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Patient Portal Adoption Rates: A Systematic Literature Review and Meta-Analysis

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Abstract

Despite the increasing availability of online patient portals that provide access to electronic health records, little is known about their adoption by patients. We systematically reviewed the literature to investigate adoption of patient portals across studies. We searched MEDLINE and Scopus to identify relevant papers. We included 40 studies: 24 were controlled experiments, with prospective data collection in an actively recruited population; 16 were real-world experiments, with adoption being evaluated retrospectively after system deployment in clinical practice. Our meta-analysis showed an overall mean adoption rate of 52% (95% Confidence Interval [CI], 42 to 62%). Rates differed markedly between study types: controlled experiments yielded a mean adoption rate of 71% (95% CI 64 to 79%), compared to 23% (95% CI, 13 to 33%) in real-world experiments. This difference was confirmed in a meta-regression analysis of the influence of study characteristics on adoption rates. Our findings suggest that adoption rates reported in controlled studies do not reflect those in everyday clinical practice. Until we understand how to effectively increase adoption, patient portals are unlikely to consistently lead to improvements in care processes and health outcomes.

Keywords:

Computers/utilization; Personal Health Record; Patient Access to Records

Introduction

Patient portals are online services that allow people to have access to their electronic health records (EHRs) and support basic activities such as booking appointments, recording symptoms, and communicating with healthcare providers [1, 2]. They are considered a valuable instrument to engage patients in having a more active role in their care [3–8] and aid self-management [8–10]. Many patient portals are developed for people with long-term conditions [9, 11].

Patient portals are increasingly available [1, 12, 13], but their impact on health outcomes has yet to be established [14–18]. Previous systematic reviews found positive effects on patient engagement and satisfaction [14, 15, 17, 18], but evidence on the effect of patient portal use on care processes and health outcomes is conflicting [14, 15, 18]. Our understanding of this variation in impact is currently limited [14, 15]. This might be related to the fact that published evaluations tend to focus on clinical endpoints, without considering the complex process that leads to them [19, 20].

As proposed by Coiera in his 'information value chain' [20], for any health information system to have impact, users first need to adopt the system and effectively interact with it (step 1) in order to receive information (step 2), which might then influence their decision making (step 3). This might lead to improved care processes (step 4), and, under beneficial conditions, to better health outcomes (step 5). Although not sufficient, good results are necessary at each step to achieve eventual positive impact on clinical endpoints [20]. Following Coiera's information value chain, evaluating adoption rates is essential for understanding the (lack of) effect of patient portals on decision making, care processes and health outcomes.

Although individual patient portal studies may have reported on adoption rates [21–23], up till now no study has summarized these rates across studies. Also, adoption rates in controlled experiments may not always translate well to a real life context [15]. This disconnect between findings from controlled and real-world experiments might partly be explained by the former being more likely to include strategies for optimizing recruitment and minimizing attrition than the latter [24]. For example, a study in primary care showed that patients in practices with a more active strategy to promote portal use were more likely to be registered users compared to those in practices with a less active or no strategy [25].

Therefore, we systematically reviewed the literature on patient portals to investigate adoption rates across individual studies, and how rates might differ between controlled and real-world experiments.

Methods

We followed the PRISMA statement [26] to design and report our systematic review and meta-analysis, where applicable.

Search strategy

We used the search strategy that we developed for a broader literature review on methodological approaches to evaluate patient portal usage, usability and effect on decision making (i.e. Coiera's information value chain steps 1-3). We searched for English language articles in MEDLINE via Ovid and in Scopus by combining subheadings and text words for patient portals with those referring to system usage, usability, and decision-making (full searches available at [27]). The searches were performed on the 18th of July 2016.

Selecting relevant studies

We considered studies relevant if they:

- Evaluated patient portals, using the definition of Irizarry *et al*. [2]: systems providing patients with access to their EHRs, and allowing them to enter health data or share information with their healthcare providers. We excluded studies on systems only providing educational material, or online booking or secure messaging functionalities.
- Had patients, carers, or healthy volunteers from the general population as the study sample, excluding those testing the system only within the research team.
- Reported sufficient information to determine portal adoption rate in the study population. Adoption was defined as the % of eligible patients who logged in at least once or—if this information was not available—had an active account during the study period. We excluded studies that only reported other types of usage statistics (e.g. frequency of use).
- Collected data on adoption through system interaction logs. Studies retrospectively asking patients about their portal use in surveys were excluded because such data lack in objectivity [28] and are known to be affected by recall bias [19]. We also excluded studies investigating intended use.
- Were peer-reviewed original articles (including conference papers) or systematic reviews in English, while excluding conference abstracts, narrative reviews, editorials, view point papers and grey literature.

After removing the duplicates from the Ovid and Scopus searches, the principal reviewer (PF) independently screened the titles and abstracts of all studies, whereas two secondary reviewers (PB; SvdV) did 50% each. For studies considered potentially relevant, we retrieved the full papers and two reviewers independently identified those meeting our inclusion criteria. At each stage of the review process, disagreement was solved through discussion.

Data extraction

We built a data abstraction form on the basis of previous systematic reviews on patient portals [17, 29] and health information systems evaluations [19, 30, 31], and pilot-tested it among the authors (PF, SvdV, MV, NP). The final form included items related to: general study characteristics; study type (controlled versus real-world experiment); study population; patient portal functionalities (data access; data recording; data sharing); number of potential patient portals users; number of patients who logged in at least once or had an active account during the study period. For real-world experiments, we additionally extracted information on strategies aimed at increasing patient portal adoption.

Controlled experiments were defined as any study where patients were actively recruited to participate in research and where data were collected prospectively. This included experiments with single groups as well as those with multiple groups (with participants being allocated either randomly or non-randomly), with the number of potential users equalling the number of participants recruited into the study. In case of multiple groups, we calculated this number across groups. Real-world experiments concerned observational studies that retrospectively evaluated adoption after a patient portal had been deployed in clinical practice. In this case, the number of potential users were all eligible patients in the clinical context of interest who should have been offered access to the portal.

One author (PF) extracted the data and performed the data synthesis for all studies. Uncertainties during the data extraction process were addressed and resolved by discussion with a second member of the research team (SvdV).

Data synthesis and analysis

We organised results according to study type. We calculated the mean adoption rate and 95% confidence interval (CI), both overall and stratified for study type. We also conducted a random-effects meta-regression analysis to evaluate the influence of the study and patient portal characteristics on adoption rates using the *metafor* R package [32]. Prior to the regression analysis, we performed a logit transformation on adoption rates reported in the included studies [33]. From the meta-regression coefficients estimates, we calculated Odds Ratios (ORs) and 95% CI. Furthermore, as prescribed by Stevens *et al.* [33], coefficients estimates were back-transformed to the proportional scale by using the mean adoption rate across all studies as anchor value. This gave us the estimated effect of each model covariate in a study with an avarage adoption rate.

Results

Figure 1 shows the flow diagram of our screening and selection process that yielded 40 relevant studies.

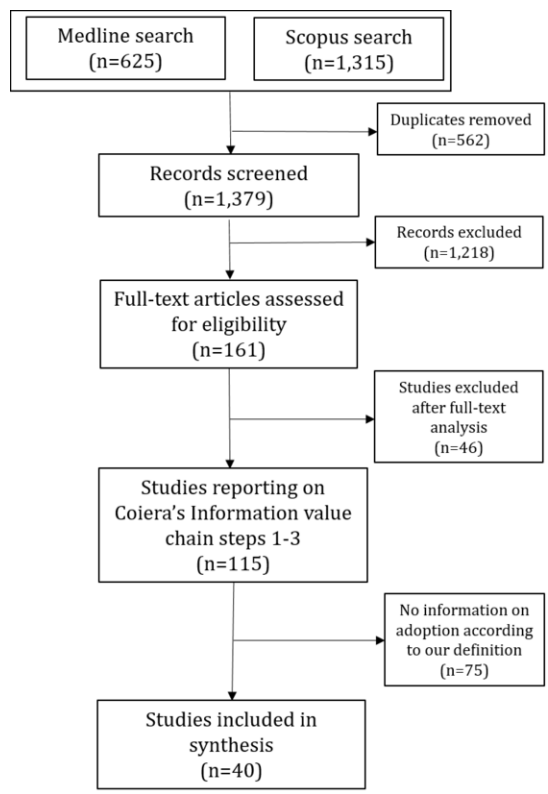

Figure 1 - Flow diagram of selecting relevant studies.

Study characteristics

Table 1 presents the general characteristics of included studies (extracted information and the full reference for each indvidual study is available at [27]). We identified 24 controlled and sixteen real-world experiments. The majority of included studies were published after 2010, conducted in the United States, and had a duration of 1 to 2 years. The vast majority of patient portals under evaluation provided some kind of access to patients' EHR as well as to data recording functionalities. Overall, the two study types had similar characteristics, with the main difference being the number of potential portal users. In particular, we found smaller numbers of potential users in controlled compared to real-world experiments, with the majority reporting values below 1,000 and above 10,000 people, respectively.

Table 1 - Characteristics of included studies and patient portal functionalities (N=40).

	Controlled experiments (N=24)	**Real-world experiments (N=16)**
Year of publication		
< 2005	2 (8)	/
2005 to 2010	5 (21)	4 (25)
> 2010	17 (71)	12 (75)
Geographical location		
United States	17 (71)	11 (69)
Europe	4 (17)	4 (25)
Other	3 (13)	1 (6)
Study population		
Patients with a specific condition	7 (29)	6 (38)
General population	6 (25)	3 (19)
Primary care	6 (25)	6 (38)
Other	5 (21)	1 (6)
Number of potential users [a)]		
<100	8 (33)	/
100 to 1,000	13 (54)	1 (6)
1,000 to 10,000	2 (8)	5 (31)
> 10,000	1 (4)	10 (63)
Study length		
<1 year	8 (33)	2 (13)
1 to 2 years	13 (54)	9 (56)
> 2 years	2 (8)	5 (31)
Main patient portal functionalities [b)]		
Data access	20 (83)	15 (94)
Data recording	18 (75)	12 (75)
Data sharing	10 (42)	6 (38)

[a)] *Calculated as: number of patients recruited into the study for controlled experiments; number of people eligible to be offered access to the patient portal for real-world experiments.*

[b)] *Categories are not mutually exclusive.*

Strategies to increase adoption in real-world experiments

Five of sixteen (31%) real-world experiments did not report any strategy to promote adoption. The remaining eleven reported a range of strategies aimed at increasing patient portal adoption rates. In five studies, eligible patients were directly invited (i.e. via mail or staff) or provided with system credentials that they only had to activate. Four studies disseminated promotional material to raise people's awareness of the portal via different channels, such as flyers and posters in waiting areas, directed electronic mailings or via staff. In three studies, computers were available in clinical settings for patients to access the portal. Lastly, two offered user training, one had personnel available onsite to support patients with using the portal, and one offered a help desk service.

Patient portal adoption rates

The overall mean adoption rate across all included studies was 52% (95% CI, 42 to 62%). When stratifying for study type, controlled experiments had a mean adoption rate of 71% (95% CI, 64 to 79%), compared to 23% (95% CI, 13 to 33%) for real-world experiments.

The results from the meta-regression are shown in Table 2. Study type was the only statistically significant covariate in the model after adjusting for all other study and patient portal characteristics. In particular, the OR for controlled versus real-world experiments was 10.8 (95% CI 3.2 to 36.3). This would translate to a difference in adoption rate of 40% (95% CI, 26 to 46%).

Table 2 - Estimates of ORs for adoption and change in adoption rate (%). Bold coefficients are stastically significant.

Study characteristics and portal functionalities	**ORs [95% CI]**	**Change in adoption (%) [a)] [95% CI]**
Study length (per year increase)	0.7 [0.4,1.4]	-7 [-21,8]
Study type		
Real-world experiment (reference category)		
Controlled experiment	**10.8 [3.2,36.3]**	**40 [26,46]**
Publication year		
<2005 (reference category)		
2005 to 2010	0.4 [0.0,7.0]	-24 [-50,36]
>2010	1.0 [0.1,18.7]	0 [-46,43]
Geographical location		
Others (reference category)		
United States	1.3 [0.3,5.9]	7 [-27,34]
Study population		
General population (reference category)		
Patients with a specific condition	0.7 [0.1,4.2]	-7 [-39,30]
Primary care patients	0.7 [0.1,3.6]	-9 [-39,28]
Other	1.4 [0.2,9.5]	8 [-34, 39]
Patient portals functionalities [b)]		
Data access provided	0.5 [0.1,3.3]	-17 [-45,26]
Data recording provided	0.6 [0.1,2.2]	-14 [-38,19]
Data sharing provided	1.9 [0.5,7.9]	16 [-18,38]

Abbreviations: CI, Confidence interval; ORs, Odds ratios.

[a)] *Change in adoption for a study with underlying adoption rate equal to 52% (i.e. mean value across all included studies).*

[b)] *Each of the three functionalities was included in the model as a binary variable, with 'Data access/recording/sharing not provided' as the reference category.*

Discussion

Summary of the findings

We performed a systematic review of the literature and a meta-analysis of adoption rates of patient portals. The overall mean adoption rate was 52% (95% CI, 42 to 62%). Despite the majority of real-world experiments reporting the use of strategy to promote adoption, rates evaluated in real life were markedly lower compared to those evaluated in controlled experiments (23 and 71%, respectively); most of the other study characteristics and patient portal functionalities were similar between study types. A meta-regression analysis confirmed these findings.

Relation to other studies

Our meta-analysis is the first comprehensive, systematic review of studies reporting patient portal adoption rates. We are also the first to provide a summary statistic of adoption rates across individual studies, while quantifying the influence of study type and other characteristics on the rates reported.

Our findings complement what was found by Irizarry *et al*. [2]. Whereas they reported on the barriers to adoption of patient portals (i.e. involving personal characteristics, system usability, provider endorsement and security), our study provides evidence on the size of the problem of suboptimal adoption.

Our study confirms what was suggested by Giardina *et al.* [15] in their systematic review of randomised controlled trials (RCTs) of patient portals, who hypothesised that evaluation of adoption in clinical practice may give different results from those obtained in RCTs. Two main reasons may underly their hypothesis. First, patients who agree to participate in this type of study are generally interested in and motivated to use the patient portal [34]. Second, patients who are recruited for a research study know that their actions will be studied, which is likely to change participants' behaviours (i.e. Hawthorne effect). Both reasons may increase the levels of adoption.

What is the meaning of the findings and what are their implications?

In the studies that we labelled real-world experiments, it was more difficult to assess the denominator than in controlled experiments. For the former, the denominator was commonly set as the largest group of patients who could have used the portal, while for the latter it was the number of patients to whom the portal was actively offered as part of the study. Due to this difference in counting, real-world experiments were more likely to have lower adoption rates, which may have resulted in our overestimating the difference between the two study types.

As prescribed by Coiera's information value chain [20], to increase the probability of improving care processes and health outcomes we first need to ensure that the previous steps in the chain have been taken successfully. Our study showed that when deployed in a real-world context, most patient portals failed to obtain high adoption rates. It is noteworthy that our findings were based on a rather crude definition of adoption (i.e. at least one login or activated account during the study period). However, in order for patients to receive substantial information from portals that might affect their decisions, more may be required than just activating a user account or logging in only once. Furthermore, applying a more sophisticated definition of adoption (e.g. logging in multiple times over a sustained period of time) is expected to have resulted in even lower adoption rates for both study types.

Low adoption rates were obtained despite real-world experiments reporting to have used active strategies to maximise enrolment and facilitate portal use. Therefore, the problem might not only be related to if and how patient portals are promoted, but also to whether patients consider portals relevant for self-managing their condition in everyday life. In this regard, a positive example comes from Kaiser Permanente, which was the only real-world experiment obtaining high adoption rates (i.e. 62%) in a large population [35]. Kaiser Permanente is the most widely used privately owned patient portal in the world [36]. They have their patient portal at the centre of their business model. Patients, in addition to gaining access to their EHRs, can use the platform to download documents and forms necessary to use Kaiser Permanente services [35]. A previous study further showed how patient-centeredness and making information actionable are other main components of their success [37].

Limitations

This systematic review has two main limitations. First, some steps of the review process were not performed by two independent researchers. Therefore, these steps might have been more prone to errors than others; it was up to the discretion of the primary reviewer to discuss items that were less straightforward to extract and required more interpretation. Second, with 40 studies included, the meta-regression analysis might have been underpowered to detect statistically significant effects for factors other than the study type. However, as shown in Table 1, study characteristics were similar between the two types of studies; therefore we do not expect this to have influenced our results.

Conclusion

Overall, studies on patient portals found that half of the targeted population adopted the intervention. However, this number was markedly lower when evaluated in real-world experiments, with only one in four patients adopting the portal once deployed in clinical practice. Therefore, patient portals are unlikely to influence clinical endpoints in a real-world setting. Future studies in this field should focus on identifying factors and processes that positively affect adoption of patient portals in clinical practice.

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References

[1] C. L. Goldzweig et al., Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review., *Annals of internal medicine* 159(10) (2013): 677–87.
[2] T. Irizarry, A. DeVito Dabbs, and R. C. Curran, Patient Portals and Patient Engagement: A State of the Science Review, *J Med Internet Res* 17(6) (2015): e148.
[3] C. Pearce and M. Bainbridge, A personally controlled electronic health record for Australia., *Journal of the American Medical Informatics Association : JAMIA* 21(4) (2014): 707–13.
[4] Institute of Medicine (USA), Achieve Meaningful use - Stage 2. http://www.healthit.gov/providers-professionals/step-5-achieve-meaningful-use-stage-2 .
[5] S. Urowitz et al., Is Canada ready for patient accessible electronic health records? A national scan., *BMC medical informatics and decision making* 8(1) (2008): 33.
[6] C. Pagliari, T. Shand, and B. Fisher, Embedding online patient record access in UK primary care: a survey of stakeholder experiences, *JRSM Short Reports* 3(5) (2012): 34.
[7] B. Fisher, Patients' access to their electronic record: offer patients access as soon as you can., *The British journal of general practice : the journal of the Royal College of General Practitioners* 63(611) (2013): e423-5.
[8] J. Adler-Milstein et al., A Comparison Of How Four Countries Use Health IT To Support Care For People With Chronic Conditions., *Health affairs (Project Hope)* 33(9) (2014): 1559–66.
[9] C. S. Kruse et al., Patient and Provider Attitudes Toward the Use of Patient Portals for the Management of Chronic Disease: A Systematic Review, *Journal of Medical Internet Research* 17(2) (2015): e40.
[10] M. Price et al., Conditions potentially sensitive to a Personal Health Record (PHR) intervention, a systematic review, *BMC Medical*

Informatics and Decision Making 15 (2015): 32.
[11] M. Price et al., Conditions potentially sensitive to a Personal Health Record (PHR) intervention, a systematic review, *BMC Medical Informatics and Decision Making* 15(1) (2015): 1–12.
[12] D. Wiljer et al., The anxious wait: assessing the impact of patient accessible EHRs for breast cancer patients., *BMC medical informatics and decision making* 10(1) (2010): 46.
[13] C. Bartlett, K. Simpson, and A. N. Turner, Patient access to complex chronic disease records on the Internet., *BMC medical informatics and decision making* 12 (2012): 87.
[14] E. Ammenwerth, P. Schnell-Inderst, and A. Hoerbst, The impact of electronic patient portals on patient care: a systematic review of controlled trials., *Journal of medical Internet research* 14(6) (2012): e162.
[15] T. Davis Giardina et al., Patient access to medical records and healthcare outcomes: a systematic review., *Journal of the American Medical Informatics Association : JAMIA* 21(4) (2014): 737–41.
[16] S. de Lusignan et al., Patients' online access to their electronic health records and linked online services: a systematic interpretative review., *BMJ open* 4(9) (2014): e006021.
[17] F. Mold et al., Patients' online access to their electronic health records and linked online services: a systematic review in primary care, *British Journal of General Practice* 65(632) (2015): e141–e151.
[18] C. S. Kruse, K. Bolton, and G. Freriks, The effect of patient portals on quality outcomes and its implications to meaningful use: A systematic review, *Journal of Medical Internet Research* 17(2) (2015).
[19] A. W. Kushniruk and V. L. Patel, Cognitive and usability engineering methods for the evaluation of clinical information systems, *Journal of Biomedical Informatics* 37(1) (2004): 56–76.
[20] Enrico Coiera, *Guide to Health Informatics* (CRC Press, 2015).
[21] S. G. Smith et al., Disparities in registration and use of an online patient portal among older adults: findings from the LitCog cohort, *Journal of the American Medical Informatics Association : JAMIA* 22(4) (2015): 888–895.
[22] D. Masys et al., Giving patients access to their medical records via the internet: The PCASSO experience, *Journal of the American Medical Informatics Association* 9(2) (2002): 181–191.
[23] G. R. Phelps et al., Patients' Continuing Use of an Online Health Record: A Quantitative Evaluation of 14,000 Patient Years of Access Data, *J Med Internet Res* 16(10) (2014): e241.
[24] A. Zweben, L. M. Fucito, and S. S. O'Malley, Effective Strategies for Maintaining Research Participation in Clinical Trials, *Drug information journal* 43(4) (2009): 10.1177/009286150904300411.
[25] C. K. Yamin et al., The digital divide in adoption and use of a personal health record, *Archives of Internal Medicine* 171(6) (2011): 568–574.
[26] A. Liberati et al., The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration., *PLoS medicine* 6(7) (2009): e1000100.
[27] Paolo Fraccaro et al., Supplementary material for "Patient portal adoption rates: a systematic literature review and meta-analysis." http://doi.org/10.5281/zenodo.439927 .
[28] J. A. Bargas-Avila and K. Hornbæk, Old Wine in New Bottles or Novel Challenges: A Critical Analysis of Empirical Studies of User Experience, *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2011): 2689–2698.
[29] C. Y. Osborn et al., Patient Web Portals to Improve Diabetes Outcomes: A Systematic Review, *Current diabetes reports* 10(6) (2010): 422–435.
[30] K. Hornbæk, Current practice in measuring usability: Challenges to usability studies and research, *International Journal of Human-Computer Studies* 64(2) (2006): 79–102.
[31] P.-Y. Yen and S. Bakken, Review of health information technology usability study methodologies, *Journal of the American Medical Informatics Association : JAMIA* 19(3) (2012): 413–422.
[32] W. Viechtbauer, Conducting Meta-Analyses in R with the metafor Package, *Journal of Statistical Software; Vol 1, Issue 3 (2010)* (2010).
[33] S. Stevens et al., Analysing indicators of performance, satisfaction, or safety using empirical logit transformation, *BMJ* 352 (2016).
[34] J. A. Casey et al., Using Electronic Health Records for Population Health Research: A Review of Methods and Applications, *Annual Review of Public Health* 37(1) (2016): 61–81.
[35] N. P. Gordon and M. C. Hornbrook, Differences in access to and preferences for using patient portals and other ehealth technologies based on race, ethnicity, and age: A database and survey study of seniors in a large health plan, *Journal of Medical Internet Research* 18(3) (2016).
[36] L. W. Johnson et al., Successful Practices in the Use of Secure E-mail, *Permanente Journal* 18(3) (2014): 50–54.
[37] T. Otte-Trojel et al., The organizational dynamics enabling patient portal impacts upon organizational performance and patient health: a qualitative study of Kaiser Permanente, *BMC Health Services Research* 15(1) (2015): 1–12.

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