QUERI

Systematic Review:

Secure Messaging between Providers and Patients, and Patients' Access to Their Own Medical Record

Evidence on Health Outcomes, Satisfaction, Efficiency and Attitudes

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PREFACE

Quality Enhancement Research Initiative's (QUERI) Evidence-based Synthesis Program (ESP) was established to provide timely and accurate syntheses of targeted healthcare topics of particular importance to Veterans Affairs (VA) managers and policymakers, as they work to improve the health and healthcare of Veterans. The ESP disseminates these reports throughout VA.

QUERI provides funding for four ESP Centers and each Center has an active VA affiliation. The ESP Centers generate evidence syntheses on important clinical practice topics, and these reports help:

- develop clinical policies informed by evidence,
- guide the implementation of effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures, and
- set the direction for future research to address gaps in clinical knowledge.

In 2009, the ESP Coordinating Center was created to expand the capacity of QUERI Central Office and the four ESP sites by developing and maintaining program processes. In addition, the Center established a Steering Committee comprised of QUERI field-based investigators, VA Patient Care Services, Office of Quality and Performance, and Veterans Integrated Service Networks (VISN) Clinical Management Officers. The Steering Committee provides program oversight, guides strategic planning, coordinates dissemination activities, and develops collaborations with VA leadership to identify new ESP topics of importance to Veterans and the VA healthcare system.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP Coordinating Center Program Manager, at nicole.floyd@va.gov.

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This report is based on research conducted by the Evidence-based Synthesis Program (ESP) Center located at the West Los Angeles VA Medical Center, Los Angeles, CA funded by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Quality Enhancement Research Initiative. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (e.g., employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

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BACKGROUND

As the Veterans Health Administration (VHA) expands the capabilities of its personal health record system, My Health*e*Vet (MHV), and places greater emphasis on encouraging its use, it is interested in understanding how best to prioritize different functionalities and which of them will provide the greatest benefits to Veterans. This systematic review was designed to evaluate the literature surrounding secure messaging systems and electronic applications that give patients access to their own medical records, specifically investigating the evidence that these systems improve health outcomes, patient satisfaction, healthcare utilization and efficiency, and adherence. Additionally, the review examined studies that evaluated attitudes, particularly regarding patients having online access to their own medical information. The review distinguished between electronic systems that were "tethered" or tied to existing healthcare institution systems similar to how MHV is tethered to VHA's EHR, versus those that were "stand-alone."

The key questions were:

Key Question #1. What is the association between secure messaging and health outcomes, patient satisfaction, adherence, efficiency or utilization, or automated email?

Key Question #2. What is the association between patient access to their own medical record and health outcomes, patient satisfaction, adherence, efficiency or utilization, and attitudes about access?

METHODS

We searched PubMed for relevant literature from 01/01/1999 through 12/03/2010, using standard search terms such as electronic health record, patient, messaging, and computerized reminder. We limited the search to peer-reviewed articles published in the English language. Two reviewers assessed for relevance the full text articles identified from the title screening of the literature searches. Each article was reviewed using a standard screener form. Initial inclusion criteria were: 1) discussion of relevant functionalities, namely messaging programs, patient access to their own medical record, patient self-reported data, or online reminders; 2) study design of descriptive qualitative, descriptive quantitative, hypothesis testing, or systematic review.

DATA SYNTHESIS

We constructed evidence tables showing the study characteristics and results for all included studies, organized by key question, intervention, or clinical condition, as appropriate. We critically analyzed studies to compare their characteristics, methods, and findings. We compiled a summary of findings for each key question or clinical topic, and drew conclusions based on qualitative synthesis of the findings.

We assessed the overall quality of evidence for outcomes using a method developed by the GRADE Working Group.

PEER REVIEW

A draft version of this report was reviewed by six technical experts and/or clinical leaders. Reviewer comments were addressed and our responses were incorporated in the final report.

RESULTS

We reviewed 4607 titles and abstracts from the electronic search, and an additional 64 from content experts for a total of 4671 references. A title screen excluded 4274 as unrelated to our topic, with 397 remaining for further review. After applying our screener form to the full-text articles, 218 references were excluded. Of these, there were 84 that were not relevant to consumer health information technology, another 57 did not address any of the four specified functionalities, and 80 had study designs warranting exclusion (non-systematic review, commentary or news, or other ambiguous designs). We sorted these articles based on functionality, study design, and outcomes. Inclusion based on functionality retained articles relating to two of the functionalities, patient access to medical records (N=121) and secure messaging (N=153), with articles relating to online reminders (N=14) and patient self-reported data (N=74) no longer of interest. These categories were not mutually exclusive, however, so an article about secure messaging that also related to online reminders would be included, for example. Of the 13 articles identified by peer reviewers, eight met the criteria for inclusion, and were added to the appropriate categories below.

Within the included functionalities, further inclusion restrictions based on study design and outcomes were applied. Within the secure messaging functionality (N=154), the 26 articles with a hypothesis testing study design that related to health outcomes (N=9), patient satisfaction (N=7), adherence (N=2), or efficiency or utilization (N=18) were included. The other 128 articles relating to secure messaging were excluded either because their study design was descriptive or a systematic review (N=42), or they did not address one of the desired outcomes (N=86). For patient access to medical records (N=131), descriptive quantitative studies relating to tethered medical records addressing health outcomes, patient satisfaction, and adherence (N=6); efficiency or utilization (N=9); patient characteristics (N=4); or attitudes (N=12) were included, in addition to 5 articles which addressed non-tethered record, for a total of 31 articles. Additionally, four descriptive qualitative articles addressing barriers or facilitators to patient access to medical records were also included. The other 93 articles relating to patient access to medical records were excluded either because their study design was descriptive qualitative, and did not address barriers or facilitators to use, or systematic review (N=12), or they did not address one of the desired outcomes (N=81).

Key Question #1. What is the association between secure messaging and health outcomes, patient satisfaction, adherence, efficiency or utilization, or automated email?

The hypothesis testing studies that include secure messaging support the following conclusions:

- There is moderate strength evidence that secure messaging (especially as part of a web-based management system) can improve glucose outcomes in patients with diabetes. (GRADE = moderate)

- There is low strength evidence that adding a web-based pharmacist to secure messaging improves blood pressure outcomes in patients with hypertension. (GRADE = low)
- There is low strength evidence that secure messaging with a web-based management system improves ulcerative colitis symptoms. (GRADE = low)
- There is low strength evidence that secure messaging improves adherence to colorectal cancer screenings or heart failure management. (GRADE = low)
- There is moderate strength evidence that secure messaging increases patient satisfaction. (GRADE = moderate)
- There is low strength evidence that secure messaging influences either positively or negatively efficiency or utilization. (GRADE = low)

Key Question #2. What is the association between patient access to their own medical record and health outcomes, patient satisfaction, adherence, efficiency or utilization, and attitudes about access?

The evidence reviewed regarding patient access to their own medical records, when this is tethered to an electronic health record, supports the following conclusions:

- There is low strength evidence that patients' access to their own medical record improves health outcomes for chronic diseases such as diabetes, hypertension, or heart failure (GRADE = low).
- There is low strength of evidence that patient access to their own records, combined with the ability to submit an electronic care plan can improve medication decisions at a subsequent visit for patients with diabetes (GRADE = low).
- There is insufficient evidence to reach conclusions regarding the potential effect of patients' access to their own medical record on efficiency (GRADE = insufficient).
- There is low strength evidence that patients' access to their own medical record influences utilization (GRADE = low).
- There is insufficient evidence to reach conclusions regarding the potential effect on patients' access to their own medical record on patient attitudes.
- There is moderate strength evidence that use of patient portals is lower among certain racial or ethnic groups, in particular African Americans (GRADE = moderate).
- There is moderate strength of evidence that use of patient portals is lower in persons with lower literacy or education level (GRADE = moderate).

CONCLUSIONS

Data are sparse, but support that the use of secure messaging can improve glucose outcomes in patients with diabetes and increase patient satisfaction. Data from other studies suggest that secure messaging as part of a web-based management program is more effective than secure messaging alone. This finding supports the conclusions from other studies of health information technology that HIT is a tool, and if implemented by itself may have modest or even no measurable effect, but HIT can enable the implementation of more comprehensive programs (e.g., the web-based management system, in this case) that have meaningful effects on quality of care.

DISCUSSION

The literature surrounding secure messaging and patient access to their own records is evolving as the systems themselves become more complex. In some respects, evaluating the individual components of patient portals may no longer be relevant since most of the functionalities are not conceptualized as independent features, but rather as part of an overall package that is intended to facilitate information exchange with patients as well as patient communication with providers and healthcare institutions. Our review identifies a few core elements consistently described in most of the published evaluations that comprise the basic patient portal: secure messaging, access to test results, access to progress notes or visit summaries, and educational materials or disease management tools.

The evaluation of the impact of these portals is further complicated when one considers that they are also being designed to align with a larger patient management system that includes case management, remote health care delivery and non-face to face care. Attributing outcomes to any one component becomes more and more difficult as these layers are added one to the other; yet it appears that utilizing patient portals as part of a broader effort to improve care, particularly one that involves case management, may in fact yield beneficial results.

These patient portals are also being created as part of a movement to make patients more active participants in their care, as opposed to passive receivers of information. Early consumer health systems provided educational materials to patients. Robust patient portals offer patients the ability to drive and direct their care. Yet our review has identified some potential key barriers to achieving more uniform access to these systems. Successful and widespread implementation will require attention to these disparities in use as well as tailored approaches to engage certain populations that are not readily embracing personal health record systems.

EVIDENCE REPORT

INTRODUCTION

As internet access and the use of mobile devices becomes more widely available, and as it is increasingly used by patients to access health information, many healthcare systems are capitalizing on this trend by offering patients electronic methods to communicate with providers and to learn about their health and medical problems. Some organizations or practices have developed stand-alone systems that allow for secure messaging between patients and their providers. Others, particularly those with existing electronic health record systems (EHRs), are developing companion applications specifically designed for patients that give patients access to email communication, access to their medical records and to test reports, and access to educational information on preventive care or disease-specific care. Much of this development is based on a perception that this is something that patients desire; and, that these systems will enhance patient satisfaction, improve care or make it more efficient.

As the Veterans Health Administration (VHA) expands the capabilities of its personal health record system, My Health*e*Vet (MHV), and places greater emphasis on encouraging its use, it is interested in understanding how best to prioritize different functionalities and which of them will provide the greatest benefits to Veterans. This systematic review was designed to evaluate the literature surrounding secure messaging systems and electronic applications that give patients access to their own medical records, specifically investigating the evidence that these systems improve health outcomes, patient satisfaction, healthcare utilization and efficiency, and adherence. Additionally, the review examined studies that evaluated attitudes, particularly regarding patients having online access to their own medical information; and specific patient characteristics associated with use of personal health record systems. The review distinguished between electronic systems that were "tethered" or tied to existing healthcare institution systems similar to how MHV is tethered to VHA's EHR, versus those that were "stand-alone."

METHODS

TOPIC DEVELOPMENT

This project was nominated by Kim Nazi, Veterans and Consumers Health Informatics Office/ Office of Informatics and Analytics, with input from a technical expert panel that included David Haggstrom, Tom Houston, Keith McInnes; Performance Evaluation Clinical Advisory Board Working Group.

The original key questions were listed in the following format:

Proposed Study Selection**:** Peer-reviewed articles assessing the effects of select personal health record functionalities on clinical outcomes, patient-centered outcomes, and system-level outcomes, especially among organizations most similar to the VA.

Proposed Data Extraction**:** Data on study participants (patient, health care provider or organization), study design, functionality, functionality variation (subsets), outcomes, and VA peer organizations will be extracted.

Population: include all studies in relevant peer-reviewed literature; make special note of VA peer organizations, i.e., integrated delivery systems whose experience with care delivery & online health activities may generalize best to the VA, including:

- Kaiser Permanente
- Group Health Cooperative
- Geisinger Health System

without insurance component:

- Partners HealthCare
- Palo Alto Medical Foundation

Functionalities: Note: we have listed these in order of priority

1) Secure messaging programs

Functionality variation (subsets):

(A) tethered secure messaging program vs. conventional (unsecured) e-mail

1. tethered programs are integrated with electronic health record; most similar to VA

(B) different implementation strategies (triage team (VA) model vs. other)

2) Patient access to their own medical record

Functionality variation (subsets):

(A) online tethered program vs. online stand-alone program vs. paper record (lower priority)

(B) allergy list vs. medication list vs. laboratory results vs. procedure/imaging results vs. physician notes

3) Online medication refills

4) Patient self-reported data

Functionality variation (subsets):

(A) different types of data (blood glucose, weight, blood pressure, food journal, activity journal)

5) Online preventive or chronic care reminders

Outcomes:

Clinical outcomes:

A. quality of care (performance measures, clinical processes)
B. health outcomes

Patient-centered outcomes:

C. patient satisfaction
D. provider satisfaction
E. quality of patient-provider communication
F. self-management
G. adherence
    1. medication
    2. visit

System-level outcomes:

H. efficiency
    1. telephone medicine utilization
    2. system workload
        a. provider time
    3. inappropriate use
I. privacy breaches
J. patient safety

These characteristics were then structured into the following sample Key Questions:

(1) Is secure messaging (function #1) associated with the following outcomes?

Clinical outcomes:

a. quality of care (performance measures, clinical processes)
b. health outcomes

Patient-centered outcomes:

c. patient satisfaction
d. provider satisfaction
e. quality of patient-provider communication
f. self-management

System-level outcomes:

g. efficiency (reduced use of telephone resources; reduced use of in-person visits)
h. breaches of privacy

(2) Is patient access to their own medical record (function #2) associated with the following outcomes?

Clinical outcomes:
a. quality of care (performance measures, clinical processes)
b. health outcomes
Patient-centered outcomes:
c. patient satisfaction
d. provider satisfaction
e. quality of patient-provider communication
f. self-management
System-level outcomes:
g. efficiency (reduced use of telephone resources)
h. breaches of privacy

(3) Is patient access to online medication refills (function #3) associated with the following outcomes?

Clinical outcomes:
a. medication adherence
b. quality of care (performance measures, clinical processes)
c. health outcomes
Patient-centered outcomes:
d. patient satisfaction
e. provider satisfaction
f. quality of patient-provider communication
g. self-management
System-level outcomes:
h. efficiency (reduced use of telephone resources)
i. breaches of privacy

SEARCH STRATEGY

We searched PubMed for relevant literature from 01/01/1999 through 12/03/2010, using standard search terms such as electronic health record, patient, messaging, and computerized reminder (see Appendix A for complete search strategy). We limited the search to peer-reviewed articles published in the English language.

STUDY SELECTION

Two reviewers assessed for relevance the full text articles identified from the title screening of the literature searches. Each article was reviewed using a standard screener form (see Appendix B). Initial inclusion criteria were: 1) discussion of relevant functionalities, namely messaging programs, patient access to their own medical record, patient self-reported data, or online reminders; 2) study design of descriptive qualitative, descriptive quantitative, hypothesis testing, or systematic review.

After we data screened 4,607 titles to identify approximately 400 relevant articles and abstracted sufficient to classify them by study type, key question, and outcome, we then presented these data to the Performance Evaluation Workgroup on December 1, 2011; after which the workgroup determined that Key Questions #1 and #2 were the highest priority, and Key Question #3 was dropped. Furthermore, for Key Question #1 only hypothesis testing articles were of interest, and for Key Question #2, only hypothesis testing or descriptive quantitative articles were of interest. This revision narrowed our inclusion criteria to only hypothesis testing studies that assessed specific outcomes for Key Question #1, and hypothesis testing and descriptive quantitative studies assessing similar specific outcomes for Key Question #2. The specific outcomes for both Key Questions are detailed in the literature flow section of the results below.

DATA ABSTRACTION

We abstracted the following data for each included study: study design, study date, HIT intervention, setting, outcome measures, and findings.

QUALITY ASSESSMENT

We assessed the quality of individual studies using study design (trials and observational designs of higher rigor such as controlled before-and-after studies and time series analyses being less prone to bias than pre-post studies), recruitment and retention or follow up data, the degree to which the intervention was described and the degree to which any effect could be attributed to a specific component (of a multi-component intervention), and the relevance of the outcome measured to the outcomes specified in the key questions. We assessed studies for applicability to the VA health care system.

In specific we assessed studies coming from integrated health care delivery systems, such as Kaiser and Group Health Cooperative as being more relevant to VA health care than studies coming from academic or non-academic non-VA sites. We also judged studies about chronic conditions common in VA (such as diabetes and hypertension) as more relevant than conditions rare in VA (in vitro fertilization). In addition to quality evaluation of individual studies, we evaluated the overall quality of the evidence for each key question as proposed by the GRADE Working Group.

DATA SYNTHESIS

We constructed evidence tables showing the study characteristics and results for all included studies, organized by key question, intervention, or clinical condition, as appropriate. We critically analyzed studies to compare their characteristics, methods, and findings. We compiled a summary of findings for each key question or clinical topic, and drew conclusions based on qualitative synthesis of the findings.

RATING THE BODY OF EVIDENCE

We assessed the overall quality of evidence for outcomes using a method developed by the GRADE Working Group (see Appendix C), which classified the grade of evidence across outcomes according to the following criteria:

- High = Further research is very unlikely to change our confidence on the estimate of effect.
- Moderate = Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
- Low = Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
- Insufficient = Any estimate of effect is very uncertain.

PEER REVIEW

A draft version of this report was reviewed by six technical experts and/or clinical leaders. Their comments and our responses are presented in Appendix D.

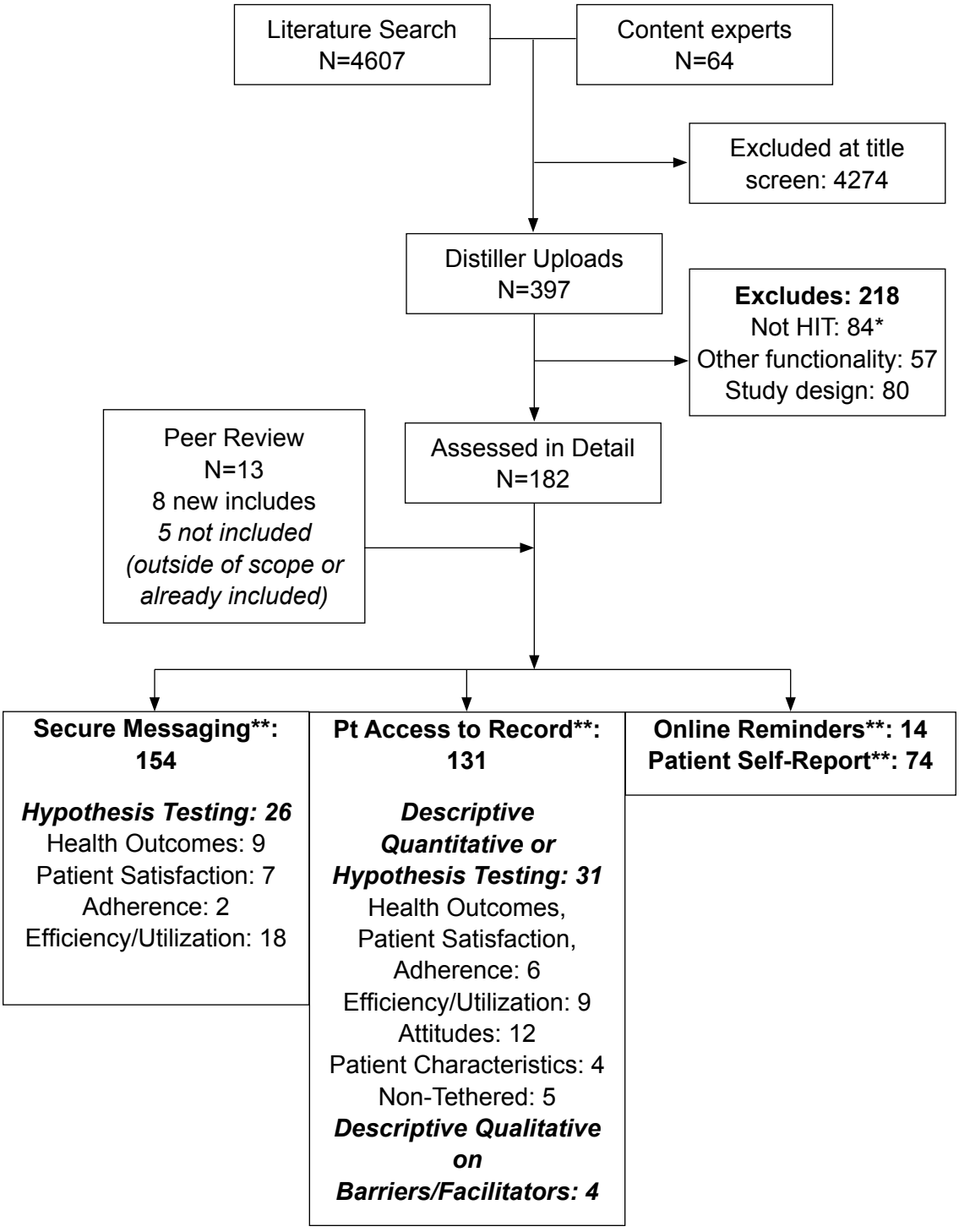
RESULTS

LITERATURE FLOW

We reviewed 4,607 titles and abstracts from the electronic search, and an additional 64 from content experts for a total of 4671 references. A title screen excluded 4,274 as unrelated to our topic, with 397 remaining for further review. After applying our screener form to the full-text articles, 218 references were excluded. Of these, there were 84 that were not relevant to consumer health information technology, another 57 did not address any of the four specified functionalities, and 80 had study designs warranting exclusion (non-systematic review, commentary or news, or other ambiguous designs). We sorted these articles based on functionality, study design, and outcomes. Inclusion based on functionality retained articles relating to two of the functionalities, patient access to medical records (N=121) and secure messaging (N=153), with articles relating to online reminders (N=14) and patient self-reported data (N=74) no longer of interest after the discussion with the Performance Evaluation Clinical Advisory Board Working Group (see Methods, p. 9). These categories were not mutually exclusive, however, so an article about secure messaging that also related to online reminders would be included, for example. Of the 13 articles identified by peer reviewers, eight met the criteria for inclusion, and were added to the appropriate categories below.

Within the included functionalities, further inclusion restrictions based on study design and outcomes were applied. Within the secure messaging functionality (N=154), the 26 articles with a hypothesis testing study design that related to health outcomes (N=9), patient satisfaction (N=7), adherence (N=2), or efficiency or utilization (N=18). The other 128 articles relating to secure messaging were excluded either because their study design was descriptive or a systematic review (N=42), or they did not address one of the desired outcomes (N=86). For patient access to medical records (N=131), descriptive quantitative studies relating to tethered medical records addressing health outcomes, patient satisfaction, and adherence (N=6); efficiency or utilization (N=9); patient characteristics (N=4); or attitudes (N=12) were included, in addition to 5 articles which addressed non-tethered record, for a total of 31 articles. Additionally, four descriptive qualitative articles addressing barriers or facilitators to patient access to medical records were also included. The other 93 articles relating to patient access to medical records were excluded either because their study design was descriptive qualitative, and did not address barriers or facilitators to use, or systematic review (N=12), or they did not address one of the desired outcomes (N=81).Figure 1 details the inclusion of articles and the number of references related to each of the key questions. The abstracted data for the included articles can be found in the evidence tables, which are organized by report section (see Appendix E).

Figure 1. Literature Flow



* Not HIT includes duplicates found during data abstraction; ** Functionality categories were not mutually exclusive.

KEY QUESTION #1. What is the association between secure messaging and health outcomes, patient satisfaction, adherence, efficiency or utilization, or automated email?

The VHA's My Health*e*Vet (MHV) application already allows for secure messaging (SM) between Veterans and their providers but because this functionality is relatively new, there is little known about the impact of SM on the health of Veterans who use SM. This was a key area of interest for the MHV team. Because of this, we focused on hypothesis testing studies of SM that evaluated its relationship to different types of outcomes, focusing more specifically on health outcomes, patient satisfaction, adherence, efficiency of care and utilization of care. This accounted for the majority of the hypothesis testing studies about SM and the results are described in the section that follows. We also found a small number of hypothesis testing studies of automated email systems, which can be distinct from SM systems that offer two-way communication between patients and providers. These automated email studies are described at the end of this section.

We identified 26 hypothesis testing articles about SM. A number of studies evaluated multiple outcomes and these studies are therefore included in each relevant section: health outcomes, patient satisfaction, adherence, and efficiency/utilization of care.

Secure Messaging and Health Outcomes

Nine hypothesis testing papers evaluated health outcomes and many focused on health conditions pertinent to VA.[1,2,3,4,5,6,7,8,9] Seven of these studies were randomized controlled trials (RCTs).[5,6,8,7,1,4,9]

Four papers focused on SM and diabetes or related conditions.[2,3,5,6] In the article by Zhou,[2] the investigators examined the relationship between SM and performance on standard HEDIS measures for diabetes and hypertension among Southern California Kaiser Permanente patients with these conditions. In regression analysis, patients with diabetes and/or hypertension who participated in SM were statistically significantly more likely to see improvements from baseline in all of the HEDIS measures (diabetes process and intermediate outcome measures and blood pressure control). Two or more emails in a two-month period (as compared to only one) were associated with better performance on some measures ("dose-response effect"). In a separate matched cohort analysis, matching patients who used SM with those who did not, email use was associated with improvement in most of the diabetes measures but not in blood pressure control in patients with hypertension.

Another study from Group Health Cooperative was a cross-sectional analysis evaluating outcomes for patients with diabetes who had completed the process of identity verification required to participate in SM, comparing those who used the service to those who did not.[3] They adjusted for a number of patient characteristics including medical comorbidity and depression severity, as well as provider characteristics such as age, sex and specialty. In terms of quality, they found that the rate of A1c<7% was 36% higher in patients with the highest rate of SM use (>= 12 threads/year); though SM was not associated with better blood pressure control and was modestly associated with better lipid control. This analysis could not ascertain whether the utilization of SM was responsible for the improved outcomes as patients who used SM more may simply have been more engaged in their health. Interestingly, primary care visit rates in this study were 32% higher in patients with high use of SM (three to four additional outpatient visits per year).

Two RCTs evaluated web-based educational programs for diabetes that included SM as a component of the system. One RCT evaluated Veteran patients with diabetes who were randomized to usual care versus web-based care management that included receipt of a notebook computer, a blood pressure monitor, a glucometer, free internet service and access to a diabetes care management website.[5] The intervention patients were able to send and receive secure messages to and from their care manager. They also had access to educational links and web-based diabetes resources. While hemoglobin A1c levels decreased over time in both groups, the intervention group demonstrated a greater decline over time (decrease of 1.6% versus 1.2% in usual care group). Blood pressure declines were also greater in the intervention patients with hypertension (-10 versus -7 mm Hg) while there were no differences in lipid levels. In the second study from the University of Washington,[6] patients were similarly randomized to usual care versus web-based and in-person care management with access to SM functionality. Hemoglobin A1c levels were 0.7% lower in the intervention group compared to usual care when evaluated nine to 12 months after the start of the study (95% CI 0.2-1.3, p=0.01). There were no differences in blood pressure or lipid control between the groups.

Another study from Group Health Cooperative evaluated the impact of managing depression care using online secure messaging available through a patient website linked to the medical record.[9] 48% of patients with new prescription for an antidepressant and who were registered for online messaging consented to participate and were randomized to usual care with their prescribing physician versus usual care augmented by three planned contacts via messaging with a mental health nurse care manager, which included structured assessments and nurse communication with the patients' providers. Intervention patients had lower depression severity at the end of the evaluation period and higher proportions experienced 50% or greater decreases in the depression scale of the Hopkins Symptom Checklist (55% v 41%, OR=1.8, 95% CI 1.0 to 3.1). Utilization rates for visits, telephone encounters and non-study online messages did not differ between the groups.

Four additional studies evaluated web-based systems that allowed patient access to medical information and SM but that were not focused solely on SM. [7,8,1,4] The two most relevant to VA included a study from Group Health and one from the University of Colorado.[7,8] The Group Health study randomized patients with hypertension to usual care versus one of two intervention groups. All participants were given access to Group Health's patient website and all were encouraged to work with their providers to improve their blood pressure control. One intervention group was given a home BP monitor and training on the use of the patient website while the other intervention group was also given access to a pharmacist care manager who initiated case management via SM and face-to-face visits.[7] Only the pharmacy case management group demonstrated significant improvements in BP control with 25% more patients with controlled BP compared to usual care (mean decrease -8.9 mm Hg) and 20% more compared to the other intervention group (mean decrease -6.0 mm Hg). The second study randomized patients with congestive heart failure (CHF) to usual care versus access to a web-based medical record system that also included an educational guide and a messaging system.[8] There were no significant differences between the intervention and usual care groups in the primary outcome of self-efficacy nor in measures of health status. General adherence to medical advice was better in the intervention group (2.3 points higher on a 0-100 scale) but there was no difference in medication adherence; and no difference overall in patient satisfaction. While there were

no differences in mortality, hospitalizations or clinic visits, there was a significant increase in emergency room visits in the intervention group. In this study, email messages did not seem to replace telephone calls and particularly early in the intervention, there were more messages (phone and email combined) from intervention patients than phone messages from the control group. The other studies included one focused on Danish and Irish patients with ulcerative colitis who were randomized to a web-based educational and care management program with email and text messaging capabilities versus usual care and found improved adherence to acute care, improved knowledge and quality of life and fewer clinic visits in the intervention group;[1] a second study that randomized couples undergoing in-vitro fertilization (IVF) in the Netherlands to usual care versus access to an internet-based personal health record with email capability and found no differences in patient empowerment (e.g. self-efficacy, knowledge) or secondary outcomes such as patient satisfaction, change in anxiety or change in depression.[4]

Secure Messaging and Patient Satisfaction

Seven hypothesis testing studies evaluated patient satisfaction and SM,[10,11,8,4,12,13,14] four of which were RCTs or controlled clinical trials.[10,11,8,4] The first RCT involved an academic internal medicine clinic affiliated with the University of Colorado in Denver which was using an electronic medical record (EMR) system.[10] Six hundred and six patients with experience using an internet browser were randomized to have access to a patient portal with SM that allowed requests for appointments, medication refills, and clinical communication with the provider, or usual telephone care. Patient satisfaction was assessed at baseline and at six months and was significantly higher in the intervention group in the areas of communication with the clinic (rated better by 44% of portal group versus 11% of controls), overall rating of clinic services (rated very good or excellent by 59% of portal group versus 48% of controls), and ratings of non-urgent messaging, prescription refills, referral requests and appointment scheduling (generally 20% improvement in portal group compared to controls).

The second RCT involved physicians and patients affiliated with a Penn State faculty-based clinic.[11] Four of eight participating physicians were assigned to offer email communication to their patients. Patients of all eight physicians were asked about their home email use and those of the participating physicians who were regular home email users were offered the opportunity to participate in the study and if consented, were given access to a secure email account for a six month period. Patients of the other four physicians continued with regular telephone contact with the clinic. All patients were surveyed at baseline, three months and six months. For the 100 patients analyzed, 67 in the email group and 35 in the control (the study excluded 72 patients who did not respond to all of the questionnaires), patient satisfaction was significantly higher in the email group in the areas of convenience of communicating with their physician and the amount of time spent contacting their physician. One hundred percent of patients in the intervention group and 97% of patients in the control group felt that patients should be able to email their doctors. Providers were not as satisfied as patients though the number of physicians involved in the study (eight) was not sufficient to draw statistical conclusions. There were trends toward increased satisfaction among intervention physicians in the areas of convenience, time spent and volume of messages.

The third randomized trial from the University of Colorado was discussed in the previous section as well and randomized patients with CHF to usual care versus access to a web-based medical

record system that also included an educational guide and a messaging system.[8] As noted, this study did not demonstrate significant differences in patient satisfaction.

The final RCT has also been previously described and randomized couples undergoing in-vitro fertilization (IVF) in the Netherlands to usual care versus access to an internet-based personal health record with email capability and found no differences in patient satisfaction.[4]

Of the three remaining studies evaluating SM and patient satisfaction, two were cross-sectional survey studies, and one was a case-control study of implementation that included a patient survey. In the first, the investigators surveyed patients who use the internet for health information regarding their email practices with physicians.[12] Of the 1881 individuals who completed the survey, 17% reported electronic communication with their physicians or physician staff, and satisfaction was highest in those who reported that their physician always responded (OR 15.9) compared to those who reported responses less than 100% of the time. The two remaining studies evaluated a web-based SM system being implemented at a clinic affiliated with the University of California Davis Health System.[13,14] In the first paper,[14] eight providers, their patients, and their staff were surveyed about the system. Two hundred thirty eight of 645 patients with email addresses (36.9%) responded to the survey with 97% having used the system at least once (49.6% used it only once or twice). Satisfaction was related to receiving a response right away or by the next business day. The second study evaluated patient satisfaction one year later and surveyed 5971 patients from 4320 email addresses with a response rate of 40.3% (1743/4320).[13] Their findings again associated higher satisfaction with more timely responses.

Secure Messaging and Adherence

There were two papers of clinical trials that evaluated SM and adherence, both of which were randomized.[15,8] One specifically evaluated SM reminders and one evaluated an online medical record with SM as one component. In a study from Northwest Permanente in Portland, OR,[15] investigators with an established EMR randomized 2100 patients with SM accounts who were due for colorectal cancer screening to usual care or to receive a letter reminder or a secure email reminder to pick up a fecal occult blood test at the lab. The cohort was subsequently reduced to 1409 patients because of logistical issues with performing the intervention leaving 494 in the usual care group, 458 in the letter group and 457 in the SM group. The two intervention groups were significantly more likely to undergo screening than the usual care group, and at similar rates (7.8% usual care, 23.6% letter, 22.7% email). They concluded that email was as effective a prompt as a letter. The final study of an online medical record for CHF from the University of Colorado which has been previously described, assessed adherence to medications and general adherence to medical regimens and found that the latter was significantly improved in the intervention group users versus controls.[8]

Secure Messaging and Efficiency/Utilization

There were 18 studies that evaluated SM and some aspect of efficiency or healthcare utilization.[1,16,17,3,18,19,20,21,22,14,23,6,24,25,26,8,13,7] Six studies were randomized controlled trials,[1,20,6,26,8,7] ten were observational analyses,[16,17,3,19,21,22,14,23,24,13] and two were survey analyses.[18,25] Four studies evaluated provider productivity and provider attitudes,[13,22,14,26] seven studies evaluated characteristics of users of SM systems,[18,16,25,24,21,17,19] and eight studies evaluated the impact of SM on utilization of healthcare services.[24,23,3,8,6,7,20,1]

There were four papers that evaluated SM and physician productivity.[13,22,14,26] Three papers described results of the same intervention with slightly different types of analyses of physician productivity.[13,22,14] These papers evaluated a secure web-messaging system being implemented at a clinic affiliated with the University of California Davis Health System that was described in the patient satisfaction section. The first was a pre-post study that found that intervention providers had higher overall averages of visits/day for the 5- month study period compared to the same period in the previous year (increasing from 24.8 to 29.5 visits/day, p=0.02).[13] The second study compared the intervention providers with providers at a control clinic site before and after the intervention.[22] Again, intervention physicians averaged 11% more visits/day than those in the control group (25.5 vs. 22.9) and averaged 10% more RVUs/day (relative value units) than the controls, though RVUs per visit did not differ. This was viewed as a positive finding for this fee-for-service environment. The third study retrospectively compared SM and telephone volumes for the intervention clinic and a control clinic.[14] Case call volume averaged 18.2% less than control (21.6 vs. 26.4, p=0.002) and case message (phone plus web) volume averaged 13.7% less than control (phone only) (22.8 vs. 26.4, p=0.025). Patient enrollment rose rapidly during this time, presumably accounting for the decrease in contacts/1000 panel patients. The fourth paper on physician productivity evaluated the introduction of a web-based communication tool for patients in a University of Michigan academic primary care practice and found that physicians in the intervention group (whose patients were given access to the web-messaging tool) did not experience a decrease in the volume of personal email and telephone messages, which remained similar to that of the control physicians despite the addition of a modest number of web-based messages.[26]

Two studies from Group Health Cooperative evaluated the characteristics of patients who used SM.[18,16] The first compared these patients to those who had registered for access to the patient web site but had not utilized SM. SM users were more likely to be middle aged (50-65 years old), female, and with a higher overall level of morbidity.[18] They were less likely to be insured by Medicaid. As would be expected, patients treated by providers with higher levels of SM use and with a higher proportion of younger patients on their panels were also more likely to use SM. The second study focused on patients with diabetes in Group Health and evaluated predictors of initial use of SM when it became available in 2003, and then subsequent use.[16] Initial use was associated with younger age, male sex, living in a higher socioeconomic status neighborhood and greater provider level of SM use. Older patients were more likely to subsequently sign up for SM if they switched to a high-use physician. Increasing morbidity also was associated with subsequent SM use. A third study similarly evaluated characteristics of patients who used the SM application associated with "PAMFOnline," a personal health record system operated by the Palo Alto Medical Foundation.[25] Users had opted to pay an annual fee of $60 for unlimited messaging ability in addition to the general functionalities of the PHR. Compared to the general PAMF patient population, PAMFOnline messaging users were older, had more active problems, took more medications and used PAMF to conduct more office visits. In a fourth study from Kaiser Permanente Northwest that compared SM users to non-users, users were older and more likely to have diabetes.[24]

The three remaining studies in this area included one from a single surgical practice that found that email users were significantly younger than non-users but found no sex differences in use;[21] a study from Europe that identified young (<25) , higher educated and urban patients as most likely to consider the availability of email access when choosing a new doctor;[17] and a study

of a Florida physician survey which found that physicians in large group practices (50 or more physicians) were more likely, and Asian-American physicians were less likely to communicate with patients via email.[19]

Data regarding healthcare utilization and SM differed among the various studies. There were two studies evaluating implementation of SM at two different Kaiser Permanente regions.[24,23] The first involved patients from KP Northwest and evaluated utilization in a pre-post fashion for a retrospective cohort of members registered for KP HealthConnect Online (the SM application) for longer than 13 months and compared utilization for a sample of this cohort to a group of non-registered patients matched for age, sex, chronic conditions and primary care physician.[24] In the pre-post cohort analysis, annual primary care office visit rates decreased significantly from 2.47 to 2.24 visits per member per year. Similarly, SM user visit rates decreased more than the visit rate for non-users (10.3% vs. 3.7%, ($p<0.003$). The second study evaluated the impact of KP HealthConnect implementation in Kaiser Permanente Hawaii and compared healthcare utilization post-implementation (2007) to that of 2004.[23] This study found significant decreases in age/sex-adjusted total office visits per member (decrease of 26.2%) and significant increases in total scheduled telephone visits per member. Total contacts including secure messages and office and telephone visits increased significantly from 5.18 contacts per member per year to 5.61. A third study from Group Health Cooperative that has been previously described compared patients with diabetes who had completed the process of identity verification required to participate in SM to those who did not.[3] Controlling for a number of variables including overall medical comorbidity and diabetes severity, primary care visit rates were statistically significantly higher in the SM users (32% higher), as were specialty visits and emergency visits. These results indicate that data is conflicting regarding whether SM results in increased or decreased visit rates and there may be unmeasured factors in these studies related to the system, the patients or the healthcare environment which contribute to the findings.

Three studies of online medical records with SM capability also looked at utilization.[8,6,7] One study involving patients with CHF that has been previously described that randomized patients to access to the system found that intervention patients had significant increases in overall emergency department visits but no differences in mortality, hospitalizations or heart failure clinic visits.[8] Another study in patients with diabetes randomized to access to an online care management application that has also been previously described found no differences in primary care or specialty care visits or inpatient days though there was additional time spent by the care managers in the intervention group.[6] The third involved patients with hypertension randomized to usual care, access to the web-based application and access to the web-based application with pharmacy case management, and has also been previously described.[7] This study found no differences in primary care visits, inpatient or urgent care/emergency use at one year. Telephone encounters were higher in the pharmacy arm than the other two though these patients had a modest but statistically significant decrease in specialty office visits.

Finally, two European studies found that patients randomized to SM with their general practitioner had fewer office visits than those without access, though there were no differences in the number of telephone consultations between groups,[20] and patients with ulcerative colitis who had access to a web-based care management program with messaging had fewer routine visits than control patients.[1]

Summary for Key Question #1

The hypothesis testing studies that include secure messaging support the following conclusions:

- There is moderate strength evidence that secure messaging (especially as part of a web-based management system) can improve glucose outcomes in patients with diabetes. (GRADE = moderate)
- There is low strength evidence that adding a web-based pharmacist to secure messaging improves blood pressure outcomes in patients with hypertension. (GRADE = low)
- There is low strength evidence that secure messaging with a web-based management system improves ulcerative colitis symptoms. (GRADE = low)
- There is moderate strength evidence that secure messaging increases patient satisfaction. (GRADE = moderate)
- There is low strength evidence that secure messaging improves adherence to colorectal cancer screenings or heart failure management. (GRADE = low)
- There is low strength evidence that secure messaging influences either positively or negatively efficiency or utilization. (GRADE = low)

KEY QUESTION #2. What is the association between patient access to their own medical record and health outcomes, patient satisfaction, adherence, efficiency or utilization, and attitudes about access?

There were 31 articles related to patient's having electronic access to their own medical records. These articles were divided into studies that evaluated "tethered" systems, where patients accessed information through a system (usually web-based) tied to a provider-based electronic record and that included functionalities such as secure messaging; and those that evaluated non-tethered systems. The studies were further subdivided into those that were hypothesis testing, evaluating outcomes such as health outcomes, satisfaction, adherence, healthcare efficiency or healthcare utilization and attitudes; and, those that were descriptive qualitative. The latter studies were generally survey studies and generally evaluated attitudes about patient access to their own records.

Patient Access to Medical Records through Tethered Systems

Of the articles evaluating patient access to their own medical record through a system tethered to a provider-based electronic record, seven were RCTs,[8,6,27,4,7,28,29] four were observational hypothesis testing studies,[16,30,31,32] and nine were descriptive quantitative studies.[33,34,35,36,37,38,39,40,41] Only one study was a cost-benefit analysis study.[42]

The systems described in these studies included a number of functionalities as part of their intervention. These are listed in Table 1. As can be seen, almost all systems included secure messaging, access to test results and progress notes/visit summaries, and education/disease management, meaning the effects cannot be disentangled and these four functionalities represent a "core" set for patient portals.

Table 1. Tethered Personal Health Record Systems and Functionalities

Author, year	Setting	Test results	Secure messaging	Progress notes/visit summaries	Educational materials/disease management	Med renewal	Make appts	Patient uploads/ diary	On-line reminders
Ralson, 2007[33]	Group Health	Yes	Yes	Yes	Yes	Yes	Yes	Yes (health assessment tools)	
Green, 2008[7]	Group Health	Yes	Yes	Yes	Yes	Yes	Yes		
Weppner, 2010[16]	Group Health	Yes	Yes	Yes	Yes	Yes	Yes		
Falcao-Reis, 2010[43]	Partners	Yes	Yes		Yes	Yes	Yes	Yes (eJournal)	
Wald, 2010[44]	Partners	Yes	Yes					Yes (eJournal)	
Ralston, 2009[6]	Univ of Washington	Yes	Yes	Yes	Yes			Yes	Yes
McCarrier, 2009[28]	Univ of Washington	Yes	Yes	Yes	Yes			Yes	Yes
Hassol, 2004[34]	Geisinger	Yes	Yes			Yes	Yes		
Burke, 2010[30]	Miami Children's	Yes - imaging		Yes	Yes – discharge instructions				
Tuil, 2007[4]	Netherlands	Yes	Yes	Yes	Yes				
Ross, 2004[8]	SPPARO – Univ of Colorado	Yes	Yes	Yes					

Patient Access and Health Outcomes, Satisfaction, and Adherence

Seven articles evaluated health outcomes, health status, satisfaction or adherence with respect to a tethered record system. Six were randomized controlled trials. The first involved patients with congestive heart failure (n=107) being treated in a specialty clinic at the University of Colorado Hospital in Denver, CO, who received usual care or were given access to a secure web-based system ("SPPARO") that included access to their medical record (notes, labs and test results), an education guide and a secure messaging system (described in SM section).[8] Participants received questionnaires at baseline, 6 months and 12 months. The study found no significant difference in the primary endpoint which was a change in the self-efficacy domain of the Kansas City Cardiomyopathy Questionnaire nor in other measures of health status, though there was a trend towards improvement in the intervention group. There was also a non-statistically significant trend towards greater patient satisfaction with doctor patient-communication but not in other satisfaction domains. This study was the only one to evaluate adherence and found that general adherence to medical advice was improved in the intervention group while there was no statistically significant improvement in medication adherence. In the second study,[6] eighty three patients with diabetes from a University of Washington General Internal Medicine Clinic were randomized to usual care versus care augmented by web-based and in-person care management for a period of 12 months. Intervention patients met with the nurse care manager who introduced them to the web-based system that provided access to test results, clinical summaries of diabetes care, secure messaging, online reminders, educational materials and the ability to upload glucose readings. Intervention patients were encouraged to send weekly glucose readings and send secure messages as needed. Hemoglobin A1c levels were significantly lower in the intervention group (change -0.7%, p=0.01). More intervention patients had A1c levels <7% (33 vs. 11%, p=0.03) though there were no significant differences in blood pressure or cholesterol. A similar intervention from the same institution was evaluated in a diabetes specialty clinic.[28] In this study, 77 patients with Type I diabetes were randomized to usual care from the Diabetes Care Center or usual care plus access to a nurse practitioner case manager and the web-based disease management module. A1c values did not differ significantly after a year of follow-up. There was an increase in psychosocial self-efficacy as measured by the Diabetes Empowerment Scale in the intervention group (difference of 0.3, 95% CI 0.01 to 0.59, p=0.04).

In the fourth study from Group Health (which has been previously described),[7] investigators randomized patients with hypertension to one of three groups, all of whom had access to a tethered patient portal with secure messaging, access to test results and clinic visit summaries, ability to renew meds and make appointments, and access to educational materials. The three groups included a control group that received usual care, a second group that received a home blood pressure monitor and patient portal training, and a third group that received the above intervention together with access to pharmacist – initiated case management via SM and face-to-face visits. Only the web-based pharmacy group demonstrated significant improvements in BP control with 25% more patients with controlled BP compared to usual care (mean decrease -8.9 mm Hg) and 20% more compared to the other intervention group (mean decrease -6.0 mm Hg). There was also greater aspirin use in the web and pharmacy group compared to the others (20% more compared to web-only group and 30% more compared to usual care).

The fifth study from Partners HealthCare involved patients with diabetes who had active accounts with Partner's patient portal, Patient Gateway, which provided access to test results,

secure messaging, medication renewal and appointment management, and educational materials[29]. Intervention patients (126) came from 11 practices where they were given access to a diabetes mellitus-specific personal health record that had modules for medication review, diabetes-related clinical data, and the ability to generate a "Diabetes Care Plan" to share with their primary care providers; while control patients from the remaining practices (118) had access to a system that allowed them to update their family history and review cancer screening and other non-diabetes related preventive services and submit updates or requests regarding these aspects of care. After one year of follow-up, there were no differences in A1c levels, blood pressure or LDL-C levels between groups. Fifty percent of intervention patients completed a Diabetes Care Plan and these patients were more likely to have a medication adjustment for diabetes, hypertension or hyperlipidemia than patients in the control arm who submitted a preventive care journal update or request (53% v 15%, $p<0.001$).

The sixth study randomized couples undergoing in-vitro fertilization (IVF) in the Netherlands to usual care versus access to an internet-based personal health record of all digital information available concerning their fertility treatments that also had secure messaging, education and discussion functionality.[4] They found no differences in patient empowerment (e.g. self-efficacy, knowledge) or secondary outcomes such as patient satisfaction, change in anxiety or change in depression between the two groups.

In a cross-sectional survey study from Group Health Cooperative in Seattle, WA,[33] investigators randomly surveyed 2002 users of their web-based patient record system (MyGroupHealth) which provided patients the potential for access to their medical record including lab results, secure messaging, medication refill services, appointment management, after-visit summaries, health information and discussion groups. There was a 46% response rate with respondents generally reporting high satisfaction with MyGroupHealth (94% satisfied or very satisfied). Patients were more satisfied with specific functionalities such as medication refills, patient-provider messaging and medical test results than they were with MyGroupHealth overall, though were not as satisfied with some of the other features.

Patient Access and Efficiency/Utilization

Nine studies evaluated tethered patient record systems and their impact on efficiency or utilization.[27,6,8,7,16,33,30,34,42] Four were randomized controlled trials.[27,6,8,7] The University of Colorado study of SPPARO for patients with CHF, previously described, found a significant increase in overall emergency department visits in the intervention group compared to the controls (20 v 8 visits, $p=0.03$) but no differences in hospitalizations.[8] The University of Washington study of patients with diabetes,[6] also previously described, found no differences among the three groups in outpatient visits, primary care provider or specialty physician visits, or inpatient days though the care manager self-reported an average of four hours per week managing the patients. The Group Health study of patients with hypertension, described above,[7] found that the mean number of secure message threads initiated by patients (includes initial message and follow-up responses), were highest in the group that included access to the web system and a pharmacist (4.2 compared to 2.7 in the web-only group and 1.8 in the usual care group), as well as higher numbers of phone encounters (mean 7.5 compared to 3.8 in the web-only group and 4.0 in the usual care group, $p<0.001$). Primary care visits, inpatient and urgent

care/emergency room utilization did not differ significantly. There was a modest but significant decrease in percent of patients with visits to specialists in the web and pharmacy group compared to the other groups (numbers not provided in text). Finally, there were more antihypertensive medications used in the intervention group compared to the web-only and usual care groups (RR 2.2, $p<0.01$ for web-only and $p<0.001$ for usual care). A fourth study from Partners HealthCare surveyed patients who had been randomly assigned to two arms of a study of "eJournal" use, a component of Patient Gateway (PG), a secure EHR-connected internet patient portal that has been described above.[27] Eligible patients having a PG account and an assigned PCP from a study site either received access to medication/allergies/diabetes eJournal modules (Arm 1) or to health maintenance/family history/personal history eJournal modules (Arm 2) and were reminded prior to certain types of appointments to complete an "eJournal" and submit it to their provider prior to the visit, updating or adding to information already available in their outpatient EHR. Providers had the option of reviewing the eJournal and uploading it to the EHR. Three percent of eligible patient users (3979) agreed to enroll in the study and 59.3% of these patients completed a post-intervention survey. Of the 84 providers whose patients submitted at least one eJournal, 29 (34%) completed the post-intervention survey. Between 64 and 78% of patients opened at least one eJournal and 97% of patients edited an existing entry. There were more eJournal entries in Arm 1, but this group received more reminders because they had more eligible visits. All providers in Arm 1 reported no change in visit length, while 47% of providers in Arm 2 felt that the visits were longer ($p<0.013$).

Four studies were observational and reported data regarding use of tethered patient health record systems.[16,33,30,34] One study from Group Health Cooperative evaluated patterns of use for its "shared medical record" (SMR) system which included secure messaging, ability to request medication refills and appointments, ability to view test results, after-visit summaries, problem and allergy lists and immunizations.[16] Investigators followed 6185 enrollees with diabetes over an average of 2.8 years. About one-third of enrollees utilized the SMR with younger age, male sex, higher socioeconomic status and higher PCP use of secure messaging significantly associated with patient use. Higher morbidity was significantly associated with earlier sign-up and on-going use (rate ratio 1.3, $p<0.001$). The most frequently used features were tests result reviews, medication refill requests and secure messaging. A second study from Group Health Cooperative[33] evaluated SMR use from 2002 to 2005 and found that ID-verified enrollment increased from 3% to 25% and that registration for basic services increased from 9% to 14%. A study from Geisinger Health System conducted an online survey of active users of "MyChart," with a 33% response rate.[34] They found that 3% of users were using MyChart on behalf of a spouse or parent. Another study evaluated a web-based patient—accessible EHR for patients with congenital heart disease—that in most cases gave the patients access to history and physical reports, patient care instructions and imaging data from surgery but did not include secure messaging.[30] Of the first 270 offered access, 252 (93%) became users, with use more common while the patients (mostly infants getting cardiac surgery) were hospitalized than after discharge (median 6 v 4 logins, $P<=0.001$). There were more views of imaging data than textual data (median 8 page views v 5, $P<0.001$).

Finally, there was one study that performed a cost-benefit analysis of the "potential value to the US" of different types of personal health record systems (PHRs) comparing provider-tethered, payer-tethered, third-party (e.g. Microsoft, Google, Dossia) and interoperable systems.[42] The

investigators performed a literature review to evaluate data on costs and benefits but augmented their models using expert opinion and evidence from non-PHR sources because of the paucity of quantitative evidence surrounding PHRs. Assuming a ten year roll-out period, all PHRs demonstrated an initial net negative value but eventually reached a break-even point and began to provide benefit. Interoperable PHRs had the earliest break-even point at three years followed by payer-tethered and third-party PHRs by four years. Provider tethered PHRs did not break even during the initial 10 year period.

Attitudes about Patient Access

There were twelve studies that assessed attitudes about patient access to their own medical records or related issues.[27,32,31,35,36,34,45,41,38,39,40,37] Three studies were hypothesis testing,[27,32,31] with one randomized controlled trial.[27] In this RCT from Partners HealthCare (which has been previously described), patients were provided with the opportunity to submit an eJournal using a tethered patient portal prior to specific types of visits. About 60% of participants responded to a post-intervention survey of which 34.4% reported submitting an eJournal to their doctor's office. Fifty-eight percent of patients agreed or strongly agreed that the eJournal gave their provider more accurate information and 55.9% of patients felt more prepared for their visits, but only 37.2% agreed or strongly agreed that communication with their provider improved, 37.7% of patients felt more satisfied with the visit and only 24.5% that the quality of care at the visit improved. Comparing the two different arms of the study, Arm 1 patients (access to medication/allergies/diabetes eJournal modules) were more likely than Arm 2 patients (access to health maintenance/family history/personal history eJournal modules) to feel prepared for their visit (59% v 51%, $P<0.02$) and Arm 1 physicians were more likely to feel their patients were prepared for the visit compared to Arm 2 patients (100% v 43%, $p<0.04$). A second hypothesis testing study from the University of Colorado evaluated attitudes of patients and physicians using SPPARO, an online record system for patients with CHF that has been previously described.[31] Pre-intervention, physicians were much more likely than patients to endorse concerns that patients with access to SPPARO would have more questions (71 v 37%), would worry more (71 v 5%), would find reports confusing (57 v 13%), and would find notes offensive (29 v 3%). Over the course of the trial, physician concerns in these domains decreased (though not significantly, perhaps due to the small number of physician participants). The final hypothesis testing study evaluated attitudes of Veterans with diabetes regarding their internet use and their interest in various aspects of My Health*e*Vet (MHV), VA's tethered patient web portal.[32] Surveys were mailed to eligible Veterans receiving primary care from a Durham VA outpatient clinic. Two hundred one Veterans completed the surveys for a 53% response rate. In a multivariate analyses, the investigators found that age and trust in the internet were independent predictors of interest in using MHV for diabetes management with odds of being "very interested" increasing by 1.4 for each decade younger a respondent was, and by 2.3 if the respondent had "a lot/some" trust in the internet.

Of the remaining studies, only four evaluated existing systems.[35,36,34,45] In a study from Geisinger Health System,[34] investigators conducted an online survey of registered users of "MyChart," a tethered personal health record system. Of 4282 users invited to participate, 33% completed the survey (60% of whom were female). Patients reported high rates of understanding of medical information and test results, with higher rates of understanding for more highly educated respondents. Only approximately 30% of respondents had concerns about confidentiality and

security. In a study from Partners HealthCare,[35] investigators surveyed a random sample of 2000 patients who held an account with Patient Gateway (PG), a secure patient web portal. There was a 23% response rate. The most highly rated features were the administrative functions such as the ability to renew prescriptions, ask administrative questions or obtain referral approvals. 38% felt that PG improved communication with the provider practice while 30% disagreed and 32% were unsure. Another study from Partners evaluated patient attitudes about a new module within Patient Gateway to improve medication safety.[45] The module allowed patients to review their medication and allergy lists and make comments about its accuracy, about their compliance, and about problems with compliance or side effects. Of 12,278 patients invited to participate, only 7% 812) were eligible for the study and completed a medications journal within Patient Gateway. A smaller number completed a survey (687). 70% found the journal very easy or easy to complete while 53% thought it gave providers more accurate information (39% were neutral). 56% felt more prepared for their visit; 35% were neutral on this issue. In the final study from Sweden,[36] investigators piloted a system called "SUSTAINS" that allowed patients access to the hospital information system and laboratories, the general practitioner's EHR and secure messaging. They surveyed 100 users of the system but did not report a response rate. 82% of "users" had no worries about security while 15% expressed "some concern; and only 2% were very concerned about the security risks of "full scale service."

The remaining studies were surveys of attitudes regarding potential systems and all but one were from Europe or Canada. In one study from Intermountain HealthCare/University of Utah,[37] investigators surveyed physicians prior to giving patients web access to their electronic medical record. Ninety-one of 150 email-using physicians responded to the survey. Providers approved of giving patients access to medication lists, normal lab studies, prescription refills, appointments and referrals ($P<0.05$) but were less likely to approve of giving patients access to abnormal lab studies, progress notes or care over the internet. A study from England assessed attitudes about a test system that was available via a booth at a London group practice.[38] Investigators surveyed patients on their interest in viewing their records before and after seeing the system, their concerns about security and accuracy, their interest in editing their record and the impact on the doctor-patient relationship. Patients had high rates of interest in viewing their records and most felt that having access to a record would break down barriers with their providers. Small numbers were concerned about security or accuracy. A study from Canada surveyed 30 patients with lung transplants given access to a personal health record simulation environment and found that 60% of patients felt that having access to information about their medical care would help them manage their care at home.[39] Another study from England gave 100 patients access to view their physician-held electronic medical records and found that most had little difficulty navigating or understanding most sections with the exception of referrals.[40] Forty-eight percent were worried about security before seeing the record while 61% were confident of the security in use after seeing the record. Another study from Canada surveyed men with prostate cancer regarding their attitudes towards web-based personalized electronic health record information systems.[41] The study included a convenience sample of 41 men and 18 spouses/significant others and found that 80% would be willing to try a web-based system. Between 36 and 55% of men had some concerns about accuracy, security and confidentiality of information.

Patient Access and Patient Characteristics

There were four studies that evaluated the characteristics associated with use of patient portals. In one study from Group Health Cooperative, diabetes patients were surveyed regarding their use or non-use of a patient portal tethered to Group Health's electronic health records system.[46] Of 873 patients eligible for inclusion, 718 or 79% agreed to participate. 53% of participants had used the patient website, and in unadjusted analyses, Whites (compared to Blacks, Asians or other), younger patients, and those with higher education and income were more likely to be users of the patient portal. In a model adjusted for age, sex, health need, education, income, and provider factors, Blacks were 82% less likely and Asians 60% less likely to use the patient portal. When restricting to those who used the internet, Blacks were still 75% less likely to use the portal.

In a second study from Kaiser Permanente Georgia,[47] investigators surveyed a cohort of racially diverse enrollees and subsequently evaluated registration rates for Kaiser's tethered personal health record, KP.org. Of the 1777 patients included in the evaluation, 35% registered with KP.org during the study period and these patients were significantly more likely to be white than African American (42 v 30%, $p<0.01$), to have diabetes or elevated lipids compared to low risk adults (36 and 38% v 30%, $p=0.01$), and to have a higher level of education (greater than high school). Differences in registration rates between whites and African Americans persisted when adjusting for different variables.

Another study from Kaiser Permanente in Northern California evaluated patients with diabetes and their use of KP.org, focusing specifically on health literacy.[48] 14,102 patients who had completed a survey as part of a larger study evaluating ethnic and educational disparities in diabetes-related behaviors, processes of care and health outcomes, were included in the analysis. Only 40% registered for KP.org and 27% signed on one or more times. African Americans, Latinos and Filipinos were more than twice as likely to not sign on to KP.org compared to Whites. Those with lower self-reported health literacy were 1.7 times less likely to sign on to KP.org. Among those with computer access, the racial/ethnic differences persisted as did the effect of limited health literacy.

A fourth study from Partners HealthCare compared primary care patients who had activated their account giving them access to an online tethered personal health record (Patient Gateway) with those who had not as of September 2009.[49] Of 75,056 included in the analysis, 43% were "adopter" – having registered for the portal. Rates of adoption were lower among all racial/ethnic minorities with blacks 50% less likely to be adopters compared to whites. Patients with selected comorbidities (asthma, CHF, diabetes, hypertension) were more likely to be adopters while patients with more visits were less likely to be adopters.

Qualitative Studies on Patient Access – Barriers and Facilitators

There were four papers that utilized qualitative research methodology to evaluate personal health records and that identified specific barriers or facilitators to their success. In one paper from a University of Washington general internal medicine clinic, patients with Type 2 diabetes mellitus had access to a patient portal that allowed them to view their record, upload glucose readings, send secure messages with a case manager and provided disease-specific information.[50]

Qualitative interviews with nine participants identified that for many, the portal provided a means for patients to discuss non-urgent matters related to their health but that frustrations with the system (e.g. technical, lack of timely response) could result in the patient feeling devalued. Two papers described results from a University of Pittsburgh evaluation of a diabetes-focused patient portal (UPMC Health Trak) that included secure messaging, preventive healthcare reminders and disease-specific tools and information.[51,52] Focus groups of 39 patients identified forgotten passcodes, lack of knowledge about all aspects of the system, and an inability to view all records of interest as potential barriers. Facilitators included an enhanced sense of patient empowerment and ability to communicate regarding appointments as well as with providers between scheduled appointments. Focus group discussions also revealed that patient use and interest in the portal was associated with dissatisfaction with the existing patient-provider relationship – particularly related to communication with and responsiveness of the provider or office, and access to information. Patients with greater satisfaction with their existing patient-provider relationship were less interested in using the portal. Lastly, an assessment of variations in adoption at four primary care practices affiliated with Partners HealthCare found differences between high and low adoption practices in leadership and marketing practices.[44] The addition of an incentive for patient enrollment was associated with 3-6 fold increases in adoption.

Summary for Key Question #2 – Tethered Systems

The evidence reviewed regarding patient access to their own medical records, when this is tethered to an electronic health record, supports the following conclusions:

- There is low strength evidence that patients' access to their own medical record improves health outcomes for chronic diseases such as diabetes, hypertension, or heart failure (GRADE = low).
- There is low strength of evidence that patient access to their own records, combined with the ability to submit an electronic care plan can improve medication decisions at a subsequent visit for patients with diabetes (GRADE = low).
- There is insufficient evidence to reach conclusions regarding the potential effect of patients' access to their own medical record on efficiency (GRADE = insufficient).
- There is low strength evidence that patients' access to their own medical record influences utilization (GRADE = low).
- There is insufficient evidence to reach conclusions regarding the potential effect on patients' access to their own medical record on patient attitudes.
- There is moderate strength evidence that use of patient portals is lower among certain racial or ethnic groups, in particular African Americans (GRADE = moderate).
- There is moderate strength of evidence that use of patient portals is lower in persons with lower literacy or education level (GRADE = moderate).

Patient Access to Medical Records: Non-Tethered Systems

There were five papers focusing on patient access to their own medical records using systems that were not necessarily tethered to a provider-based EHR.[53,54,55,56,57] All were survey studies and four were from Europe or Canada. The one US study from the University of Washington evaluated the use of a web-based personal health record by disadvantaged people living at a low-income housing facility.[56] The study utilized nursing students to help residents utilize the system

and found that utilization was much higher on the days that the students were available or on the day after. 12 of 24 registered users completed a survey. Only two were able to complete the health record entry on their own, though 92% were satisfied with the system and most felt the system helped them manage their health information. A Swedish study evaluated patient attitudes towards a national pharmacy register using a web survey.[53] Of 7860 unique site visitors, 22% completed the survey. Respondents generally rated the system highly and felt that it would help with medication safety and healthcare, particularly that given by the pharmacist. A study from Switzerland evaluated the attitudes of patients given "CardioCard," a small CD-ROM containing cardiac medical information including study reports and reports of clinical examinations.[55] Seventy three percent of 536 patients who received a CardioCard responded to the survey. Seventy three percent found it very useful or useful and 78% were willing to pay for it. Most (73%) did not access the card themselves and 88% did not have their physicians access the card. Only 5% were worried about data security.

The final two studies surveyed patients on their attitudes regarding having access to online health information.[57,54] One from England invited 1050 patients to participate in a survey with a 60% response rate (629 responses).[57] Analyses were conducted for patients aged 21 and older. Most felt they should have access to their health records (83%) and 79% thought it was a good idea to make them electronic. 35% preferred print-outs of records and 50% had concerns about the security of their records held on computers. A study from Canada surveyed Chief Executive Officers of Canadian public and acute care hospitals to understand organizational readiness for patient accessible records.[54] Eighty-three of 213 CEOs responded (39% response rate). Fifty-four percent of hospitals had some sort of EHR. 87% of respondents identified hospital financial resources as the most important barrier to providing patient access to the EHR.

Data for the non-tethered systems confirms the generally positive attitudes from other survey studies of patients regarding their interest in having access to their medical records. The one study in a low income and elderly population identifies potential barriers related to computer and internet skills.

SUMMARY AND DISCUSSION

SUMMARY OF EVIDENCE BY KEY QUESTION

A summary of the conclusions and strength of evidence is presented in Table 2.

Table 2. Conclusions and Strength of Evidence by Key Question and Outcome

Conclusion	GRADE Classification
KEY QUESTION #1. What is the association between secure messaging and health outcomes, patient satisfaction, adherence, efficiency or utilization, or automated email?	
Health Outcomes	
Secure messaging (especially as part of a web-based management system) can improve glucose outcomes in patients with diabetes.	moderate
Adding a web-based pharmacist to secure messaging improves blood pressure outcomes in patients with hypertension.	low
Secure messaging with a web-based management system improves ulcerative colitis symptoms.	low
Patient Satisfaction	
Secure messaging increases patient satisfaction.	moderate
Adherence	
Secure messaging improves adherence to colorectal cancer screenings or heart failure management.	low
Efficiency/Utilization	
Secure messaging influences either positively or negatively efficiency or utilization.	low
KEY QUESTION #2. What is the association between patient access to their own medical record and health outcomes, patient satisfaction, adherence, efficiency or utilization, and attitudes about access?	
Health Outcomes, Satisfaction, and Adherence	
Patients' access to their own medical record improves health outcomes for chronic diseases such as diabetes, hypertension, or heart failure.	low
Patient access to their own records, combined with the ability to submit an electronic care plan can improve medication decisions at a subsequent visit for patients with diabetes.	low
Efficiency/Utilization	
There is insufficient evidence to reach conclusions regarding the potential effect of patients' access to their own medical record on efficiency	insufficient
Patients' access to their own medical record influences utilization.	low
Attitudes	
There is insufficient evidence to reach conclusions regarding the potential effect on patients' access to their own medical record on patient attitudes.	insufficient
Patient Characteristics	
Use of patient portals is lower among certain racial or ethnic groups, in particular African Americans.	moderate
Use of patient portals is lower in persons with lower literacy or education level.	moderate

LIMITATIONS

The primary limitation of this systematic review is the quantity and quality of the original studies. Evidence was sparse for all but two of the outcomes assessed (the effect of SM on diabetes outcomes and patient satisfaction), and studies frequently had methodological problems including the use of study designs with greater risk of bias (pre/post studies), poor response rate or poor follow-up rate for surveys and cohort studies, and little explanation of the implementation process for the IT functionality, which has two consequences: it makes it challenging to distinguish between failure of the intervention and failure of the implementation in studies reporting no effect; and for studies that do report beneficial effects it leaves providers and policymakers at other institutions unclear about how to replicate the success. The above limitations are common to almost all systematic reviews of health information technology. An additional limitation of this review is that the functionalities of interest, secure messaging and patient access to their own records, were often part of a bundle of interventions, making attribution of any beneficial effect to any one functionality difficult. In practice, attributing the independent effect of individual functionalities may not be necessary or even meaningful, since many champions consider these two functionalities (plus others) as interdependent. Many champions consider the package of functionalities – secure messaging, patient access to renew medications and appointments, and online disease management tools to be core elements of a tethered personal health record. Additionally, there may be a "ceiling effect" present, meaning that patients practicing greater health engagement with providers and in terms of self-management may be more likely to adopt new technology sooner, making it harder to demonstrate strong improvement. Lastly, much of the evidence comes from non-VA settings – e.g., studies from academic tertiary care medical centers working in a fee-for-service or similar reimbursement environment – although several observational studies from Kaiser and from Group Health Cooperative tend to support the findings from the academic medical centers. The relevance of these settings to VA is a judgment for VA policymakers.

DISCUSSION

The literature surrounding secure messaging and patient access to their own records is evolving as the systems themselves become more complex. In some respects, evaluating the individual components of patient portals may no longer be relevant since most of the functionalities are not conceptualized as independent features, but rather as part of an overall package that is intended to facilitate information exchange with patients as well as patient communication with providers and healthcare institutions. Our review identifies a few core elements consistently described in most of the published evaluations that comprise the basic patient portal: secure messaging, access to test results, access to progress notes or visit summaries, and educational materials or disease management tools.

The evaluation of the impact of these portals is further complicated when one considers that they are also being designed to align with a larger patient management system that includes case management, remote health care delivery and non-face-to-face care. Attributing outcomes to any one component becomes more and more difficult as these layers are added one to the other; yet it appears that utilizing patient portals as part of a broader effort to improve care, particularly one that involves case management, may in fact yield beneficial results.

These patient portals are also being created as part of a movement to make patients more active participants in their care, as opposed to passive receivers of information. Early consumer health systems provided educational materials to patients. Robust patient portals offer patients the ability to drive and direct their care. Yet our review has identified some potential key barriers to achieving more uniform access to these systems. Successful and widespread implementation will require attention to these disparities in use as well as tailored approaches to engage certain populations that are not readily embracing personal health record systems.

RECOMMENDATIONS FOR FUTURE RESEARCH

Any research within VA is going to be pragmatic by design, since VA is already implementing secure messaging and patient access to their own record (meaning that any kind of randomized study where this is withheld is not practical). Nevertheless, a time series study of the implementation of secure messaging across institutions would be feasible and could provide reasonable, hypothesis-testing data to assess the effect of increasing SM use on quality (via EPRP), productivity, and patient satisfaction. Such a study would need to use both within-institution and across-institution comparisons to deal with the possibility of secular trends in quality, productivity and satisfaction as well as the "institution effect".

CONCLUSIONS

Data are sparse, but support that the use of secure messaging can improve glucose outcomes in patients with diabetes and increase patient satisfaction. Data from other studies suggest that secure messaging as part of a web-based management program is more effective than secure messaging alone. This finding supports the conclusions from other studies of health information technology that HIT is a tool, and if implemented by itself may have modest or even no measurable effect, but HIT can enable the implementation of more comprehensive programs (e.g., the web-based management system, in this case) that have meaningful effects on quality of care.

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APPENDIX A. SEARCH STRATEGY

CONSUMER HEALTH INFORMATION TECHNOLOGY SEARCH METHODOLOGIES

DATABASE SEARCHED & TIME PERIOD COVERED:
PubMed – 1990-12/3/2010

LANGUAGE:
English

SEARCH STRATEGY #1:
"Electronic Health Records"[Mesh] OR "electronic health record" OR "electronic health records" OR "electronic medical record" OR "electronic medical record" OR messaging OR email* OR "computerized alert" OR "computerized alerts" OR "computerized reminder" OR "computerized reminders" OR "computerised reminder" OR "computerised reminders" OR electronics, medical OR informatic*[tiab] OR computerized physician order entry OR computerised physician order entry OR computer provider order entry OR cpoe OR e-prescrib* OR e-prescription* OR electronic prescrib* OR electronic prescription* OR e-health
AND
patient*[ti] OR consumer*[ti] OR patient*[mh] OR consumer*[mh] OR tether* OR secure OR self-report* OR self report*
NOT
case report OR case reports OR case report[pt] OR case reports[pt]

NUMBER OF RESULTS: 2381

SEARCH STRATEGY #2:
"Electronic Health Records"[Mesh] OR "electronic health record" OR "electronic health records" OR "electronic medical record" OR "electronic medical record" OR messaging OR email* OR "computerized alert" OR "computerized alerts" OR "computerized reminder" OR "computerized reminders" OR "computerised reminder" OR "computerised reminders" OR electronics, medical OR informatic*[tiab] OR computerized physician order entry OR computerised physician order entry OR computer provider order entry OR cpoe OR e-prescrib* OR e-prescription* OR electronic prescrib* OR electronic prescription* OR e-health
AND
reminder*
NOT
case report OR case reports OR case report[pt] OR case reports[pt]
NOT
Results of Search Strategy #1

NUMBER OF RESULTS: 353

SEARCH STRATEGY #3:
["Electronic Health Records"[Mesh] OR "electronic health record" OR "electronic health records" OR "electronic medical record" OR "electronic medical record" OR messaging OR email* OR "computerized alert" OR "computerized alerts" OR "computerized reminder" OR "computerized reminders" OR "computerised reminder" OR "computerised reminders" OR electronics, medical OR informatic*[tiab]

OR computerized physician order entry OR computerised physician order entry OR computer provider order entry OR cpoe OR e-prescrib* OR e-prescription* OR electronic prescrib* OR electronic prescription* OR e-health OR "Medical Records Systems, Computerized"[Mesh]
AND
patient*[ti] OR consumer*[ti] OR patient*[mh] OR consumer*[mh] OR tether* OR secure OR self-report* OR self report*
NOT
case report OR case reports OR case report[pt] OR case reports[pt]]
OR
["Electronic Health Records"[Mesh] OR "electronic health record" OR "electronic health records" OR "electronic medical record" OR "electronic medical record" OR messaging OR email* OR "computerized alert" OR "computerized alerts" OR "computerized reminder" OR "computerized reminders" OR "computerised reminder" OR "computerised reminders" OR electronics, medical OR informatic*[tiab] OR computerized physician order entry OR computerised physician order entry OR computer provider order entry OR cpoe OR e-prescrib* OR e-prescription* OR electronic prescrib* OR electronic prescription* OR e-health OR "Medical Records Systems, Computerized"[Mesh]
AND
reminder*
NOT
case report OR case reports OR case report[pt] OR case reports[pt]]
NOT
Results of Search Strategy #1

NUMBER OF RESULTS: 2804

TOTAL OF ALL SEARCHES AFTER REMOVAL OF DUPLICATES: 4607

APPENDIX B. STUDY SELECTION FORM

ID:

1. Is this consumer HIT?

- ☐ Not HIT (STOP)
- ☐ HIT

2. Functionalities discussed in the article:

- ☐ Messaging programs
- ☐ Patient access to own medical record
- ☐ Patient self-reported data (specify)
- ☐ Online preventive or chronic care reminders (specify)
- ☐ Other (STOP)

3. What is the study design?

- ☐ Descriptive qualitative
- ☐ Descriptive quantitative
- ☐ Hypothesis testing
- ☐ Systematic review
- ☐ Non-systematic review (STOP)
- ☐ Commentary/news (STOP)
- ☐ Other (STOP)
- ☐ N/A, Not reported (STOP)

4. Study Origin

- ☐ US
- ☐ Non-US
- ☐ Not clear/Unknown

5. If STOP, save for background?

- ☐ Yes

6. Is study from a VA peer organization?

- ☐ Kaiser Permanente
- ☐ Group Health Cooperative
- ☐ Geisinger Health System
- ☐ Partners HealthCare
- ☐ Palo Alto Medical Foundation
- ☐ None
- ☐ Not Reported
- ☐ VA

Which outcomes are reported?

7. Clinical Outcomes

- ☐ Health outcomes
- ☐ Patient satisfaction
- ☐ Provider satisfaction
- ☐ Patient-provider communication
- ☐ Self-management
- ☐ Adherence (medication, visit)
- ☐ Other (specify) _____

8. System-level outcomes

- ☐ Efficiency/Utilization
- ☐ Privacy breaches
- ☐ Patient safety
- ☐ Other (specify) _____

9. Other outcomes

- ☐ Attitudes
- ☐ Usability

APPENDIX C. CRITERIA USED IN QUALITY ASSESSMENT

A summary of GRADE's approach to rating quality of evidence[58]

Study design	Initial quality of a body of evidence	Lower if	Higher if	Quality of a body of evidence
Randomized trials	High ⇒	Risk of Bias -1 Serious -2 Very serious Inconsistency -1 Serious -2 Very serious Indirectness -1 Serious -2 Very serious Imprecision -1 Serious -2 Very serious Publication Bias -1 Likely -2 Very likely	Large Effect +1 Large +2 Very large Dose response +1 Evidence of a gradient All plausible residual confounding +1 Would reduce a demonstrated effect +1 Would suggest a spurious effect if no effect was observed	High (four plus: ⊕⊕⊕⊕) Moderate (three plus: ⊕⊕⊕◯) Low (two plus: ⊕⊕◯◯) Very low (one plus: ⊕◯◯◯)
Observational studies	Low ⇒			

APPENDIX D. PEER REVIEW COMMENTS/AUTHOR RESPONSE

Prompt	Comment	Response
Are the objectives, scope, and methods for this review clearly described?	The dates of the literature review are stated as "1999 through 12/03/2010"…to improve consistency provide start and end dates in same format (e.g. 01/01/1999 through 12/03/2010).	This suggestion has been incorporated.
Are there any published or unpublished studies that we may have overlooked?	The exclusion of descriptive qualitative studies appears to be a shortcoming considering the infancy of this field and the limited availability of data about the use and efficacy of Secure Messaging, Personal Health Records, and Web-based Management Systems. The inclusion of at a minimum a summary of the qualitative findings to date could provide insights to the facilitators and barriers to use and possibly inform the "why" factor to these reported quantitative findings.	We evaluated the descriptive qualitative papers and identified those that were potentially studies of patient portals that discussed barriers and facilitators. We identified four such studies for inclusion, two of which were of the same system, that we felt were reasonable to include. A fifth study involved focus groups evaluating a "potential" system and was not included. A sixth study evaluated patient opinions regarding access to records from a kiosk in the practice waiting room in London and was not included.
	J Gen Intern Med. 2003 Sep;18(9):736-44. Effect of a triage-based E-mail system on clinic resource use and patient and physician satisfaction in primary care: a randomized controlled trial.	The email system presented does not match our definition of secure messaging. Insecure email was outside the purview of our current scope.
	Randomized Trials: 1. McCarrier KP, Ralston JD, Hirsch IB, et al. Web-based collaborative care for type 1 diabetes: a pilot randomized trial. Diabetes Technol Ther. Apr 2009;11(4):211-217. (U of Washington Study) 2. Simon GE, Ralston JD, Savarino J, Pabiniak C, Wentzel C, Operskalski BH. Randomized trial of depression follow-up care by online messaging. J Gen Intern Med. 2011. (Group Health Study)	McCarrier: Our original search only found the companion to this article. We have now included this article as well. Simon and Lyles: These articles were too recent for our original search, however our updated search did include them. They have now been incorporated into the report.

Prompt	Comment	Response
(*Continued)* Are there any published or unpublished studies that we may have overlooked?	Papers Addressing Potential Disparities in Access to SM and Patient Access to Records: 1. Lyles CR, Harris LT, Jordan L, et al. Patient race/ethnicity and shared medical record use among diabetes patients. Med Care. 2011. (Group Health)	
	2. Roblin DW, Houston TK, 2nd, Allison JJ, Joski PJ, Becker ER. Disparities in use of a personal health record in a managed care organization. J Am Med Inform Assoc. Sep-Oct 2009;16(5):683-689. (Kaiser)	Roblin: This article has now been included in a new section on patient characteristics associated with use of a patient portal/ tethered PHR.
	3. Sarkar U, Karter AJ, Liu JY, et al. 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). J Health Commun. 2010;15 Suppl 2:183-196. (Kaiser)	Sarkar: We have included this article in a new section on patient characteristics associated with use of a patient portal/tethered PHR.
	Wald JS, Grant R, Schnipper J, Gandhi T, Poon E, Businger A, Orav E, Williams D, Volk L, Middleton B. Survey analysis of Patient Experience using a Practice-linked PHR for Type 2 Diabetes Mellitus. AMIA Annu Symp Proc 2009:678-82.	Wald 2009: This article reports on a subset of patients that are included in the Grant 2008 article below and the previously included Wald 2010 artucle, and is thus an exclude.
	{post 12/3/2010}Wright A, Poon EG, Wald J, Feblowitz JC, Schnipper JL, Grant RW, Gandhi TK, Volk LA, Bloom A, Williams DH, Gardner K, Epstein M, Nelson L, Businger A, Li Q, Bates DW, Middleton B. Randomized controlled trial of health maintenance reminders provided directly to patients through an electronic PHR. J Gen Int Med 2012 Jan; 27(1):85-92. Epub 2011 Sep 9. http://www.ncbi.nlm.nih.gov/pubmed/21904945	Wright: This article is about reminders, which was not part of the revised focus for this report.
	{post 12/3/2010}Yamin CK, Emani S, Williams DH, Lipsitz SR, Karson AS, Wald JS, Bates DW. The digital divide in adoption and use of a personal health record. Arch Int Med 2011; 171(6):568-574. {This paper may be relevant since many studies are limited by selection bias in the study participants.}	Yamin: This article was too recent for our original search, but was captured by our search strategy in an update search, and is now included.
	Grant RW, Wald JS, Schnipper JL, Gandhi TK, Poon EG, Orav EJ, Williams DH, Volk LA, Middleton B. Practice-linked Online Personal Health Records for Type 2 Diabetes: A Randomized Controlled Trial. Arch Int Med 2008; 168(16):1776-82.	Grant 2008: This article is now included.
	Grant RW, Wald JS, Poon EG, Schnipper JL, Gandhi TK, Volk LA, Middleton B. Design and implementation of a web-based patient portal linked to an ambulatory care electronic health record: patient gateway for diabetes collaborative care. Diabetes Technol Ther. 2006; 8:576-86.	Grant 2006: Although our search did capture this article, it was marked as an exclude because it was descriptive qualitative and did not address barrier or facilitators to use.

Prompt	Comment	Response
(Continued) Are there any published or unpublished studies that we may have overlooked?	Wald JS. Variations in Patient Portal Adoption in Four Primary Care Practices. AMIA Annu Symp Proc 2010:837-41. {Supports the idea that it may be difficult to draw strong conclusions from practices/patients where adoption is weak; the implication for future VA work is to establish "level of adoption" metrics for comparability.} The Value of Personal Health Records. David C. Kaelber, MD, PhD, Sapna Shah, MS, Adam Vincent, MPP, Eric Pan MD, MSc, Julie M. Hook, MA, MPH, Doug Johnston, MTS, David W. Bates, MD, MSc, Blackford Middleton, MD, MPH, MSc. © 2008 by the Center for Information Technology Leadership (CITL). Published and distributed by the Healthcare Information and Management System Society (HIMSS). Requests for permission to reproduce any part of this work should be directed to: Ellen S. Rosenblatt, Manager of Operations Center for Information Technology Leadership Partners HealthCare System, Inc. One Constitution Center Information Systems Department, Second Floor West Charlestown, MA 02129 erosenblatt@partners.org. ISBN: 978-0-9800697-4-7	Wald 2010: This paper is a descriptive qualitative paper that was included in our search and that is now included in the new section on barriers and facilitators. Kaelber: This was already included, and is described in the "Patient Access and Efficiency/ Utilization."[42]
	Not including search terms such as 'personal health record', 'patient portal', 'secure email' and 'text messaging' may have reduced identification of potentially appropriate papers.	We will incorporate this suggestion into any future updated search, however for this report we rely on the original search and reference mining of included articles and the review by experts to identify potentially important missing studies. In the peer review process just completed, only three such articles (out of more than 60 already included) were identified, supporting a conclusion that the number of additional relevant studies now already identified is likely to be very small (<5%).
Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report.	There are some run-on sentences in the introduction, page 5.	We have edited the introduction.
	Recommend tabling key research question results and "GRADES".	We have included such a table in the Summary and Discussion section.
	From the automated email, I think there is a lot more research in the health behavior literature, Wayne Velicer, Vic Strecher, and many others have done this. Some has even extended to text messaging. Thus, I think that this section is not complete.	Because this was not the focus of the review, and based on the likelihood that our search did not adequately identify much of the literature in this area, we have removed this section from the report.
	Please correct all instances of My HealtheVet to be branded as shown here: "My Health***e***Vet"	This change has been incorporated.

Prompt	Comment	Response
(Continued) Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report.	It seems that there is logic to the order in which the GRADE of evidence is presented but it is unclear from the report what that logic is? It is clearly not higher to lower grades, but I wondered why? E.g. p 4	The order was based on the order of the outcomes in the key questions, and then within each outcome the evidence is sorted with GRADE going from high to low. A new table has been added for clarification.
	I find it very surprising that there is insufficient evidence to reach conclusions about the effect of patient access to their own medical record on their attitudes. Is this because most attitudinal studies were not examined since the scope was on hypothesis testing? Should that be qualified if that's the case?	In order to reach conclusions about satisfaction, we required a study to statistically test satisfaction, either between groups (with and without access to their own medical records) or across time (before and after access to their own medical records). Without these data, we can reach only limited conclusions. We started from the position that in order to reach cause-and-effect conclusions a hypothesis would need to be stated and then tested.
	I am finding that the comparison of use of PHR portal alone versus PHR portal WITH Secure Messaging has been useful in my own work. Instead the report compares SM with portal versus SM alone. Given that the model in the industry has evolved from PHR portal to portal WITH SM is there any way to reflect this in your analysis?	The original focus of the review was to evaluate secure messaging alone and then to evaluate the area of "patient access to medical records." In the patient access to medical records section, all of the tethered systems described in the 'Outcomes, Satisfaction and Adherence" section *and all but one* in the "Efficiency/Utilization" section include secure messaging as a component of their PHRs. In the one instance where this is not the case, it is specifically noted in the text.[30]
	Page 5: Dr. Nazi's office is Veterans and Consumers Health Informatics Office/Office of Informatics and Analytics	This change has been incorporated.
	P17. Missing period in para 2, could RVUs be defined?	This change has been incorporated.

Prompt	Comment	Response
(Continued) Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report	Consider further review and discussion of the interdependence of secure messaging and patient medical record access in the studies reviewed. Several of the intervention studies and most of the observational studies were in healthcare systems that intentionally tied together secure messaging and patient access to portions of the electronic medical record. Several of these interventions saw these two functions as interdependent for many patients, particularly for those needing self management support and collaborative care for chronic conditions. Parsing out the individual contribution of one of these activities may be less fruitful than seeing the value of the package.	As in the response to the comment above, the synthesis of "patient access to medical records" consisted of interventions that also included secure messaging, so the synthesis of the two interventions is already contained in the report. In addition, in the Summary and Discussion section, we have also discussed this point.
	Discuss results in the context of evolving definitions of patient medical electronic medical record access across the studies. For some of these studies, the record is a passive document viewed online by the patients. For others, the record is more interactive for patients and part of the ongoing care and communication tasks many patients face. In the latter case, the record can include secure patient provider messaging, medication refill functionality, and structured health risk assessment and feedback. Although current studies are not sufficient to determine the evidence behind the different approaches to patient access of the medical records, these differences may end up playing a role in outcomes as evidence evolves.	In order to inform this issue, we have included more detailed descriptions of the tethered systems described in the studies.
	Evaluation and discussion of equity in access to SM and patient access to medical records is missing. Secure messaging and patient access to the medical record should be seen as part of how we deliver care to all patients. Some historically vulnerable and underserved patient populations are less likely to use these services. As the VA and other similar organizations consider implementation of SM and patient access to the record, understanding and addressing these differences is essential for equitable care. I have provided a few references above to consider if the reviewers decided to encompass this domain.	We have included a new section entitled "Patient Access and Patient Characteristics" which reviews the evidence relevant to this comment.
	Page 15, second paragraph, third to last sentence. The randomized study of patients with diabetes referenced was done at the U of Washington, not Group Health (Ralston et al, Diabetes Care).	We thank the reviewer and author of the study for this observation, and have made the correction.

Prompt	Comment	Response
(Continued) Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report	Page 15, 3rd paragraph, in reference to Group Health randomized trial of essential hypertension. The review appears to erroneously imply that the control group did not have access to SM and the electronic medical record. All three study arms, including the usual care arm, had access to SM with PCP and other members of healthcare team and had access to similar portion of the electronic medical record. One intervention arm was given a home blood pressure cuff; the other intervention arm was given the blood pressure cuff and additionally access to pharmacist-based care management. All patients in the study were signed up and had access to the SM and electronic records. The strength of the study is showing how pharmacist care management over SM improves to BP control among patient who have access to SM and the services of the electronic record. May be particularly relevant to the VA's access efforts for mental health care.	We thank the reviewer and author for this clarification and have revised the description of the study and our conclusion.
	For Key Question #1, the Grant 2008 paper would justify adding to RESULTS (if authors agree): "There is ___ strength evidence that secure messaging (especially as part of a web-based management system) can improve medication decisions during a subsequent visit, reducing clinical inertia (Grant 2008 Arch Int Med).	We have added this conclusion (slightly modified) to the conclusion and given it a GRADE classification of "low" due to sparse data and concern about the generalizability of the intervention and practice settings.
	For Key Question #1, the association of secure messaging with many things (pt satisfaction, adherence, outcomes, etc.) is tempered by attitudes, workflow, service orientation, and factors beyond the tool itself. This is touched upon in the conclusion. Not sure if this "finding" can be considered given the report methodology, but I feel it's important because these factors are critical for understanding the current evidence and will likely impact future evidence as well. One paper that addresses practice (and other) factors are: Wald JS. Variations in Patient Portal Adoption in Four Primary Care Practices. AMIA Annu Symp Proc 2010:837-41.	We have now incorporated this reference in an expanded discussion of this issue.
	Not sure if this synthesis should include any high level comments about why the findings are largely indeterminate. Overall penetration of secure messaging and patient access to health records is still quite low, and given this, a paucity of rigorous data is not unexpected. Some of the findings may suffer from a ceiling effect…. Meaning that patients practicing greater health engagement with providers and in terms of self-management may be more likely to adopter new technology sooner, making it harder to demonstrate strong improvement.	We have incorporated these into the limitations.

Prompt	Comment	Response
(Continued) Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report	Comments on language: specific language and definitions could be helpful early on, with consistency throughout. Secure messaging, per VA-developed language, refers to secure email defined by online communication between patients and providers or healthcare team members. 'Messaging system' is less clear (e.g. page 14), and could include automated email, text or other technology such as interactive voice response (IVR). This review is focused on specific functionality delivered largely through patient portals and/or personal health record systems. Consider briefly defining functions early on; using either secure email or secure messaging, and avoid 'messaging' in other instances.	We have included definitions and have eliminated the section on automated email to avoid confusion.
	Comment on category of Efficiency/Utilization (page 16+): This grouping includes study findings across 3 types of measures: patient-level utilization of care or services delivered, provider-delivered care or workload measures, and patient-level characteristics or factors. The 3rd type of measure, characteristics of users and non-users, is important yet not a component of the category title. Impact on care utilization and provider workload should be distinct from one another.	We have now incorporated a new section on patient characteristics.
	Comment on Automatic Email Systems (page 19): there are several types of automatic messaging systems, including email notifications, text notification and others, such as IVR. Based on the search terms used, it appears the scoping was for the 1st type of notification only. If so, it would be valuable to describe the types of papers that were excluded. If not, there is some concern that the search terms used may have limited the studies identified.	This section has been deleted in this version.
	Comment on 'SM users': it would be helpful to clarify if a study examined patients who were enrolled or authenticated (identity-proofed) to use the PHR or secure email portal, or, whether actual use of SM was employed to identify the individuals. This is nuanced, but creates differences in study denominators.	This is an important distinction, however, most of the primary studies are not clear on this point.
	Comments on 'access to their own record': there are significant differences in the record content available for patients to view through a PHR. The VA offered access to medications and wellness reminders (at end of 2010); Kaiser and Group Health provided lab results and problem lists; few systems offered access to clinical notes. These distinctions should be described, even if there is insufficient evidence to discern the impact related to specific content or increasing level of health record access.	We have included more detailed descriptions of the tethered systems described in the studies.
	Page 14: 'web-based pharmacy group' – suggest modify to web-based system plus pharmacist	We have modified this description.
	Various pages: On-line can be one word: online; Diabetic patients should be patients with diabetes, patients with CHF, etc.	These changes have been incorporated throughout the text.

Prompt	Comment	Response
(Continued) Please write additional suggestions or comments below. If applicable, please indicate the page and line numbers from the draft report	Summary and Discussion (page 27): there appears to be a summary but no discussion.	We have now put the conclusions and GRADE information in a table and added text to the discussion.
	Limitation: all of these studies have relevance for the VA. Comments about fee-for-service or academic centers raise issues of external validity.	We have modified this text.
	Conclusion: studies showed patient satisfaction and reportedly improved communication with secure messaging alone. 'Web-based management program' could gain specificity with personal health record systems having access to online information and services… allowing patients to participate in their health and healthcare.	We have revised this section to include more information about this conclusion**.**
Please provide any recommen-dations on how this report can be revised to more directly address or assist implemen-tation needs.	Include relevant qualitative/descriptive research findings section/summary.	We have incorporated relevant qualitative descriptive studies about barriers and facilitators within the patient access section.
	Consider adding to the review a discussion of the evidence for coupling secure messaging and patient access to medical records, particularly for chronic conditions.	We have further emphasized these points.

APPENDIX E. EVIDENCE TABLES

Secure Messaging Evidence Table

Author, Year	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Health Outcomes					
Simon, 2011[9]	RCT; N=208 patients; 04/09-10/09	Online depression care management using secure messaging through a patient website linked to the medical record.	Group Health Cooperative (9 primary care clinics)	Depression severity (Hopkins Symptom Checklist)	Intervention patients had lower depression severity at the end of the evaluation period and higher proportions experienced 50% or greater decreases in depression scores (55% vs. 41%, OR=1.8, 95% CI: 1.0-3.1)
Elkjaer, 2010[1]	RCT; N=333 patients with mild/moderate ulcerative colitis; Published 2010, uncertain enrollment period	Web-group receiving disease-specific education and self-treatment. Web-patients can contact Web-doctor through email/text message	2 hospitals each in Denmark & Ireland; No mention of EHR	Feasibility of the approach, its influence on patients' compliance, knowledge, quality of life (QoL), disease outcomes (relapse), safety and health care costs	Adherence to 4 weeks of acute treatment was increased by 31% in Denmark and 44% in Ireland compared to the control groups. In Denmark IBD knowledge and QoL were significantly improved in web patients. Median relapse duration was 18 days (95% CI 10 to 21) in the web versus 77 days (95% CI 46 to 108) in the control group. The number of acute and routine visits to the outpatient clinic was lower in the web than in the control group. No difference in the relapse frequency, hospitalization, surgery or adverse events was observed.
Zhou, 2010[2]	Observational; N= 35,423; 02/05-12/08	Pt access to EHR; Secure messaging	Kaiser Permanente	Health Outcomes (HEDIS measures)	Patients with diabetes who used secure messaging with providers had better HEDIS measures with respect to Hgb, BP, and LDL, and also had greater improvements in HEDIS measures
Harris, 2009[3]	Cohort; cohort=15,247 n=2,924 used messaging; 1/1/04-3/31/05	Secure messaging	Group Health Cooperative	High quality DM care Lower outpatient utilization	Use of messaging was associated with better glycemic control [a1c <7.0%, RR 1.36 (1.16-1.58)] Use of messaging was associated with higher rate of outpatient visits [1.39 (1.26-1.53)]
Ralston, 2009[6]	RCT; N=83; 08/02-05/04	Web-based care management	UW General Internal Medicine Clinic	Primary: HgbA1c change after 12 month intervention. Secondary: total plasma cholesterol an systolic and diastolic blood pressure	A1c levels declined significantly in the intervention group compared with the usual care group (change -0.7%, p=0.01). More participants in the intervention group than in the usual-care group had A1c<7% after 12 months (33vs 11%; p=0.03). At 12 months mean changes in systolic blood pressure, diastolic blood pressure, and total cholesterol were not significantly different between groups.
Tuil, 2007[4]	Clinical RCT; N=199 couples, 122 completed informed consent and were randomized to research (61) or control (61) group; 1/04-7/04	Internet-based health record that provides patients with general and personal information about treatment for infertility Control group: no access to system	University Medical Center Netherlands	Patient empowerment; patient satisfaction; meaning of infertility programs; social support; anxiety; depression	No significant differences were observed in patient empowerment, patient satisfaction, meaning of infertility problems, social support, anxiety, or depression. No adverse effects were noted in the use of internet-based health record

Author, Year	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
McMahon, 2005[5]	Open RCT; N=104; 10/01-04/03	Web-based Care Management (received notebook computer, glucose and blood pressure monitoring device and access to care management website)	VA Medical Center, Boston	HgbA1c, Systolic and Diastolic Blood Pressure.	There was a significant decrease in HgbA1c compared to baseline in both groups (P<0.001) at all serial points of measurement. (3,6,9,12 months). There was a greater decline in HgbA1c over time in the web-based care management group when compared to the education and usual care group (p<0.05). Those in the highest tertile of data uploads had significantly greater decline in HgbA1c than those in the lowest tertile (P<0.05). Hypertensive participants in the web-based care-management group had a significantly greater decline in SBP after 12 months (P<0.01). The frequency of website logins or data uploads was not a predictor for change in blood pressure.
Ross, 2004[8]	RCT ; N=107; 2002	A web interface giving patients access to the medical record, a guide to heart failure, and a messaging system	Academic Medical Center Existing EHR	Use, Physician and patient survey	Frequency of use was 0.4 hit-days per enrolled patient per month. Clinical notes and laboratory results were the most frequently viewed items. Electronic messaging supplemented rather than replaced telephone messages. Measures of self-efficacy were not statistically significantly different between groups. General adherence increased in the intervention groups.
Green, 2008[7]	RCT (3 groups); N=778; 06/05 – 12/07	Home blood pressure (BP) monitoring and secure patient Web site only vs. home BP monitoring and secure patient Web site plus pharmacist care management delivered through Web communication	Group Health Cooperative (10 medical centers)	Percentage of patients with controlled BP (<140/90) and changes in systolic and diastolic BP at 12 months	Patients in the home BP monitoring and Web site only group had a non-significant increase in the percentage of patients with controlled BP compared with usual care (36% vs. 31%, P=.21). Adding Web-based pharmacist care to home BP monitoring and the Web site significantly increased the percentage of patients with controlled BP (56%) compared with usual care (P .001) and home BP monitoring and Web site only (P .001). Compared with usual care, the patients who had baseline systolic BP ≥160 mm Hg and received home BP monitoring and the Web site plus pharmacist care had a greater net reduction in systolic and diastolic BP.
Patient Satisfaction					
Lin, 2005[10]	RCT; N=606; 03/03 – 08/03	Secure messaging portal through established EMR	Academic internal med clinic in Denver	Use, patient satisfaction	Portal group patients reported improved communication with the clinic and higher satisfaction with overall care
Leong, 2005[11]	RCT ; Providers=8 Patients=100; 12/01 – 07/02	Patients of intervention group used email to communicate with physicians	Academic medical clinic	Use, patient and provider satisfaction	Patient satisfaction significantly increased in the email group compared to the control group in areas of convenience and amount of time spent contacting the physician. Physician satisfaction increased for convenience and amount of time and volume of messages.
Liederman, 2005[14]	Retrospective case control; Case N=6 physicians, control N=9 physicians; 11/01-11/02	Relay Health System, a web based patient-provider communication system	Academic Medical Center Existing EHR	Use, Satisfaction	9% of intervention physicians' patients used the system. Fewer than 10% of the patients sent over 5 messages, 45% of patient sent a single message. Messages about medications, "other medical questions ," and general chronic symptoms comprised half of all messages. Half of all messages were responded to in four hours, 86% within 16 hours. Telephone call volume was 18.2% less for intervention physicians than control. Patients were in general satisfied and found messaging easy to use. Providers were marginally satisfied, but found it easy to use and were neutral on the effect on workflow.

Author, Year	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Tuil, 2007[4]	Clinical RCT; N=199 couples, 122 completed informed consent and were randomized to research (61) or control (61) group; 01/04-07/04	Internet-based health record that provides patients with general and personal information about treatment for infertility Control group: no access to system	University Medical Center Netherlands	Patient empowerment; patient satisfaction; meaning of infertility programs; social support; anxiety; depression	No significant differences were observed in patient empowerment, patient satisfaction, meaning of infertility problems, social support, anxiety, or depression. No adverse effects were noted in the use of internet-based health record
Ross, 2004[8]	RCT; N=107 Patients; 2002	A web interface giving patients access to the medical record, a guide to heart failure, and a messaging system	Academic Medical Center Existing EHR	Use, Physician and patient survey	Frequency of use was 0.4 hit-days per enrolled patient per month. Clinical notes and laboratory results were the most frequently viewed items. Electronic messaging supplemented rather than replaced telephone messages. Measures of self-efficacy were not statistically significantly different between groups. General adherence increased in the intervention groups.
Liederman, 2003[13]	Observational; N=238 Patients N=8 Clinicians; 2001-2002	Relay Health System, a web based patient-provider communication system	Academic Medical Center Existing EHR	Use, Physician and patient surveys	37% of patients responded to the survey. 89% of patients found the system easy to use. 50% of patients used the system once or twice. 6 of 8 clinicians were satisfied or very satisfied with the system.
Houston, 2004[12]	Observational Internet-based survey; N=1,881; 05/01-10/01	e-mail to communicate with physicians	Survey link from website of 1) Intelihealth (health media company) and 2) CareGroup Healthcare System (Harvard-affiliated integrated health delivery network)	Use, clinical topics discussed through e-mail, perceived benefits, overall satisfaction	16.5% (of 1881) individuals reported using electronic mail to communicate with their physicians. Most frequent topics were results of lab testing (85%) and prescription renewals (85%). 21% of users inappropriately e-mailed about urgent or sensitive issues (suicidality, chest pain). 95% perceived e-mail to be more efficient than telephone. 82% of respondents were satisfied with the e-mail communication.
Adherence					
Muller, 2009[15]	Randomized cohort ; N=2100 randomized to email, letter, or usual care; 2007-2008	Secure email reminder system for colorectal cancer screening	Kaiser Permanente	Completion of CRC screening	CRC screening rates for patients receiving usual care (7.8%), email (22.7%), letter (23.6%) $p<0.0005$ usual care vs. letter $p<0.0005$ usual care vs. email $p=7.11$ letter vs. email
Ross, 2004[8]	RCT; N=107 Patients; 2002	A web interface giving patients access to the medical record, a guide to heart failure, and a messaging system	Academic Medical Center Existing EHR	Use, Physician and patient survey	Frequency of use was 0.4 hit-days per enrolled patient per month. Clinical notes and laboratory results were the most frequently viewed items. Electronic messaging supplemented rather than replaced telephone messages. Measures of self-efficacy were not statistically significantly different between groups. General adherence increased in the intervention groups.

Author, Year	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Efficiency /Utilization					
Elkjaer, 2010[1]	RCT; N=333 patients with mild/ moderate ulcerative colitis; Published 2010, uncertain enrollment period	Web-group receiving disease-specific education and self-treatment. Web-patients can contact Web-doctor through email/text message	2 hospitals each in Denmark & Ireland; No mention of EHR	Feasibility of the approach, its influence on patients' compliance, knowledge, quality of life (QoL), disease outcomes (relapse), safety and health care costs	Adherence to 4 weeks of acute treatment was increased by 31% in Denmark and 44% in Ireland compared to the control groups. In Denmark IBD knowledge and QoL were significantly improved in web patients. Median relapse duration was 18 days (95% CI 10 to 21) in the web versus 77 days (95% CI 46 to 108) in the control group. The number of acute and routine visits to the outpatient clinic was lower in the web than in the control group. No difference in the relapse frequency, hospitalization, surgery or adverse events was observed.
Weppner, 2010[16]	Retrospective cohort study; N = 6,185 enrollees > 64 years old with diabetes; 2003-2007	Shared medical record: secure messaging, medication refills, appointment requests, view test results, after-visit summaries, medical problem lists	Group Health Cooperative; probable EHR	Patients' use of shared medical record (SMR)	32.2% of enrollees used the SMR; median rate was 1.02 user-days/month. Numbers of users and rate of use increased over time. (Likelihood of initial SMR use was associated with assigned PCP's use of secure messaging.)
Santana, 2010[17]	Cross-sectional survey; N=7,022; 04/07-05/07	Use of the internet by patients to communicate with providers	European population (not specific)	Use, patient surveys, phone interviews, attitudes	In 2007, approximately 1.8% of population had used internet to order a rx, 3.2% to schedule an appt, and 2.5% to ask a health question. Among those using the internet for health purposes, more than 4 out of 10 considered it important when choosing a doctor
Harris, 2009[3]	Cross-sectional analysis; diabetes N=15,247; total N=2,924 used messaging; 1/1/04-3/31/05	Secure messaging	Group Health Cooperative	High quality DM care Lower outpatient utilization	Use of messaging was associated with better glycemic control [a1c <7.0%, RR 1.36 (1.16-1.58)] Use of messaging was associated with higher rate of outpatient visits [1.39 (1.26-1.53)]
Ralston, 2009[18]	Cross-sectional survey; N=4,059 pts over age 65 N=181 physicians; 01/01/04-03/31/05	Secure Messaging	Group Health Cooperative	Characteristics of users of secure messaging	Higher use rates associated with: Females [OR 1.15 (1.10-1.19)] greater morbidity [OR 5.64 (5.07-6.28)] PCP use with other patients [OR 1.94 (1.67-2.26)] Lower use associated with: Age over 65 [0.65 (0.59-0.71)] Medicaid vs. commercial insurance [OR 0.81 (0.68-0.96)]
Brooks, 2006[19]	Cross-sectional survey; N=10,253 primary care physicians, 3,954 ambulatory clinical specialists; 03/05-05/05	Use of email by providers to communicate with patients	Ambulatory primary care and specialists in Florida	Use, provider surveys	Of 4,203 physicians completing the survey, 16.6% had used email to communicate with patients. Only 6.7% adhered to at least half of the 13 selected guidelines for email communication

Author, Year	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Bergmo, 2005[20]	RCT; N=200; 2002-2003	Secure web messaging system	Primary care clinic in Norway	Use, efficiency	Forty-six percent of pts given access to messaging system used the online communication at least once. The reduction in office visits over time was greater for the intervention group than for the control group (p=0.034).
Ketteridge, 2005[21]	Retrospective Cohort; N=306 Cohort N=352 Control; 07/03-06/04	Informational sheet was given to patients listing surgeons email address as first option. Participants were also instructed that e-mail was the preferred communication method.	Single Surgical Practice at University of Sydney Endocrine Surgical Unit	E-mail utilization (characterization of user)	In the study group 50 of 306 patients (16%) utilized email communication, compared to 10 of 352 (3%) in the control group (P=0.0001). Email users represented a younger population, mean age 46.2 vs. 54.6 years (P=0.0004) in the study group and mean age 44.2 vs. 54.6 in the control group (P=0.03) . No difference in sex distribution. In the study group, 101 emails were sent by 50 patients and a majority of patients sent only one message (56%) and focused on only one issue. Most common reason for sending an email was to obtain general clinical information (n=123, 62%).
Liederman, 2005[22]	Controlled before and after; N is unclear, 2 clinics; 11/01-11/02	Relay Health System, a web based patient-provider communication system	Academic Medical Center Existing EHR	Use, Physician Productivity	9% of intervention physicians' patients used the system. Intervention physicians averaged 11% more visits per day than control physicians (25.5 vs. 22.9). Intervention physicians averaged 10% more RVUs per day. RVUs per visit were not different between intervention and control.
Liederman, 2005[14]	Retrospective case control; Case N=6 physicians, control N=9 physicians; 11/01-11/02	Relay Health System, a web based patient-provider communication system	Academic Medical Center Existing EHR	Use, Satisfaction	9% of intervention physicians' patients used the system. Fewer than 10% of the patients sent over 5 messages, 45% of patient sent a single message. Messages about medications, "other medical questions," and general chronic symptoms comprised half of all messages. Half of all messages were responded to in four hours, 86% within 16 hours. Telephone call volume was 18.2% less for intervention physicians than control. Patients were in general satisfied and found messaging easy to use. Providers were marginally satisfied, but found it easy to use and were neutral on the effect on workflow.
Chen, 2009[23]	Retrospective Observational Study; N=225,000; Baseline year: 2004 Comparison Year: 2007	Implementation of KP HealthConnect in primary care completed November 2004. Implementation of KP HealthConnect in specialty care completed June 2005. Patient-provider secure messaging function available Sept 2005	Kaiser Hawaii – integrated health care delivery system	Utilization of office visits, telephone visits, secure messaging and ED/Urgent Care	Total office visits decreased 26.2% between 2004 and 2007 (p<0.001). Total scheduled telephone visits increased nine-fold. Increase in Secure messages between 2005 and 2007 was statistically significant (p<0.001). Rate of urgent care (19%, p< 0.001) and ED visits (11%, p<0.001) increased between 2004 and 2007
Ralston, 2009[6]	RCT; N=83; 08/02-05/04	Web-based care management	UW General Internal Medicine Clinic	Primary: HgbA1c change after 12 month intervention. Secondary: total plasma cholesterol and systolic and diastolic blood pressure	A1c levels declined significantly in the intervention group compared with the usual care group (change -0.7%, p=0.01). More participants in the intervention group than in the usual-care group had A1c<7% after 12 months (33vs 11%; p=0.03). At 12 months mean changes in systolic blood pressure, diastolic blood pressure, and total cholesterol were not significantly different between groups.

Author, Year	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Zhou, 2007[24]	Retrospective case-control pre-post analysis; Cohort N=4,686, control N=3,201; 09/02-11/05	Patient access to secure messaging	Kaiser Permanente Northwest (KPNW)	Office visit rate and telephone contact rate.	In the cohort study annual adult primary care visit rates decreased by 9.7% (2.47-> 2.24 office visits per member/year P<0.01). In the matched control study annual adult primary care visit rates decreased by 10.3% (P<0.001). Annual primary care telephone contact rate increased by 29.9% vs. 16.2% on the study group. (P<0.1)
Tang, 2006[25]	Random sample survey; N=120 messages; 01/01/05-06/30/05	Analyzed electronic patient-physician messages	Palo Alto Medical Foundation	Content Analysis of Secure Patient Messages.	22% of clinical messages sent to physicians contained sufficient patient history taking data and decision-making components to warrant reimbursement according to authors eVisit criteria.
Katz, 2004[26]	RCT; N=132 Physicians; 2001-2002	Patients of intervention physicians were encouraged to use a web based tool to communicate with staff	Academic Medical Center No existing EHR	Use of web messaging, Physician and patient survey of attitudes	In the intervention group, 1,038 patients registered and 2,238 messages were sent. 42% of patients sent no messages, 22% of patients sent >3 messages. Over 20% were appointment-related, 15% were referral requests, 12% were prescription related. During the 40 week study period, the number of patient emails and telephone calls were not affected by the intervention, being 2 fold and 10 fold greater respectively. Intervention physicians were more positive about web communication then control physicians.
Ross, 2004[8]	RCT; N=107 Patients; 2002	A web interface giving patients access to the medical record, a guide to heart failure, and a messaging system	Academic Medical Center Existing EHR	Use, Physician and patient survey	Frequency of use was 0.4 hit-days per enrolled patient per month. Clinical notes and laboratory results were the most frequently viewed items. Electronic messaging supplemented rather than replaced telephone messages. Measures of self-efficacy were not statistically significantly different between groups. General adherence increased in the intervention groups.
Liederman, 2003[13]	Observational; N=238 Patients N=8 Clinicians; 2001-2002	Relay Health System, a web based patient-provider communication system	Academic Medical Center Existing EHR	Use, Physician and patient surveys	37% of patients responded to the survey. 89% of patient found the system easy to use. 50% of patients used the system once or twice. 6 of 8 clinicians were satisfied or very satisfied with the system.
Green, 2008[7]	RCT (3 groups); N=778; 06/05 – 12/07	Home blood pressure (BP) monitoring and secure patient Web site only vs. home BP monitoring and secure patient Web site plus pharmacist care management delivered through Web communication	Group Health Cooperative (10 medical centers)	Percentage of patients with controlled BP (<140/90) and changes in systolic and diastolic BP at 12 months	Patients in the home BP monitoring and Web site only group had a non-significant increase in the percentage of patients with controlled BP compared with usual care (36% vs. 31%, P=.21). Adding Web-based pharmacist care to home BP monitoring and the Web site significantly increased the percentage of patients with controlled BP (56%) compared with usual care (P .001) and home BP monitoring and Web site only (P .001). Compared with usual care, the patients who had baseline systolic BP ≥160 mm Hg and received home BP monitoring and the Web site plus pharmacist care had a greater net reduction in systolic and diastolic BP.

Patient Access Evidence Tables

Author, Year (ID)	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Health Outcomes, Satisfaction, and Adherence					
McCarrier, 2009 [28]	RCT; N=77 pts; 12 months	Usual care plus access to a nurse practitioner case manager and the web-based disease management module.	University of Washington Diabetes Care Center	Hemoglobin A1c, Psychosocial self-efficacy	A1c values did not differ significantly after a year of follow-up. There was an increase in psychosocial self-efficacy (difference of 0.3, 95% CI: 0.01-0.59, p=0.04).
Ralston, 2009[6]	RCT; N=83 pts; 08/02-05/04	Web-Based diabetes care management for diabetes as part of an intervention based in the chronic care model and included a case manager for training, review of blood source readings, communication with patients, adjustment of diabetes medications, and discussion with the patients' PCP.	University of Washington General Internal Medicine Clinic, 83 patients enrolled with Hsb A1c > 7.0% who spoke English and could use the computer with the internet	Hemoglobin A1c, Use of service	Compared to usual care, intervention with patients had a hemoglobin A1c < 7.0% at 12 months (33% vs. 11%, p=0.03). There was no difference between groups in blood pressure control or lipid levels. There was no difference between groups in the numbers of outpatient visits, primary care visits, specialty physician visits, or inpatient days.
Grant, 2008[29]	RCT; N=11 primary care practices (126 intervention pts, 118 control pts); 09/05-03/07	Intervention practices gave patients access to a diabetes mellitus-specific personal health record with modules for medication review, clinical data, and care plans.	Partners HealthCare	Hemoglobin A1c, blood pressure, LDL-C	After one year of follow-up, there were no differences in A1c levels, blood pressure, or LDL-C levels between groups.
Tuil, 2007[4]	Clinical RCT; N=199 couples, 122 completed informed consent and were randomized to research (61) or control (61) group; 1/04-7/04	Internet-based health record that provides patients with general and personal information about treatment for infertility Control group: no access to system	University Medical Center Netherlands	Patient empowerment; patient satisfaction; meaning of infertility programs; social support; anxiety; depression	No significant differences were observed in patient empowerment, patient satisfaction, meaning of infertility problems, social support, anxiety, or depression. No adverse effects were noted in the use of internet-based health record
Ross, 2004[8]	RCT; N=107 patients; Dates not specified but around 2002	Pt access to records; secure messaging	Academic subspecialty clinic in Colorado	Pt/provider communication, health outcomes, pt satisfaction, adherence	The intervention group was not found to be superior in self-efficacy but was superior in general adherence. There was a trend toward better satisfaction with pt/provider communication.

Author, Year (ID)	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Green, 2008[7]	RCT (3 groups); N=778; 06/05 – 12/07	Home blood pressure (BP) monitoring and secure patient Web site only vs. home BP monitoring and secure patient Web site plus pharmacist care management delivered through Web communication	Group Health Cooperative (10 medical centers)	Percentage of patients with controlled BP (<140/90) and changes in systolic and diastolic BP at 12 months	Patients in the home BP monitoring and Web site only group had a non-significant increase in the percentage of patients with controlled BP compared with usual care (36% vs. 31%, P=.21). Adding Web-based pharmacist care to home BP monitoring and the Web site significantly increased the percentage of patients with controlled BP (56%) compared with usual care (P .001) and home BP monitoring and Web site only (P .001). Compared with usual care, the patients who had baseline systolic BP ≥160 mm Hg and received home BP monitoring and the Web site plus pharmacist care had a greater net reduction in systolic and diastolic BP.
Ralston, 2007[33]	Cross sectional survey; N=2,002 patients; 09/02-12/05	My Group Health patient website, linked to EpicCare	Group Health Cooperative 750,000 patients have access, 2000 patients invited for survey	Use, Satisfaction	Over 3 years, the number of patients receiving ID verification to use My Group Health increased from 3% to 25%. Use increased over time. The most commonly used services were test results, medication refill requests, after visit summaries, and patient-provider clinical messaging.
Efficiency/Utilization					
Wald, 2010[27]	RCT; N=3,979 participants; 2005-2007	eJournal, a patient completed pre-visits electronic journal submitted to providers prior to an office visit. This eJournal was one component of Patient Gateway, which had 21,533 accounts registered.	Primary and specialty practices at Brigham & Women's hospital	Use, Patient and provider satisfaction	About 3% of eligible patients consented to the study, of which about 50% were invited to submit a journal, of which between 64% to 78% opened the journal, and of these 97% of patients edited an existing entry. eJournal invitations for medications, allergies, and diabetes history were more likely to get completed and be viewed by patients and providers as being useful to the visit than were eJournal invitations for personal and family health history and health maintenance items.
Ralston, 2009[6]	RCT; N=83 pts; 08/02-05/04	Web-Based diabetes care management for diabetes as part of an intervention based in the chronic care model and included a case manager for training, review of blood source readings, communication with patients, adjustment of diabetes medications, and discussion with the patients PCP.	University of Washington General Internal Medicine Clinic, 83 patient enrolled with Hsb A1c > 7.0% who spoke English and could use the computer with the internet	Hemoglobin A1c, Use of service	Compared to usual care, intervention with patients had a hemoglobin A1c < 7.0% at 12 months (33% vs. 11%, p=0.03). There was no difference between groups in blood pressure control or lipid levels. There was no difference between groups in the numbers of outpatient visits, primary care visits, specialty physician visits, or inpatient days.
Ross, 2004[8]	RCT; N=107 patients; Dates not specified but around 2002	Pt access to records; secure messaging	Academic subspecialty clinic in Colorado	Pt/provider communication, health outcomes, pt satisfaction, adherence	The intervention group was not found to be superior in self-efficacy but was superior in general adherence. There was a trend toward better satisfaction with pt/provider communication.

Author, Year (ID)	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Weppner, 2010[16]	Retrospective cohort study; N = 6,185 enrollees > 64 years old with diabetes; 2003-2007	Shared medical record: secure messaging, medication refills, appointment requests, view test results, after-visit summaries, medical problem lists	Group Health Cooperative; probable EHR	Patients' use of shared medical record (SMR)	32.2% of enrollees used the SMR; median rate was 1.02 user-days/ month. Numbers of users and rate of use increased over time. (Likelihood of initial SMR use was associated with assigned PCP's use of secure messaging.)
Ralston, 2007[33]	Cross sectional survey; N=2,002 patients; 09/02-12/05	My Group Health patient website, linked to EpicCare	Group Health Cooperative 750,000 patients have access, 2000 patients invited for survey	Use, Satisfaction	Over 3 years, the number of patients receiving ID verification to use My Group Health increased from 3% to 25%. Use increased over time. The most commonly used services were test results, medication refill requests, after visit summaries, and patient-provider clinical messaging.
Burke, 2010[30]	Cohort; N=272; 2006-2009	I-Rounds, a web-based electronic health record, to which patients had access to the history and physical report, patient care instructions, and on imaging data from surgery.	Miami Children's Hospital, Congenital Cardiac Disease	Use	93% of the patients or families used the system. Access was more common when the patients were in-hospital than out-of-hospital imaging data were most commonly viewed.
Hassol, 2004[34]	Descriptive quantitative; N=1421; Study dates not mentioned but probably around 2001-2004	Pt access to records; web messaging	Geisinger Health System, HMO in Pennsylvania	Use, patient attitudes, pt/provider communication; patient satisfaction; barriers; Pt's and providers surveyed	Majority of users indicated that the system was easy to use. Minority of users was concerned about the confidentiality of their information. Patients preferred e-mail communication for requesting rx renewals, obtaining general medical information. Physicians were more likely to prefer telephone communication and less likely to prefer e-mail communication.
Kaelber, 2008[42]	Descriptive Cost-benefit analysis	Value of Personal health record: 1. Provider tethered 2. Payer tethered 3. Third party PHR 4. interoperable	n/a	Net Value	All PHRs have an initial net negative value. After 10 years, steady-state annual net value ranging from $13 billion to $29 billion. Interoperable PHRs provide the most value, followed by third-party, and payer tethered. Provider tethered show a consistent negative net value.
Green, 2008[7]	RCT (3 groups); N=778; 06/05 – 12/07	Home blood pressure (BP) monitoring and secure patient Web site only vs. home BP monitoring and secure patient Web site plus pharmacist care management delivered through Web communication	Group Health Cooperative (10 medical centers)	Percentage of patients with controlled BP (<140/90) and changes in systolic and diastolic BP at 12 months	Patients in the home BP monitoring and Web site only group had a non-significant increase in the percentage of patients with controlled BP compared with usual care (36% vs. 31%, P=.21). Adding Web-based pharmacist care to home BP monitoring and the Web site significantly increased the percentage of patients with controlled BP (56%) compared with usual care (P .001) and home BP monitoring and Web site only (P .001). Compared with usual care, the patients who had baseline systolic BP ≥160 mm Hg and received home BP monitoring and the Web site plus pharmacist care had a greater net reduction in systolic and diastolic BP.

Author, Year (ID)	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Attitudes					
Wald, 2010[27]	RCT; N=3,979 participants; 2005-2007	eJournal, a patient completed pre-visits electronic journal submitted to providers prior to an office visit. This eJournal was one component of Patient Gateway, which had 21,533 accounts registered.	Primary and specialty practices at Brigham & Women's hospital	Use, Patient and provider satisfaction	About 3% of eligible patients consented to the study, of which about 50% were invited to submit a journal, of which between 64% to 78% opened the journal, and of these 97% of patients edited an existing entry. eJournal invitations for medications, allergies, and diabetes history were more likely to get completed and be viewed by patients and providers as being useful to the visit than were eJournal invitations for personal and family health history and health maintenance items.
Cho, 2010[32]	Cross sectional; N=201; Date not stated, prior to 2010	My Health*e*Vet	Durham, VA Veterans with diabetes and Hgb A1c > 8.0%	Use, Access, Interest	Of 201 patient surveys completed (53% response rate) 59% reported having internet access at home, being "moderately" comfortable with internet tasks, 18% had heard of My Health*e*Vet, and 9% had used it. 41% of patients were "very interested" in using it.
Earnest, 2004[31]	RCT; N=107 patients N=8 physicians; 01/02-12/02	Pt access to records; secure messaging	Academic subspecialty clinic in Colorado	Pt and physician attitudes via survey and phone interviews; Efficiency	Patients were significantly more likely than physicians to anticipate benefits of SPPARO and less likely to anticipate problems. Attitudes of subjects did not diverge from controls after the intervention period. In post trial interviews, physicians and staff reported no change in their workload and no adverse consequences. All of the physicians ultimately supported the concept of giving patients online access to their clinical notes and test results.
Volk, 2005[35]	Cross sectional survey; N=460; 2003	Patient Gateway, a secure web portal	Partners HealthCare 2000 patients	Patient prescriptions	23% of patients returned the survey. 70% of users of the web portal reported overall satisfaction as "good" or better. Respondents were about as evenly split on whether or not using the web portal improved communication with providers. The most frequently rated valuable functions were the ability to renew prescriptions, ask an administrative question, and obtain referral approvals.
Eklund, 2004[36]	Descriptive qualitative; N=100; 1999-2001	Pt access to EHR, secure messaging	Community surgical clinics	Use, barriers; Pts and providers surveyed	On average, the users accessed the system less than 5 times during the trial period. 82% of the users had not been at all worried about security risks during the trial, while 15% expressed "some concern".
Hassol, 2004[34]	Descriptive quantitative; N=1421; Study dates not mentioned but probably around 2001-2004	Pt access to records; web messaging	Geisinger Health System, HMO in Pennsylvania	Use, patient attitudes, pt/provider communication; patient satisfaction; barriers; Pt's and providers surveyed	Majority of users indicated that the system was easy to use. Minority of users was concerned about the confidentiality of their information. Patients preferred e-mail communication for requesting rx renewals, obtaining general medical information. Physicians were more likely to prefer telephone communication and less likely to prefer e-mail communication.
Schnipper, 2008[45]	Descriptive; Sample N/A; Not specified	Web based patient portal linked to Ambulatory EMR (Diabetes)	Multi-hospital health care network in US	None	Description of design, implementation plan, and evaluation plan. Plan to assess the impact with a clinic RCT among 14 primary care practices in the health care system

Author, Year (ID)	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Pai, 2005[41]	Cross-sectional survey; Convenience sample of 41 men and 18 sig others (SS). Focus group 11 men and 5 SS; 2002	Patient and significant other access to web based EHR Questionnaire of health information (HI) needs of prostate cancer patients; questionnaire and focus group of web-based EMR at meet HI needs	Prostate cancer support group Victoria, BC	Interest in access to EHR	75% of men desired the ability to access their health records through means other than by meeting with their health care provider, with the internet ranking as the most desired method. 70% of significant others desired the ability to access their men's health record online.
Honeyman, 2005[38]	Semi-structured interview; N=109; 2003	Patient access to their own electronic medical record	Group Practice (community) in London, UK	Accuracy Data Security Dr-Pt relationship Internet Access to EMR	82% of respondents were interested in viewing their medical record. 75% felt that access to their record would improve their relationship with their doctor. 80% were not concerned about security. 75% felt their record was accurate.
Leonard, 2004[39]	Questionnaire of physicians and patients (lung-transplant); N=20 physicians, N=30 patients; 2001	Patient & Physician input into design and content of EPR	University Health Network in Toronto, Canada	Physician and patient's perspective on who should have access to info.	Almost two-thirds of patients (63%) had seen some portion of their medical record (most commonly blood work or X-ray results) and a similar percentage believed a personal medical record would help them manage their personal health care. All physicians felt that patients should receive self-care instructions, yet only half agreed to receiving discharge summaries (10 out of 20) and a minority felt that the patients should be able to receive access to operative notes (5 out of 20, or 25%).
Pyper, 2004[40]	Questionnaire and focus groups; N=100 for questionnaire and 7 for focus group; Not specified	Patient experience when assessing their own online patient records	Urban practice in Oxford, UK serving 10,300 patients	Ease of use; confidentiality; security; expectations of content; receiving new information and bad news	Majority of patients found viewing their record useful and understood most of the content, although medical terms and abbreviations required explanation. Patients were concerned about security and confidentiality, including potential exploitation of records. They wanted the facility to give informed consent regarding access and use of data. Many found errors, although most were not medically significant. Many expected more detail and more information. Patients wanted to add personal information.
Dorr, 2003[37]	Hypothesis testing; N=150 physicians; Dates not specified	Pt access to records	"email using" physicians	Physicians attitudes via surveys and phone interviews	Most felt the medication list, normal studies, prescription refills, appointments, and referrals should be provided to the patients ($p<.05$). However, they felt progress notes, abnormal labs, and care over the internet should not be provided.
Patient Characteristics					
Lyles, 2012[46]	Cross sectional survey and medical record review; N= 718 patients with diabetes for survey, N=625 pts with diabetes for record review; 09/09	Patient portal access	5 Group Health Cooperative medical clinics in western Washington	SMR use	Whites (compared to Blacks, Asians, or others), younger patients, and those with higher education and income were more likely to be users of the patient portal.

Author, Year (ID)	Study Design; Sample; Study Date	HIT Intervention	Setting	Outcome Measures	Findings
Yamin, 2011[49]	Cross sectional analysis of prtal data; N= 75,056; 01/02-09/09	Patient Gateway; an online tethered personal health record	Partners HealthCare	Adoption/ registration	43% were "adopters," with lower rates among racial/ethnic minorities compared to whites and higher rates among patients with selected comorbidities (asthma, CHF, diabetes, hypertension) compared to patients healthier patients.
Sarkar, 2010[48]	Cross sectional survey and KP.org data; N= 14,102 pts English speakers with diabetes; 01/06-12/06	KP.org portal, a tethered personal health record	Kaiser Permanente Northern California	use	Only 40% registered for KP.org and 27% signed on one or more times. African Americans, Latinos, and Filipinos were more than twice as likely not to sign on to KP.org when compared to whites. Those with lower self-reported health literacy were 1.7 times less likely to sign on the KP.org.
Roblin, 2009[47]	Cohort study; N=1,777 pts; 10/05-11/07	KP.org, a tethered personal health record	Kaiser Permanente Georgia	Time to registration	35% of participants registered during the study period and were more likely to be white than African American (42 vs. 30%, p<0.01), to have diabetes or elevated lipids compared to low risk adults (36 and 38% vs. 30%, p=0.01), and to have a higher levels of education.
Non-Tethered					
Montelius, 2008[53]	Cross sectional survey; N=1716; 2007	"My Dispensed Medications" a web-based register of dispensed medications accessible to patients.	Sweden N=1,000,000 are on the register, during the study 7,860 accessed the site and were offered the survey	Satisfaction	1,716 completed the survey (response rate = 22%). Patient ratings were high for usefulness and design of website. Getting control of prescriptions and getting an "overview" of prescriptions was listed by 70% of patients as their reasons for accessing the site.
Urowitz, 2008[54]	Cross sectional survey; N=83; Date not stated but prior to 2008	The concept of patient accessible electronic health records. All Chief Executive Officers of Canadian public and acute care hospitals N=213	Canada This is not tethered to any electronic health record	Perceptions about providing patient access to electronic health records	The response rate to the survey was 39%. About half of responding hospitals already had some form of electronic health record, but almost no hospitals used it as the sole method for recording patient information. Financial barriers were the most commonly identified barrier to providing patient access. Patient computer literacy and physician buy-in were also considered important barriers.
Bernheim, 2006[55]	Questionnaire of patients who use device; N=536 patients; 392 (73%) responded; One year period, date not specified	CardioCard. Credit card-sized electronic patient record	University Hospital in Switzerland	Usefulness Technical concerns Data security	73% found the card to be useful. Lack of hardware or insufficient computer knowledge was factors in non-use. Privacy was a concern.
Kim, 2005[56]	Descriptive quantitative; N=24; 12/04 – 03/05	Pt access to records	Low income housing facility	Use, patient attitudes, patient satisfaction, barriers; Pts surveyed	Among 24 residents, 50% participated in the survey. Only 16.7% were able to fill in the health records by themselves. 83% agreed that they have paid more attention to their health conditions and care using PHIMS. Ninety two percent answered that they are satisfied with the personal health record system in general.