

Objective Assessment of Functional Information Requirements for Patient Portals

Mahnoosh Sadeghi, Rachal Thomassie, Farzan Sasangohar
Industrial and Systems Engineering, Texas A&M University, College Station, TX

There has been an increase in the usage of electronic health records by healthcare providers as a result of recent federal incentive programs. One benefit of electronic systems is providing patients remote access to their records and an online interface with their healthcare provider via a patient portal. Patients, however, have been slow to adopt these systems and many studies have been conducted in attempts to investigate such slow adoption. It is not clear if the users were involved in the design of such systems and if the functionality meets user expectation. This paper aims to address this issue by documenting a comprehensive and systematically-derived set of functional and information requirements for patient portals based on a review of literature and interviews with patients.

INTRODUCTION

Over the last decade, federal legislation has been passed offering incentives to healthcare providers who demonstrate meaningful use of health information technologies, specifically electronic health records (Ancker et al., 2015; Bowes, 2010). Transformation from a paper-based system to an electronic system enables access to patients' personal health records along with other services through an online system known as a patient portal. Such system may provide information such as test results, notes written by a healthcare provider, visit history or a list of prescribed medications. The system can also be used to communicate with a healthcare provider, schedule appointments and upload or record health records. Stage 2 of the legislation in effect from 2015-2017, requires providers to demonstrate actual use of the system by 5% of their patients (Ancker et al., 2015). While seemingly an innovative, highly convenient and value-added system, the portal's full potential has yet to be reached (Alpert, Krist, Aycock & Kreps, 2016). Various patient portal systems are currently being used by providers in the United States and these systems are continuously being studied for improvements in an effort to enhance usability and increase patient adoption. Studies typically focus on the human-computer interface (display design), literacy effects on ability and time to complete tasks, or system usage through data analysis. All of these areas are important considerations in determining why patients do not adopt patient portal. The aim of this study is to investigate the information and functions expected to be in a patient portal based upon a systematic literature review and patient feedback to be able to inform the design of future patient portals.

METHOD

A mixed-methodology approach was used in this study. To gather a set of functions and information that patients expect from a patient portal, a literature review and interviews with patients were conducted. This data was then transformed into a set of requirements using a novel method called Functional and Information Requirements (FIR). FIR is a

method to derive an objective set of requirements in terms of feedback from the system and input from the user. It consists of identification of high-level functionality of the system which are then decomposed into medium- or low-level functions from which specific information requirements are derived. A high-level function accommodates general tasks of the system. A low-level function encompasses more detailed functions. The paramount element of FIR is the information requirements. Information requirements identify vital information needed to be displayed to users or provided as input by the users of the system.

Literature Review

A systematic literature review was conducted to investigate the previous research for factors that need to be considered in the design of a patient portal system to improve usability and increase patient participation. OvidMedline, PubMed, Cochrane, and Google Scholar were searched using a combination of keywords. The initial search yielded 2043 articles. After removing duplicates and applying the exclusion criteria, 27 articles were selected for review. Only papers written in English were included. Search terms are shown in Table 1.

Patient Interviews

In order to collect information about patient expectations from patient portals, a semi-structured interview was conducted. A group of 10 participants were recruited from students and staff population at Texas A&M University (M = 34 years; Range = 18-68 years; SD = 14 years). A verbal protocol was used to recruit participants which included a short introduction of the project to elicit participation. Participants were asked to read and sign a consent form that provided details for the study objectives, procedure, and risks and benefits associate with the study and were given a chance to ask clarifying questions. The protocol was approved by Texas A&M University's Institutional Review Board (IRB).

Table 1: Search terms, databases, and number of results found

Database	Search Terms	Results
PubMed	“Electronic health records” and “software design” [MeSH Terms]	123
PubMed	“Personal electronic health records” and “computer software”	183
Cochrane	“Electronic health records” and “software design” [MeSH Terms]	12
Cochrane	“Patient participation” and “electronic health records” and “user-computer interface” and “software design” [MeSH Terms]	0
Ovid Medline	“Patient portal” and “usability” [keyword]	2
Google Scholar	“Usability” and “hospital” and “patient portal use”, excluding “web-based”	36
PubMed Medline	1. exp health records, personal/ or exp electronic health records/ 2. (patient adj1 portal*).ti,ab. 3. or/1-2 4. exp User-Computer Interface/ or exp Human Engineering/ 5. (usabilit* or functionalit*).ti,ab. 6. (user adj1 test*).ti,ab. 7. exp "Patient Participation"/ 8. exp "Patient Access to Records"/ 9. "Attitude to Computers"/ 10. exp Patient Satisfaction/ 11. or/4-10 12. 3 and 11 13. limit 12 to yr="2010 -Current" 14. limit 13 to English language 15. limit 12 to English language	1671

Interviews were semi-structured and user-centered. Participants were asked to respond to 10 questions. Most questions were open-ended followed by probing questions. Three categories of questions were used:

- 1- Prevalence of the usage in terms of exposure to patient portals and frequency of usage;
- 2- Context of patient portal usage; and
- 3- Users' expectations in terms of functionality and display features

RESULTS

While the detailed findings of the literature review are beyond the scope of this short paper, three themes in literature were found: software user interface (usability) as applied to display design, comprehension of information delivered as a function of literacy levels, and studies on the demographics of people accessing the software (patient participation). The findings from the literature review and patient interviews were used to conduct a Functional Information Requirements analysis to derive a set of requirements for patient portals.

The first high-level functional requirement was *communication with the clinic/hospital*. The majority of participants asked for a function that allows them to communicate with their health care provider. In addition, from literature reviews it was identified that patients prefer to receive audio messages from the healthcare provider (Tieu et al., 2016). Communication with the clinic/hospital consists of:

text message functionality, other online messaging, calls to and from hospital and patient-provided feedback regarding the system. Low level functions are decomposed into information requirements such as patient's contact number for the text option. Patient's email address, audio input path, as well as a path for asking questions should be covered for online messaging system (Table 2).

Table 2: High Level Function-Communicate with the clinic

	High Level	Low Level	Information Requirements
Communicate with the clinic/hospital		Texting option	Patient's contact number
		Online messaging system: Chat	Ask questions path(Emergency/Regular)
		Online messaging system: Email	Patient's Email address
		Online messaging system: Recording audios	Audios' input path
		Calls to and from hospital	Hospital's phone numbers
		Patient-provided feedback regarding system	Patient's feedbacks

The next high level function was *document and access medical history*. According to Marchionini, Rimer & Wildemuth (2007), being able to access medications through patient portal is important to patients. Many patients are not familiar with terms included in their prescriptions and medical terminologies are identified as barriers to use (Alper et al., 2016). Providing interpretations of medical terminologies is expected by patients. Besides, a great number of interviewees demanded access to their documents and medical history. Medical records are lasting evidence of hospital stay. Almost all hospitals charge patients to provide them a copy of their medical history. Patient portal may provide an ability of obtaining all healthcare documents without charging patients. The ability to merge all health documents was desired by participants (Table 3).

The third high level function was *scheduling*. One of the integral high-level tasks which was demanded by the majority of interviewees is being able to make appointments through patient portal. By means of this function, visits to hospitals may be reduced. While most patient portals provide this function; it was alluded to in the interviews that the information provided in the patient portal for this function is not ample (Table 4).

Assessing information is another high-level function that is desired in a patient portal. This information may apprise patients about their general health and provide frequently asked questions and forums in which doctors respond to questions (Table 5).

Both literature reviews and interviews showed the importance of *Privacy* for patients. Hospitals should provide a secure interface which protects patients' information and documents. Many patients mentioned they are uncomfortable accessing medical records electronically due to privacy issues (Table 6).

Table 3: Document and access medical history

High Level	Low Level	Information Requirements
Document and Access Medical History	Access results	-Tests completed -Lab results/diagnostic results -Medical terminology -Interpretation of lab results
	Appointments history/view appointments	-List of new appointments -Appointment history
	View medicines	-Medication history -Medication instructions
	Viewing records history	-History of surgeries
	Viewing treatments	-Actions to take to ease symptoms -Any suggestion from the physician
	Connect to Other Patient Portals (being able to merge medical history from multiple providers)	-Merged information path -Patient's log in information -Policies

Table 4: Scheduling

High Level	Low Level	Information Requirements
Scheduling	Choosing healthcare provider	List of available healthcare providers
	choose health care location	List of healthcare locations
	Designate type of appointment	-Type of appointment (test/visit/emergency)
	Choosing time and date	-Appointment verification-- Preferred time -Appointment verification: Preferred date
	Choosing clinician	-List of clinicians' names with - Professional degree -Availability

Upload documents is identified as a high-level function for patient portals. Uploading documents online is a simplistic and fast approach to share documents with health care provider. This functionality enables patients to transfer their records to the hospital and have virtual access to them without the need for paper storage (Table 7).

Majority of participants asked for a high-level function which enables them to make their *payments* online. It is expected that a patient portal will empower users to achieve this goal. Making it simple and feasible for patients to pay fees is crucial for improving efficiency of patient portals (Table 8).

Notifications and reminders are ways to encourage users to check their portal for updates and informs the users about important changes. Patients requested a notification tab to be informed about the news and recent changes in their portals (Table 9).

Table 5: Access Information

High Level	Low Level	Information Requirements
Accessing Information	Provide personal information	-Personal Information (Name-Date of birth, etc.)
	Provide general information	-Age Concerns (Aging associated diseases and solutions) -Health status -Recommended diet -Some general information about the portal and the hospital (e.g., About us)
	Provide emergency information	-Emergency steps needed to be taken right now -Severity of the illness
	Provide Frequently Asked Questions (FAQs) & forum	-Frequently asked questions and answers -Automated tool if symptoms are common

Table 6: Privacy

High Level	Low Level	Information Requirements
Privacy	View confidential documents	-A note from the hospital that shows the information will be confidential. -Privacy Policy (HIPAA) -A consent form to sign

Table 7: Upload Documents

High Level	Low Level	Information Requirements
Upload Documents	Documents input	-Documents input path
	Input symptoms of the disease	-Symptoms of disease (input) -Disease information (feedback)

Table 8: Pay Bill

High Level	Low Level	Information Requirements
Pay Bill	Online payment	-Healthcare Cost -Balance -The amount of payment that is covered by the insurance
	Input insurance information	-Insurance information (plan, group number, etc.)

Table 9: Reminders & Notifications

High Level	Low Level	Information Requirements
Reminders & Notifications	Reminders	-Upcoming appointments -Next follow up -Outstanding balance
	Notifications	-Updates to portal -Upcoming appointment -Payment confirmation

Some patient portals have a registration procedure prior to first-time use and require an access code for registration. In order to register, patients must receive an access code from their healthcare provider for *secure access*. Literature review revealed several studies that have been conducted that analyze historical data to determine: the number of patients that actually received an access code from their doctor, of these, the number that registered, and of these, the number of times the patient accessed the system (Ancker et al., 2011; Ralston

et al., 2007 & Smith et al., 2015). An analysis was done to determine if there was a pattern in the demographic of patients who received an access code as well as the ones who accessed the system more than one time (Ancker et al., 2011). It was found that out of approximately 74,000 low-income, ethnically diverse adults, only 16% were given an access code by their provider. Of these, 60% activated their account, and 81% accessed the portal more than twice over a two-year period. Those more likely to receive an access code were young, white, women, English-speaking patients and patients with a chronic condition. In a study by Smith et al. (2015), 534 middle-aged patients were analyzed. An overwhelming 93% were given an access code and 57.5% activated their account. Patients who were white, male, educated, had an adequate health literacy or had a chronic condition were more likely to register. Disparities here may result from the population sampling and differing procedures by healthcare providers in giving access codes to patients. In addition, users given an access code may not complete the steps to register. The registration process has proven difficult for users with limited computer experience (Fernandez-Aleman, Seva-Llor, Toval, Ouhbi & Fernandez-Luque, 2013 & Haggstrom et al., 2011). Older population of low income, ethnically-diverse adults is less likely to access the portal. They tend to have less familiarity with computers and do not want to learn something new. Many do not even own a computer (Table 10).

Table 10: Secure Access

High Level	Low Level	Information Requirements
Secure Access to System	Log in	-Username -Password
	Sign up	-Email address -Username -Address -Personal identifier
	Reset password	-User name -Email address -Password reset instructions
	Website updates	-Last update date (Website update)

Help feature is the last high level function for the Functional Information Requirements. Help feature should be supplied in the portal to make it easier for the patients to operate the system (Table 11).

Table 11: Help Feature

High Level	Low Level	Information Requirements
Help Feature	Navigation	Site map
	Contacting portal support	contact information (numbers, emails, address)

DISCUSSION

The Functional Information Requirements is a user-centered and design independent method that results in a systematically-derived set of requirements which can inform

future design and improvements to existing patient portal systems. An important benefit of using the FIR method is identification of specific pieces of information required as an input to the system and feedback to the user to aid the design of user interfaces for such portals. This approach will also facilitate task analysis efforts due to functional decomposition involved.

A major limitation of the interview study was small sample size. Larger samples may provide a wider range of responses and a richer set of requirements. However, even with such a relatively small sample, the results were saturated. In particular, after interviewing the sixth person, answers were redundant and repeated answers were given.

The work is in progress to compare several major patient portals with the derived information requirements to identify opportunities for improvement of user interaction. Information in an actual patient portal should be compatible with user-expected FIR. Future studies include heuristics analysis and usability testing of existing patient portal systems to ensure user expectations are met. Heuristics analysis will evaluate features of existing systems against established principles and result in a set of recommendations for change. In an iterative design process design changes can be evaluated in formative usability tests to ensure the design meets the user needs.

CONCLUSION

Design guidelines for patient portals and systematic evaluation of such systems are largely absent in the literature. Due to the importance of these systems and costly implications to hospitals, it is timely to evaluate the design requirements for such systems in a user-centered fashion. In the absence of objective assessment of user needs, designs may not meet the expectations of patients. This paper documented the findings from a literature review as well as patient interviews conducted to build functional information requirements that represent a set of user-expected information elements that should be present in the patient portals. Such analysis shows promise in informing future design of patient portal systems ensuring that user expectations are met and will eventually contribute to increased adoption and usage of these systems.

REFERENCES

Abramson, E. L., Patel, V., Edwards, A., & Kaushal, R. (2014). Consumer perspectives on personal health records: A 4-community study. *American Journal of Managed Care*, 20(4), 287-296.

Alban, C., Enghahl, K., Teague, R. (2016). Vendors provide advice on EMR usability. *ED Management*, 28(4), 44-47.

Alpert, J. M., Krist, A. H., Aycock, R. A., & Kreps, G. L. (2016). Applying multiple methods to comprehensively evaluate a patient portal's effectiveness to convey information to patients. *Journal of Medical Internet Research*, 18(5), e112.

- Ancker, J. S., Barrón, Y., Rockoff, M. L., Hauser, D., Pichardo, M., Szerencsy, A., et al. (2011). Use of an electronic patient portal among disadvantaged populations. *Journal of General Internal Medicine*, *26*(10), 1117-1123.
- Ancker, J. S., Osorio, S. N., Cheriff, A., Cole, C. L., Silver, M., & Kaushal, R. (2015). Patient activation and use of an electronic patient portal. *Informatics for Health & Social Care*, *40*(3), 254-266.
- Borycki, E., Kushniruk, A., Nohr, C., Takeda, H., Kuwata, S., Carvalho, C., et al. (2013). Usability methods for ensuring health information technology safety: Evidence-based approaches. contribution of the IMIA working group health informatics for patient safety. *Yearbook of Medical Informatics*, *8*, 20-27.
- Bowes, W. A. (2010). Assessing readiness for meeting meaningful use: Identifying electronic health record functionality and measuring levels of adoption. *AMIA ...Annual Symposium Proceedings/AMIA Symposium, 2010*, 66-70.
- Czaja, S. J., Zarcadoolas, C., Vaughn, W. L., Lee, C. C., Rockoff, M. L., & Levy, J. (2015). The usability of electronic personal health record systems for an underserved adult population. *Human Factors*, *57*(3), 491-506.
- Ertmer, A., & Uckert, F. (2005). User acceptance of and satisfaction with a personal electronic health record. *Studies in Health Technology & Informatics*, *116*, 861-866.
- Fernandez-Aleman, J. L., Seva-Llor, C. L., Toval, A., Ouhbi, S., & Fernandez-Luque, L. (2013). Free web-based personal health records: An analysis of functionality. *Journal of Medical Systems*, *37*(6), 9990-013-9990-z. Epub 2013 Nov 13.
- Goel, M. S., Brown, T. L., Williams, A., Cooper, A. J., Hasnain-Wynia, R., & Baker, D. W. (2011). Patient reported barriers to enrolling in a patient portal. *Journal of the American Medical Informatics Association: JAMIA*, *18*(Suppl 1), 8-12.
- Goel, M., & Sarkar, U. (2011). No patient left behind: Ensuring health care equity in health IT. *Intern Med*, *26*(10), 1112-1116.
- Haggstrom, D. A., Saleem, J. J., Russ, A. L., Jones, J., Russell, S. A., & Chumbler, N. R. (2011). Lessons learned from usability testing of the VA's personal health record. *Journal of the American Medical Informatics Association*, *18*(Suppl 1), 13-17.
- Kaelber, D. C., Jha, A. K., Johnston, D., Middleton, B., & Bates, D. W. (2008). A research agenda for personal health records (PHRs). *Journal of the American Medical Informatics Association: JAMIA*, *15*(6), 729-736.
- Latulipe, C., Gatto, A., Nguyen, H. T., Miller, D. P., Quandt, S. A., Bertoni, A. G., et al. (2015). Design considerations for patient portal adoption by low-income, older adults. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, pp. 3859-3868.
- Laxman, K. (2015). Barriers to adoption of consumer health informatics applications for health self-management. *Health Science Journal*, *9*(5).
- Louise Barriball, K., & While, A. (1994). Collecting Data using a semi-structured interview: a discussion paper. *Journal of Advanced Nursing*, *19*(2), 328-335.
- Marchionini, G., Rimer, B. K., & Wildemuth, B. (2007). Evidence base for personal health record usability: Final report to the national cancer institute. *University of North Carolina at Chapel Hill*.
- Nazi, K. M. (2010). Veterans' voices: Use of the american customer satisfaction index (ACSI) survey to identify my HealtheVet personal health record users' characteristics, needs, and preferences. *Journal of the American Medical Informatics Association: JAMIA*, *17*(2), 203-211.
- Neuner, J., Fedders, M., Caravella, M., Bradford, L., & Schapira, M. (2015). Meaningful use and the patient portal: Patient enrollment, use, and satisfaction with patient portals at a later-adopting center. *American Journal of Medical Quality: The Official Journal of the American College of Medical Quality*, *30*(2), 105-113.
- Ralston, J. D., Carrell, D., Reid, R., Anderson, M., Moran, M., & Hereford, J. (2007). Patient web services integrated with a shared medical record: Patient use and satisfaction. *Journal of the American Medical Informatics Association*, *14*(6), 798-806.
- Schiza, E. C., Neokleous, K. C., Petkov, N., & Schizas, C. N. (2015). A patient centered electronic health: EHealth system development. *Technology & Health Care*, *23*(4), 509-522.
- Schneider, S., Kerwin, J., Robins, C., & Dean, D. (2009). Consumer engagement in developing electronic health information systems: Final report. *Rockville: AHRQ*.
- Smith, S. G., O'Conor, R., Aitken, W., Curtis, L. M., Wolf, M. S., & Goel, M. S. (2015). 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*, *22*(4), 888-895. doi:10.1093/jamia/ocv025
- Taha, J., Czaja, S. J., Shark, J., & Morrow, D. G. (2013). Factors affecting usage of a personal health record (PHR) to manage health. *Psychology and Aging*, *28*(4), 1124-1139.
- Taha, J., Sharit, J., & Czaja, S. (2014). The impact of numeracy ability and technology skills on older adults' performance of health management tasks using a patient portal. *Journal of Applied Gerontology*, *33*(4), 416-436.
- Tang, P. C., Ash, J. S., Bates, D. W., Overhage, J. M., & Sands, D. Z. (2006). Personal health records: Definitions, benefits, and strategies for overcoming barriers to adoption. *Journal of the American Medical Informatics Association: JAMIA*, *13*(2), 121-126.
- Tieu, L., Schillinger, D., Sarkar, U., Hoskote, M., Hahn, K. J., Ratanawongsa, N., et al. (2016). Online patient websites for electronic health record access among vulnerable populations: Portals to nowhere? *Journal of the American Medical Informatics Association: JAMIA*, *24*(e1), e47-e54.
- Zarcadoolas, C., Vaughn, W. L., Czaja, S. J., Levy, J., & Rockoff, M. L. (2013). Consumers' perceptions of patient-accessible electronic medical records. *Journal of Medical Internet Research*, *15*(8), e168. doi:10.2196/jmir.2507