Design Guidelines for an Integrated PHR System: An Approach for UI Designers to Break Down Individual-Level Barriers to PHR Adoption

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Abstract. The significance of the quality of healthcare information has been recognized in the health care field. How will health information reach people, including patients, health care providers, employers, and etc.? How can information flow seamlessly among systems in a secure environment? In the case of individuals, how can one access, manage and share his/her health information with authorized health providers? To answer those questions, PHR (Personal Health records) plays a crucial role here. User interface design is essential for improving the usability of interactive systems like PHRs. In this study, two PHR applications are examined; rules will be applied to a PHR system design prototype to demonstrate how constructing and integrating of intuitive graphic design is carried out, and how to make PHRs more user-friendly by incorporating users' daily activities into personal health decision making and medical care.

Keywords: Integrated PHR System, User Interface, Design Guidelines.

1 Introduction

"The Obama administration has set a goal of computerizing all of America's medical records within five years (2011) as a means of improving efficiency, quality, and safety and ultimately money saving. The economic recovery package recently signed into law by President Obama will provide bonus payments of $44,000 to $64,000 to physicians who adopt and effectively use Electronic Health Record (EHR) systems from 2011 through 2015, and it is likely that penalties will then be introduced for physicians who do not adopt the technology.

The significance of the quality of healthcare information has been recognized in the health care field. How will health information reach people, including patients, health care providers, employers, and etc? How can information flow seamlessly among systems in a secure environment? In the case of individuals, how can one access, manage and share his/her health information with authorized health providers? To answer those questions, PHR (Personal Health Record) plays a crucial role here. Since user interface design is essential for improving the usability of interactive systems like PHRs, creating design guidelines and principles for PHR systems is an

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emerging need for the UI designers. To help UI designers recognize the UI responsibilities in the process of PHR system design, this study examined two highly recommended PHR applications, identified the rules that will break down individual-level barriers to PHR adoption, and eventually created the design guidelines for making an integrated and more efficient healthcare system in the United States.

2 The Definition and Benefits of Integrated PHR

The so-called PHR (Personal Health Record) is a system that patients, doctors, and other health care providers could securely access through the Internet no matter where a patient is seeking medical care [1]. In most scholarly articles, PHRs are described as ''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].'' In today's parlance, a PHR typically refers to a computer-based record – either a free-standing/ independent/stand-alone product that are accessible on the Internet or on a USB drive, or one that is integrated with the provider's Electronic Health Record (EHR) system. While the uptake of free-standing/ independent/ stand-alone PHRs has been slow, a growing number of patients actively use integrated PHRs [3].

Key Potential Benefits of Integrated PHR Systems	
Roles	**Benefits**
Consumers, Patients and their Caregivers	◻ Support wellness activities ◻ Improve understanding of health issues ◻ Increase sense of control over health ◻ Increase control over access to personal health information ◻ Support timely, appropriate preventive services ◻ Support healthcare decisions and responsibility for care ◻ Strengthen communication with providers ◻ Verify accuracy of information in provider records ◻ Support home monitoring for chronic diseases ◻ Support understanding and appropriate use of medications ◻ Support continuity of care across time and providers ◻ Manage insurance benefits and claims ◻ Avoid duplicate tests ◻ Reduce adverse drug interactions and allergic reactions ◻ Reduce hassle through online appointment scheduling and prescription refills ◻ Increase access to providers via e-visits
Healthcare Providers	◻ Improve access to data from other providers and the patients themselves ◻ Increase knowledge of potential drug interactions and allergies ◻ Avoid duplicate tests ◻ Improve medication compliance ◻ Provide information to patients for both healthcare and patient services purposes ◻ Provide patients with convenient access to specific information or services (e.g., lab results, Rx refills, e-visits) ◻ Improve documentation of communication with patients
Payers	◻ Improve customer service (transactions and information) ◻ Promote portability of patient information across plan ◻ Support wellness and preventive care ◻ Provide information and education to beneficiaries
Employers	◻ Support wellness and preventive care ◻ Provide convenient service ◻ Improve workforce productivity ◻ Promote empowered healthcare consumers ◻ Use aggregate data to manage employee health
Societal/Population Health Benefits	◻ Strengthen health promotion and disease prevention ◻ Improve the health of populations ◻ Expand health education opportunities

Fig. 1. Key Potential Benefits of PHRs and PHR Systems (Source: HHS, 2006)

Integrated PHRs are essentially portals into the EHRs of patients' health care providers. They are populated with patient information from a variety of sources, including EHRs, insurance claims, pharmacy data, and home diagnostics and can provide

consumers as well as providers with a more complete view of relevant health information. In 2006, the US Department of Health & Human Services [4] released a report on the key potential benefits of integrated PHR Systems, which are summarized in Figure 1. This report reveals the potential benefits brought from integrated PHR systems to the patients, healthcare providers, health insurance companies, employers, and the related societies. Many experts believe that integrated PHR systems are more than just static repositories for patient data; they combine data, knowledge, and software tools, which help patients to become active participants in their own care [5].

3 Barriers to PHR Adoption

It is quite obvious that integrated PHRs are beneficial for both consumers and clinicians. However, there are a number of obstacles to overcome for wide-scaled PHR adoption, including technical issues, environmental barriers, legal concerns, and individual-level barriers. First, technical issues include difficulties with data exchange, authentication of information, and summarization tools. The second barrier, environmental, results from the fact that currently health information on each patient resides in multiple locations. Thus, integrated PHRs must reach across organizational boundaries to interface with multiple EHR systems. A related and equally problematic barrier is that EHRs must not only exist in individual offices and hospitals, but must also be able to communicate with various PHRs. Economic and market forces are obstacles to PHR (and EHR) adoption. Another sensitive issue is that of legal concerns. While consumers appropriately desire protection of their private health information, aggressive protection measures might hamper PHR access by patients and clinicians and impede optimal care. Finally, individual-level barriers impede adoption of PHRs.

At the level of the individual, healthcare consumers must understand and accept their roles and responsibilities related to their own healthcare. However, consumer-related interfaces, technology, and access issues specific to PHRs are not yet well understood. Also, the workflow models for both providers and patients are poorly understood. An understanding is necessary of how the PHR can fit into the existing flow of day-to-day activities for both providers and patients. Part of this process includes providers and patients developing different mindsets and levels of trust of each other. In the case of PHR adoption, change management issues involve providers, consumers, and regulators. In each case, there must first be a motivation to change.

4 Understanding and Breaking Down the Barriers to PHR Adoption

The two main mechanisms for breaking down the barriers to PHR adoption are education and research. Behavioral research can identify optimal educational strategies. Provider sites that currently offer integrated PHRs offer a good starting point to determine which individuals tend to use the PHR, how frequently, and for what purposes, as well

as impacts on healthcare and workflows. Therefore, two user behavioral researches were conducted by surveying 1849 adult representatives on consumers and health information technology adoption and by observing users' interaction with two different types of PHR tools that were chosen from the results of national survey.

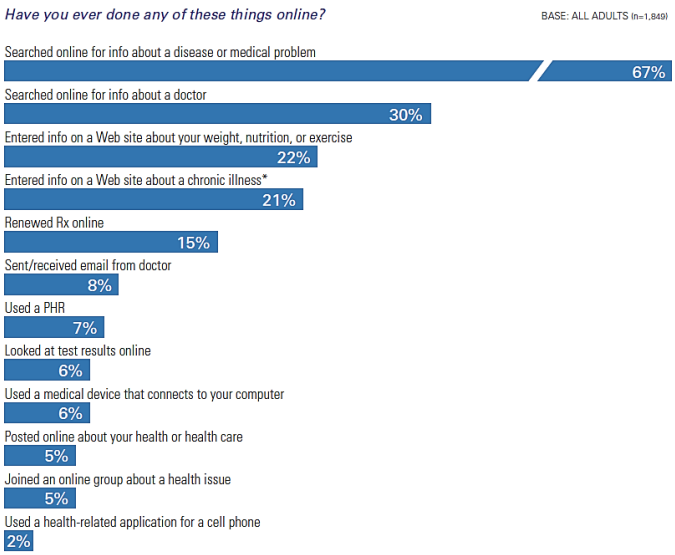

Fig. 2. The tendency of PHR adoption among 1849 adult users

The national survey results reveal the tendency of PHR adoption among 1849 adult users (Fig. 2) and their expectations of the functions in an integrated PHR system (Fig. 3). The survey summary is listed as follows:

- About 7% of those surveyed say they have used a PHR — more than twice the proportion identified two years earlier in separate research.
- Users are most likely to have a PHR supplied by their health insurer, followed by their doctor/ health care provider.
- Half or more of users indicate that the ability to look at test results, renew their prescriptions online, or email their providers is somewhat or very useful. Making sure their information is correct ranks highest in terms of usefulness.
- Although higher-income individuals are the most likely to have used a PHR, lower-income adults, those with chronic conditions, and those without a college degree are more likely to experience positive effects of having their information accessible online.
- Two-thirds of the public remain concerned about the privacy and security of their health information, but the majority of those who are using a PHR are not very worried about the privacy of the information contained in their PHR.
- Most PHR users and non-users say privacy concerns should not stop learning how health IT can improve health care.

- More than half of adults are interested in using online applications to track health-related factors, and almost half are interested in medical devices that can be connected to the Internet. Of those who do not have a PHR, 40% express interest in using one.
- Having trust in the organization that provides the PHR is a top factor in signing up for one. More than half of non-users say they would or might sign up if their doctor expressed confidence in the safety of information in a PHR.

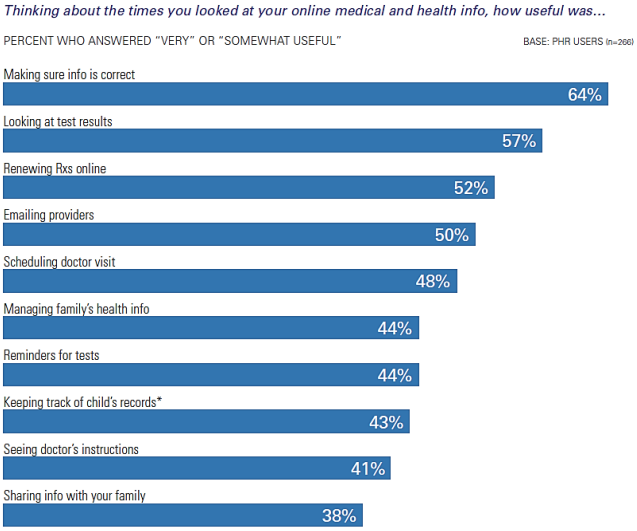

Fig. 3. The expected functions provided by an integrated PHR system

From studying the reviews and feedback from actual users, we were expecting to learn how both mobile users and web users interact with personal health management applications on different platforms. Based on popularity and availability, two products representing two types of PHRs were Nike+GPS and My ActiveHealth.

Fig. 4. The UI design of Nike + GPS- a mobile phone based PHR tool

Nike+ GPS maps user's runs, tracks the progress and Provides the motivation user needs to go even further. It plays mid-run cheers every time a user's friends like or comment on the run status or outruns them in a game of Nike+ Tag. With this app in hand, a user can track every indoor and outdoor workout easily, without a sensor. A user can also record the pace, distance and run route using the iPhone's GPS and accelerometer technology to see the progress over time and push him or herself to go even further. The UI design of Nike+ GPS is shown in Fig. 4.

My ActiveHealth manages to offer a complete integrated system of services that includes coaching for people with chronic health conditions, services that help doctors and patients make smarter health care decisions, and personal health records. The UI design of My ActiveHealth is shown in Fig. 5.

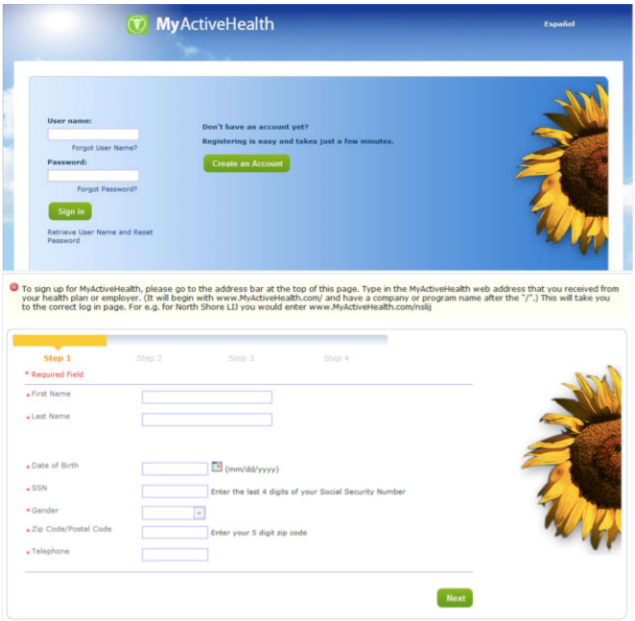

Fig. 5. The UI design of My ActiveHealth- a Website based PHR tool

After observing users' interaction with these two PHR systems respectively and conducting in-depth studies on the UI design on both PHR systems, the users' needs and frustrations with these tools were identified and analyzed by different themes. The theme analysis revealed the following facts:

- Users' privacy is the biggest concern in the adoption of PHR systems.
- There is a lack of motivation to the use of PHR.
- Excessive information is always hard to manage.
- Information transition between personal devices and medical care providers is hard to manage.
- The efficiency and usability of PHR systems decide the level of user satisfactions.

5 The Design Guidelines for an Integrated PHR System

As discussed in the previous section, three key issues inhibit the use of PHRs: privacy concerns, lack of motivation, and operational difficulty. However, in addition to the individuals, provider group and health plan organizations emphasizing PHR adoption highlight the value of using the PHR focusing on consumer-to-PHR and PHR-to-consumer interactions as levers to improve health and reduce costs [6]. Before discussing any design guidelines, the following common types of PHR interactions should be considered as each of them will affect the choices of adoption of PHRs. The first, consumer-to-PHRs connections, enable users to update their record with new information from connections such as a home monitoring device. The second, PHRs-to-consumer interactions, should include ways of sending automated notices for upcoming events from the system to the users. The third type of connections, consumer-to-consumer, promote online social networks such as emails and health forums. Finally, PHR-to-PHR connections allow transfer of information between PHRs, promoting usability by gathering and grouping user activities and experiences. These four types of PHR interactions are illustrated in Fig. 6.

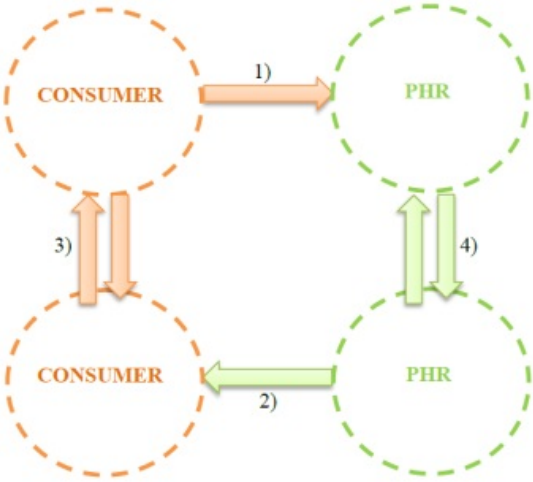

Fig. 6. Four types of PHR interactions

After considering the types of connections, the sequence of use for primary users should be planned. Based on previous research, the ideal sequence is as follows (Fig. 7):

After understanding the problems inhibiting users from the adoption of PHR systems, the different types of PHR interactions and the sequence of use in PHRs, some design guidelines can be generated and suggested to the UI designers for creating an integrated PHR system. To make these guidelines more systematic and easy to understand, they are developed accordingly in regard to a PHR's visual purpose, operational purpose and navigational purpose as shown in Fig. 8.

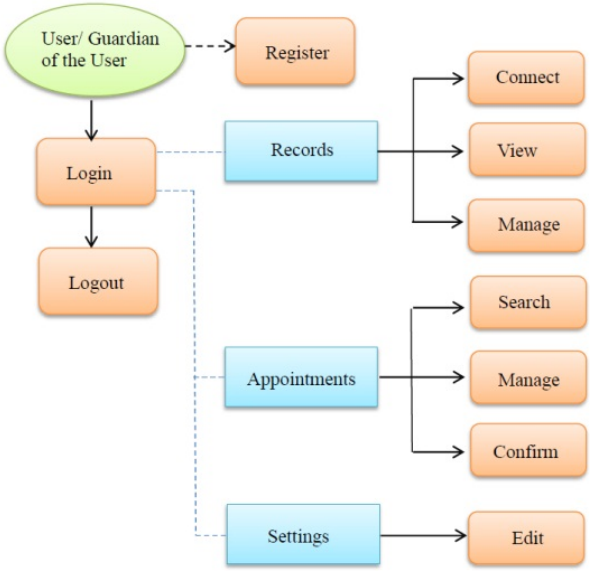

Fig. 7. The Sequence of Use in PHRs from Primary User's Perspective

Visual Guidelines	Operation Guidelines	Navigation guidelines
* Branding * Security Assurance * Format * Inform Interactive Elements	* Instructional Aids * Identification Process * Terminologies * Options * Modularity * Mobile Application	* Consistent Navigation Controls * Content Types

Fig. 8. Three main categories of design guidelines for integrated PHR systems

These guidelines are listed below:

- All information should be generalized and displayed in a simple manner.
- The use of navigation should remain consistent throughout the site unless there are areas requiring custom control unique to a specific function.
- The PHR site and application should include instructional aids such as text, illustrations or videos, to define the services provided and explain the process if applicable.
- An integrated PHR system should assure users of the privacy and security of the system by providing educational description and illustrations regarding how users' identity and information will be used and protected.

- An integrated PHR system should process identification information in a secure and timely manner.
- The PHR system should speak the users' language, with words, phrases and concepts familiar to the user, rather than official medical terms.
- User information received from medical care providers must be organized and displayed in a format that is easy to view and assistive to decision making for users.
- The PHR site or application should distinguish content types from general content to current page content by text, colors, contrast, or graphic cues.
- When there are interactive elements, there should be changes in colors or size to highlight or indicate the interaction.
- Multiple options should be provided to users in order to achieve the maximum of functionality and flexibility.
- Users should have the ability to adjust their privacy preferences.
- An integrated PHR system should be modular so as to add more components to accommodate customers with specific needs.
- Because mobile devices may serve as an entry point for customers to access their PHRs, studying the characteristics of mobile platforms accordingly before designing a mobile application is a must.

6 Suggestions for Guidelines Application

This set of design guidelines were geared towards designing a user-centric and integrated PHR system. They can always support guiding designers along the design process. In addition, they could be used in designing other user-centric or personal information management systems.

With the fast developing pace of mobile industry, the relationship between a PHR site and a PHR mobile application may change. Policies for health information may be improved to facilitate a better environment for the adoption of PHR systems. These guidelines can always be modified when necessary and used for provide direction for design, in both general and concrete terms.

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