

**USABILITY AND USER EXPERIENCES OF INPATIENT PORTALS
IN THE ACUTE CARE SETTING: A SCOPING REVIEW**

by

Bhagawati Acharya

P.C.L., Pokhara Technical Health Multipurpose Institute, 2008

P.B.B.N, Nepal Polytechnic Institute, 2013

A SCHOLARLY PRACTICE ADVANCEMENT RESEARCH PROJECT SUBMITTED IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

in

THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES

(Nursing)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

October 2018

© Bhagawati Acharya, 2018

Abstract

Background: Inpatient portals are gradually being deployed in acute care settings. These tools allow patients and their family members access to the patients' electronic health records and a means of communicating with their health care providers during hospitalization. It is suggested that inpatient portals may improve engagement for hospitalized patients and their families.

While there is a growing body of research that reports on the design and implementation of inpatient portals, the evidence evaluating the user experiences and usability of inpatient portals remains limited and existing reports provide inconsistent information.

Methods: A scoping review of literature published between 2011 and 2018 was conducted to identify and explore patient and family user experiences and the usability of inpatient portals in the acute care setting.

Results: Twenty-three articles (10 qualitative, 7 mixed-methods, 6 quantitative) were obtained from CINAHL, Medline, EMBASE, Web of Science, PsycINFO, Engineering Village, Google and Google Scholar. Analysis of included articles indicated that patients and their families are interested in using inpatient portals; however, they suggest modifications to some existing features and the addition of new features into inpatient portal applications to improve experience and usability. Some usability issues, hardware and technical challenges existed (e.g., safety of sensitive information, its disclosure, security requirement for hospital provided tablets, tablet related, connectivity, operational and system issues).

Conclusion: Inpatient portals are promising tools for engaging patients and families in hospital care. Limited literature about the usability and user experiences related to these portals exist, pointing to the need for further understanding and evaluation. Future design should include patients/families in the initial design.

Table of Contents

Abstract.....	ii
Table of Contents	iii
List of Tables	v
List of Figures.....	vi
Acknowledgements	vii
Chapter 1: Introduction	1
1.1 Background.....	2
1.2 Significance.....	4
1.3 Research Questions.....	5
1.4 Summary	6
Chapter 2: Methods	7
2.1 Identifying the Research Questions	8
2.2 Identifying Relevant Studies.....	8
2.3 Selecting Studies.....	10
2.4 Charting the Data	10
2.5 Collating, Summarizing and Reporting Results.....	11
Chapter 3: Results.....	12
3.1 Search Results and Selection of Literature	12
3.2 Summary of the Selected Literature	14
3.3 Features of Inpatient Portals Reported.....	20
3.4 Overall Findings.....	26

3.4.1	User Satisfaction and Impact	26
3.4.2	Patient Characteristics, Computer Literacy and Training.....	26
3.5	Usability Challenges	27
3.6	Hardware, Security and Other Technical Challenges	28
3.7	Additional Features Requested	29
3.8	Summary of Results	38
Chapter 4: Discussion		39
4.1	Key Findings.....	39
4.2	Gaps and Potential for Future Research.....	41
4.3	Implications for Nursing Practice	42
4.4	Implications for Nursing Policy.....	43
4.5	Limitations	43
4.6	Conclusions.....	44
References		45
Appendices.....		52
	Appendix A Summary of Search History	52
	Appendix B Characteristics of Articles on Inpatient Portal Included in Scoping Review	54

List of Tables

Table 1.1 Definitions	4
Table 2.1 Search Terms	8
Table 2.2 Search Strategy for each Database and Search Engine.....	9
Table 3.1 Number of Hits for each Database and Search Engine.....	12
Table 3.2 Articles Included in Scoping Review (Alphabetized)	14
Table 3.3 Features of Inpatient Portals included in Reviewed Literature.....	23
Table 3.4 Summary of Findings: User Satisfaction, Usability Issues, Hardware Challenges and Additional Features.....	31

List of Figures

Figure 3.1 PRISMA Flowchart of Article Selection.....	13
Figure 3.2 Distribution of Studies by Publication Year.....	18
Figure 3.3 Number of Articles by Type of Research Method	19
Figure 3.4 Number of Articles with Patient, Family and Provider Involvement.....	20

Acknowledgements

It is my great pleasure to be able to thank the people who made this SPAR possible.

First, I would like to thank my supervisor Dr. Fuchsia Howard who made this journey enjoyable and rewarding. My deepest gratitude goes to my committee members Dr. Leanne Currie and Dr. Martha Mackay for their guidance, expertise, encouragement, and commitment to the supervision of this project. I am gratefully indebted to Dr. Currie for providing valuable support in data extraction and verification.

My sincerest thanks to librarian Katherine Miller for giving advice on citation identification and management.

I want to thank my friends at University of British Columbia for providing resources, support, advice and encouragement, with a special thank you to Rupali. I am lucky to have such wonderful friends; you all are valuable gifts in my life.

I am forever indebted to my parents for their support and encouragement.

Finally, thank you to my husband for his love, support, and endless patience throughout my candidature. Without his support my journey to UBC would never have been possible.

Chapter 1: Introduction

The hospital environment frequently positions patients and their families as vulnerable to physical and psychological harm (Brown et al., 2016). These harms are potentially mitigated through the provision of patient- and family- centered care that promotes their engagement (Brown et al., 2016; Dalal et al., 2016; Mackinson, Corey, & Kelly, 2015; Vardoulakis et al., 2012; Woollen et al., 2016). The use of an inpatient portal in the acute care setting holds great promise for engaging patients and families in their care, thereby improving their experiences and health outcomes (Carman et al., 2013; Dykes et al., 2014; Vardoulakis et al., 2012). Many names have been used to describe inpatient portals including MyChart Bedside, Personal Health Record, electronic bedside communication tool, Smart Bedside Station, myNYP Inpatient, myNYP.org and Health Feed. For the purposes of this scoping review, the term “inpatient portal” will be used to refer to a secure web-based application designed to give patients and their family members access to patients’ electronic health records and communicate with their health care providers during acute care hospitalization (Robinson, Davis, Cronin, & Jackson, 2016; Walker, Menser, & Yen, 2018; Winstanley et al., 2017).

Inpatient portals are designed to be used by patients and families themselves, and might be effective tools for giving them more control over their own care and well-being (Vardoulakis et al., 2012; Vawdrey et al., 2011; Yen et al., 2018). In the larger software design industry and subsequently in the field of health informatics, increased focus has recently been placed on including patients in the design of electronic tools that would be used by patients and their families (Kachirskaia, Mate, & Neuwirth, 2018; Yoo et al., 2015). The main steps of engaging patients in the design of these tools should include assessing/understanding/empathizing,

identifying ways to improve and innovate, and testing and implementing solutions (Kachirskaia et al., 2018). User engagement early in the design process can ensure that the tools meet the needs of the end-users (Kachirskaia et al., 2018).

While there is a growing body of research that reports on the design and implementation of inpatient portals, the scope of the evidence regarding patients' and families' experiences of accessing and using inpatient portals remains unclear, providing limited direction for practice or research. Accordingly, the purpose of this review is to identify and explore the literature on patient and family user experiences and the usability of inpatient portals in the acute care setting.

1.1 Background

Hospitalization can be stressful for patients and their families (Parsapour et al., 2011; Woollen et al., 2016). Poor communication and insufficient information can have detrimental effects on patient coping (Kotrotsiou et al., 2001; Woollen et al., 2016) and recovery (Parsapour et al., 2011). Hospitalized patients frequently suffer from multiple acute and chronic conditions, undergo several examinations, and complex treatments (O'Leary et al., 2016). They not only have fears and concerns about illness and treatment but are also forced to deal with unfamiliar environments (Parsapour et al., 2011). Therefore, patient engagement has been a rapidly evolving movement in healthcare, with many patients and providers now considering this to be an essential component of contemporary medicine (Brown et al., 2016).

Engaging patients and families in their care involves providing opportunities to access and understand their health-related information (Vardoulakis et al., 2012; Winstanley et al., 2017; Woollen et al., 2016), improve patient satisfaction with care (Vardoulakis et al., 2012; Vawdrey et al., 2011; Winstanley et al., 2017; Woollen et al., 2016), decrease anxiety

(Vardoulakis et al., 2012; Woollen et al., 2016), and improve patient safety and overall quality of care (Woollen et al., 2016). Evidence suggests that those who are more engaged in their health care have active partnerships with providers (Dalal et al., 2016; Kipping, Stuckey, Hernandez, Nguyen, & Riahi, 2016) and are more likely to adhere to treatment regimens (Woollen et al., 2016) and plan of care (Dalal et al., 2016). Moreover, patient and family expertise, insights, and perspectives could be indispensable in strengthening the safety and quality of health care and ultimately bringing about dramatic change (Carman et al., 2013).

Engaging patients in their healthcare is not a new concept, but the significant role that an inpatient portal might play is emerging and evolving (Foisey, 2015). Inpatient portals have been developed with the goal of involving patients and families in their healthcare, addressing information needs (Robinson et al., 2016; Werder, 2015), and facilitating a connection between patients and their family members (Scruth, Nazanin, & Vincent, 2017), and patients and health care providers (Brown et al., 2016; Werder, 2015). One way of looking at patient engagement when using computerized systems is from the perspective of user experience (which is often abbreviated as “UX”). Two main concepts are often studied when looking at usability and user experience. Table 1.1 shows the definitions of inpatient portal, usability and user experience. Understanding the initial design and users’ needs and experiences at its early developing phase is essential to potentially prevent negative user experiences (Yen et al., 2018). This may increase patient engagement and enhance user acceptance of the portal (Yen et al., 2018).

Table 1.1 Definitions

Term	Definition
Inpatient portal	A secure web-based application designed to give patients and their family members access to patients' electronic health records and communicate with their health care providers during hospitalization (Robinson et al., 2016; Walker et al., 2018; Winstanley et al., 2017).
Usability	"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-11 as cited in Yen et al., 2017, p. 12).
User experience	"A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service" (ISO 9241-11 as cited in Yen et al., 2017, p. 12).

Inpatient portals have the potential to provide patients and their families with access to their up-to-date health related data and enable secure communication with their health care team during an acute care admission (Hefner, Sieck, Walker, Huerta, & McAlearney, 2017). For example, patients/families are able to view the patient' laboratory and diagnostic imaging results, schedule appointments, view information about their care team, educational materials, vital signs, consultation reports, operative notes, request prescription, allergies, immunization and discharge summary (Dalal et al., 2016; Davis, Osborn, Kripalani, Goggins, & Jackson, 2015; Dumitrascu et al., 2018; Robinson et al., 2016; Winstanley et al., 2017). While many of the studies that have examined inpatient portals have explored usability and/or user experience, no standard method to report methods or findings has been established, and which suggests that this is a relatively new and evolving area of research.

1.2 Significance

Growth in the development and use of inpatient portals is evident by the published literature as well as online materials in the last few years. However, evidence evaluating the user experiences and usability of inpatient portals remains limited and reports provide inconsistent

information. As patients and their families are the ultimate end-user of inpatient portals, focusing this scoping review on usability and user experiences might help care providers and hospitals to identify ways to involve patients/families in the design and use of inpatient portals. To my knowledge, a systematic review has not been conducted with respect to how patients and family members perceive and interact with inpatient portals. An important next step is to provide an overview and critical analysis of the existing evidence on user experiences and usability of inpatient portals to improve patient and family experiences in the acute care setting, as a means of clarifying, defining and developing conceptual boundaries on this topic (Whittemore and Knafl, 2005).

1.3 Research Questions

The purpose of this review is to identify and explore the literature on the patients' and families' user experiences and the usability of inpatient portals in the acute care setting. The specific research questions are as follows:

1. What is the extent and range of published evidence on patients' and families' experiences and the usability of inpatient portals in the acute care setting?
2. For what purposes are inpatient portals being used in the acute care setting?
3. What does the evidence suggest are patient and family experiences of using inpatient portals in the acute care setting?
4. What are the gaps in the existing evidence related to usability and user experiences?

1.4 Summary

Patient engagement is multifaceted. The use of inpatient portals may improve patient engagement for hospitalized patients and their families. User experience and usability is a growing area of research in healthcare and understanding user experience may help to improve patient engagement via inpatient portals.

Chapter 2: Methods

A scoping review methodology was used for this study as it supports examination of “the extent, range and nature of research activity” (Arksey & O’Malley, 2005, p. 21). This is an increasingly popular method for examining health research evidence (Levac, Colquhoun, & O’Brien, 2010). A scoping review is an exploratory review method that rapidly maps the literature on a well-defined topic (HLWIKI International, 2015), and identifies methodological and empirical gaps in the evidence and critical areas for research (The Joanna Briggs Institute, 2015). These reviews aim to address broader, more complex research questions while systematic reviews are designed to answer explicit, narrow questions (Arksey & O’Malley, 2005; HLWIKI International, 2015).

Limited literature exists on the user experiences and usability of inpatient portals in the acute care setting, and the few systematic reviews conducted to examine emerging evidence on inpatient portals have not evaluated the usability and the patient and family experiences of using inpatient portals in acute care settings. Thus, this scoping review was undertaken to provide a map of the available evidence related to this topic.

I used the methodological framework developed by Arksey & O’Malley (2005) and revised by Levac, Colquhoun and O’Brien (2010) to undertake my scoping review. This framework consists of six steps: (i) identifying the research questions, (ii) identifying relevant studies, (iii) selecting studies, (iv) charting the data, (v) collating, summarizing and reporting results and (vi) consultation with expert/stakeholder advisory group. This scoping review only focused on steps 1-5, and not the step of consulting with an expert/stakeholder advisory group, because of the scope of this Scholarly Project Advancement Research (SPAR) project.

2.1 Identifying the Research Questions

This scoping review investigated four specific questions including: (i) what is the extent and range of published evidence on patients’ and families’ experiences and the usability of inpatient portals in the acute care setting?, (ii) for what purposes are inpatient portals being used in the acute care setting?, (iii) what does the evidence suggest are patient and family experiences of using inpatient portals in the acute care setting? and (iv) what are the gaps in the existing evidence related to usability and user experiences?

2.2 Identifying Relevant Studies

For the purpose of this review, various information sources were examined. Articles were identified using six databases and two search engines including: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline, EMBASE, Web of Science, PsycINFO and Engineering Village. Grey literature was searched using Google and Google scholar. Given that the term “inpatient portal” is a relatively new concept, several search terms that are both broader and more specific were used (see Table 2.1).

Table 2.1 Search Terms

Concept	Terms
Inpatient portal	Personal Health Record Inpatient Portal Mychart Bedside Patient Portal
Inpatient/Acute Care	Hospitalized Patients Hospitalization

A University of British Columbia librarian with expertise in health research was consulted during the development of database search strategy. A comprehensive search strategy was used to identify possible literatures on the topic (see Table 2.2). Further relevant articles were identified by hand searching the reference lists of the retrieved work. The results from all databases and search engines were downloaded into the reference management software “RefWorks” and duplicate results were removed. A table was included outlining the search strategy and results of the search. A University of British Columbia librarian was contacted to obtain relevant abstracts with no full text available, which were then retrieved through inter-library loan.

Table 2.2 Search Strategy for each Database and Search Engine

Source	Strategy
CINAHL	((inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record*") AND ((MH "Aged, Hospitalized") OR (MH "Inpatients") OR (MH "Hospitalization") OR (MH "Hospitals+") OR (hospital* N2 patient*) OR (inpatient*))
Medline	((inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record*") AND (hospital* N2 patient* OR inpatient* OR (MH "Inpatients") OR (MH "Hospitalization") OR (MH "Hospitals"))
EMBASE	((inpatient portal* or mychart bedside or personal health record* or patient portal) and (hospitalization or hospital* patient*)).mp.
PsycINFO	((inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record*") AND (DE "Hospitalized Patients" OR (DE "Hospitalization" OR DE "Institutionalization" OR DE "Hospital Admission" OR DE "Psychiatric Hospital Admission" OR DE "Psychiatric Hospitalization" OR DE "Psychiatric Hospital Admission" OR DE "Psychiatric Hospital Discharge" OR DE "Psychiatric Hospital Readmission") OR (DE "Hospitals" OR DE "Psychiatric Hospitals" OR DE "Sanatoriums")) OR hospital* N2 patient* OR inpatient*))
Web of Science	((("Mychart bedside" OR "inpatient portal*" OR "patient* portal*" OR "personal health record*") AND ("hospitalization" OR "hospital* patient*") NOT "portal venous" NOT "hepatic portal")
Compendex Engineering Village	((("patient portal" or "personal health record" or "mychart bedside") AND hospital*) WN All fields)
Google Scholar	"inpatient portal" "mychart bedside"
Google	"inpatient portal". "mychart bedside"

2.3 Selecting Studies

Articles were included if they focused on inpatient portals that were used in the acute care setting, addressed the topic of current or previously hospitalized patient or family involvement, examined the functionality and/or, design of a patient portal, inpatient portal, personal health record, smart bedside station or My Chart bedside, examined usability and/or user experience of the inpatient portal, were published in English, had any date of publication, and focused on an adult population aged 18 years and above.

Articles were excluded if they were not published in English, focused on the use of portals in outpatient settings, primary care, clinics or community, patient portals used by/for children (aged below 18 years), or focused on the use of portals used by health care providers only. Furthermore, the inclusion and exclusion criteria were revisited during data collection to accommodate any changes during the time of the comprehensive search.

2.4 Charting the Data

After performing searches and removing duplicate articles, a two-stage review process was applied for the purpose of selecting the articles for this review. First, I independently reviewed the title and abstracts based on the inclusion and exclusion criteria. Then, I reviewed the full text of the remaining articles that meet the inclusion criteria. The articles were additionally reviewed by one supervisor (LC). After completing both stages of screening, general and specific information about the literature was extracted and presented with the help of the figures, table and narrative text. A data extraction form was created with the columns reflecting article characteristics as well as the research questions as shown in Appendix B, Table 3.2 and Table 3.4. Data extraction included: name of authors, year of publication, name of

journal, country of origin, title of articles, objectives, study population (patients/families), study design, key findings, name of portal used, settings, usability and user experiences methods, features participants wanted to be included in inpatient portals, and summary of findings (user satisfaction and portal usage, usability needs and issues, hardware, technical and security challenges, and additional features requested). The extracted data were reviewed for accuracy by one supervisor (LC). The systematic article selection process was presented in a PRISMA Flow Chart. As the focus of this scoping review was not be on the best available evidence, the risk of bias or overall quality was not evaluated, but the levels of evidence were examined.

2.5 Collating, Summarizing and Reporting Results

Synthesis of the articles was undertaken in order to answer the research questions that guided this study. The literature characteristics were categorized based on the key information from the selected literature. Characteristics of each study were analyzed through frequent readings of included papers and coding into groups of similar thematic categories. The results were reported in a series of tables, figures and other descriptive forms that were created from the summarized data. A narrative summary was also provided for the included tables and figures.

Chapter 3: Results

3.1 Search Results and Selection of Literature

This scoping review included available, published, peer-reviewed and grey literature until May 10, 2018. A search of the six selected databases and two search engines yielded a total of 702 individual articles for possible inclusion (See Table 3.1).

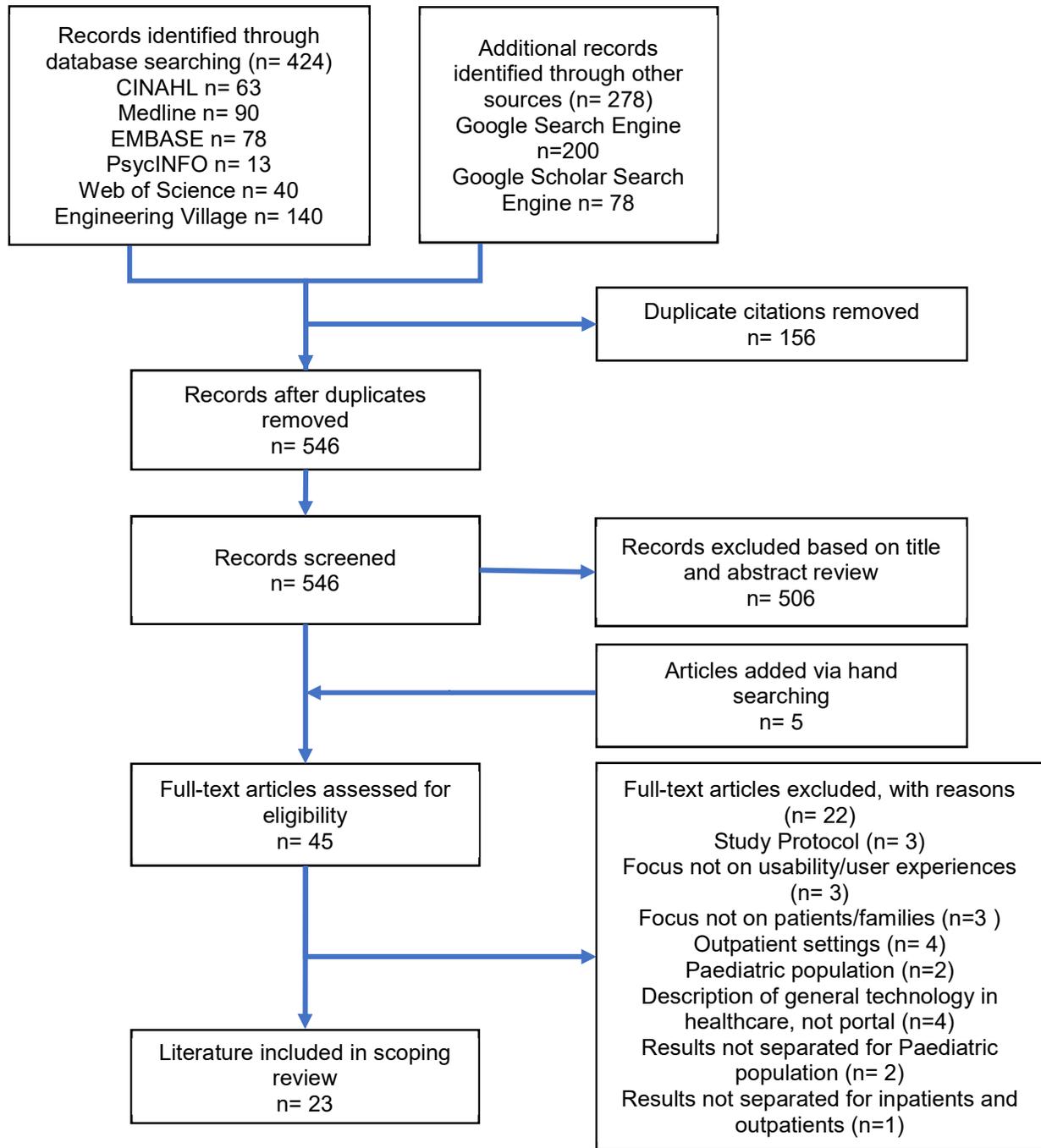
Table 3.1 Number of Hits for each Database and Search Engine

Source	N
CINAHL	n=63
Medline	n=90
EMBASE	n=78
PsycINFO	n=13
Web of Science	n=40
Compendex Engineering Village	n=140
Google Scholar	"inpatient portal" =47 + "mychart bedside" = 31 = Total n=78
Google	"inpatient portal" = 100 + "mychart bedside" = 100 = Total n=200
Total	N=702

After removing 156 duplicates using reference management software RefWorks™ (Ann Arbor, Legacy, ProQuest) titles and abstracts of 546 articles were reviewed for appropriateness. Of these, 506 articles were removed resulting in 40 articles that received full-text assessment. Five articles were added from hand searching the reference list of these 40 articles. From the 45 articles that qualified for full text review, 23 articles were selected for final review. Reasons for exclusion of the 22 articles were primarily related to the population (e.g., focus on pediatrics) or setting (e.g., focus on outpatient). Figure 3.1 shows the process involved in identifying and

selecting literature, and reasons for exclusion. Screen shots of the searches are shown in Appendix A.

Figure 3.1 PRISMA Flowchart of Article Selection



3.2 Summary of the Selected Literature

Twenty-three articles included in this scoping review provided an overview on usability and patients' and families' experiences of using an inpatient portal in the acute care setting. A majority of the literature was research-based. Publication dates ranged from 2011 to 2018, with the majority of literature published in 2015 and 2016. Table 3.2 and Appendix B provide an overview of the articles included in this scoping review. The following sections discuss these findings in greater detail.

Table 3.2 Articles Included in Scoping Review (Alphabetized)

#	Author	Year	Journal	Title of Paper	Study Objectives
1	Brown et al.	2016	Annals of the American Thoracic Society	Preferences of current and potential patients and family members regarding implementation of electronic communication portals in intensive care units	To define interest in and desired elements of an electronic communication portal among current and potential ICU patients and their family members
2	Caligtan et al.	2012	International Journal of Medical Informatics	Bedside information technology to support patient-centered care	To identify essential data elements to define requirements for a useful bedside communication tool prototype in the acute care hospital setting
3	Couture et al.	2015	CIN: Computers, Informatics, Nursing	User-centered design of the MySafeCare patient facing application	To describe the user-centered design process of developing the patient-facing application
4	Dalal et al.	2016	Journal of the American Medical Informatics Association	A web-based, patient-centered toolkit to engage patients and caregivers in the acute care setting: a preliminary evaluation	To evaluate a patient-centered toolkit, including enrollment strategy, use and usability, and content of patient generated messages
5	Davis et al.	2015	AMIA ...Annual Symposium	Health literacy, education levels, and patient portal usage during hospitalization	To explore whether health literacy and educational attainment were associated with

#	Author	Year	Journal	Title of Paper	Study Objectives
			Proceedings. AMIA Symposium		patient portal registration and portal usage in the inpatient setting
6	Dykes et al.	2013	Journal of Gerontological Nursing	Building and testing a patient-centered electronic bedside communication center	To build and test an eBCC prototype for use by patients and family caregivers during hospitalization
7	Dykes et al.	2014	MIA . Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium	Participatory design and development of a patient-centered toolkit to engage hospitalized patients and care partners in their plan of care	To identify workflow and design enhancements of an electronic bedside communication center to develop a patient-centered toolkit
8	Greysen et al.	2014	Journal of Hospital Medicine	Tablet computers for hospitalized patients: A pilot study to improve inpatient engagement	To explore inpatient satisfaction with bedside tablets and barriers to usability and to evaluate use of these devices to deliver 2 specific Web-based programs: (1) an interactive video to improve inpatient education about hospital safety, and (2) PHR access to promote inpatient engagement in discharge planning
9	Huerta et al.	2017	Annals of Internal Medicine	Introducing a patient portal and electronic tablets to inpatient care	To explore whether an inpatient portal is useful
10	Mackinson et al.	2015	N/A	<i>MyICU</i> : An electronic patient engagement portal for ICU patients and families	To implement <i>MyICU</i> , an electronic patient portal to foster meaningful engagement between patients, families, and providers, in order to improve physical and emotional outcomes of an ICU stay
11	McAlearney et al.	2015	Agency for Healthcare Research and Quality	Portals in inpatient care (PIC): Evaluating the usability, use and patient experience associated with patient portal technology at the bedside	To assess the use, usability, and impact of inpatient portals on patient experience, engagement, and perceptions of care
12	O'Leary et al.	2016	BMC Medical Informatics And Decision Making	Patients' and healthcare providers' perceptions of a mobile portal application for hospitalized patients	To assess the effect of tablet computers with a mobile patient portal application on hospitalized patients' knowledge and activation

#	Author	Year	Journal	Title of Paper	Study Objectives
13	O'Leary et al.	2016	Journal Of The American Medical Informatics Association: JAMIA	The effect of tablet computers with a mobile patient portal application on hospitalized patients' knowledge and activation	To evaluate patient and provider perceptions of an inpatient portal and identify barriers to use and enhancements
14	Pell et al.	2015	JAMA Internal Medicine	Patient access to electronic health records during hospitalization	To evaluate patient and healthcare team experiences using a portal before and after implementation
15	Vardoulakis et al.	2012	CHI '12 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems	Using mobile phones to present medical information to hospital patients	To explore the extension of patient-specific, patient-friendly information displays to the mobile phone, which authors hypothesize has unique affordances and ever-increasing availability that make it a powerful clinical information delivery medium
16	Vawdrey et al.	2011	AMIA ...Annual Symposium Proceedings. AMIA Symposium	A tablet computer application for patients to participate in their hospital care	To assess patient's knowledge of inpatient care and usefulness of portal prototype
17	Walker et al.	2018	Applied Clinical Informatics	Optimizing the user experience: identifying opportunities to improve use of an inpatient portal	To evaluate the user experience associated with an inpatient portal
18	Wilcox et al.	2012	International Health Informatics Symposium	Designing inpatient technology to meet the medication information needs of cardiology patients	To assess needs of patients to inform the design of inpatient medication electronic views
19	Wilcox et al.	2016	Journal of American Medical Informatics Association	Interactive tools for inpatient medication tracking: a multi-phase study with cardiothoracic surgery patients	To explore the design and usefulness of patient-facing tools supporting inpatient medication management and tracking
20	Winstanley et al.	2017	Telemedicine Journal And E-Health: The Official Journal Of The American	Inpatient experiences with myChart bedside	To conduct an evaluation of inpatient experiences with mychart bedside

#	Author	Year	Journal	Title of Paper	Study Objectives
			Telemedicine Association		
21	Woollen et al.	2016	Applied Clinical Informatics	Patient experiences using an inpatient personal health record	To assess the factors surrounding patients' use of an inpatient PHR, patients' experience with the application, and patients' information needs that might be partially met using an inpatient PHR
22	Yen et al.	2018	International Journal of medical informatics	Usability evaluation of a commercial inpatient portal	To understand how users interact with, learn to use, and communicate with their providers through an inpatient portal
23	Yoo et al.	2015	Journal of Medical System	Development and user research of a smart bedside station system toward patient-centered healthcare system	To design a smart bedside station terminal based on patient/caregiver experiences and healthcare team workflow

Figure 3.2 shows the evolution of literature on usability and patients and families experiences of inpatient portals. The first literature on this topic area was a qualitative pilot study conducted in 2011 with the objective of assessing patients' knowledge of inpatient care and usefulness of portal prototype (Vawdrey et al., 2011). This was the only study that addressed the usability and user experiences of inpatient portal in that year. Thereafter, the number of published articles began to grow with the highest number of papers available in 2015 and 2016 (n = 6 each year). Of 23 articles, 22 articles (95.7%) were from United States and one article was from South Korea.

Figure 3.2 Distribution of Studies by Publication Year

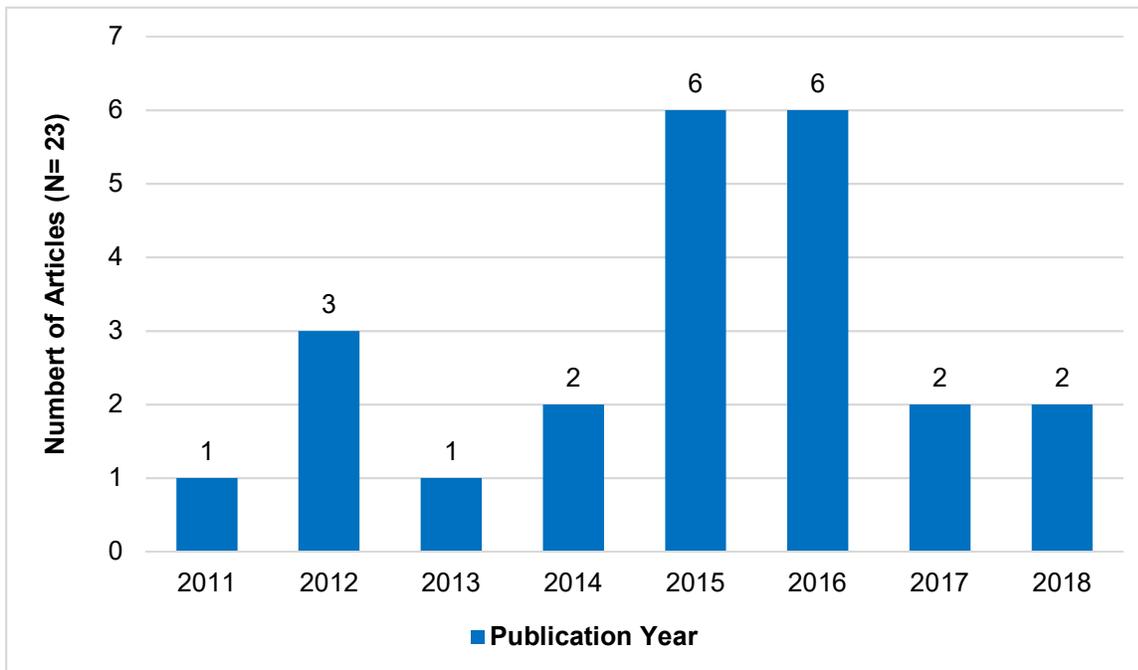


Figure 3.3 highlights the type of articles included in this scoping review. The majority of articles used a qualitative design (43.4%). Other included articles used mixed-methods (30.4%)

or a quantitative design (26%). Many of these articles used surveys and/or interviews and/or focus groups. Only one article was a non-randomized trial, four articles used a think-aloud protocol and two used a pre and post intervention method.

Figure 3.3 Number of Articles by Type of Research Method

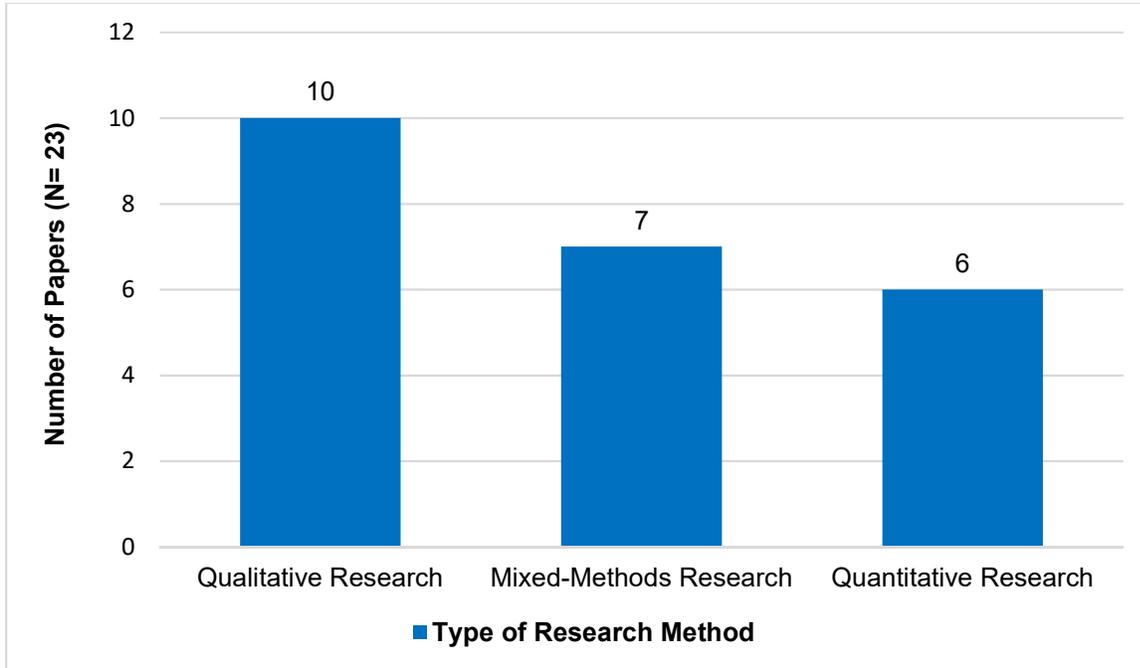
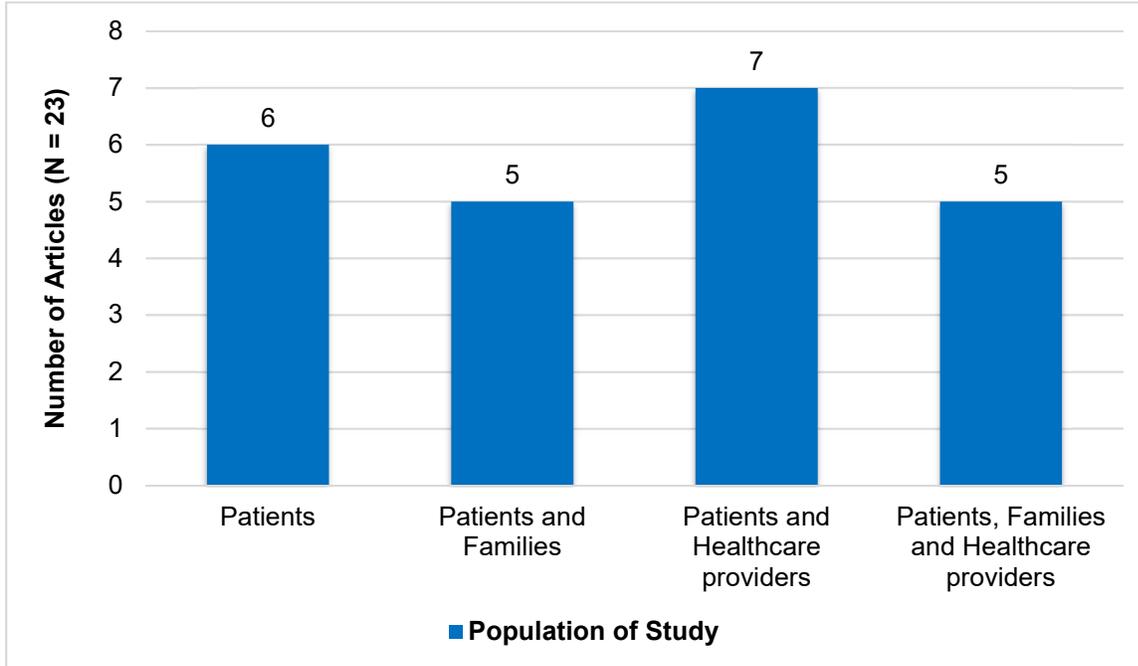


Figure 3.4 illustrates the extent of patient and family involvement in the articles included in this scoping review. The main population studied in included articles was patients. The greater number of papers (30.4%) had patients and healthcare providers as their study population. Some articles (21.7%) included patients, families and healthcare providers. Only ten papers considered families preferences and perspective for inpatient portal design and implementation.

Figure 3.4 Number of Articles with Patient, Family and Provider Involvement



3.3 Features of Inpatient Portals Reported

The features included in the inpatient portals are shown in Table 3.3. These features were divided into two categories based on patients' and families' involvement: active and passive features. The components of the active category included interacting with healthcare providers, educational resources and others. The components of the passive category included viewing health information and care plans, and general hospital information. The components of active and passive categories were further divided into sub-categories based on the functionalities of inpatient portals.

The most commonly used features of inpatient portals were viewing information related to medications, test results, medical information (e.g., vital signs, reason for hospitalization, diagnosis), schedules (e.g., consultant/physician/therapist rounds, morning care, meals,

procedures), the care team (e.g., names, photos), communicating/secure messaging with health care providers (e.g., recovery plans, reminder for hand washing, messaging to report health concerns, needs or preferences), and patient education (e.g., medications, test results, problems).

Seven articles (30.4%) reported that participants viewed information about diet (e.g., displaying any dietary reminder, food preferences, food allergies, diet order and menu) (Caligtan et al., 2012; Dalal et al., 2016; Dykes et al., 2013; Dykes et al., 2014; McAlearney et al., 2015; Walker et al., 2018; Yoo et al., 2015) as well as discharge information (e.g., discharge summary, name of discharging physicians and care manager, plan of care after hospitalization, discharge medication, estimated discharge date) (Caligtan et al., 2012; Dalal et al., 2016; Dykes et al., 2013; Dykes et al., 2014; Pell, Mancuso, Limon, Oman, & Lin, 2015; Winstanley et al., 2017; Yoo et al., 2015). In five studies, active features included entertainment such as emails, general websites, Facebook, Google Chrome, Netflix, Skype, pandora, games and virtual community (Huerta, McAlearney, & Rizer, 2017; O’Leary et al., 2016; Vardoulakis et al., 2012; Winstanley et al., 2017; Yoo et al., 2015). In five articles, the patients and families were reported to use a “daily goals” feature that included their personal day-to-day goals (Brown et al., 2016; Caligtan, Carroll, Hurley, Gersh-Zaremski, & Dykes, 2012; Dalal et al., 2016; Dykes et al., 2014; Woollen et al., 2016).

Four articles (17.3%) reported information about the patients’ care plan. Among these, the participants of three included articles viewed their care plan such as going for a test and time of morning care (Caligtan et al., 2012; Huerta et al., 2017; Vardoulakis et al., 2012), while one study reported patients and families wanting to directly participate in creating their own plan (Dykes et al., 2014). Features that were described in only a few papers were problem lists (e.g., medical diagnoses) (Dalal et al., 2016; Dykes et al., 2014; O’Leary et al., 2016; O’Leary et al.,

2016; Yoo et al., 2015), hospital information (e.g., navigating the hospital, availability of food, sleeping accommodations, parking, and visiting hours, name of hospital, phone number, date, time) (Caligtan et al., 2012; Dykes et al., 2013; Dykes et al., 2014; Yen et al., 2018; Yoo et al., 2015), safety information (Couture et al., 2015; Dalal et al., 2016; Dykes et al., 2013; Dykes et al., 2014), patient/family notes (e.g., personal written, audio or video notes) (Dykes et al., 2013; Huerta et al., 2017; Walker et al., 2018; Yen et al., 2018; Yoo et al., 2015), and the ability to request services like patient education sessions, physical therapy, and pastoral care (Walker et al., 2018; Winstanley et al., 2017; Yen et al., 2018; Yoo et al., 2015). One article illustrated that 11 minutes of portal tutorial was too long for the patients, and that patients preferred self-directed learning, guided handouts and face-to-face tutorials (Yen et al., 2018).

The least commonly reported features were a summary of family meetings (Brown et al., 2016), caregiver notes (e.g., progress notes, operative notes) (Vardoulakis et al., 2012; Winstanley et al., 2017), immunization history (Davis et al., 2015), bed assignment (Vardoulakis et al., 2012), billing information (Winstanley et al., 2017; Yoo et al., 2015), ICU diary (Brown et al., 2016), viewing and correcting personal information of patients themselves in cases of mistakes (demographic information and general information like names, reason for visit, allergies) (Vardoulakis et al., 2012) and a virtual community to interact with other patients outside of the hospital (Yoo et al., 2015). See Table 3.3.

Table 3.3 Features of Inpatient Portals included in Reviewed Literature

Author, Year	Passive														Active											
	Viewing Health Information & Plan										General Hospital Information				Interacting with Healthcare providers			Patient and Family Contributions			Educational Resources		Others			
	Care Plan	Medication	Test Results	Problem Lists	Medical Information	Caregiver Notes	Discharge Information	Summary of Family Meetings	Schedule (e.g. procedure/visitation)	Immunization History	Hospital Information	Safety Information	Diet	Bed Assignment	Billing Information	Information about Care Team	Communication/Secure Messaging	Request Services	Patient/Family Notes	Daily Goals	ICU Diary	Personal Information of Patients	Patient Education	Portal Tutorial	Entertainment	Virtual Community
Brown et al., 2016					X		X								X	X			X	X						
Caligtan et al. 2012	X	X	X				X	X		X		X			X	X			X				X			
Couture et al. 2015		X									X					X										
Dalal et al. 2016		X	X	X			X	X			X	X			X	X			X				X			
Davis et al. 2015		X	X		X			X	X							X							X	X		
Dykes et al. 2013		X	X		X		X	X		X	X	X			X				X				X			
Dykes et al. 2014	X	X	X	X			X	X		X	X	X			X	X			X				X			
Greysen et al. 2014		X						X								X										

Author, Year	Passive														Active											
	Viewing Health Information & Plan									General Hospital Information					Interacting with Healthcare providers			Patient and Family Contributions			Educational Resources		Others			
	Care Plan	Medication	Test Results	Problem Lists	Medical Information	Caregiver Notes	Discharge Information	Summary of Family Meetings	Schedule (e.g. procedure/visitation)	Immunization History	Hospital Information	Safety Information	Diet	Bed Assignment	Billing Information	Information about Care Team	Communication/Secure Messaging	Request Services	Patient/Family Notes	Daily Goals	ICU Diary	Personal Information of Patients	Patient Education	Portal Tutorial	Entertainment	Virtual Community
Huerta et al. 2017	x		x		x										x	x		x					x	x		
Mackinson et al. 2015					x										x	x							x			
McAclearney et al. 2015		x	x									x			x	x							x			
O'Leary et al. 2016		x		x				x							x								x		x	
O'Leary et al. 2016		x		x				x							x											
Pell et al. 2015		x	x																							
Vardoulakis et al. 2012	x	x	x			x									x							x	x		x	
Vawdrey et al. 2011		x						x							x								x			
Walker et al. 2018		x	x		x			x				x			x	x	x	x					x	x		

Author, Year	Passive														Active											
	Viewing Health Information & Plan										General Hospital Information				Interacting with Healthcare providers			Patient and Family Contributions			Educational Resources		Others			
	Care Plan	Medication	Test Results	Problem Lists	Medical Information	Caregiver Notes	Discharge Information	Summary of Family Meetings	Schedule (e.g. procedure/visitation)	Immunization History	Hospital Information	Safety Information	Diet	Bed Assignment	Billing Information	Information about Care Team	Communication/Secure Messaging	Request Services	Patient/Family Notes	Daily Goals	ICU Diary	Personal Information of Patients	Patient Education	Portal Tutorial	Entertainment	Virtual Community
Wilcox et al. 2012		x																								
Wilcox et al. 2016		x														x							x			
Winstanley et al. 2017		x	x		x	x	x	x						x	x	x	x						x		x	
Woollen et al. 2016		x			x										x	x			x				x			
Yen et al. 2018		x	x		x			x		x					x	x	x	x					x	x		
Yoo et al. 2015		x	x	x	x		x	x		x		x		x	x	x	x	x					x		x	x
Total	4	20	13	5	10	2	7	1	13	1	5	4	7	1	2	17	16	4	5	5	1	1	16	4	5	1

3.4 Overall Findings

3.4.1 User Satisfaction and Impact

Overall, most articles indicated that study participants were interested in using the inpatient portal, they were satisfied with the inpatient portal and they found it easy to use (Brown et al., 2016; Dykes et al., 2013; Dykes et al., 2014; Greysen, Khanna, Jacolbia, Lee, & Auerbach 2014; Huerta et al., 2017; O’Leary et al., 2016; Vawdrey et al., 2011; Winstanley et al., 2017; Woollen et al., 2016). One recent article reported that the inpatient portal helped patients cope with their acute illness (O’Leary et al., 2016). And another article found that use of the inpatient portal gave patients a sense of having more control over their care, particularly that they were able to ask better questions (McAlearney et al. (2015).

3.4.2 Patient Characteristics, Computer Literacy and Training

Some articles found that participants who were younger, female and more literate were more interested in using the portal than older, less literate and male participants (Brown et al., 2016). This finding contradicted with Woollen et al. (2016) who did not find any relationship between these factors and inpatient portals use (Woollen et al., 2016). Patients who had a background in healthcare were more interested in accessing medical information than those who did not have healthcare backgrounds (Brown et al., 2016). Participants who had previous experience with tablet devices and computers had a better experience with the inpatient portals, whereas others with less computer experience were less likely to use the inpatient portals (Woollen et al., 2016). Participants were less likely to use the inpatient portal application when they had pain, nausea, general malaise, poor eyesight and poor coordination (Vardoulakis et al., 2012; Vawdrey et al., 2011; Woollen et al., 2016). Participants who did not speak English and

who had not used an iPad before were hesitant to use the portal (Dalal et al., 2015; Vawdrey et al., 2011).

Several papers found that a short orientation on portal function would be adequate to ensure that patients/families were able to use the tool (Huerta et al., 2017; O'Leary et al., 2016; Vardoulakis et al., 2012; Wilcox et al., 2016).

3.5 Usability Challenges

Twelve articles (52.1%) showed navigational, tablet-related and system issues with the portal application. Four recent papers (17.3%) reported that participants had trouble navigating through the portal, e.g., going to a wrong page, clicking on a wrong button (McAlearney et al., 2015; Walker et al., 2018; Woollen et al., 2016; Yen et al., 2018). Four articles (17.3%) highlighted functionality issues, for example, patients assumed non-existent functionalities and assumed that the device had technology functionalities common in operation and navigation (Couture et al., 2015; McAlearney et al., 2015; Vawdrey et al., 2011; Yen et al., 2018). In another study, participants could not keep track of the relationship between lab tests, other procedures and medications (Wilcox et al., 2012). Some patients found the content of the inpatient portal to be complicated, incomplete, outdated and not personalized, such as reasons of visit or allergies (Dalal et al., 2016; Vardoulakis et al., 2012; Walker et al., 2018). Some found the number of pages of medication information to be overwhelming (Wilcox et al., 2016).

Included literature showed that the number of errors using inpatient portals committed by the participants aged above 60 years was higher as compared to those under 60 (Dykes et al., 2013; Dykes et al., 2014; McAlearney et al., 2015; Yen et al., 2018). The older adults had difficulty with navigation and with using the touch screen (McAlearney et al., 2015; Dykes et al.,

2013). One paper highlighted the preference of older patients to get information from a real person, not from computers (Dykes et al., 2013). Also, some patients did not like the feature of writing using handwriting recognition and using internal keyboard for data entry. Furthermore, the participants with lower computer literacy were confused with the application because of the busy user interface (Dykes et al., 2014).

Some of the device related challenges were noted in the included articles (Dalal et al., 2016; McAlearney et al., 2015; Walker et al., 2018; Yen et al., 2018). For example, patients did not know how to increase the volume or use a back button (Yen et al., 2018), and had problems with the sensitivity of the tablet (Walker et al., 2018). Unlike in landscape view, patients were unable to see all information in the portrait orientation (O’Leary et al., 2016). Some found the font size to be very small (Wilcox et al., 2016), and some were unknowingly directed to a wrong page (Yen et al., 2018).

3.6 Hardware, Security and Other Technical Challenges

Of 23 articles included, 7 articles (30.4%) highlighted the technological and hardware challenges encountered during inpatient portal design and implementation. However, one article reported that there were no software or hardware problems in the system (Greysen et al., 2015). In two papers, it was reported that patients were concerned about the safety of their sensitive information and the potential outcome that could result from posting this kind of information (Caligtan et al., 2012; Woollen et al., 2016). They hesitated about seeing sensitive information like a terminal prognosis before their doctor shared the information with them face-to-face (Woollen et al., 2016). One paper reported that patients did not use the portal due to the security requirement for accessing their portal account on the hospital provided tablets (Dalal et al.,

2016). Some participants found the tablet to be very heavy to hold (O’Leary et al., 2016; Walker et al., 2018). The inpatient portal was perceived to be less important by patients who were admitted for 2 days or less (Huerta et al., 2017). Issues related to data server connectivity were highlighted in another article (Vardoulakis et al., 2012).

3.7 Additional Features Requested

Many of the articles listed the additional features that patients and families wanted to be included in future inpatient portals (i.e., features and functions in addition to what they were presented as shown in Table 3.4). The most desired features were communicating with healthcare providers and viewing information related to their providers, and medication and test results (Brown et al., 2016; Caligtan et al., 2012; Dalal et al., 2016; Dykes et al., 2013; Dykes et al., 2014; Huerta et al., 2016; Mackinson et al., 2015; McAlearney et al., 2015; O’Leary et al., 2016; Vardoulakis 2012; Vawdrey et al., 2011; Wilcox et al., 2012; Wilcox et al., 2016; Woollen et al., 2016; Yen et al., 2018). However, the majority of these desired features were features that were described in other included articles. Therefore, this summary focuses on features that were requested but not reported on in any of the other articles included in this review.

Participants in four articles expressed a strong interest in communicating with their healthcare providers by having the ability to send private messages to their care providers (Brown et al., 2016; McAlearney et al., 2015; Vawdrey et al., 2011, Yen et al., 2018) and receive feedback on the status of their messages (McAlearney et al., 2015). They also requested blogging capabilities (Brown et al., 2016), videoconferencing to connect with their loved ones (Dalal et al., 2016; Dykes et al., 2013), and the opportunity to provide feedback to care providers

about the level of support they received from their care providers to meet their goals (Dykes et al., 2014).

Patients and families requested to view the names, photos, educational background and training credentials of their healthcare providers (Caligtan et al., 2012; Dykes et al., 2013; Vawdrey et al., 2011), and knowledge of the healthcare providers' professional role and related experiences (Brown et al., 2016). With respect to medication, participants wanted to view pictures, generic and trade names, and read about the purpose and side effects of their medications (Wilcox et al., 2012; Wilcox et al., 2016; O'Leary et al., 2016).

In addition to viewing progress and operative notes (Woollen 2016), participants wanted to take notes and write questions in the portal (O'Leary et al., 2016). In a few articles, participants indicated the desire to view daily medical updates (Brown et al., 2016; Mackinson et al., 2015; Vardoulakis et al., 2012; Woollen et al., 2016). Some participants were interested in ordering meals online (Dalal et al., 2016; Dykes et al., 2013). In addition to using entertainment activities such as gaming, participants were interested in accessing magazines and music (Dalal et al., 2016; Greysen et al., 2014). Other desired features were larger infobuttons, ability to use text mode, voice recognition for entering notes, electronic self-reporting of pain level and disabled lock-screen (Dalal et al., 2016; Dykes et al., 2013; Vardoulakis et al., 2012; Vawdrey et al., 2011). Participants also requested a password-protected device and wanted to see improvements in the ease of portal navigation (Vardoulakis et al., 2012; Vawdrey et al., 2011).

Table 3.4 Summary of Findings: User Satisfaction, Usability Issues, Hardware Challenges and Additional Features

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
Brown et al. 2016	<ul style="list-style-type: none"> • Overall, participants were interested in using the portal • Current ICU family members were more interested in reviewing their loved one's medical information • Younger, female, more educated, and participants with jobs in healthcare were more likely to want access to medical information on a tablet computer 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Participants indicated a desire for more detailed information • Communicating with medical teams, daily medical updates (e.g. medical status), updating daily goals, summary of family meetings, ICU diary within portal, educational background, knowledge of the role and experience of the team members • Private message board to communicate with the clinical team • Blog to communicate with family members
Caligtan et al. 2012	<ul style="list-style-type: none"> • Overall, participants wanted access to their information 	<ul style="list-style-type: none"> • Potential need to have different design if patients were cognitively impaired 	<ul style="list-style-type: none"> • Privacy issues including views on what should not be posted and potential problems that could result from posting sensitive information 	<ul style="list-style-type: none"> • Patients indicated the need for a daily plan of care, schedule, recovery goals, and room/hospital information, discharge information, education, medications (names and time of administration), and healthcare team names/photos
Couture et al. 2015	<ul style="list-style-type: none"> • First version of the MyChart safety reporting tools was confusing to participants 	<ul style="list-style-type: none"> • Participants had trouble figuring out how to choose another concern category after the first one had been selected and understanding if these concerns needed to be related and grouped together 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Ability to categorize more than one safety concerns as one type (e.g., medication or communication)

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
Dalal et al. 2016	<ul style="list-style-type: none"> • Only modest use of the portal by patients/families • 72% of users found the system useful/very useful • Patient goals was the most commonly used aspect of the tool 	<ul style="list-style-type: none"> • Lack of access for caregivers outside of hospital • Lack of ability for patients to communicate their perceptions of goals • System did not provide functions for non-English speaking patients • Information not up-to-date 	<ul style="list-style-type: none"> • Security requirements for patient portal access on hospital tablets 	<ul style="list-style-type: none"> • Provide a history and trend-view of all test results • Up-to-date care team goals and problems • Updated schedule of events including timing of imaging studies, display all types of test results including imaging studies and currently suppressed results, highlight abnormal test results • Order menu online, entertainment, video conferencing, disable lock-screen
Davis et al. 2015	<ul style="list-style-type: none"> • Probability of registration and inpatient portal use increased with higher educational attainment • Health literacy was associated with registration but not inpatient use 	<ul style="list-style-type: none"> • Educational attainment was associated with viewing health record data • Health literacy was associated with use of appointment and health education tools 	<ul style="list-style-type: none"> • Lower levels of inpatient portal use among patients with limited educational attainment. • Lower registration due to limited health literacy 	<ul style="list-style-type: none"> • Not explored
Dykes et al. 2013	<ul style="list-style-type: none"> • Participants reported satisfaction with portal components and type of information provided 	<ul style="list-style-type: none"> • Timing of hospital and patient activities (meals, tests, next time for pain medication) was the most difficult information for patients to find in the system 	<ul style="list-style-type: none"> • Participants aged older than 64 had trouble with touch screen hardware, didn't prefer writing using handwriting recognition and internal keyboard for data entry • One participant who was 90 years old preferred to get information from humans as he didn't use computers 	<ul style="list-style-type: none"> • Pictures of health care team • Ability to page, text, or e-mail messages to health care providers • Videoconferencing to connect with family members, • Ordering meals online • Larger infobuttons • Voice recognition as a means for entering notes

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
Dykes et al. 2014	<ul style="list-style-type: none"> Majority of participants liked the use of inpatient portal 	<ul style="list-style-type: none"> The interface was too busy and could be confusing for patients who are not technically savvy 	<ul style="list-style-type: none"> User interface was too busy that was confusing for older patients or who are not computer savvy to use 	<ul style="list-style-type: none"> Participants desired tools within the portal to communicate their goals, problems, concerns, and care preferences directly with the care team along with giving feedback on how well the care team was assisting them to meet these goals
Greysen et al. 2014	<ul style="list-style-type: none"> Twenty-seven (90%) reported high overall satisfaction with the tablet device 26 (87%) required 30 minutes for basic orientation (70% required 15 minutes) 	<ul style="list-style-type: none"> Not explored 	<ul style="list-style-type: none"> No device software malfunction or hardware issues were reported by the participants 	<ul style="list-style-type: none"> Entertainment (gaming, magazines, or music)
Huerta et al. 2017	<ul style="list-style-type: none"> Patients with tablets reported higher satisfaction 	<ul style="list-style-type: none"> Patients wanted access to the inpatient portal, but they wanted to use their own device (not a hospital provided tablet) 	<ul style="list-style-type: none"> Researchers observed that tablets were less important to patients who were admitted for 2 days or less 	<ul style="list-style-type: none"> Immediate access to laboratory test results
Mackinson et al. 2015	<ul style="list-style-type: none"> Participants showed a strong interest in utilizing a portal 	<ul style="list-style-type: none"> Need to design tool to fit with nurses' daily workflow 	<ul style="list-style-type: none"> Not explored 	<ul style="list-style-type: none"> Daily medical updates, access to medical information Educational resources, information about providers, and sharing information about themselves with their care team
McAclearney et al. 2015	<ul style="list-style-type: none"> Patients reported that access to MyChart Bedside (MCB) made them feel more in control of their care and able to ask better questions 	<ul style="list-style-type: none"> Participants frequently made operational errors Most errors in navigation were caused by assuming system had common technology functionality in all sections 	<ul style="list-style-type: none"> Several errors due to system design issues and insufficient user knowledge of the application. Age as a potential factor that influenced the learning to navigate the portal 	<ul style="list-style-type: none"> Individually message care providers and wanted feedback on status Resources to instruct how to use MCB

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
O'Leary et al. 2016a	<ul style="list-style-type: none"> • Patients found Information provided by the portal to be useful, especially regarding team members • Many patients described frequent use of games and non-clinical applications and felt the tablet helped them cope with their acute illness 	<ul style="list-style-type: none"> • Patients were able to view all information in landscape orientation, but needed to swipe left to see information when in portrait orientation • The presentation of medication information was confusing because the patient was on brand medication at home and generic at the hospital 	<ul style="list-style-type: none"> • Physical difficulty (e.g., iPad was too heavy to hold) 	<ul style="list-style-type: none"> • Take notes, write questions in the portal • Detailed information about current medications (timing of last dose, use of both generic and brand names, purpose), test results
O'Leary et al. 2016b	<ul style="list-style-type: none"> • Overall, participants were satisfied with the portal • 80% of intervention patients used it, 76% said was easy to use, and 71% said portal provided useful information 	<ul style="list-style-type: none"> • There was no improvement compared to the control group for patient knowledge about their treatment (new/discontinued medications, planned tests, results) 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Not explored
Pell et al. 2015	<ul style="list-style-type: none"> • Time logged onto portal ranged from 2 minutes to 1331 minutes per day 	<ul style="list-style-type: none"> • There was a decrease in several engagement activities with use of inpatient portal: follow recommendations, trust physician, understanding discharge timing • There was expected increase in patient ability to help identify medical errors, but this was not born out 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Not explored
Vardoulakis et al. 2012	<ul style="list-style-type: none"> • 'Knowing' or being in the loop helped to 	<ul style="list-style-type: none"> • Poor eyesight 	<ul style="list-style-type: none"> • Data server connectivity issues 	<ul style="list-style-type: none"> • Access to medical information • Larger-text mode

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
	<p>calm the patients and led to patient empowerment</p>	<ul style="list-style-type: none"> • One participant found it to be too complicated • Some contents of the device were incomplete (e.g., reason for visit, allergies) 	<ul style="list-style-type: none"> • Ergonomic issues related to patient equipment (e.g., IVs) 	<ul style="list-style-type: none"> • Reduced physical handling of the device • Password-protected phone
Vawdrey et al. 2011	<ul style="list-style-type: none"> • Overall, participants believed that tablet computer application would improve their satisfaction with their care and help them feel more engaged in the process 	<ul style="list-style-type: none"> • Confusion in navigating through the application, due to poor coordination and vision immediately after surgery • Functionality Issues (e.g., when clicked on meds, got search results) 	<ul style="list-style-type: none"> • Participants who had not used an iPad before exhibited some reluctance with using the portal 	<ul style="list-style-type: none"> • User interface, navigation improvements, electronic self-reporting of pain level • Record notes, comments and questions for health providers • Send messages to care providers • Education and training credentials of care providers
Walker et al. 2018	<ul style="list-style-type: none"> • Overall participants felt that the portal could be useful • But the application was “complex,” contained “a lot of information,” and would require some time and resources to understand 	<ul style="list-style-type: none"> • Physical issues: difficulty navigating content, • Cognitive issues: hard to comprehend information • Socio-behavioral experience: different learning styles & preferences need multi-modes for training 	<ul style="list-style-type: none"> • Problems with sensitivity of tablet, ergonomic issues 	<ul style="list-style-type: none"> • Normal ranges for reported laboratories and test results, personalized information
Wilcox et al. 2012	<ul style="list-style-type: none"> • Patients agreed on the value of interactive, patient-facing, inpatient medication information views available at the bedside 	<ul style="list-style-type: none"> • Patients wanted medication tracking, progress, decision-making, education, information, and formatting 	<ul style="list-style-type: none"> • Difficulty in keeping track of the relationship between lab tests, other procedures and prescribing of medication 	<ul style="list-style-type: none"> • List of current and discontinued medications, medication dosage, frequency, administration, photos, criticality, and education (alternatives, indications, side effects)
Wilcox et al. 2016	<ul style="list-style-type: none"> • 70% of participants used the portal independently • Patients made frequent use of the 	<ul style="list-style-type: none"> • Format of last dose time to see medication history was not readily apparent to users 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Explanation of medication and its class in lay terms • Schedule and method for medication administration

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
	<p>hospital medications feature and found electronic reporting of questions and comments useful</p>	<ul style="list-style-type: none"> • Scrollable inpatient medication lists limited view of discontinued medications, and was overwhelming for users • Small font size forced patients to zoom in frequently 		<ul style="list-style-type: none"> • Example of questions and comments for electronic communication with care providers • Better support for tracking changes in related medication orders • More obvious links from the generic version of a drug to a familiar brand name
Winstanley et al. 2017	<ul style="list-style-type: none"> • The portal improved communication with nurses (74.1%) and physicians (52.4%), and helped them understand their medications (89.7%) 	<ul style="list-style-type: none"> • The least useful features included taking notes, making requests, signing up for MyChart, viewing laboratory results, and learning why they were in the hospital 	<ul style="list-style-type: none"> • Not explored 	<ul style="list-style-type: none"> • Not explored
Woollen et al. 2016	<ul style="list-style-type: none"> • 85.7% of participants used the application following an initial training session • Patients reported high satisfaction with being able to view their hospital medications and access educational materials related to their medical conditions 	<ul style="list-style-type: none"> • Patients were less likely to use the portal if they were sicker: in pain or nausea, general malaise; undergoing multiple test or procedures • Hesitation about seeing sensitive materials (e.g. terminal prognosis) before their doctor could share with the patients 	<ul style="list-style-type: none"> • Privacy issues (safeguards for sensitive information) • Patient with the experience of tablet use had an easier time navigating through the application 	<ul style="list-style-type: none"> • Progress note, operative reports, documented medical conditions, laboratory test results, radiology reports, diagnosis
Yen et al. 2018	<ul style="list-style-type: none"> • 14 participants were able to complete all assigned tasks. But 8 participants needed help • Aged above 60 had the highest average error, while participants below 40 	<ul style="list-style-type: none"> • Operational errors: especially in navigation (going to a wrong page, clicking on a wrong button) and assuming non-existent functionalities 	<ul style="list-style-type: none"> • Tablet-related errors: not knowing how to turn up the volume or use the back button on the device 	<ul style="list-style-type: none"> • Ability to choose who receives messages, user control and freedom • Status of communication (whether message has been read, who would respond and when their request would be fulfilled)

Authors, Year	User Satisfaction and Portal Usage	Usability Needs & Issues	Hardware/ Technical/ Security Challenges	Additional Features Requested
	had the lowest error count	<ul style="list-style-type: none"> • System errors: being directed to a wrong page unexpectedly 		
Yoo et al. 2015	<ul style="list-style-type: none"> • The service design methodology, the Double Diamond Design Process Model, was very useful to identify complex clinical workflow, stakeholder requirements and environmental factors 	<ul style="list-style-type: none"> • User experience was identified through shadowing, a day in the life, and contextual inquiry • User needs and design components included inpatient health information and schedule, addressing privacy issues, integrating into hospital processes, and improving the patient-caregiver relationship 	<ul style="list-style-type: none"> • Patients wanted to view private information when they decided they wanted it 	<ul style="list-style-type: none"> • Not explored

3.8 Summary of Results

All twenty-three articles included in this scoping review were research-based, and published between 2011 and 2018. The increasing number of recent articles that included investigations of usability and user experiences indicate a significant growth in this field. Analysis of included articles indicates that patients and their families are interested in using inpatient portals, but that there are navigation and usability issues, hardware and technical challenges, and patients request for additional features.

Chapter 4: Discussion

In this scoping review, the range of evidence identifying the usability and the patient and family user experiences of inpatient portals was explored. A limited number of both published and online materials was found on this topic. Consideration of usability and user-centered design is a key to creating inpatient portals that encourage patient engagement and which ultimately can result in more satisfied and informed end users.

4.1 Key Findings

A total of 23 articles, published between 2011 and 2018 were identified in this scoping review. Of 23 articles on usability and user experiences, approximately 43% articles were qualitative, 30% were mixed-methods, and 26% were quantitative. All but one article originated from the United States, suggesting that the area of usability and user experiences of inpatient portals for adult patients has not been explored in other countries. It is also possible that inpatient portals have not been implemented in other countries. In the future, exploring this area in other contexts and detail might help advance patient and family-centered care specific to those acute care settings.

Based on the findings, it is noted that various information needs of the patients/families still need consideration while designing and implementing portal applications. Although, the majority of the features patients and families needed have already been included, some existing features require modification and other features should be added to meet end-user needs. For example, immediate release of laboratory findings, providing tutorials in lay terms, personalized health education and secure messaging with care providers still needs to be designed,

implemented and evaluated. These are important because incorporating the patients' desired features is likely to increase the use and satisfaction with the tools (O'Leary et al., 2016). Nevertheless, it is also vital to consider the impact of some desired features, such as the desire of patients to participate in the development of their own care plan and choose specific care providers for secure messaging, instead of the whole care team. Addressing patient demands could be a challenge for healthcare providers given that the information load of inpatient portals might result into more anxious and confused patients, and that healthcare providers might need to spend additional time addressing patients' and families' queries.

Some patients and families (e.g., older people, ill patients, non-English speakers, those with low computer literacy or no previous experiences) might not be willing or able to use inpatients portals; however, the majority of participants were satisfied and would like to engage more in their health care via inpatient portal use. Some design and usability challenges also exist in implementing inpatient portals (e.g., safety of sensitive information, its disclosure, security requirement for hospital-provided tablets, tablet related, connectivity, operational and system issues). One possible way to overcome these barriers could be to design a new inpatient portal that addresses these specific challenges and are simpler and more intuitive. To give an example, the barriers to inpatient portals use due to lower computer literacy could potentially be overcome with a shorter tutorial on the device and application as highlighted in Greysen et al. (2014), and barriers to portals use due to language could be addressed with designing portals in different languages other than English.

The growing body of literature on this topic area, that has included the involvement of patients indicates that the perspectives of patients are being acknowledged in designing and implementing inpatient portals. The active features that are seen in the included articles may

signal as the active involvement of patients and families in making decisions about patient care. However, the evidence regarding new features (e.g., virtual community, ICU diary, bed assignment, immunization history, personal information of patients, summary of family meetings) is not sufficient to draw any conclusions at this moment.

4.2 Gaps and Potential for Future Research

Despite the growth in the number of articles related to inpatient portals, there are many areas that need to be evaluated. There is a research gap in our understanding of whether it is appropriate to release sensitive laboratory findings such as HIV testing reports and CD4 counts and what kind of results are appropriate to release. The perceptions or attitudes of patients/families and healthcare providers of release of this kind of information, and its consequence should be evaluated in the future. Families play a significant role in patients care and recovery (Caligtan et al., 2015). Thus, there is a need to evaluate the perspectives and needs of families in inpatient portal use (Brown et al., 2016). On the other hand, it would also be valuable to assess the issues related to the release of personal health information to various family members. Also, future research should consider more rigorous research methods like controlled trials, think-aloud protocols for testing usability and user experiences with larger sample sizes, and on integrating inpatient portals with the devices used by the patients/families.

All the articles included in this scoping review had English-speaking participants, future studies should focus on usability tests with cognitively-impaired patients or otherwise disabled and non-English speakers. Another possible area to explore in the future is the factors that might encourage inpatient portals use for non-English speaking patients and families. In order to connect patients with their loved ones who cannot be physically present, future research is

needed on ways to provide remote access to the loved ones (O’Leary et al., 2016). One of the suggested ways to share patients’ information with family members who cannot be physically present is to explore a “subscription-based sharing” feature (Vardoulakis et al., 2012). As mentioned earlier, a large volume of electronic messages could be overwhelming to healthcare providers when they have other priorities to deal with (e.g., medication, discharge, other emergency situations), leading into job burnout. Therefore, it is also important to explore the consequences of communicating via private messaging on the clinical workflow of healthcare providers.

4.3 Implications for Nursing Practice

The implementation of inpatient portals might have numerous implications for nursing practice. The knowledge acquired through using an inpatient portal might decrease the volume of questions that patients/families might ask during their hospital stay. It might also help to reduce medication-related errors as patients/families will carefully evaluate their medication information and correct errors. On the other hand, this might provoke patients/families to ask more technical questions, which can impact the clinical workflow of nurses; it is possible that instead of decreasing, it might increase nurses’ workload. The availability of secure messaging features for communication with healthcare providers may become a burden to acute care nurses. Patients and families might send a large number of messages and expect an immediate reply to those messages. This could be a frustrating situation for patients and families as well, due to their unmet expectation with their healthcare providers and hospitals.

An alternative recommendation might be to provide support to nurses to implement a private messaging to specific care providers, rather than to the entire team. Portals could also

include client-specific educational content as well as a short portal tutorial. This might reduce the workload of nurses in the acute care setting and increase patient/family satisfaction with the care.

4.4 Implications for Nursing Policy

Inpatient portals may be an important tool to help patients and families engage in patient care in the acute care setting. As patients and families are the ultimate users of inpatient portals, hospitals and software developers should identify various ways to engage patients and families in the design and implementation. Incorporating patients' and families' evaluations and perspectives on design and features of inpatient portals would enhance their engagement in using the portals and patient care. It is recommended that hospitals allow family to access patients' health information via inpatient portals when patients cannot make decisions due to illness. Hospitals must manage workflow to facilitate secure messaging with healthcare providers along with necessary feedback. Finding ways to overcome low technology literacy and age-related barriers in designing portals is important. Hospitals should collaborate with inpatient portal development teams in regards to portal design, modifications of features, and training for the end-users. There needs to be a strong policy regarding sensitive information disclosure. They should continuously assess the impact of inpatient portals use on patients/families' satisfaction and clinical workflow.

4.5 Limitations

Some limitations exist related to conducting this scoping review. First, lack of the key terms for inpatient portals resulted into the use of various generalized terms that might not have

captured all the relevant articles. Second, all included articles were published in English, and thus other important non-English articles might have been missed. Third, the search in Google and Google Scholar was limited to first 10 pages only, which could have missed other relevant articles.

4.6 Conclusions

This scoping review was conducted to identify and explore the literature on patient and family user experiences and the usability of inpatient portals in the acute care setting. To the date of this study, very limited evidence is available to support the use of these tools. The early findings suggest that inpatient portals are a promising tool for increasing patient/family engagement in the acute care setting and that the vast majority of patients and families are interested in using this tool. However, some barriers still exist that might hinder the widespread acceptance of inpatient portals in the acute care setting. Thus, the next step is to design inpatient portals that address these barriers and meet the needs of patients and families. Future research is needed to understand the usability and patient/family user experiences associated with inpatient portals.

References

- Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, 8(1), 19-32.
doi:10.1080/1364557032000119616
- Brown, S. M., Bell, S. K., Roche, S. D., Dente, E., Mueller, A., Kim, T., Talmor, D. (2016). Preferences of current and potential patients and family members regarding implementation of electronic communication portals in intensive care units. *Annals of the American Thoracic Society*, 13(3), 391. doi:10.1513/AnnalsATS.201509-638OC
- Caligtan, C. A., Carroll, D. L., Hurley, A. C., Gersh-Zaremski, R., & Dykes, P. C. (2011;2012;). Bedside information technology to support patient-centered care. *International Journal of Medical Informatics*, 81(7), 442-451. doi:10.1016/j.ijmedinf.2011.12.005
- Carman, K. L., Dardess, P., Maurer, M., Sofaer, S., Adams, K., Bechtel, C., & Sweeney, J. (2013). Patient and family engagement: A framework for understanding the elements and developing interventions and policies. *Health Affairs (Project Hope)*, 32(2), 223.
- Couture, B., Cleveland, J., Ergai, A., Katsulis, Z., Ichihara, N., Goodwin, A., . . . Smith, A. (2015). User-centered design of the mysafecare patient facing application. *CIN: Computers, Informatics, Nursing*, 33(6), 225-226. doi: 10.1097/01.NCN.0000466962.17866.8d
- Dalal, A. K., Dykes, P. C., Collins, S., Lehmann, L. S., Ohashi, K., Rozenblum, R., . . . Bates, D. W. (2016). A web-based, patient-centered toolkit to engage patients and caregivers in the acute care setting: A preliminary evaluation. *Journal of the American Medical Informatics Association*, 23(1), 80-87. doi:10.1093/jamia/ocv093

- Davis, S. E., Osborn, C. Y., Kripalani, S., Goggins, K. M., & Jackson, G. P. (2015). Health literacy, education levels, and patient portal usage during hospitalizations. *AMIA . Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium, 2015*, 1871.
- Dumitrascu, A. G., Burton, M. C., Dawson, N. L., Thomas, C. S., Nordan, L. M., Greig, H. E., Aljabri, D. I., Naessens, J. M. (2018). Patient portal use and hospital outcomes. *Journal of the American Medical Informatics Association*, 25(4), 447–453.
doi:<https://doi.org/10.1093/jamia/ocx149>
- Dykes, P. C., Carroll, D. L., Hurley, A. C., Benoit, A., Chang, F., Pozzar, R., & Caligtan, C. A. (2013). Building and testing a patient-centric electronic bedside communication center. *Journal of Gerontological Nursing*, 39(1), 15-19. doi:10.3928/00989134-20121204-03
- Dykes, P. C., Stade, D., Chang, F., Dalal, A., Getty, G., Kandala, R., . . . Collins, S. (2014). Participatory design and development of a patient-centered toolkit to engage hospitalized patients and care partners in their plan of care. *AMIA . Annual Symposium Proceedings. AMIA Symposium, 2014*, 486-495.
- Foisy, C.Q. (2015, October 20). The importance of patient engagement and technology. Health IT Outcome, P. B2. Retrieved from <https://www.healthitoutcomes.com/doc/the-importance-of-patient-engagement-and-technology-0001>
- Greysen, S. R., Khanna, R. R., Jacolbia, R., Lee, H. M., & Auerbach, A. D. (2014). Tablet computers for hospitalized patients: A pilot study to improve inpatient engagement. *Journal of Hospital Medicine*, 9(6), 396-399. doi:10.1002/jhm.2169
- Grossman, L. V., Choi, S. W., Collins, S., Dykes, P. C., O'Leary, K. J., Rizer, M., . . . Vawdrey, D. K. (2018). Implementation of acute care patient portals: Recommendations on utility

- and use from six early adopters. *Journal of the American Medical Informatics Association : JAMIA*, 25(4), 370-379. doi:10.1093/jamia/ocx074
- Hefner, J. L., Sieck, C. J., Walker, D. M., Huerta, T. R., & McAlearney, A. S. (2017). System-Wide Inpatient Portal Implementation: Survey of Health Care Team Perceptions. *JMIR Medical Informatics*, 5(3), e31. <http://doi.org/10.2196/medinform.7707>
- HIWIKI International. (2015). Scoping reviews. Retrieved from http://hlwiki.slais.ubc.ca/index.php/Scoping_reviews
- Huerta, T. R., McAlearney, A. S., & Rizer, M. K. (2017). Introducing a patient portal and electronic tablets to inpatient care. *Annals of Internal Medicine*, 167(11), 816. doi:10.7326/M17-1766
- Kachirskaia, I., Mate, K. S., & Neuwirth, E. (2018). Human-centered design and performance improvement: Better together. *NEJM Catalyst*. Retrieved from https://catalyst.nejm.org/hcd-human-centered-design-performance-improvement/?utm_campaign=tw&utm_source=hs_email&utm_medium=email&utm_content=64178567&_hsenc=p2ANqtz9oGo6ZBEodWhZukMW61PDXxwC1POOXAEHssLS3M64wE431fOBljufBM1LV9wa5AoWrm9jVS7DSUxH2cm4Qoy70eJECQjuwnCI1zwe74PI7JMtHfSc&_hsmi=64178567
- Kelly, M. M., Coller, R. J., & Hoonakker, P. L. (2018;2017;). Inpatient portals for hospitalized patients and caregivers: A systematic review. *Journal of Hospital Medicine*, 13(6), 405. doi:10.12788/jhm.2894
- Kotrotsiou, E., Theodosopoulou, E, Papathanasiou, I. V & G, Dafogianni & V, Raftopoulos & E, Konstantinou. (2001). How do patients experience stress caused by hospitalization and

- how do nurses perceive this stress experienced by patients. A comparative study. *ICUs & Nursing Web Journal*, 7, 1-17.
- Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Science : IS*, 5(1), 69-69. doi:10.1186/1748-5908-5-69
- McAlearney, A. S. (2017). Portals in Inpatient Care: Evaluating the Usability, Use, and Patient Experience Associated With Patient Portal Technology at the Bedside - Final Report. (Prepared by the Ohio State University College of Medicine under Grant No. R21 HS024349). Rockville, MD: Agency for Healthcare Research and Quality.
- McAlearney, A. S., Sieck, C. J., Hefner, J. L., Aldrich, A. M., Walker, D. M., Rizer, M. K., Huerta, T. R. (2016). High touch and high tech (HT2) proposal: Transforming patient engagement throughout the continuum of care by engaging patients with portal technology at the bedside. *JMIR Research Protocols*, 5(4), e221. doi:10.2196/resprot.6355
- Mackinson, L., Corey, J., & Kelly, V. (2015). MyICU: An Electronic Patient Engagement Portal for ICU Patients and Families. *BIDMC Silverman Symposium Poster Database*. Retrieved from <https://bidmc.omeka.net/items/show/1488>
- Olding, M., McMillan, S. E., Reeves, S., Schmitt, M. H., Puntillo, K., & Kitto, S. (2016). Patient and family involvement in adult critical and intensive care settings: A scoping review. *Health Expectations*, 19(6), 1183-1202. doi:10.1111/hex.12402
- O'Leary, K. J., Sharma, R. K., Killarney, A., O'Hara, L. S., Lohman, M. E., Culver, E., . . . Cameron, K. A. (2016). Patients' and healthcare providers' perceptions of a mobile portal application for hospitalized patients. *BMC Medical Informatics and Decision Making*, 16(1) doi:10.1186/s12911-016-0363-7

- O’Leary, K. J., Lohman, M. E., Culver, E., Killarney, A., Randy Smith, G., & Liebovitz, D. M. (2016). The effect of tablet computers with a mobile patient portal application on hospitalized patients’ knowledge and activation. *Journal of the American Medical Informatics Association : JAMIA*, 23(1), 159-165. doi:10.1093/jamia/ocv058
- Parsapour, K., Kon, A. A., Dharmar, M., McCarthy, A. K., Yang, H., Smith, A. C., Marcin, J. P. (2011). Connecting hospitalized patients with their families: Case series and commentary. *International Journal of Telemedicine and Applications*, 1-7. doi:10.1155/2011/804254
- Pell, J. M., Mancuso, M., Limon, S., Oman, K., & Lin, C. (2015). Patient access to electronic health records during hospitalization. *JAMA Internal Medicine*, 175(5), 856. doi:10.1001/jamainternmed.2015.121
- Prey, J. E., Woollen, J., Wilcox, L., Sackeim, A. D., Hripesak, G., Bakken, S., Vawdrey, D. K. (2014). Patient engagement in the inpatient setting: A systematic review. *Journal of the American Medical Informatics Association : JAMIA*, 21(4), 742-750. doi:10.1136/amiajnl-2013-002141
- Roberts, S., Chaboyer, W., Gonzalez, R., & Marshall, A. (2017). Using technology to engage hospitalised patients in their care: A realist review. *BMC Health Services Research*, 17 doi:10.1186/s12913-017-2314-0
- Robinson, J. R., Davis, S. E., Cronin, R. M., & Jackson, G. P. (2016). Use of a Patient Portal During Hospital Admissions to Surgical Services. *AMIA Annual Symposium Proceedings*, 1967–1976.
- Vardoulakis, L. P., Karlson, A. K., Morris, D., Smith, G., Gatewood, J., & Tan, D. S. (2012). Using mobile phones to present medical information to hospital patients. Paper presented

- at Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems 2012, 1411-1420. doi:10.1145/2207676.2208601
- Vawdrey, D. K., Wilcox, L. G., Collins, S. A., Bakken, S., Feiner, S., Boyer, A., & Restaino, S. W. (2011). A tablet computer application for patients to participate in their hospital care. *AMIA . Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium*, 1428.
- Walker, D. M., Menser, T., Yen, P. (2018). Optimizing the user experience: Identifying opportunities to improve use of an inpatient portal. *Journal of American Medical Informatics Association*, 9(1), 105-113. doi: 10.1055/s-0037-1621732
- Werder, Matthew (2015). Health information technology: A key ingredient of the patient experience. *Patient Experience Journal*, 2(1), 143-147 . Retrieved from <http://pxjournal.org/journal/vol2/iss1/19>
- Whittemore, R. and Knafl, K. (2005) The Integrative Review: Updated Methodology. *Journal of Advanced Nursing*, 52, 546-553. doi:<http://dx.doi.org/10.1111/j.1365-2648.2005.03621.x>
- Wilcox, L., Feiner, S., Liu, A., Restaino, S., Collins, S., & Vawdrey, D. (2012). Designing inpatient technology to meet the medication information needs of cardiology patients. Paper presented at the 831-836. doi:10.1145/2110363.2110466
- Wilcox, L., Woollen, J., Prey, J., Restaino, S., Bakken, S., Feiner, S., . . . Vawdrey, D. K. (2016). Interactive tools for inpatient medication tracking: A multi-phase study with cardiothoracic surgery patients. *Journal of the American Medical Informatics Association*, 23(1), 144-158. doi:10.1093/jamia/ocv160
- Winstanley, E. L., Burtchin, M., Zhang, Y., Campbell, P., Pahl, J., Beck, S., Wayne Bohenek, W. (2017). Inpatient experiences with mychart bedside. *Telemedicine Journal and E-health:*

the Official Journal of the American Telemedicine Association, 23(8), 691-693. doi:
<http://dx.doi.org/10.1089/tmj.2016.0132>

Woollen, J., Prey, J., Wilcox, L., Sackeim, A., Restaino, S., Raza, S. T., Vawdrey, D. (2016).

Patient experiences using an inpatient personal health record. *Applied Clinical Informatics*, 7(2), 446-460. doi:10.4338/ACI-2015-10-RA-0130

Yen, P., Walker, D. M., Smith, JM. G., Zhou, M. P., Menser, T. L., McAlearney, A. S. (2018).

Usability evaluation of a commercial inpatient portal. *International Journal of Medical Informatics*, 110, 10-18. doi: <https://doi.org/10.1016/j.ijmedinf.2017.11.0>

Yoo, S., Lee, K., Baek, H., Ryu, B., Chung, E., Kim, K., . . . Hwang, H. (2015). Development and user research of a smart bedside station system toward patient-centered healthcare system. *Journal of Medical Systems*, 39(9), 1-11. doi:10.1007/s10916-015-0273-8

Appendices

Appendix A Summary of Search History

#	Source	N	Search History																																								
1	CINAHL	63	<table border="1"> <thead> <tr> <th>Search ID#</th> <th>Search Terms</th> <th>Search Options</th> <th>Actions</th> </tr> </thead> <tbody> <tr> <td>S9</td> <td>S1 AND S8</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (63)</td> </tr> <tr> <td>S8</td> <td>S2 OR S3 OR S4 OR S5 OR S6 OR S7</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (231,472)</td> </tr> <tr> <td>S7</td> <td>inpatient*</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (98,242)</td> </tr> <tr> <td>S6</td> <td>hospital* N2 patient*</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (41,283)</td> </tr> <tr> <td>S5</td> <td>(MH "Hospitals+")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (98,237)</td> </tr> <tr> <td>S4</td> <td>(MH "Hospitalization")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (26,700)</td> </tr> <tr> <td>S3</td> <td>(MH "Inpatients")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (72,903)</td> </tr> <tr> <td>S2</td> <td>(MH "Aged, Hospitalized")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (2,983)</td> </tr> <tr> <td>S1</td> <td>(inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record**</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (908)</td> </tr> </tbody> </table>	Search ID#	Search Terms	Search Options	Actions	S9	S1 AND S8	Search modes - Boolean/Phrase	View Results (63)	S8	S2 OR S3 OR S4 OR S5 OR S6 OR S7	Search modes - Boolean/Phrase	View Results (231,472)	S7	inpatient*	Search modes - Boolean/Phrase	View Results (98,242)	S6	hospital* N2 patient*	Search modes - Boolean/Phrase	View Results (41,283)	S5	(MH "Hospitals+")	Search modes - Boolean/Phrase	View Results (98,237)	S4	(MH "Hospitalization")	Search modes - Boolean/Phrase	View Results (26,700)	S3	(MH "Inpatients")	Search modes - Boolean/Phrase	View Results (72,903)	S2	(MH "Aged, Hospitalized")	Search modes - Boolean/Phrase	View Results (2,983)	S1	(inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record**	Search modes - Boolean/Phrase	View Results (908)
Search ID#	Search Terms	Search Options	Actions																																								
S9	S1 AND S8	Search modes - Boolean/Phrase	View Results (63)																																								
S8	S2 OR S3 OR S4 OR S5 OR S6 OR S7	Search modes - Boolean/Phrase	View Results (231,472)																																								
S7	inpatient*	Search modes - Boolean/Phrase	View Results (98,242)																																								
S6	hospital* N2 patient*	Search modes - Boolean/Phrase	View Results (41,283)																																								
S5	(MH "Hospitals+")	Search modes - Boolean/Phrase	View Results (98,237)																																								
S4	(MH "Hospitalization")	Search modes - Boolean/Phrase	View Results (26,700)																																								
S3	(MH "Inpatients")	Search modes - Boolean/Phrase	View Results (72,903)																																								
S2	(MH "Aged, Hospitalized")	Search modes - Boolean/Phrase	View Results (2,983)																																								
S1	(inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record**	Search modes - Boolean/Phrase	View Results (908)																																								
2	Medline	90	<table border="1"> <thead> <tr> <th>Search ID#</th> <th>Search Terms</th> <th>Search Options</th> <th>Actions</th> </tr> </thead> <tbody> <tr> <td>S8</td> <td>S1 AND S7</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (90)</td> </tr> <tr> <td>S7</td> <td>S2 OR S3 OR S4 OR S5 OR S6</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (337,879)</td> </tr> <tr> <td>S6</td> <td>(MH "Hospitals")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (71,875)</td> </tr> <tr> <td>S5</td> <td>(MH "Hospitalization")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (92,370)</td> </tr> <tr> <td>S4</td> <td>(MH "Inpatients")</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (17,883)</td> </tr> <tr> <td>S3</td> <td>inpatient*</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (98,843)</td> </tr> <tr> <td>S2</td> <td>hospital* N2 patient*</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (125,560)</td> </tr> <tr> <td>S1</td> <td>(inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record**</td> <td>Search modes - Boolean/Phrase</td> <td>View Results (1,642)</td> </tr> </tbody> </table>	Search ID#	Search Terms	Search Options	Actions	S8	S1 AND S7	Search modes - Boolean/Phrase	View Results (90)	S7	S2 OR S3 OR S4 OR S5 OR S6	Search modes - Boolean/Phrase	View Results (337,879)	S6	(MH "Hospitals")	Search modes - Boolean/Phrase	View Results (71,875)	S5	(MH "Hospitalization")	Search modes - Boolean/Phrase	View Results (92,370)	S4	(MH "Inpatients")	Search modes - Boolean/Phrase	View Results (17,883)	S3	inpatient*	Search modes - Boolean/Phrase	View Results (98,843)	S2	hospital* N2 patient*	Search modes - Boolean/Phrase	View Results (125,560)	S1	(inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record**	Search modes - Boolean/Phrase	View Results (1,642)				
Search ID#	Search Terms	Search Options	Actions																																								
S8	S1 AND S7	Search modes - Boolean/Phrase	View Results (90)																																								
S7	S2 OR S3 OR S4 OR S5 OR S6	Search modes - Boolean/Phrase	View Results (337,879)																																								
S6	(MH "Hospitals")	Search modes - Boolean/Phrase	View Results (71,875)																																								
S5	(MH "Hospitalization")	Search modes - Boolean/Phrase	View Results (92,370)																																								
S4	(MH "Inpatients")	Search modes - Boolean/Phrase	View Results (17,883)																																								
S3	inpatient*	Search modes - Boolean/Phrase	View Results (98,843)																																								
S2	hospital* N2 patient*	Search modes - Boolean/Phrase	View Results (125,560)																																								
S1	(inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record**	Search modes - Boolean/Phrase	View Results (1,642)																																								

#	Source	N	Search History																																	
3	PsycINFO	13	<p>S7 S1 AND S6 Search modes - Boolean/Phrase View Results (13)</p> <p>S6 S2 OR S3 OR S4 OR S5 Search modes - Boolean/Phrase View Results (106,779)</p> <p>S5 inpatient* Search modes - Boolean/Phrase View Results (68,769)</p> <p>S4 hospital* N2 patient* Search modes - Boolean/Phrase View Results (28,284)</p> <p>S3 (DE "Hospitalization" OR DE "Hospital Admission" OR DE "Psychiatric Hospital Admission" OR DE "Psychiatric Hospitalization" OR DE "Psychiatric Hospital Admission" OR DE "Psychiatric Hospital Discharge" OR DE "Psychiatric Hospital Readmission") OR (DE "Hospitals" OR DE "Psychiatric Hospitals" OR DE "Sanatoriums") Search modes - Boolean/Phrase View Results (49,063)</p> <p>S2 DE "Hospitalized Patients" Search modes - Boolean/Phrase View Results (12,178)</p> <p>S1 (inpatient* N2 portal*) OR "mychart bedside" OR "patient* portal*" OR "personal health record*" Search modes - Boolean/Phrase View Results (266)</p>																																	
4	Web of Science	40	<table border="1"> <tbody> <tr> <td># 11</td> <td>40</td> <td>#8 AND #7 NOT #9 NOT #10 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 10</td> <td>22,027</td> <td>TOPIC: (hepatic portal) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 9</td> <td>11,349</td> <td>TOPIC: (portal venous) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 8</td> <td>120,230</td> <td>#6 OR #5 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 7</td> <td>1,669</td> <td>#4 OR #3 OR #2 OR #1 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 6</td> <td>35,508</td> <td>TOPIC: ("hospital* patient*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 5</td> <td>89,063</td> <td>TOPIC: ("hospitalization") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 4</td> <td>1,166</td> <td>TOPIC: ("personal health record*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 3</td> <td>627</td> <td>TOPIC: ("patient* portal*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 2</td> <td>6</td> <td>TOPIC: ("inpatient portal*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> <tr> <td># 1</td> <td>4</td> <td>TOPIC: ("mychart bedside") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i></td> </tr> </tbody> </table>	# 11	40	#8 AND #7 NOT #9 NOT #10 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 10	22,027	TOPIC: (hepatic portal) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 9	11,349	TOPIC: (portal venous) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 8	120,230	#6 OR #5 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 7	1,669	#4 OR #3 OR #2 OR #1 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 6	35,508	TOPIC: ("hospital* patient*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 5	89,063	TOPIC: ("hospitalization") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 4	1,166	TOPIC: ("personal health record*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 3	627	TOPIC: ("patient* portal*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 2	6	TOPIC: ("inpatient portal*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>	# 1	4	TOPIC: ("mychart bedside") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>
# 11	40	#8 AND #7 NOT #9 NOT #10 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 10	22,027	TOPIC: (hepatic portal) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 9	11,349	TOPIC: (portal venous) <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 8	120,230	#6 OR #5 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 7	1,669	#4 OR #3 OR #2 OR #1 <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 6	35,508	TOPIC: ("hospital* patient*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 5	89,063	TOPIC: ("hospitalization") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 4	1,166	TOPIC: ("personal health record*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 3	627	TOPIC: ("patient* portal*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 2	6	TOPIC: ("inpatient portal*") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
# 1	4	TOPIC: ("mychart bedside") <i>Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years</i>																																		
5	Compendex Engineering Village	140	((("patient portal" or "personal health record" or "mychart bedside") AND hospital*) WN All fields)																																	
6	Google Scholar	78	"inpatient portal" = 47, "mychart bedside" = 31																																	
7	Google	200	"inpatient portal" = 100, "mychart bedside" = 100																																	
	Total	N=702																																		

Appendix B Characteristics of Articles on Inpatient Portal Included in Scoping Review

#	Author/ Year	Name of Portal Used	Population and Setting	Study Design	Usability/ User Experience Methods	Findings Related to Patients and Families
1	Brown et al., 2016	Electronic Communication Portal	1,050 adults with a personal or family history of an ICU, 1,050 adults without a history of ICU admission, 105 family members of patients currently admitted to ICUs	Quantitative	Internet-based Surveys/ in-person surveys	Respondents, especially current ICU family members, supported an electronic communication portal, including access via an electronic tablet. They wanted at least daily updates, one-paragraph summaries of family meetings including a list of key decisions made, and knowledge of the role and experience of treating clinicians. Overall, they preferred detailed rather than “big picture” information. Respondents were comfortable sharing information with their family members. Preferences regarding a communication portal varied significantly by age, sex, ethnicity, and prior experience with ICU hospitalization.
2	Caligtan et al. 2012	electronic Bedside Communication Center (eBCC)	30 providers, 30 patients from trauma, neurology, oncology, medical/surgical units	Mixed methods	Interview, surveys	Overall, participants wanted access to their information. Patients indicated the need for a daily plan of care, schedule, recovery goals, and room/hospital information, discharge information, education, medications (names and time of administration), and healthcare team names/photos.
3	Couture et al. 2015	MySafeCare	8 inpatients and family members on an oncology unit	Qualitative	Usability test/ think-aloud	Participants had trouble figuring out how to choose another concern category after the first one had been selected and understanding if these concerns needed to be related and grouped together.
4	Dalal et al. 2016	Patient-Centered Toolkit	119 inpatients, 120 caregivers in a medical ICU and an oncology unit	Quantitative	Surveys, usage data	Observed modest use of the portal by patients/families. 72% of users found the system useful/very useful.
5	Davis et al. 2015	Patient Portal/My Health at Vanderbilt	All admitted patients to Vanderbilt University hospital	Quantitative	Retrospective data analysis	Among 60,159 admissions in 2012-2013, 23.3% of patients reported limited health literacy; 50.4% reported some post-secondary education; 34.4% were registered for the portal; and 23.4% of registered patients used the portal during hospitalization. Probability of registration and inpatient portal use increased with educational attainment. Health literacy was associated with registration but not inpatient use. Among

#	Author/ Year	Name of Portal Used	Population and Setting	Study Design	Usability/ User Experience Methods	Findings Related to Patients and Families
						admissions with inpatient use, educational attainment was associated with viewing health record data, and health literacy was associated use of appointment and health education tools.
6	Dykes et al. 2013	Electronic Bedside Communication center (eBCC)	Patients/caregivers volunteers; 8 inpatients and 3 family caregivers on general medical units	Qualitative	Focus group, interviews, usability tests	Participants reported satisfaction with portal components and type of information provided. They appreciated portal access and requested revisions to care plan and communication features. The development of an eBCC prototype was considered both easy to use and helpful for accessing tailored patient information during an inpatient hospitalization to receive acute care.
7	Dykes et al. 2014	Patient-Centered Toolkit	12 advisory council; 18 nurses, 10 physicians; 5 inpatients, 2 families on intensive care and oncology units	Qualitative	Interviews, Iterative participatory design	Majority of participants liked the use of inpatient portal. Participants desired tools within the portal to communicate their goals, problems, concerns, and care preferences directly with the care team along with giving feedback on how well the care team was assisting them to meet these goals.
8	Greysen et al. 2014	Personal Health Record	30 patients at University of California San Francisco (UCSF) Medical Center	Mixed methods	Web-based interactive health education modules, pre and post intervention surveys, Interview	Twenty-seven (90%) reported high overall satisfaction with the device, and 26 (87%) required 30 minutes for basic orientation (70% required 15minutes). Twenty-one (70%) accessed their personal health record (PHR) to view their medication list, verify scheduled appointments, or send a message to their primary care physician.
9	Huerta et al. 2017	Patient Portal: Mychart Bedside	179 patients in 2 hospitals	Mixed methods	Survey/ retrospective data analysis	Patients with tablets reported higher satisfaction/wanted access to the inpatient portal, but not if they had to use unfamiliar technology.
10	Mackinson et al. 2015	MyICU	Patients, families, care providers in ICU	Mixed methods	Surveys and focus group discussion	Survey participants confirmed a strong interest in utilizing a portal for daily medical updates, access to medical information, educational resources, information about providers, and sharing information about themselves with their care team.

#	Author/ Year	Name of Portal Used	Population and Setting	Study Design	Usability/ User Experience Methods	Findings Related to Patients and Families
11	McAclearney et al. 2015	MyChart Bedside tablet-based application	Patients, care providers and hospital staff at Ohio State University Wexner Medical Center	Mixed methods	Think-aloud (usability study), log files, surveys, interviews	Usability studies showed that errors encountered by portal users were attributable to issues with system design, assumptions about functionalities, and insufficient user knowledge. Patients reported that access to MCB made them feel more in control of their care and able to ask better questions. Log file analyses developed a taxonomy of portal use.
12	O'Leary et al. 2016	Patient Portal	18 inpatients and 21 providers	Qualitative	Interview, focus group	Patients found information provided by the portal to be useful, especially regarding team members and medications. Many patients described frequent use of games and non-clinical applications and felt the tablet helped them cope with their acute illness. Patients expressed a desire for additional detail about medications, test results, and the ability to record questions
13	O'Leary et al. 2016	Patient Portal	202 inpatients on 2 general medical service units	Quantitative	Non-randomized trial, intervention, interviews	80% of intervention patients used it, 76% said was easy to use, and 71% said portal provided useful information. There was no improvement compared to the control group for patient knowledge about their treatment (new/discontinued medications, planned tests, results).
14	Pell et al. 2015	Patient Portal	50 inpatients, 28 clinicians, 14 nurses	Quantitative	Prospective cohort, pre & post intervention, surveys	Time logged onto portal ranged from 2 minutes to 1331 minutes per day. There was a decrease in several engagement activities with use of inpatient portal: follow recommendations, trust physician, understanding discharge timing. There was expected increase in patient ability to help identify medical errors, but this was not born out.
15	Vardoulakis et al. 2012	Health Feed	25 Patients, 8 family members, 11 hospital staff members in an emergency department	Mixed methods	Interviews, researcher notes, phone usage logs	'Knowing' or being in the loop helped to calm the patients and led to patient empowerment. Some contents of the device were incomplete (e.g., reason for visit, allergies). Participants wanted access to medical information, a larger-text mode, reduced physical handling of the device and a password-protected phone.

#	Author/ Year	Name of Portal Used	Population and Setting	Study Design	Usability/ User Experience Methods	Findings Related to Patients and Families
16	Vawdrey et al. 2011	Personal Health Record Web Portal: myNYP.org	5 inpatients on a cardiology step-down unit	Mixed methods	Interview, surveys	While patients exhibited varying levels of comfort with using the tablet computer, they were highly enthusiastic about the application's ability to supply health information such as their inpatient medication histories and photographs of their care providers.
17	Walker et al. 2018	Inpatient Portal: Mychart Bedside	19 Previous patients and families at Midwestern academic medical center	Qualitative	Think-aloud protocol	This study highlighted the navigational errors and technical challenges associated with the use of MCB. It also found that issues associated with the cognitive experience included comprehension problems that spurred anxiety and uncertainty. Analysis of the socio-behavioral experience suggested that users have different learning styles and preferences for learning including self-guided, handouts, and in-person training.
18	Wilcox et al. 2012	N/A	11 inpatients, 6 nurses on cardiac step-down unit	Qualitative	Interviews	Patients agreed on value. General themes emerged regarding the need for medication tracking, progress, decision-making, education, information, and formatting. Patients indicated the need for information about medication dosage, frequency, administration, photos, criticality, and education (alternatives, indications, side effects).
19	Wilcox et al. 2016	Personal Health Record: myNYP Inpatient	20 post-op inpatients, 2 families; 5 pharmacists	Qualitative	Interviews, data usage	Patients made frequent use of the hospital medications feature and found electronic reporting of questions and comments useful, they confirmed the usability and usefulness of the refined tools.
20	Winstanley et al. 2017	Mychart Bedside	88 patients	Quantitative	Web-based surveys	78% respondents reported that MyChart Bedside was easy to use. The respondents agreed that MyChart Bedside improved communication with their nurses (74.1%) and with their physicians (52.4%), as well as helped them understand their medications (89.7%) during their inpatient hospitalization.

#	Author/ Year	Name of Portal Used	Population and Setting	Study Design	Usability/ User Experience Methods	Findings Related to Patients and Families
21	Woollen et al. 2016	Inpatient Personal Health Record	14 postop cardiac inpatients and families on a step-down unit	Qualitative	Observations, Interviews	All participants responded favorably to having access to view their clinical information. 85.7% of participants used the application following an initial training session. Patients reported high satisfaction with being able to view their hospital medications and access educational materials related to their medical conditions. Patients reported a desire to view daily progress reports about their hospital stay and have access to educational information about their post-acute recovery. In addition, patients expressed a common desire to view their diagnoses, laboratory test results, radiology reports, and procedure notes in language that is patient-friendly.
22	Yen et al. 2018	Mychart Bedside	19, Current and previous patients or primary caregivers that provide feedback of their experience at the medical center	Qualitative	Usability evaluation/think-aloud protocol	Participants frequently made operational errors with most in navigation and assuming non-existent functionalities. They also noted that participants' learning styles varied, with age as a potential factor that influenced how they learned MCB. Also, participants preferred to individually message providers and wanted feedback on status. Design of inpatient portals can impact how patients navigate and comprehend information.
23	Yoo et al. 2015	Smart Bedside Station	Multiple inpatients, caregivers, nurses, clinicians, researchers	Qualitative	Stakeholder map, shadowing, journey map, contextual inquiry, co-operation workshop, idea sketch clustering	The service design methodology, the Double Diamond Design Process Model, was very useful to identify complex clinical workflow, stakeholder requirements and environmental factors. User needs and design components included inpatient health information and schedule, addressing privacy issues, integrating into hospital processes, and improving the patient-caregiver relationship.