An Overview of Reviews of Personal Health Records (PHRs) and Portals:

Barriers, Enablers and Benefits.

by

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ABSTRACT

Background: Personal Health Records (PHRs) and Patient Portals (Portals) are said to be facilitators of a new paradigm emerging in the delivery of healthcare where the patients are empowered to take an active role in their health by setting goals and making decisions from gaining a greater understanding of one's conditions and treatment options. These systems have the potential to increase patient engagement, improve communication between patient and the healthcare system, and enable the healthcare system to move towards a more personalized medical model. Despite the promises of these systems, recent studies have identified barriers to use from both patients and providers, and limited conclusive benefits.

Objective: To explore previous research that have examined the use of PHRs and Portals in order to identify any barriers, enablers and benefits of use.

Method: An overview of reviews was conducted to present the barriers, enablers and benefits of PHR and Portal use as identified in systematic reviews over the past 10 years. Eleven systematic reviews were evaluated and selected for the overview. An adapted Clinical Adoption Framework was used to capture the findings of the reviews and to show how they interlinked and influenced each other.

Conclusion: Several barriers to use were identified, namely, the socio-economic background of users, the patient's and provider's beliefs of the system, and the usability and usefulness of the systems. An enabler of use included encouragement from social supports and providers to use these systems. The use of PHRs and Portals do appear to produce some benefits, such as improved communication. However, the ability of these systems to empower patients leading to positive health outcomes remains to be confirmed with inconclusive results being reported for improvements in self-care and/or management or participation in care, and inconclusive results for improvements in disease/health outcomes.

Recommendations for future research and implementation of PHRs and Portals include improving access and use for those who are less empowered, developing systems to meet the needs of patient and providers, and ensuring users are encouraged and supported to use these systems once implemented.

1.0 INTRODUCTION

A new paradigm is said to be emerging in the delivery of healthcare where instead of a physician being the focal point of control and decision making, this power is moving unto patients (Schneider et al., 2016; Wasson et al., 2012 in Thompson et al., 2016). Patient empowerment is where a patient takes an active role in their healthcare by setting own health goals and making decisions from gaining an understanding of their condition and the possible treatment options. By patients taking an active role, it is hoped that patients work together with physicians in shared decision making and initiate changes in behaviour that help to better manage a condition, potentially leading to positive health outcomes. This shift in care revolves around providing patients access to their medical information and tools to help manage their care. Health Information Technology (IT) has been developed to facilitate this new paradigm in the form of Personal Health Records and Patient Portals which, when used, are said to have the potential to increase patient engagement, improve communication between patients and the healthcare system, and enable the healthcare system to move towards a more personalized medical model (Cimino et al., 2002; Nobin et al., 2013; Nobin et al., 2012; Price et al., 2015; Donje et al., 2014; Archer et al., 2011).

A Personal Health Record (PHR) is a complete or partial health record, which is owned by the person rather than a health care provider, and as it is owned by the patient or user, the user can manage, control, or share information as preferred (Canada Health Infoway 2016; Archer et al., 2011). The PHR can hold relevant electronic health information or data about that person over their lifetime, drawing data from multiple sources (Canada Health Infoway, 2016; Archer et al., 2011). PHRs can be standalone or tethered to other information systems such as an Electronic Health Record (EHR) (Price et al., 2015). Through PHRs, users can review medical data from providers such as consults and lab results, access health information which can help to educate patients on their conditions, record and track conditions overtime, receive decision support and communicate with care teams and support groups (Price et al., 2015).

Patient Portals provide similar functionality as a tethered PHR such as direct access to a patient's Electronic Health Record and functions or tools to communicate with care teams and to manage conditions, however the portals are owned by the care provider, not the patient (Amante et al., 2014; Ammenwerth et al., 2012; Goldzweig et al., 2013; Kruse et al., 2015a). The advantage of tethered PHRs or Portals are that they are updated automatically, whereas standalone systems rely on the patient to enter data (Kruse et al., 2015). The introduction of these systems aide to bridge episodic care and allows the access to services in-between clinical visits (Amante et al., 2014).

The potential benefit of allowing patients access to their medical records facilitated by these systems has led to Canada Health Infoway to invest in the development of patient portals and e-viewer services across Canada (Canada Health Infoway, 2016a) and so there is the likelihood of patients having increased access to their information. The increasing investments being made in these systems stress the importance of analyzing existing literature on enrollment, utilization and benefits (Goal et al., 2011 in Amante et al., 2014). Despite the promises of these systems, recent studies have identified barriers to use from both patients and providers, and limited conclusive benefits of use (Thompson et al., 2016; Amante et al., 2014; Price et al., 2015; Bush et al., 2015; Mold et al., 2015).

2.0 RATIONALE FOR THE OVERVIEW

It is argued that in order to fully comprehend the differences in the use of health IT; potential barriers to adoption and utilization must be considered from several perspectives (Gibbons, 2011). These perspectives include the provider and healthcare system perspective, the perspective of patients, families, and caregivers, and the impact of the system, and the environment perspective in which the system is to be deployed (Gibbons, 2011). Issues or barriers arising in any of these different areas or domains could directly impact the use and outcomes associated with a system (Gibbons, 2011).

Consequently, in order to fully comprehend potential barriers to adoption and utilization of PHRs and Portals and to explore the outcomes of use, an overview would need to capture factors impacting use which are associated with patients, caregivers, providers, the healthcare system, the system itself and the environment in which the system is being deployed. Combining these factors and how they interlink may shed light into the reasons as to why use is low and why there are currently inconclusive benefits from use.

3.0 OBJECTIVE

To support the rational, the objective of this overview was to explore previous research that had examined the use of PHRs and Portals in order to identify any barriers, enablers and benefits of use. Themes were then drawn from the findings to show how the different factors can interlink and influence the use and outcomes of PHRs and Portals. Recommendations for future implementation of PHRs and Portals were then formed that may improve and/or increase use and potentially any benefits from use.

4.0 METHODOLOGY

4.1 METHOD

Systematic reviews of individual studies have been identified as a useful method for appraising, summarizing and bringing together existing studies into one place, as such there has been an increase in the volume of systematic reviews (Smith et al., 2011). Multiple systematic reviews on a topic may provide challenges for decision makers when trying to interpret, extract and apply any findings to practice (Smith et al., 2011). To assist decision makers, a research method called an Overview of Reviews has been developed, which allows for the findings of individual systematic reviews to be compared and contrasted in a single place (Smith et al., 2011; The Cochrane Collaboration, 2011).

For the purpose of providing a single source for decision makers concerning PHR and Portal adoption, this study undertook an overview of reviews to appraise, compare and summarize the existing literature of review studies over the past 10 years that have examined the use and outcomes of PHRs and Portals (Smith et al., 2011). The method on how to conduct an overview of reviews was borrowed from the Cochrane Handbook of reviews which provides a step by step guide on the overview process (The Cochrane Collaboration, 2011). For the structure and reporting of the findings, this overview followed the check-list of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement including the four-phase flow diagram with an additional phase for a quality assessment of each review (Moher et al., 2009).

4.2 THE INTERVENTION

For the purpose of this overview a Personal Health Record (PHR) is defined as a complete or partial health record, which is owned by the patient but is tethered to the their medical record so to allow access to medical data from providers, access to health information which can help to educate them on their conditions and contain tools that allow them to record and track conditions overtime, receive decision support and communicate with care teams and support groups (Price et al., 2015; Bush et al., 2015; Amante et al., 2014).

A Patient Portal is defined as a system that is owned by the care provider and that allows direct access to a patient's medical Record as well as functions or tools to communicate with care teams and to manage conditions (Amante et al., 2014; Ammenwerth et al., 2012; Goldzweig et al., 2013; Kruse et al., 2015a).

4.3 THE SEARCH STRATEGY

The search strategy for an overview of reviews is said to be a similar process to when conducting a review of individual studies (Smith et al., 2011) and similarly for this overview, the process involved assessing the retrieved abstracts for relevance, obtaining full text of chosen reviews for further review of eligibility, performing an appraisal of methodological quality before finally identifying reviews for the analysis. Figure 1 shows the flow diagram of the literature selection process (Smith et al., 2011; Moher et al., 2009).

For identifying review studies, a search string used by the McMaster Hedges Project to identify reviews was applied along with MeSH 2017 terms to query the MEDLINE database for reviews on PHRs and Portals conducted between 2006-2016 with restrictions to articles that have an abstract, are written in English and are freely accessible (Black et al., 2011; ULM, 2017). Applying the search string by McMaster Hedges Project along with MeSH terms aided in standardizing and increasing the quality of the search strategy (Table 1).

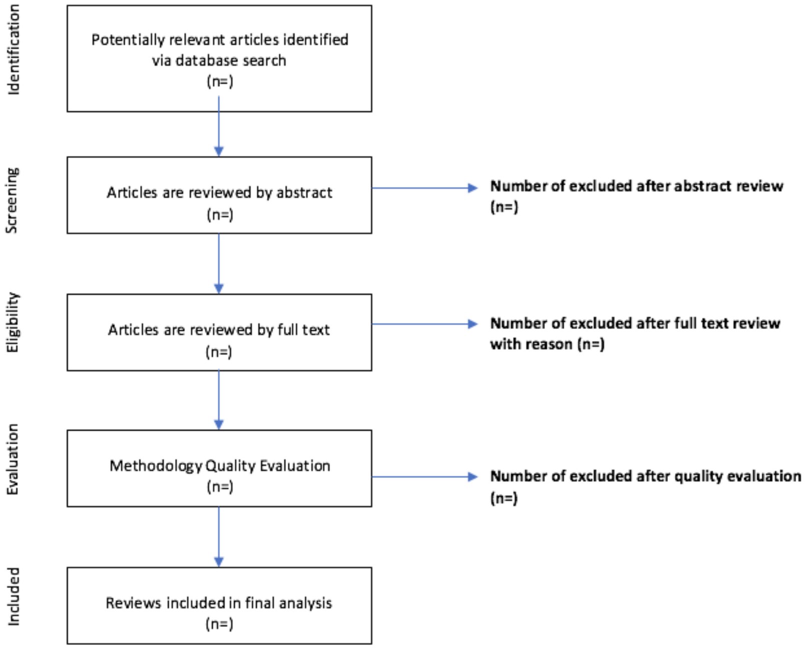


Figure 1: Flow Diagram for Literature Search

Table 1: Search Strategy

MeSH Term(s)	Health record, personal
	Longitudinal patient-maintained records of individual health history and tools that allow individual control of access.
Keywords	*PHR, Patient Portal*
Search String	(((systematic review [ti] OR meta-analysis [pt] OR meta-analysis [ti] OR systematic literature review [ti] OR this systematic review [tw] OR pooling project [tw] OR (systematic review [tiab] AND review [pt]) OR meta synthesis [ti] OR meta-analy*[ti] OR integrative review [tw] OR integrative research review [tw] OR rapid review [tw] OR umbrella review [tw] OR consensus development conference [pt] OR practice guideline [pt] OR drug class reviews [ti] OR cochrane database syst rev [ta] OR acp journal club [ta] OR health technol assess [ta] OR evid rep technol assess summ [ta] OR jbi database system rev implement rep [ta]) OR (clinical guideline [tw] AND management [tw]) OR ((evidence based[ti] OR evidence-based medicine [mh] OR best practice* [ti] OR evidence synthesis [tiab]) AND (review [pt] OR diseases category[mh] OR behavior and behavior mechanisms [mh] OR therapeutics [mh] OR evaluation studies[pt] OR validation studies[pt] OR guideline [pt] OR pmcbook)) OR ((systematic [tw] OR systematically [tw] OR critical [tiab] OR (study selection [tw]) OR (predetermined [tw] OR inclusion [tw] AND criteri* [tw]) OR exclusion criteri* [tw] OR main outcome measures [tw] OR standard of care [tw] OR standards of care [tw]) AND (survey [tiab] OR surveys [tiab] OR overview* [tw] OR review [tiab] OR reviews [tiab] OR search* [tw] OR handsearch [tw] OR analysis [ti] OR critique [tiab] OR appraisal [tw] OR (reduction [tw]AND (risk [mh] OR risk [tw]) AND (death OR recurrence))) AND (literature [tiab] OR articles [tiab] OR publications [tiab] OR publication [tiab] OR bibliography [tiab] OR bibliographies [tiab] OR published [tiab] OR pooled data [tw] OR unpublished [tw] OR citation [tw] OR citations [tw] OR database [tiab] OR internet [tiab] OR textbooks [tiab] OR references [tw] OR scales [tw] OR papers [tw] OR datasets [tw] OR trials [tiab] OR meta-analy* [tw] OR (clinical [tiab] AND studies [tiab]) OR treatment outcome [mh] OR treatment outcome [tw] OR pmcbook)) NOT (letter [pt] OR newspaper article [pt]))) AND ("Health Records, Personal"[Mesh] OR PHR[tiab] OR "patient portal"[tiab])
Database	MEDLINE (PubMed)
Restriction(s)	2006-2016 Abstract available English

4.4 INCLUSION/EXCLUSION CRITERIA

Under the selection criteria in the method by Cochrane, it is stated that an inclusion and exclusion criteria should be provided (The Cochrane Collaboration, 2011). During the screening of titles and abstracts, articles were assessed for their relevance and excluded if they were identified as either being off topic (did not focus on the use of PHRs or Portals), if they were not a systematic review or if they focused on a paper-based record. The remaining articles underwent a full text review to assess eligibility and again were excluded if they were identified as either being off topic (did not focus on the use of PHRs or Portals), if they were not a systematic review, if they focused on a paper-based record and also if they were identified as a duplicate study or if the full text was not freely accessible. The articles excluded from the overview are available in Appendices 2 and 3, each with an assigned reason for exclusion. Apart from excluding articles that were not identified as systematic reviews, no restrictions were used to exclude articles based-on methodology used, such as qualitative, quantitative or mixed methods.

For the purpose of this overview, a systematic review is defined as a review that attempts to collate all empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question (The Cochrane Collaboration, 2011). Systematic reviews are said to include 1) a clearly stated set of objectives with pre-defined eligibility criteria for studies, 2) an explicit, reproducible methodology, 3) a systematic search that attempts to identify all studies that would meet the eligibility criteria, 4) an assessment of the validity of the findings of the included studies, and 5) a systematic presentation, and synthesis, of the characteristics and findings of the included studies (The Cochrane Collaboration, 2011). There are said to be three types of systematic reviews: meta-analyses, qualitative systematic reviews, and realist reviews (Pare et al., 2015).

4.5 ASSESSMENT OF METHODOLOGICAL QUALITY OF INCLUDED REVIEWS

Once the systematic reviews were identified for inclusion, each systematic review was appraised for its methodology. An evaluation of the methodological quality of the reviews included in this overview is vital in order to assess the validity of findings and avoid the presentation of inaccurate or misleading data which may be then used by decision makers (Shea et al., 2007: Faggion, 2015). The AMSTAR Tool has been frequently used for the purpose of assessing systematic reviews to see if they meet the minimum requirement based on quality and it has been suggested that this tool can also be applied in the assessment of review studies in an overview of reviews (Smith et al., 2011; Shea et al., 2007; Faggion, 2015). Although frequently used, it is recognized that the tool has some limitations, including the opinion that the tool assesses the quality of reporting of a systematic review more than its methodological quality, that it does not assess the quality of the primary studies and that the interpretation of the checklist can also be challenging to the user (Faggion, 2015; AHRQ, 2014).

Another identified flaw is that the tool generates a qualitative evaluation, and does not quantify the systematic review quality (Kung et al., 2010). Although the AMSTAR tool was not intended to provide quantitative scores, researchers have adapted and revised the tool to include scoring by imbedding criteria within the 11 domains of the original AMSTAR that produces scores based on the satisfactory vs. unsatisfactory meeting of each criterion (Kung et al., 2010). The revised tool, R-AMSTAR (Appendix 11.) underwent a number of pilot studies which lead to refinements of the criteria within each of the 11 domains. The R-AMSTAR tool is said to detract nothing from its original version in forms of content and construct validity, which despite limitations as a tool, it is said to have good face and content validity for measuring the methodological quality of systematic reviews (Shea et al., 2007; Kung et al., 2010). The revised tool is not without limitations also, as it is suggested that the tool poses challenges for the user when assigning adequate weighting of items according to their importance of inclusion. It is suggested that the need for the tool to contain a quantifiable measure remains open for discussion. For the purpose of this overview, however and to allow for quantitative comparison of systematic reviews based on their methodology quality, the revised R-AMSTAR tool by Kung et al. (2010) was used to assess the quality of the included reviews. The results of the evaluation of each review were captured in 2 tables which have been adapted from the paper by Kung et al. (2010) who present the revised tool.

An example for the first table is available as Table 2, which captures the scores for each of the reviews based on the R-AMSTAR rating. For each domain, score ranges between 1 and 4 (maximum), and the total score has a range of 11 (no criteria met) to 44 (all criteria met). Reviews with lower scores would indicate concern around the confidence in the findings of the study.

Table 2: R-AMSTAR Scores

Study	1	2	3	4	5	6	7	8	9	10	11	Total
1												
2												
3												

The example in Table 3 shows the comparison of scores across the literature and each review has a A-D grading based on their percentile of the aggregate scores. The grading and scoring of the reviews is applicable when excluding reviews for analysis due to concerns around quality. An example of a cut off criteria is provided in the paper by Kung et al. (2010), which suggests excluding studies which score 22 points or less as a total of 22 indicates that on average only two criteria for each of the domains tested were satisfied. For the purpose of this overview and to ensure lesser quality reviews are excluded from the findings and subsequent analysis, all reviews that scored 22 or less were excluded.

Table 3: Comparison of Studies by R-AMSTAR Scores

Study	Total	Rank
1		
2		
3		

4.6 DATA COLLECTION AND ANALYSIS

Once appraised, the reviews first underwent data extraction where the findings of the reviews were extrapolated into two tables: Characteristics of Included Reviews and a Summary of Findings (Smith et al., 2011; The Cochrane Collaboration, 2011). The Characteristics of Included Reviews includes details of the scope of each review, sources of evidence and the assessment of quality (Table 4).

Table 4: Characteristics of Included Reviews

Author/ Year	Aim/ Objective	Time Period & No. of Studies Included	No. of Participants	Population	Origin of Primary Studies/Language	R-AMSTAR Grade	Conclusions

Following the methodology in the Cochrane Handbook for conducting an overview of reviews, the purpose of this overview was to summarize evidence from the included systematic reviews of the effects of the interventions, in this case PHRs and Portals, and to rely on the analyses reported in the included reviews (The Cochrane Collaboration, 2011). The Summary of Findings table (Table 5) provides a comparison of the findings in each systematic review and captures the reported barriers, enablers and outcomes of PHR and Portal use. Where possible, a summary of the findings from the primary studies were pulled from the either an included summary of findings table or extrapolated from the text instead of pulling data from each primary study.

Table 5: Summary of Findings

Author(s)/Year	Barriers/Enables/Outcomes	Description	A-CAF Coding

In addition to providing a summary of review results; Cochrane states that additional analyses may be undertaken for comparisons across reviews (The Cochrane Collaboration, 2011). For this purpose, the results were analyzed for themes using a form content analysis where the identified barriers, enablers and outcomes of use from Summary of Findings table were coded to the factors of an adapted version of the Clinical Adoption Framework (Pare et al., 2015; Hsieh and Shannon, 2005; Archer et al., 2011).

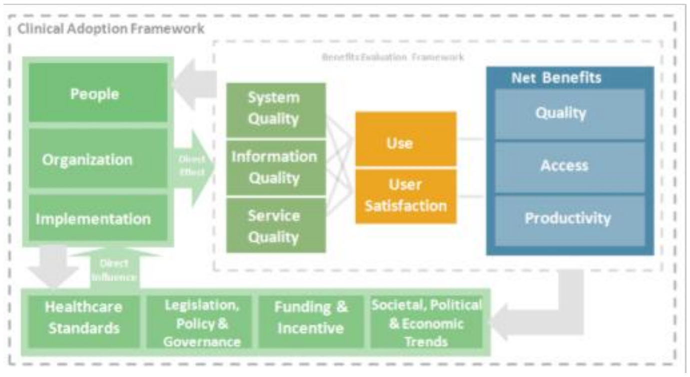


Figure 2: Clinical Adoption Framework (eHealth Observatory, 2017)

The Clinical Adoption Framework (CAF) (Figure 2), developed by eHealth Observatory (eHealth Observatory, 2017), was derived from DeLone and McLean and their Information Systems Success Model and extends the Benefits Evaluation Framework to create a multi-level view of adoption of health information systems and the different factors that interplay and impact adoption (eHealth Observatory, 2017; DeLone and McLean, 2003).

The CAF consists of 3 core dimensions of the Benefits Evaluation Framework, developed by Canada Health Infoway in partnership with the eHealth Observatory, that focus on the micro level of adoption, these are: health information quality, use and net benefits. The quality dimension examines the functionality of the system including the 3 dimensions from the DeLone and Mclean IS Success Model: System Quality, Information Quality and Service Quality (DeLone and McLean, 2003). The user dimension examines system usage and user satisfaction, including impressions of usefulness, ease of use and competency (Lau et al., 2011). The Information Quality, System Quality, and Service Quality interconnect and impact or influence the latter 3, as they will affect the use of or intention to use the system, user satisfaction associated with using the system and any net benefits (either positive or negative) achieved from using the system (Abu-Khadra and Ziadat, 2012).

The net benefits achieved could be in the terms of care quality (patient safety, appropriateness/effectiveness and health outcomes), patient access (provider/patient participation and availability/access to services), and provider productivity (care coordination, efficiency and net cost) (eHealth Observatory, 2017; Lau et al., 2011). By extending the Benefits Evaluation Framework to include the additional levels allows the capture of contextual factors such as organizational, political and socio-economic and how these factors interplay and impact adoption. The meso level (people, organization and implementation) is said to have a direct effect on the micro level and the adoption of health information systems by clinicians. The meso level is then affected by changes in the macro level (health care standards, legislation, policy and governance, funding & incentives, and societal, political and economic trends). The interplay of dimensions as noted in DeLone and Mclean's model: Quality, Use and Net Benefits can be expected to magnify when there is correlation or alignment between the dimensions of the meso level and that higher adoption is likely if the organization's efforts are aligned with the micro dimensions (eHealth Observatory, 2017).

An example of an outcome would be where a PHR that has a high system, information and service quality is associated with more use and greater user satisfaction, which then potentially leads to a positive result or net benefit with the knowledge of success being fed back into the environment level and informing opinion and knowledge of PHR use. Whereas, a PHR with a negative net benefit could be as a result of a poor-quality system with greater dissatisfaction and less use and in turn, negatively affect the opinion of PHRs (Lau et al., 2011).

The purpose of an adapted version of the CAF (Figure 3) is to encompass factors that are specific to PHR and portal adoption and show how these factors can influence each other. According to Emani et al. (2012), there has been little work undertaken that has applied a theoretical framework to the study of patient adoption and use of PHRs. The Summary of Findings table initially categorized each finding as a general overarching factor under the adapted version of the CAF, these were; Environment, People, Organization, Technology, Use/User Satisfaction or Outcomes. The factors are based on the original factors of the CAF in the Micro, Meso and Macro levels and from additional codes generated from the findings of the systematic reviews in this Overview.

The findings from this Overview were then extracted into a further table called Synthesis of Results (Table 6) and grouped into categories under each overarching factor (Environment, People, Organisation, Technology, Use/User Satisfaction and Outcomes) to include additional specific factors that impact the use and outcome of PHRs and Portals.

Table 6: Synthesis of Results

Environment	
Factor	**Reference**
Example of factor	
People	
Factor	**Reference**
Example of factor	
Organisation	
Factor	**Reference**
Example of factor	
Technology	
Factor	**Reference**
Example of factor	
Use/User Satisfaction	
Factor	**Reference**
Example of factor	
Outcomes	
Factor	**Reference**
Example of factor	

The specific factors under Environment were: 1) Societal/Family Beliefs, Preferences and Trends, 2) Polices, Standards and Governance and 3) Funding and Incentives. Under People the factors were 1) Health/Computer Literacy, 2) Demographic/Health, 3) Beliefs, preferences and behaviour, and 4) Awareness and Access. Under Organization the factors were 1) Provider Demographics and Location, 2) Provider's Beliefs and Preferences, 3) Implementation, 4) Service Quality, 5) Provider Skills and Computer Literacy, and 6) Provider Awareness and Access. Under Technology the factors included 1) System Quality, 2) Information Quality, 3) Fit to Patient/Caregiver and 4) Fit to Workflow. Outcomes captured the specific factors of 1) Quality, 2) Knowledge, 3) Productivity, 4) Behaviour and 5) Access. The Synthesis of Results table also provides examples of each of the factors as derived from the findings of the systematic reviews.

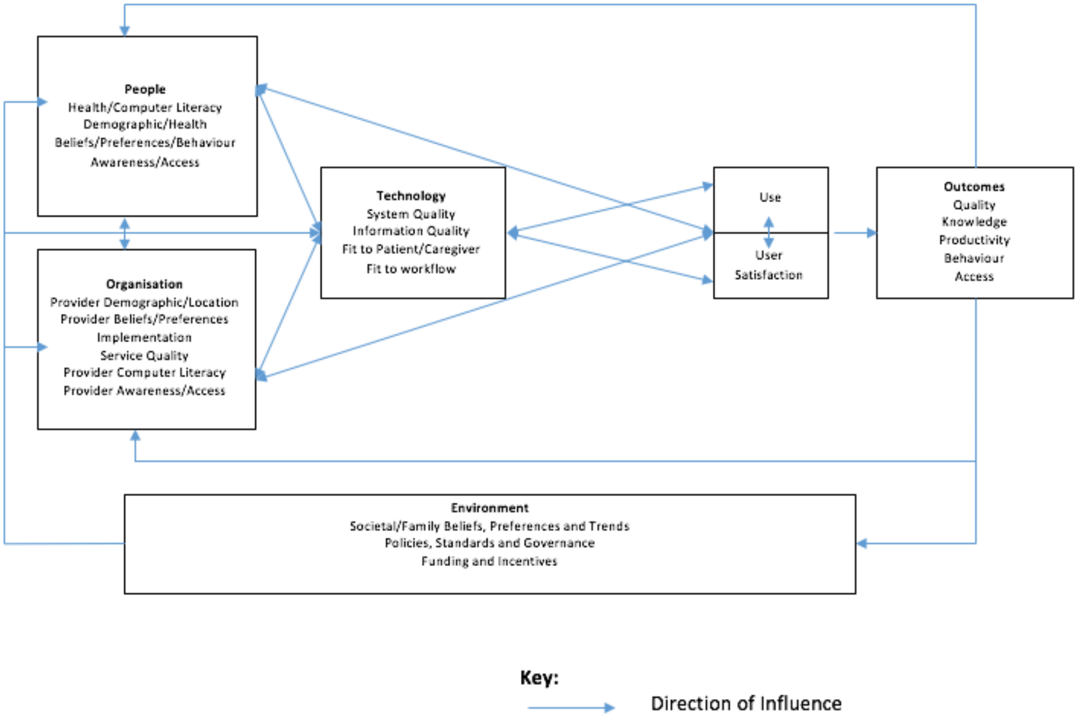


Figure 3: Adapted Clinical Adoption Framework

The micro level of the adapted CAF still focusses on the health information quality, use and net benefits. Technology is used at the umbrella term for system quality factors in the micro level. The meso level including people factors and organization factors (including implementation) is said to have a direct effect on the micro level and the adoption of the system. Then as per the original CAF, the meso level is then affected by changes in the macro level, Environmental factors, in terms of standards, legislation, policy and governance, funding & incentives, and societal believes, preference and trends. As with the original

CAF, the adapted CAF aims to illustrate how these different factors impact or influence each other at different levels. Significant themes identified in the findings are provided in the Results and Discussion chapters including an analysis on how these factors interlink and influence each other.

After the synthesis, an additional analysis was performed to explore the extent of overlap of primary studies within the included reviews to see if the findings of individual studies have been reported more than once. The purpose of the analysis was to highlight any duplication of primary studies and how their inclusion may have had an effect on the findings and caused a distortion in the data (Smith et al., 2011).

In summary, there were 7 outputs from this overview: 1) Details of search process (the inclusion/exclusion of reviews), 2) R-AMSTAR scores table, 3) Comparison of R-AMSTAR scores table, 4) Characteristics of Included Reviews table, 5) Summary of Findings table, 6) Synthesis of Results table and 7) an Adapted Clinical Adoption Framework that captures factors that impact the level of PHR and portal adoption over the past 10 years.

The extraction of data and analysis was conducted by the author in consultation with a Research Supervisor.

4.7 ETHICAL APPROVAL

Permission and approval for this overview of reviews was sought from the University of Victoria's Research Ethics Board. Documentation of approval is provided in Appendix 12.

5.0 RESULTS

5.1 STUDY SELECTION

The initial search of the Medline database using the MeSH terms, Keywords, Search String and Restrictions listed in Table 1 returned 410 citations. Screening of titles and abstracts left 18 citations which were then subjected to full text review. Articles were included for further review if they 1) focused on the use of an electronic PHR/Portal, 2) were in English, 3) had an abstract available, and 4) were published between Jan 2006 - Dec 2016. Articles were excluded if 1) they were off topic or were not relevant to study, 2) they focused on a paper based record, and 3) were not identified as a systematic review. A further 7 articles were removed after full text review (either off topic or a duplicate) leaving 11 articles to be included for analysis (Figure 4).

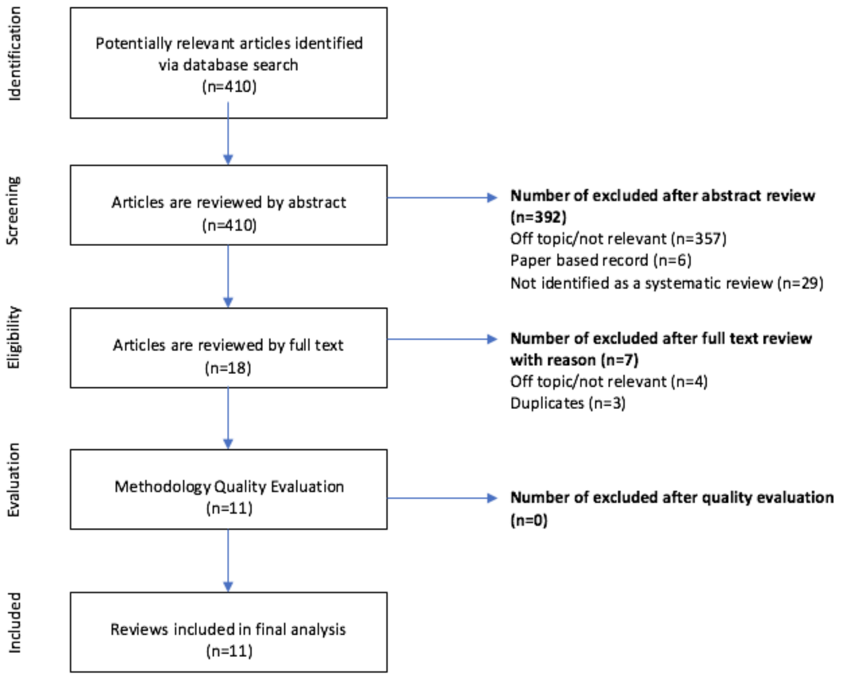


Figure 4: Literature Search Flow Diagram

5.2 STUDY CHARACTERISTICS

Of the 11 reviews included, 2 were from 2016 (Thompson et al., 2016; Otte-Trojel et al., 2016), 5 from 2015 (Mold et al., 2015; Kruse et at., 2015; Kruse et al., 2015a; Bush et al., 2015; Price et al., 2015), 2 from 2014 (Giardina et al., 2014; Amante et al., 2014), 1 from 2013 (Goldzweig et al., 2013) and 1 from 2012 (Ammenwerth et al., 2012). Patient portals were a focus of 7 of the included reviews (Amante et al., 2015; Ammenwerth et al., 2012; Bush et al., 2015; Goldzweig et al., 2013; Kruse et al., 2015; Kruse et al., 2015a; Otte-Trojel et al., 2016), 2 focused on PHRs (Price et al., 2015; Thompson et al., 2016) and 2 focused on patient accessible records in general (not stipulating type of system) (Giardina et al., 2014; Mold et al., 2015). The perspectives of patients and providers were captured in 3 reviews (Thompson et al., 2016; Mold et al., 2015; Kruse et al., 2015) and 2 of the reviews also focused on the perspectives of caregivers and the use of a PHR or Portal (Thompson et al., 2016; Mold et al., 2015). A further study also captured the perspectives of pediatric patients and their parents/caregivers (Bush et al., 2015). Six of the studies focused solely on the perspectives of patients (Kruse et al., 2015a; Price et al., 2015; Giardina et al., 2014; Amante et al., 2014; Goldzweig et al., 2013; Ammenwerth et al., 2013) and 4 specifically focused on patients with a chronic disease (Amante, et al., 2014; Price et al., 2015; Kruse et al., 2015a; Kruse et al., 2015). One review took a general approach on portal development and did not specifically focus on one type of user (Otte-Trojel et al., 2016).

Two reviews focused on barriers either for patient, provider, or caregiver use (Thompson et al., 2016; Amante et al., 2014). Six reviews aimed to capture the impact, outcomes or benefits of a system (Mold et al., 2015; Kruse et al, 2015a; Giardina et al., 2014; Goldzweig et al., 2013; Ammenwerth et al, 2012; Price et al., 2015). Then Bush et al. (2015), focused on use and utilization and Kruse et al. (2015) focused on the perspectives of patient and providers have and where systems can be improved. The final paper by Otte-Trojel et al. (2016) focused on problems and solutions to portal development.

Of the 11 reviews, 2 focused only on primary studies from the U.S.A (Amante et al., 2014; Goldzweig et al., 2013), whereas the remaining 9 did not specify a restriction and so it is assumed that, without examining the origin of each individual study, their findings may include studies from different countries (Thompson et al., 2016; Otte-Trojel et al., 2016; Ammenwerth et al., 2012; Bush et al., 2015; Giardina et al., 2014; Kruse et al., 2015; Mold et al., 2015; Price et al., 2015; Kruse et al., 2015a). Although the majority of reviews did not specify a restriction for region, eight did specify that the included studies are to be written in English (Thompson et al., 2016; Otte-Trojel et al., 2016; Amante et al., 2014; Bush et al., 2015; Giardina et al., 2014; Goldzweig et al., 2013; Kruse et al., 2015; Price et al., 2015).

Further details of each review are provided in the Characteristics of Included Reviews table in the Appendix 7.

5.3 EVALUATION OF METHODOLOGY QUALITY

The quality of each of the 11 included reviews were assessed using the R-AMSTAR evaluation tool. The highest score was 38 out of 44 with the lowest score recorded at 23 out of 44. As no review scored less than the cut-off of 22 points or less, all 11 reviews were included for analysis. Although no article was excluded due to what would be considered low quality, of the 11 articles, 8 (Bush et al., 2015; Price et al., 2015; Goldzweig et al., 2013; Thompson et al., 2016; Kruse et al., 2015a; Amante et al., 2014; Otte-Trojel et al., 2016; Kruse et al., 2015) only scored a grade of C indicating that 73% of included studies had a comparably low score of quality which may indicate concern around the confidence in the findings of these reviews (Kang et al., 2010). The remaining reviews had a higher quality rating with 1 review scoring a grade of B (Giardina et al., 2014) and 2 reviews scoring the highest grade of A (Ammenwerth et al.2012; Mold et al., 2015) (Table 7.) which indicates that compared to the other reviews, these 3 may warrant higher level of confidence in the findings. Further information on the quality of each review is available in Appendices 4 and 5, which shows how each review compared to the 11 criteria of the R-AMSTAR tool.

Table 7: R-AMSTAR Results

Study	Total (44)	Percentile
Ammenwerth et al. (2012)	**38**	A
Mold et al. (2015)	**35**	A
Giardina et al. (2014)	**30**	B
Bush et al. (2015)	**29**	C
Price et al. (2015)	**29**	C
Goldzweig et al. (2013)	**29**	C
Thompson et al. (2016)	**28**	C
Kruse et al. (2015a)	**28**	C
Amante et al. (2014)	**26**	C
Otte-Trojel et al. (2016)	**24**	C
Kruse et al. (2015)	**23**	C

5.4 RESULTS OF INDIVIDUAL STUDIES

The findings of each of the included systematic reviews are captured in the Summary of Findings table available in Appendix 8. The findings are separated into barriers, enablers and outcomes of use and each finding is coded to an overarching factor of the Adapted CAF. The findings included 113 factors that were barriers of use, 28 factors that enable use and 50 outcomes of use.

5.5 SYNTHESIS OF RESULTS

The Synthesis of Results table, in Appendix 9, shows how the findings under each of the overarching factors from the Summary of Findings table are collated together to form further specific factors that impact the use and outcomes. The main specific factors identified in the Synthesis of Results are provided below which are categorized under the overarching factors: Environment, People, Organization, Technology, Use/User Satisfaction and Outcomes.

Environmental Factors

One of the specific factors captured under Environmental Factors, was Societal/Family Beliefs, Preferences and Trends, which included the finding that the recommendation or support of family and friends were found to enable the use of systems by patients (Amante et al., 2014). The normal technology practices of a healthcare organization or instructions and incentive to use were also found to impact or influence use by providers (Thompson et al., 2016).

People Factors

Under People Factors, specific factors included the Health Literacy and Computer Literacy, and the Demographic and Health background of the users, which were mentioned in several studies as factors that impacted the use of either a PHR or Portal. Six articles referred to health literacy being a factor and included the ability of a user to understand the medical terminology captured in the medical record (Otte-Trojel et al., 2016; Thompson et al., 2016; Bush et al., 2015; Kruse et al., 2015; Kruse et al., 2015a; Amante et al., 2014). With this, the level of educational attainment of the user also appeared to be a factor with users tending to have a higher level of education than non-users (Thompson et al., 2016; Bush et al., 2015; Kruse et al., 2015a; Goldzeig et al., 2013; Amante et al., 2014). The age, gender, ethnicity and financial background of a user also appeared to a be factor with users tending to be younger in age (Thompson et al., 2016; Otte-Trojel et al., 2016; Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015a; Amante et al., 2014), of a non-minority group (Thompson et al., 2016; Otte-Trojel et al., 2016; Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015a; Goldzeig et al., 2013; Amante et al., 2014), and have a greater source of income with users more likely to have private insurance (Thompson et al., 2016 ; Otte-Trojel et al., 2016; Mold et al., 2015; Bush et al., 2015; Amante et al., 2014). Although users may be in a higher socio-economic group, this advantage does not appear to relate to health background as users tended to a chronic disease and greater morbidity (Otte-Trojel et al., 2016; Mold et al., 2015; Goldzeig et al., 2013; Amante et al., 2014; Bush et al., 2015).

Another specific factor, Beliefs/Preferences/Behaviour, focused on the beliefs the user had around the value, use and usefulness of the system (including prior experience of using one) which either impacted the use or willingness to use a system as noted in 4 reviews (Thompson et al., 2016; Otte-Trojel et al., 2016; Goldzeig et al., 2013; Amante et al., 2014). This may be coupled with concerns around security, privacy and confidentiality when using the system which included concerns around sharing data and impact on the user's insurance coverage and the possibility of being subjected to discrimination (Thompson et al., 2016; Otte-Trojel et al., 2016; Bush et al., 2015; Amante et al., 2014).

The behaviour of a user including prior level of health service utilization, practice of a healthy lifestyle, and norms for technology use and communication also played factor in who used the system (Thompson et al., 2016; Kruse et al., 2015a; Amante et al., 2014). Users may have a greater engagement in health services, are following a healthy lifestyle and have adopted technology into their everyday activities.

A user's awareness of a technology and the ability to access the technology was also identified as another specific factor under People. Four reviews noted access to either the internet, computer, and/or a smartphone impacted a users' ability to use a system (Thompson et al., 2016; Otte-Trojel et al., 2016; Kruse et al., 2015; Amante et al., 2014). Furthermore, being aware of the system and its functions also impacted how and if a system is used (Thompson et al., 2016; Otte-Trojel et al., 2016; Kruse et al., 2015a; Amante et al., 2014).

Organization Factors

The Provider's Beliefs/Preference were identified as a specific factor under Organization as the use of a PHR or Portal was also impacted by the perspectives of a provider with 3 reviews commenting on a providers' belief around the value and benefits of a system including the cost benefit and how this would impact the providers' use of the system (Thompson et al., 2016; Kruse et al., 2015; Otte-Trojel et al., 2016). The beliefs around value maybe coupled with a providers' concerns with the impact that the system will have on either workload and workflow as noted in 5 reviews (Thompson et al., 2016; Otte-Trojel et al., 2016; Mold et al., 2015; Kruse et al., 2015; Amante et al., 2014). Furthermore, providers' expressed concern if they would be reimbursed or reimbursed appropriately from using the system (Thompson et al., 2016; Otte-Trojel et al., 2016; Kruse et al., 2015; Amante et al., 2014). The beliefs and attitudes towards the system would appear to correspond with the level of provider encouragement, support or promotion given to their patients to use the system, which was also found as a factor impacting use in 3 reviews with provider promotion and encouragement being seen as an enabler of patient use (Thompson et al., 2016; Amante et al., 2014; Otte-Trojel et al., 2016). The level of support and encouragement of providers to patients was captured under the factor of Service Quality.

Technology Factors

Under Technology Factors, the specific factor System Quality captured the usability (Thompson et al., 2016; Bush et al., 2015; Amante et al., 2014; Kruse et al., 2015), availability of functions and features (Thompson et al., 2016; Bush et al., 2015; Amante et al., 2014), level of security (Thompson et al., 2016; Otte-Trojel et al., 2016; Kruse et al., 2015) and interoperability of the system which were all found to impact use (Price et al., 2015; Thompson et al., 2016; Otte-Trojel et al., 2016).

A further factor included Information Quality as it was found the content of the system may also impact its use and/or usefulness with complexity of data or terminology used (Thompson et al., 2016; Bush et al., 2015; Kruse et al., 2015) and or the integrity of the data in terms of accuracy and completeness within the system (Thompson et al., 2016; Otte-Trojel et al., 2016; Amante et al., 2014) being factors that impacted use.

The ability of the system to fit to Patient/Caregiver needs was also identified as a specific factor under technology as three reviews referred to the ability of the system to fit into a user's or patient's everyday routines and time constraints with concerns expressed by users with how long the system takes to use and not having enough time in a busy life schedule to use the system (Thompson et al., 2016; Bush et al., 2015; Amante et al., 2014).

Use/User Satisfaction

The above technology factors may be linked to the formation of beliefs of the patients and providers have around the system as a system that seen is as easy to use and useful would likely enable use. However, the findings concerning Usability/Usefulness were mixed (Kruse et al., 2015; Giardina et al., 2014). Furthermore, satisfaction with the system was more so connected with the response time from providers when using the system (Thompson et al., 2016; Amante et al., 2014).

Outcomes

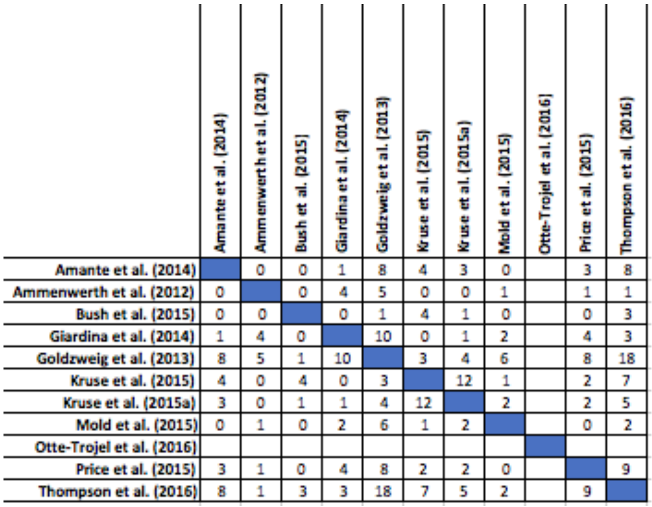
Several studies identified outcomes of use and included exploring if concerns around use materialised. Under Outcomes included the specific factor Quality which focused on the improvements to disease/health outcomes from using the systems, which were said to be mixed with some reviews identifying improvements whereas others stated that there was no evidence to support this (Kruse et al., 2015; Kruse et al., 2015a; Giardina et al., 2014; Goldzweig et al., 2013). There were however improvements noted in a patient's satisfaction with care (Mold et al., 2015; Kruse et al., 2015; Kruse et al., 2015a; Price et al., 2015; Giardina et al., 2014) and the communication between patient and provider (Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015; Kruse et al., 2015a; Price et al., 2015; Ammenwerth et al., 2012) which were also captured under Quality. There was further conflicting evidence if the systems saved patients time and decreased telephone calls and clinic visits (Mold et al., 2015; Giardina et al., 2014; Ammenwerth et al., 2012) which were examples under the specific factor, Productivity.

The specific factor, Behaviour, captured one of the most reported outcomes which was on the notion that the systems improved self-care and/or management and participation in care (adherence to medication) and relates to the idea that these systems empower patients to be active in their healthcare. Although there were findings that showed improved participate and management in care, these results were again inconclusive (Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015; Kruse et al., 2015a; Price et al., 2015; Giardina et al., 2014; Ammenwerth et al., 2012). A final significant finding related to outcomes, under Behaviour, concerns a patient emotional response from using the systems and 3 reviews noted that a user's anxiety or distress either decreased and did not increase as a result of using the systems (Bush et al., 2015; Price et al., 2015; Giardina et al., 2014).

5.6 STUDY OVERLAP AND DUPLICATION OF FINDINGS

A list of all the included primary studies for the 11 systematic reviews is provided in Appendix 10 which also shows which primary studies are included in multiple reviews. Table 8 shows an overview of the overlap of primary studies included in the 11 systematic reviews, for example, the review by Thompson et al. (2016) included 8 primary studies that were also found in the review by Amante et al. (2014).

Table 8: Overlap of Primary Studies



	Amante et al. (2014)	Ammenwerth et al. (2012)	Bush et al. (2015)	Giardina et al. (2014)	Goldzweig et al. (2013)	Kruse et al. (2015)	Kruse et al. (2015a)	Mold et al. (2015)	Otte-Trojel et al. (2016)	Price et al. (2015)	Thompson et al. (2016)
Amante et al. (2014)	🟦	0	0	1	8	4	3	0		3	8
Ammenwerth et al. (2012)	0	🟦	0	4	5	0	0	1		1	1
Bush et al. (2015)	0	0	🟦	0	1	4	1	0		0	3
Giardina et al. (2014)	1	4	0	🟦	10	0	1	2		4	3
Goldzweig et al. (2013)	8	5	1	10	🟦	3	4	6		8	18
Kruse et al. (2015)	4	0	4	0	3	🟦	12	1		2	7
Kruse et al. (2015a)	3	0	1	1	4	12	🟦	2		2	5
Mold et al. (2015)	0	1	0	2	6	1	2	🟦		0	2
Otte-Trojel et al. (2016)									🟦		
Price et al. (2015)	3	1	0	4	8	2	2	0		🟦	9
Thompson et al. (2016)	8	1	3	3	18	7	5	2		9	🟦

The 11 reviews consisted of 267 primary studies (excluding studies in the review by Otte-Trojel et al., 2016), with which 96 (36%) were duplicates. By excluding the duplicates, results in 171 individual primary studies that are captured in this overview. It is important to identify any overlap of primary studies within the included reviews to see if the results of papers are duplicated and in turn effect the overall findings by distorting the data (Smith et al., 2011).

Individual reviews have identified overlap with previous papers such as Kruse et al. (2015a) which states that its aim was to update and build upon the review by Ammenwerth et al. (2012) and also assess the outcome of patient portal use and its effect on quality of care and medical outcomes. This included duplicating the systemic review by Ammenwerth et al. (2012) with material published from 2011-2014 but including a wider array of publications which are considered to have weaker research designs such as observational studies. The Kruse et al. (2015a) included 27 primary studies and did not include any of the studies from the Ammenwerth et al. (2012) review. As a result, both papers produced different findings, such as the Ammenwerth et al. (2012) reportedly did not identify any improvements in health outcomes, whereas the review by Kruse et al. (2015a) identified several clinical and administrative improvements. Another review by Kruse et al. (2015) was the only review to include systematic reviews from this overview; Ammenwerth et al. (2012) and Goldzweig et al. (2013), which may mean the finding of those two reviews are duplicated in this review thus causing an over representation of the findings.

By comparing the synthesis of results with data on the overlap of findings may provide some indication of some results having an overrepresentation and thus distorting the findings of the overview**.** One of the outcomes of use included improvements in patient's satisfaction with care which was noted in 5 reviews: Mold et al. (2015), Kruse et al. (2015), Kruse et al. (2015a), Price et al. (2015) and Giardina et al. (2014). From looking at the Summary of Overlap table and exploring one review, such as Mold et al. (2015), it can be noted that this review has 1 paper that overlaps with Kruse et al (2015), 2 papers that overlap with Kruse et al. (2015a) and 2 papers that overlap with Giardina et al. (2014). It is possible that the reviews are referring to the same study that identified that patient satisfaction with care improved from using the system, but instead of this result being captured once, it is captured multiple times thus inflating the result. However, without looking at the findings of each individual primary study it will likely not be possible to identifying specifically which finding has been reported more than once, and this example of overrepresentation or distortion of data for patient satisfaction is theoretical. Only by removing the duplicates and then performing a reanalysis of the data would allow for a truer representation of the findings. Without this re-analysis, the findings of this review should be interpreted with some caution as it is possible that of some results have inflated power than others.

6.0 DISCUSSION

This discussion will present the key findings (Table 9) of the overview and how these findings are applied to the Adapted Clinical Adoption Framework. Included in this discussion are recommendations derived from the findings which may aid in increasing or improving the use and outcomes of use of PHRs and Portals.

Table 9: Key Barriers, Enablers and Benefits.

Key Barriers:	• User's Socio-economic background (level of education, IT literacy, health literacy, employment, and income as well as their age, gender and ethnicity). • User's beliefs of the system. • Usability and usefulness of the systems.
Key Enablers:	• Influence or recommendations of family and friends for patients • Influence or recommendations of healthcare organizations for providers • Level of provider encouragement, promotion, engagement or support to use system provided to patients
Key Benefits	• Improved communication between the patient and provider. • Improved patients' satisfaction with care.

6.1 KEY FINDINGS

The key message from this overview is that despite the promises of PHRs and Portals to foster patient engagement and empower them to be active participants in their care, this overview revealed inconclusive findings in this area. Some reviews identified improved decision making (Mold et al., 2015) and improved understanding of conditions (Bush et al., 2015; Giardina et al., 2014), but when it came to a change in behaviour such as improved self-care and/or management or participation in care, these results were mixed (Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015; Kruse et al., 2015a; Price et al., 2015; Giardina et al., 2014; Ammenwerth et al., 2012). As a change in behaviour is inconclusive, it may be considered unsurprising that improvements on disease/health outcomes from use were also inconclusive (Kruse et al., 2015; Kruse et al., 2015a; Giardina et al., 2014; Goldzweig et al., 2013).

6.2 KEY BENEFITS

The use of PHRs and Portals do however appear to produce some positive outcomes with one of the key benefits of use found in this overview being that the use of the systems improved communication between the patient and provider (Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015; Kruse et al., 2015a; Price et al., 2015; Ammenwerth et al., 2012). This outcome was recorded in more than half of the reviews. Another frequently reported benefit from use also identified in terms of quality was that use improved a patient's satisfaction with care.

6.3 KEY BARRIERS

However, this overview revealed that these benefits may only be experienced by certain populations with reported barriers in use of these systems associated with a user's socio-economic background (Thompson et al., 2016; Otte-Trojel et al., 2016; Goldzeig et al., 2013; Mold et al., 2015; Bush et al., 2015; Kruse et al., 2015a; Amante et al., 2014). The level of someone's education, IT literacy, health literacy, employment, and income as well as their age, gender and ethnicity all seem to impact the use of systems. The digital divide is often a factor when new systems are introduced and who can benefit from these systems. In this overview, users tended to be younger, of a majority, have as higher income and level of education attainment with higher health/computer literacy and with a chronic disease.

A similar study by Archer et al. (2011) conducted a scoping review of the literature on PHRs in order to describe the design, functionality, implementations, applications, outcomes, and perceived and real benefits of PHRs, which had a focus on use in Canada and the U.S. Included in the findings of the review were that people with a strong interest in maintaining healthy lifestyles, are more likely to adopt PHRs. It seems that those who are already have a level of empowerment and understanding of their health and technology will use the system. Whereas, those who may benefit more from use and are currently not empowered (have limited control of their health, not partaking in decision making and have less knowledge of conditions) are being left behind.

When it comes to access and providing equal access to all patients, those who use the system would potentially have greater access to their care provider than those who do not use the system as this overview identified that use improved communication with providers and increased access to health information and preventative care (Price et al., 2015; Mold et al., 2015). For current use of systems or for future implementations, it is vital that all users are able to access these systems and have the opportunity to benefit from use as otherwise as Gibbons (2011) identified, *"if the problems (associated with use) are of a nature such that one population benefits more than another from the technology, the adoption of health IT could actually increase or exacerbate existing healthcare disparities" (p.4).*

Other studies have noted that there limited research into the use of PHRs in particular by elderly users, low-income or minority populations and it is recommended that future research focus on use by users of different ages, education, SES and cultural backgrounds, and health and computer literacy levels (Kim and Nahm, 2012).

Providing access may not remove all barriers, as the motivation to use these systems may revolve around the beliefs or concerns an individual has around the system. This overview also captured components associated with the quality of the system and how the beliefs of both the patients and providers about the quality, value, benefits and usefulness of a system impacts its use (Thompson et al., 2016; Otte-Trojel et al., 2016; Goldzeig et al., 2013; Amante et al., 2014). The usefulness of a system may depend on whether it fits to needs of patients and providers. In this overview, systems that are both patient centered design, fit in with patient busy lives, can be personalized as well as being able to fit with provider's workflows were factors that impacted use (Otte-Trojel et al., 2016; Thompson et al., 2016; Bush et al., 2015; Amante et al., 2014). Other studies have highlighted that PHR systems in particular tend to be physician-oriented, and do not include patient-oriented functionalities and thus do not meet patient needs, furthermore most of the studies on the subject are oriented towards the care providers' points of view, indicating a lack of patient/user involvement in the design and study of PHRs (Pushpangadan and Seckman, 2015; Archer et al., 2011).

The integrity and complexity of data also impacted use highlighting the need for systems to ensure the data contained with the record is accurate, complete and understandable for the user (Thompson et al., 2016; Otte-Trojel et al., 2016; Amante et al., 2014; Bush et al., 2015; Kruse et al., 2015). Lastly, concerns around security were also identified in this overview as the level of security including encryption, firewalls and robust authentication a system has may impact the level of concern a user has about the security, privacy and confidentiality of their data stored in the systems. Concerns around security appears to be an ever pressing one referring to recent events around the world involving ransomware attacks, in particular attacks involving the National Health System in the UK where parts of the service were left paralyzed until the ransom is paid or a fix is found (BBC, 2017). A report by the Economist (2015) on data breaches in the U.S. states that the reports of hacking are on the rise and it is the medical sector that has reported the largest increase in thefts since 2010 with medical records accounting for 43% of all data stolen in 2014. Studies have highlighted concerns around security as a number of healthcare organizations have said to have found that the current encryption and security approaches for many mobile ehealth applications are inadequate at protecting the privacy and confidentiality of data (Househ et al., 2012; Huckvale et al., 2015), which is likely to raise concerns to users as more devices and applications connect and become integrated generating more data of which may be more detailed and personal (Huckvale et al., 2015; Varshney, 2009).

6.4 KEY ENABLERS

To overcome concerns of systems, the use of trials and demonstrations were identified as methods to enable use (Otte-Trojel et al., 2016; Bush et al., 2015). Other enablers included methods to enable use and improve access to systems such as providing users with training to assist those with lower IT literacy and/or proving onsite kiosks to improve access to the system for those whom may not have access to technology (Otte-Trojel et al., 2016). However, a key enabler identified was the influence or recommendations of family and friends (Amante et al., 2014) for patients or healthcare organizations for providers (Thompson et al., 2016). Furthermore, the findings from the reviews captured in the overview also identified that the level of provider encouragement, promotion, engagement or support to use system affected the likelihood of use by patients (Thompson et al., 2016; Amante et al., 2014; Otte-Trojel et al., 2016).

6.5 APPLYING THE ADAPTED CLINICAL ADOPTION FRAMEWORK

It is reported that there has been little work undertaken that has applied a theoretical framework to the study of adoption and use of PHRs (Emani et al., 2012). Other studies such as Nobin et al. (2013) and Emani et al. (2012) have applied theoretical models and concepts to understand PHR adoption such as the Technology Acceptance Model (Davis et al., 1989) and Roger's Diffusion of Innovation theory (Rogers, 2003) respectively. A study by Logue and Efffken (2012) developed a model specific to PHR adoption called the Personal Health Records Adoption Model (PHRAM). The PHRAM describes four factors that interact and influence a user's behaviour (using PHRs to self-manage chronic disease), which shares similar components as presented in the adapted version of the Clinical Adoption Framework, however the adapted CAF aims to capture not only factors of PHR use but also factors concerning Patient Portals as well. The 3 factors of the PRHAM; personal (People) factors (cognitive, affective, and biologic variables that may influence a person's behaviour or decision to change a behaviour), technology factors (how its characteristics influence self- management), and environmental factors (social and physical conditions that may influence a person's behaviour or decision to change a behaviour) are seen as the overarching factors of the adapted CAF. The fourth factor in the PRHAM, chronic disease (covering factors around the ability to self-manage), is seen as a separate entity, whereas in the adapted CAF, this factor could be captured under Personal or People as the specific factor Demographic/Health. How these factors impact behaviour is then captured as a specific outcome.

The development of the PRHAM was in response to the limited comprehensive model of personal health record adoption among older adults with chronic illness found in the literature. Similarly, to the adapted CAF, the purpose of the PHRAM was to capture the barriers and facilitators that could predict adoption of PHRs with the long-term goal of aiding in the development of interventions that increase PHR adoption and reduce barriers, but with the focus on older adults with chronic illness. The adapted CAF aims to take a broader view by not restricting the age of the user and also by capturing the perspectives of providers as well. As mentioned in the rational of this overview, in order to fully comprehend potential barriers to adoption and utilization of PHRs and Portals and to explore the outcomes of use, an overview would need to capture factors impacting use which are associated with patients, caregivers, providers, the healthcare system, the system itself and the environment in which the system is being deployed. By combining these factors and showing how they interlink may shed light into the reasons as to why use is low and why there are currently inconclusive benefits from use. This is the aim of the adapted framework; to illustrate how different factors impact or influence each other at different levels.

The meso level of the adapted CAF including people factors and organization factors (including implementation) is said to have a direct effect on the micro level (Technology, Use/User Satisfaction and Outcomes) and the use of the system. Then as per the original CAF, the meso level is then affected by changes in the macro level, Environmental factors, in terms of standards, legislation, policy and governance, funding & incentives, and societal believes, preference and trends.

As mentioned in the methodology, a proposed of example of an outcome of use would be where a system that has a high system, information and service quality is associated with more use and greater user satisfaction, which then potentially leads to a positive result or net benefit with the knowledge of success being fed back into the environment level and informing opinion and knowledge of system use. Whereas, a system with a negative net benefit could be as a result of a poor-quality system with greater dissatisfaction and less use and in turn, negatively affect the opinion of the systems in general (DeLone and McLean, 2003).

Using the Adapted CAF, a proposed scenario or interplay of factors from the findings of the overview could include an outcome, such as improved communication which may impact a decision or motivation by a health organisation to implement or use a system (Environment) thus impacting access for providers (Organisation) and patients (People) and/or support or incentives to providers to use these systems. The use of the system may be affected by the providers' belief of the system such as impact of workload, which may then impact their level support provided to patients to use the system (Organisation, Technology and Use/User Satisfaction). Using the system could either affirm or allay concerns and beliefs and in turn impact further use, furthermore use may depend on ensuring all have equal access to these systems (People, Organisation, Technology, Use/User Satisfaction). As a result of use, it is observed that communication (Outcomes) has improved then knowledge of this outcome may flow back to influence the provider and patient's beliefs around value as well as to the environment and influence decision of organisations or health authorities.

This overview identified improved communication as an outcome, however, a negative or inconclusive outcome such as the ability of the systems to live up to the promise to empower patients leading to positive health outcomes may result in deterring organizations to invest and implement these systems. That being said this overview did identify a number of benefits from use and highlighted factors that may be impeding use and impacting the generation of further positive outcomes.

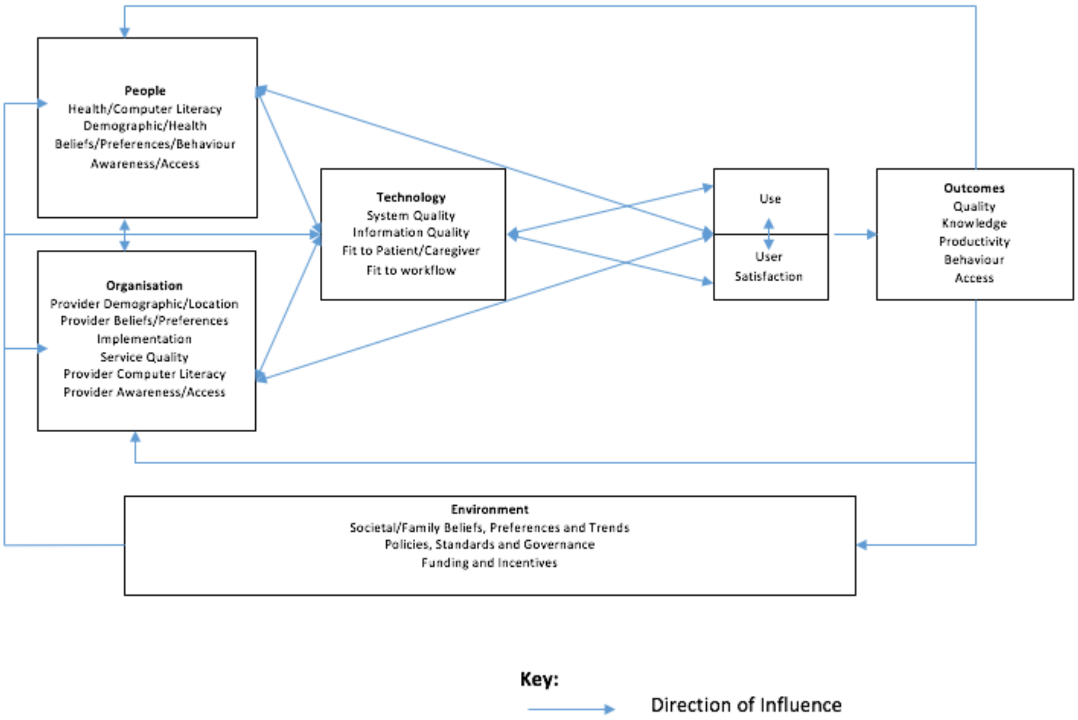


Figure 5: Adapted Clinical Adoption Framework

6.6 RECOMMENDATIONS

The following recommendations for future research and implementations of PHRs and Portals were derived from the findings of this overview:

1. Future research of PHRs and Portals should include identifying ways to improve access and use for those who are less empowered such as minorities, those with lower income and lower educational attainment, and those with less health literacy and computer literacy. Other studies have noted a shortfall in this reach area and have recommended that future research focus on the needs of users with different ages, level of education, SES and cultural backgrounds, and health and computer literacy levels (Kim and Nahm, 2012).
2. Within this research and also future development of systems, there should be a focus on patient-oriented functionalities as well as providers', this includes developing systems that fit in with patients' busy lives, can be personalized as well as being able to fit with providers' workflows (Otte-Trojel et al., 2016; Thompson et al., 2016; Bush et al., 2015; Amante et al., 2014; Pushpangadan and Seckman, 2015; Archer et al., 2011).
3. The use of trials and demonstrations may improve future implementations by helping to ensure that the system chosen meets the needs of all users (Otte-Trojel et al., 2016; Bush et al., 2015). Furthermore, once implemented, classes should be set up to teach users, particularly with lower IT literacy, to use these systems and onsite kiosks should be provided to improve access to the systems. (Otte-Trojel et al., 2016).
4. Finally, ensuring users are encouraged and supported to use these systems once implemented. This involves ensuring buy-in from providers as this overview revealed that providers can influence patient use. Linked to this would be ensuring that the systems meet providers' needs as mentioned above and also putting in place appropriate levels of incentives for providers to use them.

7.0 LIMITATIONS AND STUDY CHALLENGES

There a number of limitations to this overview that need to be acknowledged including confounding factors that may impact the findings. The restrictions in dates, availability of abstract and language in the search criteria may have resulted in excluding reviews relevant to this overview. Smith et al. (2011) states that although applying language restrictions is not recommended, it is likely unavoidable due to constraints such as a lack of access to translation services. It is advised reporting the difference between searches with and without language restrictions may be beneficial in order to estimate the amount of citations that may have been excluded (Smith et al., 2011), however due to time restrictions for this overview this action was not possible. This approach could also be followed for identifying reviews that have been excluded due to not having an abstract and or fall outside the date period, but again due to time limitations this additional search was not performed. Further limitations in the selection of the reviews for this overview may be caused in the choice to include reviews that only identify themselves as systematic reviews which may have led to excluding papers which did undertake a systematic review methodology, but did not state this in the title of the article (Pare et al., 2015). By only including papers that identify as systematic reviews did provide a standardised process for selecting papers and decreases the potential of the author misinterpreting if a paper is truly is a systematic review or not. That being said, although a paper is identifying as a systematic review, this does not necessarily mean that it follows the systematic review methodology as mentioned in the article by Pare et al. (2015) which highlights inaccuracy or inconsistently in the titling of review studies.

The literature search and data extraction was conducted by just one author which opens the possibility for potential selection bias in terms of interpretation of relevance when selecting systematic reviews, assessing the quality of each review and extracting and coding the findings of each of the reviews. The standardised tool R-AMSTAR was used to assist with assessing the methodological quality of each review and to identify studies that may have a higher potential of bias. Excluding lesser quality papers would then improve the overall quality of the findings. No systematic reviews within this overview were excluded due to concerns around overall quality, which would suggest that the quality of the reviews was considered acceptable, however further caution is warranted as the use of the R-AMSTAR tool is not without limitations as well. As mentioned in the Methodology chapter, it has been suggested that the R-AMSTAR tool poses challenges for the user when assigning adequate weighting of items according to their importance of inclusion. Furthermore, the evaluation of each review is based on the user's interpretation of the reporting and if the information provided meets the criteria or not. It is possible that another user may interpret the quality of each paper differently and assign a different score. The use of a second evaluator who then compares scores may improve the accuracy of the reporting on quality.

It could be argued that the R-AMSTAR evaluates the reporting of each paper, and as Mohel et al. (2009) highlights, the absence of reporting one of the criteria such as a of publication bias, does not necessarily indicate that it was not done. Furthermore, even if the possibility of publication bias is assessed, there is no guarantee that authors of the systematic reviews have assessed or interpreted it appropriately (Mohel et al., 2009). Secondly, the use of R-AMSTAR may show if a review reports accurately, but then does not identify if the results of the studies are interpreted correctly. As this is an overview of review, the author provides an interpretation of the findings of each systematic review with each systematic review having interpreted the findings of each of the primary studies. This may have resulted in errors in interpretation which are carried through each of the findings. An important factor in one of the primary studies may have been missed or misinterpreted, thus impacting the findings of the systematic review, and this overview of reviews. Only by re-analysing the findings of the individual primary studies included in the systematic reviews, would reduce the presence of publication bias and highlight any misinterpretation of the findings present in the systematic reviews.

Similarly, with the overlap and duplication of findings, without looking at the findings of each of the individual primary studies, it will likely not be possible to identify which finding has been reported more than once. Only by removing the duplicates and then performing a reanalysis of the data would allow for a truer representation of the findings and reduce the possibility that of some results having an overrepresentation and distorting the findings. To counter this weakness, a summary of the overlap was provided to give some indication of potential overlap of the findings. The benefit of the summary of overlap results were slightly impacted by not being able to identify the studies included in the systematic review of Otte-Trojel et al. (2016) which consisted of 109 studies. In the systematic review by Otte-Trojel et al. (2016), it mentions that the details of the included studies are available in an online supplementary file, however this author through consultation with the library of the University of Victoria, was unable to locate this supplementary file. This author also contacted the author of the said systematic review to see if the details of the primary studies could be provided, however received no response.

With the acknowledgment of potential bias in the findings and possibility of findings having overrepresentation, the findings of this review should be interpreted with some caution. Kruse et al. (2015a) criticizes a systematic review by Ammenwerth et al. (2012) who included PHRs in their search as the system is significantly different from a patient portal in terms of ownership and management. This overview also combines PHRs and Portals together and presenting the findings referring to the system which could be a PHR or Portal. It is noted that the majority of papers included in the overview do focus on portals and so the findings reported may reflect this.

By following the PRISMA statement, provided a standardised structure to help to improve the reporting of this overview and increased the reliability and reproducibility of the overview process by providing comprehensive documentation of the literature search process, data extraction, coding and the analysis performed in the overview (Pare et al., 2015). These details were included using the Literature Search Flow Diagram and tables that details papers included and excluded with reason provided and tables that detail the findings of each review and how they were coded and incorporated into an adapted CAF.

8.0 CONCLUSION

The above overview of reviews presented the barriers, enablers and benefits of PHR and Portal use as identified in systematic reviews over the past 10 years. An adapted Clinical Adoption Framework was used to capture these findings and show how they interlink and influence each other. Although the methodological quality of the included 11 reviews were evaluated as satisfactory, this overview had a number of limitations as described above which mean that the findings of this review should be interpreted with some caution.

Several barriers to use were identified in this overview namely, the socio-economic background of users, the patient's and provider's beliefs of the system and the usability and usefulness of the systems. An enabler of use included encouragement from social supports and providers to use these systems. The use of PHRs and Portals do appear to produce some benefits such as improved communication, but the ability of these systems to empower patients leading to positive health outcomes remains to be confirmed with inconclusive results being reported for improvements in self-care and/or management or participation in care, and inconclusive results for improvements in disease/health outcomes.

Recommendations for future research and implementation of PHRs and Portals include improving access and use for those who are less empowered, developing systems to meet the needs of patient and providers, and ensuring users are encouraged and supported to use these systems once implemented.

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APPENDICES

Appendix 1: Literature Search - Indentification

Search String	Criteria	Citations
(((systematic review [ti] OR meta-analysis [pt] OR meta-analysis [ti] OR systematic literature review [ti] OR this systematic review [tw] OR pooling project [tw] OR (systematic review [tiab] AND review [pt]) OR meta synthesis [ti] OR meta-analy*[ti] OR integrative review [tw] OR integrative research review [tw] OR rapid review [tw] OR umbrella review [tw] OR consensus development conference [pt] OR practice guideline [pt] OR drug class reviews [ti] OR cochrane database syst rev [ta] OR acp journal club [ta] OR health technol assess [ta] OR evid rep technol assess summ [ta] OR jbi database system rev implement rep [ta]) OR (clinical guideline [tw] AND management [tw]) OR ((evidence based[ti] OR evidence-based medicine [mh] OR best practice* [ti] OR evidence synthesis [tiab]) AND (review [pt] OR diseases category[mh] OR behavior and behavior mechanisms [mh] OR therapeutics [mh] OR evaluation studies[pt] OR validation studies[pt] OR guideline [pt] OR pmcbook)) OR ((systematic [tw] OR systematically [tw] OR critical [tiab] OR (study selection [tw]) OR (predetermined [tw] OR inclusion [tw] AND criteri* [tw]) OR exclusion criteri* [tw] OR main outcome measures [tw] OR standard of care [tw] OR standards of care [tw]) AND (survey [tiab] OR surveys [tiab] OR overview* [tw] OR review [tiab] OR reviews [tiab] OR search* [tw] OR handsearch [tw] OR analysis [ti] OR critique [tiab] OR appraisal [tw] OR (reduction [tw]AND (risk [mh] OR risk [tw]) AND (death OR recurrence))) AND (literature [tiab] OR articles [tiab] OR publications [tiab] OR publication [tiab] OR bibliography [tiab] OR bibliographies [tiab] OR published [tiab] OR pooled data [tw] OR unpublished [tw] OR citation [tw] OR citations [tw] OR database [tiab] OR internet [tiab] OR textbooks [tiab] OR references [tw] OR scales [tw] OR papers [tw] OR datasets [tw] OR trials [tiab] OR meta-analy* [tw] OR (clinical [tiab] AND studies [tiab]) OR treatment outcome [mh] OR treatment outcome [tw] OR pmcbook)) NOT (letter [pt] OR newspaper article [pt]))) AND ("Health Records, Personal"[Mesh] OR PHR[tiab] OR "patient portal"[tiab])	Jan-2006 to Dec-2016 Abstract Available English	410

Appendix 2: Literature Search - Screening

Included

Author(s)	Year	Title	Reason For Inclusion
Akhlaq et al.	2015	Barriers and facilitators to health information exchange in low-and middle-income country settings: a systematic review protocol.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available
Amante et al.	2014	A systematic review of electronic portal usage among patients with diabetes.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Ammenwerth et al.	2011	Patient empowerment by electronic health records: first results of a systematic review on the benefit of patient portals.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Ammenwerth et al.	2012	The impact of electronic patient portals on patient care: a systematic review of controlled trials.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Bush et al.	2015	Implementation of the Integrated Electronic Patient Portal in the Pediatric Population: A Systematic Review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Giardina et al.	2014	Patient access to medical records and healthcare outcomes: a systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
De Lusignan et al.	2014	Patients' online access to their electronic health records and linked online services: a systematic interpretative review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review

Goldzweig et al.	2013	Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Kruse et al.	2015	Patient and provider attitudes toward the use of patient portals for the management of chronic disease: a systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Kruse et al.	2015	The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Mair et al.	2012	Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Mold et al.	2015	Patients' online access to their electronic health records and linked online services: a systematic review in primary care.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Mold et al.	2012	The provision and impact of online patient access to their electronic health records (EHR) and transactional services on the quality and safety of health care: systematic review protocol.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Otte-Trojel et al.	2016	What do we know about developing patient portals? a systematic literature review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Prey et al.	2014	Patient engagement in the inpatient setting: a systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review

Price et al.	2015	Conditions potentially sensitive to a personal health record (PHR) intervention, a systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Thompson et al.	2016	Work system barriers to patient, provider, and caregiver use of personal health records: A systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review
Videl et al.	2013	Health information technologies in geriatrics and gerontology: a mixed systematic review.	1. Focused on use of an electronic PHR/Portal 2. English language 3. Abstract available 3. Published between Jan 2006 - Dec 2016 4. Included for further review

Excluded

Author(s)	Year	Title	Reason For Exclusion
?	2015	Progress in electronic medical record adoption in Canada.	1. Off topic/not relevant - does not focus on PHR/Portals.
Abdul Pari et al,	2014	Economic evaluations in bipolar disorder: a systematic review and critical appraisal.	1. Off topic/not relevant - does not focus on PHR/Portals.
Abhyankar et al.	2014	Combining structured and unstructured data to identify a cohort of ICU patients who received dialysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Abramson et al.	2014	Consumer perspectives on personal health records: a 4-community study.	3. Not identified as a systematic review
Adelson et al.	2014	Implementation of electronic chemotherapy ordering: an opportunity to improve evidence-based oncology care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Aghazadeh et al.	2014	The impact of software quality characteristics on healthcare outcome: a literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Aizpuru et al.	2012	Variability in the detection and monitoring of chronic patients in primary care according to what is registered in the electronic health record.	1. Off topic/not relevant - does not focus on PHR/Portals.
Al-Rawajfah et al.	2015	Use of Electronic Health-Related Datasets in Nursing and Health-Related Research.	1. Off topic/not relevant - does not focus on PHR/Portals.
Albu et al.	2013	Expansion of electronic health record-based screening, prevention, and management of diabetes in New York City.	1. Off topic/not relevant - does not focus on PHR/Portals.
Alkureishi et al.	2016	Impact of Electronic Medical Record Use on the Patient-Doctor Relationship and Communication: A Systematic Review.	1. Off topic/not relevant - does not focus on PHR/Portals.

Alton et al.	2015	Is there a difference in neurologic outcome in medical versus early operative management of cervical epidural abscesses?	1. Off topic/not relevant - does not focus on PHR/Portals.
Andreasen et al.	2012	Dental Trauma Guide: a source of evidence-based treatment guidelines for dental trauma.	1. Off topic/not relevant - does not focus on PHR/Portals.
Arend et al.	2012	The patient-centered medical home: history, components, and review of the evidence.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ateya et al.	2016	The value of structured data elements from electronic health records for identifying subjects for primary care clinical trials.	1. Off topic/not relevant - does not focus on PHR/Portals.
Au-yeung et al.	2010	Physician's manual reporting underestimates mortality: evidence from a population-based HIV/AIDS treatment program.	1. Off topic/not relevant - does not focus on PHR/Portals.
Azad et al.	2016	Building an electronic health record integrated quality of life outcomes registry for spine surgery	1. Off topic/not relevant - does not focus on PHR/Portals.
Azim et al.	2012	Prognosis of pregnancy-associated breast cancer: a meta-analysis of 30 studies.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bachiri et al.	2016	Mobile personal health records for pregnancy monitoring functionalities: Analysis and potential.	3. Not identified as a systematic review
Baer et al.	2013	Using electronic health records to address overweight and obesity: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bailey et al.	2013	Does health information exchange reduce unnecessary neuroimaging and improve quality of headache care in the emergency department?	1. Off topic/not relevant - does not focus on PHR/Portals.
Baro et al.	2015	Toward a Literature-Driven Definition of Big Data in Healthcare.	1. Off topic/not relevant - does not focus on PHR/Portals.
Baumlin et al.	2010	Electronic collaboration: using technology to solve old problems of quality care.	3. Not identified as a systematic review
Beaulleu et al.	2013	Endoscopy reporting standards.	1. Off topic/not relevant - does not focus on PHR/Portals.
Beckam et al.	2016	Marked sex differences in all-cause mortality on antiretroviral therapy in low- and middle-income countries: a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ben-Assuli et al.	2015	On Analyzing Readmissions Using A Trajectory Model: Evidence From Israel.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bernacki et al.	2014	Communication about serious illness care goals: a review and synthesis of best practices.	1. Off topic/not relevant - does not focus on PHR/Portals.
Berry et al.	2011	ProvenCare perinatal: a model for delivering evidence/ guideline-based care for perinatal populations.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bhatti et al.	2012	Managing data in surgical trials: a guide to modern-day data management systems.	1. Off topic/not relevant - does not focus on PHR/Portals.
Black et al.	2015	Pharmacovigilance in children: detecting adverse drug reactions in routine electronic healthcare records. A systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.

Black et al.	2011	The impact of eHealth on the quality and safety of health care: a systematic overview.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bloice et al.	2013	On the usage of health records for the design of Virtual Patients: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Boland et al.	2013	Adoption of electronic health records and preparations for demonstrating meaningful use: an American Academy of Ophthalmology survey.	1. Off topic/not relevant - does not focus on PHR/Portals.
Boonstra & Broekhuis	2010	Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions.	1. Off topic/not relevant - does not focus on PHR/Portals.
Boonstra et al.	2014	Implementing electronic health records in hospitals: a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bouaud et al.	2009	Consequences of the verification of completeness in clinical practice guideline modeling: a theoretical and empirical study with hypertension.	1. Off topic/not relevant - does not focus on PHR/Portals.
Boyle et al.	2014	Use of electronic health records to support smoking cessation.	1. Off topic/not relevant - does not focus on PHR/Portals.
Boyle et al.	2011	Use of electronic health records to support smoking cessation.	1. Off topic/not relevant - does not focus on PHR/Portals.
Boyle et al.	2010	Electronic medical records to increase the clinical treatment of tobacco dependence: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Branstetter et al.	2014	Evidence-based use of electronic clinical tracking systems in advanced practice registered nurse education: an integrative review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Breckenridge et al.	2015	How to routinely collect data on patient-reported outcome and experience measures in renal registries in Europe: an expert consensus meeting.	1. Off topic/not relevant - does not focus on PHR/Portals.
Bretthauer et al.	2016	Requirements and standards facilitating quality improvement for reporting systems in gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement.	1. Off topic/not relevant - does not focus on PHR/Portals.
Brown et al.	2016	Preferences of Current and Potential Patients and Family Members Regarding Implementation of Electronic Communication Portals in Intensive Care Units.	3. Not identified as a systematic review
Brown et al.	2015	Giving women their own case notes to carry during pregnancy.	2. Paper based record
Burnett et al.	2011	Missing clinical information in NHS hospital outpatient clinics: prevalence, causes and effects on patient care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Busetto et al.	2016	Context, mechanisms and outcomes of integrated care for diabetes mellitus type 2: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.

Butler et al.	2015	The Combat Medic Aid Bag: 2025. CoTCCC Top 10 Recommended Battlefield Trauma Care Research, Development, and Evaluation Priorities for 2015.	1. Off topic/not relevant - does not focus on PHR/Portals.
Butt et al.	2015	Endothelial function in migraine with aura - a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Byrom et al.	2015	Increased mortality for pregnancy-associated melanoma: systematic review and meta-analysis	1. Off topic/not relevant - does not focus on PHR/Portals.
Caldarella et al.	2012	Feasibility of evaluating quality cancer care using registry data and electronic health records: a population-based study.	1. Off topic/not relevant - does not focus on PHR/Portals.
Caldwell & Power	2012	The pros and cons of electronic prescribing for children.	1. Off topic/not relevant - does not focus on PHR/Portals.
Callen et al.	2015	Emergency physicians' views of direct notification of laboratory and radiology results to patients using the Internet: a multisite survey.	3. Not identified as a systematic review
Campanella et al.	2016	The impact of electronic health records on healthcare quality: a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Capurro et al.	2013	Palliative care from a medical informatics perspective in Chile, Germany, and Peru.	1. Off topic/not relevant - does not focus on PHR/Portals.
Carayon et al.	2015	Impact of electronic health record technology on the work and workflow of physicians in the intensive care unit.	1. Off topic/not relevant - does not focus on PHR/Portals.
Carling et al.	2013	Risks to patient safety associated with implementation of electronic applications for medication management in ambulatory care--a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Carmell et al.	2012	Evicase: an evidence-based case structuring approach for personalized healthcare.	1. Off topic/not relevant - does not focus on PHR/Portals.
Carrion Senor et al.	2012	Are personal health records safe? A review of free web-accessible personal health record privacy policies.	3. Not identified as a systematic review
Carspecken et al.	2013	A clinical case of electronic health record drug alert fatigue: consequences for patient outcome.	1. Off topic/not relevant - does not focus on PHR/Portals.
Castillo et al.	2010	A knowledge-based taxonomy of critical factors for adopting electronic health record systems by physicians: a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Cataldo et al.	2010	Cigarette smoking is a risk factor for Alzheimer's Disease: an analysis controlling for tobacco industry affiliation.	1. Off topic/not relevant - does not focus on PHR/Portals.
Chambers et al.	2012	Position paper on digital communication in dentistry.	1. Off topic/not relevant - does not focus on PHR/Portals.
Chazard et al.	2015	Process assessment by automated computation of healthcare quality indicators in hospital electronic health records: a systematic review of indicators.	1. Off topic/not relevant - does not focus on PHR/Portals.
Chen et al.	2015	Why providers transfuse blood products outside recommended guidelines in spite of integrated electronic best practice alerts.	1. Off topic/not relevant - does not focus on PHR/Portals.

Chomutare et al.	2011	Features of mobile diabetes applications: review of the literature and analysis of current applications compared against evidence-based guidelines.	1. Off topic/not relevant - does not focus on PHR/Portals.
Chrimes et al.	2014	Usability testing of Avoiding Diabetes Thru Action Plan Targeting (ADAPT) decision support for integrating care-based counseling of pre-diabetes in an electronic health record.	1. Off topic/not relevant - does not focus on PHR/Portals.
Christmas et al.	2009	Removal of erythropoietin from anemia trauma practice guideline does not increase red blood cell transfusions and decreases hospital utilization costs.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ciemins et al.	2009	Beyond health information technology: critical factors necessary for effective diabetes disease management.	1. Off topic/not relevant - does not focus on PHR/Portals.
Cole et al.	2015	Reported Use of Electronic Health Records to Implement Evidence Based Approaches to Colorectal Cancer Screening in Community Health Centers.	1. Off topic/not relevant - does not focus on PHR/Portals.
Collins et al.	2011	Content overlap in nurse and physician handoff artifacts and the potential role of electronic health records: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Cormick et al.	2016	Inter-pregnancy interval and risk of recurrent pre-eclampsia: systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Crain et al,	2013	Designing and implementing research on a statewide quality improvement initiative: the DIAMOND study and initiative.	1. Off topic/not relevant - does not focus on PHR/Portals.
Crumbley & Kane	2010	Development of an evidence-based pressure ulcer program at the National Naval Medical Center: nurses' role in risk factor assessment, prevention, and intervention among young service members returning from OIF/OEF.	1. Off topic/not relevant - does not focus on PHR/Portals.
Crux Zapata et al.	2014	Mobile PHRs compliance with Android and iOS usability guidelines.	3. Not identified as a systematic review
Cuggia et al.	2015	Automatic Selection of Clinical Trials Based on A Semantic Web Approach.	1. Off topic/not relevant - does not focus on PHR/Portals.
Cusack et al.	2013	The future state of clinical data capture and documentation: a report from AMIA's 2011 Policy Meeting.	1. Off topic/not relevant - does not focus on PHR/Portals.
Daker-white et al.	2015	Blame the Patient, Blame the Doctor or Blame the System? A Meta-Synthesis of Qualitative Studies of Patient Safety in Primary Care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Danaei et al.	2013	Statins and risk of diabetes: an analysis of electronic medical records to evaluate possible bias due to differential survival.	1. Off topic/not relevant - does not focus on PHR/Portals.
Darsaklis et al.	2011	Predictive validity of Prechtl's Method on the Qualitative Assessment of General Movements: a systematic review of the evidence.	1. Off topic/not relevant - does not focus on PHR/Portals.

Davis et al.	2014	A qualitative study of rural primary care clinician views on remote monitoring technologies.	1. Off topic/not relevant - does not focus on PHR/Portals.
Davis et al.	2014	A systematic review of clinician and staff views on the acceptability of incorporating remote monitoring technology into primary care.	1. Off topic/not relevant - does not focus on PHR/Portals.
De Bruin et al.	2014	Data use and effectiveness in electronic surveillance of healthcare associated infections in the 21st century: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
De Hoog et al.	2014	Family history tools for primary care are not ready yet to be implemented. A systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
De la Torre-Diez et al.	2015	Cost-utility and cost-effectiveness studies of telemedicine, electronic, and mobile health systems in the literature: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
De Lusignan	2014	Coding errors in an analysis of the impact of pay-for-performance on the care for long-term cardiovascular disease: a case study.	1. Off topic/not relevant - does not focus on PHR/Portals.
Dean et al.	2009	Review: use of electronic medical records for health outcomes research: a literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Declerck & Aime	2014	Reasons (not) to Spend a Few Billions More on EHRs: How Human Factors Research Can Help.	1. Off topic/not relevant - does not focus on PHR/Portals.
Dellefield et al.	2008	Best practices in nursing homes. Clinical supervision, management, and human resource practices.	1. Off topic/not relevant - does not focus on PHR/Portals.
Demonceau et al.	2013	Identification and assessment of adherence-enhancing interventions in studies assessing medication adherence through electronically compiled drug dosing histories: a systematic literature review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Di Giorgio et al.	2016	Potentially inappropriate drug prescribing in elderly hospitalized patients: an analysis and comparison of explicit criteria.	1. Off topic/not relevant - does not focus on PHR/Portals.
Dorling et al.	2015	The NIHR Public Health Research Program: responding to local authority research needs in the United Kingdom.	1. Off topic/not relevant - does not focus on PHR/Portals.
Dragen et al.	2015	Using a Simulated Infobutton Linked to an Evidence-Based Resource to Research Drug-Drug Interactions: A Pilot Study with Third-Year Dental Students.	1. Off topic/not relevant - does not focus on PHR/Portals.
Drake et al.	2012	Chromium infusion in hospitalized patients with severe insulin resistance: a retrospective analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Dullabh et al.	2010	Measurement of the utilization of an installed electronic health record.	1. Off topic/not relevant - does not focus on PHR/Portals.
Duong et al.	2012	Evaluation of primary/preferred language data collection.	1. Off topic/not relevant - does not focus on PHR/Portals.

Eden et al.	2016	Barriers and facilitators to exchanging health information: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Eidlitz-Markus et al.	2014	Characteristics and management of arachnoid cyst in the pediatric headache clinic setting.	1. Off topic/not relevant - does not focus on PHR/Portals.
El Miedany et al.	2010	Incorporating patient reported outcome measures in clinical practice: development and validation of a questionnaire for inflammatory arthritis.	1. Off topic/not relevant - does not focus on PHR/Portals.
El-Mallakh et al.	2014	Challenges of implementing a medication management evidence-based practice in a community mental health setting: results of a qualitative study.	1. Off topic/not relevant - does not focus on PHR/Portals.
Elkin et al.	2013	The usability-error ontology.	1. Off topic/not relevant - does not focus on PHR/Portals.
Englemann & Jordan	2012	Outcome measures used in pediatric stroke studies: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Erwin et al.	2016	Time to Guideline-Based Empiric Antibiotic Therapy in the Treatment of Pneumonia in a Community Hospital: A Retrospective Review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Farrelly et al.	2013	User-held personalised information for routine care of people with severe mental illness.	3. Not identified as a systematic review
Fernado et al.	2012	Benefits and risks of structuring and/or coding the presenting patient history in the electronic health record: systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fernández-Aceñero et al.	2015	Morphological aspects of the hepatic response to neoadjuvant therapy.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fernández-Aleman et al.	2013	Security and privacy in electronic health records: a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fernández-Alemán et al.	2013	Free Web-based personal health records: an analysis of functionality.	3. Not identified as a systematic review
Flemming & Hubner	2013	How to improve change of shift handovers and collaborative grounding and what role does the electronic patient record system play? Results of a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fontaine et al.	2010	Systematic review of health information exchange in primary care practices.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fossum et al.	2013	Effects of a computerized decision support system on care planning for pressure ulcers and malnutrition in nursing homes: an intervention study.	1. Off topic/not relevant - does not focus on PHR/Portals.
Foster et al.	2012	The use of routinely collected patient data for research: a critical review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fowler et al.	2014	Electronic health record: integrating evidence-based information at the point of clinical decision making.	1. Off topic/not relevant - does not focus on PHR/Portals.

Fraccaro et al.	2016	An external validation of models to predict the onset of chronic kidney disease using population-based electronic health records from Salford, UK.	1. Off topic/not relevant - does not focus on PHR/Portals.
Frisher et al.	2010	Determining patient characteristics for decision analysis support systems using anonymized electronic patient records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Fritz et al.	2015	Success criteria for electronic medical record implementations in low-resource settings: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Froen et al.	2016	eRegistries: Electronic registries for maternal and child health.	1. Off topic/not relevant - does not focus on PHR/Portals.
Gallego et al.	2010	Assessing the cost of electronic health records: a review of cost indicators.	1. Off topic/not relevant - does not focus on PHR/Portals.
Garcia-Rio et al.	2013	Spirometry. Spanish Society of Pulmonology and Thoracic Surgery (SEPAR).	1. Off topic/not relevant - does not focus on PHR/Portals.
Garg et al.	2015	Development and evaluation of an electronic health record-based best-practice discharge checklist for hospital patients.	1. Off topic/not relevant - does not focus on PHR/Portals.
Gephart et al.	2015	A Systematic Review of Nurses' Experiences With Unintended Consequences When Using the Electronic Health Record.	1. Off topic/not relevant - does not focus on PHR/Portals.
Giglio et al.	2016	Oncological Outcomes of Major Liver Resection Following Portal Vein Embolization: A Systematic Review and Meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Giuse et al.	2010	Integrating best evidence into patient care: a process facilitated by a seamless integration with informatics tools.	3. Not identified as a systematic review
Given et al.	2014	Comparing patient generated blood glucose diary records with meter memory in type 2 diabetes.	1. Off topic/not relevant - does not focus on PHR/Portals.
Given et al.	2013	Comparing patient-generated blood glucose diary records with meter memory in diabetes: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Gold et al.	2016	Low Back Imaging When Not Indicated: A Descriptive Cross-System Analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Gold et al.	2015	Study protocol for "Study of Practices Enabling Implementation and Adaptation in the Safety Net (SPREAD-NET)": a pragmatic trial comparing implementation strategies.	1. Off topic/not relevant - does not focus on PHR/Portals.
Goldstein et al.	2014	Brief review: Adoption of electronic medical records to enhance acute pain management.	1. Off topic/not relevant - does not focus on PHR/Portals.
Goldzweig et al.	2015	Electronic health record-based interventions for improving appropriate diagnostic imaging: a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.

Gooch & Roudsari	2011	Computerization of workflows, guidelines, and care pathways: a review of implementation challenges for process-oriented health information systems.	1. Off topic/not relevant - does not focus on PHR/Portals.
Goveia et al.	2013	Educational interventions to improve the meaningful use of Electronic Health Records: a review of the literature: BEME Guide No. 29.	1. Off topic/not relevant - does not focus on PHR/Portals.
Govindarajan et al.	2010	Patient-centered integrated networks of emergency care: consensus-based recommendations and future research priorities.	1. Off topic/not relevant - does not focus on PHR/Portals.
Gravely-Witte et al.	2010	Effects of cardiac rehabilitation referral strategies on referral and enrollment rates.	1. Off topic/not relevant - does not focus on PHR/Portals.
Griebel et al.	2013	Key factors for a successful implementation of personalized e-health services.	3. Not identified as a systematic review
Gulliford et al.	2011	Cluster randomised trial in the General Practice Research Database: 1. Electronic decision support to reduce antibiotic prescribing in primary care (eCRT study).	1. Off topic/not relevant - does not focus on PHR/Portals.
Gysels et al.	2008	Does the patient-held record improve continuity and related outcomes in cancer care: a systematic review.	2. Paper based record
Haga & Moaddeb	2014	Comparison of delivery strategies for pharmacogenetic testing services.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hage et al.	2013	Implementation factors and their effect on e-Health service adoption in rural communities: a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hanauer et al.	2015	Supporting information retrieval from electronic health records: A report of University of Michigan's nine-year experience in developing and using the Electronic Medical Record SearchEngine (EMERSE).	1. Off topic/not relevant - does not focus on PHR/Portals.
Handel & Hackman	2010	Implementing electronic health records in the emergency department.	1. Off topic/not relevant - does not focus on PHR/Portals.
Handel et al.	2011	Using information technology to improve the quality and safety of emergency care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hardiker & Grant	2011	Factors that influence public engagement with eHealth: A literature review.	3. Not identified as a systematic review
Hardiker & Grant	2010	Barriers and facilitators that affect public engagement with eHealth services.	3. Not identified as a systematic review
Harrison et al.	2015	Developing the surveillance algorithm for detection of failure to recognize and treat severe sepsis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hartman & Eslick	2016	The prognosis of women diagnosed with breast cancer before, during and after pregnancy: a meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.

Hartzler et al.	2011	Sharing is caring, but not error free: transparency of granular controls for sharing personal health information in social networks.	3. Not identified as a systematic review
Hattink et al.	2016	Evaluation of the Digital Alzheimer Center: Testing Usability and Usefulness of an Online Portal for Patients with Dementia and Their Carers.	3. Not identified as a systematic review
Hawley et al.	2014	In a maternity shared-care environment, what do we know about the paper hand-held and electronic health record: a systematic literature review.	2. Paper based record
He et al.	2015	Assessing the Collective Population Representativeness of Related Type 2 Diabetes Trials by Combining Public Data from ClinicalTrials.gov and NHANES.	1. Off topic/not relevant - does not focus on PHR/Portals.
Heaton et al.	2016	Effect of scribes on patient throughput, revenue, and patient and provider satisfaction: a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hedges & Woon	2010	Alcohol use and hippocampal volume deficits in adults with posttraumatic stress disorder: A meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Herasevich et al.	2010	Informatics infrastructure for syndrome surveillance, decision support, reporting, and modeling of critical illness.	1. Off topic/not relevant - does not focus on PHR/Portals.
Heselmans et al.	2013	Feasibility and impact of an evidence-based electronic decision support system for diabetes care in family medicine: protocol for a cluster randomized controlled trial.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hoerbst et al.	2010	SeReM2--a meta-model for the structured definition of quality requirements for electronic health record services.	1. Off topic/not relevant - does not focus on PHR/Portals.
Holroyd-Leduc et al.	2011	The impact of the electronic medical record on structure, process, and outcomes within primary care: a systematic review of the evidence.	1. Off topic/not relevant - does not focus on PHR/Portals.
Holstiege et al.	2015	Effects of computer-aided clinical decision support systems in improving antibiotic prescribing by primary care providers: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hopf et al.	2014	Views of healthcare professionals to linkage of routinely collected healthcare data: a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Horsky et al.	2012	Interface design principles for usable decision support: a targeted review of best practices for clinical prescribing interventions.	1. Off topic/not relevant - does not focus on PHR/Portals.
Howie et al.	2014	Assessing the value of patient-generated data to comparative effectiveness research.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hsieh	2015	Physicians' acceptance of electronic medical records exchange: an extension of the decomposed TPB model with institutional trust and perceived risk.	1. Off topic/not relevant - does not focus on PHR/Portals.

HU et al.	2012	A healthcare utilization analysis framework for hot spotting and contextual anomaly detection.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hudgins et al.	2013	Navigating the legal and ethical foundations of informed consent and confidentiality in integrated primary care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Huebsch et al.	2015	A qualitative study of processes used to implement evidence-based care in a primary care practice.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hughes	2011	Evidence-based medicine in health care reform.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hume et al.	2016	Current applications and future directions for the CDISC Operational Data Model standard: A methodological review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Hypponen et al.	2014	Impacts of structuring the electronic health record: a systematic review protocol and results of previous reviews.	1. Off topic/not relevant - does not focus on PHR/Portals.
Irani et al.	2009	The use of electronic health records in the exam room and patient satisfaction: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Irizarry et al.	2015	Patient Portals and Patient Engagement: A State of the Science Review.	3. Not identified as a systematic review
Jaana et al.	2012	EMRs and clinical IS implementation in hospitals: a statewide survey.	1. Off topic/not relevant - does not focus on PHR/Portals.
Jackson et al.	2014	United Kingdom National Ophthalmology Database study of vitreoretinal surgery: report 3, retinal detachment.	1. Off topic/not relevant - does not focus on PHR/Portals.
Jago et al.	2016	Bristol Girls Dance Project: a cluster randomised controlled trial of an after-school dance programme to increase physical activity among 11- to 12-year-old girls.	1. Off topic/not relevant - does not focus on PHR/Portals.
Jamal et al.	2009	The impact of health information technology on the quality of medical and health care: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
James et al.	2014	GAPS in implementing health assessments in primary care: a literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Jensen et al.	2012	A systematic review of validated methods for identifying atrial fibrillation using administrative data.	1. Off topic/not relevant - does not focus on PHR/Portals.
Jilka et al.	2015	"Nothing About Me Without Me": An Interpretative Review of Patient Accessible Electronic Health Records.	3. Not identified as a systematic review
Johansen & Henriksen	2014	The evolution of personal health records and their role for self-management: a literature review.	3. Not identified as a systematic review
Jones	2012	Overview of electronic data sharing: why, how, and impact.	1. Off topic/not relevant - does not focus on PHR/Portals.
Jones et al.	2011	Meaningful use in practice using patient-specific risk in an electronic health record for shared decision making.	1. Off topic/not relevant - does not focus on PHR/Portals.
Joukes et al.	2013	Composite quality of care scores, electronic health record maturity models, and their associations; preliminary literature review results.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kaferle & Wimsatt	2012	A team-based approach to providing asthma action plans.	1. Off topic/not relevant - does not focus on PHR/Portals.

Kahn et al.	2014	Impact of nurse-led remote screening and prompting for evidence-based practices in the ICU*.	1. Off topic/not relevant - does not focus on PHR/Portals.
Karakulah et al.	2012	A data-driven living review for pharmacogenomic decision support in cancer treatment.	1. Off topic/not relevant - does not focus on PHR/Portals.
Karlin--Zysman et al.	2012	Struggling to bring clinical prediction rules to the point of care: missed opportunities to impact patient care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kasarskis et al.	2011	Integrative genomics strategies to elucidate the complexity of drug response.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kato-Lin	2014	Does e-pain plan improve management of sickle cell disease associated vaso-occlusive pain crisis? a mixed methods evaluation.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kazmi	2013	Effects of exam room EHR use on doctor-patient communication: a systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Keijzers et al.	2015	What is the effect of a formalised trauma tertiary survey procedure on missed injury rates in multi-trauma patients? Study protocol for a randomised controlled trial.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kelley et al.	2011	Electronic nursing documentation as a strategy to improve quality of patient care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Keltie et al.	2014	Identifying complications of interventional procedures from UK routine healthcare databases: a systematic search for methods using clinical codes.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kim et al.	2010	A physician's role following a breach of electronic health information.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kinder & Pettgrew	2014	Improving primary care through information. A Wonca keynote paper.	1. Off topic/not relevant - does not focus on PHR/Portals.
Klan et al.	2014	Decision support from local data: creating adaptive order menus from past clinician behavior.	1. Off topic/not relevant - does not focus on PHR/Portals.
Klatt & Hopp	2012	Effect of a best-practice alert on the rate of influenza vaccination of pregnant women.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ko et al.	2010	Patient-held medical records for patients with chronic disease: a systematic review.	2. Paper based record
Koch & Vimarlund	2012	Critical advances in bridging personal health informatics and clinical informatics.	3. Not identified as a systematic review
Kohane	2015	An autism case history to review the systematic analysis of large-scale data to refine the diagnosis and treatment of neuropsychiatric disorders.	1. Off topic/not relevant - does not focus on PHR/Portals.
Koutkias & Thiessard	2014	Big data - smart health strategies. Findings from the yearbook 2014 special theme.	1. Off topic/not relevant - does not focus on PHR/Portals.

Krum et al.	2014	The need for harmonized structured documentation and chances of secondary use - results of a systematic analysis with automated form comparison for prostate and breast cancer.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kruse et al.	2015	Adoption factors associated with electronic health record among long-term care facilities: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kuhn et al.	2015	Clinical documentation in the 21st century: executive summary of a policy position paper from the American College of Physicians.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kushda et al.	2012	Strategies for de-identification and anonymization of electronic health record data for use in multicenter research studies.	1. Off topic/not relevant - does not focus on PHR/Portals.
Kushniruk et al.	2013	National efforts to improve health information system safety in Canada, the United States of America and England.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lapane et al.	2012	Tailored DVDs: a novel strategy for educating racially and ethnically diverse older adults about their medicines.	1. Off topic/not relevant - does not focus on PHR/Portals.
Large et al.	2012	Meta-analysis of self-reported substance use compared with laboratory substance assay in general adult mental health settings.	1. Off topic/not relevant - does not focus on PHR/Portals.
Larun et al.	2016	Use of forms for follow-up of diabetes in general practice.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lau et al.	2012	Impact of electronic medical record on physician practice in office settings: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lau et al.	2010	A review on systematic reviews of health information system studies.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ledwich et al.	2009	Improved influenza and pneumococcal vaccination in rheumatology patients taking immunosuppressants using an electronic health record best practice alert.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lehmann et al.	2014	Assessing medication adherence: options to consider.	1. Off topic/not relevant - does not focus on PHR/Portals.
Leite et al.	2016	Near real-time vaccine safety surveillance using electronic health records-a systematic review of the application of statistical methods.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lepage et al.	2012	Standardized Procedural Practices of the Ontario Prenatal Screening Program for aneuploidies and open neural tube defects.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lessard et al.	2015	Quality assessment of primary care for common mental disorders in isolated communities: Taking advantage of health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Leventhal et al.	2012	The patient-centered medical home and health information technology.	3. Not identified as a systematic review
Lewis et al.	2012	E-health in low- and middle-income countries: findings from the Center for Health Market Innovations.	3. Not identified as a systematic review

Li et al.	2012	Integrating usability testing and think-aloud protocol analysis with "near-live" clinical simulations in evaluating clinical decision support.	1. Off topic/not relevant - does not focus on PHR/Portals.
Li et al.	2013	Review of computerized physician handoff tools for improving the quality of patient care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Liau et al.	2015	The National Anesthesia Clinical Outcomes Registry.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lindoerfer & Manmann	2015	A Comprehensive Assessment Tool for Patient Registry Software Systems: The CIPROS Checklist	1. Off topic/not relevant - does not focus on PHR/Portals.
Lindoerfer & Manmann	2014	CIPROS--a checklist with items for a patient registry software system.	1. Off topic/not relevant - does not focus on PHR/Portals.
Liu et al.	2013	An efficacy driven approach for medication recommendation in type 2 diabetes treatment using data mining techniques.	1. Off topic/not relevant - does not focus on PHR/Portals.
Liu et al.	2013	Comparative analysis of pharmacovigilance methods in the detection of adverse drug reactions using electronic medical records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Long et al.	2010	Evidence review of technology and dietary assessment.	1. Off topic/not relevant - does not focus on PHR/Portals.
Lowe et al.	2013	Does incorporation of a clinical support template in the electronic medical record improve capture of wound care data in a cohort of veterans with diabetic foot ulcers?	1. Off topic/not relevant - does not focus on PHR/Portals.
Lu	2010	Electronic data-capturing technology for clinical trials: experience with a global postmarketing study.	1. Off topic/not relevant - does not focus on PHR/Portals.
Luna et al.	2016	Cyber threats to health information systems: A systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Maehara et al.	2014	Journal club: Renal masses detected at abdominal CT: radiologists' adherence to guidelines regarding management recommendations and communication of critical results.	1. Off topic/not relevant - does not focus on PHR/Portals.
Magee et al.	2011	Identifying potentially eligible subjects for research: paper-based logs versus the hospital administrative database.	1. Off topic/not relevant - does not focus on PHR/Portals.
Maggio et al.	2013	Evidence-based medicine training in undergraduate medical education: a review and critique of the literature published 2006-2011.	1. Off topic/not relevant - does not focus on PHR/Portals.
Malka et al.	2015	Professional e-mail communication among health care providers: proposing evidence-basedguidelines.	1. Off topic/not relevant - does not focus on PHR/Portals.
Mapp et al.	2013	Prevention of unplanned intensive care unit admissions and hospital mortality by early warning systems.	1. Off topic/not relevant - does not focus on PHR/Portals.
Martin et al.	2014	Clinical Pharmacogenetics Implementation Consortium Guidelines for HLA-B Genotype and Abacavir Dosing: 2014 update.	1. Off topic/not relevant - does not focus on PHR/Portals.
Mason-Blakley & Weber	2013	A systems theory classification of EMR hazards: preliminary results.	1. Off topic/not relevant - does not focus on PHR/Portals.

McAlearney et al.	2014	Evidence-based management of ambulatory electronic health record system implementation: an assessment of conceptual support and qualitative evidence.	1. Off topic/not relevant - does not focus on PHR/Portals.
McGinn et al.	2013	Efficacy of an evidence-based clinical decision support in primary care practices: a randomized clinical trial.	1. Off topic/not relevant - does not focus on PHR/Portals.
McGinn et al.	2011	Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
McGinn et al.	2012	Users' perspectives of key factors to implementing electronic health records in Canada: a Delphi study.	1. Off topic/not relevant - does not focus on PHR/Portals.
McInnes et al.	2010	Disparities in health-related internet use by US veterans: results from a national survey.	1. Off topic/not relevant - does not focus on PHR/Portals.
McMahon et al.	2015	Pediatric post-marketing safety systems in North America: assessment of the current status.	1. Off topic/not relevant - does not focus on PHR/Portals.
Meier	2013	A role for data: an observation on empowering stakeholders.	1. Off topic/not relevant - does not focus on PHR/Portals.
Melton et al.	2012	Social and behavioral history information in public health datasets.	1. Off topic/not relevant - does not focus on PHR/Portals.
Menaker & Miller	2016	Best practice in unbilled account management: one medical center's story.	1. Off topic/not relevant - does not focus on PHR/Portals.
Menon et al.	2016	Epidemiology of HPV Genotypes among HIV Positive Women in Kenya: A Systematic Review and Meta-Analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Meraji et al.	2016	Applications of Information Technology in Nursing During 2005-15: Evidence from Iran.	1. Off topic/not relevant - does not focus on PHR/Portals.
Messner & Schnepp	2014	Staff experiences within the implementation of computer-based nursing records in residential aged care facilities: a systematic review and synthesis of qualitative research.	1. Off topic/not relevant - does not focus on PHR/Portals.
Minard et al.	2014	Development and implementation of an electronic asthma record for primary care: integrating guidelines into practice.	1. Off topic/not relevant - does not focus on PHR/Portals.
Minard et al.	2010	Asthma electronic medical records in primary care: an integrative review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Minshall	2013	A review of healthcare information system usability & safety.	1. Off topic/not relevant - does not focus on PHR/Portals.
Mohammed et al.	2016	Creating a Patient-Centered Health Care Delivery System: A Systematic Review of Health Care Quality From the Patient Perspective.	1. Off topic/not relevant - does not focus on PHR/Portals.
Moja et al.	2014	Effectiveness of computerized decision support systems linked to electronic health records: a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Monsen et al.	2012	Exploring the value of clinical data standards to predict hospitalization of home care patients.	1. Off topic/not relevant - does not focus on PHR/Portals.
Moore & Furberg	2015	Electronic Health Data for Postmarket Surveillance: A Vision Not Realized.	1. Off topic/not relevant - does not focus on PHR/Portals.

Moore et al.	2016	Utility of plain radiographs and MRI in cervical spine clearance in symptomatic non-obtunded pediatric patients without high-impact trauma.	1. Off topic/not relevant - does not focus on PHR/Portals.
Moreno-Conde et al.	2015	Clinical information modeling processes for semantic interoperability of electronic health records: systematic review and inductive analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Morgan et al.	2015	Association of a Best-Practice Alert and Prenatal Administration With Tetanus Toxoid, Reduced Diphtheria Toxoid, and Acellular Pertussis Vaccination Rates.	1. Off topic/not relevant - does not focus on PHR/Portals.
Mykkannen et al.	2016	Standardized Nursing Documentation Supports Evidence-Based Nursing Management	1. Off topic/not relevant - does not focus on PHR/Portals.
Nagle et al.	2015	Obesity and survival among women with ovarian cancer: results from the Ovarian Cancer Association Consortium.	1. Off topic/not relevant - does not focus on PHR/Portals.
Narra et al.	2015	Clinical data warehousing for evidence based decision making.	1. Off topic/not relevant - does not focus on PHR/Portals.
Neff et al.	2015	Stratification of children by medical complexity.	1. Off topic/not relevant - does not focus on PHR/Portals.
Nguyen et al.	2014	Electronic health records implementation: an evaluation of information system impact and contingency factors.	1. Off topic/not relevant - does not focus on PHR/Portals.
Noren et al.	2013	Empirical performance of the calibrated self-controlled cohort analysis within temporal pattern discovery: lessons for developing a risk identification and analysis system.	1. Off topic/not relevant - does not focus on PHR/Portals.
Norman et al.	2011	Ethics and electronic health information technology: challenges for evidence-based medicine and the physician-patient relationship.	1. Off topic/not relevant - does not focus on PHR/Portals.
O'Donnell et al.	2011	Healthcare consumers' attitudes towards physician and personal use of health information exchange.	3. Not identified as a systematic review
Orrico et al.	2011	Assessment of the appropriateness of serum digoxin concentration measurement in a medical group setting.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ouyang et al.	2016	A design of experiments approach to validation sampling for logistic regression modeling with error-prone medical records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ovretveit et al.	2016	Comparing and improving chronic illness primary care in Sweden and the USA.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pappas et al.	2011	Computer-assisted history-taking systems (CAHTS) in health care: benefits, risks and potential for further development.	1. Off topic/not relevant - does not focus on PHR/Portals.
Park et al.	2014	Applied nursing informatics research - state-of-the-art methodologies using electronic health record data.	1. Off topic/not relevant - does not focus on PHR/Portals.
Parker et al.	2016	Health information exchanges--Unfulfilled promise as a data source for clinical research.	1. Off topic/not relevant - does not focus on PHR/Portals.

Pasquali et al.	2016	Report of the National Heart, Lung, and Blood Institute Working Group: An Integrated Network for Congenital Heart Disease Research.	1. Off topic/not relevant - does not focus on PHR/Portals.
Patel et al.	2014	Spinal epidural abscesses: risk factors, medical versus surgical management, a retrospective review of 128 cases.	1. Off topic/not relevant - does not focus on PHR/Portals.
Paterson et al.	2011	Electronic care plans and medicolegal liability.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pathak et al.	2011	Mapping clinical phenotype data elements to standardized metadata repositories and controlled terminologies: the eMERGE Network experience.	1. Off topic/not relevant - does not focus on PHR/Portals.
Paxton et al.	2010	Kaiser Permanente National Total Joint Replacement Registry: aligning operations with information technology.	1. Off topic/not relevant - does not focus on PHR/Portals.
Peiris et al.	2014	Use of mHealth systems and tools for non-communicable diseases in low- and middle-income countries: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Peloquin et al.	2016	Diagnostic and Therapeutic Yield of Endoscopy in Patients with Elevated INR and Gastrointestinal Bleeding.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pereira et al.	2013	A mapping of information security in health Information Systems in Latin America and Brazil.	1. Off topic/not relevant - does not focus on PHR/Portals.
Petersen et al.	2016	Risks and benefits of psychotropic medication in pregnancy: cohort studies based on UK electronic primary care health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Phansalkar et al.	2013	Criteria for assessing high-priority drug-drug interactions for clinical decision support in electronic health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Phansalkar et al.	2012	High-priority drug-drug interactions for use in electronic health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pilgrim et al.	2010	Administrative challenges to regionalization.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pin et al.	2011	Use of intrathecal baclofen therapy in ambulant children and adolescents with spasticity and dystonia of cerebral origin: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pivovarov & Elhadad	2015	Automated methods for the summarization of electronic health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Platt et al.	2012	The U.S. Food and Drug Administration's Mini-Sentinel program: status and direction.	1. Off topic/not relevant - does not focus on PHR/Portals.
Plazzotta et al.	2013	Natural language processing and inference rules as strategies for updating problem list in an electronic health record.	1. Off topic/not relevant - does not focus on PHR/Portals.
Poder et al.	2011	Implementation of a multi-professional standardized care plan in electronic health records for the care of stroke patients.	1. Off topic/not relevant - does not focus on PHR/Portals.
Poe	2011	Building nursing intellectual capital for safe use of information technology: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.

Police et al.	2010	Adoption and use of health information technology in physician practice organisations: systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Polling et al.	2015	Using routine clinical and administrative data to produce a dataset of attendances at Emergency Departments following self-harm.	1. Off topic/not relevant - does not focus on PHR/Portals.
Pons et al.	2016	Natural Language Processing in Radiology: A Systematic Review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Porter et al.	2014	Variability in date of prostate cancer diagnosis: a comparison of cancer registry, pathology report, and electronic health data sources.	1. Off topic/not relevant - does not focus on PHR/Portals.
Porto et al.	2013	Stress cardiomyopathy (tako-tsubo) triggered by nervous system diseases: a systematic review of the reported cases.	1. Off topic/not relevant - does not focus on PHR/Portals.
Prins & Hasman	2013	Appropriateness of ICD-coded diagnostic inpatient hospital discharge data for medical practice assessment. A systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Rahurkar et al.	2015	Despite the spread of health information exchange, there is little evidence of its impact on cost, use, and quality of care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Rajkumar et al.	2015	Antiplatelet therapy as a modulator of stroke aetiology: a meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Randell et al.	2015	Electronic whiteboards: review of the literature.	1. Off topic/not relevant - does not focus on PHR/Portals.
Rangraz et al.	2013	Evaluating the ability of hospital information systems to establish evidence-based medicine in Iran.	1. Off topic/not relevant - does not focus on PHR/Portals.
Raval et al.	2016	Association between statins and clinical outcomes among men with prostate cancer: a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Raval et al.	2015	Impact of metformin on clinical outcomes among men with prostate cancer: a systematic reviewand meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Remote Preconditioning	2014	Remote preconditioning and major clinical complications following adult cardiovascular surgery: systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Rezaeibagha et al.	2015	A systematic literature review on security and privacy of electronic health record systems: technical perspectives.	1. Off topic/not relevant - does not focus on PHR/Portals.
Richardson et al.	2012	Bridging informatics and implementation science: evaluating a framework to assess electronic health record implementations in community settings.	1. Off topic/not relevant - does not focus on PHR/Portals.
Rischen et al.	2013	Records needed for orthodontic diagnosis and treatment planning: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Robinson et al.	2016	Review of information technology for surgical patient care.	3. Not identified as a systematic review
Ross et al.	2014	"Big data" and the electronic health record.	1. Off topic/not relevant - does not focus on PHR/Portals.

Rosenthal	2014	The role of pragmatic clinical trials in the evolution of learning health systems.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ross et al.	2015	Exploring the challenges of implementing e-health: a protocol for an update of a systematic reviewof reviews.	1. Off topic/not relevant - does not focus on PHR/Portals.
Roumia & Steinhubl	2014	Improving cardiovascular outcomes using electronic health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Rubbo et al.	2015	Use of electronic health records to ascertain, validate and phenotype acute myocardial infarction: A systematic review and recommendations.	1. Off topic/not relevant - does not focus on PHR/Portals.
Safran	2014	Reuse of clinical data.	1. Off topic/not relevant - does not focus on PHR/Portals.
Sainato et al.	2013	Management of infants born to women infected with hepatitis B in the military healthcare system.	1. Off topic/not relevant - does not focus on PHR/Portals.
Salahuddin & Ismail	2015	Classification of antecedents towards safety use of health information technology: A systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Sartain et al.	2015	Patients' views on the effectiveness of patient-held records: a systematic review and thematic synthesis of qualitative studies.	2. Paper based record
Schickdanza	2013	Access, interest, and attitudes toward electronic communication for health care among patients in the medical safety net.	3. Not identified as a systematic review
Schoevers et al.	2009	Patient-held records for undocumented immigrants: a blind spot. A systematic review of patient-held records.	2. Paper based record
Schulz et al.	2013	The use of best practice alerts with the development of an antimicrobial stewardship navigator to promote antibiotic de-escalation in the electronic medical record.	1. Off topic/not relevant - does not focus on PHR/Portals.
Schwartze et al.	2014	Authentication systems for securing clinical documentation workflows. A systematic literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Schweitzer et al.	2014	Structuring clinical workflows for diabetes care: an overview of the OntoHealth approach.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shah et al.	2011	Threshold haemoglobin levels and the prognosis of stable coronary disease: two new cohorts and a systematic review and meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shaha et al.	2015	The Growing Gap in Electronic Medical Record Satisfaction Between Clinicians and Information Technology Professionals: Issues of Most Concern and Suggested Remediations.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shahpori & Doig	2010	Systematized Nomenclature of Medicine-Clinical Terms direction and its implications on criticalcare.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shaikh et al.	2015	Impact of electronic health record clinical decision support on the management of pediatric obesity.	1. Off topic/not relevant - does not focus on PHR/Portals.

Shang et al.	2015	Studies on nurse staffing and health care-associated infection: methodologic challenges and potential solutions.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shen et al.	2011	Mammography in 40-year-old women: what difference does it make? The potential impact of the U.S. Preventative Services Task Force (USPSTF) mammography guidelines.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shivade et al.	2014	A review of approaches to identifying patient phenotype cohorts using electronic health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shoenbill et al.	2014	Genetic data and electronic health records: a discussion of ethical, logistical and technological considerations.	1. Off topic/not relevant - does not focus on PHR/Portals.
Shultz & Holmtrom	2015	The use of medical scribes in health care settings: a systematic review and future directions.	1. Off topic/not relevant - does not focus on PHR/Portals.
Simons & Chung	2014	Are high coronary risk patients missing out on lipid-lowering drugs in Australia?	1. Off topic/not relevant - does not focus on PHR/Portals.
Simpao et al.	2014	A review of analytics and clinical informatics in health care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Skinner et al.	2016	Development of the Parkland-UT Southwestern Colonoscopy Reporting System (CoRS) for evidence-based colon cancer surveillance recommendations.	1. Off topic/not relevant - does not focus on PHR/Portals.
Skinner et al.	2014	Realist review to inform development of the electronic advance care plan for the personally controlled electronic health record in Australia.	3. Not identified as a systematic review
Solar et al.	2015	Evidence-based rules from family practice to inform family practice; the learning healthcare system case study on urinary tract infections.	1. Off topic/not relevant - does not focus on PHR/Portals.
Son et al.	2015	Visualization of e-Health Research Topics and Current Trends Using Social Network Analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Song et al.	2015	Evaluation of Evidence-based Nursing Pain Management Practice.	1. Off topic/not relevant - does not focus on PHR/Portals.
Song et al.	2013	Reusing electronic patient data for dental clinical research: a review of current status.	1. Off topic/not relevant - does not focus on PHR/Portals.
Spyropoulos et al.	2015	Features of electronic health records necessary for the delivery of optimized anticoagulant therapy: consensus of the EHR Task Force of the New York State Anticoagulation Coalition	1. Off topic/not relevant - does not focus on PHR/Portals.
St Peter	2010	Improving medication safety in chronic kidney disease patients on dialysis through medication reconciliation.	1. Off topic/not relevant - does not focus on PHR/Portals.
Staccini et al.	2013	Evidence-based Practice. Findings from the Section on Education and Consumer Health Informatics.	3. Not identified as a systematic review
Stavropoulou et al.	2015	How Effective Are Incident-Reporting Systems for Improving Patient Safety? A Systematic Literature Review.	1. Off topic/not relevant - does not focus on PHR/Portals.

Stevenson et al.	2010	Nurses' experience of using electronic patient records in everyday practice in acute/inpatient ward settings: A literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Stockwell et al.	2016	Development of an Electronic Pediatric All-Cause Harm Measurement Tool Using a Modified Delphi Method.	1. Off topic/not relevant - does not focus on PHR/Portals.
Strudwick & Eyasu	2015	Electronic health record use by nurses in mental health settings: a literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Studeny & Coustasse	2014	Personal health records: is rapid adoption hindering interoperability?	3. Not identified as a systematic review
Sun et al.	2014	Association of MDR1 gene C3435T polymorphism with childhood intractable epilepsy: a meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Thomas et al.	2014	Systematic review of methods for individual patient data meta- analysis with binary outcomes.	1. Off topic/not relevant - does not focus on PHR/Portals.
Thompson et al.	2015	Impact of the Electronic Medical Record on Mortality, Length of Stay, and Cost in the Hospital and ICU: A Systematic Review and Metaanalysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Topaz et al.	2014	The Omaha System: a systematic review of the recent literature.	1. Off topic/not relevant - does not focus on PHR/Portals.
Trigo et al.	2012	A review on digital ECG formats and the relationships between them.	1. Off topic/not relevant - does not focus on PHR/Portals.
Trinanes et al.	2015	Development and impact of computerised decision support systems for clinical management of depression: A systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Uzuner et al	2012	Evaluating the state of the art in coreference resolution for electronic medical records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Van Staa et al.	2014	The opportunities and challenges of pragmatic point-of-care randomised trials using routinely collected electronic records: evaluations of two exemplar trials.	1. Off topic/not relevant - does not focus on PHR/Portals.
Van Staa et al.	2014	Use of electronic healthcare records in large-scale simple randomized trials at the point of care for the documentation of value-based medicine.	1. Off topic/not relevant - does not focus on PHR/Portals.
Varela-lema et al.	2012	Observation of health technologies after their introduction into clinical practice: a systematic review on data collection instruments.	1. Off topic/not relevant - does not focus on PHR/Portals.
Venkatesan et al.	2015	Development of processes allowing near real-time refinement and validation of triage tools during the early stage of an outbreak in readiness for surge: the FLU-CATs Study.	1. Off topic/not relevant - does not focus on PHR/Portals.
Vesely et al.	2016	Obesity Treatment at HealthPartners: Adaptation of Clinical Guidelines into Systems for Practice Operations.	1. Off topic/not relevant - does not focus on PHR/Portals.

Vest et al.	2015	Image Sharing Technologies and Reduction of Imaging Utilization: A Systematic Review and Meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Vigen et al.	2016	Validation of self-reported comorbidity status of breast cancer patients with medical records: the California Breast Cancer Survivorship Consortium (CBCSC).	1. Off topic/not relevant - does not focus on PHR/Portals.
Villarreal-Garza	2014	Platinum-based chemotherapy in triple-negative advanced breast cancer.	1. Off topic/not relevant - does not focus on PHR/Portals.
Vimalananda et al.	2015	Electronic consultations (e-consults) to improve access to specialty care: a systematic review and narrative synthesis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Virginio & Ricarte	2015	Identification of Patient Safety Risks Associated with Electronic Health Records: A Software Quality Perspective.	1. Off topic/not relevant - does not focus on PHR/Portals.
Vuokko et al.	2015	Secondary use of structured patient data: interim results of a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Walker et al.	2016	Computer-assisted expert case definition in electronic health records.	1. Off topic/not relevant - does not focus on PHR/Portals.
Walsh et al.	2013	Provider-to-provider electronic communication in the era of meaningful use: a review of the evidence.	1. Off topic/not relevant - does not focus on PHR/Portals.
Walsh et al.	2012	Lack of association between electronic health record systems and improvement in use of evidence-based heart failure therapies in outpatient cardiology practices.	1. Off topic/not relevant - does not focus on PHR/Portals.
Walsh et al.	2010	Electronic health records and quality of care for heart failure	1. Off topic/not relevant - does not focus on PHR/Portals.
Warner & Alterovitz	2012	Phenome based analysis as a means for discovering context dependent clinical reference ranges.	1. Off topic/not relevant - does not focus on PHR/Portals.
Weber & Kohane	2013	Extracting physician group intelligence from electronic health records to support evidence based medicine.	1. Off topic/not relevant - does not focus on PHR/Portals.
Weinberg et al.	2016	Are Readmissions After THA Preventable?	1. Off topic/not relevant - does not focus on PHR/Portals.
Welch et al.	2014	Technical desiderata for the integration of genomic data with clinical decision support.	1. Off topic/not relevant - does not focus on PHR/Portals.
Welden	2013	Electronic Health Record: Driving Evidence-Based Catheter-Associated Urinary Tract Infections (CAUTI) Care Practices	1. Off topic/not relevant - does not focus on PHR/Portals.
Wells et al.	2010	Implementing an electronic point-of-care medical record at an organized athletic event: challenges, pitfalls, and lessons learned.	1. Off topic/not relevant - does not focus on PHR/Portals.
West et al.	2015	Innovative information visualization of electronic health record data: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Westra et al.	2015	A national action plan for sharable and comparable nursing data to support practice and translational research for transforming health care.	1. Off topic/not relevant - does not focus on PHR/Portals.
Wexler et al.	2016	Incidence of adult Huntington's disease in the UK: a UK-based primary care study and a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.

Wollersheim et al.	2009	Archetype-based electronic health records: a literature review and evaluation of their applicability to health data interoperability and access.	1. Off topic/not relevant - does not focus on PHR/Portals.
Wood et al.	2012	An electronic health record-enabled obesity database.	1. Off topic/not relevant - does not focus on PHR/Portals.
Woodfield et al.	2015	Accuracy of Electronic Health Record Data for Identifying Stroke Cases in Large-Scale Epidemiological Studies: A Systematic Review from the UK Biobank Stroke Outcomes Group.	1. Off topic/not relevant - does not focus on PHR/Portals.
Wu et al.	2016	Improving an electronic system for measuring PROs in routine oncology practice.	3. Not identified as a systematic review
Wu et al.	2015	CD44 family proteins in gastric cancer: a meta-analysis and narrative review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Ye et al.	2015	Associations between statin use and non-Hodgkin lymphoma (NHL) risk and survival: a meta-analysis.	1. Off topic/not relevant - does not focus on PHR/Portals.
Yeh et al.	2011	Intravenous bisphosphonates for post-menopausal osteoporosis: adherence to a network guideline.	1. Off topic/not relevant - does not focus on PHR/Portals.
Young	2015	Increasing Diagnosis and Treatment of Overweight and Obese Pediatric Patients.	1. Off topic/not relevant - does not focus on PHR/Portals.
Zahabi et al.	2015	Usability and Safety in Electronic Medical Records Interface Design: A Review of Recent Literature and Guideline Formulation.	1. Off topic/not relevant - does not focus on PHR/Portals.
Zaslavsky et al.	2012	The role of emerging information technologies in frailty assessment.	1. Off topic/not relevant - does not focus on PHR/Portals.
Zhang et al.	2015	Data-driven CT protocol review and management—experience from a large academic hospital.	1. Off topic/not relevant - does not focus on PHR/Portals.
Zhong et al.	2015	Cost-utility analyses in diabetes: a systematic review and implications from real-world evidence.	1. Off topic/not relevant - does not focus on PHR/Portals.
Zhou et al.	2010	Development of traditional Chinese medicine clinical data warehouse for medical knowledge discovery and decision support.	1. Off topic/not relevant - does not focus on PHR/Portals.
Patterson	2012	Technology support of the handover: promoting observability, flexibility and efficiency.	1. Off topic/not relevant - does not focus on PHR/Portals.
Radadhan et al.	2012	Understanding unintended consequences for EMR: a literature review.	1. Off topic/not relevant - does not focus on PHR/Portals.
Silow-Carroll et al	2012	Using electronic health records to improve quality and efficiency: the experiences of leading hospitals.	1. Off topic/not relevant - does not focus on PHR/Portals.
Trussler & Tabbal	2012	Patient safety in plastic surgery.	1. Off topic/not relevant - does not focus on PHR/Portals.
Van Der Vaart et al.	2013	Need for online information and support of patients with systemic sclerosis.	3. Not identified as a systematic review

Vines & Dean	2012	Technology implementation impacting the outcomes of patients with CAP.	1. Off topic/not relevant - does not focus on PHR/Portals.
Weiskopf & Wong	2013	Methods and dimensions of electronic health record data quality assessment: enabling reuse for clinical research.	1. Off topic/not relevant - does not focus on PHR/Portals.
Zipkin et al.	2012	Evidence-based medicine and primary care: keeping up is hard to do.	1. Off topic/not relevant - does not focus on PHR/Portals.

Appendix 3: Literature Search - Eligibility

Included

Author(s)	Year	Title	Reason For Inclusion	Full text
Thompson et al.	2016	Work system barriers to patient, provider, and caregiver use of personal health records: A systematic review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Otte-Trojel et al.	2016	What do we know about developing patient portals? a systematic literature review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Mold et al.	2015	Patients' online access to their electronic health records and linked online services: a systematic review in primary care.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Bush et al.	2015	Implementation of the Integrated Electronic Patient Portal in the Pediatric Population: A Systematic Review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Kruse et al.	2015	Patient and provider attitudes toward the use of patient portals for the management of chronic disease: a systematic review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Kruse et al.	2015	The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Giardina et al.	2014	Patient access to medical records and healthcare outcomes: a systematic review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Amante et al.	2014	A systematic review of electronic portal usage among patients with diabetes.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Goldzweig et al.	2013	Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes
Ammenwerth et al.	2012	The impact of electronic patient portals on patient care: a systematic review of controlled trials.	1. Focused on use of an electronic PHR/Portal. 2. A systematic review	Yes

Excluded

Author(s)	Year	Title	Primary Reason For Exclusion	Full text
Ammenwerth et al.	2011	Patient empowerment by electronic health records: first results of a systematic review on the benefit of patient portals.	5. Duplicate	Yes

Mair et al.	2012	Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.	Yes
Mold et al.	2012	The provision and impact of online patient access to their electronic health records (EHR) and transactional services on the quality and safety of health care: systematic review protocol.	5. Duplicate	Yes
Videl et al.	2013	Health information technologies in geriatrics and gerontology: a mixed systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.	Yes
De Lusignan et al.	2014	Patients' online access to their electronic health records and linked online services: a systematic interpretative review.	5. Duplicate	Yes
Prey et al.	2014	Patient engagement in the inpatient setting: a systematic review.	1. Off topic/not relevant - does not focus on PHR/Portals.	Yes
Akhlaq et al.	2015	Barriers and facilitators to health information exchange in low- and middle-income country settings: a systematic review protocol.	1. Off topic/not relevant - does not focus on PHR/Portals.	Yes

Appendix 4: Literature Search - Evaluation (R-AMSTAR Scores)

Study	1	2	3	4	5	6	7	8	9	10	11	Total (44)
Ammenwerth et al. (2012)	3	4	4	4	4	4	4	2	3	3	3	**38**
Mold et al. (2015)	4	4	4	4	2	2	3	2	3	4	3	**35**
Giardina et al. (2014)	3	4	3	3	3	3	2	2	2	2	3	**30**
Amante et al. (2014)	3	1	4	2	3	4	2	1	2	2	2	**26**
Bush et al. (2015)	3	4	4	2	3	4	1	1	2	2	3	**29**
Goldzweig et al. (2013)	3	4	4	2	2	4	2	2	2	1	3	**29**
Kruse et al. (2015)	3	2	4	2	3	2	1	1	1	1	3	**23**
Kruse et al. (2015a)	3	4	4	2	3	4	1	1	1	2	3	**28**
Otte-Trojel et al. (2016)	3	4	3	2	3	1	1	1	1	2	3	**24**
Price et al. (2015)	3	4	3	2	3	4	2	2	2	1	3	**29**
Thompson et al. (2016)	3	4	3	2	3	4	1	1	3	2	2	**28**

Appendix 5: Literature Search - Evaluation (Comparison of R-AMSTAR Scores)

Study	Total (44)	Grade
Ammenwerth et al. (2012)	**38**	A
Mold et al. (2015)	**35**	A
Giardina et al. (2014)	**30**	B
Amante et al. (2014)	**26**	C
Bush et al. (2015)	**29**	C
Goldzweig et al. (2013)	**29**	C
Kruse et al. (2015)	**23**	C
Kruse et al. (2015a)	**28**	C
Otte-Trojel et al. (2016)	**24**	C
Price et al. (2015)	**29**	C
Thompson et al. (2016)	**28**	C

Percentile	
90th	35
80th	30
70th	29

Appendix 6: Literature Search - Included

Author(s)	Year	Title
Kruse et al.	2015a	The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review.
Otte-Trojel et al.	2016	What do we know about developing patient portals? a systematic literature review.
Thompson et al.	2016	Work system barriers to patient, provider, and caregiver use of personal health records: A systematic review.
Bush et al.	2015	Implementation of the Integrated Electronic Patient Portal in the Pediatric Population: A Systematic Review.
Kruse et al.	2015	Patient and provider attitudes toward the use of patient portals for the management of chronic disease: a systematic review.
Mold et al.	2015	Patients' online access to their electronic health records and linked online services: a systematic review in primary care.
Price et al.	2015	Conditions potentially sensitive to a personal health record (PHR) intervention, a systematic review.
Amante et al.	2014	A systematic review of electronic portal usage among patients with diabetes.
Giardina et al.	2014	Patient access to medical records and healthcare outcomes: a systematic review.
Goldzweig et al.	2013	Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review.
Ammenwerth et al.	2012	The impact of electronic patient portals on patient care: a systematic review of controlled trials.

Appendix 7: Characteristics of Included Reviews

Author(s)/Year	Aim/Objective	Time Period & No. of studies included	No. of Participants	Population	Origin of Primary Studies/ Language	R-AMSTAR Grade	Conclusions
Thompsonet al., 2016	To apply a human factors/ergonomics (HF/E) paradigm to assess individual, work system/unit, organization, and external environment factors generating barriers to patient, provider, and informal caregiver personal health record (PHR) use.	Jan 2000-Oct 2013. 60.	377,970	Patients, provider and caregivers - no specified care area, demographic or medical condition.	No restriction on origin. English language	C	The study used the HF/E paradigm to frame an assessment of factors creating barriers to PHR use. A majority of the articles found barriers related to individual factors and work system/unit factors; however, less than half found barriers related to organization factors and external environment factors. Few studies examined caregiver barriers, despite growing recognition of the critical role these individuals play. Although all 3 users may benefit from use, this review demonstrates that each group has unique roles and is embedded in a different context. Results indicate that design efforts should address literacy, interoperability, access to health information, and secure messaging. A deeper understanding of the interactions between work systems and the role of organization and external environment factors is required.
Otte-Trojel et al., 2016	To review articles on portal development to inform future patient portal development efforts and to provide a summary of the evidence base that can guide future research.The problem-solving cycle is used to address the problems encountered in patient portal development.	Jan 2005-Jan 2015. 109.	?	No specified care area, demographic or medical condition.	No restriction on origin. English language	C	Five problem categories were identified: achieving patient engagement, provider engagement, appropriate data governance, security and interoperability, and a sustainable business model. Key factors contributing to these problems as well as solutions proposed to ameliorate them were identfied. Few studies systematically report on the patient portal development processes and so, the review does not provide an evidence base for portal development. The findings support a set of recommendations for advancement of the evidence base.

Mold et al., 2015	To 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.	1999-Sep 2012. 17.	?	Defined as users or non-users of online record access and remote contact services, including both patients (including carers and children) and clinicians/support staff in primary care.	No restriction on origin. No restriction on language.	A	While the Risk of Bias scores suggest many of the studies were of low quality, patients using online services reported increased convenience and satisfaction. These services positively impacted on patient safety, although there were variations of record access and use by specific ethnic and socioeconomic groups. Professional concerns about privacy were unrealised and those about workload were only partly so.
Bush et al., 2015	To study was to systematically review existing research on the state of the science, describe the way others have defined the patient portal, and examine pediatric patient portal utilization.	1992-2014. 11.	104,789	Pediatric population (includiing perspectives from cargivers/parents).	No restriction on origin. English language	C	Reflecting the additional considerations of pediatric proxy access and fewer chronically ill patients, pediatric medicine has yet to use patient portal as a modality for outcomes measurement. Given the paucity of studies within this age group, it is difficult to measure outcome improvements or the effect of patient record access on healthcare behaviors. This systematic review presents innovative research on the general acceptance of the patient portal among parents and highlights that the implementation of the portal is still in its early stages and has yet to be used widely in diverse populations or studies in a longitudinal manner. Further studies should confirm that protected access to health information and secure communication and information sharing with healthcare providers have an impact in the pediatric population on healthcare outcomes.

Kruse et al., 2015	To identify the shared characteristics of portals that receive favorable responses from patients and providers and to identify the elements that patients and providers believe need improvement	Jan 2004- July 2014. 27 (+8 added in Peer-review process = 35).	?	Patients with chronic diseases and providers.	No restriction on origin. English language		C	This systematic review revealed mixed attitudes from patients and their providers regarding the use of patient portals to manage their chronic disease. The authors suggest that a standard patient portal design providing patients with the resources to understand and manage their chronic conditions will promote the adoption of patient portals in health care organizations
Kruse et al., 2015a	To 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.	Jan 2011 - Aug 2014. 27.	1,325,781 (of those reported)	Patients with chronic diseases	No restriction on origin. No listed restriction on language.		C	The results of this review demonstrate that more healthcare organizations today offer features of a patient portal than in the review published in 2011. Articles reviewed rarely analyzed a full patient portal but instead analyzed features of a portal such as secure messaging, as well as disease management and monitoring. The ability of patients to be able to view their health information electronically meets the intent of Meaningful Use, Stage 2 requirements, but the ability to transmit to a third party was not found in the review.
Price et al., 2015	To to discover which conditions were potentially sensitive to the PHR as an intervention, that is, what conditions have empirical evidence of benefit from PHR-enabled management.	2008-2014. 23.	44,852 (of those reported)	Patients with conditions - no specified care area, demographic	No restriction on origin. English language		C	There is a small body of condition specific evidence that has been published. Conditions with evidence of benefit when using PHRs tended to be chronic conditions with a feedback loop between monitoring in the PHR and direct behaviours that could be self-managed. These findings can point to other potentially PHR sensitive health conditions and guide PHR designers, implementers, and researchers. More research is needed to link PHR design, features, adoption and health outcomes to better understand how and if PHRs are making a difference to health outcomes.

Giardina et al., 2014	To determine the effect of providing patients access to their medical records (electronic or paper-based) on healthcare quality, as defined by measures of safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity.	1970-2012. 27.	181,141	Adult patients - no specified care area or medical condition.	No restriction on origin. English language	B	Although few positive findings generally favored patient access, the literature is unclear on whether providing patients access to their medical records improves quality.
Amante et al., 2014	To examine characteristics associated with enrollment in and utilization of portals among patients with diabetes and to identify barriers and facilitators of portal enrollment and utilization.	Feb 1, 2005 - Jan 1, 2014. 16.	73,579	Patients with diabetes.	USA English langauge	C	This review shows that patients with diabetes won't enroll in portals if they lack the skills, desire, and/or knowledge of them. Even after patients have enrolled, they won't use the portals if they experience difficulty accessing and/or using the technology, or if they or their providers don't buy into the potential benefits. To increase portal utilization among those who could benefit most, the technology needs to be accessible, easy to use, and secure, and both patients and providers need to believe in the portal's benefits. Provider and family encouragement to utilize portals are major facilitators to portal enrollment and utilization by patients with diabetes. Patients, their family members, and providers all need to be educated how to use the technology and be informed about the potential benefits. For providers to buy into the use of portals, they need to be educated on the benefits and may require compensation for time spent interacting with patients through the portal.

Goldzweig et al., 2013	To systematically review the literature reporting the effect of patient portals on clinical care.	Jan 1, 1990 to Jan 24, 2013. 46.	790,578	Patients - no specified care area, demographic or medical condition.	Focus on USA English Language	C	Evidence that patient portals improve health outcomes, cost, or utilization is insufficient. Patient attitudes are generally positive, but more widespread use may require efforts to overcome racial, ethnic, and literacy barriers. Portals represent a new technology with benefits that are still unclear. Better understanding requires studies that include details about context, implementation factors, and cost.
Ammenwerth et al., 2012	To systematically review the impact of electronic patient portals on patient care by analyzing controlled studies on the use of patient portals	1990-2011. 5 (including 1 duplicate study).	7137 (of those reported)	Patients - no specified care area, demographic or medical condition.	No restriction on origin. English, French and German language	A	The number of available controlled studies with regard to patient portals is low. Even when patient portals are often discussed as a way to empower patients and improve quality of care, there is insufficient evidence to support this assumption.

Appendix 8: Summary of Findings

Author(s)/Year	Barriers	Description	A-CAF Factor
Thompson et al., 2016	Patient use: skills, employment, knowledge, training, and education.	Patient use impacted by a user's understanding, such as awareness of system functions and computer literacy which were identified as barriers to use. Those with a lower educational attainment were found more likely to never have logged on.	People Factors
	Patient use: age, gender, ethnicity, language and marital status	Patient use reflected demographic groups. There were noted ethnicity differences in use.	People Factors
	Patient use: needs, biases, beliefs, and mood	Patient use reflected user's mindset and focused on perceived value of system, degree of need or existence of alternative technologies, and communication preferences.	People Factors
	Patient use: behaviour.	Patient use reflected users' actions including health service utilization, practice of a healthy lifestyle, and norms for technology use and communication - example using email already set up and in use.	People Factors
	Patient use: task demands, complexity and difficulty	Patient use reflected users' ability to complete related work and related to issues encountered when using the system, such as unintuitive navigation, password recovery and understanding terminology.	Technology Factors People Factors
	Patient use: time and sequence demands	Patient use reflected the temporal length and order of completing related work and focused on provider and system response times and the systems' fit with patients' everyday routines. Patients expressed dissatisfaction with response time from provider, not meeting expectations so reverted to previous methods.	Organization Factors Use/User Satisfaction Technology Factors
	Patient use: availability of usable technology	Patient use reflected users' access to electronic resources including Internet, computer, and smartphone. Lack of access is described as a barrier to use.	People Factors
	Patient use: technology functions and features	Patient use reflected characteristics of the electronic resources and included posed barriers to patients because of challenging content (e.g., difficult terminology), inadequate privacy and security settings, missing functionality, and limited technology platform options)	Technology Factors
	Patient use: physical layout and geography	Patient use reflected users' location and focused on the location where the patient lived and whether the patient used the system while hospitalized or after discharge. A study showed greater use when admitted.	People Factors
	Patient use: organizational policy/priorities	Focused on whether members of their home and community (e.g., family, friends) would have access to patients' PHRs.	Environment Factors

Patient use: organizational structure	Patient use reflected home and community members' structure and participation. Home and community members' presence at doctors' appointments and in the household, was identified as a barrier.	Environment Factors
Patient use: financial resources	Patient use reflected available financial resources within the home and community including household income, insurance, and willingness to pay for PHR service. Users were more likely to have higher incomes and be privately insured.	People Factors
Patient use: staffing levels	Patient use reflected the availability of home and community members and the availability of home and community members to assist patients with using system.	Organization Factors Environment Factors
Patient use: social climate/ culture.	Patient use reflected home and community members' values, experiences, and practices and focused on home and community members' support, health status, and education. Study showed that users were younger, more likely to have insurance, identify as Caucasian, have higher household incomes, and live in a region with higher rates of high school completion.	Environment Factors
Patient use: extra-organizational rules, standards, legislation enforcement	Patient use reflected policies surrounding the healthcare system such as 3rd party access, interoperability with EHRs, and the ability/inability to contact multiple providers, which were recognized as barriers.	Environment Factors Technology Factors
Patient use: industry social influences	Patient use reflected users' interactions with providers and focused on patient provider relationships and the value of the system to providers. Study identified that there was a fear of losing relationships as some participants valued choice in how to communicate, and were concerned that the system might cause them to lose those choices.	People Factors Organization Factors
Patient use: industry workforce characteristics	Patient use reflected aspects of providers' work such as the degree of involvement from the healthcare team and issues related to provider work (e.g., difficulty responding to patient inquiries, inconsistencies in provider notes, and un- availability of clinical support), which also presented barriers to patients.	Organization Factors
Provider use: skills, employment, knowledge, training, and education.	Providers' use reflected their understanding which included the awareness of system and provider specialty, which were described as barriers to providers' use. Limited knowledge of system limits providers' ability to endorse patient use, or to integrate use of features within the clinical practice setting.	People Factors Organization Factors
Provider use: age, gender, ethnicity, language and marital status	Providers' use reflected demographic groups. Male physicians disclosed greater use than female.	Organization Factors

Provider use: needs, biases, beliefs, and mood	Providers' use reflected individuals' mindset, such as perceived system value, degree to which an alternative technology solution was perceived as feasible or appropriate, and beliefs regarding patient self-care, which were described as barriers. Believing that system is more beneficial for patients than providers such as for education.	Organization Factors
Provider use: behaviour.	Providers' use reflected individuals' actions including use of EHRs, degree of engagement with system, and prior use of alternative forms of technology, which were recognized as a barrier.	Organization Factors
Provider use: task demands, complexity and difficulty	Providers' use reflected individuals' ability to complete related work and focused on concerns regarding patients' expectations and issues encountered while using the system (e.g., cumbersome system interface and navigation)	Organization Factors Technology Factors
Provider use: time and sequence demands	Providers' use reflected the temporal length and order of completing related work such as time allotted to patient care, workload, timing of information access, and time required to use and learn the system, which were identified as barriers.	Technology Factors
Provider use: availability of usable technology	Providers' use reflected individuals' access to electronic resources, specifically the lack of patient- accessible computers in waiting rooms, posed barriers to providers.	Organization Factors
Provider use: technology functions and features	Providers' use reflected characteristics of the electronic resources including accuracy of and patient access to sensitive information, missing functions, privacy, awkward security procedures, and general technical issues, which were described as barriers.	Technology Factors
Provider use: physical layout and geography	Providers' use reflected location and focused on the clinic setting (e.g., rural or urban settings). Users were more often urban, in group practices or hospital employed, and in none primary care specialties	Organization Factors
Provider use: organizational policy/priorities	Providers' use reflected established practices for healthcare institutions' system use such as sensitive information permissions and lack of alignment with workflow, which were recognized as barriers to providers' use.	Environment Factors Technology Factors
Provider use: financial resources	Providers' use reflected available financial resources within the healthcare institution and focused on the cost-benefit of using the system.	Environment Factors
Provider use: rewards structure	Providers' use reflected healthcare institutions' incentives for use and providers had concerns whether or not they would be appropriately reimbursed for time spent reviewing PHRs.	Environment Factors Organization Factors
Provider use: training provided	Providers' use reflected healthcare institutions' instruction in PHR use and inadequate training provided to healthcare institution staff and patients posed barriers to providers. More training and improved usability testing were said to be needed for the system to be used more effectively.	Environment Factors Organization Factors

Provider use: staffing levels	Providers' use reflected the availability of healthcare institution staff or the availability of healthcare institution staff to work with patients on system, which was described as a barrier.	Organization Factors
Provider use: social norms and pressures	Providers' use reflected the healthcare institutions' technology use norms. Using alternative tools and resources with little incentive to change.	Environment Factors
Provider use: extra-organizational rules, standards, legislation enforcement	Providers' use reflected the policies surrounding the larger healthcare system, such as patient access to provider entered data and provider liability for all information within a patient's PHR, which posed barriers to providers' use. Other concerns included unintentional and intentional data inaccuracies in these records.	Environment Factors Technology Factors
Provider use: industry social influences	Providers' use reflected individuals' interactions with patients and focused on the amount of time spent with patients and patients' expectations and assumptions. System seen as increasing workload and decreasing time spent on patient in the office.	Organization Factors
Caregiver use: skills, knowledge, training, education	Caregivers' use reflected individuals' understanding including system awareness and experience using the Internet, were recognized as barriers to caregivers' use. Users were those with college degree and insurance for child.	People Factors
Caregiver use: needs, biases, beliefs, mood	Caregivers' use reflected individuals' mindset including the perceived system value, degree of need, comfort sharing medical information on the Internet, and communication preferences, which posed barriers. Preferences to have some information directly from provider or sometimes saw information that scared them.	People Factors
Caregiver use: behavior	Caregivers' use reflected individuals' actions and included the likelihood of receiving information from other sources which was described as a barrier.	People Factors
Caregiver use: task demands, complexity difficulty	Caregivers' use reflected individuals' ability to complete related work, such as the ease with which caregivers could access and use the system, were recognized as barriers.	Technology Factors
Caregiver use: time and sequence demands	Caregivers' use reflected the temporal length and order of completing related work and focused on provider and system response times, Internet speed, and general time constraints.	Organization Factors Technology Factors
Caregiver use: availability of usable technology	Caregivers' use reflected individuals' access to electronic resources which including computer and Internet access, which posed barriers to caregivers	People Factors
Caregiver use: technology functions/features	Caregivers' use reflected characteristics of the electronic resources and were described as barriers due to the lack of specific functions or features and concerns such as accessing frightening information, including new information which had previously been disclosed to patient.	Technology Factors People Factors

	Caregiver use: financial resources	Caregivers' use reflected available monetary resources within the home and community and included the type of insurance caregivers have for their child, were recognized as barriers to caregivers. Users had higher education.	People Factors
	Caregiver use: extra-organizational rules, standards, legislation enforcement	Caregivers' use reflected policies surrounding the healthcare system including the sharing of data with external parties (e.g., government agencies, outside providers), which posed barriers to caregivers. Included concerns with sharing data with insurance companies and the potential for discrimination.	Environment Factors People Factors
Otte-Trojel et al., 2016	Patient engagement: Privacy and confidentiality concerns	Low use associated with patient concerns about confidentiality of their personal health data.	People Factors Technology Factors
	Patient engagement: Awareness	Low use associated with being unaware of having access to a portal.	People Factors
	Patient engagement: Usefulness and usability	Low use associated with not recognizing the usefulness of using a portal or had poor experience using one	People Factors
	Patient engagement: Digital access	Low use associated with limited digital access	People Factors
	Patient engagement: Health literacy	Low use associated with level of health literacy	People Factors
	Patient engagement: Socio-economic disparities	Low use associated with demographic and socio-economic characteristics - generally use was associated with being female, young, white, affluent, and having a chronic disease.	People Factors
	Health service provider engagement: Workload and workflow	Providers' fears that use of system features would increase workload and disrupt workflow, especially in light of inadequate compensation.	Organization Factors Environment Factors
	Health service provider engagement: Skills and capacities	Concern among providers that they did not possess the skills and capacities to adjust to technical requirements and new models of patient care induced by electronic means of interacting with patients, which would give patients more control as well as responsibility.	Organization Factors
	Health service provider engagement: Liability	Concerns around liability in case of breached privacy or harmful patient behavior, e.g., providers could fail to respond in a timely way to patient inquiries or be required to base decision making on patient-entered data, that may not be accurate or complete. Concerns about their possible liability related to patients who may not be able to interpret clinical content and the resulting anxiety, confusion, and perhaps inappropriate or harmful behavior.	Organization Factors Technology Factors
	Health service provider engagement: Autonomy	Provider concerns around giving up autonomy, a consequence of giving patients control over activities traditionally arranged by the providers, such as booking appointments.	Organization Factors
	Security and interoperability: Data exchange	Problems of use associated with having no standardized technical and semantic language and rules for setting up and managing health information system infrastructures. Also includes existence of non-interoperable systems i.e. stand alone.	Environment Factors Technology Factors

	Security and interoperability: Authentication	For systems to exchange data, they must be able to identify and verify the owners of the data and corresponding records, requiring robust authentication mechanisms.	Technology Factors
	Security and interoperability: System robustness	For use, systems need to protect against security breaches from, for instance, hacking or inappropriate system use, although noted that ramping up security measures typically lowers the flexibility and friendliness of use.	Technology Factors
	Data governance: Data transparency	Problems around uncertainty with what data should be included in the PHR, when to make these data available, and in what way to convey them. Data have traditionally been recorded for an expert audience as opposed to lay people.	Technology Factors
	Data governance: Authorization/ privacy control	Concerns around who should have access to records and who should be able to determine such access rights e.g. minors should have access to portals and whether patients should be able to assign proxy access to their informal caregivers. Concerns around patients not being able to properly manage the activities of the people to whom they have extended access to.	Environment Factors
	Data governance: Data integrity	Concerns around how to guarantee the accuracy and completeness of data and whether data in the record could be altered and complemented and how revisions would be visible in the record.	Technology Factors
	Financial sustainability: Inadequate reimbursements	Concerns around inadequate and often contradictory reimbursement structures for services provided electronically such as incentives that are too modest and the thresholds too high.	Environment Factors Organization Factors
	Financial sustainability: Uncertainty about cost savings	Concerns with lack of documented cost savings from using system, attainable, for example, through better-managed patients or administrative efficiencies.	Organization Factors
Mold et al., 2015	Users of these services were more likely to be female, middle aged or older, with much greater morbidity than non-users	Socio-economic factors impacting use.	People Factors
	People with Medicaid cover were less likely to use these services than people with commercial insurance	Financial status/resources impacting use.	People Factors
	African–American, other non-white ethnicities, and females with lower socioeconomic classification were less likely to use the services	Disparity in who accesses online records and services, with people of non-white ethnicities and those from lower socioeconomic groups potentially being disadvantaged.	People Factors

	About half of US patients were willing to pay for online access, and 21% were unwilling. Of those who were willing, the median value assigned was $2 per message	Many patients would not be willing to pay for, or only placed a low value on, online services, such as online communication with clinicians. Those who had communicated with their clinician electronically for at least a year had a lower willingness to pay than those who did not have access. Future research is said to be needed as research presented here is either unclear or at high risk of bias.	People Factors
	1–8% of patients say that viewing their record online caused confusion, worry, or offence	1–8% of patients stated that viewing consultation notes caused confusion, worry, or felt offended with note comments. Similarly, clinicians had fears about potentially offending or worrying patients.	People Factors Organization Factors
	Clinicians had concerns about the additional burden and workload from online access.		Organization Factors
Bush et al., 2015	Reported utilization of the patient portal was generally low, especially in light of the cross-sectional nature of most of the studies, which did not follow adherence over time.		Use/User Satisfaction
	Difficulty in graphing and interpreting data, the need for more explanation of test results, and understanding medical terminology		Technology Factors People Factors
	Dislike of having separate accounts for each child and the lack of a symptom checker.		Technology Factors
	Logistical reasons included being too busy and forgetting the login/password for the system.		People Factors
	Concerns about confidentiality, especially among teenagers and their parents, are also seen as a barrier to use		People Factors
	Found that use of the portal was higher for children with autism and those who had more conditions listed on the medical report problem list.		People Factors
	Individuals of color and those with Medicaid or who were low income were less likely to obtain a portal account. Users were likely to have more education and commercial insurance versus nonusers. Adolescents are also less likely to activate the patient portal		People Factors
Kruse et al., 2015	Security	Even though patients and providers view secure messaging capabilities in system as a beneficial attribute, 11 of the 27 articles (41%) stated that there was insufficient security in the design	Technology Factors

	User friendliness	11 of 27 articles, patients did not perceive the system as user-friendly and had difficulty navigating Web applications due to a lack of patient technical support, education, and access to the Internet.	Technology Factors Use/User Satisfaction
	Secure messaging	Combination with time management as providers expressed frustration that they would not have sufficient time to take care of business that is reimbursable.	Organization Factors
	Time management	Time management was most often mentioned by providers as an expression of frustration that they would not have sufficient time to take care of business that is reimbursable	Organization Factors
	Cost	3 in 27 articles (11%) identified cost as a concern.	Organization Factors Environment Factors
	Educational resources	Although patients value the educational resources provided in their patient portal, in 3 articles, many patients reported difficulty understanding and navigating interactive resources such as health libraries in their patient portal.	People Factors Technology Factors
Kruse et al., 2015a	Portal users tend to be female, Caucasian, under 65 years old, well educated, and prefer electronic means of communication		People Factors
	Sociodemographic disparities exist for portal use, and users need to improve their health literacy in order to better interpret the medical information they are viewing		People Factors
	Providers who offer the portals will not be able to capitalize on the Meaningful Use, stage 2 incentive due to lack of awareness of the patient portal service.		People Factors
Amante et al., 2014	Portal enrollment - Lack of capacity: Lack of computer skills		People Factors
	Portal enrollment - Lack of capacity: No computer/internet access		People Factors
	Portal enrollment - Lack of capacity: Don’t wont to spend time learning system		People Factors
	Portal enrollment - Lack of desire: Already satisfied with provider relationship		People Factors
	Portal enrollment - Lack of desire: Already email provider directly without portal		People Factors
	Portal enrollment - Lack of desire: Don’t want to spend time on the computer		People Factors
	Portal enrollment - Lack of awareness: Unaware of portal		People Factors

Portal enrollment - Lack of awareness: Unaware of portal features		People Factors
Portal utilization - patient barrier: Too busy/not enough time		People Factors
Portal utilization - patient barrier: No computer/internet access		People Factors
Portal utilization - patient barrier: Low knowledge/technical literacy		People Factors
Portal utilization - patient barrier: Unaware of portal/portal features		People Factors
Portal utilization - patient barrier: Doubts about technology and reliability of message exchange, security concerns, or prefer traditional communication		People Factors Technology Factors
Portal utilization - patient barrier: Don't believe in benefits.		People Factors
Portal utilization - provider barrier: Provider instructed patient not to use		Organization Factors
Portal utilization - provider barrier: Provider less engaged in portal use		Organization Factors
Portal utilization - provider barrier: Patient assumptions of provider engagement, interruptions, or reimbursement.		Organization Factors
Portal utilization - usability barrier: Lost/unknown user name/passwords.		People Factors
Portal utilization - usability barrier: Negative experience using portal.		People Factors
Portal utilization - usability barrier: Can't directly message all providers		Technology Factors
Portal utilization - usability barrier: No reminders sent		Technology Factors
Portal utilization - usability barrier: Inaccurate patient information on portal		Technology Factors
Portal utilization - usability barrier: Slow response from secure messages		Organization Factors People Factors Use/User satisfaction
Patient enrollment demographic factors: Higher education, younger age, higher income, private health insurance, and non-Hispanic/ non-black race		People Factors

	Psychosocial and disease knowledge enrollment factors: higher self-efficacy, more diabetes and insulin-related knowledge, higher health literacy, greater trust in the Internet as a health information source, better-controlled diabetes, nonsmoker and having higher morbidity burden.		People Factors
	Provider enrollment factors: Provider engaged in use, better provider quality measures, greater trust in providers and better communication with provider		Organization Factors
	Patient utilization demographic factors: Higher education, younger age, higher income,and non-Hispanic, non-black race.		People Factors
	Patient utilization diabetes factors: Patients utilized portals more if they had better controlled diabetes and reported less self-perceived diabetes distress and severity. Patients with greater morbidity burdenor high use of clinical services were more likely to utilize portals. One article found that using insulin was associated with higher portal utilization.	Findings for diabetes-related factors were mixed.	People Factors
Goldzeig et al., 2013	Patient-specific factors with lower use by racial and ethnic minorities, lower use with lower education level or literacy, and greater use with increased numbers of medical problems.		People Factors
	Barriers including instances of suboptimal patient attitudes of system worth		People Factors

Author(s)/Year	Enablers	Description	CAF Factor
Otte-Trojel et al., 2016	Patient-centered design	Designing systems to meet needs defined by patients' characteristics, preferences, and capacities, as opposed to the most easily operationalized features of the technology - results in systems with high patient-perceived usefulness and usability. Achieved through patient interviews, surveys, focus groups and usability testing	Technology Factors
	Training and education	Providing training to users who lack skills in the use of system and improve access by providing for example, onsite kiosks.	Organization Factors

	Promotional initiatives	Promotion initiatives for attracting patient attention and increasing awareness such as through encouragement by providers, through providing written or visual materials or follow-up registration reminders.	Organization Factors
	Workflow engineering	Using workflow engineering to mirror current workflow and capitalizing on existing provider roles could inform minimal burden workflow revisions (involving providers in the process).	Organization Factors
	Workflow training	To improve provider engagement, provide communication and practical training to providers to equip them to handle technical, interpersonal, and workflow aspects of system use.	Organization Factors
	Notification and signaling of urgency	To counter providers’ liability-related concerns by notifying providers if patients had not opened an email and designing the system to detect messages that signal medical urgency.	Technology Factors
	International Communication Standards	Standardizing interoperability guidelines to allow for data exchange among organizations such as the international Health Level 7 (HL7) standard.	Environment Factors
	Access control mechanisms	Setting up authentication mechanisms such as Public Key.	Technology Factors
	Encryption , internet firewalls, audits	Improve system security through encryption tools, firewalls, and audits of adherence to security protocol.	Technology Factors
	Health information exchanges	Setting up (Regional) Health Information Exchanges that can standardize data and facilitate ex- change among different organizations.	Environment Factors
	Policies for data availability and timing	Setting up policies for data viability and timing in order to improve data governance.	Environment Factors
	In-person authorization/user agreements	Patients to show identification in person before gaining access to a portal or using an electronically signed user agreement.	Environment Factors Technology Factors
	Provider and patient electronic signatures	Using electronic signatures to determine who had revised the records in order to improve data integrity.	Technology Factors
	Trial period to establish business case	Trial period before committing to purchasing a system to allow organizations to test usability and be better able to estimate financial and organizational effects of use.	Organization Factors
	Appropriate reimbursement criteria	Developing and testing reimbursement criteria for secure messaging that could be used by payers to determine whether and by how much to reimburse an online encounter.	Environment Factors
Bush et al., 2015	Following a demonstration of the portal to parents in an academic practice waiting room, 92% thought the patient portal was easy to use, and they planned to view medical records and laboratory results in the future.		Organization Factors
Price et al., 2015	76% (13/17) studies that used tethered PHR reported benefit. In comparison, only 50% (3/6) studies that used standalone PHRs showed benefit.		Technology Factors

Giardina et al., 2014	Usage of PHR - access to personalized medical information.	3 RCT compared usage of informational resources when given computer access to either personalized medical information or general health information, and found that access to personalized information increased the likelihood of usage.	Technology Factors
	Perceived usefulness of access to medical records	One trial randomly assigned pregnant patients to use an internet-based pregnancy resource either with or without additional access to personal antenatal health records. Although both groups found the information easy to access and useful, there was no significant difference in perceived usefulness.	Use/User Satisfaction
Amante et al., 2014	Portal enrollment - facilitator: Family recommended/supported		Environment Factors
	Portal enrollment - facilitator: Provider recommended		Organization Factors
	Portal enrollment - facilitator: Dissatisfied with provider-patient relationship		Organization Factors
	Portal utilization - facilitator: Family recommended/provided support.		Environment Factors
	Portal utilization - facilitator: Provider instructed patients to use		Organization Factors
	Provider utilization factors: Provider engaged in use, encourage use, patients reporting greater trust in their providers and better quality measures for their care		Organization Factors
	Portal enrollment - facilitator: Experienced difficulty obtaining medical information.		Organization Factors
Kruse et al., 2015	User-friendliness	Seven out of 27 articles (26%) reported from both patients and providers of the ease of navigation and user-friendliness of the system	Technology Use/User Satisfaction
	Secure messaging	Ten of 27 articles (37%) reported a positive association with the secure messaging offered by the system	Technology Use/User Satisfaction

Author(s)/Year	Benefits	Description	CAF Factor
Mold et al., 2015	70% of clinicians felt that online access strengthened relationships, enhanced trust, and improved decision making		Outcomes
	Patients who used online access to test results were more satisfied than those who did not	Patient satisfaction improved through enabling better self-care. The introduction of a system which enabled patients to view their test results, manage their medication list, and have secure messaging with their practice, resulted in responders saying the system facilitated their participation in their own care and another post-intervention survey found that patients felt more in control of their care.	Outcomes

	Use of a secure messaging tool improved patient satisfaction with care	Patient satisfaction improved through enabling better self-care. Several trials showed that online access to records and services improved communication.	Outcomes
	Patients felt themselves better able to express their concerns in writing (34%), to communicate about difficult topics (36%), and to send psychosocial information when using online tools versus telephone.	Several trials showed that online access to records and services improved communication.	Outcomes
	Online systems saved patients time, telephone calls, and clinic visits		Outcomes
	Patients given online access to their records identified more than twice as many medication list discrepancies with potential for severe harm than those who did not	Patient safety was largely improved through patients identifying errors in their medication list. Online access to consultation notes was also found to increase reported medication adherence.	Outcomes
	Users of online services received 84% of preventive care services compared with 68% of controls, including influenza vaccine (22% versus 14%) and mammography (49% versus 30%); children whose parents used online services received 96% of immunizations versus 87% in controls. Online services also facilitated health maintenance/appointment reminders	Online services facilitated uptake of preventive care services by providing prevention or health maintenance reminders. Online access to consultation notes was also found to increase reported medication adherence.	Outcomes
	Clinicians had concerns about the additional burden and workload from online access but found their fears only partly realized	Clinicians thought e-mail was useful for answering patients' non-urgent medical questions and helpful in managing patients' administrative concerns. However, a few intervention clinicians felt that e-mails were too lengthy or were concerned about incomplete information.	Outcomes
	1–8% of patients say that viewing their record online caused confusion, worry, or offence	Only 1–8% of patients stated that viewing consultation notes caused confusion, worry, or felt offended with note comments. Similarly, clinicians had fears about potentially offending or worrying patients; however, these concerns did not materialize in practice.	Outcomes
	The impact of online record access on patient use of face-to-face services and telephone calls was unclear	Online access has an inconsistent effect on face-to-face consultations, which increased in some studies and went down in others.	Outcomes
Bush et al. 2015	Parents of chronically ill children (diabetes mellitus, cystic fibrosis, and juvenile idiopathic arthritis) reported that the portal was accurate and timely, helping them to communicate with their children's care providers		Outcomes

	The portal helped to manage and understand child's condition, reducing anxiety and offering reassurance.		Outcomes
	Parents of both healthy and chronically ill children like the concept of the patient portal.	Parents of chronically ill children (diabetes mellitus, cystic fibrosis, and juvenile idiopathic arthritis) reported that the portal was accurate and timely, helping them to communicate with their children's care providers.	Outcomes
	Portal use was statistically significant predictor of glycosylated hemoglobin level but not of low-density lipoprotein and total cholesterol levels.		Outcomes
Kruse et al., 2015	Patient-provider communication	A total of 11 out of 27 articles (41%) reported an improvement of patient-provider communication as a result of using the system	Outcomes
	Quality of care	Ten out of 27 articles (37%) mentioned improvements in quality of care as reported by both patient and provider	Outcomes
	Disease outcomes	Ten of 27 articles (37%) reported an increase in disease outcomes as a result of using the system. Only two of 27 articles (7%) reported negative medical outcomes as a result of use.	Outcomes
	Educational resources	Nine out of 21 articles (33%) attributed greater self-management of chronic conditions through the presence of educational resources presented through a patient portal	Outcomes
	Time	Example: Using the mobile monitoring apps allow patients to access their patient portal at their own convenience	Outcomes
Kruse et al., 2015a	The use of the patient portals in this review illustrates a higher retention rate of patient loyalty		Outcomes
	Lower appointment no-show rates		Outcomes
	Studies documented a high rate of patient satisfaction with the portal, which enables patients to take a more active role in medical decision making		Outcomes
	Portal use also seems to increase patient-to-provider communication with only a slight increase in workload or office visits		Outcomes
	Results varied on improved outcomes		Outcomes
Price et al., 2015	Improved patient satisfaction with care		Outcomes
	Improved disease control	PHR sensitive conditions identified included: diabetes, hypertension, asthma, HIV, fertility management, glaucoma, and hyperlipidemia. These conditions share several common characteristics: Each of these conditions is chronic.	Outcomes
	Decreased patient distress		Outcomes
	improved continuity		Outcomes

	Improved medication management		Outcomes
	Improved access to own information		Outcomes
	Improved access to health knowledge		Outcomes
	Improved access to patient information by provider		Outcomes
	More effective face-to-face visits		Outcomes
	Better patient-provider communication		Outcomes
	Improved ability to self manage	Significant benefit from self-management through behavioural changes.	Outcomes
	More activated patient		Outcomes
Giardina et al., 2014	Physical health outcomes	Mixed findings for biological outcomes such as laboratory values, body mass index, and blood pressure. Found no current evidence to substantiate any negative patient outcomes resulting from access to health information	Outcomes
	Psychosocial health outcomes	Five studies addressed psychosocial variables including depression, anxiety, contentment, and quality of life. Three studies found no significant differences in anxiety between groups, while two studies found that anxiety decreased with access to medical information. Two studies evaluated self-reported depression and contentment in patients and found no significant differences between the intervention and control groups. Found no current evidence to substantiate any negative patient outcomes resulting from access to health information. Access to medical information did not increase patient anxiety.	Outcomes
	Health behaviors and adherence outcomes	Four studies included measures of patient health behaviors, and outcomes were mixed.	Outcomes
	Recall of medical information	Two studies addressed patient recall of medical information as an outcome of patient access to medical records, and the results were mixed.	Outcomes
	Accuracy of the medical record	One uncontrolled observational study evaluated the influence of a secure web-based patient portal on the accuracy of medication lists in the electronic health record, and found no significant differences.	Outcomes
	Patient satisfaction	Limited evidence suggests that patients with access to medical records have improved levels of satisfaction	Outcomes
	Informed patient	Three studies measured pregnant women’s perceptions of being informed when provided with access to their medical records of which two found a significant effect	Outcomes
	Patient involvement in care	Mixed findings around self-efficacy, control and empowerment.	Outcomes
	Studies of efficiency	Mixed finding with impact on office visits and telephone calls. PHR users as a group had significantly more after-hours clinic visits, emergency department visits, and hospital visit	Outcomes

Goldzweig et al., 2013	Improved outcomes for patients with chronic conditions	Identified examples in which portal use was associated with improved outcomes for patients with chronic diseases, such as diabetes, hypertension, and depression, but these studies generally used the portal in conjunction with case management.	Outcomes
Ammenwerth et al., 2012	Quicker decrease in office visit rates and slower increase in telephone contacts		Outcomes
	Increase in number of messages sent	A study mentions that a quarter of portal users indicated they would have scheduled an appointment in lieu of electronic messaging; so there seems to be a possibility of saving resources by a portal with electronic messaging; but there is not sufficient data to decide conclusively on this.	Outcomes
	Changes of the medication regimen		Outcomes
	Better adherence to treatment	It seems plausible that better-informed patients show higher adherence to treatment or to clinical advices, but there is not sufficient evidence to support this assumption.	Outcomes

Appendix 9: Synthesis of Results

Environment Factors

Societal/Family Beliefs, Preferences and Trends	Reference
Social climate/culture (home and community members' values, experiences, practices, support, health status, and education)	Thompson et al. (2016)
Recommendation or support from family	Amante et al. (2014)
Healthcare social norms and pressures (technology use norms, instructions to use, incentive to change)	Thompson et al. (2016)
Policies, Standards and Governance	**Reference**
Policy, priorities and privacy controls (who has access to system/data-patients and caregivers)	Thompson et al. (2016); Otte-Trojel et al. (2016)
Rules, standards, and legislation (3rd party access, interoperability, ability/inability to contact multiple providers and provider liability concerning data)	Thompson et al. (2016)
Standardized technical and semantic language -allow for data exchange.	Otte-Trojel et al. (2016)
Funding and Incentives	**Reference**
Practice/Health organization's financial resources (including cost-benefit of system)	Thompson et al. (2016); Kruse et al. (2015)
Level/amount of incentives to use (rewards structure)	Thompson et al. (2016); Otte-Trojel et al. (2016)

People Factors

Health/Computer Literacy	Reference
Level of computer skills/literacy (experience of using the internet)	Thompson et al. (2016); Amante et al. (2014)
Level of health literacy (understanding terminology)	Otte-Trojel et al. (2016); Thompson et al. (2016); Bush et al. (2015); Kruse et al. (2015); Kruse et al. (2015a); Amante et al. (2014)
Demographic/Health	**Reference**
Level of education + training	Thompson et al. (2016); Bush et al. (2015); Kruse et al. (2015a); Goldzeig et al. (2013); Amante et al. (2014)
Level of employment	Thompson et al. (2016)
Age	Thompson et al. (2016); Otte-Trojel et al. (2016); Mold et al. (2015); Bush et al. (2015); Kruse et al. (2015a); Amante et al. (2014)
Gender	Thompson et al. (2016); Otte-Trojel et al. (2016); Mold et al. (2015); Kruse et al. (2015a)
Ethnicity (minority)	Thompson et al. (2016); Otte-Trojel et al. (2016); Mold et al. (2015); Bush et al. (2015); Kruse et al. (2015a); Goldzeig et al. (2013); Amante et al. (2014)
Language	Thompson et al. (2016)
Financial resources (income, private insurance , ability to pay for system access)	Thompson et al. (2016); Otte-Trojel et al. (2016); Mold et al. (2015); Bush et al. (2015); Amante et al. (2014)

Chronic disease/ greater morbidity	Otte-Trojel et al. (2016); Mold et al. (2015); Goldzeig et al. (2013); Amante et al. (2014); Bush et al. (2015)
Location (admitted vs community)	Thompson et al. (2016)
Socio economic status	Mold et al. (2015); Kruse et al. (2015a); Otte-Trojel et al. (2016)

Beliefs/Preferences/Behaviour	Reference
Preference for existing methods for communication, sharing and accessing information (including receiving new/concerning information from provider directly)	Thompson et al. (2016); Amante et al. (2014)
Preferences for existing/alternative technology	Thompson et al. (2016); Amante et al. (2014)
Beliefs of value, use and usefulness of system (including prior experience of using one)	Thompson et al. (2016); Otte-Trojel et al. (2016); Goldzeig et al. (2013); Amante et al. (2014)
Behaviour (health service utilization, practice of a healthy lifestyle, and norms for technology use and communication)	Thompson et al. (2016); Kruse et al. (2015a); Amante et al. (2014)
Security, Privacy and Confidentiality concerns (including impact of sharing data on insurance and discrimination)	Thompson et al. (2016); Otte-Trojel et al. (2016); Bush et al. (2015); Amante et al. (2014)
Willingness to pay for system/access/service	Thompson et al. (2016); Mold et al. (2015)
Concerns with not understanding, becoming worried or being offended by information accessed through system.	Thompson et al. (2016); Mold et al. (2015)
Willingness to learn system or use system	Amante et al. (2014)

Awareness/Access	Reference
Level of awareness of system/access and functions	Thompson et al. (2016); Otte-Trojel et al. (2016); Kruse et al. (2015a); Amante et al. (2014)
Access or availability of technology (Internet, computer, and smartphone)	Thompson et al. (2016); Otte-Trojel et al. (2016); Kruse et al. (2015); Amante et al. (2014)
Remembering passwords	Bush et al. (2015); Amante et al. (2014)

Organization Factors

Provider Demographic/Location	Reference
Age	Thompson et al. (2016)
Gender	Thompson et al. (2016)
Ethnicity	Thompson et al. (2016)
Language	Thompson et al. (2016)
Location (clinic setting rural vs urban)	Thompson et al. (2016)

Provider's Beliefs/Preferences	Reference
Preference for existing methods for communication	Thompson et al. (2016)
Preferences for existing/alternative technology	Thompson et al. (2016)
Beliefs (expectations/assumptions from patients, time to learn system, impact on time with patients)	Thompson et al. (2016); Amante et al. (2014)
Beliefs of value and benefits of system (including cost benefit)	Thompson et al. (2016); Kruse et al. (2015); Otte-Trojel et al. (2016)
Concerns with liability (data breaches, decision making with inaccuracy data entered by patients)	Thompson et al. (2016); Otte-Trojel et al. (2016)
Concerns with patients not understanding data or information entered causes stress or harmful behaviour	Otte-Trojel et al. (2016); Mold et al. (2015)

Concerns with autonomy (giving up autonomy and consequences of allowing patients more control of provider activities)	Otte-Trojel et al. (2016)
Concerns with amount/lack of reimbursement with use	Thompson et al. (2016); Otte-Trojel et al. (2016); Kruse et al. (2015); Amante et al. (2014)
Concerns with impact on workload/workflow with use	Thompson et al. (2016); Otte-Trojel et al. (2016); Mold et al. (2015); Kruse et al. (2015); Amante et al. (2014)
Behaviour (norms for technology use and communication)	Thompson et al. (2016)
Implementation	**Reference**
Provider's training	Thompson et al. (2016); Otte-Trojel et al. (2016)
Patient/caregiver training	Otte-Trojel et al. (2016)
Providing access to Patient/caregiver (onsite kiosk)	Otte-Trojel et al. (2016)
Workflow engineering (involving providers)	Otte-Trojel et al. (2016)
Trial period and demonstrations	Otte-Trojel et al. (2016); Bush et al. (2015)
Service Quality	**Reference**
Response time from provider	Thompson et al. (2016); Amante et al. (2014)
Level of support for patients using system (staffing levels)	Thompson et al. (2016); Kruse et al. (2015)
Level of provider encouragement, promotion, engagement or support to use system (industry influence)	Thompson et al. (2016); Amante et al. (2014); Otte-Trojel et al. (2016)
Patient's trust and satisfaction with provider (high and low satisfaction led to use)	Amante et al. (2014); Otte-Trojel et al. (2016)
Provider Skills/Computer Literacy	**Reference**
Provider's skills and knowledge of understanding and using system	Thompson et al. (2016); Otte-Trojel et al. (2016)
Provider Awareness/Access	**Reference**
Provider's level of awareness of system and functions	Thompson et al. (2016)
Provider's patients level of access/availability of usable technology	Thompson et al. (2016)

Technology Factors

System Quality	Reference
Usability (access, task demands, complexity, difficulty & response time)	Thompson et al. (2016); Bush et al. (2015); Amante et al. (2014); Kruse et al. (2015)
Functions and features (missing functionality)	Thompson et al. (2016); Bush et al. (2015); Amante et al. (2014)
Level of security(encryption firewalls)/confidentiality (robust authentication)	Thompson et al. (2016); Otte-Trojel et al. (2016); Kruse et al. (2015)
Patient centered design/personalization	Otte-Trojel et al. (2016)
Interoperability (tethered vs standalone)	Price et al. (2015); Thompson et al. (2016); Otte-Trojel et al. (2016)
Notifications (to counter liability and assist with signaling urgency)	Otte-Trojel et al. (2016)
Information Quality	**Reference**
Complexity of data/terminology	Thompson et al. (2016); Bush et al. (2015); Kruse et al. (2015)
Data integrity (accuracy and completeness of data, use of provider and patient electronic signatures)	Thompson et al. (2016); Otte-Trojel et al. (2016); Amante et al. (2014)

Personalized information	Giardina et al. (2014)
Data transparency (what data should be included - for the expert or lay people?)	Otte-Trojel et al. (2016)
Fit to Patient/Caregiver	**Reference**
Fit to everyday routines and time constraints (time and sequence demands, not enough time to use system)	Thompson et al. (2016); Bush et al. (2015); Amante et al. (2014)
Fit to Workflow	**Reference**
Fit to Workflow (time and sequence demands - time taken to complete related work, access information and to use and learn the system)	Thompson et al. (2016)

Use/User Satisfaction

User/User Satisfaction	**Reference**
Response time from provider not meeting expectations	Thompson et al. (2016); Amante et al. (2014)
Low use	Bush et al. (2015)
Usability/usefulness (mixed)	Kruse et al. (2015); Giardina et al. (2014)

Outcomes

Quality	**Reference**
Enhanced trust	Mold et al. (2015)
Strengthened relationships	Mold et al. (2015)
Patient satisfaction (with care)	Mold et al. (2015); Kruse et al. (2015); Kruse et al. (2015a); Price et al. (2015); Giardina et al. (2014)
Provider satisfaction (with care)	Kruse et al., (2015)
Improved communication (patient-provider)	Mold et al. (2015); Bush et al. (2015); Kruse et al. (2015); Kruse et al., (2015a); Price et al. (2015); Ammenwerth et al. (2012)
Improved patient safety	Mold et al. (2015)
Improvements on disease/health outcomes (mixed)	Kruse et al. (2015); Kruse et al, (2015a); Giardina et al, (2014); Goldzweig et al. (2013)
Accuracy of the medical record (no Significant differences)	Giardina et al. (2014); Bush et al. (2015)
Knowledge	**Reference**
Improved decision making	Mold et al. (2015)
Improved understanding of condition	Bush et al. (2015); Giardina et al. (2014)
Recall of medical information (mixed)	Giardina et al. (2014)
Productivity	**Reference**
Saved patients time, decreased telephone calls, and clinic visits (mixed results)	Mold et al. (2015); Giardina et al. (2014); Ammenwerth et al. (2012)
Decreased no shows	Kruse et al. (2015a)
Concerns re: increased workload only partly realized	Mold et al. (2015); Kruse et al. (2015a)
Improved continuity	Price et al. (2015)
More effective face-to-face visits	Price et al. (2015)
Behaviour	**Reference**

Improved self care and/or management and participation in care (adherence to medication) (mixed results)	Mold et al. (2015); Bush et al. (2015); Kruse et al. (2015); Kruse et al. (2015a); Price et al. (2015); Giardina et al. (2014); Ammenwerth et al. (2012)
Reduced anxiety/distress (or did not increase anxiety)	Bush et al. (2015); Price et al. (2015); Giardina et al. (2014)
Higher retention rate of patient loyalty	Kruse et al. (2015a)
Access	**Reference**
Improved access to preventative care	Mold et al. (2015)
Allowed patients to access system at own convenience	Kruse et al. (2015)
Improved access to information by patient	Price et al. (2015)
Improved access to information by provider	Price et al. (2015)
Improved access to health knowledge	Price et al. (2015)

Appendix 10: Overlap of Primary Studies Included in Reviews

Primary Study	Year	Title	Thompson et al. (2016)	Otte-Trojel et al. (2016)	Bush et al. (2015)	Kruse et al. (2015)	Kruse et al. (2015a)	Mold et al. (2015)	Price et al. (2015)	Amante et al. (2014)	Giardina et al. (2014)	Goldzweig et al. (2013)	Ammenwerth et al. (2012)	Total
-Schmidt and Nguyen	2013	Parent intention to use a patient portal as related to their children following a facilitated demonstration			x									1
Ammenwerth et al	2012	The impact of electronic patient portals on patient care: a systematic review of controlled trials				x								1
Ancker et al	2011	Use of an electronic patient portal among disadvantaged populations	x											1
Banet and Felchlia	1997	The potential utility of a shared medical record in a “first-time” stroke population									x			1
Beaudoin et al	2005	Enhancing access to patient education information: a pilot usability study				x								1
Bergman et al	2008	Teen use of a patient portal: a qualitative study of parent and teen attitudes			x									1
ergmo and Wangberg	2007	Patients’ willingness to pay for electronic communication with their general practitioner						x						1
Bergmo et al	2005	Electronic patient-provider communication: will it offset office visits and telephone consultations in primary care?						x						1

Boland et al	2014	Automated telecommunication-based reminders and adherence with once-daily glaucoma medication dosing: the automated dosing reminder study.							x					1
Bredfeldt et al	2011	Effects of between visit physician-patient communication on Dia- betes Recognition Program scores								x				1
Britto et al	2009	Usability testing finds problems for novice users of pediatric portals			x	x								2
Britto et al	2013	Parents' perceptions of a patient portal for managing their child's chronic illness	x		x	x								3
Burke et al	2010	Transforming patient and family access to medical information: Utilization patterns of a patient-accessible electronic health record	x									x		2
Byczkowski et al	2011	Variation in use of Internet-based patient portals by parents of children with chronic disease			x	x								2
Byczkowski et al	2014	Family perceptions of the usability and value of chronic disease web-based patient portals	x		x	x								3
Chiche et al	2012	Evaluation of a prototype electronic personal health record for patients with idiopathic thrombocytopenic purpura							x					1
Cho et al	2010	Do diabetic veterans use the Internet? Self-reported usage, skills, and in- terest in using My HealtheVet Web portal								x		x		2

Crotty et al	2013	Preparing residents for future practice: Report of a curriculum for electronic patient-doctor communication providers	x											1
Crouch	2014	Patient Activation in HIV-Infected Veterans Who Use Electronic Personal Health Records							x					1
Day and Gu	2012	Influencing factors for adopting personal health record (PHR)	x									x		2
De Jong et al	2014	The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a chronic condition: a systematic review				x	x							2
De Tora and Linkon	2009	The new age of healthcare communications				x								1
Delbanco et al	2012	Inviting patients to read their doctors' notes: a quasi-experimental study and a look ahead					x	x				x		3
Denton	2001	Will patients use electronic personal health records? Responses from a real-life experience	x											1
Do et al	2001	The military health system's personal health record pilot with Microsoft HealthVault and google health	x											1
Earnest	2004	Use of a patient-accessible electronic medical record in a practice for congestive heart failure: patient and physician experiences	x									x	x	3
nd and Joustra-Enquist	2004	Sustains—direct access for the patient to the medical record over the Internet.										x		1

Elbourne et al	1987	The Newbury Maternity Care Study: a randomized controlled trial to assess a policy of women holding their own obstetric records.									x			1
Emani et al	2012	Patient perceptions of a personal health record: A test of the diffusion of innovation model	x									x		2
Emont	2011	Measuring the impact of patient portals: what the literature tells us				x								1
Fairhurst and Sheikh	2008	Texting appointment reminders to repeated non-attenders in primary care: randomised controlled stud						x						1
Fiks et al	2014	A shared e-decision support portal for pediatric asthma			x									1
Fonda et al	2009	Changes in diabetes distress related to participation in an internet-based diabetes care management program and glycemic control							x	x				2
Fuji et al	2008	Personal health record use by patients as perceived by ambulatory care physicians in Nebraska and South Dakota: A cross-sectional study	x											1
Garrido et al	2014	Secure e-mailing between physicians and patients: transformational change in ambulatory care					x							1
Goel et al	2011	Disparities in enrollment and use of an electronic patient portal	x											1
Goel et al	2011	Patient reported barriers to enrolling in a patient portal				x	x					x		3
Goldner et al	2013	The intersection of gender and place in online health activities	x											1
Goldzweig et al	2013	Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review				x								1

Gordon et al	2012	Processes and outcomes of developing a continuity of care document for use as a personal health record by people living with HIV/AIDS in New York City.	x						x					2
Grant et al	2008	Practice-linked online personal health records for type 2 diabetes mellitus: a randomized controlled trial							x		x	x	x	4
Green et al	2008	Effectiveness of home blood pressure monitoring, Web communication, and pharmacist care on hypertension control: a randomized controlled trial										x		1
Gravis et al	2011	Full access to medical records does not modify anxiety in cancer patients: results of a Randomized Study									x			1
Gu and Day	2013	Propensity of people with long-term conditions to use personal health records	x											1
Guy et al	2012	Evaluation of a web-based patient portal for chronic disease management	x											1
Hanauer et al	2014	Patient-initiated electronic health record amendment requests					x							1
Hannan	2010	Providing patients online access to their primary care computerised medical records: a case study of sharing and caring			x									1
Harris et al	2009	Diabetes quality of care and outpatient utilization associated with electronic patient-provider messaging: a cross-sectional analysis								x				1
Haggstrom et al	2011	Lessons learned from usability testing of the VA's personal health record										x		1

Hassol et al	2004	Patient experiences and attitudes about access to a patient electronic health care record and linked web messaging.										x		1
Haun et al	2014	Evaluating user experiences of the secure messaging tool on the Veterans Affairs' patient portal system				x	x							2
Hess et al	2007	Exploring challenges and potentials of personal health records in diabetes self-management: implementation and initial assessment.	x							x		x		3
Hess et al	2014	Patterns of response to patient-centered decision support through a personal health record							x					1
Hogan et al	2014	Technology-assisted patient access to clinical information: an evaluation framework for blue button				x	x							2
Homer et al	1999	The introduction of a woman-held record into a hospital antenatal clinic: the bring your own records study									x			1
Horvath et al	2011	Impact of health portal enrollment with email reminders on adherence to clinic appointments: a pilot study.				x	x							2
Jethwani et al	2012	Diabetes con- nect: an evaluation of patient adoption and engagement in a web-based remote glucose monitoring program								x				1
Jones et al	1999	Randomised trial of personalised computer based information for cancer patients.									x			1
Jung et al	2011	Who are portal users vs. early E-Visit adopters? A preliminary analysis	x									x		2

Kahn et al	2010	Personal health records in a public hospital: experience at the HIV/AIDS clinic at San Francisco General Hospital.	x						x					2
shiwagi and Tsukahara	2014	Impact of patient access to Internet health records on glaucoma medication: randomized controlled trial.				x	x							2
Katz et al	2003	Effect of a triage-based E-mail system on clinic resource use and patient and physician satisfaction in primary care: a randomized controlled trial.						x						1
Katz et al	2004	Crossing the digital divide: evaluating online communication between patients and their providers						x						1
Ketterer et al	2013	Correlates of patient portal enrollment and activation in primary care pediatrics			x		x							2
Kim et al	2009	Challenges to using an electronic personal health record by a low-income elderly population	x											1
Kittler et al	2004	Primary care physician attitudes towards using a secure web-based portal designed to facilitate electronic communication with patients				x								1
Krist et al	2011	Designing a patient-centered personal health record to promote preventive care	x											1
Krist et al	2012	Interactive preventive health record to enhance delivery of recom- mended care: a randomized trial										x		1
Kruse et al	2012	Internet use by primary care patients: where is the digital divide?				x								1
Kummervold et al	2004	Patient-physician interaction over the internet						x						1

Lam et al	2013	Older adult consumers' attitudes and preferences on electronic patient-physician messaging					x							1
Lau et al	2014	Impact of patient use of an online patient portal on diabetes outcomes				x			x					2
Lau et al	2013a	Consumers' online social Network topologies and health behaviors	x											1
Lau et al	2013b	Social and self-reflective use of a web-based personally controlled health management system	x											1
Lau et al	2013c	Which bundles of features in a web-based personally controlled health management system are associated with consumer help- seeking behaviors for physical and emotional well-being?	x											1
Leveille et al	2009	Health coaching via an internet portal for primary care patients with chronic conditions: a randomized controlled trial				x								1
Liaw et al	1998	The impact of a computer generated patient held health record									x			1
Liaw et al	1996	The effect of a computer-generated patient-held medical record summary and/or a written personal health record on patients’ attitudes, knowledge and behaviour concerning health promotion									x			1
Lin et al	2005	An Internet-based patient-provider communication system: randomized controlled tria	x					x				x		3

Liss et al	2014	Changes in office visit use associated with electronic messaging and telephone encounters among patients with diabetes in the PCMH					x							1
Lober et al	2006	An internet-based patient-provider communication system: Randomized controlled trial	x											1
Lovell et al	1987	Tomas's Hospital maternity case notes study: a randomised controlled trial to assess the effects of giving expectant mothers their own maternity case notes									x			1
Luzio et al	2007	Results of the pilot study of DIADEM: a comprehensive disease management programme for type 2 diabetes				x								1
Lyles et al	2013	Patient-provider communication and trust in relation to use of an online patient portal among diabetes patients: The Diabetes and Aging Study				x	x			x				3
Lyles et al	2012	Patient race/ethnicity and shared medical record use among diabetes patients								x		x		2
Maly et al	1999	A randomized controlled trial of facilitating information giving to patients with chronic medical conditions: effects on outcomes of care.									x			1
Matheny et al	2007	Impact of an automated test results management system on patients' satisfaction about test result communication						x						1
Mayberry et al	2011	Bridging the digital divide in diabetes: family support and implica- tions for health literacy	x							x				2

McCarrier et al	2009	Web-based collaborative care for type 1 diabetes: a pilot randomized trial.									x	x		2
McInnes et al	2013	Personal health record use and its association with antiretroviral adherence: survey and medical record data from 1871 US veterans infected with HIV							x			x		2
McInnes et al	2013	Development and evaluation of an internet and personal health record training program for low-income patients with HIV or hepatitis C	x											1
Miller et al	2011	Web-based self-management for patients with multiple sclerosis: a practical, randomized trial							x					1
Miller et al	2007	Determinants of personal health record use	x											1
Nagykaldi et al	2012	Impact of a Wellness Portal on the delivery of patient-centered preventive care.	x					x						2
Nazi	2010	Veterans' voices: use of the American Customer Satisfaction Index (ACSI) Survey to identify My HealtheVet personal health record users' characteristics, needs, and preference	x											1
Nazi	2013	The personal health record paradox: Healthcare professionals' perspectives and the information ecology of personal health record systems in organizational and clinical settings	x											1
Nazi et al	2013	Evaluating patient access to electronic health records results from a survey of veterans	x				x							2

Neuner et al	2014	Meaningful Use and the Patient Portal: Patient Enrollment, Use, and Satisfaction With Patient Portals at a Later-Adopting Center					x							1
Nielsen et al	2012	Internet portal use in an academic multiple sclerosis center	x											1
Nijland et al	2011	Factors influencing the use of a Web-based application for supporting the self-care of patients with type 2 diabetes: a longitudinal study				x	x							2
North et al	2011	Patient portal doldrums: does an exam room promotional video during an office visit increase patient portal registrations and portal use?						x						1
North et al	2013	Patient-generated secure messages and eVisits on a patient portal: are patients at risk?				x								1
f National Coordinator	2014	What is a patient portal?				x								1
Or et al	2014	Does the use of consumer health information technology improve outcomes in the patient self-management of diabetes? A meta-analysis and narrative review of randomized controlled trials				x								1
Orsborn et al	2010	Patient web portals to improve diabetes outcomes: a systematic review				x								1
Osborn et al.	2013	Under- standing patient portal use: implications for medication management	x			x	x			x				4
Palen et al	2012	Association of online patient access to clinicians and medical records with use of clinical services					x	x			x	x		4

Poon et al	2007	Empowering patients to improve the quality of their care: design and implementation of a shared health maintenance module in a US integrated healthcare delivery network	x											1
Robin et al	2009	Disparities in use of a personal health record in a managed care organization.										x		1
Ralston et al	2004	Patients’ experience with a diabetes support programme based on an interactive electronic medical record: qualitative study.										x		1
Ralston et al	2009	Patient use of secure electronic messaging within a shared medical record: a cross-sectional study				x		x						2
Ralston et al	2007	Patient web services integrated with a shared medical record: patient use and satisfaction										x		1
Ralston et al	2009	Web-based collaborative care for type 2 diabetes: a pilot randomized trial.									x	x		2
Ricciardi et al	2013	A national action plan to support consumer engagement via e-health				x								1
Ross et al	2004	Providing a web-based online medical record with electronic communication capabilities to patients with congestive heart failure: randomized trial									x	x	x	3
Ross et al	2006	Adoption and use of an online patient portal for diabetes (Diabetes-STAR									x			1
Rubin et al	2007	What is the most effective way to communicate results after endoscopy?									x			1

Sarker et al	2010	The literacy divide: health literacy and the use of an internet-based patient portal in an integrated health system—results from the Diabetes Study of Northern California (DISTANCE)	x			x				x		x		4
Sarker et al	2011	Social disparities in internet patient portal use in diabetes: evidence that the digital divide extends beyond access.	x							x				2
Sarker et al.	2014	Use of the refill function through an online patient portal is associated with improved adherence to statins in an integrated health system							x					1
Saunders et al	2003	Does receiving a copy of correspondence improve patients' satisfaction with their out-patient consultation?									x			1
Schnipper et al	2012	Effects of an online personal health record on medication accuracy and safety: a cluster-randomized trial						x				x		2
Schnipper et al	2008	Design and implementation of a web-based patient portal linked to an electronic health record designed to improve medication safety: the Patient Gateway medications module	x									x		2
Schprechman et al	2013	Health Literacy and Global Cognitive Function Predict E-Mail but Not Internet Use in Heart Failure Patients.					x							1

Shade et al	2014	Health information technology interventions enhance care completion, engagement in HIV care and treatment, and viral suppression among HIV-infected patients in publicly funded settings							x					1
Shaw and Ferranti	2011	Patient-provider internet portals--patient outcomes and us			x									1
Shaw et al	2008	Access to web-based personalized antenatal health records for pregnant women: a randomized controlled trial									x			1
Shimada et al	2013	Patient-provider secure messaging in VA: variations in adoption and association with urgent care utilization					x							1
Simon et al	2011	Randomized trial of depression follow-up care by online messaging										x		1
Sobko	2011	Associations Among Measures Of Engagement With Kp.Org And Clinical Outcomes							x					1
Solomon et al	2012	Effects of a web-based intervention for adults with chronic conditions on patient activation: online randomized controlled trial.							x					1
Spodik et al	2008	Providing an endoscopy report to patients after a procedure: a low-cost intervention with high returns.									x			1
Staroselsky et al	2008	An effort to improve electronic health record medication list accuracy between visits: patients’ and physicians’ response									x			1
Stevens et al	1977	What happens when hospitalized patients see their own records.									x			1

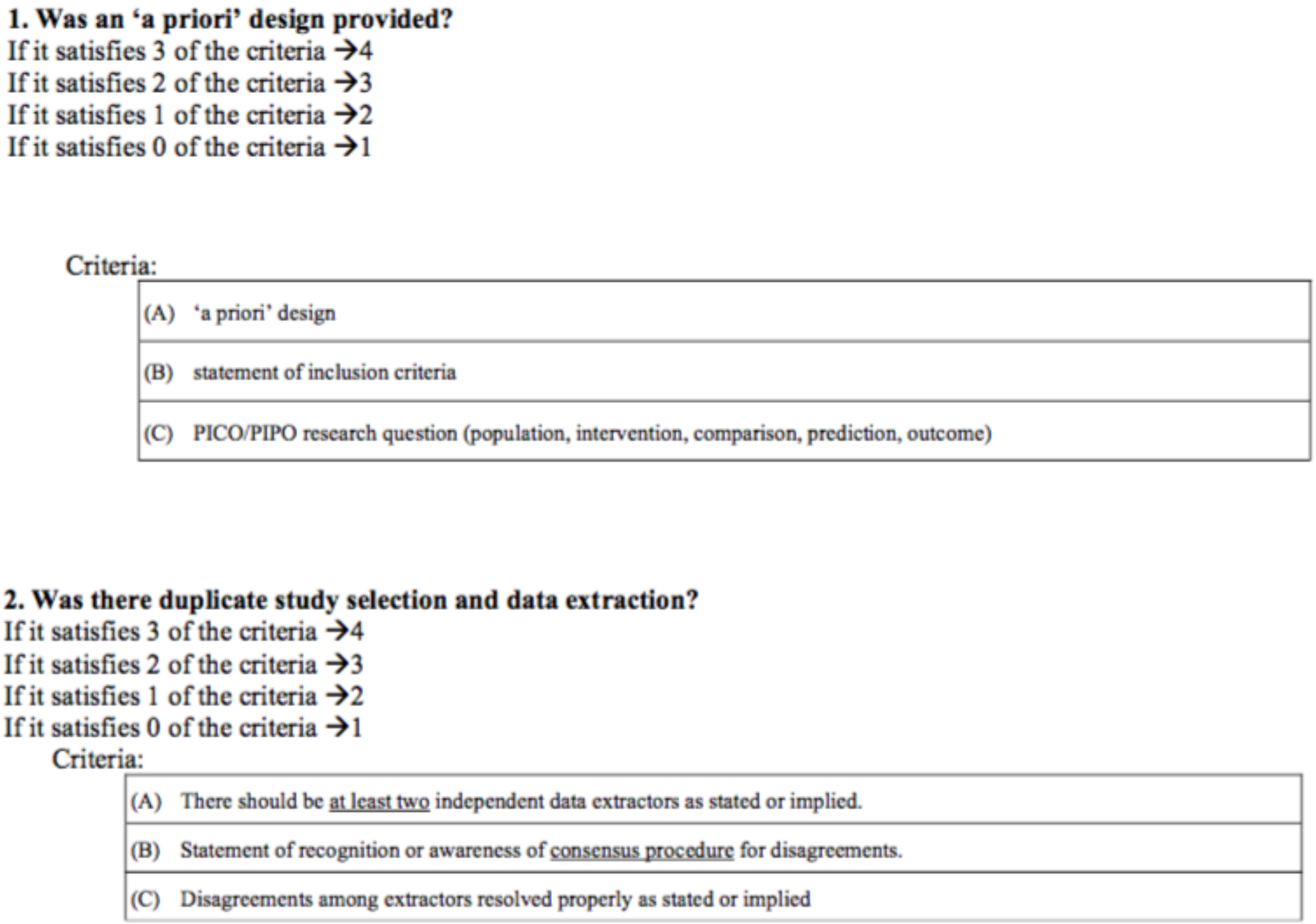
Tang et al	2013	Online disease management of diabetes: engaging and motivating patients online with enhanced resources-diabetes (EMPOWER-D), a randomized con- trolled tria										x		1
Tenforde et al	2012	The association between personal health record use and diabetes quality measures	x						x	x	x	x		5
Tjora et al	2005	Privacy vs. usability: A qualitative exploration of patients' experiences with secure internet communication with their general practitioner	x											1
Tom et al	2012	Integrated personal health record use: association with parent-reported care experiences	x		x							x		3
Tsai and Rosenheck	2012	Use of the internet and an online personal health record system by US veterans: comparison of Veterans Affairs mental health service users and other veterans nationally	x									x		2
Tuil et al	2007	Empowering patients undergoing in vitro fertilization by providing Internet access to medical data									x	x	x	3
Tuli et al	2006	Patient-centered care: using online personal medical records in IVF practice	x											1
Turvey et al	2014	Blue Button use by patients to access and share health record information using the Department of Veterans Affairs' online patient portal					x							1
Urowitz et al	2012	Improving diabetes management with a patient portal: a qualitative study of diabetes self-management portal	x			x	x		x					4

Van Empel et al	2011	Organizational determinants of patient-centered fertility care: a multilevel analysis							x					1
Varsi et al	2013	Patients’ Reported Reasons for Non-Use of an Internet-Based Patient-Provider Communication Service: Qualitative Interview Study					x							1
Villarreal et al	2014	Mobile and ubiquitous architecture for the medical control of chronic diseases through the use of intelligent devices: Using the architecture for patients with diabetes.				x								1
Virji et al	2006	Use of email in a family practice setting: opportunities and challenges in patient- and physician-initiated communication						x						1
Volk et al	2005	Patients’ perceptions of a Web portal offering clinic messaging and personal health information.										x		1
Vodicka et al	2013	Online access to doctors' notes: patient concerns about privacy	x											1
Wackerle et al	2010	Notes on a stick: use and acceptability of woman-held maternity note									x			1
Wade-Vuturo et al.	2013	Secure messaging and diabetes management: experiences and perspectives of patient portal users	x				x		x	x		x		5
Wagner et al	2012	Personal health records and hypertension control: a randomized trial	x						x		x	x		4
Wagner et al	2010	Incorporating patient perspectives into the personal health record: implications for care and caring	x											1

Wald et al	2010	Implementing practice-linked pre-visit electronic journals in primary care: patient and physician use and satisfaction	x						x			x		3
Wald et al	2010	Variations in patient portal adoption in four primary care practices.										x		1
Wald et al	2009	Survey analysis of patient experience using a practice-linked PHR for type 2 diabetes mellitus	x						x			x		3
Wang et al	2004	Personal health information management system and its application in referral management	x											1
Weingart et al	2006	Who uses the patient internet portal? The PatientSite experience	x											1
Weitzman et al	2012	Willingness to share personal health record data for care improvement and public health: a survey of experienced personal health record users	x											1
Wen et al	2010	Consumers' perceptions about and use of the internet for personal health records and health information exchange: Analysis of the 2007 Health Information National Trends Survey	x											1
Weppner et al	2010	Use of a shared medical record with secure messaging by older pa- tients with diabetes								x		x		2
Wiljer et al	2010	The anxious wait: assessing the impact of patient accessible EHRs for breast cancer patients	x						x		x	x		4

Woods et al	2013	Patient experiences with full electronic access to health records and clinical notes through the My HealtheVet personal health record pilot: Qualitative study	x			x	x							3
Wright et al	2012	Randomized controlled trial of health maintenance reminders provided directly to patients through an electronic PHR						x				x		2
Wynia et al	2011	Many physicians are willing to use patients' electronic personal health records, but doctors differ by location, gender, and practice	x											1
Yamin et al	2011	The digital divide in adoption and use of a personal health record										x		1
Zarcadoolas et al	2013	Consumers' perceptions of patient-accessible electronic medical records				x	x							2
Zhou et al	2007	Patient access to an electronic health record with secure messaging: impact on primary care utilization.						x			x	x	x	4
Zickmund et al	2008	Interest in the use of computerized patient portals: role of the provider-patient relationship	x			x				x		x		4
Zikmund-fisher et al	2014	Numeracy and literacy independently predict patients' ability to identify out-of-range test results.					x							1
Zulman et al	2011	Patient interest in sharing personal health record information, a web-based survey	x											1

Appendix 11: R-AMSTAR Tool (Kung et al., 2010)



1. Was an 'a priori' design provided?

If it satisfies 3 of the criteria →4
If it satisfies 2 of the criteria →3
If it satisfies 1 of the criteria →2
If it satisfies 0 of the criteria →1

Criteria:

(A)	'a priori' design
(B)	statement of inclusion criteria
(C)	PICO/PIPO research question (population, intervention, comparison, prediction, outcome)

2. Was there duplicate study selection and data extraction?

If it satisfies 3 of the criteria →4
If it satisfies 2 of the criteria →3
If it satisfies 1 of the criteria →2
If it satisfies 0 of the criteria →1

Criteria:

(A)	There should be at least two independent data extractors as stated or implied.
(B)	Statement of recognition or awareness of consensus procedure for disagreements.
(C)	Disagreements among extractors resolved properly as stated or implied

3. Was a comprehensive literature search performed?

If it satisfies 4 or 5 of the criteria → 4
If it satisfies 3 of the criteria → 3
If it satisfies 2 of the criteria →2
If it satisfies 1 or 0 of the criteria → 17

Criteria:

(A)	At least two electronic sources should be searched.
(B)	The report must include years and databases used (e.g. Central, EMBASE, and MEDLINE).
(C)	Key words and/or MESH terms must be stated **AND** where feasible the search strategy outline should be provided such that one can trace the filtering process of the included articles.
(D)	In addition to the electronic databases (PubMed, EMBASE, Medline), all searches should be supplemented by consulting current contents, reviews, textbooks, specialized registers, or experts in the particular field of study, and by reviewing the references in the studies found.
(E)	Journals were "hand-searched" or "manual searched" (i.e. identifying highly relevant journals and conducting a manual, page-by-page search of their entire contents looking for potentially eligible studies)

4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?

(Grey literature is literature produced at all levels of government, academia, business and industry in print and electronic formats, but is not controlled by commercial publishers. Examples can be but not limited to dissertations, conference proceedings.) Here is an extra description of what grey literature is.

If it satisfies 3 of the criteria →4
If it satisfies 2 of the criteria →3
If it satisfies 1 of the criteria →2
If it satisfies 0 of the criteria →1

Criteria:

(A)	The authors should state that they searched for reports regardless of their publication type.
(B)	The authors should state whether or not they excluded any reports (from the systematic review), based on their publication status, language etc.
(C)	"Non-English papers were translated" or readers sufficiently trained in foreign language
(D)	No language restriction or recognition of non-English articles

5. Was a list of studies (included and excluded) provided?

If it satisfies 4 of the criteria →4
If it satisfies 3 of the criteria →3
If it satisfies 2 of the criteria →2
If it satisfies 1 or 0 of the criteria → 1

Criteria:

(A)	Table/list/or figure of **included** studies, a reference list does not suffice.
(B)	Table/list/figure of **excluded** studies[1] either in the article or in a supplemental source (i.e. online). (Excluded studies refers to those studies seriously considered on the basis of title and/or abstract, but rejected after reading the body of the text)
(C)	Author satisfactorily/sufficiently stated the **reason for exclusion** of the seriously considered studies.
(D)	Reader is able to **retrace** the included **and** the excluded studies anywhere in the article bibliography, reference, or supplemental source

6. Were the characteristics of the included studies provided?

If it satisfies 3 of the criteria →4
If it satisfies 2 of the criteria →3
If it satisfies 1 of the criteria →2
If it satisfies 0 criteria → 1

Criteria:

(A)	In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions **AND** outcomes.
(B)	Provide the ranges of **relevant** characteristics in the studies analyzed (e.g. age, race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.)
(C)	The information provided appears to be complete and accurate (i.e. there is a tolerable range of subjectivity here. Is the reader left wondering? If so, state the needed information and the reasoning).

7. Was the scientific quality of the included studies assessed and documented?

If it satisfies 4 of the criteria →4
If it satisfies 3 of the criteria →3
If it satisfies 2 of the criteria →2
If it satisfies 1 or 0 of the criteria → 1

Criteria:

(A)	'A priori' methods of assessment should be provided (e.g., for effectiveness studies if the author(s) chose to include only randomized, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.
(B)	The scientific quality of the included studies appears to be meaningful.
(C)	Discussion/recognition/awareness of level of evidence
(D)	Quality of evidence should be rated/ranked based on characterized instruments. (Characterized instrument is a created instrument that ranks the level of evidence, e.g. GRADE[Grading of Recommendations Assessment, Development and Evaluation.])

8. Was the scientific quality of the included studies used appropriately in formulating conclusions?

If it satisfies 4 of the criteria →4
If it satisfies 3 of the criteria →3
If it satisfies 2 of the criteria →2
If it satisfies 1 or 0 of the criteria → 1

Criteria:

(A)	The results of the methodological rigor and scientific quality should be considered in the analysis and the conclusions of the review
(B)	The results of the methodological rigor and scientific quality are **explicitly stated** in formulating recommendations.
(C)	To have conclusions integrated/drives towards a clinical consensus statement
(D)	This clinical consensus statement drives toward revision or confirmation of clinical practice guidelines

9. Were the methods used to combine the findings of studies appropriate?
If it satisfy 4 of the criteria → 4
If it satisfy 3 of the criteria → 3
If it satisfy 2 of the criteria → 2
If it satisfy 1 or 0 of the following criteria → 1

Criteria:

(A)	Statement of criteria that were used to decide that the studies analyzed were similar enough to be pooled?
(B)	For the pooled results, a test should be done to ensure the studies were combinable, to assess their homogeneity (i.e. Chi-squared test for homogeneity, I^2).
(C)	Is there a recognition of heterogeneity or lack of thereof
(D)	If heterogeneity exists a "random effects model" should be used and/or the rationale (i.e. clinical appropriateness) of combining should be taken into consideration (i.e. is it sensible to combine?), or stated explicitly
(E)	If homogeneity exists, author should state a rationale or a statistical test

10. Was the likelihood of publication bias (a.k.a. "file drawer" effect) assessed?
If it satisfies 3 of the criteria →4
If it satisfies 2 of the criteria →3
If it satisfies 1 of the criteria →2
If it satisfies 0 of the criteria →1

Criteria:

(A)	Recognition of publication bias or file-drawer effect
(B)	An assessment of publication bias should include graphical aids (e.g., funnel plot, other available tests)
(C)	Statistical tests (e.g., Egger regression test).

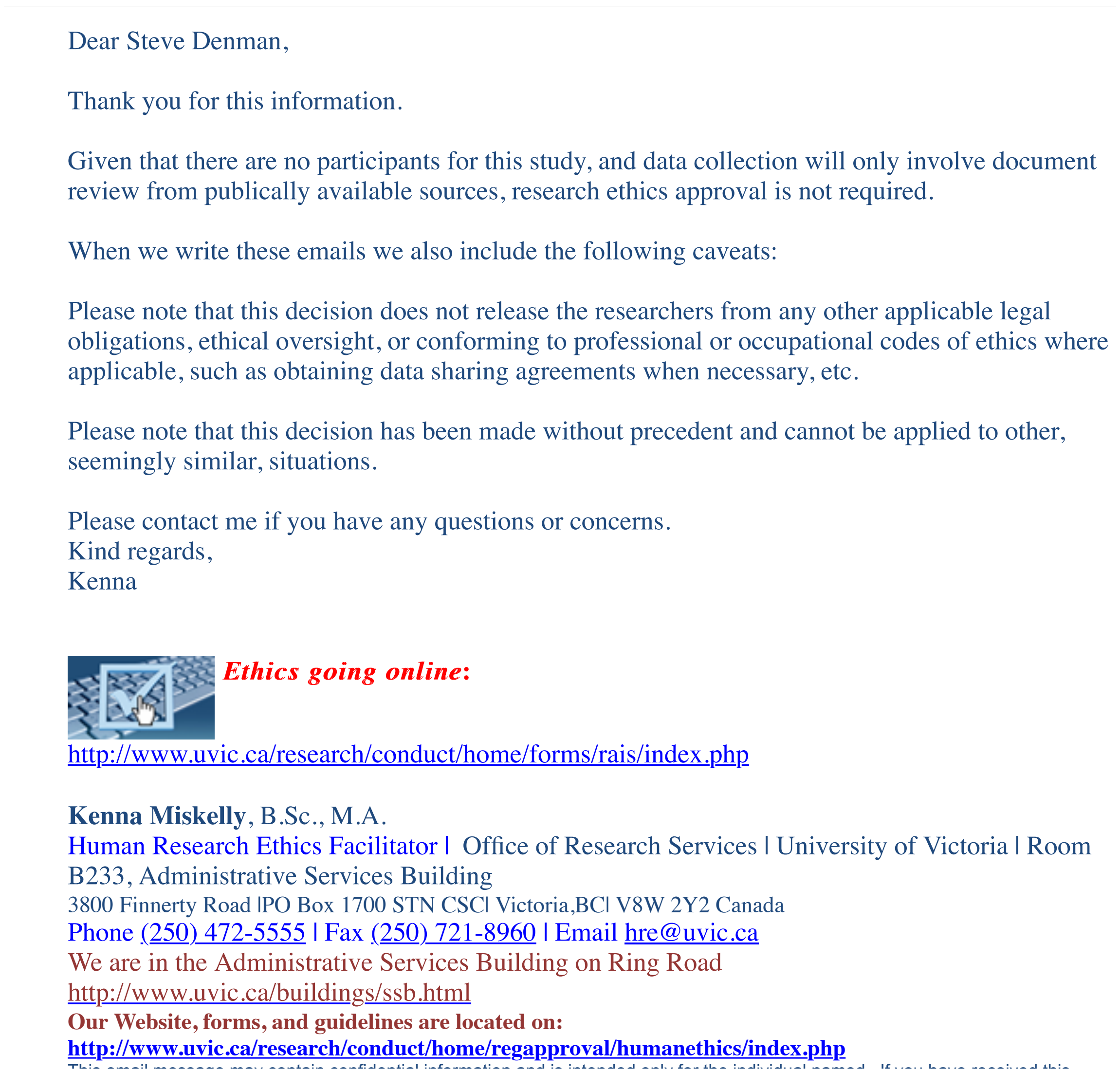
11. Was the conflict of interest stated?

If it satisfies 3 of the criteria →4
If it satisfies 2 of the criteria →3
If it satisfies 1 of the criteria →2
If it satisfies 0 of the criteria →1

Criteria:

(A)	Statement of sources of support
(B)	No conflict of interest. This is subjective and may require some deduction or searching.
(C)	An awareness/statement of support or conflict of interest in the **<u>primary</u>** inclusion studies

Appendix 12: Documentation of Research Approval from the University of Victoria's Research Ethics Board



Dear Steve Denman,

Thank you for this information.

Given that there are no participants for this study, and data collection will only involve document review from publically available sources, research ethics approval is not required.

When we write these emails we also include the following caveats:

Please note that this decision does not release the researchers from any other applicable legal obligations, ethical oversight, or conforming to professional or occupational codes of ethics where applicable, such as obtaining data sharing agreements when necessary, etc.

Please note that this decision has been made without precedent and cannot be applied to other, seemingly similar, situations.

Please contact me if you have any questions or concerns.
Kind regards,
Kenna

***Ethics going online*:**
http://www.uvic.ca/research/conduct/home/forms/rais/index.php

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We are in the Administrative Services Building on Ring Road
http://www.uvic.ca/buildings/ssb.html
Our Website, forms, and guidelines are located on:
http://www.uvic.ca/research/conduct/home/regapproval/humanethics/index.php