

# Proposed PHR Architecture for Saudi Arabia Health Services

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## Abstract

This study addresses the necessity to develop a new personal health record (PHR) system, which represents a benefit, compared to the existing electronic health record (EHR). To bring this necessity on stage, we proposed the development of a globally accessed PHR system in the kingdom of Saudi Arabia. Therefore, the proposed PHR system is targeting the development of PHR theme that involves a patient centric tool that is mostly controlled by the individual (patient). Due to several issues including but not limited to travelling and far distances between cities in the kingdom of Saudi Arabia, the PHR system should be immediately available electronically. By the achievement of this stage, all other working EHR systems (in all health care providers) should be linked into one integrated PHR system. This vision once implemented could deeply help individuals maintaining their health and be an active party in their health management.

Keywords: PHR, EHR, patient-centric, global access.

## 1. Introduction

The Center for Information Technology Leadership (CITL) defines a PHR as having both an infrastructure component, which allows for data viewing and sharing, and an application component, allowing for self-management and information exchange (Vincent et al., 2008). PHR can also be defined as a new technological approach aimed at standardizing electronic management of medical information between the patient and its physicians (Artur et al., 2015). The definition of PHR in the context of this research is the single-logical patient health record along with the data elements comprising that record. While electronic health record (EHR) means the clinical generated health-data record.

Due to vast available technology surrounded us; it can help patients, particularly those with chronic diseases, manage and monitor their health care. The available and inexpensive smart phones along with their PC-like capabilities, can collect, store, update patient's information, and transmit it via internet to a centric-PHR system (Win et al., 2006, Vance et al., 2015). Therefore, patient who access such PHR system from a portable communication device can make informed health decisions using fewer health system resources. Using mobile-PHR facilitates the establishment of patient-centric health care services. Thereby, the delivery of healthcare can be integrated across the continuum of services, from prevention to follow up, and care can be coordinated across all settings (Wendy et al., 2009).

Abroad access to PHR is a key point for the provision of support to assist healthcare providers in their treatment plan, individuals manage their health, which in turn, enabling them to enhance health services and risk minimization (Rolim et al., 2010). Off-hospital PHR services may be requested by the patient himself since PHR system can be remotely accessed, patient managed and centralized updated. The most interesting potential PHR system applications are categorized into five main domains: decision support, social networking, provider-patient interaction, disease/health management, and financial services (Wendy et al., 2009, Vassiliki et al., 2013). However, this work focuses on provider-patient interaction to allow Saudi People able to access and interact with their PHR systems. Concerning patient's health care, PHR system should provide full- guidance through their treatment to facilitate the required notifications.

## 2. Literature Reviews

Oberdan et al., 2010 conducted a research on current medical processes, which are responsible for gathering patient's data. They concluded that the current processes are slow and more error prone, which in turn requires more labor work to collect data and to analyze the data. Koufi et al., 2013 introduced a prototype PHR-based system, which aims at supporting chronic disease management at any point of care such as Google's Android. In fact, the proposed prototype assists healthcare professionals in assessing an

individual's condition and in forming the appropriate treatment plan for patient while it provides individuals with step-to-step guidance to their treatment plans.

Aaron *et al.*, 2011 found that while barriers to PHR adoption exist (such as concerns about privacy, security and the lack of visible use of PHRs by others within immediate social groups) intention to use PHRs are high. Their findings suggest that active consumer involvement in healthcare may be on the rise and, more importantly, that information may become a key mediator in the physician-patient relationship.

Leslie *et al.*, 2011 used a multi-method approach to evaluate PHR systems. They interviewed potential end users (clinicians and patients) and conducted evaluations with patients and caregivers as well as a heuristic evaluation with HCI experts. They investigated three PHR systems: Google Health, Microsoft Health Vault, and World MedCard. Their results demonstrate that both usability concerns and socio-cultural influences are barriers to PHR adoption and use.

Hosam *et al.*, 2012 studied the development of conceptual framework for the exchanging of patient records located in different hospitals all over KSA. Their system design is based on Cloud Computing Service Oriented Architecture. Generally, this work utilizes a web service technology to share EHRs among different health care providers. Due to the lack of a comprehensive taxonomy that fully describes the PHR system, a PHR taxonomy has been created by CIST (Vincent *et al.*, 2008) for data viewing and sharing. The developed taxonomy might help in the definition of the field of PHRs and provide a framework for assessing PHR value.

The PHR system has the potential to facilitate access to health-related information, improve care, promote more active patient participation in their health and further the cause of patient-centered care in the country (Paraskevas *et al.*, 2015). Marie *et al.*, 2016 studied the adoption of PHR in Canada and concluded that still an uncommon sight in the Canadian healthcare IT landscape. However, their results showed that both specialists and patients need to be provided with a much greater awareness about PHR system.

### 3. Methods

#### 3.1 Problem statement and motivation

Due to the vast distances between cities in the

kingdom of Saudi Arabia, people usually met some difficulties in accessing their health data outside their living-nearby health services. However, as their health information is kept secured in the local databases of those healthcare centers. Therefore, patients sometimes may need to get services from different healthcare centers for different reasons such as traveling to another city, emergency accident while traveling, and the need for specialized care from distance health center. The stored health information in a healthcare center (EHR) is usually accessible only to healthcare personnel of that center. For every healthcare center, there are separate systems to record patients' health information. Therefore, bringing all those EHRs into one integrated, updated and improved PHR is the utmost necessity. We are motivated to having a full-integrated medical data for each patient accessible anywhere and at any time in the Kingdom of Saudi Arabia. Without a doubt, this vision could deeply improve the possibilities of risk prevention and correctly medical intervention.

#### 3.2 Architecture Design

Being needed, globally reached, and inexpensive, Mobile-PHR is proposed to meet the needs for saving human's health in Saudi Arabia. Along with the various available health care providers scattered all around the country, in addition to the wide distance that separates cities inside KSA, mobile-PHR could play an important role in risk reduction, perfect diagnosis, and self-care. The architecture that we are investigating relies on the connection of several EHRs from different hospitals and health care providers to be integrated into one globally reached system, the mobile-PHR system.

In this section, we will discuss three main categories in relation to PHR adaptation in Saudi Arabia:

- **Personal health**  
Patient's profile is the core element of personal health component. The awareness of patient to adopt such technology and their willingness to use it are also pillars in personal health component. Thereby. The ability of patient to manage his/ her health education and their ability to interact with their health-care providers can improve disease prevention and risk reduction.
- **Supportive**  
Does this project will be fully supported by ministry of health so this service will be introduced by free? or patients will be charged for it? And how health-care providers will be

engaged to manage PHR's resources.

- **Information infrastructure**  
The PHR should be able to manage health record information that applied interoperability-based standards. As PHR contains a significant amount of sensitive information, security constitutes a major concern when building PHR-based applications (Win, Susilo & Mu, 2006). Surely, PHR must guarantee security and privacy issues.

We propose Patient health record architecture for Saudi Arabia in which it elaborates the process of combining different EHRs into single-customized PHR. An overview of the system is presented in Fig. 1.

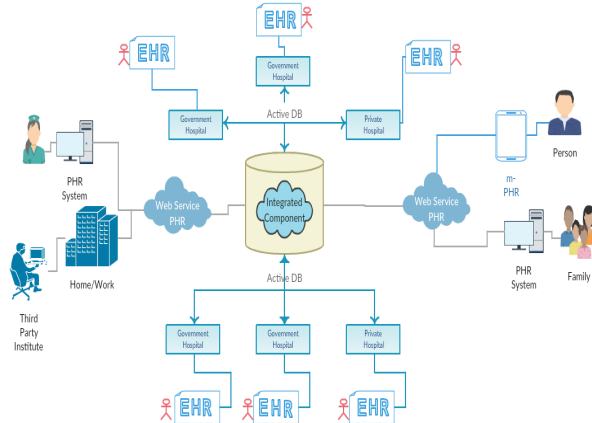
**Fig. 1: An overview of the proposed health-data integration** This process describes how different EHRs can be updated and integrated into one component (integrated component). Regardless the issuer of EHR (public or private hospital) and regardless the used infrastructure to implement that EHR, data coming from different EHRs can be stored, updated and managed from one place, the integrated component. However, we are trying to eliminate health-care provider's dependence, by neglecting the thinking of the nature of their platforms and just bring their data into our proposed web service to be utilized for PHR system development. Fig. 2 below demonstrates how people, institutes and any other third parties can benefit from this proposed model to gain global access to the authorized medical data using their authorized access to the PHR system.

### 3.3 Components description:

This part concerns the elaboration of each component in the proposed model and how it is functioning to its connected components.

- **EHR:**  
Electronic health record represents the electronic management of medical information between the patient and its physicians, in the context of this work; EHR is managed locally by health-care provider.
- **PHR:**  
Personal health record represents an integrated single-logical patient health record along with the data elements comprising that record in which its database may be changed, modified, or updated globally.

- **Government hospital:**  
It represents any hospital owned by government that introduces a medical-care free of charge to its citizens, which in turn maintains its own EHRs that can be part of the integrated PHR system.
- **Private hospital:**  
It represents any private hospital that introduces a paid medical-care to people, which in turn maintains its own EHRs that can be part of the integrated PHR system.



**Fig. 2: Global access to PHR system by different parties**

- **Integrated component:**  
It is an integrated architecture that accommodates data from different health-care providers, update the data, protect the data and disseminate it to authorized users.
- **Web service:**  
A web service is any piece of software that uses a standardized XML messaging system, which is available over the internet. XML is used to encode all communications to a web service regardless the operating system or programming languages running in user's side.
- **PHR user:**  
Any authorized user of PHR system (Patient, physician, Doctor, etc...) that have some privileged functions into his/ her PHR system.

## 4. Discussion

As EHR, system plays an important role in containing patient's health data, still, patient himself/herself away from that record which in turn prevents him/ her from participating in managing and updating

his/ her health care. However, the development of electronic PHR by independent vendors and national health systems is understood to empower patients and create a new kind of consumerism in healthcare (Vezyridis & Timmons, 2015). Thereby, bringing the vision of adopting a PHR system that has the capabilities of letting patients being involved in the management of their health care, being willing to share their health data, being able to participate in any health activity, and being able to access their health data globally, without doubt, will improve health services and improve health style to those patients. However, there is not even a single PHR system being deployed in Saudi Arabia considering the special needs of Saudi Arabian society. Therefore, 164 respondents were participating in a survey to measure the ability of Saudi people to move towards the adaptation of PHR system in the kingdom of Saudi Arabia. Among these 164 respondents, there was only one female while the rest of 163 respondents were males.

There were eleven questions asked in the awareness section of the questionnaire. The intent of this division was to gauge the knowledge of the respondents on the PHR. For the analytical purpose, these eleven questions were split into two parts; the first character is comprised of those selected five questions whose responses may be 'Yes' or 'No' or even 'No Answer at All'. Nevertheless, the second part was comprised of the remaining six questions where there were some given options on 'Strongly Agree', 'Agree', 'Neutral', 'Disagree', 'Strongly Disagree' or 'Missing Values'.

In the given Fig. 3, we can notice a significant boost in the favor of sharing the medical information of the individuals on a PHR system/site. Even so, we may likewise discover that a great number of respondents were not aware of the term PHR that may be a cause of their reluctant behavior towards adoption of PHR. Another worth noticing ratio in the given Fig. 1 is the stage of understanding the treatment prescribed by the doctor through PHR, as most of the answerer showed their willingness to adopt the PHR approach for the quality improvement of their health care.

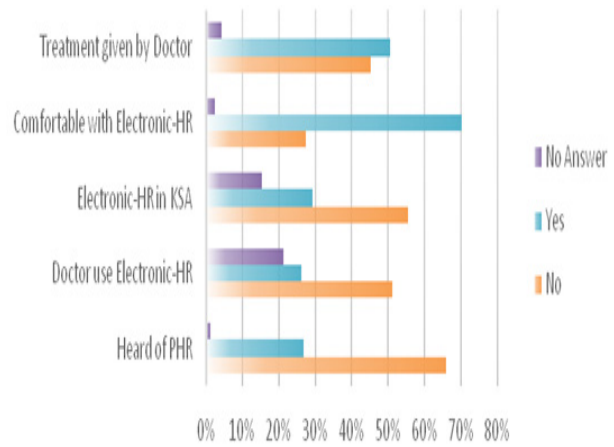


Fig. 3: The favor of sharing the medical information of the individuals on a PHR system

Fig. 4 below illustrates their response. As noticed in the Fig. 4, most Saudi's people are willing to share their health data and be part of their health management. Aiming to have a PHR system that is globally accessible which in turn allows them to access and participate in their health management.

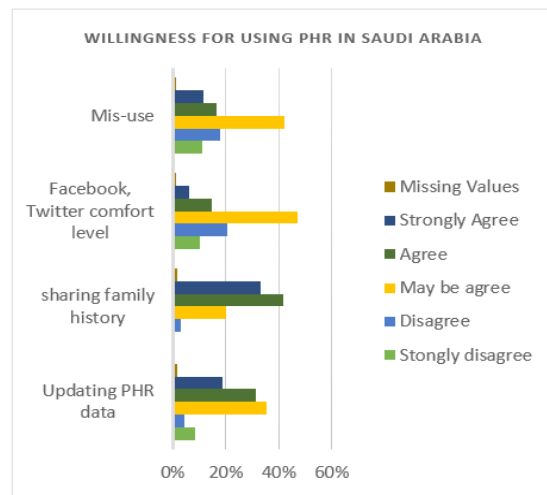


Fig. 4: The willingness of using PHR system between Saudi's people

The bulk of the respondents (57.3 percent) indicated their business title was public and the next largest group (29.9 percent) was unemployed, 6.7 percent people were regarded in their businesses, 5.5 percent were doing private jobs and only 0.6 percent respondents were employed in some other professions. The interviewees made it certain to involve those respondents who are educated and who can properly

interpret the queries asked in the questionnaire.

As illustrated in Fig. 4, Saudi's people showed high degree of sharing their family's health-data history. This indicates a good sign since it measures the culture of sharing family health-data history. In addition, it reflects them believe about the family health history as an important factor in developing diseases especially the chronic ones. The results also demonstrate low agreement in sharing their health data through social networks. This raises the concerns about security and privacy issues.

One more important indication highlighted by the above results, is that there is a big concern about the reasons behind sharing and using the data available in PHR systems by different parties. People seem to be worried about the misuse of their health data. Finally, there was a big agreement upon updating the PHR data by patients themselves. This in fact contributes towards lowering labor work and saving costs. The survey also shows that there were some ambiguities in the conduct of the respondents towards the misuse of their personal information that they are sharing on PHR. Yet, there was likewise a huge ratio of the neutral respondents in the survey who were most probably being the flexible individuals ready to take this technology change.

The proposed architecture provides a global access to the PHR system, direct access to any training or education materials that may be given by health-care providers; it should support free-platforms to run the PHR system, facilitates the connection between patients and doctors, and importantly, this architecture allows doctors to directly proceed to treatment in case of emergency.

The proposed architecture hypothesizes that PHR system could potentially change healthcare services over the coming years. As it enables patients to become more involved and engaged in their health care by letting them accessing their health information, which was not available previously, with low cost and easy access electronically. However, PHR could facilitate health management by following clinician's guidelines. The patient can access and manage his/ her PHR to check for upcoming events such as tests, appointments, cancelation of appointments, manage medications, receive advices and/ or have some consultations.

A PHR system has given control to the consumer and has provided patients with autonomy and empowerment. However, "full intent of functionality and use of PHRs will occur when patients and providers believe the information is safe, accurate, reliable and

applicable for improving health" (Vance. B et al, 2015).

## 5. Conclusion

In this work, we proposed a PHR architecture that can be globally accessed, managed by both health-care providers and by patient, and platform-free application. Saudi people concern about their health care. However, bringing their health information to be distance-accessed, without doubt, plays a more active role in their healthcare using a patient-centric information tool - the PHR. In addition, perceptive and motivated patients in Saudi Arabia can be taught and trained about their health status and they can be engaged in health-care culture dissemination that might improve the ability of patients in managing their health. This system once approved for adoption in Saudi Arabia, without doubt will improve the introduced health services and it will assist towards disease prevention and emergency treatment intervention. Finally, we hypothesized that increased patient engagement in their healthcare can improve the quality of the provided services and surely improving their health life style.

## Acknowledgements

This research was supported in part by Majmaah University, Saudi Arabia

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