Usability of Web-based Personal Health Records: An Analysis of Consumers' Perspectives

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Abstract

Personal health records (PHRs) have many benefits, including the ability to increase involvement of patients in their care, which provides better healthcare outcomes. Although issues related to usability of PHRs are a significant barrier to adoption, there is a paucity of research in this area. Thus, the researchers explored consumers' perspective on the usability of two commercially available web-based PHRs. Data from the Usefulness, Satisfaction, and Ease of Use questionnaire were collected from a sample of health information management students ($N = 90$). A one-way analysis of variance (ANOVA) showed that Microsoft HealthVault had higher scores in most usability categories when compared to Health Companion. Study results indicated that PHR developers should evaluate Microsoft HealthVault as a model for improving PHR usability.

Keywords: personal health records, web-based, usability, consumer

Background and Significance

The concept of a personal health record (PHR) emerged at the turn of the 21st century with consumers' increasing engagement in activities related to healthcare,[1] but to date no consensus has been reached on the definition of a PHR. The widely cited definition by the Markle Foundation is "an electronic application through which individuals can access, manage, and share their health information, and that of others for whom they are authorized, in a private, secure, and confidential environment."[2] However, numerous other organizations, including the National Committee on Vital and Health Statistics (NCVHS), American Health Information Management Association (AHIMA), Department of Health and Human Services (HHS), and Healthcare Information and Management Systems Society (HIMSS), have also proposed definitions of the PHR. For example, AHIMA defines a PHR as "an electronic, universally available, lifelong resource of health information needed by individuals to make health decisions. Individuals own and manage the information in the PHR, which comes from healthcare providers and the individual. The PHR is maintained in a secure and private environment, with the individual determining rights of access. The PHR is separate from and does not replace the legal record of any provider."[3]

The stage 2 criteria of the Center for Medicare and Medicaid Services incentive program for the meaningful use of electronic health records (EHRs) came into effect in 2014.[4] Significantly, two of the core criteria that addressed patient engagement recommended providing patients with online access to their health information and ensuring secure patient-provider messaging. However, a majority of patients (87 percent) are still using paper-based PHRs instead of electronic PHRs.[5]

Electronic PHR usage by consumers has many benefits. It can help facilitate patients' engagement in their healthcare, which improves the quality of care outcomes and reduces the cost of care delivery.[6] Indeed, a widely cited Institute of Medicine report showed that improving healthcare quality depends on patients' involvement.[7] Similarly, selecting the appropriate PHR platform can expedite EHR adoption and use in the US healthcare sector, which has been shown to have many patient care benefits.[8]

Many scholars have discussed the role of PHRs in promoting better health outcomes by facilitating patient-physician communication[9-11] and by allowing users to manage their own health information.[12] PHRs can be programmed to send reminders to patients to get routine immunizations[13-15] or to schedule a mammography,[16] resulting in higher compliance rates. Moreover, they can support prompt correction of medical record inaccuracies.[17]

There are still several significant barriers to PHR adoption. Customers are concerned about privacy and security issues related to the storage and transmission of PHR data, especially when vendors who are not compliant with Health Insurance Portability and Accountability Act (HIPAA) regulations maintain the PHR data.[18] Interoperability between PHRs and EHRs remains low because of patient concerns, which further impedes adoption of PHRs.[19] This finding is unfortunate because consumer acceptance plays an integral role in increasing providers' use of interoperable EHRs.[20]

The usability of a PHR is critical to the users' adoption of the PHR and to the ability of the PHR to maintain a good consumer market share. To maximize the benefits of PHRs and increase their usage, PHRs must be easy to access and easy for consumers to use.[21] However, the development of new PHRs that address healthcare consumer needs is lagging,[22] and the record-keeping systems of current PHRs are not designed for optimal consumer usability.[23]

PHRs can have many different implementations. They can be paper-based, computer-based, USB-based, or web-based. Several researchers have studied USB-based PHRs.[24,25] Jian et al. surveyed outpatients regarding the adoption factors that most influenced patients' readiness to use a USB-based PHR. Results indicated that usage intentions, perceived usefulness, and subjective norms of people close to the patient were the top three key factors influencing PHR adoption.[26] A related study by Maloney and Wright compared the features of thirteen USB-based PHR products currently in use to the features recommended by certification bodies**.** The researchers determined that none of the USB-based PHRs on the market at the time of the study had all the desired features, and they recommended the adoption of tethered or web-based PHRs.[27] Connecting for Health proposed seven best practices for a PHR, one of which is that "PHRs are to be accessible from any place at any time."[28] Obviously, web-based PHRs are more easily able to meet this criterion, compared to paper records and computer-based or USB-based PHRs, because customers increasingly access the Internet for their healthcare services.

Objective

Many of the previous studies of web-based PHRs have addressed their functionality[29] but not their usability. Thus, a knowledge gap exists in the literature regarding consumers' perspective on the usability of web-based PHRs. To close the gap, this paper will focus on the customers' perspectives on the usability of two web-based PHRs in order to inform the design of future web-based PHR systems.

Materials and Methods

The purpose of this mixed-methods retrospective convenience study was to analyze the perceptions of the usability of two PHR systems from the viewpoint of health information management students at Texas State University in San Marcos, Texas. The study was conducted with a survey approach. Institutional Review Board approval was secured from the university where the study took place. The Usefulness, Satisfaction, and Ease of Use (USE) questionnaire was used for data collection.[30] Respondents' USE questionnaire data was analyzed using the statistical analysis software SPSS.

Participants

The participants in the study were on-campus and online students ($N = 90$) in the bachelor of health information management program who completed the USE questionnaire during the spring of 2013 and 2014. Table 1 shows the demographic characteristics of the participants. There were more on-campus ($n = 51$, 57.3 percent) than online ($n = 38$, 42.7 percent) student participants. The age of the participants ranged from 22 to 59, with an average age of 31 years (SD = 10.63). There were considerably more women (84 percent) than men (16 percent), with one participant not indicating gender. The majority of the participants ($n = 52$, 58 percent) were white (non-Hispanic), while the second largest ethnic group representation ($n = 24$, 37 percent) was Hispanic. The participants are not representative of the public. However, the participants are qualified assessors because they had been educated regarding the characteristics, functional specifications, uses, and challenges of implementing health information systems before enrolling in the course in which they completed the USE surveys.

Table 1: Demographic Characteristics of Participants

Characteristics	*N*	%

Gender		
Male	14	15.7
Female	75	84.3
Ethnicity		
White, non-Hispanic	52	58.4
African American	12	13.5
Hispanic	24	27.0
Asian	1	1.1
Cohort		
Campus	51	57.3
Online	38	42.7

Variables

The independent variable in the study was the type of personal health record that was being evaluated, which was Microsoft HealthVault or Health Companion. The dependent variables in the study were the Likert seven-point scores for each USE question in the four categories on the USE questionnaire.

The selection of PHRs to utilize for the consumer study was modeled on the evaluation framework of previous studies in which participants assessed the functionality of two PHRs, Microsoft HealthVault and Google Health.[31] For the earlier study, the respondents rated features that the researchers derived from a literature review. For this study, the two free, commercially available web-based PHRs Microsoft HealthVault and Health Companion were utilized. Google Health was not used for this study because that system is defunct. The free USE study questionnaire was employed to facilitate less subjective evaluations of the PHRs.

Instrument

Data were collected from the retrospective results of the self-administered USE survey questionnaire, developed by Lund in 2001.[32] The USE survey was designed to allow respondents to subjectively evaluate the usability of a variety of products. The four USE categories, which are Usefulness, Ease of Use, Ease of Learning, and Satisfaction, comprise the 28 Likert-scale questions on the USE questionnaire.[33,34] The questions on the USE questionnaire encouraged the respondents to consider if the PHR being surveyed helped them be more productive and efficient, saved time, was user friendly, was easy to learn to use, and was fun to use.[35] The questions on the USE questionnaire are available at http://hcibib.org/perlman/question.cgi?form=USE.

The internal consistency (i.e., reliability) of the USE questionnaire was established by standard psychometric testing that indicated that the questions in each category contributed equally to the scales.[36] Moreover, factor analyses showed that all questions were needed to explain the PHR's usability.[37]

Procedures

The USE survey was completed as part of a course assignment during the spring 2013 and 2014 semesters. For the assignment, each participant completed two web-based USE questionnaires, one each for Microsoft HealthVault and Health Companion. The USE data were downloaded, and the paper forms were printed out.

The data were abstracted manually from the students' completed USE questionnaires and placed in an Excel spreadsheet. The data were de-identified by assigning an identification number to the participants. The year (2013 or 2014), the cohort (on-campus or online), the PHR (Microsoft HealthVault or Heath Companion), and the ordinal Likert question ratings (1 = strongly disagree, 7 = strongly agree) were coded in the Excel spreadsheet to facilitate quantitative analysis of the Likert scores.

The data were then loaded into SPSS version 23, where the variables were labeled. Data from the three open-ended questions that were part of the assignment but were not a part of the USE questionnaire were also abstracted and were placed in a Microsoft Word document.

Data Analysis

Descriptive statistical analysis was computed using SPSS version 23 to describe the data. The mean, standard deviation, minimum, and maximum of the Likert scores for each question were computed as shown in Table 2.

Table 2: Descriptive Statistics of Dependent Variables

Category		Personal Health Record (PHR) System	*N*	Mean	Standard Deviation	Min	Max
Usefulness	It is useful	Microsoft HealthVault	77	6.06	1.260	1	7
		Health Companion	76	5.49	1.309	1	7
	It does everything I expected	Microsoft HealthVault	77	5.70	1.348	1	7
		Health Companion	76	5.16	1.534	1	7
	It gives me control over activities	Microsoft HealthVault	77	5.47	1.343	1	7
		Health Companion	76	5.25	1.490	1	7
	It makes it easier to accomplish what is needed	Microsoft HealthVault	77	5.31	1.453	1	7
		Health Companion	76	4.57	1.637	1	7
	It helps me be more effective	Microsoft HealthVault	77	5.25	1.416	1	7
		Health Companion	76	4.92	1.505	1	7
	It meets my needs	Microsoft HealthVault	77	5.44	2.224	1	7
		Health Companion	76	4.87	1.695	1	7
	It saves me time	Microsoft HealthVault	77	5.25	1.425	1	7
		Health Companion	76	4.45	1.711	1	7
Ease of Use	It is easy to use	Microsoft HealthVault	76	6.09	1.1333	2	7
		Health Companion	70	4.66	1.817	1	7
	It is simple to use	Microsoft HealthVault	76	6.01	0.959	1	7
		Health Companion	70	4.56	1.682	3	7
	It is user friendly	Microsoft HealthVault	76	5.97	1.143	3	7
		Health Companion	70	4.77	1.787	1	7
	It requires the fewest steps to accomplish what I want	Microsoft HealthVault	76	5.67	1.193	2	7
		Health Companion	70	4.21	1.693	1	7
	It is flexible	Microsoft HealthVault	76	5.46	1.216	2	7
		Health Companion	70	4.81	1.526	1	7
	Using it is effortless	Microsoft HealthVault	76	5.49	1.342	1	7
		Health Companion	70	4.31	1.629	1	7
	I can use it without written instructions	Microsoft HealthVault	76	6.01	1.160	2	7
		Health Companion	70	4.60	1.853	1	7
	I don’t notice any inconsistencies when using	Microsoft HealthVault	76	5.79	1.123	2	7
		Health Companion	70	5.16	1.293	2	7
	Occasional and regular users would like it	Microsoft HealthVault	76	5.67	1.248	3	7
		Health Companion	70	4.87	1.503	2	7

	I can recover from mistakes quickly and easily	Microsoft HealthVault	76	5.76	1.165	1	7
		Health Companion	70	4.93	1.478	1	7
	I can use it successfully every time	Microsoft HealthVault	76	5.70	1.211	1	7
		Health Companion	70	4.80	1.708	1	7
Ease of Learning	I learned to use it quickly	Microsoft HealthVault	77	6.00	1.225	1	7
		Health Companion	75	4.76	1.837	1	7
	I easily remember how to use it	Microsoft HealthVault	77	6.00	1.203	1	7
		Health Companion	75	4.85	1.799	1	7
	It is easy to learn how to use it	Microsoft HealthVault	77	6.03	1.277	2	7
		Health Companion	75	4.67	1.826	1	7
	I quickly became skillful with it	Microsoft HealthVault	77	6.00	1.267	1	7
		Health Companion	75	5.00	2.919	1	7
Satisfaction	I am satisfied with it	Microsoft HealthVault	76	5.64	1.344	1	7
		Health Companion	74	4.84	1.647	1	7
	I would recommend it to a friend	Microsoft HealthVault	76	5.67	1.518	1	7
		Health Companion	74	4.64	1.920	1	7
	It works the way I want it to work	Microsoft HealthVault	76	5.57	1.360	1	7
		Health Companion	74	4.58	1.767	1	7
	I feel I need to have it	Microsoft HealthVault	76	4.25	1.682	1	7
		Health Companion	74	4.07	1.875	1	7
	It is pleasant to use	Microsoft HealthVault	76	6.11	1.138	2	7
		Health Companion	74	4.64	1.818	1	7

For the statistical test, the null hypothesis was that the means of the PHR Likert scores are all equal. The alternate hypothesis was that the means of the PHR Likert scores are not all equal. The significance level was set at a = .05, and the null hypothesis would be rejected if the *p*-value was less than or equal to a = .05.

Because both the dependent and the independent variables are categorical, a nonparametric statistical significance test, the Kruskal-Wallis one-way analysis of variance (ANOVA), was used. This test is designed to assess the differences between the means of a dependent variable, the Likert scores, when grouped by an independent variable, the PHR type. The assumptions of the Kruskal-Wallis test were met because the dependent variables, the seven-point Likert scores, were ordinal; the independent variable, the PHR type, had two independent groupings; the sample consisted of more than 30 observations; and there was no relationship between the scores because each semester's cohort contained different participants.

In order to evaluate the means of the participants' USE Likert question scores for differences between the USE categories for each PHR, a Kruskal-Wallis ANOVA was conducted for each of the four USE question categories. A post hoc test was not conducted because there were only two PHR groups. For that reason, researchers examined the means of the scores to determine which of the two PHRs had the highest USE question ratings.

Results

The nonprobability convenience sample was composed of the 90 participants who completed a USE questionnaire during the spring of 2013 and 2014. The 90 participants completed 153 USE questionnaires, which were analyzed using SPSS version 23 statistical software.

USE Score Analysis

A Kruskal-Wallis one-way ANOVA was completed to determine if there were any statistically significant differences in the dependent ordinal USE scores for the two PHRs being assessed. The results in Table 3 indicated that statistically significant differences exist at the $p < .05$ level for most of the USE category scores. For example, in the Usefulness category five of the seven questions showed statistically significant differences in the values for the means shown in Table 2. These five questions were the questions labeled “It is useful”, “It does everything I expected,” “It makes it easier to accomplish what is needed,” “It meets my needs,” and “It saves me time,” with values of $\chi^2(1) = 11.135$, $p = .001$, $\chi^2(1) = 6.064$, $p = .014$, $\chi^2(1) = 8.117$, $p = .004$, $\chi^2(1) = 4.324$, $p = .038$, and $\chi^2(1) = 8.716$, $p = .003$, respectively.

Table 3: Statistical Significance

Category		Chi-square	*df*	Asymp. Sig.
Usefulness	It is useful	11.135	1	0.001
	It does everything I expected	6.064	1	0.014
	It gives me control over activities	0.828	1	0.363
	It makes it easier to accomplish what is needed	8.117	1	0.004
	It helps me be more effective	1.904	1	0.168
	It meets my needs	4.324	1	0.038
	It saves me time	8.716	1	0.003
Ease of Use	It is easy to use	29.320	1	0.000
	It is simple to use	34.915	1	0.000
	It is user friendly	23.130	1	0.000
	It requires the fewest steps to accomplish what I want.	30.178	1	0.000
	It is flexible	7.970	1	0.005
	Using it is effortless	20.449	1	0.000
	I can use it without written instructions	24.421	1	0.000
	I don’t notice any inconsistencies when using	8.512	1	0.004
	Occasional and regular users would like it	10.711	1	0.001
	I can recover from mistakes quickly and easily	13.393	1	0.000
	I can use it successfully every time	12.229	1	0.000
Ease of Learning	I learned to use it quickly	20.581	1	0
	I easily remember how to use it	17.977	1	0
	I quickly become skillful with it	16.063	1	0
	It is easy to learn how to use it	22.877	1	0
Satisfaction	I am satisfied with it	10.132	1	0.001
	I feel I need to have it	0.602	1	0.438
	It works the way I want it to work	14.184	1	0
	It is pleasant to use	29.32	1	0
	I would recommend it to a friend	13.435	1	0

Similarly, in the Ease of Use questions all questions had statistically significant differences at the $p < .001$ significance level. In the Ease of Learning category, all questions showed statistically significant differences with respect to the means, with $p <$

.001 for all. Moreover, all the questions in the Satisfaction category had statistically significant differences in the means except for the question labeled “I feel I need to have it.”

Participant Comments on Usability

In addition to completing the questionnaire, participants responded to three open-ended questions regarding which PHR was better according to their knowledge and experience, the advantages and disadvantages of electronic PHRs, and the future of electronic PHRs. There were 153 respondents in the USE questionnaire portion of the study. However, only 115 respondents answered the first open-ended question, 76 answered the second open-ended question, and 78 answered the third open-ended question.

Discussion

Various subjective factors, such as effectiveness and the ability to save time, can greatly influence a user’s adoption of new software.[38] Indeed, the results of the descriptive data analysis showed a significant difference in the means of the four USE categories, which indicates that participants’ usability ratings varied across the USE categories by PHR. For example, in the Ease of Use category, Microsoft HealthVault had higher scores in all questions.

The Ease of Learning scores for Microsoft HealthVault were higher in all categories. However, in the Satisfaction category Microsoft HealthVault had statistically significant ratings in four of the five categories, the questions labeled “I am satisfied with it,”, “I would recommend it to a friend”, “It works the way I want it to work,” “It is pleasant to use.”

In the open-ended questions, many respondents who preferred Microsoft HealthVault stated that it was easier to use, “synched with [their] existing Microsoft account,” “had more clear-cut [menu] choices,” a “simpler interface,” provided more health information and more applications, and had a “better ability to track health and diet issues.” Noted advantages of electronic PHRs were that all the health information was in one place and that using a PHR increased patient engagement. Disadvantages of electronic PHRs noted by respondents included privacy and security issues, difficulty updating the information, and concerns about potential inaccuracy of patient-generated information. Responses regarding the future of electronic PHRs reflected the consumer perspective that they would become more popular.

According to our study, Microsoft HealthVault had higher scores in most categories, which shows that participants rated the Microsoft HealthVault web-based PHR higher in terms of several usability factors. This study’s outcomes match some previous findings in the literature. For example, researchers have found that users prefer PHRs that are easy to use[39] and useful.[40] The winner in the current study, Microsoft HealthVault, had significant higher scores in the Ease of Use category for “easy to get things done,” in the Satisfaction category for “easy to use,” and in most items of the Usefulness category. The results of this study could inform the developers of other web-based PHRs about the consumers’ preferences regarding the usability of a web-based PHR.

Limitations

This study has several potential limitations. The sample was a convenience sample of two groups at one university, which indicates that generalizations cannot be made to other universities in other locations. The sample size was moderate ($N = 90$), the study was limited to participants at one location, and only two PHR products were reviewed. Larger studies at multiple sites that review more products may have different results. The sample included only students enrolled in the spring semester in 2013 and 2014, so results may differ for other semesters, or other years, and the students are not representative of the users of PHRs in general. However, this study does provide valuable information about the perceptions of the usability of two PHR systems from the viewpoint of these participants that adds to the body of knowledge about this topic.

Conclusion

PHRs help patients make informed decisions about their own health and wellness, and they allow healthcare providers to access patients’ health information to provide optimal and safe care. Web-based applications enable the users to access the information at any time and from any location. Therefore, web-based PHRs could be a future trend in the development of

PHRs. Researchers studied the usability of web-based PHRs by comparing retrospective USE survey data on two PHRs and concluded that Microsoft HealthVault received higher evaluations by users in most categories. The developers of other web-based PHRs may refer to Microsoft HealthVault for better usability development. Future studies may explore additional web-based PHRs and provide evaluations that are more comprehensive.

Disclosures

The authors declare that there are no conflicts of interest.

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