CM diagnostic codes associated with each visit. • Administrative race data was obtained by clinical registration staff. • Developed a natural experiment to assess the impact of reminders on patients' viewing patterns. • Used information systems data from the respective patient portals to identify which notes patients accessed, when they accessed them, and how many times they accessed each note.	• In the presence of invitations and reminders to view notes, interest was high and remained durable. • At the first clinic setting viewing did not decline in year 2 even when reminders ceased. In the second setting, patients viewed notes far less frequently as soon as the reminders ceased. • Compared to white patients, black patients viewed notes less frequently (55.1% vs 36.3%, respectively, P<.001) and other/multiracial patients viewed notes less frequently (55.1% vs 50.2%, respectively, P<.001). Race/ethnicity did not affect the persistence of notes viewed over time: black and other/multiracial subgroups continued to view notes with similar frequencies over time during the 2-year period.
Petullo et al	United States	Retrospective method	Secure messaging	• EHR administrative data • Patient portal administrative data	• The following data was collected: age, gender, race, most recent insurance status, most recent body mass index, diabetes type, and prior insulin use. • The primary outcome of interest was the most recent HbA1c within the observation period.	• Active secure messaging use was associated with a 0.156% lower HbA1c compared with inactive patients (P = 0.0002), and a 0.263% lower HbA1c compared with active nonusers (P < 0.0001). • The number of messages among users, was not associated with HbA1c.

Author/s	**Country**	**Study design**	**Evaluated patient portal features**	**Methodological approach for evaluation**	**How was the methodology implemented**	**Study results**
Graham et al	Canada	Survey method	Patient portal in general	• Survey • Patient portal administrative data	• A novel 30-question survey instrument was developed and sent to all registered portal users. • The survey focused on: satisfaction with the patient portal; utility of the patient portal; impact of the patient portal; and demographic characteristics.	• Patients had high general satisfaction, with over 90% reporting that it was easy to use, and almost half reporting that it saved them a medical visit. • From the respondents, 48% reporting avoiding a clinic visit and 2.7% avoiding an emergency department visit.
Garry et al	United States	Survey method	Viewing laboratory and diagnostic results	• Survey • EHR administrative data	• Survey was developed to capture the satisfaction and understanding of patients from portal usage. Developed two versions of an original 14-question survey: one form for patients who had viewed results in the online portal and another for patients who had not viewed their results on the portal. More than one choice could be selected. • Patient characteristics were pulled from the medical record. • Patient characteristics that were self-reported included race, ethnicity, education level, and health literacy.	• From total responders, 87.8% reported having received their imaging test results, with 48.4% first being notified through the patient portal, and 39.4% via direct provider communication. • One of every six patients who had MRI or CT scans (17%) reported clear understanding of their results when first receiving the results through the portal. • Satisfaction with the timing of test result notification did not differ for auto-release to patient portals compared with provider-led communication, but fewer patients understood their imaging results clearly when they first were notified through the patient portal.
Graetz et al	United States	Retrospective method	Medication adherence	• EHR administrative data • Patient portal administrative data	• Medication adherence was measured based on the number of days' supply of oral diabetes prescription drug dispensed in each month of the study. • Assessed the associations of portal access with outcomes of medication adherence and HbA1c level. • Used portal administrative data to capture portal use and access device, and EHR data to capture prescription refills for oral diabetes drugs and glycemic levels, as measured by HbA1c laboratory test	• For patients not previously using the portal, adding mobile access was associated with statistically significant improvements in adherence to oral diabetes drugs and lower glycemic levels. • Improvements associated with mobile portal access were greater among patients with higher clinical need at baseline (HbA1c level >8%). • Found a more modest but still statistically significant increase in adherence among patients with lower initial glycemic levels and in the overall population estimates, translating to increased adherence of approximately 0.5 additional days per month.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					results, control variables, and demographic characteristics.	
Walker et al	United States	Survey method	OpenNotes	• Survey • Patient portal administrative data	• A survey was conducted with portal users who used portal accounts and had at least 1 visit note available in a recent 12-month period. • The main outcome measures included patient-reported behaviors and their perceptions concerning benefits versus risks.	• Patients report that reading clinical notes provided them substantial benefit. • Only a third of patients recalled discussing their notes during visits or having their clinicians recommend that they read them. • Few were very confused or more worried after reading notes. • Results strongly suggested that transparency helps patients feel more engaged in their care.
Devkota et al	United States	Retrospective method	Patient portal in general	• EHR administrative data • Patient portal administrative data	• Patients were offered access to a patient portal. EHR administrative data was used to capture various patient information. • Three levels of e-mail use were defined: nonusers were those not activating an account or those who activated an account but neither read nor wrote e-mails; readers activated an account and read e-mails but did not write e-mails; and readers and writers activated, read, and wrote e-mails.	• Patients who read and wrote e-mails had significantly ($P<0.001$) lower average HbA1c values compared to nonusers. • In adjusted analysis, patients who only read email also had significantly ($P<0.05$) lower mean HbA1c values compared to nonusers. • Patients with more active e-mail communication via a patient portal appeared to have the greatest likelihood of HbA1c control.
Manard et al	United States	Retrospective method	Patient portal in general	• EHR administrative data	• Study variables were created from International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes. • Blood pressure measures were obtained from vital sign data available from the electronic medical record.	• Patients who used the portal, compared with nonusers, were 24% more likely to achieve blood pressure control; however, after adjusting for sociodemographic factors, this association was no longer present. • Low rates of portal use among minorities and disadvantaged patients contributed to a decreased likelihood of achieving blood pressure control.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					• Sociodemographic variables available in the medical record included age, race, sex, and marital status.	
Zanaboni et al	Norway	Survey method	Patient portal in general	• Survey	• The survey was available after secure log-in on the national health portal. The survey included questions about background characteristics, use of the service, and experience with the service. Most of the questions concerning user experiences were scored on a 4-point Likert scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree). • Three open ended questions for additional information.	• Patients found the service useful to look up health information (88.3%), keep track of their treatment (87.9%), prepare for a hospital appointment (64.0%), and share documents with their general practitioner (37.5%) or family (24.9%). Most users found it easy to access their EHR online (93.1%) and did not encounter technical challenges. • From the respondents, 85.2% understood the content. • The overall satisfaction with the service was very high (92.7%). • Clinical advantages to the patients included enhanced knowledge of their health condition (81.8%), easier control over their health status (92.6%), better self-care (87.4%), greater empowerment (73.1%), easier communication with health care providers (79.8%), and increased security (89.7%). • Approximately one-third of all respondents thought that some documents were incomplete.
Forster et al	Australia	Retrospective method	Patient portal in general	• Survey • EHR administrative data	• The survey consisted of 14 closed ended questions relating to: ease of registration, identity verification, what prompted access, ease of use, value in improving patients' abilities to understand appointments with care givers, and an overall rating of the value of the portal and the EMR.	• Majority of patients who were offered an account went on to create one. • The majority of maternity patients submitted registration forms online via the patient portal (56.7%). • Overall, most patients were satisfied with the portal and the majority stated they would use it for future pregnancies.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					• Eight question responses were recorded on a 5-point Likert scale from strongly agree to strongly disagree.	
Esch et al	United States	Mixed method	OpenNotes	• Survey • Semi-structured interviews	• Survey with free-text responses was conducted. • Conducted semi structured interviews with 'heavy user' patients, defined as those who read at least 8 notes in a 24-month period.	• Frequent users of OpenNotes reported positive experiences. • Patients pointed to increased trust, improved management of medications, and a stronger sense of control, and they hoped that easy access to doctors' notes would become more widespread. • Two-thirds of the high-use patients chose not to share notes with others.
Reed et al	United States	Survey method	Secure messaging	• Survey	• Survey asked about the patient–provider messages for any type of condition or concern. The survey included questions about the impact of patient out-of-pocket costs.	• Patients with higher out of pocket cost-sharing for in-person visits were statistically significantly more likely to use secure messaging as their first method of contact when they had a question. • One in 3 reported that their phone contacts or office visits decreased because of secure messaging exchanges with providers. • Less than 3% reported that they would have avoided contact with their provider, and less than 1% reported that they would have instead sought care at the emergency department if they did not have access to secure messaging.
Haun et al	United States	Survey method	Secure messaging	• Survey • Patient literacy screening tools	• A mail-delivered paper-and-pencil survey was sent to portal users. The survey collected demographic data, assessed health literacy and eHealth literacy, and secure messaging use and perceptions. • The following tools were included in the data collection: BRIEF Health Literacy Screening Tool; Computer-Email-Web (CEW) Fluency	• Majority of the respondents reported using secure messaging at least once a year. Less than 15% reported never using secure messaging. • Respondents reported being satisfied with secure messaging, as it provides a safe and secure communication tool that was easy to use and saves time.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					Scale; and The eHealth Literacy Scale (eHEALS).	• A small percentage of respondents reported using secure messaging to address sensitive health topics. • Over 40% of respondents recommended that more education in how to access and use the portal was needed.
Raghu et al	United States	Retrospective method	Secure messaging and medication list	• EHR administrative data • Pharmacy call logs	• Demographics and patient information were obtained from the EHR. • The pharmacy call center logs phone calls made to patients in the patient record.	• Secure message response rate (49.5%) was statistically significantly lower than that for phone calls (54.8%, $p<0.001$). • Time to complete medication list update was significantly higher if patients faxed the medication list ($p<0.001$) when compared to using secure messaging or telephone. • The time to complete difference between secure messaging and telephone was not statistically significant ($p=0.41$). • Although the difference between secure messaging and phone was not significant, the authors concluded that messaging services had the potential to augment existing phone-based medication update process.
Dalal et al	United States	Prospective method	Care plan	• Structured interview data collection	• A modified care plan interview instrument was utilized to ask patients to identify a single Haberle recovery goal during the hospitalization.	• There was a non-significant increase in the mean concordance score for the overall care plan (adjusted $p=0.13$) among patient and clinician participants. • The patient portal was specifically configured to encourage patients to enter recovery goals, and this was reinforced via teach-back.
Broman et al	United States	Prospective method	Uploading of images and symptoms	• Survey	• A survey was conducted to determine the acceptability of an online postoperative care follow up.	• Using patent portal was effective in the postoperative care and follow up. • Seventy-six percent of patients (38 of 50) reported that they would be okay with only having an online visit for their postoperative care.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Wang et al	China	Survey method	Patient records	- Survey	- A survey was conducted with patient portal users.	- Patient and doctor levels of use were dependent on each other. - Among enrolled users of the portal, over 76% of patients were satisfied with its overall performance. Enrolled patients had high satisfaction levels with the portal.
Peremislov	United States	Retrospective method	Secure messaging	- EHR administrative data - Patient portal administrative data	- The secure messaging encounters were tallied, and the analysis proceeded to include open coding, category creation, and abstraction of themes. - Conventional content analysis was used.	- Three major themes that emerged as to why secure messages were sent: inform, instruct/ request, and question. - The portal was used for requests by patients and instruction by providers, showing relatively short message encounters with a high number of partially completed encounters, frequent lack of resolution, and a low level of involvement of diabetes specialists in secure messaging.
Crotty et al	United States	Retrospective method	Secure messaging	- EHR administrative data - Patient portal administrative data	- Reviewed all message sent through the patient portal. The focus was to assess for differences in the prevalence of unread messages according to sociodemographic characteristics.	- Messages sent from physicians to patients were reliably read in a timely manner. - Rate of unread messages for patients was 3.1% at 21 days. - Estimated 13% of unread messages were associated with a potential delay in care. - From all physician initiated outreach messages, 50% were unread.
Sorondo et al	United States	Prospective method	Patient portal in general	- Patient experience survey - Self-efficacy tool - Health state tool	- Data was obtained from the electronic medical records reports on the forms filled by participants using the portal. - Patient self-efficacy: Efficacy (CDSE) was assessed by utilizing a six-item questionnaire developed by Lorig et al. - Functional status: PROMIS Functional global items.	- The use of a patient portal among patients with chronic conditions enrolled in a care coordination program did not demonstrate a statistically significant improvement in self-efficacy, perception of health status, or patients’ experience with their primary care practice after 7 months of patient portal use. - Self-reported functional status was the only outcome measure to improve significantly.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
				- EHR administrative data	- Patient-self-rated health state: EQ VAS using a single item EuroQol Visual Analogue Scale. - Patient experience with the primary care practice: AHRQ's Clinician & Group Survey of Adult Primary Care 1.0 (CG-CAHPS) survey.	
Brohman et al	Canada	Mixed method	Patient portal in general	- Administrative data	- To describe the findings from a home-based remote patient monitoring system that transmitted data about a patient's health status from home to healthcare providers through the patient use of portal.	- After many tries, the enrollment process was figured out which allowed for growth. The portal was found to be useful. Allowed family members to track the health of their loved ones. Enrollment process negatively impacted the scope of deployment. The portal was not integrated with the EMR.
eHealth Saskatchewan	Canada	Mixed method	Patient portal in general	- Survey - Focus group - Patient portal administrative data - EHR administrative data	- A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	- By the time of the final survey, 88% reported that the portal allowed to manage their health better. 43% of respondents indicated that they had actually shared their information with a family member or care provider by the end of the rollout. - Patients reported easy of usability: 58% of participants stated that CHIP was easy to navigate. 75% of providers did not feel that CHIP had increased their workload. By survey two, 50% of respondents felt CHIP had positively impacted their relationship with their healthcare provider. 83% of respondents confirm having access to results prior to appointment with physician results in more value. - 60% felt CHIP had resulted in an increased sense of partnership with their health care provider. 86% of respondents report a decrease in the number of visits to their health care provider. 43% indicated they had shared their personal health information with family members or care providers. Of this number, 73% report a positive impact due to sharing. Less than 1%

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						reported using the medication reminder feature in CHIP.
Holland Bloorview	Canada	Mixed method	Patient portal in general	• Surveys • Semi-structured interviews	• Cross sectional survey of patients • Existing satisfaction measures • Case studies/series and focus groups • Clinician Interviews	• 97% of survey respondents (58/60) would definitely or probably recommend connect2care to other clients and families of Holland Bloorview as a tool to support care. • The average number of unique sessions per month between the months of June 2015 and October 2015was 420, ranging from 325 to as many as 473.
Children's Hospital of Eastern Ontario	Canada	Mixed method	Patient portal in general	• EHR administrative data	• Adopted the LEAN metholdolgy which was aligned with all indicators. • Evaluation conducted based on 'Key Performance Indicator Workbook' and 'CHEOnext Strategic Directions'.	• Although it was anticipated that there would have bene more telephone calls related to results, our analysis in fact demonstrated a reduction in calls post implementation resulting in time savings of 77 minutes (1.3 hours) per month. 33% of end users avoided making a telephone call. • The average telephone calls per month increased by 17 from 48 to 65 for MyChart® active users and increased by 80 from 287 to 366 for non-active users. • The majority of patients/families agreed the portal was easy to use (89%), their health information was accurate (83%), their personal information was secure and private (91%) and they felt more confident managing their health and well-being (or that of the person they care for) (70%). • Twenty-eight percent (28%) of patients/families avoided making a telephone call to a healthcare provider because they could access health information electronically. • 90% of the participants would recommend MyChart® to family or friends as a tool to support their healthcare. 205 patients/proxies have accessed

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						MyChart® over 1,800 times having over 11,000 feature hits. The overall enrollment number was less than CHEO anticipated but was on par with current literature on adoption rates.
Health Quality Innovation Collaborative	Canada	Mixed method	Patient portal in general	• Survey • Patient portal administrative data • EHR administrative data	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• The overall responses were positive. 17.40% of responses either did not receive a prescription or don't know if they received a prescription. 94.7% saved time by not having to travel to see the doctor. • 21.1% said they saved time by not having to arrange for childcare or other care for someone else they cared for with an average saving of 3 hours. • 100% saved money by not having to pay for gas, parking, public transit etc. 69% said they would recommend the e-Refill requests to other patients, family or friends. 63% would request all or most of their prescription refills electronically. • A significant decrease (-74%) in the wait time for a patient to interact with their health care provider.
Group Health Centre	Canada	Mixed method	Patient portal in general	• Survey • Focus group • Patient portal administrative data • EHR administrative data	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• 99% of patients reported confidence to recommend to other. Office efficiency in terms of decreased calls (73%) and no visit necessary (48%). • The most used functions: test results (78%); messaging (59%); scheduling an appointment (51%); and prescription renewal (50%). Ease of uses was based on easy registration (93%); not much training needed (90%); satisfaction with layout (90%); and user friendly (97%). Experienced value determined by having access to results (94%); health information available online (94%); messaging (90%); prescription refills (89%); proxy (85%). • Use indicators (log ins, medical advice requests and medical renewal requests) showed 57,441 target uses.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Barrie Community Health Link	Canada	Mixed method	Patient portal in general	• Survey • Patient portal administrative data • EHR administrative data	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• The patient portal acted as an “expansion of the standard 15-minute consultation appointment enabling patient access to a very valuable resource”. • From the patients’ perspective, the results were very favorable in support of a portal. Patients value the access to both their provider and their own personal health information. There was an overwhelming interest in receiving their results. • Patients demonstrated a readiness and willingness for more active engagement in the management of their health care. 27.4% of patients identified that they have used the patient portal at least once over the pilot period to request an appointment with a primary care provider.
Agency for Healthcare Research and Quality	United States	Mixed method	Patient portal in general	• Survey • Patient portal administrative data • EHR administrative data	• Various survey and administrative data from portal use and health records system were summarized to show impact of patient portals on decreasing disparities.	• Over 50% of the non-federal acute care hospitals in the US offer portals. Optum Institute/Harris Interactive Multi-stakeholder Health Care Environment Survey, June 2012 showed that there was a high interest in using portals and access to information. • Patients stating that they find it useful and easy. • Useful for patients due to informational supplement to verbal communication, objective indicator of health and progress in the hospital, gave patients ownership over data, and wanted access to outpatient notes as well. “If only affluent, well-educated patients can access portals and understand them, then these technologies could potentially worsen health disparities.” Disparities began with who was offered an access code.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
The Social Research and Demonstration Corporation	Canada	Mixed method	Patient portal in general	• Survey • Semi structured interviews	• Surveys and interviews were conducted with patients to explore impact of viewing laboratory results through a patient portal.	• Service users also reported significantly higher rates of satisfaction with the overall process of having lab tests completed. Rates of lab test-related anxiety were low for both groups. Direct lab access was not associated with increased contact with physicians and their offices. • The comparison group were significantly more likely to have made contact with their health care provider while waiting for the results (28%) relative to the service users group (9%). The odds of in-person visits were lower (OR=0.82, $p < 0.1$) for those who had six or more lab tests per year. • Those who first learned their results online had significantly lower odds of knowing if they needed to follow up with their physician (OR=0.37, $p < 0.001$). Patients in the service users group (27%) were slightly but significantly more likely to feel some anxiety beforehand, relative to patients in the comparison group (23%). Some anxiety was explained by an "empowerment effect" related to online access to results and related information
Canada Health Infoway	Canada	Survey method	Patient portal in general	• Survey	• A survey was conducted to capture the citizens' use and interest in accessing their health information online and digitally enabled health services.	• Total market interest in selected digital health services, 2019, %: e-view personal health information 79%, e-view RX & RX history 76%, e-RX renewal request 76%, e-booking services with regular doctor 75%, appointment reminders 75%, specialist referrals tracking 74%, e-booking services with specialists & other health professionals 72%, e-view specialist referral request 69%, virtual care- secure email 64%, e-assessment of health / mental health status 64%, web & app for monitoring health/ well-being 60%, virtual care- SMS or app 59%, e-mental health tools

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						58%, remote patient monitoring device for home 54%, and virtual care - virtual visit 44%. Did access in past year: 2018 15%, 2019 17%. Have ever accessed 2018 17%, 2019 20%. Can currently access 2018 22%, 2019 27%. 63% were satisfied with the online access. 37% have avoided an in-person visit (doctor or ED). 12% viewed list of current prescriptions in 2019.
Canada Health Infoway	Canada	Survey method	Patient portal in general	• Survey • Patient portal administrative data	• A survey was conducted to capture the citizens' use and interest in accessing their health information online and digitally enabled health services.	• 36% of patients avoided an in-person visit. 67% of patients felt better able to manage their health. At 50% adoption, it was estimated that patients and caregivers could avoid costs estimated at $940 million in travel and expenses.
Canada Health Infoway	Canada	Mixed method	Patient portal in general	• Semi-structured interviews	• Conducted key informant interviews to gain insights about portal use.	• Concerns with privacy and security. The capacity to consent was incremental and situational. Most common ways of providing access was on a Case-by-Case Assessment. Establishment of proxy access for teenagers requires discussions about the capacity of a minor, cut-off age. • "Ages 0-11: A parent or legal guardian can be granted full access to MyChart®. The patient will have access only with parent/guardian permission. • Ages 12-15: A parent/guardian can be granted full access to a patient's MyChart® record unless the patient advises CHEO that s/he doesn't want that parent/guardian to have access. • Ages 16 or older: The parent/guardian will only have MyChart® access if the patient gives permission by proxy."
eHealth Saskatchewan	Canada	Mixed method	Patient portal in general	• Semi-structured interviews	• Conducted key informant interviews to gain insights about portal use.	• The range of technology adoption in the participant pool, spanning the full scope of the Rogers' continuum.

Author/s	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						- Strong support for empowerment was evident and many positive views about the concept were expressed. - Patients wanted to know more and wanted access to be maintained.
Canada Health Infoway	Canada	Survey method	Patient portal in general	- Survey	- Survey was implemented to seek input from citizens in their ability to access health information online.	- The majority of Canadians (85%) reported they currently have a regular doctor/place of care. The majority (58%) saw multiple care providers – in addition to their regular doctor/place of care. - Approximately two-thirds of Canadians (18yrs+) were prescribed a medication in the past two years. When prescriptions were lost or damaged, most patients (83%) proactively find a way to contact the prescriber to get the medication, while 17% decide to go without the medication. - Among those who currently access medical records online, lab test results were the most common type of health information accessed – primarily via a lab testing company website. - 71% preferred to view lab results as soon as testing was complete. - Making appointments electronically was on par with results from 2016. Current levels of access to e-visit and virtual visit e-services was down significantly since 2016 (-4% e-visits and -2% virtual visits). - Interest in these e-services had significantly increased. Among other e-services, 1 in 10 Canadians could utilize online tools for viewing and notification of specialist referrals. - Similarly, ~10% could send text (SMS) messages to consult with their doctor/ regular place of care. These e-services were of high interest to Canadians.

Author/s	**Country**	**Study design**	**Evaluated patient portal features**	**Methodological approach for evaluation**	**How was the methodology implemented**	**Study results**
Canada Health Infoway	Canada	Qualitative method	Patient portal in general	• Semi-structured interviews	• Synthesized outcomes generated by benefits evaluations conducted at multiple sites implementing PHRs and/or eServices in Canada, across different types of care settings.	• 7%-8% Canadians reported accessing their medical records online. • 5% - 8% consulted with healthcare providers online via e-mail. • 3% - 4% visited virtually with provider online. • 10% - 12% sent an Rx renew request online.

Table 14: Population perspective

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Hanna et al	Australia	Qualitative method	Patient portal in general	• Semi structured interviews	• Interviews lasted 30– 45 min and were audio-recorded and transcribed verbatim prior to analysis. • Interviews explored participants' reasons for registering with and using the portals. Also, explored participants' expectations and lived experiences of using the portal, usability, perceived effects on health outcomes, and suggestions for system improvement.	• Participants identified two advantages of portals: improved quality of care due to access to the health information; and the ability to use the information to manage their own healthcare. • Patients suggested that more providers should be using the portal. • The portal needed to be more accessible and simple to use. • Lack of awareness of portals might be one reason for low registration and use by consumers and healthcare providers.
Cutrona et al	United States	Randomized Controlled Trial	Reminders	• Survey • EHR administrative data	• This was a RCT where patients were assigned to one of the study arms: receipt of a portal message promoting influenza vaccines, (b) receipt of interactive voice recording call with similar content, (c) both a and b, or (d) neither (usual care). • Tracked self-report (via portal or interactive voice response calls) of influenza vaccines administered outside the medical group. • The primary outcome was the receipt of an influenza vaccine. • Barriers were captured via a survey.	• Small but statistically significant improvement in completion of influenza vaccination among portal users receiving a portal message, an interactive voice recording call, or both. • Attained greater than 50% rates for patients to open portal messages, and over two-thirds of those who logged in during flu season opened the reminder message.
Lyles et al	United States	Retrospective method	Prescription request and renewal	• EHR administrative data	• Medication adherence was calculated by the percentage of times that patients lacked a supply of medication. • Compared refill function users with those who used other online portal features but did not use the refill function.	• The most highly engaged online refill function users experienced significant improvement in statin adherence regardless of their race/ ethnicity. • Once patients started using the portal, medication adherence increased.

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Szilagyi et al	United States	Randomized Controlled Trial	Reminders	• EHR administrative data • Patient portal administrative data	• Vaccination reminder letters were distributed through a patient portal. The letters included: information that influenza season was coming; recommendation to receive an influenza vaccine; a website link to input influenza vaccinations received elsewhere; and another website link to a containing information about influenza vaccine and video testimonials about influenza vaccination. • Patient characteristics were collected through administrative EHR data. • Metrics: opened the portal reminder letter; updated influenza vaccinations received outside the system; and clicked on the informational website link embedded in the portal letter.	• Vaccination rates were 37.5% among controls (no reminders), 38.0% in the 1-reminder group (P = .008 vs controls), 38.2% in the 2-reminder group (P = .03 vs controls), and 38.2% in the 3-reminder group (P = .02 vs controls). • A small, statistically significant effect on increasing influenza vaccination rates among adults aged 18 to 64 years, male patients, non-Hispanic patients, and those not vaccinated in the prior 2 years. • Only 0.3% of portal user accessed the influenza educational materials. When self-reported vaccinations received elsewhere were included, influenza vaccination rates were 1.4 to 2.9 percentage points higher in the portal reminder groups.
Foster et al	United States	Retrospective method	Viewing laboratory and diagnostic results	• EHR administrative data • Patient portal administrative data	• Conducted a retrospective analysis of EHR patient portal records. For viewing of the diagnostic test results, an analysis was performed for both the total cohort (including those who have never activated a patient portal account) and the more limited subset with active patient portal accounts. • Analysis of the 2 populations helped address the separate impact of 2 broad barriers in patient portal usage: getting patients to activate accounts and, once activated, to utilize portal functionality such as viewing diagnostic test results.	• Activation rates were lower for those with only a single ED visit (7312/20,430, 35.79%) compared with either those with 2 to 3 ED visits (1770/4069, 43.50%; P<.001) or 4 or more ED visits (368/862, 42.7%; P<.001). Overall, 8.91% of laboratory tests (18,573/ 208,635) ordered in the ED were viewed in the patient portal. • Females and white patients had higher view rates than males and non-white patients.

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
					- The intent was to describe the differences between active and inactive portal status. - Epic Reporting Workbench (RWB) was used as a reporting tool within the EHR that can retrieve data based on specified query parameters related to the patient portal use. - All laboratory test and radiologic imaging orders during the emergency department encounters were captured.	
eHealth Saskatchewan	Canada	Mixed method	Patient portal in general	- Survey - Focus group - Patient portal administrative data - EHR administrative data	- A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	- By the time of the final survey, 88% reported that the portal allowed to manage their health better. 43% of respondents indicated that they had actually shared their information with a family member or care provider by the end of the rollout. - By survey two, 50% of respondents felt CHIP had positively impacted their relationship with their healthcare provider. 83% of respondents confirm having access to results prior to appointment with physician results in more value.
Health Quality Innovation Collaborative	Canada	Mixed method	Patient portal in general	- Survey - Patient portal administrative data - EHR administrative data	- A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	- The overall responses were positive. 17.40% of responses either did not receive a prescription or don’t know if they received a prescription. 94.7% saved time by not having to travel to see the doctor. 21.1% said they saved time by not having to arrange for childcare or other care for someone else they cared for with an average saving of 3 hours. 100% saved money by not having to pay for gas, parking, public transit etc. 69% said they would recommend the e-Refill requests to other patients, family or friends. 63% would request all or most of their prescription refills electronically.

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						- A significant decrease (-74%) in the wait time for a patient to interact with their health care provider.
Group Health Centre	Canada	Mixed method	Patient portal in general	- Survey - Focus group - Patient portal administrative data - EHR administrative data	- A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	- 99% of patients reported confidence to recommend to other. Office efficiency in terms of decreased calls (73%) and no visit necessary (48%). - The most used functions: test results (78%); messaging (59%); scheduling an appointment (51%); and prescription renewal (50%). Ease of uses was based on easy registration (93%); not much training needed (90%); satisfaction with layout (90%); and user friendly (97%). Experienced value determined by having access to results (94%); health information available online (94%); messaging (90%); prescription refills (89%); proxy (85%). - Use indicators (logins, medical advice requests and medical renewal requests) showed 57,441 target uses.
Barrie Community Health Link	Canada	Mixed method	Patient portal in general	- Survey - Patient portal administrative data - EHR administrative data	- A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	- The patient portal acted as an "expansion of the standard 15 minute consultation appointment enabling patient access to a very valuable resource". - From the patients' perspective, the results were very favorable in support of a portal. Patients value the access to both their provider and their own personal health information. There was an overwhelming interest in receiving their results. - Patients demonstrated a readiness and willingness for more active engagement in the management of their health care. 27.4% of patients identified that they have used the patient portal at least once over the pilot period to request an appointment with a primary care provider.

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Agency for Healthcare Research and Quality	United States	Mixed method	Patient portal in general	• Survey • Patient portal administrative data • EHR administrative data	• Various survey and administrative data from portal use and health records system were summarized to show impact of patient portals on decreasing disparities.	• Over 50% of the non-federal acute care hospitals in the US offer portals. Optum Institute/Harris Interactive Multi-stakeholder Health Care Environment Survey, June 2012 showed that there was a high interest in using portals and access to information. • Patients stating that they find it useful and easy. • Useful for patients due to informational supplement to verbal communication, objective indicator of health and progress in the hospital, gave patients ownership over data, and wanted access to outpatient notes as well. “If only affluent, well-educated patients can access portals and understand them, then these technologies could potentially worsen health disparities.” Disparities began with who was offered an access code.
The Social Research and Demonstration Corporation	Canada	Mixed method	Patient portal in general	• Survey • Semi structured interviews	• Surveys and interviews were conducted with patients to explore impact of viewing laboratory results through a patient portal.	• Satisfaction with the overall process for delivery of lab test results was generally high, particularly in the service users group, where 91% scored 7-10 on this item. • The comparison group were significantly more likely to have made contact with their health care provider while waiting for the results (28%) relative to the service users group (9%). • The odds of in-person visits were lower (OR=0.82, $p < 0.1$) for those who had six or more lab tests per year. Those who first learned their results online had significantly lower odds of knowing if they needed to follow up with their physician (OR=0.37, $p < 0.001$). • Patients in the service users group (27%) were slightly but significantly more likely to feel some anxiety beforehand, relative to patients in the

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
						comparison group (23%). Some anxiety was explained by an "empowerment effect" related to online access to results and related information
Canada Health Infoway	Canada	Survey method	Patient portal in general	• Survey	• Survey was implemented to seek input from citizens in their ability to access health information online.	• The majority of Canadians (85%) report they currently have a regular doctor/place of care. The majority (58%) also see multiple care providers – in addition to their regular doctor/place of care. • Approximately two-thirds of Canadians (18yrs+) were prescribed a medication in the past two years. When prescriptions were lost or damaged, most patients (83%) proactively find a way to contact the prescriber to get the medication, while 17% decide to go without the medication. • Among those who currently access medical records online, lab test results were the most common type of health information accessed – primarily via a lab testing company website. • 71% preferred to view lab results as soon as testing was complete. • Making appointments electronically was on par with results from 2016. Current levels of access to e-visit and virtual visit e-were down significantly since 2016 (-4% e-visits and -2% virtual visits). • Interest in these e-services had significantly increased. Among other e-services, 1 in 10 Canadians could utilize online tools for viewing and notification of specialist referrals. • Similarly, ~10% could send text (SMS) messages to consult with their doctor/ regular place of care. These e-services were of high interest to Canadians.

#	Country	Study design	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented	Study results
Canada Health Infoway	Canada	Survey method	Patient portal in general	• Survey	• Survey was implemented to seek input from citizens in their ability to access health information online.	• Many PHR initiatives in Canada. More knowledge of their health increased (78- 94 %). More confident managing their health (78- 95 %). • More involved in their health care 77%. Allowed them to have more informed discussions with their doctor 93 %.

Table 15: Healthcare workforce perspective

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
Grünloh et al	Sweden	Qualitative method	Patient portal in general	• Semi-structured interviews	• The main research question was: “how do physicians view the idea of patient participation in general and in particular in relation to patient accessible electronic health records (PAEHR)?” • Interviews were transcribed, translated, and repeatedly read by all authors. Researchers used the same template for questions to cover the required areas of interest. Complete coding was used for the thematic analysis.	• Providers not necessarily opposed to patients having access. But providers needed to understand the needs of the patient and then guide the patient toward the right treatment. • Providers stated that portals have negative impact on "the anxious, the layperson, the child, the detail-focused, the overwhelmed, and the shopper patient". • “Patient empowerment” as a problematic concept.
Bush et al	United States	Mixed method	Patient portal in general	• Survey • Semi-structured interviews	• A survey was distributed among healthcare providers. • The first part of the survey captured areas such as quantified demographics; attitude toward technology adoptions (respondent’s type and frequency of social medial use); and number of e-mails, telephone calls, and secure messages received monthly from patients to approximate practice volume. • The second consisted of 15 questions with a 5-item Likert-type scale ranging from strongly disagree to strongly agree to capture responders’ perceptions of the effect of the portal on workload, telephone calls, patient satisfaction, number of patient visits, patient quality of care, treatment compliance, professional	• From the survey respondents, 72% were neutral as to whether it was easy to enroll patients, while 60% of the respondents stated that it improved patient care; 52% stated that it improved patient adherence. • Majority stated that the portal implementation did not negative impact on their salary but 43% believed that the portal increased their workload.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
					satisfaction, and impact on clinical income.	
Cajander et al	Sweden	Qualitative method	Patient portal in general	• Semi-structured interviews	• Semi-structured interviews were conducted with nurses to determine their views of how the portal implementation had impacted their work. • The interviews were transcribed and complete coding was used for the thematic analysis.	• Due to access to the medical record, patients came pre-prepared with more informed questions which led to “more in-depth discussions that took time for the nurses.” • Nurses were stressed over the fact that now patients could read the notes with the potential to read about serious diagnoses. Increased transparency requires providers to consider how they chart and what words were being used. Increased workload due to duplication on services. • Patients would send an email and call over the same questions. Nurses had to respond through both communication pathways. Nurses did not have the appropriate knowledge to educate/train patients. Nurses acknowledged that patients were more informed which lead to better provider-patient relationship.
Johansen et al	United States	Survey method	Patient portal in general	• Survey	• A survey was developed which was based on a questionnaire used during a pilot study that preceded the study pilot study was used as a template for the survey development. • The questionnaire was pilot-tested by four researchers several times until no suggestion for modification came up. No questionnaires were excluded from the analysis due to incomplete answers.	• 25.6% of administrative staff had received feedback from patients and/or their relatives regarding mistakes or missing information in their health record. 36.4% clinical and 36.8% administrative staff had received questions from the patients and/or their relatives related to use of the PAEHR. • More doctors than nurses claimed they changed their way of reporting, and twice as many doctors than nurses worried that they will have to spend more time reassuring patients, or their relatives, after they read their record.
Grossman et al	United States	Survey method	Patient portal in general	• Survey	• A healthcare provider survey instrument was developed. The instrument was based	• Providers did not see their patients as technology users. Perceiving certain patients as less likely to use

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
					on provider surveys from previous studies as well as the Telemedicine Satisfaction and Usefulness Questionnaire. • The instrument was tested and reviewed by the study team, which included 3 clinicians and an expert in questionnaire development. Questions used both negatively and positively worded stems to guard against acquiescence. • The final survey contained 5 items on inpatients' technology use, 8 items on perceptions of the portal and its impact on care, and 8 items on usefulness of portal features	technology impacted how providers promoted acute care portals to patients. • Every provider reported that displaying laboratory test results in the portal was moderately useful or very useful.
Moll et al	Sweden	Survey method	Patient portal in general	• Survey	• A questionnaire was developed which contained 12 multiple-choice questions covering the following areas: demography (age and years of working in health care); perceived effects on contact with patients; perceived effects on documentation practices; perceived effects on quality of care; attitude towards the portal system (Journalen); and effects supposedly experienced by patients. Four questions had binary answers (yes/no) and the rest had either interval choices (2 demographic questions) or 4-point Likert-type scale choices (7 questions).	• Results mainly showed moderate effects in the different areas that were surveyed. In most cases, no statistically significant differences between physicians and nurses could be found. • When asked if it was generally a good idea to make medical records available through the portal, 73% of the physicians and 79% of the nurses agreed or partly agreed. The results also showed that the majority of both physicians and nurses believe that the medical notes were confusing for most patients and that patient's felt more worried after accessing their records.
Vydra et al	United States	Mixed method	Patient portal in general	• Focus group • Survey	• A focus group was conducted with providers. An audio recording of the focus group was transcribed using detailed	• Among the factors contributing to patient-level adoption of PHRs, aggressive marketing by providers was identified as the strongest factor.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
					transcription, by focusing not only verbal content but also on the conversational features such as pauses, stuttering, and interruptions. This allowed for the capture of emotions, such as enthusiasm and discomfort, in addition to content. • Electronic survey was sent out to all primary care physicians affiliated with the medical center that were part of the MyChart® implementation. The surveys asked physicians to estimate the average amount of time spent per week on MyChart® activities, the average number of e-mails received by patients through MyChart®, the average number of new activations of patient accounts, and the average number of prescription requests.	• Physicians estimated spending an average of 12.5 hours per week logged into MyChart®; however, institutional records indicate an average of 8.2 hours per week ($p = 0.034$). Lower adoption rates of PHRs among older physicians.
Grünloh et al	Sweden	Qualitative method	Access to medical records and log list	• Semi-structured interviews	• Semi structured interviews were conducted with physicians from different specialties. Interviews were transcribed and translated. A theoretically informed thematic analysis was performed.	• The thematic analysis revealed 4 main themes: work tool, process, workload, and control. • Physicians saw themselves as owners of the records. The transformation of the medical record to a patient portal was seen as time consuming and a threat to the effectiveness of their work tool. • Paper access to record was not seen as controversial, but portal access was. The physicians described that patients who demand for them to sign various forms or ask for explanations at once would interfere with their work processes.
Winget et al	United States	Survey method	Viewing laboratory and	• Survey	• Developed a questionnaire to obtain the opinions and experiences of practicing	• Oncologists agreed that patient online access to abnormal radiology/ pathology results had negative

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
			diagnostic results		oncologists approximately 4 months after the portal was implemented. - The questionnaire included six Likert-scale questions: four about oncologist opinions and two about their experiences with release of radiology and pathology results to patients, and one open-ended additional comment field.	consequences (87%), whereas opinions were more mixed for normal results. - A strong majority of respondents wanted, at most, 14 days to communicate results to patients, only 27% wanted 7 days (the current embargo).
Lieu et al	United States	Qualitative method	Secure messaging	- Semi-structured interviews	- Conducted semi structured, in-depth telephone interviews with primary care physicians, including internists and family practice physicians, and primary care chiefs. The questions focused on identifying local practices with a range of group-level strategies for inbox support.	- Participants expressed mixed feelings about the increased ease of patient access created by secure portal messaging. All participants described electronic messaging as having led to increased work outside normal work hours. - Several participants reported anxiety from the lack of limits on the volume of electronic messages. Physicians described varying approaches to timing their replies to patient messages.
Åkerstedt et al	Sweden	Survey method	Patient portal in general	- Survey	- A survey was developed based on the questionnaire “Questions on violence and threats about violence”. Two variations of the same basic questionnaire were constructed. At the very end of the questionnaire, the respondents were given a chance to give their overall comments.	- Two out of five of respondents indicated that they believed that risks of threats and violence increased as patients gain access to their online EHRs. - The psychiatric staff were more prone than the emergency staff to believe that the risks would increase. These differences between the groups were, however, not statistically significant.
Shaw et al	United States	Mixed method	Patient portal in general	- Survey	- A survey was conducted with the two nurse navigators who were part of an educational intervention for post-operative patients.	- Nurses reported barriers to providing portal education due to inconsistent patient volumes, low referrals, understanding, and patients had subsequent appointments.
Federman et al	United States	Qualitative method	After visit summary /	- Focus groups	- Focus groups and interviews were conducted with clinicians in adult primary care practices serving socioeconomically	- Core themes included the use and purpose of the AVS, content modification and prioritization, formatting improvements, customization, privacy and accuracy

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
			clinical summary	- Semi-structured interviews	diverse communities. Focus group and interview transcripts were coded and analyzed following standard qualitative methods.	concerns, and clinician workflow concerns. Clinicians viewed the AVS as a valuable tool for communicating health care information. - They emphasized the need for improvement. There was dissatisfaction with the EHR-generated AVS. Clinicians raised concerns about the risk of violating patient privacy and challenges to clinician workflow.
Sieck et al	United States	Qualitative method	Secure messaging	- Semi-structured interviews	- All interviews were conducted by telephone by using a semi structured interview guide. The interviews were transcribed verbatim to permit rigorous qualitative analysis by focusing on the themes involving secure messaging.	- Providers appreciated the ability to use secure messaging for communication. An electronic record of exchanges as a benefit. Concerns about overuse and security of information expressed by providers in pre-implementation studies may no longer apply as users gain experience. - Providers articulated a lack of clarity as to the appropriate way to communicate via MyChart® and suggested that additional training for both patients and providers might be important.
Pillemer et al	United States	Mixed method	Viewing laboratory and diagnostic results	- Semi-structured interviews	- Conducted qualitative interviews with physicians. The interviews were conducted via telephone by the study authors and were audio recorded and transcribed. - The physicians were part of an EHR advisory panel of practicing primary care physicians.	- The interviewed physicians were concerned about patient anxiety resulting from patient portal test release. Several providers described experiences in which patients contacted them for abnormalities that were clinically insignificant, increasing the clinician's workload. Some physicians perceived that quick interpretations of the results eliminated patient anxiety.
Broman et al	United States	Prospective method	Uploading of images and symptoms	- Survey	- A survey was conducted with surgeons to compare their views about the efficacy of online vs in-person visits, amount of time required for patients and surgeons to complete each visit type, and agreement	- Using patent portal was effective in the postoperative care and follow up. - Surgeons reported that online and clinic visits were equally effective for 68% (34 of 50) of patients; the clinic visit was more effective for 24% (12 of 50) and the online visit was more effective for 8% (4 of 50).

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
					between findings on online vs in-person evaluations.	• Evaluative findings for online vs clinic visits were generally in agreement.
Wang et al	China	Survey method	Patient records	• Survey	• A self-administered surveys were sent by postal mail to registered doctors. The survey contained questions on subjects' awareness, acceptance, and perceptions of portals, perceived benefits and obstacles of participating in the program, reasons for not using the system after enrolling, and perceived areas for service improvement of the system.	• Patient and doctor levels of use were dependent on each other. Among enrolled users of the portal, 67% of doctors were satisfied with its overall performance. Enrolled patients, in general, had higher satisfaction levels than enrolled doctors ($P < 0.001$). Around 10% ([40+10]/409, 12.2%) of enrolled doctors were dissatisfied or very dissatisfied with the online system, which was far higher than that among enrolled patients ([1+1]/501, 0.4%)
King et al(173)	Canada	Prospective method	Patient portal in general	• Survey • Patient portal administrative data • Semi-structured interview	• Adopted a concurrent triangulation approach, in which quantitative and qualitative data were collected at the same time and integrated at the level of interpretation.	• Service providers were concerned about how to best manage their investment of time and effort (the use, effort, and investment in the portal theme).
Women's College Hospital	Canada	Mixed method	Patient portal in general	• Survey • EHR administrative data	• Surveys were distributed to each wave cohort of healthcare providers to capture their experiences with portal implementation.	• The implementation was done in 3 wave cohorts of providers and locations. Wave 2 respondents exhibited statistically significant rates of dissatisfaction with respect to training and support as compared to the Wave 1 and Wave 3 cohorts. • The Physician cohort exhibited statistically significant rates of dissatisfaction with respect to completion of clinical documentation using Epic than did their Nursing and Health Discipline cohorts. Issues were reported with the scheduling, workflow, technology, incomplete information, and inappropriate work templates. Highest satisfaction was reported with access to service.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
Barrie Community Health Link	Canada	Mixed method	Patient portal in general	• Survey • Patient portal administrative data • EHR administrative data	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• 100% of the champion users of the portal indicated that the portal had improved the communication and interactions between themselves and their patients. • 52.3% of providers believed that the portal had not improved their interactions with patients. 73.7% of patients rated that the portal improves transparency in the care that they receive.
Canada Health Infoway	Canada	Mixed method		• Semi-structured interviews • Environmental scan	• To gain understanding about what information patients were sharing (or want to share) with their health care providers that would contribute to providers' understanding of who they were as people, beyond who they were as patients	• "Getting to Know Me" forms have been developed in various health care systems to assist providers to learn about their patients. These type of documents go under various names such "All About Me", "Patient Story", "We Ask Because We Care", "Know Me", "Patient Preference Passport". • In an evaluation done on Phase 1, the majority of staff (91%) reported that the form was easy to use, with 70% reporting it was not time consuming, 74% citing that it decreased patient agitation and distress, 61% reporting that it led to a decrease in the use of physical or chemical restraints, and 79% reporting increased satisfaction with work.

Table 16: Health system perspective

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
Nicolas et al	Spain	Prospective method	Patient portal in general	• EHR administrative data	• The electronic health record data were used in the analysis. Pre-period observations and trends acted as controls for post-period observations. • Outcomes were any hospitalization, any emergency department use, any 30-day all-cause readmission and number of outpatient visits.	• The rate of hospital admissions decreased by 0.44/10 000 per month (5.28/10 000 per year) in the post-intervention period. The rate of 30-day all-cause readmission decreased by 0.44/10 000 per month (5.2/10 000 per year) after the implementation of the portal. • The portal was not associated with an increase in outpatient visit rates. The portal led to no changes in service use for persons with a malignant hematological disease.
Leveille et al	United States	Prospective method	OpenNotes	• EHR administrative data • Ambulatory care claims data	• From the EHR data repository, information about dates of hospital admissions and emergency department visits that occurred during the study period was obtained. • Obtained patient-level diagnoses from ambulatory care claims data. • Examined patient characteristics and health care utilization according to baseline portal login frequency within each site. • Login days were categorized according to the average number of login days per month: no login days, fewer than 2 login days per month, and 2 or more login days per month. • The goal was to examine the relationship between portal use and primary care visits.	• In the first 2 months of the 2-year period, 14% of 44,951 primary care patients engaged in portal use 2 or more days per month, 31% did so 1 day per month, and the remainder had no portal use. Less than 0.1% of patients engaged in high levels of portal use. Office visits led to subsequent clinical portal use. • Did not observe an increase in the correlation between login days and primary care visits. • Could not confirm specific relationships between patients viewing their records and, as a result, choosing to make appointments to see their primary care providers.

Author/s	**Country**	**Study design/ characteristics**	**Evaluated patient portal features**	**Methodological approach for evaluation**	**How was the methodology implemented?**	**Study results**
Dexter et al	United States	Retrospective method	Secure messaging	• EHR administrative data • Patient portal administrative data	• A retrospective time series analysis of the correlation between the rate of MyChart® messages and incoming telephone calls. • Consecutive monthly differences for both MyChart® messages per 1000 patients and telephone calls per 1000 patients were calculated. • Portal use was defined as: electronic patient-to-physician messaging. • Incoming calls were defined: calls placed during regular business hours to the clinic. • Panel size was defined: the number of unique patients who have had a visit with their primary care provider at the provider's clinic within the past 3 years.	• The hypothesis was that increase in secure messages would decrease telephone calls. • Four clinics were part of the study. Electronic patient-to-provider messaging was significantly positively correlated with incoming telephone calls at 2 of the 4 clinics (r=0.546, $P < .001$ and $r = 0.543$, $P < .001$). For the other 2 clinics, there was no indication of even a slight decrease in telephone calls. • As secure messages increased, so did the telephone calls. Staff had to adjust workflow to handle both approaches. Patients did not know how long to wait for an answer through the portal, so additional calls were made. • Assumption was made that appointment scheduling increased the number of calls. Several issues with the appointment system were identified.
Bryan et al	United States	Retrospective method	Secure messaging	• EHR administrative data	• This was a retrospective cohort study used EHR administrative data. • Focus was on capturing the association between the number of messages sent and the number of traditional encounters. Examine the differences in number of traditional encounters and patients who sent at least 1 message the year after activation and those who sent none.	• 28% patients sent at least 1 message. Patients who sent messages were more likely to be female (63.9% vs 58.0%, P<0.001), white (92.2% vs 90.0%, P< 0.001), and have depression (27.0% vs 24.2%, P <0.001) than those who sent none. • Patients who sent messages had a greater number of traditional encounters the year after activation than those who sent none (mean 17.6 vs 11.4, P< 0.001). Also had both more in-person office visits (7.6 vs 5.0, P< 0.001) and telephone calls (9.9 vs 6.4, P< 0.001). • As the number of messages sent increased, so did the number of encounters. Patients who sent 1 message had 2.4 times greater odds of having a traditional encounter.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
Zhou et al	United States	Retrospective method	Patient portal in general	• EHR administrative data • Patient portal administrative data	• Portal administrative data was used to evaluate the levels of PHR use by pediatric patients and their caregivers. • The intent was to evaluate the associations between PHR use and health care utilization. • PHR use was defined as the total number of features accessed on behalf of the child by the child's caregiver. • Calculated the average number of outpatient clinic visits, telephone encounters, and emergency department visits between PHR-registered and nonregistered children. The data was from when children were 18 months of age until they reached 2.5 years or until they became disenrolled as members. • Message thread was defined as: the initial secure message along with all responses either by a proxy or the health care provider. • Counted each secure message thread once.	• PHR users had a higher mean number of ambulatory care visits (5.2 vs 4.1; P<.0001) and telephone encounters (3.5 vs 2.6; P<.0001). • The difference in the number of emergency department visits was not statistically significant between users and non-users. • PHR use lead to the identification of additional health concerns that lead, in turn, to increased use of outpatient clinic visits and telephone encounters. • Occasional PHR use was not associated with higher health care utilization. • PHR use by caregivers was associated with statistically significant increases in outpatient clinic visits and telephone encounters among pediatric patients.
Riippa et al	Finland	Prospective method	Secure messaging	• EHR administrative data	• The cost of primary health care contacts during the 6 months before the intervention and in the 6 months following were calculated for each individual, as were the costs of providing access to the portal.	• Costs decreased by an average of €91 in the unadjusted model, but increased by €48 in the adjusted model. • The unadjusted analysis showed an 89% probability of cost-effectiveness with no willingness to pay for increased patient activation, whereas in the adjusted sample, the probability of the portal being more cost-effective than care as usual exceeded 50% probability at a willingness to pay €700 per clinically significant increase in patient activation score.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
					• The use of primary health care resources was collected directly from the patient administration system. • Extracting the patient-level was done by using the Ambulatory and Primary Care Related Patient Groups (APR) grouper software.	• Although no statistically significant improvement (>90% probability) in cost-effectiveness was detected, the results indicated over 50% probability for cost-effectiveness of the intervention at a willingness to pay €18 per 1-point increase in the patient activation score. • The results of the cost-effectiveness analysis show some support for the cost-effectiveness of a simple electronic patient portal that provided patients access to their own health records and secure messaging with the health care provider.
Zhong et al	United States	Retrospective method	Patient portal in general	• EHR administrative data • Patient portal administrative data	• Difference-in-Difference model for heterogeneous enrollment and treatment times was developed. • The intent was to investigate the use of primary care services by patients, adjusting for their disease burden and allowing for time-dependent portal effect. • The main outcome measures were disease burden adjusted rates of office visits arrived, no-show, and cancellation to primary care physicians per quarter between patient portal users and non-users.	• The quarterly primary care physicians' office visit rate ratio (RR) of patient portal users to non-users was 1.33 (95% CI, 1.27–1.39; $p < 0.001$). • The quarterly no-show rates of the users were significantly smaller except for the seventh, eighth and tenth quarters post adoption. Quarterly cancellation rates were not significantly affected by portal adoption ($p > 0.05$ for all cases). • Portal users were found to have fewer office visits. No-show rate of the user group were significantly lower than that of non-users. • The differences in cancellation rate was not significant between users and non-users.
Zhong et al	United States	Retrospective method	Patient portal in general	• EHR administrative data	• Demographics and patient information were obtained from the EHR, in addition to their active problem number (APN). • Patient's APN was considered as a time-varying confounder to account for individual disease burdens.	• A high propensity to adopt patient portals did not necessarily imply more frequent use of portals. • The number of active health problems was significantly negatively associated with portal adoption (all $P<.001$) but was positively associated with portal usage (all $P\leq.01$). The same was true for being enrolled in Medicare for portal adoption and message usage.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
					• To characterize portal usage patterns, focused on four major portal functions: messaging, laboratory, medication, and appointment. • The intent was to evaluate how portal usage affects primary care service utilization and appointment adherence. • Patients' office visits and telephone encounters were used as an indicator of the overall primary care service utilization.	• The no-show rates were significantly lower in most quarters postadoption. Users were lower by 30% on average than nonusers. • Patients using more messaging and messaging and laboratory combined had a larger reduction in no-show rates (P<.001).
Sorondo et al	United States	Prospective method	Patient portal in general	• EHR administrative data	• Data was obtained from the electronic medical records reports on the forms filled by participants using the portal.	• Emergency department visits/ 1000 patients were reduced by 26% and 21% in the intent to treat and users groups, respectively. • Hospital admissions/ 1000 patients were reduced by 46% in the intent to treat group and by 38% in the users group.
Mendel et al	United States	Survey method	Appointment reminders	• EHR administrative data • Patient portal administrative data	• Baseline measures were captured from the administrative data. • No-shows were studied through a prospective chart review and telephone interviews. • Process measures: portal enrolment, email reminder receipt, and call volumes. • Outcome measures were no-shows and patient and staff satisfaction.	• Reminders were associated with higher patient satisfaction and decrease in no-show appointments after 3.5 months, but it was not sustained thereafter. • Promoting portal for reminders, increased immediate enrollment. • Technical issues and lack of reminders did not decrease no-show appointments.
Plate et al	United States	Retrospective method	Secure messaging	• EHR administrative data	• Usage and healthcare utilization data were analyzed.	• Active MyChart® status was not associated with 90-day ED return. For patients who sent 2 or more MyChart® messages, a provider or staff response rate of <75% was significantly associated with 90-day readmission

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
				- Patient portal administrative data		(P=.004) and showed greater 90-day ED visits that neared statistical significance (P=.070).
Dumitrascu et al	United States	Retrospective method	Patient portal in general	- EHR administrative data	- EHR was used to obtain: patient demographics, clinical information, and hospital outcomes (30-day readmission, 30-day mortality, and inpatient mortality).	- Out of the admitted patients with a portal account, 20.8% accessed the portal while in the hospital. - Compared to patients who did not access the portal, patients who accessed the portal had fewer elective admissions (54.2% vs 64.1%), were more frequently admitted to medical services (45.8% vs 35.2%), and were more likely to have liver disease (21.9% vs 12.9%) and higher disease severity scores (0.653 vs 0.456). - There was no statistically significant difference between the users and non-user cohorts.
Shah et al	United States	Retrospective method	Appointment reminders	- EHR administrative data - Patient portal administrative data	- A retrospective chart review of: date of scheduled clinic visit, appointment status, MyChart® enrollment, sex, age, race, preferred language, and method of referral to the clinic. Patients were defined as (1) no-shows, (2) showed, and (3) canceled.	- Portal users had lower rates of no-show appointment compared to non-users. - Rate of cancellation was similar between users and non-users.
Griffin et al	United States	Retrospective method	Patient portal in general	- EHR administrative data - Patient portal administrative data	- Compared the average number of times active and light users used specific features in the 30 days after discharge.	- Approximately 15% of patients were readmitted within 30 days; 15% were non-users, 13% were light users, and 21% were active users. Only 16% used the patient portal within 30 days of discharge. - Statistically significant difference ($p<0.05$) in 30-day readmission between non-users and active users. For patients who were active users, the odds of being readmitted within 30 days was 66% higher than patients who were non-users.

Author/s	Country	Study design/ characteristics	Evaluated patient portal features	Methodological approach for evaluation	How was the methodology implemented?	Study results
Graham et al	Canada	Survey method	Patient portal in general	• Patient portal administrative data • EHR administrative data	• No-show rates were calculated for users with an active patient portal account at the time of the visit and compared to rates for users attending the same clinics without a patient portal account at the time of the visit.	• 53% relative reduction in the no-show rate seen in patient portal users in the 5 pilot clinics.
GL 3	Canada	Mixed method	Patient portal in general	• Patient portal administrative data • EHR administrative data	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• The patient portal data showed decrease in face-to-face visits.
GL 8	Canada	Mixed method	Patient portal in general	• Patient portal administrative data • EHR administrative data	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• The percentage of missed appointments was calculated by each participating clinic, and a comparison of the percentage change was made. • It showed that portal users missed 18% of total appointments compared to non-portal users' 20% missed appointments for 2015. It showed that portal users missed 9% of total appointments compared to non-portal users' 14% missed appointments for 2015.
GL 16	Canada	Survey method	Patient portal in general	• Survey	• A benefits evaluation framework approach was utilized to capture and document implementation of a portal within a health setting.	• Making appointments electronically was on par with results from 2016. Current levels of access to e-visit and virtual visit e-services was down significantly since 2016 (-4% e-visits and -2% virtual visits). Interest in these e-services had significantly increased. • Among other e-services, 1 in 10 Canadians can currently utilize online tools for viewing and notification of specialist referrals. Similarly, ~10% can currently send text (SMS) messages to consult with their doctor/ regular place of care. These e-services were of high interest to Canadians.

Table 17: Mapping the peer-reviewed studies according to the Benefits Evaluation Framework

Study	System Quality			Information Quality		Service Quality	Care Quality			Access		Productivity			Usage			User Satisfaction			Patient			Provider		Change/ Improvement	Implementation
	Functionality	Performance	Security	Content	Availability	Responsiveness	Patient Safety	Appropriateness/ effectiveness	Health outcomes	Ability of patients/providers to access services	Patient and caregiver participation	Efficiency	Care coordination	Net cost	Use Behavior/ Pattern	Self-Reported Use	Intention to Use	Competency	User Satisfaction	Ease of Use	Knowledge, attitude, perception, decision confidence, compliance	Overall satisfaction	Knowledge acquisition, relationship	Attitude, perceptions, autonomy, experience and performance	Workflow	Data quality improvement, reduced loss/paper and transcription errors	Barriers, training, organizational support, time-to-evaluation, lessons, success factors, project management, leadership, costs
Shaw 2017	X	X		X				X		X					X		X			X				X	X		X
Gerard 2017				X	X					X	X				X	X	X	X	X	X	X	X	X				
Giardina 2018				X	X					X						X			X	X		X	X				
Dumitrascu 2018									X	X				X	X		X										
Grunloh 2018								X		X		X	X		X			X	X	X	X		X	X	X		X
Kayastha 2018				X	X					X	X				X	X	X	X	X	X	X	X	X				
Bush 2017																								X	X		
King 2017				X	X					X	X	X				X	X	X	X	X	X	X	X	X	X		
Denneson 2018										X					X	X		X	X	X	X	X	X				
Chimowitz 2018										X	X				X	X			X	X	X	X	X				
Cajander 2018																								X	X		
Zhong 2018										X		X	X	X	X												
Moll 2018				X	X					X	X				X	X	X		X		X	X					
Plate 2019										X				X	X										X		
Shah 2019												X		X													
Robinson 2019		X		X	X					X					X	X			X	X	X	X	X				
Fossa 2018																X	X				X						
Reed 2019				X	X					X	X				X	X	X	X	X	X	X	X	X	X			
Cutrona 2018								X		X		X			X										X		

Study	System Quality			Information Quality		Service Quality	Care Quality			Access		Productivity			Usage			User Satisfaction			Patient			Provider		Change/ Improvement	Implementation
Walker 2019										X	X				X	X	X	X	X	X							
Foster 2019					X					X				X													
Dalal 2019						X		X		X	X	X	X														
Sorondo 2016									X	X				X	X												
Johansen 2019				X																				X	X		
Grossman 2018																								X	X		
Graetz 2020							X		X	X					X												
Wang 2020	X	X	X	X						X		X			X	X	X	X	X	X	X	X		X	X		X
Bryan 2020										X		X		X											X		
Nicolas 2019									X					X													
Graham 2020										X	X			X		X			X			X					
Moll 2019										X					X									X	X		
Zanaboni 2020	X	X		X	X					X					X	X	X	X	X	X	X	X	X				
Zhong 2020										X				X	X				X								
Garry 2020										X						X		X	X	X	X	X	X				
Szilagyi 2020	X	X								X					X												
Fiks 2015					X					X	X				X	X	X	X	X	X	X	X	X				
Ronda 2015										X	X				X	X	X	X	X	X	X	X	X				
Crotty 2015							X	X		X		X	X		X										X		
Shah 2015										X	X				X	X	X	X	X	X	X	X	X				
Saberi 2015							X	X		X																	
Wright 2015								X		X	X				X												
KummerowBroman 2015							X	X		X			X						X			X		X	X		
Jhamb 2015										X	X				X												
Riippa 2015									X					X	X												
Haun 2015										X	X				X	X	X	X	X	X	X	X	X				

Study	System Quality			Information Quality		Service Quality	Care Quality			Access		Productivity			Usage			User Satisfaction			Patient			Provider		Change/ Improvement	Implementation
Raghu 2015										X	X				X	X	X										
Giardina 2015										X	X				X	X	X	X	X	X	X	X	X				
Mendel 2017		X										X		X		X	X					X					X
Sieck 2017										X	X	X	X		X	X	X	X	X	X	X	X	X				
Vydra 2015												X	X											X	X		
Reed 2015										X	X				X	X		X	X			X	X				
Forster 2015										X	X				X	X	X	X	X	X	X	X	X				
Wildenbos 2018										X	X				X	X	X	X	X	X	X	X	X	X			
Esch 2016										X	X				X	X	X	X	X		X	X	X				
Mafi 2016	X									X	X				X												
Pillemer 2016				X	X	X	X	X		X	X	X		X	X			X	X			X	X	X	X		
Grunloh 2016										X		X												X	X		
Shimada 2016									X	X																	
Winget 2016										X		X												X	X		
Manard 2016									X	X					X						X		X				
Petullo 2016								X	X	X				X													
Griffin 2016							X		X	X	X			X	X												
Devkota 2016									X	X					X						X						
Lyles 2016							X	X	X						X												
Millman 2016							X	X	X																		
Leveille 2016												X															
Reicher 2016													X		X				X							X	
Dexter 2016												X		X												X	
Rief 2017										X	X				X	X		X	X	X	X	X	X				
Hanna 2017										X	X				X	X	X	X	X	X	X	X	X				
Federman 2017				X	X	X		X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		

Study	System Quality			Information Quality		Service Quality	Care Quality			Access		Productivity			Usage			User Satisfaction			Patient			Provider		Change/Improvement	Implementation
Wolff 2017				X	X					X	X				X				X	X	X	X					
Lieu 2019										X		X												X	X		
Peremislov 2016							X	X		X					X										X		
Akerstedt 2018										X														X	X		
Zhou 2015										X		X		X													
Crouch 2015										X	X					X			X		X	X	X				

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Chapter 5: Conclusion and future directions

This dissertation research set out to address the following questions: (1) why and how are patient portals conceptualized, developed, and implemented within a healthcare setting?; (2) what factors influence uptake and what elements are deemed crucial for uptake and access for all end users?; (3) what are the intended outcomes during the conceptualizations and planning stages for patient portals?; (4) how is the impact of patient portals measured, from the standpoint of the four specific dimensions (patients, population, healthcare workforce, and health system) of the Quadruple Aim Framework?; and (5) what components from the benefits evaluation framework are most commonly evaluated to measure impact? These questions were addressed by first exploring how decision-making and planning processes occurred in a publicly-funded healthcare system that decided to introduce a patient portal(1). This was followed by observing implementation of this portal, enrollment by patients, and adoption in various clinical settings in this system, and by providers and patients (2). Finally, a review of the literature was conducted to determine how the impact of patient portals is currently being measured. The research questions and the corresponding methods were linked by the overall aim of this study, which was to generate evidence that could be used to determine the capacity for a province-wide implementation of patient portal in Alberta. So what is the path ahead in providing patients accesses to their health record?

This dissertation showed that the implementation and subsequent adoption of the patient portal system in Alberta was a convoluted process, which impacted clinical settings and practices in different ways(3). This complexity was demonstrated through the evaluation of the MyChart® proof of concept within Alberta Health Services (1). Although the delivery of patient portals in Alberta required a substantial investment of time, resources, planning, and determination, they were seen as tools with the potential to enhance patient-centered care. Clinically useful uptake of patient portals was deemed as an essential enabler for patients as partners in managing their health and transforming the wider health system. Without adequate support for patients as complete partners in the management of their health, patients would be left to take actions based on incomplete and possibly inaccurate information from untrustworthy sources. The studies in this dissertation showed what has been done and what needs to be done in order for Alberta to fulfil its provincial goal in providing its citizens access to their medical record.

The historical research study revealed the facilitators and barriers to patient portal planning and implementation that exist in a large publicly funded healthcare system in Canada. A focussed scope for the implementation project, supportive system leadership with timely decision making, project management, and appropriate technology and vendor selection were some of the facilitators that allowed for the commencement and growth of the proof of concept. The main barriers were a lack of awareness about the technology, of adequate and proper training, of buy-in from diverse key system leaders, and the challenge that resulted from the parallel implementation of two portals due to government priorities and decision making(1).

Although many aspects of what occurred during the MyChart® proof of concept processes were considered common with the implementation of health information technologies in general, there were several features of patient portals which have broad implications for planning and delivering them in a large public health care system that became evident during the MyChart® proof of concept. First, the implementation of information technology innovations can be disruptive, especially as the value of the technology is rarely conveyed to, and so understood by, all users. Second, although implementation leaders tend to be committed to the implementation of information technologies, they do not always possess the requisite technical and project management skills. Third, the learning needs of users needs to be evaluated prior to implementation so appropriate portal use training can be delivered (to both providers and patients). Fourth, a lack of centralized decisions relating to the purchase and implementation of information technologies can lead to unnecessary and expensive duplication of technologies. Fifth, internal and external buy-in before implementation is needed. Sixth, information technologies need to be evaluated early in implementation before wider adoption is considered. The findings from the historical study highlighted the importance of understanding and mitigating internal organizational and decision-making approaches that could hinder the planning and implementation of the patient portal. It showed how organizations decide on information technologies investments, the intricacies of the decision processes, and factors affecting decisions at each stage to provide better future preparation for the successful implementation of these technologies.

Through the qualitative case study, it became apparent that dissatisfaction with current health care communication tools appeared to be the primary factor that drove patients' and providers' decisions to consider the use of MyChart®. Once a clinic had made the decision to use it, uptake was dependent on performance expectancy, which included understanding how to use the technology and valuing the additional functionality that it offered. Several themes emerged from the interview data which aligned with the *theory of technology acceptance* by Davis(4), including perceived usefulness, perceived ease of use, barriers to ease of use, and future usage(4). The conditions that facilitated understanding of the technology varied across clinics. Clinic managers were foundational to the uptake of MyChart®, a finding that has not been discussed in the literature to date. They made decisions about whether to present the technology to providers to begin with. The actions of the clinic managers could be observed through Roger's theory of diffusion, as they served as early adopters by assessing the advantages or disadvantages of the innovation themselves. They determined its perceived efficiencies, its compatibility with the existing system, the complexities associated with it, and, ultimately, the benefits and unintended consequences of the innovation(5).

In addition, the comparative case study showed that usage and enrollment depended on how patients were informed about the portal. Quick introductions without demonstrating the added value did not lead to higher enrollment rates. In clinics with higher uptake, a short introduction became incorporated into the clinic visit workflow, which allowed for more efficient means to entice patients to sign up. Knowledge about the technology was another important component that led to increased or decreased enrollment and usage. Although not all health care providers saw the value of patients having access to the same information, provider participants 'championing' use of MyChart® experienced more efficient ways to connect and communicate with their patients.

The purpose of the scoping review was to explore what is known about patient portal evaluations and provide recommendations for future endeavours. Based on the results from this scoping review, several gaps in the literature were identified. First, there is a lack of studies with multidimensional impact evaluation strategies. Second, lack of studies based on suitable methodology and sample size to evaluate patient portal technology. Third, lack of recognition and evidence utilization from organizational and health system level internal impact evaluations of patient portals. Fourth, there is an identified lack of operative recommendations based on study findings. Finally, the scoping review identified lack of use of patient self-reported health outcomes when evaluating patient portal impact. Despite the extensive and existing research in the area of patient portals, the evidence from the scoping review suggests that impact research is available, but it lacks multidimensionality by what means is measured and captured.

Although this dissertation was conducted to answer real-world problems and was guided by the research questions, there are several areas that are still worthy of further examination and attention. First, it is important to understand more about how ‘value’ can be planned for and delivered through patient portals. Through the studies, ‘value’ kept appearing as the concept that influenced enrollment and adoption. It would be beneficial to understand how to balance the ‘value’ expressed by patients, providers, and healthcare systems, which were very different and even opposing in some instances. Second, a better understanding is needed about how mandatory use of patient portals by healthcare providers could be achieved in a publicly funded healthcare system operating within health organizations or regional health authorities. Studies have been done within private healthcare systems that have implemented these systems, and mandated providers to use the system, but there is a need to understand how mandatory usage can be accomplished in a publicly funded fee-for-service systems where healthcare providers are considered individual business entities. A third area for future research is to determine if effective marketing strategies have the capacity to increase portal enrollment and continuous portal usage. Currently, enrollment depends on healthcare providers to provide information to patients and encourage their enrollment. This approach has not been very effective for the providers who are not considered the ‘early adopters’. If increasing enrollment and subsequent usage is a goal, understanding about how this could be done in more efficient ways would be crucial for future applications. Finally, disparities continue to exist among patients in terms of portal access. Future research needs to tackle how some of the issues and barriers encountered by disadvantaged groups might be resolved, thus increasing potential for better health outcomes.

While attempts have been made to provide access to the technology, no effective recommendations for solving the problem of access inequities have been provided.

The three studies part of this dissertation provide insights that are practical and relevant to decision-makers, technology implementation teams, healthcare providers, and patient portal developers. They provide a better understanding of what should be considered during the planning, implementation, and adoption stages when attempting to incorporate patient portals in complex healthcare systems. The evidence has been mapped and synthesised, which shows that a systemic shift of this magnitude could only be accomplished with transformative actions, including broad support from policy makers, health care providers, health administrators, and patients. It is important to acknowledge that implementing portals is not as much as about the technology as it is about the various users and organizational forces that create internal and external pull and push. The evidence documented in this dissertation provide[s] information decision makers can use to understand how to manage the necessary organizational change and the individual expectations when implementing a technology that would be used by different users for different needs.

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Appendix 1: Recruitment card

Charting the Implementation and Impact of a Patient Portal Study

We would like to invite **YOU** to participate in a research study in bringing forward your views and opinions about **how Albertans can and should access their own personal medical record.** You are asked TO **PARTICIPATE IN AN INTERVIEW** and share **YOUR VIEWS** on this topic. Your participation is **entirely voluntary** and would take up approximately **30 minutes of your time**.

The interview will be held at a location or over the phone, and a time convenient for you. There are no direct benefits to your participation in this study, but by participating in this study, you will be helping us to present your voice on this issue.

Please contact Melita at avdagovs@ualberta.ca or at 780-908-3334 with an opening in your schedule so we can arrange an interview.

University of Alberta Research Ethics Board Pro00084135

Appendix 2: Comparative case interview guide questions

Thank you for agreeing to meet with me today. As noted in the consent form, your participation is entirely voluntary, and the interview will take approximately 30 minutes.

Patient interview guide questions

As mentioned in the letter attached to the consent form for this study, I am interested in learning more about why you used or did not use the MyChart®® portal, and what were your experiences.

Where you offered information about the patient portal MyChart®®?

If YES:

- Did you sign up as per information material?
  - If YES:
    - Can you please tell me about your introduction to the portal?
    - How and why did you use it?
    - What did you like?
    - What you didn't like?
    - What would you change?
    - What would you recommend that it should be done in regards to the portal?
    - Is there anything else you would like to add and you did not get a chance?
  - If NO:
    - Why you didn't sign up?
    - What would have made a difference in you signing up for the portal?

What would you recommend that it should be done in regards to the portal?

Is there anything else you would like to add and you did not get a chance?

If NO:

What is your opinion about having access to your own electronic medical record?

What would that do for you?

What you want to be available in healthcare that will help you as a patient?

Healthcare provider interview guide questions

As mentioned in the letter attached to the consent form for this study, I am interested in learning more about your perceptions and experiences regarding the benefits or limitations of MyChart®® in the patient/healthcare provider relationship, strategies for assessing the benefits and risk of implementing MyChart®®, information input and sharing, data security and confidence in the information, and reporting by patients about lifestyle choices and behaviours.

1. Tell me about your perspective on patient portals?
2. What a ‘good’ patient portal should do?
3. How has the MyChart®® Proof of Concept impacted your practice? (Positive and negative consequences)
4. What about sharing sensitive information with your patients?
5. What patient’s feedback did you receive?
6. What do you wish was done differently?
7. What improvements would you recommend to be incorporated into MyChart®® prior to the provincial implementation?
8. Is there anything else you would like to add and you did not get a chance?

Administrator/manager interview guide questions

As mentioned in the letter attached to the consent form for this study, I am interested in learning more about the plans and barriers to adoption and problem-solving approaches related to MyChart®®.

1. Tell me about your perspective on patient portals?
2. What a ‘good’ patient portal should do?
3. Why did you decide to participate in the MyChart®® Proof Concept?
4. How has the MyChart®® Proof of Concept impacted your practice?
5. What do you wish was done differently?
6. What patient’s feedback did you receive?
7. What improvements would you recommend to be incorporated into MyChart®® prior to the provincial implementation?
8. Is there anything else you would like to add and you did not get a chance?

Non-medical providers interview guide questions

As mentioned in the letter attached to the consent form for this study, I am interested in learning more about how your clinic implemented the online appointment booking and canceling option.

1. Tell me how was the booking function introduced at your clinic?
2. How patients used the functions?
3. What were some of the facilitators from having the function available to patients?
4. What were some of the barriers from having the function available to patients?
5. What would you recommend for improvement?

Appendix 3: Interview codes for all interviewed participants per case setting

Case Study	Type of Participant	Interview Code
Case 1 (medium user)	Clinic Manager	1CM1
	Healthcare Providers	1HCP1
		1HCP2
		1HCP3
	Patients	1PAT1
		1PAT2
		1PAT3
		1PAT4
		1PAT5
		1PAT6
	Caregiver	1CGP1
Case 2 (high user)	Clinic Manager	2CM21
	Healthcare Providers	2HCP1
		2HCP2
		2HCP3
		2HCP4
		2HCP5
	Patients	2PAT1
		2PAT2
		2PAT3
		2PAT4
		2PAT5
Case 3 (low user)	Clinic Manager	3CM1
	Healthcare Providers	3HCP1
		3HCP2
		3HCP3(NU)*
		3HCP4
		3HCP5
	Patients	3PAT1
		3PAT2
		3PAT3
		3PAT4(NU)
		3PAT5
Case 4 (high user)	Clinic Manager	4CM1
	Healthcare Providers	4HCP1
		4HCP2
		4HCP3(NU)
		4HCP4(NU)
		4HCP5(NU)
		4HCP6(NU)

		4HCP7(NU)
	Patients	4PAT1
		4PAT2
		4PAT3
		4PAT4
		4PAT5
		4PAT6
		4PAT7
		4PAT8
		4PAT9
		4PAT10
		4PAT11(NU)
		4PAT12
	Non-medical Providers	4NON1
		4NON2
		4NON3
		4NON4
Case 5 (non-user)	Healthcare Provider	5HCP1(NU)
*(NU) means non-user		

Appendix 4: Interview participants demographic information

Patient demographics (n=27)		
Characteristics	n	(%)
Gender		
Female	17	(62.96%)
Male	10	(37.03%)
Age		
18 to 25	1	(3.70%)
26 to 35	1	(3.70%)
36 to 45	0	(0.00%)
46 to 60	16	(59.25%)
61 and over	9	(33.33%)
Marital Status		
Never legally married	2	(7.40%)
Legally married (and not separated)	18	(66.66%)
Separated, but still legally married	0	(0.00%)
Divorced	2	(7.40%)
Common law	4	(14.81%)
Widowed	1	(3.70%)
Education Level		
Less than high school degree	0	(0.00%)
High school degree or equivalent	5	(18.51%)
Some post-secondary education but no degree	7	(25.92%)
Registered Apprenticeship or other trades certificate or diploma	5	(18.51%)
Associate degree	1	(3.70%)
Bachelor degree	7	(25.92%)
Graduate degree	0	(0.00%)
Post-graduate degree	2	(7.40%)
Employment Status		
Employed, working 40 or more hours per week	9	(33.33%)
Employed, working 1-39 hours per week	7	(25.92%)
Not employed, looking for work	0	(0.00%)
Not employed, NOT looking for work	2	(7.40%)
Retired	4	(14.81%)
Unable to work	3	(11.11%)
Self-Employed	2	(7.40%)
Family Income		
Less than $20,000	0	(0.00%)
$20,000 to $34,999	1	(3.70%)
$35,000 to $49,999	2	(7.40%)
$50,000 to $74,999	1	(3.70%)
$75,000 to $99,999	4	(14.81%)
$100,000 to $149,999	8	(29.62%)

$150,000 or More	11	(40.74%)
Chronic Condition		
Yes	23	(85.18%)
No	4	(14.81%)
MyChart®® Users		
Yes	25	(92.59%)
No	2	(7.40%)
And/or Proxy	5	(18.51%)

Non-medical providers demographics (n=4)		
Characteristics	n	(%)
Gender		
Female	4	(100.00%)
Male	0	(0.00%)
Age		
Over 18	0	(0.00%)
18 to 29	1	(25.00%)
30 to 39	1	(25.00%)
40 to 49	0	(0.00%)
50 to 59	0	(0.00%)
60 to 64	0	(0.00%)
65 and over	2	(50.00%)
Work setting		
Academic based care		
Community based care	4	(100.00%)
Both	0	(0.00%)

Appendix 5: Additional quotes supporting thematic analysis

<table>
<tr><th colspan="2">Additional patient participant quotes supporting thematic analysis</th></tr>
<tr><td colspan="2">Theme 1: My health, my responsibility, but I need the information to do that (perceived usefulness)</td></tr>
<tr><td></td><td>“I really feel that the number one thing that MyChart®® system is it keeps you plugged into your health and well-being so that you're more empowered as a patient to be aware of what your issues are, and to really take a more active role in your wellness. When you really know what you're dealing with. And to be more informed, and to ask more applicable questions, things that you should know. I would really be disappointed to see them drop this program.” (2PAT4)</td></tr>
<tr><td></td><td>“I actually think it reduces your anxiety because you're... number one, you're not sitting back waiting to hear like was it normal. They're not having to call you and say oh everything's great. And I think that that process and that ability to have that information and access those people, gives you more power. You know taking back some power and some control of your health when you feel like you've gone through a diagnosis for all those things that really been minimized minimize or take away from you.” (2PAT4)</td></tr>
<tr><td></td><td>“I am overjoyed to use MyChart®®, but I am also frustrated at the glacial pace of development. The capability to do this kind of thing has existed for decades, yet still we are doing trials over at least two years to prove the concept. GET ON WITH IT!” (1PAT3)</td></tr>
<tr><td colspan="2">Theme 2: Convenience, convenience, convenience (perceived ease of use)</td></tr>
<tr><td></td><td>“We traveled to Scotland a couple of times a year and stayed for three months at a time helping my aging father in law staying in his own home as long as he can. And what MyChart®® gave me was instant access to my medical team. I knew if anything came up, if I lost my prescription, if something dramatic happened I could send them an e-mail through MyChart®®.” (1MAPAT00416JAN2019)</td></tr>
<tr><td></td><td>“So if I get a test result that's unusual and I look it up and I go OK that doesn't make sense to me. Then I can send a message to the team I'm dealing with and they can let me know.” (3PAT2)</td></tr>
<tr><td></td><td>“I mean reminders for appointments and reminders for all my blood work so I can go and look at it and it gave me the assurance that it was real, and it was active, and it was reliable.” (1PAT4)</td></tr>
<tr><td></td><td>“I am kind of a spontaneous individual so if I want to, I can make my appointment at midnight if I so choose. And I just find that amount of freedom... I guess a freedom of choice just appealing.” (4PAT12)</td></tr>
<tr><td></td><td>“So, we can take care of their families better and at home and rely on the system less. And then when they do require assistance from the system, it's very targeted, it's very precise, it's very timely.” (4PAT2)</td></tr>
</table>

Theme 3: Few tweaks will do it (barriers to ease of use)	
	“The push is to have healthcare providers actually explain their medical jargon in layman's terms. So, I think there probably needs to be some push to especially get oncologists, radiologists, pathologist to put somehow in all their reports either some sort of how to explain this in layman's terms.” (4PAT5)
	“I think if you're going to have access to some information, you should have access to all of it. Because access to only partial information can be detrimental all on its own. Either you get all of the information or there's no point in having any of the information.” (4PAT6)
	“When I ask my Gastroenterologist if she had access to MyChart®®, she said no. They haven't opened it up yet to certain offices.” (4PAT8)
	“So, you're just sitting there and thinking, there could be a better use of time but I don't know how they're going to do this. Now that computers have become a part of medicine, how do we make this better by still keeping that patient-doctor looking at each other in the face?” (4PAT9)
Theme 4: Don’t take it away (future usage)	
	“Is it going to be rolled out completely next week? Why has nothing changed whatsoever in over two years? Tell the patient users what is going on.” (1PAT3)
	“I think it would be a huge disservice to Albertans if this project doesn't come to fruition across the area.” (4PAT1)

Additional healthcare provider participant quotes supporting thematic analysis	
Theme 1: Of course we need it (perceived usefulness)	
	“Should be accessible for patients who just want to learn more about their conditions or what's coming up and gives that one place for accurate information.” (1HCP1)
Theme 2: Yes, it did some good things (perceived ease of use)	
	“You’re from out of town far away and you have to drive in now and sit your bum in the chair to know that your thyroid levels are OK.” (4HCP1)
	“I will get it if the patient communicates with the doctor and then the doctor will actually either cc me in a message and highlight something that needs to be further investigated and then I'll see that communication.” (3HCP3NU)
Theme 3: Not all was great (barriers to ease of use)	
	“I can choose which patients I think I want to communicate with that way. So, I haven't invited everyone. It's just I select as I as I'm trying to figure out who the best one is. But that certainly makes it a whole lot easier.” (1HCP2)
	“I feel like if they wanted to launch the study they should have had somebody or some people or a team or whatever do phone support for these patients that they could call in one number like 800 number, and have somebody talk them through whatever it is that they're having problems with MyChart®®.” (2HCP1)
Theme 4: Consider my needs (future usage)	
	“We need to figure out how we compensate professionals from being involved in these portals. Particularly given that the cost implications are massive, and it is a completely different way of doing work.” (1HCP3)
	“Education is going to be very important or teaching people both physicians and patients about this new system.” (3HCP4)
	“Potentially hearing from other colleagues that it wasn't a burden to their practice. And if anything it made certain parts of their practice easier.” (2HCP3)

Additional clinic manager participant quotes supporting thematic analysis	
Theme 1: Time for some efficiency in communication (perceived usefulness)	
	“Should improve communication between the patient and the healthcare provider, so that the patient feels supported.” (2ADM)
Theme 2: Heard great things about it (perceived ease of use)	
	“It really was around the fact that my patients were trying to get hold of the clinic and couldn't get through on the phone lines. And this was causing me a lot of angst and they would bring it up and they were dissatisfied with the support that we were providing to them because they couldn't get through to report new symptoms or to book a follow up appointment. And so I really saw it as a much easier way, or an additional way to communicate with them when they needed outside of phone.” (2CM1)
Theme 3: Heard about some issues as well (barriers to ease of use)	
	“The other issue is that we had two physicians in our clinic who were adamant about not having it to be part of their practice. So the two of us agreed to move ahead with it and two did not. And then we had actually had a separate system set up for half of our clinic. So half of our clinic went with the old system of phone calls and stuff like that, and then the other half went with MyChart®®.” (2CM1)
	“There is a little bit of a loss of control for the physician in terms of who sees the data and how they decide to act upon it.” (2CM1)
	“The MyChart®® form that they developed really was not user friendly. And it didn't put in the information they wanted. So, the idea was great, but we couldn't send the paper back and forth.” (1CM1)
	“We weren't given the authority to like to develop questionnaires sent to patients. So, I think rheumatology did that but and we wanted it because I think for there's lots of kind of you mean questionnaires that would be great to track or whatever.” (2CM1)
	“So, that whole messaging a physician could be a little bit of a problem because lots of times, you can't even phone and get hold of a physician.” (1CM1)
Theme 4: Change is needed (future usage)	
	“So that requires the discipline and the carved out time to sit down for a certain period of time every day because it builds up if you don't do it every day to catch those results that might be alarming to patients and then send a little note through, or enact an action in relation to that lab result.” (2 CM1)

Non-medical providers’ participant quotes supporting thematic analysis	
Theme 1: Great services for the patient (perceived usefulness)	
	“The patients are able to go on MyChart®® as long as there is an availability appointment time they can get in there and book their appointments.” (4NON1)
	“They love booking their own appointments especially because they know something happens in the middle of the night, they can go on and book for the next day if there's openings.” (4NON2)
Theme 2: Needs some education (barriers to ease of use)	
	“We look at all the appointments that are being made by MyChart®® every day daily. And we just see what they are. Like if there are certain things that we need to address because maybe they booked it incorrectly. And that's fine. It's not that difficult.” (4NON1)
Theme 3: Need to maintain and expand (future usage)	
	“More awareness and if they ask questions I can help as I can't help them much now.” (4NON3)
	“I would probably like to know more about it.” (4NON3)

Appendix 6: Scoping review search strategy

Patient Portals

Final Strategy

2020 Jun 8

Ovid Multifile

Database: Ovid MEDLINE(R) ALL <1946 to June 05, 2020>, Embase <1974 to 2020 June 05>, APA PsycInfo <1806 to June Week 1 2020>

Search Strategy:

----

1 Patient Portals/ (175043)

2 (patient? adj2 (portal or portals)).tw,kf. (11738)

3 Electronic Health Records/ (35402)

4 limit 3 to yr="2010-2016" (15491)

5 4 and (portal or portals).tw,kf. (349)

6 4 and (patient* adj2 access*).tw,kf. (305)

7 4 and (personal* adj2 access*).tw,kf. (40)

8 ((web or web-based or web-site or website or internet or online or www or cyber*) adj3 (portal or portals)).tw,kf. (5756)

9 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (portal or portals)).tw,kf. (417)

10 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (patient* adj2 access*)).tw,kf. (328)

11 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (person* adj2 access*)).tw,kf. (80)

12 ((medical record? or EMR or EMRs) adj3 (portal or portals)).tw,kf. (126)

13 ((medical record? or EMR or EMRs) adj3 (patient* adj2 access*)).tw,kf. (522)

14 ((medical record? or EMR or EMRs) adj3 (person* adj2 access*)).tw,kf. (36)

15 (clinical record? adj3 (portal or portals)).tw,kf. (2)

16 (clinical record? adj3 (patient* adj2 access*)).tw,kf. (28)

17 (clinical record? adj3 (person* adj2 access*)).tw,kf. (0)

18 ((health information or medical information or clinical information) adj3 (portal or portals)).tw,kf. (175)

19 ((health information or medical information or clinical information) adj3 (patient* adj2 access*)).tw,kf. (359)

20 ((health information or medical information or clinical information) adj3 (person* adj2 access*)).tw,kf. (177)

21 ((health data or medical data or clinical data) adj3 (portal or portals)).tw,kf. (66)

22 ((health data or medical data or clinical data) adj3 (patient* adj2 access*)).tw,kf. (86)

23 ((health data or medical data or clinical data) adj3 (person* adj2 access*)).tw,kf. (43)

24 health portal?.tw,kf. (341)

25 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (portal or portals)).tw,kf. (105)

26 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (patient* adj2 access*)).tw,kf. (17)

27 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (person* adj2 access*)).tw,kf. (6)

28 (resource? adj3 (portal or portals)).tw,kf. (221)

29 Electronic Health Records/ (35402)

30 Health Records, Personal/ (167153)

31 Internet/ (209452)

32 Health Services Accessibility/ (121030)

33 Information Seeking Behavior/ (5671)

34 Patient Access to Records/ (14759)

35 Patient-Centered Care/ (197819)

36 Patient Participation/ (54970)

37 Physician-Patient Relations/ (75194)

38 Self Care/ (95439)

39 Self-Management/ (55738)

40 (29 or 30) and (31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39) (12743)

41 or/1-2,5-28,40 [PATIENT PORTALS] (196090)

42 exp Animals/ not Humans/ (16838428)

43 41 not 42 [ANIMAL-ONLY REMOVED] (135426)

44 43 use medall [MEDLINE RECORDS] (9169)

45 (patient? adj2 (portal or portals)).tw,kw. (11739)

46 ((web or web-based or web-site or website or internet or online or www or cyber*) adj3 (portal or portals)).tw,kw. (5763)

47 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (portal or portals)).tw,kw. (417)

48 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (patient* adj2 access*)).tw,kw. (330)

49 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (person* adj2 access*)).tw,kw. (81)

50 ((medical record? or EMR or EMRs) adj3 (portal or portals)).tw,kw. (126)

51 ((medical record? or EMR or EMRs) adj3 (patient* adj2 access*)).tw,kw. (526)

52 ((medical record? or EMR or EMRs) adj3 (person* adj2 access*)).tw,kw. (37)

53 (clinical record? adj3 (portal or portals)).tw,kw. (2)

54 (clinical record? adj3 (patient* adj2 access*)).tw,kw. (28)

55 (clinical record? adj3 (person* adj2 access*)).tw,kw. (0)

56 ((health information or medical information or clinical information) adj3 (portal or portals)).tw,kw. (176)

57 ((health information or medical information or clinical information) adj3 (patient* adj2 access*)).tw,kw. (359)

58 ((health information or medical information or clinical information) adj3 (person* adj2 access*)).tw,kw. (177)

59 ((health data or medical data or clinical data) adj3 (portal or portals)).tw,kw. (66)

60 ((health data or medical data or clinical data) adj3 (patient* adj2 access*)).tw,kw. (87)

61 ((health data or medical data or clinical data) adj3 (person* adj2 access*)).tw,kw. (44)

62 health portal?.tw,kw. (349)

63 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (portal or portals)).tw,kw. (106)

64 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (patient* adj2 access*)).tw,kw. (19)

65 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (person* adj2 access*)).tw,kw. (7)

66 (resource? adj3 (portal or portals)).tw,kw. (221)

67 electronic health record/ (36611)

68 electronic medical record/ (74298)

69 electronic patient record/ (2299)

70 Internet/ (209452)

71 information seeking/ (7117)

72 patient right/ (22384)

73 exp health care access/ (66868)

74 patient participation/ (54970)

75 doctor patient relationship/ (2962)

76 self care/ (95439)

77 self help/ (17607)

78 (67 or 68 or 69) and (70 or 71 or 72 or 73 or 74 or 75 or 76 or 77) (5193)

79 or/45-66,78 [PATIENT PORTALS] (23281)

80 exp animal/ or exp animal experimentation/ or exp animal model/ or exp animal experiment/ or nonhuman/ or exp vertebrate/ (50995912)

81 exp human/ or exp human experimentation/ or exp human experiment/ (39478597)

82 80 not 81 (11518911)

83 79 not 82 [ANIMAL-ONLY REMOVED] (22937)

84 83 use oemezd [EMBASE RECORDS] (14113)

85 (patient? adj2 (portal or portals)).tw,id. (11648)

86 ((web or web-based or web-site or website or internet or online or www or cyber*) adj3 (portal or portals)).tw,id. (5726)

87 ((health record? or EHR or EHRsor PHR or PHRs) adj3 (portal or portals)).tw,id. (368)

88 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (patient* adj2 access*)).tw,id. (325)

89 ((health record? or EHR or EHRs or PHR or PHRs) adj3 (person* adj2 access*)).tw,id. (80)

90 ((medical record? or EMR or EMRs) adj3 (portal or portals)).tw,id. (126)

91 ((medical record? or EMR or EMRs) adj3 (patient* adj2 access*)).tw,id. (521)

92 ((medical record? or EMR or EMRs) adj3 (person* adj2 access*)).tw,id. (36)

93 (clinical record? adj3 (portal or portals)).tw,id. (2)

94 (clinical record? adj3 (patient* adj2 access*)).tw,id. (28)

95 (clinical record? adj3 (person* adj2 access*)).tw,id. (0)

96 ((health information or medical information or clinical information) adj3 (portal or portals)).tw,id. (175)

97 ((health information or medical information or clinical information) adj3 (patient* adj2 access*)).tw,id. (358)

98 ((health information or medical information or clinical information) adj3 (person* adj2 access*)).tw,id. (177)

99 ((health data or medical data or clinical data) adj3 (portal or portals)).tw,id. (66)

100 ((health data or medical data or clinical data) adj3 (patient* adj2 access*)).tw,id. (86)

101 ((health data or medical data or clinical data) adj3 (person* adj2 access*)).tw. (43)

102 health portal?.tw,id. (340)

103 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (portal or portals)).tw,id. (105)

104 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (patient* adj2 access*)).tw,id. (17)

105 ((ehealth or e-health or mhealth or m-health or mobile health) adj3 (person* adj2 access*)).tw,id. (6)

106 (resource? adj3 (portal or portals)).tw,id. (221)

107 Electronic Health Records/ (35402)

108 Internet/ (209452)

109 exp Information Seeking/ (10059)

110 Client Participation/ (2229)

111 Self-Management/ (55738)

112 107 and (108 or 109 or 110 or 111) (1178)

113 or/85-106,112 [PATIENT PORTALS] (19482)

114 113 use medall,oemezd (18564)

115 113 not 114 [PSYCINFO RECORDS] (918)

116 44 or 84 or 115 [ALL DATABASES] (24200)

117 limit 116 to yr="2018-current" (5041)

118 remove duplicates from 117 (3571)

119 limit 116 to yr="2015-2017" (5256)

120 remove duplicates from 119 (3868)

121 limit 116 to yr="2011-2014" (5684)

122 remove duplicates from 121 (4155)

123 limit 116 to yr="2000-2010" (4956)

124 remove duplicates from 123 (3371)

125 116 not (117 or 119 or 121 or 121 or 123) (3263)

126 remove duplicates from 125 (1942)

127 118 or 120 or 122 or 124 or 126 [TOTAL UNIQUE RECORDS] (16907)

128 127 use medall [MEDLINE UNIQUE RECORDS] (9071)

129 127 use oemezd [EMBASE RECORDS] (7302)

130 127 not (128 or 129) [PSYCINFO RECORDS] (534)

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CINAHL

#	Query	Limiters/Expanders	Results
S40	S37 OR S38	Limiters - Exclude MEDLINE records Expanders - Apply equivalent subjects Search modes - Find all my search terms	3,494

S39	S37 OR S38	Expanders - Apply equivalent subjects Search modes - Find all my search terms	6,292
S38	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23	Expanders - Apply equivalent subjects Search modes - Find all my search terms	3,526
S37	S35 AND S36	Expanders - Apply equivalent subjects Search modes - Find all my search terms	3,045
S36	S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34	Expanders - Apply equivalent subjects Search modes - Find all my search terms	264,761
S35	S24 OR S25	Expanders - Apply equivalent subjects Search modes - Find all my search terms	27,293

S34	(MH "Self-Management")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	744
S33	(MH "Self Care")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	42,813
S32	(MH "Physician-Patient Relations")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	34,259
S31	(MH "Consumer Participation")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	20,894
S30	(MH "Patient Centered Care")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	32,860

S29	(MH "Patient Access to Records")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1,007
S28	(MH "Information Seeking Behavior")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	4,684
S27	(MH "Health Services Accessibility+")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	92,116
S26	(MH "Internet")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	52,241
S25	(MH "Medical Records, Personal")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1,267

S24	(MH "Electronic Health Records")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	26,364
S23	TI (resource# N3 (portal or portals)) OR AB (resource# N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	63
S22	TI ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") N3 (personal* N2 access*)) OR AB ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") N3 (personal* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	5
S21	TI ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") N3 (patient* N2 access*)) OR AB ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") N3 (patient* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	11
S20	TI ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") N3 (portal or portals)) OR AB ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	21

S19	TI ("health portal" or "health portals) OR AB ("health portal" or "health portals)	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1,560
S18	TI (("health data" or "medical data" or "clinical data") N3 (personal* N2 access*)) OR AB (("health data" or "medical data" or "clinical data") N3 (personal* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	12
S17	TI (("health data" or "medical data" or "clinical data") N3 (patient* N2 access*)) OR AB (("health data" or "medical data" or "clinical data") N3 (patient* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	38
S16	TI (("health data" or "medical data" or "clinical data") N3 (portal or portals)) OR AB (("health data" or "medical data" or "clinical data") N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	14
S15	TI (("health information" or "medical information" or "clinical information") N3 (personal* N2 access*)) OR AB (("health information" or "medical information" or "clinical information") N3 (personal* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	70

S14	TI (("health information" or "medical information" or "clinical information") N3 (patient* N2 access*)) OR AB (("health information" or "medical information" or "clinical information") N3 (patient* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	154
S13	TI (("health information" or "medical information" or "clinical information") N3 (portal or portals)) OR AB (("health information" or "medical information" or "clinical information") N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	67
S12	TI (("clinical record" or "clinical records") N3 (personal* N2 access*)) OR AB (("clinical record" or "clinical records") N3 (personal* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	0
S11	TI (("clinical record" or "clinical records") N3 (patient* N2 access*)) OR AB (("clinical record" or "clinical records") N3 (patient* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	6
S10	TI (("clinical record" or "clinical records") N3 (portal or portals)) OR AB (("clinical record" or "clinical records") N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1

S9	TI (("medical record" or "medical records" or EMR or EMRs) N3 (personal* N2 access*)) OR AB (("medical record" or "medical records" or EMR or EMRs) N3 (personal* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	8
S8	TI (("medical record" or "medical records" or EMR or EMRs) N3 (patient* N2 access*)) OR AB (("medical record" or "medical records" or EMR or EMRs) N3 (patient* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	166
S7	TI (("medical record" or "medical records" or EMR or EMRs) N3 (portal or portals)) OR AB (("medical record" or "medical records" or EMR or EMRs) N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	40
S6	TI (("health record" or "health records" or EHR or EHRs or PHR or PHRs) N3 (personal* N2 access*)) OR AB (("health record" or "health records" or EHR or EHRs or PHR or PHRs) N3 (personal* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	38
S5	TI (("health record" or "health records" or EHR or EHRs or PHR or PHRs) N3 (patient* N2 access*)) OR AB (("health record" or "health records" or EHR or EHRs or PHR or PHRs) N3 (patient* N2 access*))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	169

S4	TI (("health record" or "health records" or EHR or EHRs or PHR or PHRs) N3 (portal or portals)) OR AB (("health record" or "health records" or EHR or EHRs or PHR or PHRs) N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	131
S3	TI ((web or "web-based" or "web-site" or website or internet or online or www or cyber*) N3 (portal or portals)) OR AB ((web or "web-based" or "web-site" or website or internet or online or www or cyber*) N3 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1,037
S2	TI (patient# N2 (portal or portals)) OR AB (patient# N2 (portal or portals))	Expanders - Apply equivalent subjects Search modes - Find all my search terms	1,429
S1	(MH "Patient Portals")	Expanders - Apply equivalent subjects Search modes - Find all my search terms	88

Web of Science

6 21,018 #5 OR #4 OR #3 OR #2 OR #1

		Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years
# 5	1,530	**TOPIC:** ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") NEAR/3 portal) *OR* **TOPIC:** ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") NEAR/3 portals) *OR* **TOPIC:** ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") NEAR/3 patient access*) *OR* **TOPIC:** ((ehealth or "e-health" or mhealth or "m-health" or "mobile health") NEAR/3 personal access*) *OR* **TOPIC:** (resource* NEAR/3 (portal or portals)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years
# 4	2,163	**TOPIC:** (("health data" or "medical data" or "clinical data") NEAR/3 portal) *OR* **TOPIC:** (("health data" or "medical data" or "clinical data") NEAR/3 portals) *OR* **TOPIC:** (("health data" or "medical data" or "clinical data") NEAR/3 patient access*) *OR* **TOPIC:** (("health data" or "medical data" or "clinical data") NEAR/3 personal access*) *OR* **TOPIC:** ("health portal" or "health portals") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years

# 3	3,656	**TOPIC:** (("clinical record" or "clinical records") NEAR/3 portal) *OR* **TOPIC:** (("clinical record" or "clinical records") NEAR/3 portals) *OR* **TOPIC:** (("clinical record" or "clinical records") NEAR/3 patient access*) *OR* **TOPIC:** (("clinical record" or "clinical records") NEAR/3 personal access*) *OR* **TOPIC:** (("health information" or "medical information" or "clinical information") NEAR/3 portal) *OR* **TOPIC:** (("health information" or "medical information" or "clinical information") NEAR/3 portal) *OR* **TOPIC:** (("health information" or "medical information" or "clinical information") NEAR/3 patient access*) *OR* **TOPIC:** (("health information" or "medical information" or "clinical information") NEAR/3 personal access*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years
# 2	4,694	TS=(("health records" or EHR or EHRs or PHR or PHRs) NEAR/3 portal) OR TS=((" health records" or EHR or EHRs or PHR or PHRs) NEAR/3 portals) OR TS=((" health records" or EHR or EHRs or PHR or PHRs) NEAR/3 patient access*) OR TS=(("health records" or EHR or EHRs or PHR or PHRs) NEAR/3 personal access*)

		OR TS=(("medical record" or "medical records" or EMR or EMRs) NEAR/3 portal) OR TS= (("medical record" or "medical records" or EMR or EMRs) NEAR/3 portals) OR TS =(("medical record" or "medical records" or EMR or EMRs) NEAR/3 patient access*) OR TS=(("medical record" or "medical records" or EMR or EMRs) NEAR/3 personal access*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years
# 1	12,642	**TOPIC:** (patient* NEAR/2 (portal or portals)) *OR* **TOPIC:** ((web or "web-based" or "web-site" or website or internet or online or www or cyber*) NEAR/3 portal) *OR* **TOPIC:** ((web or "web-based" or "web-site" or website or internet or online or www or cyber*) NEAR/3 portals) *OR* **TOPIC:** (("health record" or EHR or EHRs or PHR or PHRs) NEAR/3 portal) *OR* **TOPIC:** (("health record" or EHR or EHRs or PHR or PHRs) NEAR/3 portals) *OR* **TOPIC:** (("health record" or EHR or EHRs or PHR or PHRs) NEAR/3 patient access*) *OR* **TOPIC:** (("health record" or EHR or EHRs or PHR or PHRs) NEAR/3 personal access*)

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years