Usability and User Acceptance for Personal Health Records: A Perspective from Healthcare Citizens

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Abstract. Personal Health Records (PHR) allow patients to carry their own health records in some format for their own review purposes as well as across doctors and other care providers. This study aimed at determining the usability and user acceptance issues involving a Web-based personal health record system. The study indicated that such a Web-based system was found useful by the patients and they would be willing to enter and retrieve information regarding their own health from the system. A usable interface allows mobility and ease of information sharing using the system.

Keywords: Personal health records system, usability, user acceptance, patients, health care.

1 Introduction

The preventive activities that can be Web-based can play a critical role on patients' preventive health care screening (such as informing them about mammograms or colonoscopies recommended at certain time periods for certain demographics) as well as living a healthy lifestyle (for example by motivating them to pay attention to their diet or quit smoking) [1]. Every year, thousands of people get preventable illnesses such as heart attack, stroke and cancer. The cost due to preventable illnesses is also very high

according to recent studies [2]. While the primary focus of the current paper does not include a detailed look at preventive care and patient activation, PHR can play a significant role in improving both concepts. PHR is primarily defined as the engagement and involvement of patients in their health records via electronic means and tools [3]. PHR includes Web-assisted access of patients to their own records for informational purposes only, patients carrying their own health records in whole or partial form with them via mobile electronic means, manipulation of certain allowed portions of health records (with strict appropriate access restrictions in place), and doctors and electronic manipulation and exchange of patient health records by doctors and other caregivers [4].

The study reports on preliminary findings regarding the usability and perceived usefulness of the system based on data collected from patients, primary care physicians and medical assistants. It aimed at determining the perceived usefulness and usability aspects of a Web-based preventive care system. While usability deals with the effectiveness in task completion, it can be in the form of real and perceived usability. Actual usability evaluation is concerned with human performance and satisfaction issues and their optimization, while perceived usability deals with its perception by the users [5]. Perceived usefulness deals with the perceptions of how useful the system is thought of by the users. The current study is focused on perceived usefulness due to the Technology Acceptance Model by Davis et al. and the shortness of research in the area of personal health records and record-keeping [6, 7]. The current study aims at comprehensively evaluating a sample Web-based PHR system from the human computer interaction (HCI) perspective. A total of thirty subjects (twenty-two patients, four physicians, and four medical assistants) were used in the study as part of the data collection. Results were analyzed from both qualitative and quantitative perspectives. In the next section, a literature overview of PHR, usability, Technology Acceptance Model, and their connection are presented.

2 Literature Survey

2.1 Personal Health Records

One way to reduce health care costs enable the accurate treatment of ailments includes promoting the common health care records and information sharing. In recent years, public demand for flexible and mobile access to health information and services are encouraged by internet trends and policies. These trends and policies promote patient rights and empowerment. Although there is no universal definition of PHR [8], it has primarily been defined as "the engagement and involvement of patients in their health records via electronic means and tools" [3] and as "an electronic application through which individuals can access, manage and share their health information … in a private, secure and confidential environment. [9]"

Endsley et.al. summarize PHR in three visions [10]:

1. A provider-owned and provider-maintained digital summary of clinically relevant health information that is made available to patients.
2. A patient-owned software program which lets patients enter, organize and retrieve their health information and that captures the patient's concerns, problems, symptoms, emergency contact information and more.

3. A portable and interoperable digital file in which clinically relevant data regarding health can be managed, secured and transferred. Portable PHRs can include smart cards, personal digital assistants (PDAs), cell phones and USB (universal serial bus) compatible devices that can be plugged into almost any computer.

As defined by David Lansky and Patricia Flatley Brennan [11], the fully realized PHR can provide patients with a clinical summary of all episodes of health services and patient care issues; health status parameters including exercise, nutrition and spiritual well-being; periodic risk assessment survey results; decision support tools, risk management and professional advice; consumer-focused health information and education and more.

Generally, PHR offer a number of potential benefits to patients, physicians and the health care system, including empowerment of patients, improved patient-provider relationships, increased patient safety, improved quality of care, more efficient delivery of care, better safeguards on health information privacy, bigger cost savings, privacy and accuracy [10]. Tang et al. also pointed out that PHR provide greater patient access to a wide variety of reliable health information, data, and knowledge. PHR also provide a constant connection between patient and physician, which can have and effect on encounters by changing them from episodic to continuous, thereby significantly shortening the time to address problems that may arise. Besides, the PHR can benefit clinicians in ways that patients entering data into their health records can elect to submit the data into their clinicians' Electronic Health Records (HER), and having access to richer data can help clinicians make better decisions [4]. In the public health sector, data from personal health records could continuously update state and national data registries (for example, for immunizations, sexually transmitted diseases and the like). In the personal health direction, push technology could direct national guidelines for preventive clinical services into user records [12].

By empowering consumers, PHR is likely to play a significant role in the evolution of electronically enabled health information environments. Consumers want to be more engaged in their own healthcare and are seeking out information online, and despite intense concerns about issues including confidentiality and security, they have high expectations for electronic health information [13].

2.2   Usability

Usability measures the quality of a user's experience when interacting with a product or system. In general, usability refers to how well users can learn and use a product to achieve their goals and their satisfaction through that process. The international standards define usability as:

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of user." - ISO 9241-11

Usability is usually measured in terms of learnability, efficiency, memorability, errors and satisfaction [14]:

With the number of possibilities of introducing IT systems to the healthcare area, it is critical to focus on health care workers' real information needs in their daily work environments. However, many traditional software engineering methods are not adequate to capture the exact nature of user needs in the health care complex

environment. In the field of medical informatics, issues of usability gained more importance, with the acceptance or rejection of systems such as computerized patient records depending to a large extent on their usability [15]. It has been reported that usability problems that have had a direct impact on patient outcomes include opportunity cost and the indirect impact of usability on computer based systems; coping strategies to deal with software usability problems; software complexity and the limitations involving dealing strategies with this complexity; communication breakdown and software usability; monitoring bias and the indirect impact of usability on patient safety [16].

Currently, consumers have a broad range of personal health information management tools available to them. The ability of PHR to truly meet the needs of individuals depends to some extent on how well product designers attend to the users' needs as well as how involved the users are in the design as well as testing and re-design of a variety of PHR. However, usability methodology is not widely employed in PHR development. User-centered design is a natural fit for the kind of patient-centered healthcare that PHRs represent [17].

2.3 TAM

Technology Acceptance Model (TAM) is an adaptation of the Theory of Reasoned Action (TRA) to the field of Information Science. Broadly, TAM points out that the intensity of an individual's intention to use a technology can be explained by their perception about the technology's usefulness and attitude towards the technology use [18]. The goal of TAM includes "to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified" [19]. TAM posits that *perceived usefulness* and *perceived ease of use* determine an individual's intention to use a system with intention to use serving as a mediator the actual use [6].

Among its endless uses, the Internet can be seen a tool for health care strategy. The Medical Records Institute [20] suggests that Internet-based health applications (IHA), including, but not limited to, electronic health records, e-prescribing, and mobile health, are the goals of most healthcare organizations. It is essential first to learn if consumers would actually incorporate personal health records into their health management routines as well as use them regularly. It is also critical to explore the implications for providers who may sometimes have a wait-and-see attitude toward clinical information technologies [12]. However, while TAM has been applied and tested in academic and corporate settings, few studies have evaluated TAM in the health care environments [21].

3 Experimental Methodology

3.1 Participant Group and Location

The study was conducted at a small-size primary care clinic in Lino Lakes, Minnesota between February and May of 2008. Twenty-two patients and eight health care workers, which included four primary care physicians and four medical assistants,

were recruited. Patient participants had a moderate level of experience with computers and the Internet, and had scheduled an annual physical exam while the study was conducted. Regarding age distribution, six participants were under the age of thirty-five, eight were between thirty-five and fifty years of age, six were between the ages of fifty-one and sixty-five, and two participants were older than sixty-five. They were evenly distributed between males and females (eleven each). Two participants had attended high school without graduating, eight participants were high school graduates, five had attended a college or completed a two-year college degree, six had completed a four-year college, and one participant owned a degree higher than a four-year college.

3.2 Experimental Tasks and Interfaces

The tasks generally included information entry and retrieval processes and are summarized in this section. Task 1 allowed the participants to enter their own Demographic Information. Task 2 required that the participants enter their Personal Health History. The 3rd Task was shorter in nature and was titled Health Habits and as part of the completion of this task, the participants answered a number of questions for the system to classify them into one of the Health Habits categories. Task 4 involved the entry of Family History into the system. Participants were presented a set of instructions and asked to enter information regarding the medical history of their individual family members. As part of Task 5 the participants were asked to view their Profile Summary. The 6th task was called View Recommendations task. As part of this task, the participants were asked to read health recommendations given to them by mySafe-T.net. The system produced these recommendations based on their previous entries and using some complex algorithms. The next task, Task 7, allowed the participants to print a Doctor's Letter produced by the system based on the participant's entries. Finally, as part of the final task (Task 8), patients were asked to click on the Resources link, and click on at least two recommended pages and review the information provided to them on the external Web pages. When participants completed reviewing the Web pages, they logged out of the system, and were instructed to share the Doctor's Letter with their health care specialist at the beginning of their examination. They also filled out a survey regarding the mySafe-T.net system.

3.3 Experimental Procedure

Patients were instructed to conduct a total of eight simple tasks on the mySafe-T.net Web site scattered on a number of pages. They were then instructed to print out and review the recommendation letter from the mySafe-T.net page. This print-out was specifically for them to show their care provider (physician and medical assistant) in their examination. Following the experimentation, the participants were asked to fill out a survey and were administered a follow-up interview regarding items of the Web-based systems from the perspectives including perceived usefulness, perceived ease of use, usability and satisfaction. On average, c the entire experimentation in total took less than an hour.

A follow-up interview was conducted via phone and took approximately ten minutes. The surveys filled out during the experimentation process were pen-and-paper-based. All the interviews and focus groups were audio-taped.

3.4 The Personal Health Records Survey

The Personal Health Records Survey (PHRS) was administered to the participants following the tasks, and was a paper-based survey. It consisted of eight sections, and aimed at determining user perceptions regarding the mySafe-T.net system in terms of usefulness, trustworthiness, impact on personal health management, potential benefits, ease of use, and overall satisfaction. Seven-point Likert scales were used in all sections except for the last two. A response of 1 corresponded to the statement "Strongly Disagree," a response of 4 corresponded to "Neutral," and a response of 7 corresponded to "Strongly Agree."

3.5 The Patient Interview Process

The participants answered some questions via a short interview by the experimenter after the completion of the experiment. The interview had the main goal of determining the positive and negative perceptions of the patients regarding the mySafe-T.net system. Questions included whether they found the site easy to use and why, and positive and negative aspects of the site they found. Some follow-up questions were asked such as "I noticed you had some difficulty with [this particular task]. Can you tell me about that?" and/or "You seemed to like [this particular section/task]. What did you like about it?" A follow-up phone interview was also conducted three weeks after the experimentation.

4   Results and Discussion

4.1 Descriptive Statistics on Survey Responses

User perceptions regarding the usefulness of the site, which corresponded to Section A and consisted of seven questions, were relatively strong. Seven questions scoring higher than 4.9 in a seven-point Likert scale and four questions scoring 5.5 or higher. Interestingly, the highest score in this section belonged to Question 4 (Mean = 5.50, Std. Dev. = 1.12) which indicated that participants believed with the help of the mySafe-T.net Web site care providers could keep a better eye on their health. It is encouraging to observe the perception regarding the site being highly important in such a critical issue like providers tracking patients' health situation. The second highest score belonged to the question regarding the usefulness of the "Resources" page (Mean = 5.59, Mean = 0.94) and Item 5 on overall usefulness of the site (Mean = 5.50, Std. Dev. = 1.118) and Item 1 on the relevance of the information the site provided (Mean = 5.50, Std. Dev. = 1.16) tying for the third highest scores. Participant opinions regarding the usefulness of the "Recommendations" page and (Question 6, Mean = 5.36, Std. Dev. = 1.89) and perceived usefulness of the page recommendations (Item 2, Mean = 5.18, Std. Dev. = 1.27) also received high scores.

The initial results on the usefulness opinions involving the mySafe.T-net page were highly encouraging, with overall perceived usefulness scores being around or above 80% of perfect score. They therefore indicate a high level of potential adoption of the system among the users. Additionally, the links provided for recommendations and resources receiving high scores indicate the patients found these external links relevant and useful for them as well.

In the next section, patients also gave high marks to the security and trustworthiness of the site. The perceived technical reliability of the site (Item 10, Mean = 6.09, Std. Dev. = 0.95) scored highest in this section, followed by the perceived trustworthiness (Mean = 5.95, Std. Dev. = 1.02) and the confidence of entering confidential information by the participants (Mean = 5.77, Std. Dev. = 1.38). The results were unusually encouraging in indicating that the participants had no problem in the least in hesitating to enter their information and trusting the site. It should be noted that the participant group does not consist of computer and/or security specialists. It can be assumed that the participant group has a moderate amount of technology familiarity that may be representative of the general population.

The next section was concerned with the impact of the information and convenience offered by the site and the individuals' personal health management. The highest scores belonged to Question 16 on the potential help offered by the site in allowing the patients to be more in charge of their own health care (Mean = 5.5, Std. Dev. = 1.37) and Question 12 regarding the site's potential help in the patients' having more informative conversations with their physicians (Mean = 5.41, Std. Dev. = 1.64). These Questions were followed by Question 15 which indicated that the participants felt more informed regarding health risks stemming from their family heritage with the help of the site (Mean = 5.36, Std. Dev. = 1.43). More moderate scores were obtained for Questions 11 and 13 regarding whether participants would be interested in collecting information from the site before their next physician's visit (Mean = 5.27, Std. Dev. = 1.60) and whether the site is helpful in more closely following recommended preventive health screenings (Mean = 5.27, Std. Dev = 1.48), respectively. Participants also responded favorably to the inquiry of Question 19 on whether the site helped them have a better understanding of the potential consequences of not following a healthy life style (Mean = 5.05, Std. Dev. = 1.46). The participants didn't have a high number additional questions to as and/or topics to discuss with their physician (Question 17, Mean = 3.77, Std. Dev. = 1.62).

Results from Section C were interesting concerning patient views of the mySafe-T.net site from the perspective of its impact on their personal health management. It was observed that from the perspectives of the informational role of the site, such as learning about one's health risks due to heritage or lifestyle as well as what to do to improve one's health, the tool was very well-received.

While Section D was focused on the patient perceptions regarding the benefits offered by the mySafe-T.net system, its three questions were duplicates of questions in previous sections. These duplications had the primary goal of calculating the Cronbach's Alpha coefficient of the survey. Item 20 on preventive health screening was a duplicate of Item 18, Item 21 on maintaining a healthy lifestyle was a duplicate of Item 19, and Item 22 was a duplicate of Item 17. The Cronbach's Alpha values consequently calculated for these pairs were 0.896, 0.931, and 0.814, respectively, resulting in an overall determined Cronbach's Alpha internal reliability coefficient of

0.880. According to Cronbach (Ref!), an Alpha coefficient of 0.70 or higher usually provides enough evidence to conclude acceptable internal reliability of a survey. Overall, it was therefore determined that the survey had sufficient internal reliability.

Section E questions focused on the perceived ease of use and usability of the mySafe-T.net system, mainly because ease of use is a part of the Technology Acceptance Model (TAM) and also to some extent to determine the pressing usability issues of the system. The highest score received for this section belonged to the perceived ease of use of the site (Question 23, Mean = 6.27, Std. Dev. = 0.91), followed by how well-designed the screens were found to be (Question 26, Mean = 6.23, Std. Dev. = 0.85) and not having difficulty understanding the Web site content (Question 29, Mean = 6.14, Std. Dev. = 0.92)and the consistency of different page designs within the Web site (Question 32, Mean = 6.05, Std. Dev. = 0.93). The very high scores of the perceived usability and ease of use Questions are striking, indicating that the site needed little to improve in terms of usability and it fulfilled most if not all usability requirements for optimal perceived user performance as well as user satisfaction, with crucial Questions scoring 90% or more of the perfect score. The majority of participants also found screen instructions understandable (Question 30, Mean = 5.95, Std. Dev. = 1.21), screens well-designed (Question 27, Mean = 5.86, Std. Dev. = 1.01), the site interesting in general (Question 28, Mean = 5.82, Std. Dev. = 0.98), and fast to work on (Question 31, Mean = 5.73, Std. Dev. = 1.21). Additionally, two "reverse" questions, where negative usability Questions were asked, received relatively low scores, further boosting the notion regarding the site's high level of perceived usability. To a great extent, participants did not think that they made a lot of mistakes using the Web site (Question 24, Mean = 2.77, Std. Dev. = 1.76) and there were too many steps to complete some of the tasks (Question 25, Mean = 2.45, Std. Dev. = 1.53).

Overall, the results from Section E did not produce any problems on the patients' part and potential solutions for improvement of perceived and real usability of the mySafe-T.net system. As part of the qualitative analysis discussed in next section, usability of the site is further analyzed.

4.2 Patient Interviews

The interview identified a number of positive items of the site as perceived by the patients. Patients specifically liked the family history section and corresponding recommendations, indicated continuity of care would be more useful if they could see multiple providers or medications. They indicated the site is another tool to communicate with a care provider. They also enjoyed the tailored nature of the site. Recommendations for improvement included focusing more on details, working as a reminder system and involving more patient activation, and focusing on personal health records.

It can be concluded that personalized information is gaining more importance in health care sector with patients getting more computer-savvy and becoming willing to be more involved in their own care. The study pointed out that a Web-based comprehensive system can be developed to maximize this involvement in the future. The weaknesses of the study included focusing on a small section of patient population and making the assumption that the majority of patients can access a

Web-based patient information system on a regular basis. Future studies can explore the role of interactive personalized records on other platforms such as the mobile platform.

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