

Personal Health Records and Patient Portals:  
An Umbrella Review

by

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Bachelor of Science, University of Victoria, 2009

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## Abstract

**Objective:** The objective of this research project is to conduct an umbrella review to provide a summary of evidence in previously published systematic reviews on Personal Health Records (PHR) and patient portals. This umbrella review presents a summary of evidence through a comparison of the features and function of PHRs and patient portals, the outcomes and impact on patient care and patient facilitators and barriers to PHR and patient portal use.

**Introduction:** PHRs and patient portals are tools that are used to engage patients and individuals to support them self-manage their care. PHRs and patient portals aim to develop patient awareness about their health status and to help improve healthcare coordination.

**Methods:** A search for systematic reviews on PHRs or patient portals was completed using the electronic databases, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete (EBSCO), Medline with Full Text (EBSCO), PubMed, Cochrane Database of Systematic Reviews (EBSCO) and Joanna Briggs Institute EBP Database (OVID). The published systematic reviews included in this appraisal are on the characteristics, function, outcomes and impact of PHRs or patient portals. The selected systematic reviews were reviews on all types of participants and settings and were published August 2008 to August 2018, in English, and are available full text online.

**Results:** There was a total of 19 published systematic reviews included in this appraisal, 11 focused on patient portals while eight were on PHRs including patient portals. A summary of evidence was presented comparing PHRs and patient portals based on their characteristics and functions. The similarities of PHRs and patient portals are on who utilizes the tool as well as its purpose of engaging patients to manage their care. The differences between PHRs and patient portals are on the management of the health information and the tethered connection to a health organization's electronic health record (EHR). A summary of evidence on the outcome and impact of PHR and patient portals on patient care is discussed through the reported impact on health outcomes, behavioural outcomes and affective-cognitive outcomes. The available evidence on the facilitators and barriers in patients' use of PHRs and patient portals are themed and categorized as patient characteristics, patient perception, PHR and patient portal access and support and PHR and patient portal design.

**Conclusions:** This appraisal gathered the available evidence on the types of features and functions of PHRs and patient portals, the outcomes and impact of its use as well as the facilitators and barriers for patients in the use of PHRs and patient portals.

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## **1. Introduction**

Providing patient access to their health information encourages them to take an active part in the management of their health and wellness (Canada Health Infoway, 2019a). The Canada Health Infoway strategic plan for 2019 to 2020 includes a strategic goal of Access Health which aims to provide Canadians and health care providers access to personal health information and digital health services (2019b). Health information technology that can support this access and awareness are Personal Health Records (PHR) and patient portals. Applications that support patients and individuals manage their health are called Personal Health Records (PHRs). PHRs support individuals to take the initiative in care self-management for improved quality of life (Pushpangadan & Seckman, 2015). PHRs can be standalone or tethered to a health organization's electronic health record (EHR) and is commonly called patient portals (Turner, Klamann, & Shea, 2016). The essential features of patient portals include patient access to their health information and may include discharge summaries, medications, immunizations, allergies, and lab results (Kruse, Argueta, Lopez, & Nair, 2015). Advanced features may include appointment scheduling, secure messaging, prescription refills and education resources (Ammenwerth, Schnell-Inderst, & Hoerbst, 2012). Canada Health Infoway lists the benefits of patient portals for patients and caregivers as having increased knowledge and confidence in managing their health. The tools provided through patient portals help patients and caregivers feel more involved in their health care. Other benefits include access to health information allowing patients to have informed discussions with their health care providers (Canada Health Infoway, 2019a).

Patients access to health data has been available in different forms since the 1970s, but PHRs have not been widely in use until the 2000s (Bouayad, Ialynytchev, & Padmanabhan, 2017). In Alberta, access to the MyHealth Records patient portal will be made available to Albertans in 2019 (MyHealth.Alberta.ca, 2018). Features that would be made available include, view community pharmacy dispensed medications, laboratory tests and immunizations. Albertans will also be able to record blood pressure and blood glucose levels, upload and track information from health devices and print out reports and health records to share with their health care providers (MyHealth.Alberta.ca, 2018). In BC, the Interior Health Authority has a MyHealthPortal currently made available to patients. The features made available are the ability

to view laboratory and medical imaging results, some transcribed clinical reports and hospital visit history (Interior Health Authority, 2019).

Continuous improvement of PHRs and patient portals to support patient engagement is essential to ensure they are a dynamic component of a patient and healthcare provider relationship rather than a repository of information (Irizarry, DeVito Dabbs, & Curran, 2015). PHRs and patient portals have different characteristics, but these tools share the same purpose of supporting patient engagement (Price et al., 2015). An engaged patient is an individual who is involved in their care and who are confident and well informed to make decisions about their health (Irizarry et al., 2015). Patient engagement is a healthcare strategy that takes into account the importance of including patients and their families in being active members of their healthcare team (Irizarry et al., 2015).

A scan of the literature was completed to search for any umbrella reviews completed on PHRs and patient portals. One published systematic review of reviews was identified that looked a patient and provider perspective on the impact of providing patients access to patient portals (Jilka, Callahan, Sevdalis, Mayer, & Darzi, 2015). The systematic review of reviews found mixed outcomes and insufficient evidence on the effect of patient portals on health outcomes (Jilka et al., 2015). Similar to this published systematic review of reviews, this umbrella review looks into the outcomes and impact of patient portals. This umbrella review includes electronic PHRs to provide a current overview of the available evidence on the outcomes and impact of these tools. Also, this umbrella review presents a more in-depth summary of all the available evidence as it looks at the available functions and features of PHRs and patient portals as well as the facilitators and barriers for patients use. Understanding the characteristics, function, outcomes and impact of PHRs and patient portals will support the engagement of patients and individuals in the management of their health care. By identifying the available evidence on PHRs and patient portals, this umbrella review provides healthcare organizations and professionals with an overview of the importance of PHRs and patient portals in support of quality patient care.

### **1.1 Objective**

The objective of this research project is to conduct an umbrella review to provide a summary of evidence in previously published systematic reviews on PHRs and patient portals to

inform quality patient care. This umbrella review presents a summary of evidence through a comparison of the features and function of PHRs and patient portals, the outcomes and impact on patient care and patient facilitators and barriers to PHR and patient portal use. Another objective of this umbrella review is to include an overview and comparison of the umbrella review method with other types of review of reviews.

## **1.2 Review Questions**

1. What are PHRs and patient portals? What are the similarities and differences between PHRs and patient portals in terms of their characteristics and function?
2. What are the outcomes and impact of using PHRs and patient portals?
3. What are the facilitators and barriers to a patient's use of PHRs and patient portals?
4. What are the types of published systematic reviews on PHRs and patient portals and the quality instruments used to appraise their methodological quality?
5. How does the umbrella review method compare with other review of reviews methods?

## **2. Inclusion and Exclusion Criteria**

The inclusion and exclusion criteria guided the selection of published reviews for this appraisal. The JBI Reviewers Manual recommends outlining the Types of Participants, Interventions/Phenomena of Interest, Context/Setting, Outcomes and Types of Studies (2017). For types of participants, this appraisal included published systematic reviews with all types of participants inclusive of any patient subgroup. For Interventions/ Phenomena of Interest, this appraisal included systematic reviews on PHRs or patient portals. For this appraisal the definition of PHR that will guide the inclusion of published systematic reviews is: PHRs are electronic applications used by patients to collect, track, store their health information, is untethered to electronic health records and is under the control of the patient (Irizarry et al., 2015; Pushpangadan & Seckman, 2015). The definition of a patient portal for this appraisal is: patient portals are electronic personal health records that are tethered or directly linked to an electronic health record (Irizarry et al., 2015). Only electronic versions of PHRs are included in this appraisal. Reviews which include paper-based health records are excluded. For context, this appraisal includes published systematic reviews completed in any healthcare setting. For outcomes, this appraisal includes systematic reviews on any outcomes and impact of PHRs or patient portals on patient care. Reviews excluded are on other eHealth technologies or patient care applications. Reviews, where PHRs or patient portals are not the central primary intervention or phenomena of interest, will also be excluded.

Included in this appraisal are systematic reviews comprised of primary studies of any designs. A systematic review is a type of research method that summarizes relevant evidence on a clinical question by searching, including and appraising clinical studies (Papageorgiou & Biondi-Zoccai, 2016). The different types of systematic reviews include critical review, literature review, mapping/ systematic map, meta-analysis, mixed studies review/mixed methods review, qualitative systematic review/ qualitative evidence synthesis, rapid review, scoping review, state-of-the-art review, systematic review, systematic search and review, systematized review (Grant & Booth, 2009).

### **3. Method**

An umbrella review was completed to examine the available evidence on the characteristics, outcomes, impact, facilitators and barriers in the use of PHRs or patient portals. An umbrella review is a new research method that has emerged as a response to the high number of published systematic reviews (Papageorgiou & Biondi-Zoccai, 2016). Umbrella reviews of published systematic reviews provide an overall examination of the available body of information and aim to provide a summary of the findings of the published systematic reviews on a given topic (Aromataris et al., 2017). These types of reviews can also provide timely responses to general health care or clinical questions (Papageorgiou & Biondi-Zoccai, 2016). Umbrella reviews are also referred to as overviews of reviews, reviews of reviews, a summary of systematic reviews and synthesis of reviews (Aromataris et al., 2015). For this appraisal, the term umbrella review is used and guided by the Joanna Briggs Institute (JBI) Reviewer's Manual (Aromataris et al., 2017).

#### **3.1 Search Strategy**

A search for systematic reviews with the keywords PHRs or patient portals was completed using the electronic databases, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete (EBSCO), Medline with Full Text (EBSCO), PubMed, Cochrane Database of Systematic Reviews (EBSCO) and Joanna Briggs Institute EBP Database (OVID). The systematic reviews selected are reviews published in English, between August 2008 to August 2018 and are available full text online. The search was limited to 10 years as the selected reviews would have captured original research conducted in the last 30 years (Aromataris et al., 2017). The keywords, MESH terms or search terms used were patient portal, personal health record, systematic review and meta-analysis. Table 1 shows a summary of the search strategy used for each of the electronic databases used for this umbrella review. For the overview and comparison of umbrella reviews with other reviews of reviews, key documents on umbrella reviews were gathered through a search using the University of Victoria Library online database using the keyword search term 'umbrella review.' A scan on the references of the retrieved key documents was also completed to find additional resources.

### **3.2 Review Screening and Selection**

The review selection strategy for this umbrella review was based on the specified inclusion criteria and a three-step review selection strategy. In step one identification of reviews, the search strategy using the inclusion criteria was completed. The specified electronic databases were searched with the identified keywords or search terms. Another process completed in the identification step was a review of duplicate citations. For step two screening of relevant reviews, the title and abstract of the remaining citations were scanned for relevant systematic reviews. The review's title and abstract were examined to ensure only systematic reviews on PHRs or patient portals were retrieved. The third step was determining the eligibility of the remaining reviews; the remaining citations from step two were scanned by completing a full-text examination. The criteria used to check for the eligibility of reviews in the full-text examination are reviews on characteristics, functions, outcome, impact, facilitators and barriers for patients in the use of PHRs and patient portals. The criteria on the eligible reviews support to answer the review questions for this umbrella review. A scan on the reference list of the remaining reviews was also completed.

### **3.3 Assessment of Methodological Quality**

The reviews included for this umbrella review were assessed for methodological quality. The JBI Critical Appraisal Checklist for Systematic Reviews and Research Synthesis was used to evaluate each of the included reviews for their methodological quality (Aromataris et al., 2017). The JBI Critical Appraisal Checklist for Systematic Reviews and Research Synthesis consists of 11 quality criteria and can be applied to quantitative or qualitative systematic reviews and meta-analysis. Each of the selected reviews was assessed using the checklist, and a value of Yes (1point), Unclear (.5 point) and No (0 points) was applied to each quality criterion. Reviews with 80% of criteria met are considered a high-quality review as at least 9 of the 11 criteria was taken into consideration when completing the review. While reviews with 79% and below are considered a low-quality review. None of the reviews was excluded from the appraisal based on the result of the assessment of methodological quality. Figure 1 displays the JBI Critical Appraisal Checklist for Systematic Reviews and Research Synthesis used for this umbrella review (Aromataris et al., 2017).

### **3.4 Data Collection**

The data collection was completed using a data extraction tool to avoid the risk of bias. The JBI Data Extraction Form for Review for Systematic Reviews and Research Synthesis guided data collection for this appraisal (Aromataris et al., 2017). Microsoft Excel was used to organize and collate the items identified in the JBI Data Extraction Form. Figure 2 displays the JBI Data Extraction Form for Review for Systematic Reviews and Research Synthesis used for this umbrella review. These include capturing the review details, objectives, description of interventions, outcome assessed, appraisal instruments used and results/findings. For the overview and comparison of umbrella reviews with other reviews of reviews, data collected from the identified key resources include appraisal terminology used, definition of appraisal and characteristics of the appraisal method.

### **3.5 Data Summary**

The data collected from the reviews included in this appraisal is used to present an overview of umbrella reviews, PHRs, patient portals and methodological qualities of the reviews used in this appraisal. A comparison of PHRs and patient portals are presented as a tabular overview and a narrative summary. The comparison of PHRs and patient portals are presented to provide an overview of the similarities and differences between PHRs and patient portals. For the data collected on functions and features, the available evidence is presented as a tabular overview and a narrative summary. The reported features of PHRs and patient portals are categorized by mechanism as guided by the Otte-Trojel, de Bont, Rundall, & van de Klundert (2014) review. The mechanism categories are Patient insight to information, Activation of information, Interpersonal continuity of care and Patient convenience.

The data on outcome and impact is presented as a tabular overview and a narrative summary. The reported outcomes and impacts are categorized by type of patient outcomes identified by the Davis, Roudsari, Raworth, Courtney, & MacKay (2017) review. The types of patient outcomes used to categorize the reported outcomes and impacts are Health outcomes, Behavioural outcomes and Affective-cognitive outcomes. The data collected on the facilitators and barriers in patient's use of PHRs and patient portals are also presented as a tabular overview and narrative summary. The available evidence on the facilitators and barriers in patients' use of

PHRs and patient portals are themed and categorized as Patient characteristics, Patient perception, PHR and patient portal access and support and PHR and patient portal design.

For the synthesis of evidence for PHRs and patient portals, the data collected from the reviews on the description of interventions or phenomena of interest, outcome assessed and results or findings are examined and synthesized to provide an overview of the available evidence on PHRs and patient portals. For the types of published systematic reviews on PHRs and patient portals and the quality instruments used to appraise their methodological quality, data collected on study details, types of studies included and appraisal instruments used is presented in a table. A narrative summary was included to provide a summary of the types of published systematic reviews on PHRs and patient portals and the instruments used by the reviews to appraise the methodological quality of the primary studies. For the overview and comparison of umbrella reviews with other reviews of reviews, the data collected from the key documents are displayed in a table to present the characteristics of umbrella reviews and other review of reviews. A narrative summary was included to describe umbrella reviews, why umbrella reviews are completed and how does umbrella reviews compare to other reviews of reviews.

## 4. Results

### 4.1 Review Inclusion and Exclusion

The review selection strategy for this appraisal was based on the specified inclusion criteria and a three-step review selection strategy. In step one identification of reviews, the search strategy using the inclusion criteria was completed. The specified electronic databases were searched with the identified keywords or search terms on September 2018. There was a total of 359 citations retrieved from the electronic databases. There were 96 citations obtained using CINAHL Complete (EBSCO), 196 citations retrieved using Medline (EBSCO) and 67 citations retrieved using PubMed. There were no reviews retrieved using the Cochrane Database of Systematic Reviews (EBSCO) and Joanna Briggs Institute EBP Database (OVID) databases. Another process completed in the identification step was a review of duplicate citations. There were 68 duplicate citations removed from a total of 359 citations, leaving a total of 291 citations.

For step two screening of relevant reviews, the title and abstract of the remaining 291 citations were scanned for relevant systematic reviews. The reviews' title and abstract were examined to ensure only systematic reviews on PHRs or patient portals were retrieved. Upon completion of this step, 252 citations were excluded based on an examination of the title and abstract, leaving a total of 39 citations. The reviews excluded in this step were non-systematic reviews, reviews on eHealth initiatives and eHealth technologies. Other reviews excluded include reviews on web-based policies, consumer health informatics and consumer mobile health applications. Reviews on information technology empowerment, mobile care applications, paper health records, non-specific user-held records, Internet-based digital health interventions and patient care applications and evaluations of specific PHRs were also excluded.

The third step was determining the eligibility of remaining reviews; the remaining 39 citations were scanned by completing a full-text examination. Upon completion of this step, 17 citations were remaining while 22 citations were excluded. The criteria used to check for the eligibility of reviews in the full-text examination are reviews on characteristics, functions, outcomes, impact, facilitators and barriers in the use of PHRs and patient portals. Reviews that were excluded in this step were reviews that were not systematic reviews including one review of reviews (n = 5), reviews on development, technology interoperability (n= 5), reviews on patient accessible health record which included paper records (n= 4), reviews on patient-provider

communication and asynchronous technologies (n= 2), non-peer reviewed reviews (n= 1), review on adoption rates (n=1), reviews unavailable in full text form (n=2) and reviews that were updated or of the same review (n=2). A scan on the reference list was completed at the same time as the full-text examinations which resulted in two reviews added to this umbrella review. A total of 19 systematic reviews are included for this umbrella review. Figure 3 shows a summary of the review selection strategy completed for this umbrella review. The figure was based on the PRISMA statement by Moher, Liberati, Tetzlaff, Altman, & PRISMA Group (2009). Appendix A lists the included reviews, reviews included from reference tracking and excluded reviews.

#### **4.2 Assessment of Methodological Quality**

Each of the review included in this appraisal was assessed for its methodological quality. Table 2 presents a summary of the assessment for each of the review. In total, there were 67.46% instances the reviews met a criterion, 23.44% were unclear while 9.09% did not meet a criterion. There were no criteria assigned as not applicable. The highest met criteria with 100% met are the criteria *“Were the inclusion criteria appropriate for the review question,” “Was the search strategy appropriate” and “Were the methods used to combine studies appropriate.”* The lowest met criterion with 43% is *“Was the critical appraisal conducted by two or more reviewers independently.”* From a total of 19 reviews, nine were assessed as high-quality reviews. Reviews that were assessed as a high quality were reviews by Amante, Hogan, Pagoto, & English (2014), Bush, Connelly, Fuller, & Perez (2016), Goldzweig Dr. et al. (2013), Kruse, Bolton, & Freriks (2015), Mold et al. (2015), Price et al. (2015), Sakaguchi-Tang, Bosold, Choi, & Turner (2017), Turner et al. (2016) and Wildenbos, Peute, & Jaspers (2017). The lowest quality assessed at 64% were by Irizarry et al. (2015), Osborn et al. (2010) and Zhao et al. (2017). None of the reviews were excluded from the appraisal based on the result of the assessment of methodological quality.

#### **4.3 Findings of the Review**

##### **4.3.1 What are PHRs and patient portals? What are the similarities and differences between PHRs and patient portals in terms of their characteristics and function?**

From the 19 reviews included in this appraisal, 11 of the reviews were specific to patient portals while eight reviews were on PHRs including patient portals. The 11 reviews are by Amante et al. (2014), Bouayad et al., (2017), Bush et al. (2016), Goldzweig et al. (2013), Irizarry

et al. (2015), Kruse, Argueta, et al. (2015), Kruse, Bolton, et al. (2015), Mold et al. (2015), Osborn, Mayberry, Mulvaney, & Hess (2010) and Otte-Trojel et al. (2014) and Wildenbos et al. (2017). The eight reviews on PHRs including patient portals are by Davis et al. (2017), Price et al. (2015), Pushpangadan & Seckman (2015), Sakaguchi-Tang et al. (2017), Saparova (2012), Thompson et al. (2016), Turner et al. (2016) and Zhao et al. (2017).

PHRs are electronic records that are managed, shared or maintained by patients to support patient-centred care (Price et al., 2015). PHRs can be standalone/web-based or incorporated/ tethered to EHRs (Pushpangadan & Seckman, 2015). Electronic PHRs tethered to EHRs are commonly called patient portals (Bouayad et al., 2017). The review by Davis et al. (2017), mentioned another type of PHR called interconnected PHR, which are PHRs that gathers and auto-populates patient data from multiple health information systems. Davis et al. (2017), differentiate tethered and interconnected PHRs as tethered PHRs are linked to a specific provider's health information system while interconnected PHRs have multiple sources. Also, the review included that even with variable PHR features and designs, all PHR types share a goal of improving patient engagement. The review by Pushpangadan et al. (2015) identified the characteristics and features of PHRs and patient portals that are important from a consumer's perspective. Examples of these features are the ability to manage and view health information and medical records, appointments and scheduling. Other important features mentioned are managing bill payments, referrals, process prescriptions, request prescription refills and viewing laboratory results. The definition of PHRs and patient portals used for this appraisal is under Inclusion and Exclusion Criteria, and the various definitions used by the reviews included in this study are listed under Phenomena of Interest in Table 3.

The characteristics and functions defining the similarities between PHRs and patient portals are on how these are patient-focused tools, its function of health record keeping and viewing as well as its purpose of engaging a patient to be a part of managing their health. For differences, PHRs and patient portals differ in who manages, owns, stores and if the tool is connected to an EHR or a standalone system. The similarities of PHRs and patient portals include the types of users of the system, function and overall purpose of the system. PHRs and patient portals are intended to be used by patients rather than by health care providers (Bouayad et al., 2017). PHRs and patient portals are tools used to collect, track, and store medical data in

an easily accessible secure location (Pushpangadan & Seckman, 2015). Patients populate and enter their health information into PHRs and patient portals (Irizarry et al., 2015). PHRs and patient portals are not only static repositories but a combination of data, knowledge and software tools which supports patients become active participants in their care (Osborn et al., 2010).

Patient portals are a type of electronic PHRs, and the differences between PHRs and patient portals are seen in the management, ownership, storage and whether the PHR is untethered/ standalone or tethered/incorporated. The management of health information differs between a PHR and patient portal. The management and ownership of an untethered ePHR are with the patient while for tethered patient portals are managed and owned by the health care organization (Irizarry et al., 2015; Kruse, Argueta, et al., 2015). PHRs that are untethered/standalone is stored in a patient's computer or the internet and is used to track and monitor their health-related behaviours which include diet and exercise (Pushpangadan & Seckman, 2015). Patient portals are extensions of EHRs and patients are provided access through secure portals (Bouayad et al., 2017). Patient portals are intermediary for patients to have access to their EHR information (Kruse, Bolton, et al., 2015). Patient portals are updated when there is new health data in EHRs while updates to PHRs are the responsibility of patients to update (Kruse, Argueta, et al., 2015). Patient portals are interoperable and populated by patient information through the EHR (Irizarry et al., 2015). Table 6 presents a summary of the similarities and differences between PHRs and patient portals.

#### **4.3.2 What are the outcomes and impact of using PHRs and patient portals?**

Thirteen out of the 19 reviews included in this appraisal provided information on the outcomes and impact of using PHRs and patient portals. From the 13 reviews, five were on PHRs including patient portals while eight were on patient portals. The five reviews on PHRs and patient portals were by Price et al. (2015), Pushpangadan & Seckman (2015), Sakaguchi-Tang et al. (2017), Saporova (2012) and Turner et al. (2016). The reviews on patient portals were by Bush et al. (2016), Goldzweig et al. (2013), Irizarry et al. (2015), Kruse, Argueta, et al. (2015), Kruse, Bolton, et al. (2015), Mold et al. (2015), Osborn et al. (2010) and Otte-Trojel et al. (2014).

Otte-Trojel et al. (2014) summarize mechanisms through which patient portals affect patient outcomes. These mechanisms are Patient insight into information, Activation of

information, Interpersonal continuity of care and Patient convenience. Patient insight into information supports patient empowerment, clinical outcomes and patient adherence. The mechanism activation of information support patient adherence. Interpersonal continuity of care support patient-provider communication. Patient convenience support patient satisfaction and health resource consumption. These mechanisms defined by Otte-Trojel et al. (2014) are used to categorize the reported features of PHRs and patient portals. Table 7 provides an overview of PHR and patient portal functions and features categorized by mechanism.

The available evidence on the outcomes and impact of using PHRs and patient portals are grouped by type of outcomes. These Health outcomes, Behavioral outcomes and Affective-cognitive outcomes. These categorizations are defined by the review by Davis et al. (2017). The types of outcomes are further analyzed by positive outcomes and outcomes with mixed evidence or no effect. None of the reviews provided any adverse outcomes and the review by Otte-Trojel et al. (2014), reported that none of the studies included in their review found severe adverse consequences of patient portal implementation. The review by Price et al. (2015), mentioned one potential negative impact of PHRs and patient portals. In one of the studies included in the review providers mentioned that patients assume healthcare providers are continually monitoring the PHRs which may cause patients not to report a change in their health status as they assume health care providers are made aware through the PHR. Table 8 provides a summary of the reported outcomes and impact of PHRs and patient portals on patient care.

#### **4.3.2.1 Health Outcomes**

Health outcomes are related to PHR and patient portal impact to physiological measures, quality of life and symptom management (Davis et al., 2017). Positive health outcomes are seen in patients with chronic diseases that used patient portals in conjunction with case management (Goldzweig et al., 2013). Certain conditions like diabetes, hypertension, asthma, HIV, fertility management, glaucoma, and hyperlipidemia has shown early evidence of benefiting in the use of PHRs as a health intervention (Price et al., 2015). There is an uptake of preventive care services by providing prevention or health maintenance reminders (Mold et al., 2015). A study included in the Irizarry et al. (2015) found that 1 in 4 users of PHRs or patient portals were up-to-date on all preventive services which are almost double as compared to non-users. A difference is also

seen in immunization, where a study in the Mold et al. (2015) review found that 95.5% in a children intervention group received immunizations compared to 87.2% in control.

Overall, there is mixed evidence on the impact of PHRs and patient portals on health outcomes. For example, Goldzweig et al. (2013) reported insufficient evidence and Kruse, Argueta, et al. (2015) reported 37% of the articles included in the review had positive disease outcomes as a result of using the patient portal. For patients with diabetes, PHR and patient portal use is a statistically insignificant predictor of low-density lipoprotein and total cholesterol levels. There are mixed results on Hemoglobin A1c levels, where one study found that PHR and patient portal use is a statistically significant predictor of glycosylated hemoglobin level (Bush et al., 2016), but Goldzweig et al. (2013) found that this effect was short-term only. Short term effects were also seen in screening rates after receiving reminders (Irizarry et al., 2015) and electronic outreach through the PHR and patient portals (Saparova, 2012). Patient portals could lead to improvements in clinical outcomes, but the effects were not reliable or consistent over time (Otte-Trojel et al., 2014).

#### **4.3.2.2 Behavioural Outcomes**

Behavioural outcomes are about patient decision making, medication management and adherence to health behaviours (Davis et al., 2017). The positive behavioural outcomes from the use of PHRs and patient portals are in medication adherence and self-maintenance of health (Kruse, Bolton, et al., 2015). Medication adherence is seen mainly for those individuals with chronic illnesses like diabetes (Kruse, Bolton, et al., 2015). PHR or patient portal features such as diabetes care plan support medication adjustment for patients with diabetes, hypertension, or hyperlipidemia (Goldzweig et al., 2013). There was an increase in pre-visit use of patient portal and increased rates of diabetes-related medication adjustment at 12 months (Irizarry et al., 2015). PHRs and patient portals promote positive behaviour change (Saparova, 2012). Patients are observed to have an improved quality of behaviours with the use of patient portals (Osborn et al., 2010). The review by Turner et al. found that PHR usage served as a cue to action for patients living with human immunodeficiency virus (HIV) (2016). Patients living with HIV had reduced HIV-related risk behaviours and engaged in HIV self-management as a result of using the PHR (Turner et al., 2016).

Behavioural outcomes with mixed evidence or no effect include mixed evidence in adherence to antiretroviral therapy (Turner et al., 2016) Use of a PHR or patient portals did not have a statistically significant effect on patients' behaviours associated with influenza prevention (Saparova, 2012). PHRs and patient portals can lead to improved patient adherence, but the effects are not sustained over time (Otte-Trojel et al., 2014).

#### **4.3.2.3 Affective-Cognitive Outcomes**

Affective-cognitive outcomes are outcomes on patient-provider communications, patient knowledge, satisfaction and ease of care (Davis et al., 2017). The positive affective-cognitive outcomes include a reported increase in patient empowerment (Goldzweig et al., 2013) and patient engagement in patient disease self-management (Kruse, Bolton, et al., 2015; Mold et al., 2015; Sakaguchi-Tang et al., 2017). There is an increased sense of empowerment and increased motivation (Saparova, 2012). 33% of studies included in the Kruse, Argueta, et al. (2015) review credited improved self-management of chronic conditions through the availability of educational resources presented in the patient portal. Both patients and providers report improvements in quality of care through patient portals (Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Osborn et al., 2010). Knowledge of diabetes targets had improved (Osborn et al., 2010). Improved awareness of HIV-related health outcomes, including CD4 count and viral load, PHR users were significantly more likely to correctly estimate their CD4 count and viral load compared to non-users (Turner et al., 2016). Patients believe that patient portals helped them better manage health (Sakaguchi-Tang et al., 2017). There is an improvement of patient-provider communication as a result of using a patient portal and increase in communication between patients and their health system (Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Mold et al., 2015; Price et al., 2015; Pushpangadan & Seckman, 2015). Patients and providers report an increase in collaborative decision making with the use of patient portals (Kruse, Bolton, et al., 2015). PHR usage affected antiretroviral therapy self-efficacy where the self-efficacy scores significantly increased from pre to postintervention (Turner et al., 2016). The use of PHRs and patient portals showed a significant decline in no shows or missed appointments (Irizarry et al., 2015; Kruse, Bolton, et al., 2015; Osborn et al., 2010). Patient safety increased as patients identify errors in their medication lists through patient portals (Mold et al., 2015). There is also an increase in care access with the use of PHRs and patient portals (Price et al., 2015). Improved

patient satisfaction, improved continuity and more effective face-to-face visits were also seen in the use of PHRs and patient portals (Price et al., 2015; Sakaguchi-Tang et al., 2017).

For affective-cognitive outcomes with mixed evidence or no effect, the evidence was mixed about the effect of portals on health care utilization and efficiency (Goldzweig et al., 2013). Patient portals are seen as a complement to the provision of care rather than substitutes to existing health services (Otte-Trojel et al., 2014). Patient portals can lead to improvements in patient-provider communication, patient empowerment, and patient satisfaction with health services but some studies reported that the effects were not reliable or consistent over time (Otte-Trojel et al., 2014). Use of a PHR did not have a statistically significant effect on patients' knowledge and beliefs associated with influenza prevention (Saparova, 2012)

#### **4.3.3 What are the facilitators and barriers to a patient's use of PHRs and patient portals?**

The available evidence gathered on the facilitators and barriers on a patient's use of PHRs, and patient portals were analyzed and categorized as patient characteristics, patient perception, PHR and patient portal access and support and PHR and patient portal design. Table 9 presents the reported facilitators and barriers to a patient's use of PHRs and patient portals. From the 19 reviews included in this appraisal, 16 reviews reported facilitators and barriers on patient's use of PHRs and patient portals. These reviews are by Amante et al. (2014), Bush et al. (2016), Davis et al. (2017), Goldzweig et al. (2013), Irizarry et al. (2015), Kruse, Argueta, et al. (2015), Kruse, Bolton, et al. (2015), Mold et al. (2015), Osborn et al. (2010), Price et al. (2015), Pushpangadan & Seckman (2015), Sakaguchi-Tang et al. (2017), Thompson et al. (2016), Turner et al. (2016), Wildenbos et al. (2017) and Zhao et al. (2017)

##### **4.3.3.1 Patient Characteristics**

Different patient characteristics have been reported to either be a facilitator or a barrier in the use of PHRs and patient portals. Patient characteristics include sociodemographic factors, education and different patient population features. The facilitators in a patient's use of PHR and patient portal are having higher education (Bush et al., 2016; Thompson et al., 2016; Wildenbos et al., 2017), having commercial health insurance (Bush et al., 2016), being a younger adult (Goldzweig et al., 2013; Turner et al., 2016) and certain racial ethnicities e.g. Caucasians, Hispanic (Pushpangadan & Seckman, 2015; Thompson et al., 2016; Wildenbos et al., 2017).

Other facilitators include having high computer literacy (Goldzweig et al., 2013; Pushpangadan & Seckman, 2015; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017), high health literacy (Irizarry et al., 2015), and having better health conditions (Wildenbos et al., 2017).

The reported patient characteristics that are barriers in the use of patient portals are low technical literacy and lack of computer skills (Amante et al., 2014; Sakaguchi-Tang et al., 2017; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017; Zhao et al., 2017). Other barriers include low health literacy (Davis et al., 2017; Irizarry et al., 2015; Wildenbos et al., 2017; Zhao et al., 2017), difficulty interpreting data, need explanation of test results, and understanding medical terminology (Bush et al., 2016; Price et al., 2015; Pushpangadan & Seckman, 2015), general difficulty understanding resources such as health libraries (Kruse, Argueta, et al., 2015) and low numeracy skills (Irizarry et al., 2015; Kruse, Bolton, et al., 2015). Other patient characteristics that encounter barriers to the use of PHRs and patient portals are disadvantaged, lower socioeconomic groups, non-white ethnicities, low income, individuals on financial support programs (Bush et al., 2016; Mold et al., 2015; Turner et al., 2016) and elderly or disabled individuals (Pushpangadan & Seckman, 2015; Sakaguchi-Tang et al., 2017; Wildenbos et al., 2017).

#### **4.3.3.2 Patient's Perception**

A patient's perception also affects their use of PHRs and patient portals. Patient perception is factors which include a patients' attitudes, concerns and views. The patient perception facilitators include trust in technology and the internet (Goldzweig et al., 2013; Wildenbos et al., 2017). Patients who feel are part of their care team (Sakaguchi-Tang et al., 2017) and patients who believe in the benefits of PHRs and patient portals (Sakaguchi-Tang et al., 2017; Zhao et al., 2017) are more likely to use these applications. A couple of instances of patient challenges and dissatisfaction were seen as facilitators to the use of PHR and patient portal. These instances are difficulty in obtaining medical information (Amante et al., 2014) and dissatisfaction with provider-patient relationship (Amante et al., 2014; Wildenbos et al., 2017).

The patient perception and attitudes that are barriers to PHR and patient portal use are lack of motivation to use and learn the system (Amante et al., 2014; Wildenbos et al., 2017; Zhao et al., 2017). Patients have doubts on using technology, security and reliability of message

exchange (Amante et al., 2014). Patients also have concerns with confidentiality and privacy (Bush et al., 2016; Davis et al., 2017; Pushpangadan & Seckman, 2015; Sakaguchi-Tang et al., 2017; Thompson, Reilly, & Valdez, 2016; Turner et al., 2016; Wildenbos et al., 2017; Zhao et al., 2017). Other barriers on patient perception and attitudes include fear of accessing unwanted or frightening information (Thompson et al., 2016) and misuse of health data (Pushpangadan & Seckman, 2015). Instances of positive provider-patient relationships were seen as barriers to the use of PHRs and patient portals. For example, patients prefer traditional modes of communication. (Amante et al., 2014). Patients are satisfied with status quo, satisfied with their provider relationship and prefer to leave disease management to physicians (Amante et al., 2014; Wildenbos et al., 2017; Zhao et al., 2017).

#### **4.3.3.3 PHR and Patient Portal Access and Support**

PHR and patient portal access and support are also facilitators and barriers to PHR and patient portal use. The reported facilitators in this category are where family and care providers recommend and instruct patient to use PHRs or patient portals (Amante et al., 2014; Sakaguchi-Tang et al., 2017; Wildenbos et al., 2017; Zhao et al., 2017). The availability of technical support and training are also seen as a facilitator (Sakaguchi-Tang et al., 2017; Zhao et al., 2017).

The reported barriers in this category are no computer or internet access (Amante et al., 2014; Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Pushpangadan & Seckman, 2015; Sakaguchi-Tang et al., 2017; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017; Zhao et al., 2017) and lack of technical support (Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015). A barrier to patient's use of PHRs and patient portals are the availability of supports outside of the applications, for example; some patients reported that e-mail communication is already available without patient portal use (Amante et al., 2014). Other barriers reported are patients were unaware of the PHR or patient portal (Amante et al., 2014; Wildenbos et al., 2017; Zhao et al., 2017) or are unaware of portal features (Amante et al., 2014; Osborn et al., 2010; Zhao et al., 2017).

#### **4.3.3.4 PHR and Patient Portal Design**

The last category in the reported facilitators and barriers is PHR and patient portal design. PHR and patient portal design are factors related to the technical design, usability and human factors. The facilitators in this category are the use of patient-friendly language when presenting

medical information (Irizarry et al., 2015). Another facilitator is the availability of PHR and patient portals in mobile devices (Wildenbos et al., 2017).

The barriers seen in PHR and patient portal design are separate accounts for each family member (Bush et al., 2016), lack of e.g. symptom checker (Bush et al., 2016) and human factor issues with the interface and system usability issues (Davis et al., 2017; Goldzweig et al., 2013; Zhao et al., 2017). Patients report the use of PHRs and patient portals can be complicated, time-consuming and difficult (Thompson et al., 2016; Wildenbos et al., 2017). Patients forget their user login and password (Bush et al., 2016; Sakaguchi-Tang et al., 2017). Inaccurate information is presented in the PHRs or patient portals (Price et al., 2015; Pushpangadan & Seckman, 2015) and lack of interoperability (Davis et al., 2017; Thompson et al., 2016).

#### **4.3.4 Characteristics of the included reviews**

##### **4.3.4.1 Population**

This appraisal includes all types of participants. From the 19 included reviews, seven reviews specified a specific population, patient subgroup or disease in their reviews (Amante et al., 2014; Bush et al., 2016; Osborn et al., 2010; Pushpangadan & Seckman, 2015; Sakaguchi-Tang et al., 2017; Turner et al., 2016; Wildenbos et al., 2017). The population of two reviews (Amante et al., 2014; Osborn et al., 2010), were patients with diabetes while the review by Turner et al. (2016) was on people living with the Human Immunodeficiency Virus (HIV). The population selected by the remaining four reviews are defined by age group. Bush et al. (2016) review was on the population 0 to 18 years age group. Pushpangadan & Seckman (2015) review was on the population aged 18 years and older. Sakaguchi-Tang et al. (2017) were on older adults aged 60 years and older while Wildenbos et al. (2017) was on adults aged 50 years and older.

##### **4.3.4.2 Setting**

Similar to the population, all types of settings are included in this appraisal. From the 19 included reviews, 16 reviews did not specify or limit their selected studies to a particular clinical setting (Amante et al., 2014; Bouayad et al., 2017; Bush et al., 2016; Davis et al., 2017; Goldzweig et al., 2013; Irizarry et al., 2015; Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Osborn et al., 2010; Otte-Trojel et al., 2014; Pushpangadan & Seckman, 2015; Sakaguchi-Tang et al., 2017; Saporova, 2012; Thompson et al., 2016; Turner et al., 2016; Zhao et al., 2017).

The remaining three reviews specified a clinical setting for their reviews. Mold et al. (2015) review was specific to primary care, Price et al. (2015) review setting was the outpatient environment while the review by Wildenbos et al. (2017) specified hospital or primary care settings.

#### **4.3.4.4 Phenomena of Interest**

For phenomena of interest, from the 19 reviews, eight reviews were on PHRs including patient portals (Davis et al., 2017; Price et al., 2015; Pushpangadan & Seckman, 2015; Sakaguchi-Tang et al., 2017; Saparova, 2012; Thompson et al., 2016; Turner et al., 2016; Zhao et al., 2017). The remaining 11 reviews were specific to patient portals (Amante et al., 2014; Bouayad et al., 2017; Bush et al., 2016; Goldzweig et al., 2013; Irizarry et al., 2015; Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Mold et al., 2015; Osborn et al., 2010; Otte-Trojel et al., 2014; Wildenbos et al., 2017).

Table 3 summarizes the objective, the participants, setting and phenomena of interest of the selected reviews for this appraisal. Additional characteristics of the selected reviews are summarized in Table 4. These characteristics are the types of citation databases used by the reviews, the time frame used in the search, the number of studies included in the reviews, the study designs of the included studies and the country of origin of the studies included in the reviews.

#### **4.3.5 What are the types of published systematic reviews on PHRs and patient portals and the quality instruments used to appraise their methodological quality?**

Table 5 summarizes the types of published systematic reviews on PHRs and patient portals and the quality instruments used to appraise their methodological quality.

##### **4.3.5.1 Type of Systematic Review**

The types of systematic reviews included in this appraisal are Literature Review, Realist Review, Scoping Review, State of the Science Review and Systematic Review. The reviews by Bouayad et al. (2017), Pushpangadan & Seckman (2015), Wildenbos et al. (2017) were literature reviews. Otte-Trojel et al. (2014) completed their review as a realist review. The reviews by Davis et al. (2017) and Saparova (2012) were scoping reviews. Irizarry et al. (2015) review was completed as a state of the science review. The remaining 12 reviews were completed as general

systematic reviews (Amante et al., 2014; Bush et al., 2016; Goldzweig et al., 2013; Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Mold et al., 2015; Osborn et al., 2010; Price et al., 2015; Sakaguchi-Tang et al., 2017; Thompson et al., 2016; Turner et al., 2016; Zhao et al., 2017).

#### **4.3.5.2 Quality Appraisal Instrument**

In the assessment of methodological quality, one of the lowest met criteria were on ‘*Were the criteria for appraising studies appropriate?*’, from the 19 reviews included in this appraisal, only eight reviews mentioned that a quality appraisal of the studies was completed for their reviews. The types of quality appraisal methods used were Mixed Methods Appraisal Tool (MMAT), Grading of Recommendations Assessment Development and Evaluation (GRADE), Extended evidence hierarchy based on Australia’s National Health and Medical Research Council (NHMRC), Statement on the Reporting of Evaluation studies in Health Informatics (STARE-HI), Quality criteria of qualitative studies and Quality criteria of quasi-experimental and cross-sectional studies. Two reviews mentioned that quality assessment was done, but no appraisal tool was specified.

### **4.3.6 How does the umbrella review method compare with other review of reviews methods?**

#### **4.3.6.1 What are Umbrella Reviews?**

An umbrella review is a method used to review published systematic reviews to compare, contrast and provide an examination of the information available on a given question or topic (Aromataris et al., 2017). Umbrella reviews aim to summarize the evidence from multiple research syntheses on a given topic or question (Aromataris et al., 2015). Umbrella reviews gather, summarize and enhance the accessibility of existing evidence on a given topic through the review of published systematic reviews (Hunt, Pollock, Campbell, Estcourt, & Brunton, 2018). Umbrella reviews are useful in assessing health technology which aims to inform decision-making and guidelines (Biondi-Zoccai, La Torre, Roever, & D’Ascenzo, 2016). Umbrella reviews focus on a topic or problem that could have two or more potential interventions and highlight the reviews that address these potential interventions and their results (Grant & Booth, 2009). Umbrella reviews can focus on outcomes, risk factors or interventions (Ioannidis, 2017). Umbrella reviews is a way to highlight information around a topic or question

to see if the information or evidence available is consistent or contradictory (Aromataris et al., 2017). Umbrella reviews is a transparent and systematic way to support informed decision making in instances that conflicting evidence exists on a given topic or question (Grant & Booth, 2009). In these instances where the available evidence is contradictory, umbrella reviews can group the reasons why the evidence may be contradicting each other (Aromataris et al., 2017).

#### **4.3.6.2 Why are Umbrella Reviews completed?**

The number of systematic reviews on a specific issue or question is increasing, and Umbrella reviews is a mechanism for aggregating the findings of these systematic reviews (Grant & Booth, 2009). Umbrella reviews provide readers with a quick overview and an exhaustive list of systematic reviews relevant to a particular topic, issue or question (Grant & Booth, 2009). Umbrella reviews also provide a faster way to gather a high-quality body of evidence on a given question or topic (Aromataris et al., 2015). Umbrella reviews provide a means to refine and understand vast amounts of evidence providing a high-level synthesis of evidence and also provide a way to recognize biases, uncertainties and knowledge gaps (Ioannidis, 2017). Having a higher-level view provide a way to understand the effects, heterogeneity, possible bias and quality that affect the credibility of the compiled evidence (Ioannidis, 2017). As the number of published systematic reviews increases, umbrella reviews has an essential role in supporting evidence-based healthcare and evidence-informed decision making (Aromataris et al., 2015).

Umbrella reviews are completed to review and synthesize the findings of systematic reviews already available, for example, if good quality, current and multiple systematic reviews exist on a given topic umbrella reviews can be conducted to synthesize the findings (Aromataris et al., 2017). There are many resources available to support reviewers in conducting umbrella reviews. A list of critical resources is available in the Appendix – Umbrella Reviews Key Documents. The Joanna Briggs Institute (JBI) Reviewer's Manual and Cochrane Handbook for Systematic Reviews of Interventions guide how to conduct an umbrella review and overview of reviews (Papageorgiou & Biondi-Zoccai, 2016). A clear description of research questions, issues and purpose statements are required when initiating umbrella reviews (Conn & Coon Sells, 2014). These defined research questions will help determine the inclusion criteria for the

umbrella review as well as the search strategy to be used to gather available published systematic reviews (Conn & Coon Sells, 2014).

#### **4.3.6.3 How does the umbrella review method compare with other review of reviews methods?**

The method of reviewing published systematic reviews is referred to by different names and the most common names in use are umbrella review which is used by Joanna Briggs Institute (JBI) and Overviews of reviews which is used by The Cochrane Collaboration. Umbrella review is the term used in the JBI synthesis of existing systematic reviews (Aromataris et al., 2017). Overview of systematic reviews or commonly called overview is a term utilized by Cochrane to describe the review of systematic reviews published in the Cochrane Library (Hunt et al., 2018) Other terminologies used are Systematic Review of Systematic Reviews, Summary of Systematic Reviews, Synthesis of Reviews, Review of Systematic Reviews, Review of Reviews, Review of Meta-analyses, Meta-review, Systematic Meta-review (Higgins & Green, 2011).

A comparison of umbrella reviews and overviews was completed to understand each methods' characteristics, similarities and differences. Table 10 displays the characteristics of each review of systematic reviews method. The main similarity between umbrella reviews and overviews of reviews is its study type inclusion criteria which are the use of systematic reviews (Aromataris et al., 2015). Another similarity between the two methods is that umbrella reviews and overviews focus on reviews are on the effectiveness of an intervention or therapy (Aromataris et al., 2017). Evidence gathered through overviews can be used to generate new insights and understanding, but similar to umbrella reviews its primary goal is to provide a summary of available evidence. (Hunt et al., 2018).

A primary difference between the two methods is that overviews have subtypes based on the research question and overall overview objective which may be specific types of systematic reviews or systematic reviews that contain specific types of primary research studies (Hunt et al., 2018). These subtypes include Overviews of intervention reviews, Overviews of diagnostic test accuracy reviews, Overviews of reviews of prognosis or prevalence and Overviews of qualitative reviews (Hunt et al., 2018). Comparing the two methods, a difference highlighted in the JBI Reviewers Manual is that JBI umbrella review method gathers best available evidence from multiple research synthesis and not solely on randomized control trials and experimental studies

(Aromataris et al., 2017). In addition to providing a summary of results gathered from multiple systematic reviews, overviews are also used to examine questions already addressed by existing systematic reviews, for example in variations in population, condition or intervention. (Hunt et al., 2018). Both umbrella reviews and overview uses study types of published systematic reviews but overviews typically only include relevant Cochrane intervention systematic reviews produced by Cochrane review groups and does not consider non-Cochrane reviews or qualitative evidence (Aromataris et al., 2015). Umbrella reviews in comparison are inclusive of other published systematic reviews and meta-analyses (Aromataris et al., 2015).

## **5. Summary of Evidence**

A comprehensive summary of evidence for this appraisal is presented in Table 7, 8 and 9. Table 7 provides a summary of evidence on the features and functions of PHRs and patient portals. Table 8 provides a summary of evidence on the outcomes and impact of PHRs and patient portals. Table 9 provides a summary of evidence from the included reviews in this appraisal on the facilitators and barriers in a patient's use of PHRs and patient portals.

## 6. Discussion

This appraisal looked into a comparison of PHRs and patient portals to understand the differences in its characteristics and functions. The similarities between PHRs and patient portals are on how these are patient-focused tools, its function of health record keeping and viewing as well as its purpose of engaging a patient to be a collaborative part of their health care team. Patient portals are a type of electronic PHRs, and the differences between PHRs and patient portals are seen in the management, ownership, storage and whether the PHR is untethered/standalone or tethered/incorporated. The types of mechanisms presented and used to categorize the different features of PHRs and patient portals relate to the type influence these features and functions have on patient outcomes. Patients having insight into information is meant to support clinical outcomes. The reported evidence on clinical outcomes is currently mixed, but it has been reported that PHR and patient portal use in combination with case management or other health services can improve clinical outcomes. Features on the activation of information such as reminders support outcomes on patient adherence which is seen in the behavioural outcomes on medication management, and patients own self-care management. The features that support patient-provider communication, in turn, can result in the positive outcomes on reported improvement in the quality of care which is reported by both patient and providers. Features that target patient conveniences like online appointment scheduling and prescription refills supports positive outcomes on patient engagement. The available evidence on the features and outcomes of PHRs and patient portals is presented to inform the importance and potential of these applications in promoting patient care self-management. This appraisal also presents the available evidence in the facilitators and barriers in the use of PHRs and patient portals. The facilitators and barriers were grouped under factors related to patient characteristics, patient perception, PHR and patient portal access and support and PHR and patient portal design. An essential facilitator in the use of the patient portal is patient, family and health care team support. Patients who feel supported and involved in their care influences the impact of the use of PHRs and patient portals.

The identified published systematic review of reviews by Jilka et al. (2015) looked at the impact of providing patients access to patient portals from a patient and provider perspective. The systematic review of reviews used the term patient accessible electronic health records. Jilka

et al. (2015) looked into outcome measures which included health outcome, self-efficacy and patient satisfaction. Jilka et al. (2015) reported that there is a positive impact on patient empowerment, but there are mixed results for patient safety, usefulness, satisfaction and self-efficacy. The systematic review of reviews concludes that patient portal developers are not clear whether these tools make a difference to patients and the care providers. Comparing the results of this appraisal to the results of Jilka et al. (2015), similar evidence on patient empowerment has been reported as a positive outcome, and there is limited or mixed evidence with PHR and patient portal impact to health outcomes. The evidence gathered by this appraisal adds to the result of the systematic review of reviews as it gathered positive reported outcomes on improvements in patient decision-making, medication management, and adherence to health behaviours. Positive outcomes were also gathered on patient-provider communication, patient knowledge, satisfaction and ease of care.

A limitation of this appraisal is one reviewer. Gray literature or reports were not included and is also a limitation of this appraisal. Another limitation that is also described by the JBI Reviewer's Manual is this appraisal is subject to the limitations of the identified reviews, with the assessment of methodological quality most of the reviews included in this appraisal did not describe the criteria used to appraise the studies included in their reviews.

## **7. Conclusion and Recommendations**

This research project provided a summary of evidence in previously published systematic reviews on PHRs and patient portals. A summary of evidence was gathered using the umbrella review appraisal method, comparing PHRs and patient portals based on their characteristics and functions. The similarities of PHRs and patient portals are seen on who utilizes the tool as well as its purpose of engaging patients to manage their care. The differences between PHRs and patient portals are seen on who manages, owns, stores and if the tool is tethered to a health organization's EHR. A summary of evidence was presented on the outcome and impact of PHR and patient portals specific to health outcomes, behavioural outcomes and affective-cognitive outcomes. This appraisal highlighted the reported evidence on positive outcomes as well as evidence that is mixed or no effect. From the reported evidence, there are highlighted positive outcomes and impact in patients self-managing their care who have chronic diseases such as diabetes and hypertension. A summary of evidence was also identified on the available evidence on the facilitators and barriers in a patient's use of PHRs and patient portals. Facilitators and barriers were identified on factors related to patient characteristics, patient's perception, PHR and patient portal access, available support and design. This appraisal compared the umbrella review method with overviews to provide a summary of when one method is used compared to another. This appraisal utilizes the umbrella review method as it is inclusive of all published systematic reviews and follows the guidelines set by the JBI reviewer's manual compared to the Overview method which follows the Cochrane Handbook for Systematic Reviews of Interventions.

### **7.1 Recommendation for Research**

This appraisal identified evidence on the barriers in the use of PHRs, and patient portals, a recommendation for future research is to gather further evidence to support healthcare organizations implement solutions in facilitating the use of PHRs and patient portals. On outcomes and impact of PHRs and patient portals, this appraisal identified reported evidence that was mixed or no effect. A recommendation for future research is to understand and provide more evidence on how PHRs and patient portals impact patient care, especially on health outcomes.

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<sup>1</sup> Mendeley, American Psychological Association 6<sup>th</sup> edition

## Tables

**Table 1: Search Strategy**

Search Engines	Search	Number of Records
CINAHL Complete (EBSCO)	(patient portal or personal health record) AND (systematic review or meta-analysis) Limit to: <ul style="list-style-type: none"> <li>- Full Text</li> <li>- English Language</li> <li>- August 2008 to August 2018</li> </ul>	96
Medline (EBSCO)	(patient portal or personal health record) AND (systematic review or meta-analysis) Limit to: <ul style="list-style-type: none"> <li>- Full Text</li> <li>- English Language</li> <li>- August 2008 to August 2018</li> </ul>	196
PubMed	"patient portal"[Title] OR "patient portal"[Title/Abstract] OR "patient portals"[MeSH Terms] OR "patient portal"[Text Word]  OR  "personal health record"[Title] OR "personal health record"[Title/Abstract] OR "personal health record"[Text Word]  AND  ("systematic review"[Title] OR "systematic review"[Title/Abstract] OR "systematic review"[Text Word] OR "meta analysis"[Title] OR "meta analysis"[Title/Abstract] OR "meta analysis"[Publication Type] OR "review"[Publication Type])  AND  ("loattrfull text"[sb] AND ("2008/08/01"[PDAT] : 2018/08/31"[PDAT]) AND English[lang])	67
Cochrane Database of Systematic Reviews (EBSCO)	patient portal or personal health record	0
Joanna Briggs Institute EBP Database (OVID)	patient portal or personal health record	0

*Note:* Table 1 shows a summary of the search strategy that was used for this umbrella review.

**Table 2: Assessment of Methodological Quality**

Review	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	%	Quality
Amante et al., 2014	U	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	91%	High
Bouayad et al., 2017	U	Y	Y	Y	N	N	Y	Y	U	Y	Y	73%	Low
Bush et al., 2016	U	Y	Y	Y	Y	Y	Y	Y	Y	U	U	86%	High
Davis et al., 2017	Y	Y	Y	Y	N	N	Y	Y	U	U	Y	73%	Low
Goldzweig Dr. et al., 2013	U	Y	Y	U	U	Y	Y	Y	Y	Y	U	82%	High
Irizarry et al., 2015	U	Y	Y	Y	N	N	U	Y	U	U	Y	64%	Low
Kruse, Argueta, et al., 2015	U	Y	Y	Y	N	N	Y	Y	U	Y	U	68%	Low
Kruse, Bolton, et al., 2015	U	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	91%	High
Mold et al., 2015	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	95%	High
Osborn et al., 2010	U	Y	Y	U	N	N	Y	Y	U	U	Y	64%	Low
Otte-Trojel et al., 2014	Y	Y	Y	Y	N	N	Y	Y	U	U	Y	73%	Low
Price et al., 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	95%	High
Pushpangadan & Seckman, 2015	U	Y	Y	Y	N	N	U	Y	U	Y	Y	68%	Low
Sakaguchi-Tang et al., 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	95%	High
Saparova, 2012	Y	Y	Y	U	U	N	Y	Y	Y	U	Y	77%	Low
Thompson et al., 2016	U	Y	Y	Y	N	N	Y	Y	U	U	Y	68%	Low
Turner et al., 2016	U	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	91%	High
Wildenbos et al., 2017	U	Y	Y	U	Y	Y	Y	Y	Y	U	Y	86%	High
Zhao et al., 2017	0.5	1	1	0.5	0	0	1	1	0.5	0.5	1	64%	Low
	60%	95%	95%	83%	45%	43%	90%	95%	73%	63%	88%		

*Note:* Table 2: Assessment of Methodological Quality, displays the assessment of each of the reviews included in the umbrella review using the JBI Critical Appraisal Checklist for Systematic Reviews and Research Synthesis. Each criterion and its overall quality. Each of the criterion was applied a value of 1 for Yes (Y), 0 for No (N), 0.5 for Unclear (U).

**Table 3: Characteristics of Included Reviews: Objectives, Participants, Setting, Phenomena of Interest**

	<b>Review</b>	<b>Objectives</b>	<b>Participants</b>	<b>Setting</b>	<b>Phenomena of interest</b>
1	Amante et al., 2014	Examine characteristics associated with enrollment and utilization of portals among patients with diabetes and identify barriers and facilitators of electronic patient portal enrollment and utilization.	Patient with Diabetes	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• The electronic patient portal is an online personal health record that is “tethered” with a healthcare provider’s electronic health record system</li> </ul>
2	Bouayad et al., 2017	Assess PHR data types and functionalities through a review of the literature to inform the health care informatics community, and to provide recommendations for PHR design, research, and practice.	Not specified	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• The review uses the term Patient Health Record</li> <li>• Patient Health Record is an electronic record designed for patients to self-manage care. Focused on data that were either entered by or transmitted to the patient to enable self-care management, regardless of PHR type or brand.</li> <li>• An extension of traditional electronic health records (EHRs), Patient Health Record created a patient-centric platform supporting the new vision of health services that enable patient-provider information sharing and collaboration, with the goal of</li> </ul>

	<b>Review</b>	<b>Objectives</b>	<b>Participants</b>	<b>Setting</b>	<b>Phenomena of interest</b>
					improving health outcomes and reducing costs.
3	Bush et al., 2016	Understand the state of the science of pediatric patient portal utilization, including to describe the ways in which authors have described the implementation of the patient portal, the ways in which it is integrated in the EHR, and the methodology adopted to measure the impact of the portal.	0 to 18 years age group	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• Patient portal refers to a secure web site, integrated with the EHR, through which patient can complete forms, communicate electronically with healthcare providers, access personal health information such as progress notes, problem lists, current medications, immunization history, laboratory data, and radiology reports, schedule appointments, request prescription refills, and pay bills.</li> </ul>
4	Davis et al., 2017	Determine the size and scope of the published literature on Shared Decision Making via PHR in terms of system design and effect.	Not limited to any particular patient subgroup or disease.	Not limited to any particular clinical setting.	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• PHR is a patient facing electronic health record system through which individuals can access, manage, and share their health information (and that of others for whom they authorized), in a private, secure, and confidential environment to support patient-centered care.</li> </ul>
5	Goldzweig Dr. et al., 2013	Evaluate the patient portal literature, specifically	Patients with access to	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> </ul>

	<b>Review</b>	<b>Objectives</b>	<b>Participants</b>	<b>Setting</b>	<b>Phenomena of interest</b>
		investigating the evidence that these systems improve health outcomes, patient satisfaction, health care utilization and efficiency, and adherence. We also evaluated evidence about patient attitudes and characteristics and barriers or facilitators to portal use.	their records through a patient portal.		<ul style="list-style-type: none"> <li>• Patient portals are companion applications to electronic health record (EHR) systems, which are designed to give patients secure access to various health information and allow secure methods for communication and information sharing. Patient portals are “tethered” to existing health care institutions as opposed to those that are standalone.</li> </ul>
6	Irizarry et al., 2015	Present the definition, background, and how current literature addresses the encouragement and support of patient engagement through the patient portal, and provide a summary of future directions for patient portal research and development to meaningfully impact patient engagement.	Studies were not targeted to any particular patient subgroup, disease, or clinical setting.	Not limited to any particular clinical setting.	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• Patient portal is an ePHR that directly links or is "tethered" to an EHR. Patient information from the EHR such as the problem list, allergies, and lab test results populate the patient portal. In some instances, patients may enter data to populate the EHR.</li> </ul>
7	Kruse, Argueta, et al., 2015	Identify provider/patient attitudes toward the use of patient portals for the management of chronic disease. Identify portal features that received favourable responses from patients and providers, and	Not specified	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• Patient portal is a secure online website that gives patients convenient 24-hour access to personal health information from anywhere with an Internet</li> </ul>

	<b>Review</b>	<b>Objectives</b>	<b>Participants</b>	<b>Setting</b>	<b>Phenomena of interest</b>
		identify the portal services that patients and providers find valuable but believe need improvement.			connection. The data in a patient portal are owned and managed by the health care organization along with the electronic health record (EHR)
8	Kruse, Bolton, et al. 2015	Outline and summarize study results on the effect of patient portals on quality, or chronic-condition outcomes as defined by the Agency for Healthcare Research and Quality, and its implications to Meaningful Use since the beginning of 2011. This review updates and builds on the work by Ammenwerth, Schnell-Inderst, and Hoerbst.	Not specified	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• Patient portal is a secure online website that gives patients convenient 24-hour access to personal health information from anywhere with an Internet connection. The data in a patient portal are owned and managed by the health care organization along with the electronic health record (EHR) organizations can choose different features of even the same vendor solution.</li> </ul>
9	Mold et al., 2015	Assess the impact of providing patients with access to their general practice electronic health records (EHR) and other EHR-linked online services on the provision, quality, and safety of health care.	Users or non-users of online record access and remote contact services, including both patients	Primary care	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• Review uses the term online access</li> <li>• Online access is defined as access to the patient's medical record, access to the portal messaging service or e-mail and access to online transactional services such as requesting prescription renewals</li> </ul>

	Review	Objectives	Participants	Setting	Phenomena of interest
			(including carers and children) and clinicians/ support staff in primary care.		and booking an appointment.
10	Osborn et al., 2010	Evaluate the evidence on the impact of patient web portals delivered interventions in improving health behaviors, health outcomes, care, and/or processes of care for persons with diabetes.	Persons with Diabetes	Not specified	<ul style="list-style-type: none"> <li>• Patient Portals</li> <li>• Review uses the term Patient web portals (PWP)</li> <li>• Patient web portals are PHRs integrated with EHRs, either through tethering or interconnectivity.</li> </ul>
11	Otte-Trojel et al., 2014	Synthesize and analyze evaluations of patient portals to explain the reported outcomes. Two main research questions are by what mechanism(s) do patient portals contribute to outcomes? And How can variations in outcomes across different contexts be explained?	Not specified	Not specified	<ul style="list-style-type: none"> <li>• Patient Portal</li> <li>• Patient portal is a secure website for patients, typically maintained by provider practices, that offers access to a variety of functions linked to a physician's EHR including secure messaging, protected health information (e.g., lab results, medication lists, and immunizations), appointment scheduling, and tethered PHRs, more advanced portals may offer</li> </ul>

	Review	Objectives	Participants	Setting	Phenomena of interest
					programs for self-management or patient questionnaires.
12	Price et al., 2015	Develop an evidence-based list of conditions that have evidence of improvements that correlate with PHR use. Review Questions: 1. What health conditions have evidence for benefits of PHR enabled self-management? 2. What are the common care activities related to these conditions that are supported through the use of PHR? 3. Can we use these characteristics to predict other potentially PHR sensitive conditions?	Patients using PHRs	Outpatient environment	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• Personal Health Records (PHRs) are electronic health records controlled, shared, or maintained by patients to support patient centered care. PHRs can be standalone or tethered to another clinical information system such as a hospital information system or part of a regional electronic health record.</li> </ul>
13	Pushpangadan & Seckman, 2015	Understand the consumer's perspective on PHRs.	Aged 18 years and older.	Not specified	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• PHR is an electronic, lifelong resource of health information needed by individuals to make health decisions. There are two types of PHR models: standalone/web-based and incorporated/tethered.</li> <li>• An incorporated/tethered PHR communicates with a healthcare</li> </ul>

	Review	Objectives	Participants	Setting	Phenomena of interest
					organization's EHR. This model allows for communication through the sharing of data from multiple healthcare sources and provides email, reminders and scheduling features to support care management.
14	Sakaguchi-Tang et al., 2017	The aim of this study was to assess the existing research landscape related to patient portal and ePHR use and experience among older adults and to understand the benefits and barriers to older adults' use and adoption of patient portals and ePHRs.	Adults who were 60 years or older	Not specified	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• ePHRs that are not connected to EHRs</li> <li>• Patient portals are systems for health information management that are linked, or tethered, to a patient's EHR</li> </ul>
15	Saparova, 2012	Demonstrate the scope of current research on whether or not existing PHRs were capable of functioning as persuasive tools by delivering to their users tailored and personalized health information, guidance for disease and/or medication management, and health-related decision support; and whether or not the presence of such features had a	Not specified	Not specified	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• PHRs are a set of computer-based tools that allow people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it and can be both standalone and interoperable with web applications and external devices.</li> </ul>

	Review	Objectives	Participants	Setting	Phenomena of interest
		positive effect on patients' sense of empowerment and adoption of target health behaviors associated with disease and medication management.			
16	Thompson et al., 2016	Apply human factors/ergonomics (HF/E) paradigm to assess individual, work system/unit, organization, and external environment factors generating barriers to the patient, provider, and informal caregiver personal health record (PHR) use.	Not specified	Not specified	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• Internet-based set[s] of tools that allow people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it.</li> </ul>
17	Turner et al., 2016	Review has three aims: identify types of self-management tools available through PHRs for PLHIV; examine how PHR usage impacts HIV related health beliefs and ART adherence among PLHIV and to determine if there are differences in PHR usage based on socio-demographic variables that influence ART adherence.	People living with HIV (PLHIV)	Not specified	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• PHRs come in many forms including paper-based or electronic and standalone or tethered. The review focused on electronic PHRs, including both standalone and tethered PHRs.</li> </ul>
18	Wildenbos et al. 2017	Determine the facilitators and barriers that drive older adult patients to adopt EHR patient	Patients aged 50 years old and above	Hospital or primary care setting	<ul style="list-style-type: none"> <li>• Patient Portals</li> </ul>

	Review	Objectives	Participants	Setting	Phenomena of interest
		portals by using the Unified Theory of Acceptance and Use of Technology (UTAUT), a prominent technology acceptance framework, as a classification model for those factors.			
19	Zhao et al., 2017	Aim to systematically review the literature to identify publications that specifically address barriers, facilitators, and solutions to successful enrollment and use of patient portals and PHRs.	Not specified	Not specified	<ul style="list-style-type: none"> <li>• PHR including Patient Portal</li> <li>• PHRs are online applications that are owned and managed by patients or their proxies and allow for patient input of information for greater control of patients' own health information management.</li> <li>• Patient portals are secure online tools that can stand alone or be tethered to a healthcare organization's health record, through which patients can access their personal health information from anywhere with an internet connection.</li> </ul>

*Note:* Table 3: Characteristics of Included Reviews: Objectives, Participants, Setting, Phenomena of Interest displays the purpose or aim of the reviews, the participants, setting and phenomena of interest including its description.

**Table 4: Characteristics of Included Reviews: Search Strategy, Types of Studies, Country of Origin for included studies**

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
1	Amante et al., 2014	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• CINAHL</li> </ul>	February 1, 2005 to January 1, 2014.	16	<ul style="list-style-type: none"> <li>• Quantitative</li> <li>• Qualitative</li> <li>• Mixed-methods</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> </ul>
2	Bouayad et al., 2017	<ul style="list-style-type: none"> <li>• Pubmed</li> <li>• Embase</li> <li>• MEDLINE</li> </ul>	Pubmed 1950 to 2015 Embase 1966 to 2015 MEDLINE 1966 to 2015	106	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> </ul>
3	Bush et al., 2016	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• CINAHL</li> <li>• PsycINFO</li> <li>• Academic Search Premier</li> </ul>	1992 to 2014	11	<ul style="list-style-type: none"> <li>• Focused interviews</li> <li>• Cross-sectional surveys</li> <li>• Retrospective observational analysis</li> <li>• Usability testing</li> </ul> *One study combined both cross-sectional surveys and focused interviews.	<ul style="list-style-type: none"> <li>• United States</li> <li>• United Kingdom</li> </ul>
4	Davis et al., 2017	<ul style="list-style-type: none"> <li>• Medline</li> <li>• Google Scholar</li> <li>• CINAHL</li> <li>• Engineering Village (Compendex/ Inspec)</li> </ul>	2005 to 2015	38	<ul style="list-style-type: none"> <li>• Descriptive study</li> <li>• Feasibility study: pre-post with control</li> <li>• Focus groups</li> <li>• Interviews, Interview and survey</li> </ul>	<ul style="list-style-type: none"> <li>• Norway</li> <li>• Sweden</li> <li>• EU</li> <li>• France</li> <li>• Taiwan</li> <li>• Germany</li> <li>• UK</li> </ul>

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
		<ul style="list-style-type: none"> <li>• Web of Science</li> <li>• Gray literature (e.g., technical reports, organization websites, and conferences)</li> </ul>			<ul style="list-style-type: none"> <li>• Post-survey, Post-test, Post-test with control</li> <li>• Pre-, post-test pilot</li> <li>• Randomized control trials protocol</li> <li>• Prospective Randomized control trials</li> <li>• Randomized cluster trial protocol</li> <li>• Randomized control trials</li> <li>• User-centered design: interviews, User-centered design: focus groups, User-centered design: interviews and focus groups</li> </ul>	<ul style="list-style-type: none"> <li>• Netherlands</li> <li>• US</li> </ul>
5	Goldzweig Dr. et al., 2013	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• Web of Science</li> </ul>	January 1, 1990 to January 24, 2013	46	<ul style="list-style-type: none"> <li>• Randomized control trials</li> <li>• Observational</li> <li>• Hypothesis-testing studies</li> <li>• Descriptive</li> <li>• Quantitative studies</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> <li>• English Speaking Countries</li> <li>• Western Europe</li> </ul>

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
					<ul style="list-style-type: none"> <li>• Qualitative studies</li> </ul>	
6	Irizarry et al., 2015	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• Ovid Medline</li> <li>• PsycInfo</li> </ul>	2006 to 2014	120	<ul style="list-style-type: none"> <li>• Non-experimental descriptive</li> <li>• Qualitative or mixed-methods</li> <li>• Randomized controlled trials</li> <li>• Pilot studies or case reports</li> <li>• Cohort studies</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>
7	Kruse, Argueta, et al., 2015	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• CINAHL</li> </ul>	January 2004 to July 2014	27	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>
8	Kruse, Bolton, et al. 2015	<ul style="list-style-type: none"> <li>• PubMed (including MEDLINE)</li> <li>• CINAHL (excluding MEDLINE)</li> <li>• Google Scholar</li> </ul>	January 1, 2011 to August 24, 2014	27	<ul style="list-style-type: none"> <li>• Non-experimental</li> <li>• Qualitative</li> <li>• Quantitative</li> <li>• Mixed-methods – both quantitative and qualitative</li> <li>• Quasi-experimental</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>
9	Mold et al., 2015	<ul style="list-style-type: none"> <li>• MEDLINE</li> <li>• Embase</li> <li>• CINHAL</li> <li>• Cochrane Database</li> </ul>	1999 to September 2012	17	<ul style="list-style-type: none"> <li>• Experimental</li> <li>• Randomized control trials (including one Randomized control pilot study with qualitative element)</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> <li>• Norway</li> <li>• UK</li> </ul>

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
		<ul style="list-style-type: none"> <li>• Cochrane Effective Practice and Organization of Care Group (EPOC)</li> <li>• Database of Abstracts of Reviews of Effects (DARE)</li> <li>• King’s Fund</li> <li>• Nuffield Health</li> <li>• PsycINFO</li> </ul>			<ul style="list-style-type: none"> <li>• Cohort studies (including one retrospective cohort study, one cross-sectional cohort study, one retrospective cohort and matched controlled study)</li> <li>• Cluster randomized control trials</li> <li>• Quasi-experimental non-randomized design</li> </ul>	
10	Osborn et al., 2010	<ul style="list-style-type: none"> <li>• MEDLINE (PubMed interface)</li> <li>• PsycInfo</li> </ul>	January 2000 to June 2010	26	<ul style="list-style-type: none"> <li>• Quantitative analyses</li> <li>• Randomized control trials</li> <li>• Pre-posttest evaluations</li> <li>• Quasi-experimental evaluations</li> <li>• Focus groups</li> <li>• Interviews</li> <li>• Surveys</li> <li>• “think aloud” procedures</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> <li>• United States and Puerto Rico</li> <li>• Taiwan</li> <li>• Italy</li> <li>• Korea</li> <li>• Austria</li> </ul>

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
11	Otte-Trojel et al., 2014	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• LISTA</li> <li>• PsycINFO</li> <li>• Scopus</li> </ul>	January 2003 to August 2013	32	<ul style="list-style-type: none"> <li>• Randomized control trials</li> <li>• Observational studies</li> <li>• Qualitative studies using focus groups or interviews</li> <li>• Mixed methods</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> <li>• Netherlands</li> <li>• Canada</li> </ul>
12	Price et al., 2015	<ul style="list-style-type: none"> <li>• Medline</li> <li>• CINAHL</li> </ul>	2008 to 2014	23	<ul style="list-style-type: none"> <li>• Randomized control trials</li> <li>• Quasi-experimental</li> <li>• Observational studies</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> <li>• Netherlands</li> <li>• Canada</li> <li>• France</li> </ul>
13	Pushpangadan & Seckman, 2015	<ul style="list-style-type: none"> <li>• CINAHL</li> <li>• MEDLINE</li> <li>• Pub Med</li> <li>• EBSCO</li> </ul>	January 2005 to September 2014	25	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>
14	Sakaguchi-Tang et al., 2017	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• EMBASE</li> <li>• CINAHL Complete</li> <li>• Compendex (includes ACM digital library IEEE Xplore)</li> </ul>	January 2006 to November 2016	17	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Observations</li> <li>• Focus groups</li> <li>• Design sessions</li> <li>• User studies</li> <li>• Surveys or questionnaires</li> <li>• Mixed-methods studies</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
		<ul style="list-style-type: none"> <li>• Inspec</li> </ul>				
15	Saparova, 2012	<ul style="list-style-type: none"> <li>• SciVerse Scopus</li> </ul>	1999 to 2012	22	<ul style="list-style-type: none"> <li>• Randomized control trial</li> <li>• Clinical trial</li> <li>• Cluster trial</li> <li>• Qualitative</li> </ul>	<ul style="list-style-type: none"> <li>• US</li> <li>• Greece</li> <li>• Germany</li> <li>• Turkey</li> <li>• Austria</li> <li>• Spain</li> <li>• France</li> <li>• Italy</li> <li>• Sweden</li> <li>• Netherlands</li> <li>• China</li> <li>• Canada</li> </ul>
16	Thompson et al., 2016	<ul style="list-style-type: none"> <li>• PubMed, CINAHL (excluding MEDLINE records)</li> <li>• Engineering Village (Compendex and INSPEC)</li> <li>• IEEE Xplor</li> <li>• ACM Digital Library</li> </ul>	January 2000 to October 2013 Completed: October 2013	60	<ul style="list-style-type: none"> <li>• Mixed-methods</li> <li>• Quantitative</li> <li>• Qualitative</li> </ul>	<ul style="list-style-type: none"> <li>• United States</li> <li>• New Zealand</li> <li>• Canada</li> <li>• Australia</li> <li>• Norway</li> <li>• Netherlands</li> </ul>

	<b>Review</b>	<b>Sources Searched</b>	<b>Time frame of studies</b>	<b>Number of studies</b>	<b>Types of studies included</b>	<b>Country of origin of studies</b>
17	Turner et al., 2016	<ul style="list-style-type: none"> <li>• PubMed</li> <li>• CINAHL</li> <li>• Web of Science</li> <li>• Scopus</li> <li>• EMBASE</li> <li>• PsycINFO</li> </ul>	1 January 2009 to 18 July 2015	12	<ul style="list-style-type: none"> <li>• Qualitative</li> <li>• Mixed-methods</li> <li>• Cross-sectional</li> <li>• Quasi-experimental</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>
18	Wildenbos, Peute, & Jaspers, 2017	<ul style="list-style-type: none"> <li>• PUBMED</li> </ul>	January 2010 to July 2016 Completed: October 7, 2016	8	<ul style="list-style-type: none"> <li>• Qualitative</li> <li>• Unspecified</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>
19	Zhao et al., 2017	<ul style="list-style-type: none"> <li>• MEDLINE® via Ovid</li> </ul>	2000 to 2017	32	<ul style="list-style-type: none"> <li>• Quantitative</li> <li>• Qualitative</li> <li>• Mixed Methods</li> </ul>	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>

*Note:* Table 4: Characteristics of Included Reviews: Search Strategy, Types of Studies, Country of Origin for included studies displays additional characteristics of the reviews included in the appraisal. These characteristics are the types of citation databases used by the reviews, the time frame used in the search, the number of studies included in the reviews, the study design of the included studies and the country of origin of the studies.

**Table 5: Characteristics of Included Reviews: Quality Appraisal Methods and Type of Reviews**

	<b>Review</b>	<b>Quality Appraisal Method</b>	<b>Type of Review</b>
1	Amante et al., 2014	<ul style="list-style-type: none"> <li>Mixed Methods Appraisal Tool (MMAT)</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
2	Bouayad et al., 2017	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Literature Review</li> </ul>
3	Bush et al., 2016	<ul style="list-style-type: none"> <li>Grading of Recommendations Assessment Development and Evaluation (GRADE)</li> <li>The nature of the reported results, wide variation of methodology and absence of summary measures unable to conduct an outcome-level assessment evaluating the reliability and validity of the data for each important outcome by determining the methods used to assess them in each individual study as suggested by the Grading of Recommendations Assessment Development and Evaluation (GRADE).</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
4	Davis et al., 2017	<ul style="list-style-type: none"> <li>Not assessed, only the frequency of report in the literature was collected and analyzed.</li> </ul>	<ul style="list-style-type: none"> <li>Scoping Review</li> </ul>
5	Goldzweig Dr. et al., 2013	<ul style="list-style-type: none"> <li>No specific appraisal instrument specified</li> <li>Assessed the quality of studies on health outcomes, satisfaction, adherence, efficiency, and utilization using a modification of criteria developed to assess patient safety strategies that included health IT applications.</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
6	Irizarry et al., 2015	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>State of the Science Review</li> </ul>
7	Kruse, Argueta, et al., 2015	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
8	Kruse, Bolton, et al. 2015	<ul style="list-style-type: none"> <li>Studies were evaluated, but no specific appraisal instrument was specified.</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>

	<b>Review</b>	<b>Quality Appraisal Method</b>	<b>Type of Review</b>
9	Mold et al., 2015	<ul style="list-style-type: none"> <li>Grading of Recommendations Assessment, Development and Evaluation (GRADE) instrument</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
10	Osborn et al., 2010	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
11	Otte-Trojel et al., 2014	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Realist review</li> </ul>
12	Price et al., 2015	<ul style="list-style-type: none"> <li>Extended evidence hierarchy based on Australia's National Health and Medical Research Council (NHMRC)</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
13	Pushpangadan & Seckman, 2015	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Literature Review</li> </ul>
14	Sakaguchi-Tang et al., 2017	<ul style="list-style-type: none"> <li>Statement on the Reporting of Evaluation studies in Health Informatics (STARE-HI)</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
15	Saparova, 2012	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Scoping Review</li> </ul>
16	Thompson et al., 2016	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
17	Turner et al., 2016	<ul style="list-style-type: none"> <li>Quality criteria of qualitative studies</li> <li>Quality criteria of quasi-experimental and cross-sectional studies.</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>
18	Wildenbos, Peute, & Jaspers, 2017	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Literature Review</li> </ul>
19	Zhao et al., 2017	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ul style="list-style-type: none"> <li>Systematic Review</li> </ul>

*Note:* Table 5: Characteristics of Included Reviews: Quality appraisal methods and the type of reviews displays the types of published systematic reviews on PHRs and patient portals and the quality instruments used to appraise their methodological quality.

**Table 6: Comparison of PHRs and Patient Portals**

<b>Similarities</b>	<b>Differences</b>
<ul style="list-style-type: none"> <li>• PHRs and patient portals are electronic records designed for patients to self-manage care.</li> <li>• Functionalities available through the PHRs and patient portals are intended to be used by patients, rather than by providers.</li> <li>• Patients can populate data into PHRs and patient portals.</li> <li>• PHRs and patient portals are not only static repositories but a combination of data, knowledge and software tools which supports patients become active participants in their care.</li> <li>• PHRs and patient portals are tools used to collect, track, and store their lifelong health data in an easily accessible secure location.</li> </ul>	<ul style="list-style-type: none"> <li>• PHR types can be standalone/web-based and incorporated/tethered. Patient portals is a type of PHR that is incorporated/tethered.</li> <li>• The management or ownership of data differs between a PHR and patient portal. The management of an untethered ePHR is with the patient. Tethered patient portals are owned and managed by the health care organization.</li> <li>• Patient portals is interoperable and is populated by patient information through the EHR such as the problem list, allergies, and lab test results populate the patient portal.</li> <li>• Patient portals are updated when there is new health data in EHRs while health and medical information in a PHR is under a patient's responsibility to update.</li> <li>• Patient portals are intermediary for patients to have access to their EHR information.</li> <li>• A standalone PHR is stored in a patient's computer or the internet and is used to track and monitor their health-related behaviours which can include diet and exercise. Patient portals are extensions of EHRs and patients are provided access through secure portals.</li> </ul>

*Note:* Table 6: Comparison of PHRs and patient portals displays the similarities and differences of PHRs and patient portals

**Table 7: Summary of Evidence: Functions and Features of PHRs and Patient Portals**

<b>Mechanisms</b>	<b>Functions and Features of PHRs and Patient Portals</b>
Patient insight into information	<ul style="list-style-type: none"> <li>• Access health records, medical records, provider notes, allergies (Price et al., 2015; Pushpangadan &amp; Seckman, 2015; Sakaguchi-Tang et al., 2017; Turner et al., 2016; Wildenbos et al., 2017)</li> <li>• Access to handouts, protocol information, embedded knowledge base (Price et al., 2015)</li> <li>• Immunization records (Bush et al., 2016; Pushpangadan &amp; Seckman, 2015)</li> <li>• Integrated health data from multiple sources, care plans, provider clinical notes, provider annotated clinical data (Davis et al., 2017)</li> <li>• Education resources (Davis et al., 2017; Pushpangadan &amp; Seckman, 2015)</li> <li>• Access multiple family medical records (Irizarry et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Recommendations, guidelines, advice on a patient's treatment, health condition, medication management (Mold et al., 2015; Saparova, 2012)</li> <li>• Viewing of test results e.g. laboratory (Mold et al., 2015; Pushpangadan &amp; Seckman, 2015; Sakaguchi-Tang et al., 2017; Turner et al., 2016)</li> <li>• Viewing medication lists, medication history (Pushpangadan &amp; Seckman, 2015; Turner et al., 2016)</li> <li>• History of providers visited, prior medical visits, surgeries (Pushpangadan &amp; Seckman, 2015)</li> </ul>
Activation of information	<ul style="list-style-type: none"> <li>• Self-health monitoring with incentive programs (Bouayad et al., 2017)</li> <li>• Decision support through reminders, alerts and decision aids, personalized alerts for overdue health screenings, evidence-based reminders and alerts (Davis et al., 2017; Irizarry et al., 2015; Osborn et al., 2010; Price et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Record health information through structured templates e.g. observations of daily living (Davis et al., 2017; Price et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Health monitoring through health risk assessments and integrated devices (Davis et al., 2017; Saparova, 2012; Wildenbos et al., 2017)</li> <li>• Personalized goals, health targets and tasks e.g. blood glucose targets (Price et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> </ul>
Interpersonal continuity of care	<ul style="list-style-type: none"> <li>• Health care visit preparation through questionnaires, medication list management, record management (Bouayad et al., 2017; Sakaguchi-Tang et al., 2017; Zhao et al., 2017)</li> </ul>

Mechanisms	Functions and Features of PHRs and Patient Portals
	<ul style="list-style-type: none"> <li>• Assessment of environment-related risk factors and recommendations for preventive care (Bouayad et al., 2017)</li> <li>• Secured messaging, Communication between patients and providers, care team, virtual support groups or networks, virtual assistant, interactive bulletin boards, email (Bush et al., 2016; Davis et al., 2017; Irizarry et al., 2015; Price et al., 2015; Pushpangadan &amp; Seckman, 2015; Sakaguchi-Tang et al., 2017; Wildenbos et al., 2017)</li> <li>• Secure support forums (Price et al., 2015)</li> <li>• Medication reconciliation (Irizarry et al., 2015)</li> </ul>
Patient convenience	<ul style="list-style-type: none"> <li>• Search health care provider and health support groups (Bouayad et al., 2017)</li> <li>• Scheduling and viewing upcoming appointments (Bush et al., 2016; Osborn et al., 2010; Pushpangadan &amp; Seckman, 2015; Turner et al., 2016)</li> <li>• Bill Payments (Pushpangadan &amp; Seckman, 2015)</li> <li>• Schedule screening examinations (Irizarry et al., 2015)</li> <li>• Order prescription refills (Irizarry et al., 2015; Pushpangadan &amp; Seckman, 2015; Turner et al., 2016; Zhao et al., 2017)</li> <li>• Printable health summaries for sharing with care providers or family members (Irizarry et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Request Referrals (Pushpangadan &amp; Seckman, 2015)</li> <li>• Online calendars (Pushpangadan &amp; Seckman, 2015)</li> </ul>

*Note:* Table 7: Summary of Evidence: Functions and Features of PHRs and patient portals presents a summary of evidence in the features of PHRs and patient portals group by function.

**Table 8: Summary of Evidence: Reported Outcomes and Impact of PHRs and Patient Portals**

Type of Outcome	Positive Outcomes	Outcomes with mixed evidence or no effect
<p><b>Health outcomes</b></p> <ul style="list-style-type: none"> <li>• impact on physiological measures, quality of life, and symptom management.</li> </ul>	<ul style="list-style-type: none"> <li>• Improved outcomes for patients with chronic diseases were on studies that used patient portals in conjunction with case management (Goldzweig et al., 2013)</li> <li>• A small group of conditions (diabetes, hypertension, asthma, HIV, fertility management, glaucoma, and hyperlipidemia) have evidence of benefit to using a PHR as a health intervention (Price et al., 2015)</li> <li>• The difference in immunization rates where children an intervention group received 95.5% of immunizations compared to 87.2% in the control (Mold et al., 2015)</li> <li>• Increased use of preventive care services by providing prevention or health maintenance reminders (Mold et al., 2015)</li> <li>• 1 in 4 users was up-to-date on all preventive services—nearly double that of non-users (Irizarry et al., 2015)</li> </ul>	<ul style="list-style-type: none"> <li>• The evidence is insufficient about the effect of patient portals on health outcomes (Goldzweig et al., 2013)</li> <li>• Weak results on medical outcomes (Kruse, Bolton, et al., 2015)</li> <li>• 37% of studies in the review reported an increase in disease outcomes as a result of using the patient portal (Kruse, Argueta, et al., 2015)</li> <li>• Patient portals could lead to improvements in clinical outcomes although in some studies the effects were not reliable or consistent over time (Otte-Trojel et al., 2014)</li> <li>• Screening rates were significantly higher in 1 month for patients who received reminders than those who did not, but the difference was no longer significant at four months (Irizarry et al., 2015).</li> <li>• Electronic outreach via a PHR produced an initial increase in colorectal cancer screening rates among patients but that the increase was not sustained (Saparova, 2012)</li> <li>• Results for patients with diabetes showed mixed results: <ul style="list-style-type: none"> <li>○ A statistically significant predictor of glycosylated hemoglobin level but not low-</li> </ul> </li> </ul>

Type of Outcome	Positive Outcomes	Outcomes with mixed evidence or no effect
		<p>density lipoprotein and total cholesterol levels (Bush et al., 2016).</p> <ul style="list-style-type: none"> <li>○ Goldzweig et al. (2013) found that results are not sustained one study reporting intervention patients had lower hemoglobin A1c levels at six months (1.32% vs. 0.66%).</li> </ul>
<p><b>Behavioural outcomes</b></p> <ul style="list-style-type: none"> <li>● patient decision-making, medication management, and adherence to health behaviours</li> </ul>	<ul style="list-style-type: none"> <li>● Patients who completed a Diabetes Care Plan were more likely to have a medication adjustment for diabetes, hypertension, or hyperlipidemia than patients in the control group (Goldzweig et al., 2013)</li> <li>● Feature on patient-tailored decision support and enabled the patient to author a “Diabetes Care Plan” for electronic submission to the physician before upcoming appointments which increase pre-visit use of patient portal and increased rates of diabetes-related medication adjustment at 12 months (Irizarry et al., 2015)</li> <li>● Portal users noted greater medication adherence, particularly for those individuals with chronic illnesses like diabetes (Kruse, Bolton, et al., 2015)</li> <li>● Association of patient portal use with medication adherence and self-maintenance of health (Kruse, Bolton, et al., 2015)</li> </ul>	<ul style="list-style-type: none"> <li>● Mixed evidence in the adherence to antiretroviral therapy (Turner et al., 2016)</li> <li>● Patient portals could lead to improvements in patient adherence although some studies show the effects were not reliable or consistent over time (Otte-Trojel et al., 2014)</li> <li>● Use of a PHR did not have a statistically significant effect on patients’ behaviours associated with influenza prevention (Saparova, 2012)</li> </ul>

Type of Outcome	Positive Outcomes	Outcomes with mixed evidence or no effect
	<ul style="list-style-type: none"> <li>• Quality of monitoring of behaviours improved for 61.6% of patients (Osborn et al., 2010)</li> <li>• PHR usage served as a cue to action for PLHIV to engage in HIV self-management (Turner et al., 2016)</li> <li>• Promoted positive behaviour change (Saparova, 2012)</li> <li>• 41% of participants believed that they had reduced HIV-related risk behaviours as a result of using the PHR. Assessment of how PHR usage affects antiretroviral therapy self-efficacy and found that self-efficacy scores significantly increased from pre- to postintervention (Turner et al., 2016)</li> </ul>	
<p><b>Affective-cognitive outcomes</b></p> <ul style="list-style-type: none"> <li>• patient-provider communication , patient knowledge, satisfaction and ease of care</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in patient empowerment in diabetes self-management (Goldzweig et al., 2013)</li> <li>• Increase in patient engagement (Kruse, Bolton, et al., 2015; Mold et al., 2015; Sakaguchi-Tang et al., 2017)</li> <li>• Increased sense of empowerment and increased motivation (Saparova, 2012)</li> <li>• A significant decline in ‘no shows’ or missed appointments (Irizarry et al., 2015; Kruse, Bolton, et al., 2015; Osborn et al., 2010)</li> <li>• 33% of studies included in the review attributed greater self-management of chronic conditions through the presence of educational</li> </ul>	<ul style="list-style-type: none"> <li>• Evidence was mixed about the effect of portals on health care utilization and efficiency (Goldzweig et al., 2013)</li> <li>• Patient portals are complements rather than substitutes to existing health services (Otte-Trojel et al., 2014)</li> <li>• Patient portals could lead to improvements in patient-provider communication, patient empowerment, and patient satisfaction with health services. Some studies show that the effects were not reliable or consistent over time (Otte-Trojel et al., 2014)</li> </ul>

Type of Outcome	Positive Outcomes	Outcomes with mixed evidence or no effect
	<p>resources presented through a patient portal (Kruse, Argueta, et al., 2015)</p> <ul style="list-style-type: none"> <li>• Improved patient-provider communication as a result of using a patient portal, increase in communication between patients and their health system (Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Mold et al., 2015; Price et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Higher levels of patient education (Kruse, Bolton, et al., 2015)</li> <li>• More collaborative decision making between patients and providers (Kruse, Bolton, et al., 2015)</li> <li>• Improvements in quality of care as reported by both patient and provider (Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Osborn et al., 2010)</li> <li>• Improved patient safety through patients identifying errors in their medication list (Mold et al., 2015)</li> <li>• Benefits were seen in care quality, access, and productivity (Price et al., 2015)</li> <li>• Improved patient satisfaction with care, improved continuity, more effective face-to-face visits (Price et al., 2015; Sakaguchi-Tang et al., 2017)</li> </ul>	<ul style="list-style-type: none"> <li>• Use of a PHR did not have a statistically significant effect on patients' knowledge and beliefs associated with influenza prevention (Saparova, 2012)</li> </ul>

Type of Outcome	Positive Outcomes	Outcomes with mixed evidence or no effect
	<ul style="list-style-type: none"> <li>• Improved awareness of HIV-related health outcomes, including CD4 count and viral load, PHR users were significantly more likely to correctly estimate their CD4 count and viral load compared to non-users (Turner et al., 2016)</li> <li>• Knowledge of diabetes targets had improved (Osborn et al., 2010)</li> <li>• Patients believe patient portals helped them better manage health (Sakaguchi-Tang et al., 2017)</li> </ul>	

*Note:* Table 8: Summary of Evidence: Impact of PHRs and patient portals provides the summary of evidence from the included reviews in this appraisal on the impact of PHRs and patient portals.

**Table 9: Summary of Evidence: Facilitators and Barriers for Patients**

Category	Facilitators	Barriers
<b>Patient characteristics</b>	<ul style="list-style-type: none"> <li>• Individuals with higher education (Bush et al., 2016; Thompson et al., 2016; Wildenbos et al., 2017)</li> <li>• Individuals with commercial health insurance (Bush et al., 2016)</li> <li>• Younger individuals (Goldzweig et al., 2013; Turner et al., 2016)</li> <li>• High computer literacy (Goldzweig et al., 2013; Pushpangadan &amp; Seckman, 2015; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017)</li> <li>• High health literacy (Irizarry et al., 2015)</li> <li>• Certain racial ethnicities, e.g. Caucasians, Hispanic (Pushpangadan &amp; Seckman, 2015; Thompson et al., 2016; Wildenbos et al., 2017)</li> <li>• Individuals with better health conditions (Wildenbos et al., 2017)</li> </ul>	<ul style="list-style-type: none"> <li>• Low knowledge/technical literacy, lack of computer skills (Amante et al., 2014; Sakaguchi-Tang et al., 2017; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017; Zhao et al., 2017)</li> <li>• Low health literacy (Davis et al., 2017; Irizarry et al., 2015; Wildenbos et al., 2017; Zhao et al., 2017)</li> <li>• Difficulty in graphing and interpreting data need an explanation of test results, and understanding medical terminology (Bush et al., 2016; Price et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Difficulty understanding resources such as health libraries (Kruse, Argueta, et al., 2015)</li> <li>• Numeracy skills, patients encountered problems when presented with health information involving numeric concepts (Irizarry et al., 2015; Kruse, Bolton, et al., 2015)</li> <li>• Disadvantaged, lower socioeconomic groups, non-white ethnicities, low income, individuals on financial support programs (Bush et al., 2016; Mold et al., 2015; Turner et al., 2016)</li> <li>• Elder or disabled individuals (Pushpangadan &amp; Seckman, 2015; Sakaguchi-Tang et al., 2017; Wildenbos et al., 2017)</li> </ul>
<b>Patient perception</b>	<ul style="list-style-type: none"> <li>• Trust in technology, internet, search health information on the internet</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of motivation to use the system, do not want to spend time learning system, computer (Amante et al., 2014; Wildenbos et al., 2017; Zhao et al., 2017)</li> </ul>

Category	Facilitators	Barriers
	<p>(Goldzweig et al., 2013; Wildenbos et al., 2017)</p> <ul style="list-style-type: none"> <li>• Experienced difficulty obtaining medical information (Amante et al., 2014)</li> <li>• Dissatisfied with provider-patient relationship (Amante et al., 2014; Wildenbos et al., 2017)</li> <li>• Individuals who feel are part of the team with their health care provider (Sakaguchi-Tang et al., 2017)</li> <li>• Individuals who believe in feature benefits (Sakaguchi-Tang et al., 2017; Zhao et al., 2017)</li> <li>• A couple of instances of patient challenges and dissatisfaction were seen as facilitators to the use of PHR and patient portal. <ul style="list-style-type: none"> <li>○ difficulty in obtaining medical information (Amante et al., 2014)</li> <li>○ dissatisfaction provider-patient relationship (Amante et al., 2014; Wildenbos et al., 2017)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Doubts about technology and reliability of message exchange, security concerns, prefer traditional communication (Amante et al., 2014)</li> <li>• Concerns on confidentiality, privacy and security (Bush et al., 2016; Davis et al., 2017; Pushpangadan &amp; Seckman, 2015; Sakaguchi-Tang et al., 2017; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017; Zhao et al., 2017)</li> <li>• Misuse of health data (Pushpangadan &amp; Seckman, 2015)</li> <li>• Satisfied with the status quo, provider relationship without the portal, prefer to leave disease management to the physician (Amante et al., 2014; Wildenbos et al., 2017; Zhao et al., 2017)</li> <li>• Fear of accessing unwanted or frightening information (Thompson et al., 2016)</li> <li>• Concerns with commercially developed PHRs (Pushpangadan &amp; Seckman, 2015)</li> </ul>
<b>PHR and patient portal access and support</b>	<ul style="list-style-type: none"> <li>• Family recommended/supported (Amante et al., 2014; Sakaguchi-Tang et al., 2017; Wildenbos et al., 2017; Zhao et al., 2017)</li> </ul>	<ul style="list-style-type: none"> <li>• No computer/internet access (Amante et al., 2014; Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015; Pushpangadan &amp; Seckman, 2015; Sakaguchi-Tang et al., 2017; Thompson et al., 2016; Turner et al., 2016; Wildenbos et al., 2017; Zhao et al., 2017)</li> </ul>

Category	Facilitators	Barriers
	<ul style="list-style-type: none"> <li>• Provider recommended/instructed to use (Amante et al., 2014; Sakaguchi-Tang et al., 2017; Wildenbos et al., 2017; Zhao et al., 2017)</li> <li>• Available technical support, training, video training (Sakaguchi-Tang et al., 2017; Zhao et al., 2017)</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Already e-mail provider directly without portal (Amante et al., 2014)</li> <li>• Lack of technical support (Kruse, Argueta, et al., 2015; Kruse, Bolton, et al., 2015)</li> <li>• Unaware of the patient portal (Amante et al., 2014; Wildenbos et al., 2017; Zhao et al., 2017)</li> <li>• Unaware of portal features (Amante et al., 2014; Osborn et al., 2010; Zhao et al., 2017)</li> </ul>
<b>PHR and Patient Portal Design</b>	<ul style="list-style-type: none"> <li>• Medical jargon and abbreviations presented in patient-friendly language (Irizarry et al., 2015)</li> <li>• Access available through mobile devices (Wildenbos et al., 2017)</li> </ul>	<ul style="list-style-type: none"> <li>• Too complicated, time-consuming, difficulty in data entry (Thompson et al., 2016; Wildenbos et al., 2017) Separate accounts for each family member (Bush et al., 2016)</li> <li>• Lack of features, e.g. symptom checker (Bush et al., 2016)</li> <li>• Forgetting login and password (Bush et al., 2016; Sakaguchi-Tang et al., 2017)</li> <li>• Human factor issues with the interface, System usability (Davis et al., 2017; Goldzweig et al., 2013; Zhao et al., 2017)</li> <li>• Inaccurate information (Price et al., 2015; Pushpangadan &amp; Seckman, 2015)</li> <li>• Lack of interoperability (Davis et al., 2017; Thompson et al., 2016)</li> </ul>

*Note:* Table 9: Summary of Evidence: Facilitators and Barriers provides a summary of the facilitators and barriers in the use of PHRs and patient portals by Patients

**Table 10: Comparison of Umbrella Reviews with Overviews of Reviews**

Appraisal	Characteristics
Umbrella Reviews	<ul style="list-style-type: none"> <li>• The term utilized by JBI syntheses of existing systematic reviews</li> <li>• Synthesize the findings of published systematic reviews</li> <li>• Aims to summarize existing research syntheses related to a given topic or question and not to re-synthesize evidence</li> <li>• Incorporates all types of syntheses of research evidence, including systematic reviews in their various forms and meta-analyses</li> <li>• Summarize evidence from multiple research syntheses of different interventions for the same condition, of one condition with different reported outcomes or for different conditions, issues or populations</li> <li>• Gather evidence to support evidence-based decision-making</li> </ul>
Overviews of reviews (Overviews)	<ul style="list-style-type: none"> <li>• The term utilized by Cochrane to describe the review of systematic reviews published in the Cochrane Library</li> <li>• Summarize multiple Cochrane Intervention reviews addressing the effects of two or more potential interventions for a single condition or health problem</li> <li>• Highlight the Cochrane reviews that address the effects of potential interventions and summarize their results for important outcomes</li> <li>• Summarize evidence from multiple systematic reviews of interventions into one accessible and usable document</li> <li>• Summarize evidence from multiple systematic reviews at a variety of different levels such as the combination of different interventions, outcomes, conditions, issues or populations</li> <li>• Summarize evidence on the adverse effects of an intervention</li> </ul>

*Note:* Table 10: Comparison of Umbrella Reviews with Overviews of Reviews displays the characteristics of each review of systematic reviews method.

## Figures

**Figure 1: JBI Critical Appraisal Checklist for Systematic Reviews and Research Synthesis**

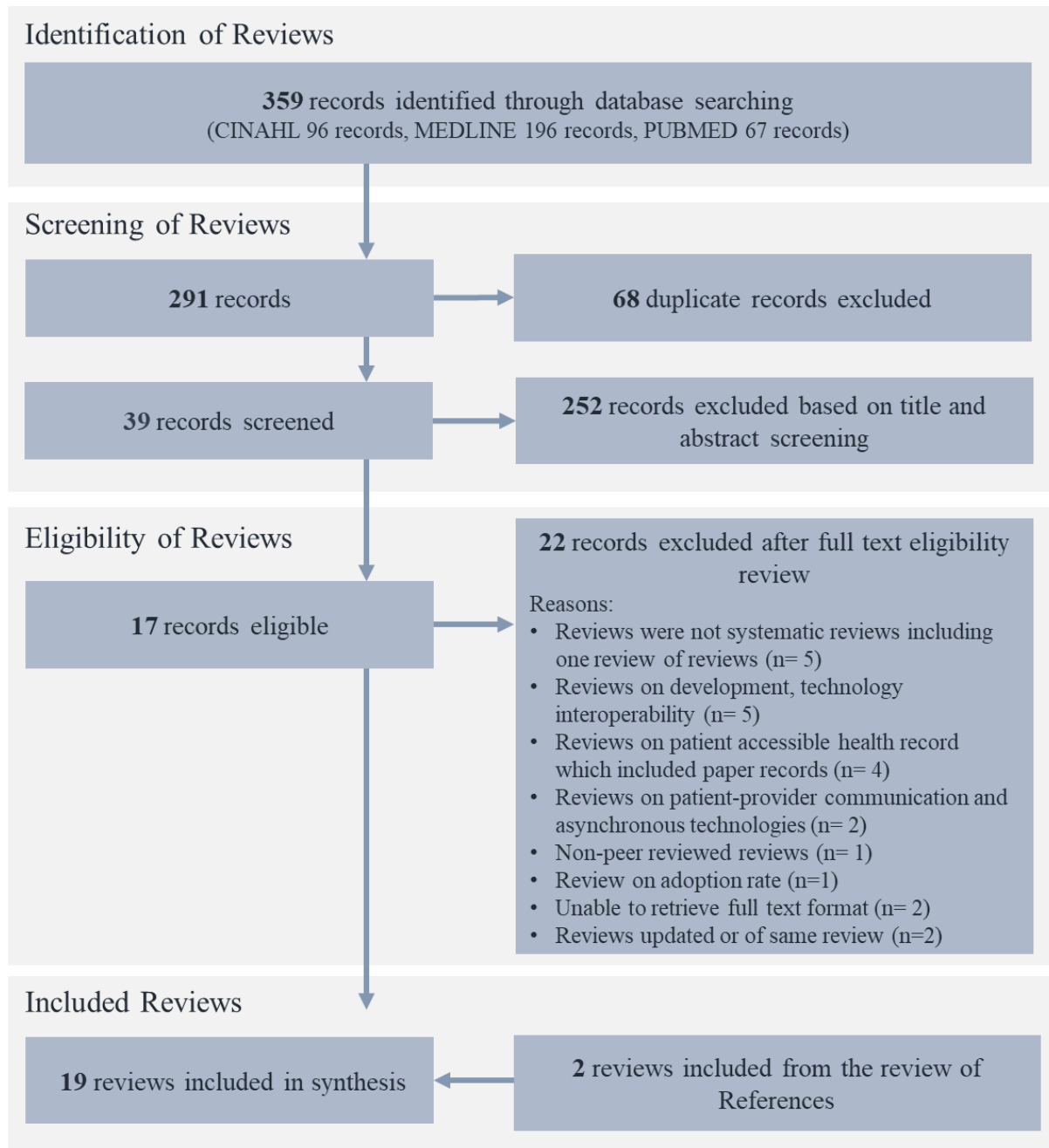
<b>JBI Critical Appraisal Checklist for Systematic Reviews and Research Syntheses</b>				
Reviewer _____	Date _____			
Author _____	Year _____	Record Number _____		
	Yes	No	Unclear	Not applicable
1. Is the review question clearly and explicitly stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the inclusion criteria appropriate for the review question?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the search strategy appropriate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were the sources and resources used to search for studies adequate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were the criteria for appraising studies appropriate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was critical appraisal conducted by two or more reviewers independently?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were there methods to minimize errors in data extraction?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were the methods used to combine studies appropriate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was the likelihood of publication bias assessed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Were recommendations for policy and/or practice supported by the reported data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Were the specific directives for new research appropriate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall appraisal:	Include <input type="checkbox"/>	Exclude <input type="checkbox"/>	Seek further info <input type="checkbox"/>	
_____				
_____				
_____				

*Note:* Figure 1 displays the JBI Critical Appraisal Checklist for Systematic Reviews and Research Synthesis (Aromataris et al., 2017).

**Figure 2: JBI Data Extraction Form for Review for Systematic Reviews and Research Synthesis**

Study Details	
Author/year	
objectives	
Participants (characteristics/ total number)	
Setting/context	
Description of Interventions/ phenomena of interest	
Search Details	
Sources searched	
Range (years) of included studies	
Number of studies included /	
Types of studies included	
Country of origin of included studies	
Appraisal	
Appraisal instruments used	
Appraisal rating	
Analysis	
Method of analysis	
Outcome assessed	
Results/Findings	
Significance/direction	
Heterogeneity	
Comments	

*Note:* Figure 2 displays the JBI Data Extraction Form for Review for Systematic Reviews and Research Synthesis (Aromataris et al., 2017).

**Figure 3: Appraisal Selection Strategy**

*Note:* Figure 3: Review Selection Strategy, shows a summary of the review selection strategy completed for this umbrella review. The figure was based on the PRISMA statement by Moher et al. (2009).

## Appendix 1

### 1.1 Included Reviews

- Amante, D. J., Hogan, T. P., Pagoto, S. L., & English, T. M. (2014). A Systematic Review of Electronic Portal Usage Among Patients with Diabetes. *Diabetes Technology & Therapeutics*, 16(11), 784–793. <https://doi.org/10.1089/dia.2014.0078>
- Bouayad, L., Ialynytchev, A., & Padmanabhan, B. (2017). Patient Health Record Systems Scope and Functionalities: Literature Review and Future Directions. *Journal of Medical Internet Research*, 19(11), 35. <https://doi.org/10.2196/jmir.8073>
- Bush, R. A., Connelly, C. D., Fuller, M., & Perez, A. (2016). Implementation of the Integrated Electronic Patient Portal in the Pediatric Population: A Systematic Review. *Telemedicine Journal and E-Health: The Official Journal of the American Telemedicine Association*, 22(2), 144–152. <https://doi.org/10.1089/tmj.2015.0033>
- Davis, S., Roudsari, A., Raworth, R., Courtney, K. L., & MacKay, L. (2017). Shared decision-making using personal health record technology: a scoping review at the crossroads. *Journal of the American Medical Informatics Association: JAMIA*, 24(4), 857–866. <https://doi.org/10.1093/jamia/ocw172>
- Goldzweig Dr., C. L., Orshansky Dr., G., Paige Dr., N. M., Towfigh Dr., A. A., Haggstrom Dr., D. A., Miake-Lye Dr., I., ... Shekelle Dr., P. G. (2013). Electronic patient portals: Evidence on health outcomes, satisfaction, efficiency, and attitudes. *Annals of Internal Medicine*, 159(10), 677–687. <https://doi.org/10.7326/0003-4819-159-10-201311190-00006>
- Irizarry, T., DeVito Dabbs, A., & Curran, C. R. (2015). Patient Portals and Patient Engagement: A State of the Science Review. *Journal of Medical Internet Research*, 17(6), e148–e148. <https://doi.org/10.2196/jmir.4255>
- Kruse, C. S., Argueta, D. A., Lopez, L., & Nair, A. (2015). Patient and provider attitudes toward the use of patient portals for the management of chronic disease: a systematic review. *Journal of Medical Internet Research*, 17(2), e40–e40. <https://doi.org/10.2196/jmir.3703>
- Kruse, C. S., Bolton, K., & Freriks, G. (2015). The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review. *Journal of Medical Internet Research*, 17(2), e44–e44. <https://doi.org/10.2196/jmir.3171>
- Otte-Trojel, T., de Bont, A., Rundall, T. G., & van de Klundert, J. (2014). How outcomes are achieved through patient portals: a realist review. *Journal of the American Medical Informatics Association: JAMIA*, 21(4), 751–757. <https://doi.org/10.1136/amiajnl-2013-002501>
- Price, M., Bellwood, P., Kitson, N., Davies, I., Weber, J., & Lau, F. (2015). Conditions potentially sensitive to a Personal Health Record (PHR) intervention, a systematic review.

*BMC Medical Informatics & Decision Making*, 15(1), 1–12. <https://doi.org/10.1186/s12911-015-0159-1>

- Pushpangadan, S., & Seckman, C. (2015). Consumer perspective on personal health records: A review of the literature. *Online Journal of Nursing Informatics*, 19(1). Retrieved from <https://www.scopus.com/inward/record.uri?eid=2-s2.0-84929379400&partnerID=40&md5=dc91258607d132e515eb4a3b08a61aaa>
- Sakaguchi-Tang, D. K., Bosold, A. L., Choi, Y. K., & Turner, A. M. (2017). Patient Portal Use and Experience Among Older Adults: Systematic Review. *JMIR Medical Informatics*, 5(4), e38. <https://doi.org/10.2196/medinform.8092>
- Saparova, D. (2012). Motivating, Influencing, and Persuading Patients through Personal Health Records: A Scoping Review. *Perspectives in Health Information Management*, 1–18. Retrieved from <http://ezproxy.library.uvic.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=104198819&site=ehost-live&scope=site>
- Thompson, M. J., Reilly, J. D., & Valdez, R. S. (2016). Work system barriers to patient, provider, and caregiver use of personal health records: A systematic review. *Applied Ergonomics*, 54, 218–242. <https://doi.org/10.1016/j.apergo.2015.10.010>
- Turner, K., Klaman, S. L., & Shea, C. M. (2016). Personal health records for people living with HIV: a review. *AIDS Care*, 28(9), 1181–1187. <https://doi.org/10.1080/09540121.2016.1153594>
- Wildenbos, G. A., Peute, L., & Jaspers, M. (2017). Facilitators and Barriers of Electronic Health Record Patient Portal Adoption by Older Adults: A Literature Study. *Studies in Health Technology and Informatics*, 235, 308–312. <https://doi.org/10.3233/978-1-61499-753-5-308>
- Zhao, J. Y., Song, B., Anand, E., Schwartz, D., Panesar, M., Jackson, G. P., & Elkin, P. L. (2017). Barriers, Facilitators, and Solutions to Optimal Patient Portal and Personal Health Record Use: A Systematic Review of the Literature. *AMIA ... Annual Symposium Proceedings*. AMIA Symposium, 2017, 1913–1922.

## **1.2 Reviews included from Reference Tracking**

- Osborn, C. Y., Mayberry, L. S., Mulvaney, S. A., & Hess, R. (2010). Patient Web Portals to Improve Diabetes Outcomes: A Systematic Review. *Current Diabetes Reports*, 10(6), 422–435. <https://doi.org/10.1007/s11892-010-0151-1>
- Mold, F., de Lusignan, S., Sheikh, A., Majeed, A., Wyatt, J. C., Quinn, T., ... Ellis, B. (2015). Patients' online access to their electronic health records and linked online services: a systematic review in primary care. *The British Journal of General Practice : The Journal of*

*the Royal College of General Practitioners*, 65(632), e141-51.  
<https://doi.org/10.3399/bjgp15X683941>

### 1.3 Excluded Reviews

	Review	Exclusion Reason
1.	Ahmadi, M., Jeddi, F. R., Gohari, M. R., & Sadoughi, F. (2012). A review of the personal health records in selected countries and Iran. <i>Journal Of Medical Systems</i> , 36(2), 371–382. <a href="https://doi.org/10.1007/s10916-010-9482-3">https://doi.org/10.1007/s10916-010-9482-3</a>	The review was carried out using the descriptive-comparative method
2.	Ammenwerth, E., Schnell-Inderst, P., & Hoerbst, A. (2011). Patient empowerment by electronic health records: first results of a systematic review on the benefit of patient portals. <i>Studies in Health Technology &amp; Informatics</i> , 166, 63–67. Retrieved from <a href="http://ezproxy.library.uvic.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&amp;db=ccm&amp;AN=104665116&amp;site=ehost-live&amp;scope=site">http://ezproxy.library.uvic.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&amp;db=ccm&amp;AN=104665116&amp;site=ehost-live&amp;scope=site</a>	Review details and search results similar to another review by the same authors.
3.	Ammenwerth, E., Schnell-Inderst, P., & Hoerbst, A. (2012). The impact of electronic patient portals on patient care: a systematic review of controlled trials. <i>Journal of Medical Internet Research</i> , 14(6), e162–e162. <a href="https://doi.org/10.2196/jmir.2238">https://doi.org/10.2196/jmir.2238</a>	Review details were updated by another review by Kruse, Bolton, & Freriks, 2015.
4.	Archer, N., Fevrier-Thomas, U., Lokker, C., McKibbin, K. A., & Straus, S. E. (2011). Personal health records: a scoping review. <i>Journal of the American Medical Informatics Association : JAMIA</i> , 18(4), 515–522. <a href="https://doi.org/10.1136/amiajnl-2011-00010">https://doi.org/10.1136/amiajnl-2011-00010</a>	Includes paper-based PHRs
5.	Azizi, A., Aboutorabi, R., Mazloun-Khorasani, Z., Hoseini, B., & Tara, M. (2016). Diabetic Personal Health Record: A Systematic Review Article. <i>Iranian Journal of Public Health</i> , 45(11), 1388–1398.	Review for development of PHR system for diabetic patients.
6.	Chan, S., Li, L., Torous, J., Gratzer, D., & Yellowlees, P. M. (2018). Review of Use of Asynchronous Technologies Incorporated in Mental Health Care. <i>Current Psychiatry Reports</i> , 20(10), 85. <a href="https://doi.org/10.1007/s11920-018-0954-3">https://doi.org/10.1007/s11920-018-0954-3</a>	Review on Asynchronous technology.
7.	Davis Giardina, T., Menon, S., Parrish, D. E., Sittig, D. F., & Singh, H. (2014). Patient access to medical records and healthcare outcomes: a systematic review. <i>Journal of the American Medical Informatics Association</i> , 21(4), 737–741. <a href="https://doi.org/10.1136/amiajnl-2013-002239">https://doi.org/10.1136/amiajnl-2013-002239</a>	Review on patient accessible health record including paper records.

8.	Fraccaro, P., Vigo, M., Balatsoukas, P., Buchan, I. E., Peek, N., & van der Veer, S. N. (2017). Patient Portal Adoption Rates: A Systematic Literature Review and Meta-Analysis. <i>Studies in Health Technology and Informatics</i> , 245, 79–83.	The rate of adoption.
9.	Fraccaro, P., Vigo, M., Balatsoukas, P., Buchan, I. E., Peek, N., & van der Veer, S. N. (2018). The influence of patient portals on users' decision making is insufficiently investigated: A systematic methodological review. <i>International Journal of Medical Informatics</i> , 111(October 2017), 100–111. <a href="https://doi.org/10.1016/j.ijmedinf.2017.12.028">https://doi.org/10.1016/j.ijmedinf.2017.12.028</a>	Focus on influence on users' decision-making
10.	Gefen, R., Bruno, M. A., & Abujudeh, H. H. (2017). Online Portals: Gateway to Patient-Centered Radiology. <i>AJR. American Journal of Roentgenology</i> , 209(5), 987–991. <a href="https://doi.org/10.2214/AJR.17.18291">https://doi.org/10.2214/AJR.17.18291</a>	Full text not available.
11.	Genitsaridi, I., Kondylakis, H., Koumakis, L., Marias, K., & Tsiknakis, M. (2015). Evaluation of personal health record systems through the lenses of EC research projects. <i>Computers in Biology and Medicine</i> , 59, 175–185. <a href="https://doi.org/10.1016/j.compbimed.2013.11.004">https://doi.org/10.1016/j.compbimed.2013.11.004</a>	Evaluation of personal health record systems.
12.	Jilka, S. R., Callahan, R., Sevdalis, N., Mayer, E. K., & Darzi, A. (2015). “Nothing About Me Without Me”: An Interpretative Review of Patient Accessible Electronic Health Records. <i>Journal of Medical Internet Research</i> , 17(6), e161–e161. <a href="https://doi.org/10.2196/jmir.4446">https://doi.org/10.2196/jmir.4446</a>	Systematic reviews of reviews
13.	Kneale, L., & Demiris, G. (2017). Lack of Diversity in Personal Health Record Evaluations with Older Adult Participants: A Systematic Review of Literature. <i>Journal of Innovation in Health Informatics</i> , 23(4), 881.	Full text not available.
14.	Nguyen, M., Lennox, N., & Ware, R. (2014). Hand-held health records for individuals with intellectual disability: a systematic review. <i>Journal of Intellectual Disability Research</i> , 58(12), 1172–1178. <a href="https://doi.org/10.1111/jir.12104">https://doi.org/10.1111/jir.12104</a>	Review hand-held records including paper records.
15.	Otte-Trojel, T., de Bont, A., Rundall, T. G., & van de Klundert, J. (2016). What do we know about developing patient portals? A systematic literature review. <i>Journal of the American Medical Informatics Association</i> , 23(e1), e162–e168. <a href="https://doi.org/10.1093/jamia/ocv114">https://doi.org/10.1093/jamia/ocv114</a>	Development of patient portals.
16.	Powell, K. R. (2017). Patient-Perceived Facilitators of and Barriers to Electronic Portal Use: A Systematic Review. <i>CIN:</i>	Non-peer reviewed review

	<i>Computers, Informatics, Nursing</i> , 35(11), 565–573. <a href="https://doi.org/10.1097/CIN.0000000000000377">https://doi.org/10.1097/CIN.0000000000000377</a>	
17.	Rigby, M., Georgiou, A., Hypponen, H., Ammenwerth, E., de Keizer, N., Magrabi, F., & Scott, P. (2015). Patient Portals as a Means of Information and Communication Technology Support to Patient-Centric Care Coordination - the Missing Evidence and the Challenges of Evaluation. A joint contribution of IMIA WG EVAL and EFMI WG EVAL. <i>Yearbook of Medical Informatics</i> , 10(1), 148–159. <a href="https://doi.org/10.15265/IY-2015-007">https://doi.org/10.15265/IY-2015-007</a>	Reviews of initiatives and literature reviews.
18.	Roehrs, A., da Costa, C. A., da Rosa Righi, R., & de Oliveira, K. S. F. (2017). Personal Health Records: A Systematic Literature Review. <i>Journal of Medical Internet Research</i> , 19(1), 1. <a href="https://doi.org/10.2196/jmir.5876">https://doi.org/10.2196/jmir.5876</a>	Review to identify the concepts and issues with PHR technology.
19.	Sartain, S. A., Stressing, S., & Prieto, J. (2015). Patients' views on the effectiveness of patient-held records: a systematic review and thematic synthesis of qualitative studies. <i>Health Expectations: An International Journal Of Public Participation In Health Care And Health Policy</i> , 18(6), 2666–2677. <a href="https://doi.org/10.1111/hex.12240">https://doi.org/10.1111/hex.12240</a>	Review on patient held records including paper records.
20.	Studený, J., & Coustasse, A. (2014). Personal Health Records: Is Rapid Adoption Hindering Interoperability? <i>Perspectives in Health Information Management</i> , 1–17. Retrieved from <a href="http://ezproxy.library.uvic.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&amp;db=ccm&amp;AN=103986305&amp;site=ehost-live&amp;scope=site">http://ezproxy.library.uvic.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&amp;db=ccm&amp;AN=103986305&amp;site=ehost-live&amp;scope=site</a>	Personal Health Record and healthcare information interoperability.
21.	Van Kasteren, Y., Maeder, A., Williams, P. A., & Damarell, R. (2017). Consumer perspectives on myhealth record: A review. <i>Studies in Health Technology and Informatics</i> , 239(March 2016), 146–152. <a href="https://doi.org/10.3233/978-1-61499-783-2-146">https://doi.org/10.3233/978-1-61499-783-2-146</a>	Evaluation on consumer perspectives of a patient portal.
22.	Voruganti, T., Grunfeld, E., Makuwaza, T., & Bender, J. L. (2017). Web-Based Tools for Text-Based Patient-Provider Communication in Chronic Conditions: Scoping Review. <i>Journal of Medical Internet Research</i> , 19(10), 1. <a href="https://doi.org/10.2196/jmir.7987">https://doi.org/10.2196/jmir.7987</a>	General internet-based tools for communication between patients and providers.

## Appendix 2

### 2.1 Umbrella Reviews Key Documents

- Aromataris, E., Fernandez, R., Godfrey, C., Holly, C., Khalil, H., & Tungpunkom, P. (2015). Summarizing systematic reviews: methodological development, conduct and reporting of an umbrella review approach. *International Journal of Evidence-Based Healthcare*, 13, 132-140. doi:10.1097/XEB.0000000000000055
- Biondi-Zoccai, G. (2016). *Umbrella Reviews Evidence Synthesis with Overviews of Reviews and Meta-Epidemiologic Studies*. Springer.
- Grant, M., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and. *Health Information and Libraries Journal*, 26, 91-108. doi:10.1111/j.1471-1842.2009.00848.x
- Higgins, J. P., & Green, S. (2011). *Cochrane Handbook for Systematic Reviews of Interventions*. Retrieved August 7, 2018, from <http://handbook-5-1.cochrane.org/>
- The Joanna Briggs Institute. (2014). *The Joanna Briggs Institute Reviewers' Manual 2014 Methodology for JBI Umbrella Reviews*. Retrieved April 17, 2018, from <https://joannabriggs.org/>: [https://joannabriggs.org/assets/docs/sumari/ReviewersManual-Methodology-JBI\\_Umbrella%20Reviews-2014.pdf](https://joannabriggs.org/assets/docs/sumari/ReviewersManual-Methodology-JBI_Umbrella%20Reviews-2014.pdf)
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D., & Group, T. P. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *International Journal of Surgery*, 8, 336-341. doi:10.1016/j.ijsu.2010.02.007

### 2.2 Assessment of Methodological Quality Key Documents

- Ballard, M., & Montgomery, P. (2007). Risk of bias in overviews of reviews: a scoping review of methodological guidance and four-item checklist. *Research Synthesis Methods*, 8(1), 92-108. doi:10.1002/jrsm.1229
- Smith, V., Devane, D., Begley, C., & Clarke, M. (2011). Methodology in conducting a systematic review of systematic reviews of healthcare interventions. *BMC Medical Research Methodology*, 11(15), 1-6. doi:<http://www.biomedcentral.com/1471-2288/11/15>
- Pussegoda, K., Turner, L., Garritty, C., Mayhew, A., Skidmore, B., Stevens, A., . . . Moher, D. (2017). Identifying approaches for assessing methodological and reporting quality of systematic reviews: a descriptive study. *Systematic Reviews*, 6. doi:10.1186/s13643-017-0507-6