

Improving Smart Healthcare based on the Self-management Concept

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Abstract--- The smart healthcare concept is new and interdisciplinary knowledge in the modern world, and it has not been a long time since its emergence and is also important from a management point of view. The electronic contexts can have several benefits as well as real-time responsiveness for patients in hospital. Due to the growth of smart healthcare in developed cities as well as megalopolises, management of this field has also faced several challenges. With the purpose of introducing smart healthcare characteristics as well as the self-management concept, this research has also been able to investigate privacy in real-time responsiveness and users' loyalty to improve smart healthcare management. This study is conducted to improve smart healthcare based on the self-management concept and identify factors with priority. Findings have shown smart technologies, monitoring devices, and privacy had quite significant factors in the findings of this research.

Keyword-: smart healthcare, real-time responsiveness, privacy, self-management.

I. INTRODUCTION

Due to increasing the population all over the world and the emergence of new diseases like COVID-19, smart healthcare has been a positive impact on the health management systems. The system is required in the smart platform, organising the data and information that is being transmitted on this platform (Yang, Hsu, and Wu 2022). As (Yang et al. 2022) argued that smart healthcare can have a significant impact on increasing the quality of life, especially for the elderly.

Zhan and Miller indicated that deaths due to human error in the medication field in 2003 were about 32,000 people per year (Zhan and Miller 2003). So, developing a personalised self-management system in the healthcare industry in sending health records to healthcare professionals has been recommended for chronic conditions (Zheng et al. 2010). Furthermore, a comprehensive healthcare management system based on smart context should consider real-time responsiveness. Basically, smart health is a definition of telemedicine, healthcare systems such as mobile health (m-health) and electronic health (e-health) (Pramanik et al.

2017). Today, telemedicine has been able to improve remote diagnosis and treatment technologies rather than existing technologies (Keogh, Rosser, and Eccleston 2010), as well as increase the quality of healthcare services (Lotfi, Fatehi, and Badie 2020).

Since remote management with m-health has been possible, responsiveness in real-time is performed at a high-velocity, and diagnostic accuracy is also improved (Kauw et al. 2019). Information management in clinics and hospitals by software packages and in the context of mobile health has solved several problems in real-time response and provided quick access to operators (Olivero et al. 2019). The adoption of efficient m-health systems depends on system quality, service quality, information quality, and other factors. Nowadays, information related to patients, physicians, and clinics is managed in m-health systems (Lotfi et al. 2020). It should be added that mobile health is defined by the World Health Organisation (WHO) as an important principle in healthcare management (Fan and Zhao 2022).

E-health applications require secure management, wearable sensors, etc., which are mainly used in the context of wireless networks to monitor the field of health and have high security and reliability (Kompara, Kumari, and Hölbl 2019). However, protecting individuals' privacy of information in smart healthcare management systems should be a high priority to increase trust in such services (Lotfi and Soleimani 2020). Advances in e-health have also led to improvements in the diagnosis of chronic pain (Keogh et al. 2010). It should be noted that new technologies such as smart mobile phones have been able to become practical tools of e-health and are expanding gradually (Olivero et al. 2019).

Generally, while healthcare is a type of business, emerging technologies for treatment have had a significant impact in this area and health standards had been raised accordingly (Radenković et al. 2021). Recently, the importance of mobile technologies has played a vital role in supporting healthcare during the COVID-19 pandemic, which does not limit individuals' access to healthcare centres' services (Fan and Zhao 2022).

II. LITERATURE REVIEW

A. *Smart healthcare*

Smart healthcare as a critical component of the smart city concept, as it involves the use of technology and data to improve the delivery of healthcare services and the overall health of citizens. The perspective of smart cities is to reach the concept of smart earth, in which two concepts of smart management and a smart system (Pramanik et al. 2017).

Recently, the health industry has been changed by Information and Communications Technology (ICT), and these changes are very tangible. In fact, using new technologies like information technology concept is not a threat to medical professions, new technologies have been used to cover some weaknesses in medicine. However, it is not yet possible to define a comprehensive definition of the concept of smart health. In general, smart health is the application of ICT knowledge and other new technologies like artificial intelligence that have entered the field of health with diagnosis and treatment. It should be mentioned that progress in the field of smart health is growing in both scientific and industrial areas (Keogh et al. 2010; Lotfi and Soleimani 2020).

Research findings have shown paying attention to factors like health management, clinical decision, smart equipment, personalisation, and hospital management to provide patients with high-quality services of healthcare in smart hospitals have been introduced (Tian et al. 2019). Nowadays, smart health has also been developing rapidly, and applications related to medicine and the use of smart technologies and devices are expanding over the days. The concept of smart health refers to most areas of health like smart healthcare, smart hospital, smart tools, and so on (Olivero et al. 2019). Today, big data analysis and its transition in the context of the Internet of Things (IoT) have been possible and the use of smart wearables to grow and promote smart health is growing (Din and Paul 2021).

In addition to these concepts, smart healthcare is based on real-time responsiveness and decision-making to access data processing. This parameter is rather important in sensitive areas of health like heart rate. The required data is then sent to the queue and the others are deleted, by doing this, the data is somehow filtered and cleared. Therefore, due to the large volume of data, architecture, and systems, are needed to be able to facilitate heavy processing (Babar et al. 2018).

It should also be argued that the capabilities of smart devices like smart mobile phones have increased so that they had already been mentioned to analyse patients' records.

However, one of the main challenges in this regard is to provide access to the health department and physicians to monitor the patients' records as well as Electronic Health Record (EHR) (Sethia, Gupta, and Saran 2019). All in all, smart health monitoring technologies have always been growing, and such technologies had been displayed in the form of designs, patents, research articles, scientific reports, and so on (Shen, Wang, and Yang 2020).

B. *Management in smart healthcare*

In this decade, different facilities of smart healthcare in hospitals and clinics have been increasing to the better services for patients. At the beginning of every project in this regard and by managing and monitoring smart healthcare, there are several challenges and obstacles during implementing and managing a smart healthcare system. In addition, the management of different kinds of levels in smart healthcare services in smart hospitals has reduced human errors, which could help to ensure that patients receive the care they need in a timely (Shen et al. 2020). For instance, according to (Yang et al. 2018), a mechanism that is called CD-AGKMS is proposed, which controls some of the patients' treatment measures. In this mechanism, a secret key is given to the user so that can use some facilities of medical centres and such key expires in a certain period (Yang et al. 2018). The management knowledge also has argued the secure key protocol to decrypt or encrypt the data sent on the network platform (Kompara et al. 2019). However, the diagnosis of some diseases like heart disease, hypertension, and so on are the benefits of using m-health for the management of patients' situations of healthcare services (Kauw et al. 2019). Furthermore, managing chronic skin and respiratory diseases can be well felt and observed using mobile technologies (Fan and Zhao 2022). It should be noted that data on healthcare needs to be managed in a framework to better clinical activities promptly and in time. Healthcare management has been able to categorise data or information for cost reduction and time management (Lappa and Giannakopoulos 2013). Elsewhere, there is a definition that is called self-management. Hence, according to studies, patients have been able to manage their health conditions by using smart wearables as well as mobile health apps. For example, one of the most prominent services in this regard, reminding to take medication. Nowadays, patients have also been able to manage their medication use remotely by using m-health apps, and this is rather an important service, especially for the elderly. In recent developments, m-health has been able to manage epilepsy situation. Furthermore, mobile health has placed this task on the patients themselves (Choi et al. 2021). The following figure shows the m-health architecture.

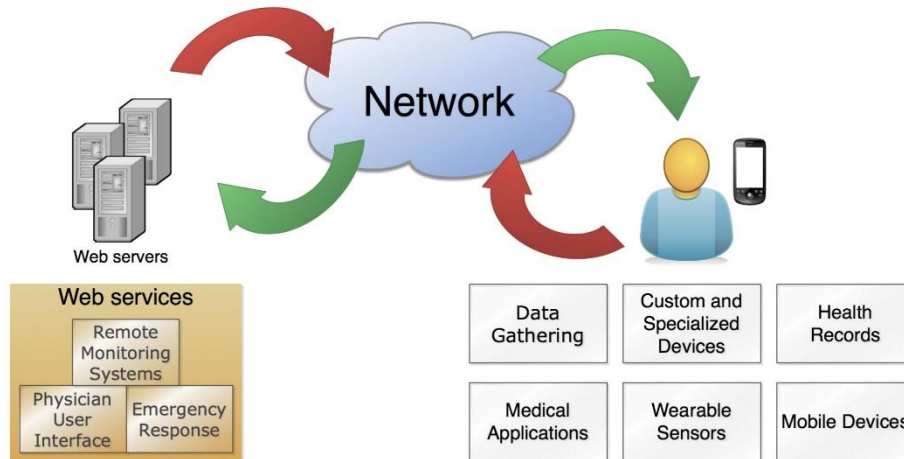


Fig 1. Architecture of Mobile Health (Silva et al. 2015).

In the following and in completing the mentioned issues, and according to Figure 1, the user or patient in the healthcare system can communicate with the doctor through the internet. The doctor can access the patient's electronic file through smart devices such as smart mobile phones, regardless of time and place. Furthermore, mobile health systems have actually performed better in patient status management rather than conventional monitoring systems. In this architecture, some warnings about medication usage are given to the patient in real time. On the one hand, the invalidity of the medication and many other cases in this type of system can be easily managed (Silva et al. 2015).

EHR plays a vital role in smart healthcare management. EHR is an electronic version so that can save the patients' records and has strengthened efficient management (Silva et al. 2015). Due to the existence of sensitive data in the context of smart healthcare, it should be pointed to having a comprehensive system for decision-making and management (Babar et al. 2018) and in the modern technological world, the performance of an architecture of decision management related to big data analysis in healthcare services has enhanced.

Research findings have shown that the development of smart healthcare management strongly depends on users satisfaction and loyalty (Yang et al. 2022). Hence, it should be divided into different categories, including medication management systems or medical information systems.

In this section, an overview of management knowledge in smart healthcare is presented. This study is given an overview of smart healthcare management.

III. APPLICATION OF PRINCIPLES OF MANAGEMENT IN SMART HEALTHCARE

Creating a smart healthcare management system using big data and in the context of modern technologies like the Internet of Things can optimise data management and respond to the user in real-time. According to (Zhang, Zhang, and Wu 2021), a smart healthcare management system that utilises big data in the context of the IoT has the potential to greatly improve the efficiency and effectiveness of the healthcare industry, leading to better outcomes for patients. For example, 5 desirable models of management functions in smart healthcare are presented:

The study of Sethia et al. (2019): In this study, it has been argued that patients who have dispersed health records had several problems and challenges across hospitals. These challenges included real-time responsiveness, treatment, and so on. This research also mentioned that cloud-based solutions have serious challenges with privacy and security. Furthermore, they developed a portable smart health record management system. It provided a secure platform to assist patients' mobility at hospitals. Accessing easy to this system was an important and useful tool that users could access directly with their smart mobile phones. This study has been focused on security and privacy issues.

The study of Fedele et al. (2021): In this study, asthma self-management was improved using mobile health in adolescence. The target population of this study was adolescents who were at the beginning of puberty, adolescents aged 12 to 15 years, and were studied over a period of 4 months. Management and control of asthma and lung activity to improve quality of life were the outcomes of this study. The outcome of the study improved self-management and asthma control ($P= 0.04$). Using a platform

called AIM2ACT, adolescent asthma self-management behaviours were developed through a two-way intervention. After reviewing the initial goals (evaluation and acceptance rate) and the duration of testing and monitoring for 20 weeks, the result of asthma management was evaluated positively. It was also found this model can be used for children. Finally, this research indicated that asthma management is able to identify some unpleasant consequences.

The study of Himes et al. (2019): This study has been focused on asthma management like the previous study, which is associated with health benefits, except that inhalation-based monitoring is a key factor here. The findings of this study also showed that m-health applications with smart devices and wearables are effective in improving asthma management. Many apps can be installed on smart mobile phones and tablets by connecting to airflow sensors, and some alerts like medication alerts have been examined in this study. In addition, these benefits can be used by the EHR to collect long-term symptoms of the disease and control airflow sensors for evaluation and diagnosis. Other benefits of the mobile health system in the management and improvement of lung health, the symptoms, and cases of lung irritation have been mentioned in this study. Concerns about protecting the privacy of asthmatic patients have always been a serious challenge in this regard. If such concerns are alleviated, maximum satisfaction with different ethnicities for using new technologies shall increase. The research was conducted with an app so which could be installed on smart mobile phones. By using the “Health App”, the monitoring of symptoms and peak flow are the prominent features of this app, and also the advice and reminders of medication are mentioned as secondary features of this app. The research was conducted by using this app with patients between 12 and 17 years old in hospital in Arkansas. Using the “Health App”, the ACT score has improved, and it also managed the scope of asthma attack prevention. It should be noted that (Himes et al. 2019) has proposed a list of important inhalation-based monitoring devices for asthma management, which have achieved acceptable results based on mobile health programmes in controlling asthma. An example of these devices is Flo-Tone. This device wasn't able to store data for quite a long time and also had measured breathing speed by sound and breathing length. Proper inhalation triggers a signal to stop taking the drug at that moment. This device also records inhalation performance at different moments. As a result of this study, it should be noted that there were many individuals who had quite a difficulty controlling their symptoms, asthma monitoring, and controlling programmes by using this platform.

The study of Du et al. (2020): This research paper provided a meta-analysis of the effectiveness of e-health on self-management in chronic back pain. In this meta-analysis, the amount of pain in the back has been investigated as a primary consequence. It should be noted that they have used 8 randomised trials for their analysis that e-health-based self-

management programmes had been able to be effective in relieving pain. The study has also argued that mobile health had a greater impact rather than web-based applications and also long-term effects. Therefore, the findings of this study have shown that there were good strategies in e-health-based self-management for following chronic back pain and reducing pain. The target population in this study was selected among individuals who needed long-run treatment. Even though this research mentioned that e-health-based self-management programmes had been significantly helpful in improving back pain, on the one hand it has been argued that more comprehensive trials should be conducted to optimise e-health-based self-management programmes.

The study of CHELLADURAL et al. (2021): This research article introduced e-health management in terms of a disease-based EHR storage system and smart management using Blockchain technology. In this study, the security of health data and privacy in health systems in improving healthcare management has been pointed out. In fact, this research has provided the possibility of secure communication through Blockchain technology. In this proposed system, patients' health files are recorded digitally. This system has been guaranteed privacy and security, interoperability, and transparency. It should also be noted that the proposed system used a modified Merkle tree. This tree provided access to information in sensitive and necessary situations in this regard. The system could also provide remote services to patients based on their electronic medical records. Quantitative and qualitative data were selected as measurement criteria. However, in this research, an encrypted system has been implemented through hash functions. Better performance is extracted at the output, rather than existing systems. Besides, the proposed system allows users of healthcare services to put their health data in electronic form, and this choice can be useful for their future because many tests have been done in terms of real-time. As a result, Blockchain technology has been able to improve the performance of the healthcare system and minimise data transmission delays.

IV. IMPROVING SMART HEALTHCARE BASED ON THE SELF-MANAGEMENT CONCEPT

In this study, it has been argued that a smart healthcare system can be upgraded to the self-management concept. For instance, mobile health is able to improve asthma self-management behaviours, and has affected the quality of life through online monitoring in the context of the IoT (Din and Paul 2021; Fedele et al. 2021). Moreover, asthma management apps helped to improve health outcomes as well (Himes et al. 2019).

In addition to these reasons, there has been sustained interests in the use of mobile health in management studies. Furthermore, some of the most important factors in smart healthcare and management were mentioned in this study. In fact, key and common factors were extracted in studies of

(CHELLADURAI et al. 2021; Du et al. 2020; Fedele et al. 2021; Himes et al. 2019; Sethia et al. 2019) as well. These factors have been explained below (Fig. 2).

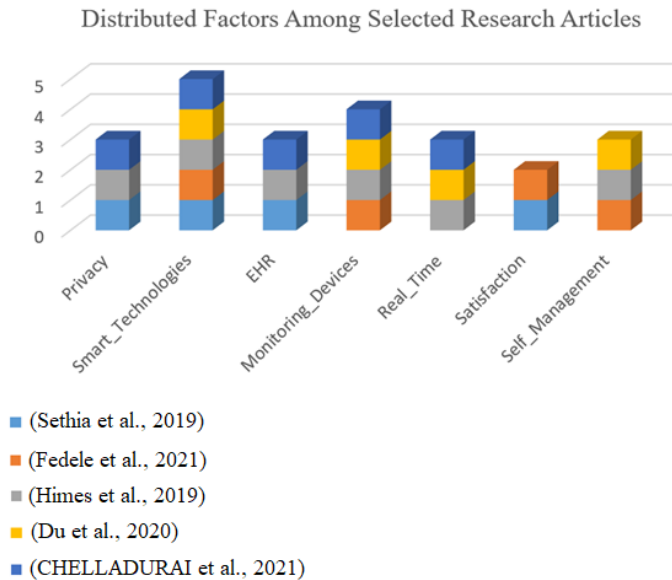


Fig 2. Improving smart healthcare based on the self-management concept.

Privacy is the first important factor that is mentioned in every smart system like smart transportation, smart education, smart healthcare, and so on (CHELLADURAI et al. 2021; Himes et al. 2019; Pramanik et al. 2017; Sethia et al. 2019). All the projects that are focused on smart healthcare context with self-management must pay attention to privacy. Customers should confirm their private data, such as health data. There is much more information and data about patients and their records in clinics and hospitals, so which can help experts to analyse those data in real-time. That is why there should be a comfortable feeling about data privacy before using such services and apps (CHELLADURAI et al. 2021; Himes et al. 2019; Lotfi and Soleimani 2020; Sethia et al. 2019). Second, apps in smartphones have positive impacts on self-management like asthma self-management. HER is the factor that was mentioned in this study. Today, the world population has been raised and that is why hospitals and other related organisations cannot manage the patients' situation without EHR (CHELLADURAI et al. 2021; Himes et al. 2019; Sethia et al. 2019). On the other hand, smart systems can work by ICT in smart cities. For example, monitoring devices need to work in the context of the ICT. Monitoring devices have also improved health data records. The EHR manager can also manage the health data via monitoring devices. There are quite impacts of monitoring devices for different ages of people, patients, hospitals or clinics managers, and so on (CHELLADURAI et al. 2021; Du et al. 2020; Fedele et al. 2021; Himes et al. 2019). If data is flowing in an electronic or smart platform, the responsiveness to

customers can also occur in real time (CHELLADURAI et al. 2021; Du et al. 2020; Himes et al. 2019).

If customers or patients receive high-quality service and treatment through the use of smart devices and electronic tools, their satisfaction is likely to increase (Fedele et al. 2021; Lotfi and Soleimani 2020; Sethia et al. 2019). A final factor that has been examined in this study named self-management. Although ICT created the modern context in the healthcare industry, middle-aged, adults and elderly people should pay attention to the self-management concept (Du et al. 2020; Fedele et al. 2021; Himes et al. 2019). All in all, as has been mentioned in this research, diseases needed to be monitored constantly and consistently, these factors were selected from related research articles.

V. MEASURING PRIVACY IN SMART HEALTHCARE MANAGEMENT SYSTEMS

A smart system operates continuously may encounter various privacy and security challenges. Portable platforms also limited information for patients across hospitals (Sethia et al. 2019). These key factors should be analysed to have a smart and manageable healthcare system. The result of research findings that confirm privacy is the higher important factor in smart systems, which is why it has been argued in this study (Motwani, Shukla, and Pawar 2022). Quantitatively measuring privacy by smart health apps in healthcare platforms can have a positive impact on self-management systems related to healthcare. At first, the SQL queries that made by a data curator/ analyst with specific attributes including "forename", "surname", and so on. Asking for the attribute "forename" can increase the privacy score every time. "Safe" queries are common issues in computing the privacy score as well. Second, the privacy score model should be extracted from behavioural profiles (Khan, Foley, and O'Sullivan 2020). In addition, and on the other hand, there is an indirect methodology to measuring privacy which has known as the best solution in this regard. In fact, in "direct" and "indirect" ways of measuring privacy, several questions for users have been identified. In the methodology of indirect, questions are prepared for the conjecture while in "direct privacy" there are specific questions for the specific issue (Braunstein, Granka, and Staddon 2011).

In measuring the privacy factor in research (Sethia et al. 2019), "indirect" can be appropriate because of several patients with emotional behaviours. As argued before, the research of (Himes et al. 2019) has worked on mobile health-based monitoring devices for the management of asthma. They used an app, personal monitoring devices, and wearables to improve asthma management. The monitoring devices for asthma management factors can be used with "direct" and the "indirect" methodology. The research of (CHELLADURAI et al. 2021) was also about EHR storage and integrity management for e-health systems. As it has been argued in Fig 2., the Blockchain healthcare system has

provided privacy to the patient. They improved the IoT-based EHR storage, and that is why our suggestion for measuring the privacy for the research (CHELLADURAI et al. 2021) is quantitatively measuring privacy by smart health apps (Khan et al. 2020).

VI. DISCUSSION AND CONCLUSION

In recent years, and in the busy world of communications, clinical performance by smart tools has grown significantly. Experts have also been involved with smart devices, healthcare providers, clinics, and so on because the demand for improving management quality in the realm of smart health had been growing rapidly (Olivero et al. 2019).

This study has been able to introduce an overview of smart healthcare management and conducted a useful study on privacy and self-management concept in this regard. Furthermore, some important and effective factors in previous research and studies are collected and discussed, such as real-time responsiveness, enhancing users' loyalty to the healthcare system to improve smart healthcare management. It is pointed out that a data security framework is necessary for smart health management because it is one of the vital concerns of the smart manufacturing process. Furthermore, essential to maintain the privacy of users' information in analysing health data and improving management performance in this regard (Bagheri, Rezapoor, and Lee 2020). Although management knowledge in smart healthcare has solved many problems like privacy concerns, it is well established that smart healthcare management has certain subtleties and faces many challenges. Moreover, the increasing data in the context of smart health has faced serious challenges in management in this area (Pramanik et al. 2017). Since smart healthcare is an interdisciplinary knowledge, the progress and study in different fields should proceed in the same way and parallel in order to see fewer challenges in this field. However, another suggestion of this study is that artificial intelligence should be used in this field so that the obstacles that are removed in one area of smart health can be a solution for similar cases in other areas. Finally, to measure privacy in healthcare management systems, researchers should use several methodologies for their research as well as smart tools and wearables to increase treatment efficiency. Concentrating on privacy in smart systems can help managers to plan and then increase users' satisfaction and loyalty.

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