Evaluating the Healthcare Professionals' Perceptions about the Adoption of Electronic Health Records in Primary Care Centres in Riyadh City, Saudi Arabia

by

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STATEMENTS AND DECLARATIONS

Declaration of Originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

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Statement of Ethical Conduct

The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government's Office of the Gene Technology Regulator and the rulings of the Safety, Ethics and Institutional Biosafety Committees of the University. Ethics Approval No/s 1438-2155598 (Saudi Arabia Ministry of Health) and H0016730 (Tasmanian Social Sciences Human Research Ethics Committee).

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LIST OF ABBREVIATIONS

CFA	Confirmatory Factor Analysis
CI	Confidence Interval
EHR	Electronic Health Record
GCC	Gulf Cooperation Council
HIT	Health Information Technology
HITECH	Health Information Technology for Economic and Clinical Health
ICT	Information Communication Technology
IS	Information System
IT	Information Technology
MoH	Ministry of Health
MU	Meaningful Use
PCCs	Primary Care Centres
REDCap	Research Electronic Data Capture
SPSS	Statistical Package for Social Sciences
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reason Action
WHO	World Health Organization

ABSTRACT

Electronic health records (EHRs) play a critical role in improving the quality of health care and patient safety. An EHR can facilitate the provision of patient care by providing several clinical benefits to both the healthcare providers and patients. The literature shows that these systems are being increasingly adopted in many healthcare settings globally. There is also evidence that various factors can hinder or promote the adoption and use of the systems. Many hospitals in Saudi Arabia are also rapidly adopting EHRs; however, the same is not true in primary care settings. As such, there is little published literature examining the adoption and use of EHRs in primary care in Saudi Arabia. This study evaluated the perceptions of healthcare professionals towards the adoption of EHRs in primary care centres (PCCs) in Riyadh City, Saudi Arabia.

This thesis was based on a modified version of the Technology Acceptance Model (TAM) as a theoretical framework and drew from both the published literature and the findings of a large survey of healthcare providers to inform a conceptual framework for the adoption and use of EHRs in primary care settings in the Gulf Cooperation Council (GCC) countries. The adopted TAM has five attributes, namely external variables, perceived ease of use, perceived usefulness, attitude towards use, and intention to use that help to explain users' behaviour towards the adoption, acceptance, and use of technology. Applying this model, this thesis examined the influence of individual, organisational and system characteristics on the healthcare professionals' perceptions of EHR in primary care, including perceived usefulness, perceived ease of use and satisfaction, to predict the adoption and use of EHR in PCCs in Saudi Arabia and the GCC countries at large.

Using a positivist paradigm as the research lens, the study employed a survey to evaluate the perceptions of healthcare professionals in primary care in Riyadh city, Saudi Arabia. All

1710 healthcare providers working in PCCs in Riyadh city were invited via email to complete an online survey on the secure Research Electronic Data Capture (REDCap) system between 30 November 2017 and 30 January 2018. A total of 1127 participants completed the survey, representing a 65.9% response rate. Quantitative results were analysed using Statistical Package for Social Sciences (IBM® SPSS v.20.0), and open-ended comments were thematically analysed in MS Excel.

The findings from the survey identified that the majority of primary care providers in Riyadh perceived EHRs to be an important tool in primary care (77.0%). Respondents reported a strong level of agreement across several areas of potential benefits to the individual providers or primary care organisations. For example, the benefits to the individual healthcare professionals included improved communication between healthcare providers and patients (73.7%), reduced time in health data documentation (75.2%), and provision of access to practice standards (73.6%). Some of the benefits to PCCs were decreased paper-based documentation (77.1%), provision of access to patient data and analysis (76.8%), and reduction in medical errors (63.5%). Furthermore, respondents reported a low level of agreement across several areas of perceived obstacles at the individual, organisational or system level, such as the system decreases interaction between healthcare professionals and patients (20.5%), increases health professionals' workloads (23.5%), is too complicated and not user friendly (17.0%), is 'down' frequently (20.9%), compromises patient safety (18.8%), and does not provide adequate data security (19.6%). The only conflicting result was that nearly half (45.3%) of the respondents agreed that the need for frequent revisions due to technological advancement was a perceived barrier to using EHRs in primary care. The findings also identified that primary healthcare providers in Riyadh were satisfied with EHR in primary care (69.1%) with strong perceptions that these systems improve quality of care (74.8%) and patient safety (65.8%).

Analysis of the qualitative data identified additional information that corroborates the quantitative findings of the perceptions of the healthcare professionals towards EHR benefits and obstacles in primary care. Based on their personal experiences, the respondents reported several benefits of EHR with the most emerging ones being, for example, better delivery of healthcare due to improvement in all aspects of patient care (45.7%), increased productivity and efficiency (26.5%), improved sharing of information between healthcare providers (26.5%), and enhanced access to past medical history (24.1%). Conversely, lack of staff training in EHRs emerged as the main obstacle to EHR adoption in primary care settings in Riyadh (39.2%). Others included poor IT infrastructure (15.5%), reduced practice productivity and disruption of the workflow (13.5%), lack of adequate technical support (9.8%), and low-quality service provision in primary care (9.4%), among others.

There were several associations identified in the analysis of the data. The canonical correlation showed that healthcare professionals' perceptions of EHR benefits were strongly associated with satisfaction with EHRs in primary care (canonical correlation coefficient, $r = 0.91$). Conversely, the perceptions of the obstacles to adopting EHRs had a medium negative association with the healthcare professionals' satisfaction (canonical correlation coefficient, $r = 0.45$). These findings suggest that perceived usefulness and perceived ease of use had a positive association with healthcare professionals' perceptions towards the adoption of EHRs in primary care settings in the GCC countries. However, these perceptions were influenced by external factors related to the individual users, organisation and system. The individual or sociodemographic characteristics of the respondents were found to influence these perceptions; however, they had mixed results. Significant associations were found between the healthcare professionals' perceptions of EHR benefits and occupation, age, experience working outside Saudi Arabia and previous training in EHRs ($p < 0.05$). For instance, occupation was significantly associated with the healthcare professionals' perceptions of EHR benefits such as easy access to information from past medical records ($\chi^2(8) = 69.722$, $p < 0.001$), reduced time in documenting patient data ($\chi^2(8) = 32.47$, $p < 0.001$), and decreased paper-based documentation ($\chi^2(8) = 51.876$, $p < 0.001$). However, only age and occupation were significantly associated with the perceptions of obstacles to adopting EHR. Gender, nationality and length of experience working in PCCs had significant associations with the perceptions of most EHR benefits as opposed to most EHR obstacles, which were significantly associated with nationality and experience working outside Saudi Arabia. Whereas previous experience in EHRs had no significant associations with the perceptions of most EHR benefits, it had no significant associations with the providers' perceptions of all the listed EHR obstacles. Gender, length of experience working in PCCs and previous training had no significant associations with the perceptions of most EHR obstacles. Furthermore, mixed results were found on the influence of the respondents' sociodemographic characteristics on the healthcare professionals' satisfaction with EHRs in primary care. Significant associations were found between satisfaction with EHRs and age ($\chi^2(4) = 29.293$, $p < 0.001$), gender ($\chi^2(2) = 14.453$, $p < 0.001$), occupation ($\chi^2(8) = 52.687$, $p < 0.001$), nationality ($\chi^2(2) = 15.232$, $p < 0.001$), length of experience working in PCCs ($\chi^2(4) = 30.163$, $p < 0.001$), previous experience working outside Saudi Arabia ($\chi^2(2) = 83.446$, $p < 0.001$), and previous training in EHRs ($\chi^2(2) = 43.059$, $p < 0.001$). Previous experience in EHRs had no significant associations with the healthcare professionals' satisfaction with EHRs in primary care ($\chi^2(2) = 3.386$, $p = 0.184$).

As postulated in the conceptual framework, this study indicated that individual, organisational, and system characteristics (external variables) influence the perceptions of primary healthcare providers in Riyadh city, Saudi Arabia, towards EHRs in primary care. These perceptions are also related to satisfaction with EHRs, which is likely to influence the acceptance and use of the system. In particular, the perceived usefulness and perceived ease of use of the EHRs are associated with positive attitude towards EHRs in primary care. On the other hand, lack of perceived usefulness and perceived ease of use, including the obstacles, such as compromised patient safety, decreased interaction between healthcare professionals and patients, increased healthcare professionals' workloads, and complexity of the system, are associated with negative attitudes and low satisfaction with the EHRs.

From the study results, a conceptual framework for the adoption of EHRs in primary care in Saudi Arabia was derived. The conceptual framework showed that primary healthcare professionals in Riyadh had a positive perception of EHRs due to their perceived usefulness and perceived ease of use, hence they were more likely to accept the system in the primary care setting. However, there were also reported challenges and risks of using EHRs in primary care that were associated with negative perceptions of the system. It was also shown that the perceptions of the healthcare professionals were influenced by individual, organisational, and system characteristics. The personal characteristics, including occupation, age, and previous experience outside Saudi Arabia had a significant influence on the healthcare professionals' perception of EHRs' usefulness and ease of use. For example, physicians, older professionals (≥ 50 years), and those with longer experience working in primary care were more likely to accept and use EHRs in primary care settings as opposed to their respective counterparts. Gender, nationality, length of work experience in PCCs and previous training in EHRs had a significant relationship with only perceived usefulness and not perceived ease of use. Previous experience using EHRs did not have any significant influence on the providers' perception of either EHR usefulness or ease of use. The system characteristics included perceived usefulness and perceived ease of use that were found to influence the healthcare providers' attitude towards EHRs and final adoption in primary care as postulated by the TAM. Lastly, the identified organisational factors that could affect users' perceptions towards EHRs, hence the adoption in PCCs in Saudi Arabia, included staff training, technical support, and staff resistance. The study findings could be contextualised to the GCC setting due to the similarities in social, political and economic factors of the GCC countries.

These findings suggest that EHR implementers such as governments and health managers should take into account the external factors, including the characteristics of users, organisational characteristics, and system characteristics that may affect the adoption of EHRs at all stages of implementation (pre-implementation, during implementation and post-implementation) in primary care settings. This is important because of the significant influence these factors have on the perception and adoption of the technology. This would help to reduce resistance and improve acceptance of the EHRs by the users to realise the intended benefits in primary care. Furthermore, this thesis highlights the need for all healthcare providers to be trained about EHRs, irrespective of their characteristics such as age and occupation, to improve their knowledge and skills to promote acceptance and adoption. Healthcare facilities should also adopt EHRs that are more beneficial and easy to use. Finally, similar research should be conducted in other GCC countries to validate the findings.

In conclusion, this thesis identified an overall positive perception of EHRs by primary healthcare professionals in Riyadh city, Saudi Arabia. This positive perception was demonstrated by a strong level of agreement with EHR benefits in primary care and a low level of agreement with the obstacles. Moreover, perceptions of EHR benefits were positively associated with satisfaction with EHRs in primary care settings as opposed to attitudes towards barriers to adopting EHRs in primary care. However, the perceptions that influence the adoption and use of EHRs were found to be influenced by sociodemographic characteristics of the respondents, system characteristics and organisational characteristics.

CHAPTER 1 : INTRODUCTION

1.1 Chapter overview

This chapter describes the study that was undertaken to examine the perceptions of healthcare professionals on the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. The background and rationale of the study are presented. The research aim, objectives, and questions are also detailed. The chapter also outlines the organisation of the thesis, and a summary of the chapter is provided at the end.

1.2 Background and rationale of the study

The objective of this thesis is to examine the perceptions of healthcare professionals towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. This thesis then draws from the study findings and published literature to develop a conceptual framework for the acceptance and use of EHRs by primary care providers in the GCC context. Thus, it aims to contribute to the efforts of the successful implementation of EHRs in primary care settings by both the government and private sectors in the GCC countries.

1.2.1 Theoretical background

The need for safer health systems that ensure a reduction in medical errors and an improvement in patient safety was brought to the world's attention by the Institute of Medicine Committee on Quality of Health Care report, *To err is human: building a safer health system* (Donaldson, Corrigan & Kohn 2000). The report showed that up to 98,000 mortalities arising from preventable medical errors in hospitals were reported per year. This figure is even more than deaths from road traffic accidents, breast cancer, and cancers combined. Therefore, all the stakeholders in the health sector, such as the governments, policymakers, hospital administrators, and healthcare providers aimed to find efficient and effective strategies for reducing medical errors and improving the quality of healthcare. This need, coupled with the growing complex nature of healthcare systems, called for better solutions of managing patient health information to promote healthcare quality and improve health outcomes. The adoption of health information technology (HIT), particularly EHRs, could be useful in achieving these healthcare goals.

1.2.1.1 Electronic health records

EHRs are perceived as an innovative and promising solution for improving the quality of care and patient safety (Heywood 2014; Stone 2014; Evans 2016; Yanamadala et al. 2016). As one of the most common HITs, EHRs present a new frontier in the management of medical data for present and future healthcare. The US Office of the National Coordinator for Health Information Technology (2019a) reported that an EHR contains a vast amount of patient-related health information such as demographics, medical history, laboratory reports, medications, and progress assessment notes that can be used to inform care. The stored patient data are generated in one or more healthcare delivery settings but can be accessed virtually from almost everywhere by healthcare providers (Evans 2016). Thus, an EHR provides several clinical benefits, such as increased access to past health information, improved communication between healthcare providers, and reduced medical errors that result in the provision of high-quality and cost-effective care.

It is due to these potential benefits of EHRs that the systems are rapidly being adopted globally across various healthcare settings. For instance, the adoption rates of EHRs in the US have doubled between 2008 and 2017. It is reported that 42% of office-based physicians had adopted some type of EHR system in 2008; however, this had increased to 86% by 2017 (Office of the National Coordinator for Health Information Technology 2019b). Many countries across Europe have also increasingly adopted EHRs over time in various healthcare settings, including primary care. The Organisation for Economic Cooperation and Development (OECD)/European Union (2018) estimated the average proportion of primary care practices using an EHR system in 2016 across 15 countries of the European Union to be 80%, with all or almost all primary care practices in some countries, such as Denmark, Finland, Greece, Sweden, Estonia, Spain and the United Kingdom, having adopted EHRs. Between 2012 and 2016, the proportions of primary care practices doubled in Denmark and the United Kingdom. The increased adoption of EHRs has also been reported in Asian countries. For example, the current adoption rate in South Korea is reported to be 97.3% in hospitals and 95.7% in clinics (Park & Han 2017).

The increasing adoption of EHRs in healthcare systems in several countries, including the developing ones such as Saudi Arabia, is fuelled by the system's perceived usefulness in healthcare (AlJarullah & El-Masri 2013; Hasanain, Vallmuur & Clark 2015). However, the adoption rates are still reported to be low in some settings (Alqahtani, Crowder & Wills 2017). The slow adoption rates have been attributed to various reasons ranging from users' perceptions of the cost that affects the implementation, adoption, and use of the EHR technology (Gray et al. 2011; Menachemi & Collum 2011; Stone 2014). For instance, high cost of implementation has been identified as a major obstacle to adopting EHRs in several settings (Ajami & Bagheri-Tadi 2013; Kruse et al. 2016). Healthcare professionals' perceptions of EHRs is also a key determinant to successful implementation and adoption of EHRs. According to Dimitrovski et al. (2013), healthcare providers are the main users of EHR systems and at the centre of their implementation programs in healthcare. Thus, the perceptions of healthcare professionals should be taken into account for successful implementation and adoption of EHRs in various settings.

1.2.1.2 EHRs in primary care

Although EHRs serve the main purpose of managing health records in healthcare, the systems demonstrate significant differences across different settings. Specifically, the EHR system for primary care is different from that of the hospital and other settings in various ways such as capacity and use. For instance, a hospital EHR system is a multiple system with extensive use that is linked to different hospital departments such as clinical units, laboratories and pharmacies through intranet connection to allow sharing of patient information between healthcare professionals within a particular organisation (Mantas, Househ & Hasman 2014).

Conversely, the EHR system in a primary care setting is a single system used in one workstation to collect and manage data related to disease epidemiology and prevalence. For this purpose, EHRs in primary care are useful for providing preventative care as well as healthcare education to patients and the general public (Wickramasinghe, Troshani & Tan 2016). EHRs are also used in primary care to provide ambulatory care, manage community-based primary care, and provide guidelines on various health issues such as nutrition and management of lifestyle conditions (Mantas, Househ & Hasman 2014). Broadly, EHR systems in primary care are used to guide the development of health policies at the population level (Maki & Petterson 2013). From these examples, it is clear that EHRs used in primary care are different to those in other settings such as a hospital.

1.2.2 Contextual background

1.2.2.1 Geographical context of the study

The study which formed a component of this thesis was conducted in Riyadh city, which is the capital of Saudi Arabia. Riyadh is the largest city in Saudi Arabia, belonging to the Nejd and Al-Yamama historical regions (Riyadh Development Authority 2018). It is also the capital of Riyadh province, which is one of the 13 regions in the country. Riyadh is also the second-largest city in the Middle East after Cairo in Egypt (Harrigan 2013). Geographically, Riyadh city lies on a desert plateau of the Arabian Peninsula, which is the central part of the country extending over 1,500 square kilometres (Figure 1.1). For administrative purposes, Riyadh city is divided into 15 municipal districts. These are managed by Riyadh Municipality, which is headed by the mayor of Riyadh, and Riyadh Development Authority. Relying on its own budget, the Authority is responsible for development in the city in all areas, including social, economic, cultural and environmental aspects. It also develops plans and policies for the improvement of facilities and services for the residents of Riyadh.

Figure 1.1: Geographical location of Riyadh

Riyadh city is a modern metropolis and one of the most populated cities in the Middle East. The city has recorded a continuous population growth over time, which is attributed to high birth rates and rapid economic growth in the 1970s and 1980s that led to the influx of millions of immigrants, including Saudis from rural areas as well as foreigners (Harrigan 2013). The 2010 Population Census showed that Riyadh city had a total population of 5,271,991, with the majority (3,153,478, 59.8%) being Saudis (General Authority for Statistics 2010). This represents 60% of the total population of Riyadh city.

Riyadh has heavily invested in modern infrastructure to serve its growing population. Specifically, it provides access to a wide range of social, economic, and healthcare services to its residents. The healthcare services, including advanced care, are provided for free through the public health centres and hospitals. However, the residents can also receive healthcare services from private clinics or other facilities outside the country. There is a huge demand for healthcare services in the city occasioned by the large population. Thus, proper systems are required to ensure efficient delivery of healthcare services in Riyadh.

1.2.2.2 EHRs in Saudi Arabia and primary care centres

Over recent years, Saudi Arabia has made significant strides in the adoption of EHRs in both its hospitals and PCCs. These initiatives have been undertaken as part of the e-health program to strengthen healthcare services and to improve and ensure continuity of the health of its residents and healthcare services in both quantity and quality (Al-Hanawi 2017). However, the adoption of HITs in Saudi's PCCs is still in its infancy stage (Almaiman et al. 2014). The adoption rates are still low both in public hospitals and clinics in Saudi Arabia, with fewer doctors or hospitals possibly having just basic EHRs (Menachemi & Collum 2011; Jabali & Jarrar 2018).

The low adoption rates are partly explained by the challenges faced by the healthcare system in Saudi Arabia, which are similar to those in the developed nations when it comes to the adoption of new technology. Some of these problems include adaptation to technology, privacy and security concerns, costs, and lack of computer skills (Menachemi & Collum 2011; Ajami & Bagheri-Tadi 2013). Alghamdi (2015) noted that these problems could be more common in PCCs where the use of EHRs is a new idea. Almaiman et al. (2014) also noted that the advantages of EHRs in primary care in Saudi Arabia have not been fully utilised despite equipping most of the PCCs with basic ICT requirements. This is attributed to various challenges associated with the system’s use, such as inadequate technical skills, problems with online accessibility, system failure, and loss of interest due to increased work overloads. Disparities in resource distribution between urban and rural or remote areas have also affected the allocation and utilisation of HITs in PCCs in Saudi Arabia. Due to these challenges, the use of paper-based records together with EHRs is still prevalent in the majority of PCCs in Saudi Arabia, with only a few exclusively using EHRs (Almaiman et al. 2014).

These deficiencies in EHR utilisation in PCCs in Saudi Arabia highlight the need to identify the factors that may influence a comprehensive adoption of EHRs in these settings. As such, various technology acceptance theories and models have been used to predict the factors that influence the adoption of EHRs in primary care. In this thesis, the TAM (detailed in Chapter 3) was used to explain healthcare professionals’ perceptions towards the adoption of EHRs in primary care settings in Riyadh city in order to predict acceptance and use.

1.2.3 Rationale of the study

The literature evidence shows that the integration of EHRs into primary care settings faces several challenges, such as individual, cultural and financial factors, and bureaucratic procedures (Alsulame, Khalifa & Househ 2015; Mason & DiDomenica 2016). Users’ perceptions, in particular, have been found to have a significant influence on the acceptance or rejection of EHRs, hence adoption (Lakbala & Dindarloo 2014; Dutta et al. 2015; Kruse et al. 2016). However, the previous studies have mainly been conducted in other settings, and the translation of this evidence into the GCC context, such as Saudi Arabia, is unknown. Further, the approach of implementing EHR systems is not a ‘one size fits all’ as different countries use various models of implementation (Stone 2014).

In Saudi Arabia, EHRs are mainly used in hospital settings but are limited in primary care, which is the first point of care for the majority of the Saudi population (O'Malley et al. 2015). Previous studies on EHR adoption have primarily focused on hospital settings but not on primary healthcare practice, which faces lower rates of EHR adoption compared to hospital settings, the reasons for which are yet to be known (McAlearney et al. 2013; Reid Jr 2016). Those conducted in primary care settings also have not been able to yield sufficient knowledge on the subject of healthcare professionals' perception of the adoption of EHRs in PCCs. The research gap is even wider in the context of a GCC country, and this lack of evidence about the attitudes of healthcare professionals towards the adoption of EHRs in a primary care setting is likely to derail the successful implementation of these systems in such settings.

In view of this research gap, the developed conceptual framework in this thesis will contribute to the understanding of the factors that could promote or hinder acceptance, adoption and successful implementation of EHR systems in primary care practices in the GCC countries and in similar settings across the globe to improve the quality of health service provision. Of more considerable significance is that this research will be of benefit to various stakeholders in the healthcare sector both in Saudi Arabia, across the Gulf region, and globally. First, the findings from this study will inform the Saudi's Ministry of Health (MoH) strategy for the implementation of EHRs in all PCCs in the country, and in particular their healthcare professional engagement strategy. The Saudi MoH may also use the research findings to evaluate its current strategy of implementing EHRs in all ministry-operated healthcare centres. Other governments across the GCC areas may also use the results of this study for the same purpose. Health professionals are the primary users of the EHRs, and therefore this research will inform their knowledge base of the benefits of EHR systems in providing safe and high-quality healthcare. Policymakers and managers in the healthcare sector may gain insights into the potential factors that may affect the adoption and implementation of EHR systems from the user, organisational and system perspectives.

This study will also become the basis for translational research in the Gulf region. Researchers may also benefit from this study as it makes a unique contribution to the research knowledge regarding the factors affecting EHR adoption in a primary setting in the GCC context from the perspective of health professionals. It is hypothesised that the proposed conceptual framework is translatable across countries with a similar system and culture, which needs to be tested. Thus, it can be used as an important resource for future research. Lastly, academics and students can also benefit from this research as it provides both theoretical and empirical knowledge on the use of EHR systems in primary healthcare and associated benefits.

1.3 Research aim and objectives

This thesis aims to explore healthcare professionals' perceptions towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. This is examined in terms of perception of benefits and obstacles to adopting EHRs and satisfaction with the system in primary care. In order to achieve the research aim, the objectives of this thesis are to:

1. Explore healthcare professionals' perceptions of the benefits and obstacles of adopting EHRs in PCCs in Riyadh city, Saudi Arabia.
2. Determine healthcare professionals' satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia.
3. Assess the influence of sociodemographic characteristics on healthcare professionals' perceptions of benefits, obstacles, and satisfaction with the EHRs in PCCs in Riyadh, Saudi Arabia.

4. Determine the relationship between perceived benefits, obstacles, and satisfaction with EHRs in PCCs in Riyadh city, Saudi Arabia.

5. Develop an empirically derived conceptual model, based on the literature and real-world perceptions in Saudi Arabia that can be applied across the GCC areas.

1.4 Research questions

The primary research question for this thesis is:

What are the perceptions of healthcare professionals about the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia?

This can be further broken down into the following sub-questions:

1. What are the healthcare professionals' perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

2. What are the healthcare professionals' perceptions of obstacles to adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

3. Are healthcare professionals satisfied with the EHRs in PCCs in Riyadh city, Saudi Arabia?

4. What is the influence of the sociodemographic characteristics of healthcare professionals towards their perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

5. What is the influence of sociodemographic characteristics of healthcare professionals towards their perceptions of obstacles to adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

6. What is the influence of sociodemographic characteristics of healthcare professionals towards their satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia?

7. What is the relationship between perceived benefits, obstacles, and satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia?

8. How do the perceptions of healthcare professionals in Saudi Arabia differ from elsewhere in the GCC areas and world at large?

1.5 Organisation of the thesis

This thesis is organised into eight chapters as follows:

Chapter 1: Introduction

This chapter introduces the thesis and sets the stage by providing the background and rationale of the thesis, the research aim, objectives and questions.

Chapter 2: Literature Review

A critical review of the literature about EHRs in primary healthcare from both theoretical and empirical perspectives was undertaken. It provides a historical review of health information capture. The relevant literature on the benefits and challenges to adopting EHRs, as well as satisfaction with the system in general and specifically in primary care are also reviewed. The research on the factors influencing the adoption of EHRs in healthcare from the providers' perspective was also examined. The chapter also provides context about the Saudi healthcare system, specifically PCCs, and critiques the literature on EHRs in Saudi Arabia.

Chapter 3: Technology Acceptance Model and Draft Conceptual Framework

Chapter 3 describes the selected theoretical approach to this research, namely the Technology Acceptance Model (TAM). The chapter also details how the individual, organisational and system factors influence technology acceptance, and applies the TAM to the available literature presented in Chapter 2. The chapter concludes by presenting a draft conceptual framework of the thesis.

Chapter 4: Methodology

This chapter presents the employed methodology to achieve the aim of this thesis. The chapter describes the research lens for this thesis and the study method, including the study design, study location, target population, participant recruitment and selection, statistical methods including the sampling method and size, data collection instruments and their validation, and data collection and analysis procedures. The data management plan and other ethical considerations of the research study are described.

Chapter 5: Results

Chapter 5 provides the results of the survey. An overview of the findings is presented, including the response rate and the demographic characteristics of the respondents. The chapter is then divided by research sub-question, showing the results of the analysis that addresses each of the research questions. The findings from the thematic analysis of qualitative data are also presented.

Chapter 6: Discussion

This chapter discusses the findings in relation to the research questions and links these findings with the previous research as identified in the literature review. The discussion particularly focuses on the healthcare professionals' perceptions of the benefits, obstacles and satisfaction associated with the EHRs in primary care. The factors influencing the perceptions identified from this thesis are also discussed.

Chapter 7: Final Conceptual Model

The chapter presents the final developed conceptual model of the thesis for the adoption of EHRs in PCCs within the GCC context. The components of the model are also discussed with respect to the broader range of literature as well as within the Saudi context.

Chapter 8: Conclusion and Recommendations

The chapter provides the recommendations and conclusion of the study, including the implications of the findings for practice, research and education. The chapter also summarises the key points of the research, discusses the strengths, contribution of the study to the literature and limitations of the study, and ends with recommendations for future research.

1.6 Chapter summary

This chapter has presented the background information related to this study. It has also provided the rationale and research aim and objectives as well as the research questions. The chapter ended by presenting the organisation of the thesis, thereby setting the stage for the next chapter.

CHAPTER 2 : LITERATURE REVIEW

2.1 Introduction

This chapter critically reviews the literature pertinent to the research question. Key definitions for EHRs, user satisfaction and primary care are provided. The chapter also provides a detailed examination of EHRs, including historical development, purpose and meaningful use. The differences in EHRs' use across different health settings, and the benefits, challenges, risks and obstacles associated with EHR adoption and implementation are also provided. In addition, factors that influence the perception of these are discussed. This chapter also examines the Saudi healthcare system and the use of EHRs in Saudi Arabia.

2.2 Definitions

2.2.1 Electronic health record

The EHR is an evolving concept in health information management with varied definitions. Maki and Petterson (2013) defined an EHR as 'an electronic record of health-related information belonging to an individual that is created, managed, and can be electronically shared amongst authorised health professionals in more than one health care organisation' (p. 2). This definition is similar to that by Castillo, Martínez-García and Pulido (2010) who defined an EHR as a digital repository of all the information regarding the health of an individual, stored in a form that is processable, transmissible, and accessible by multiple authorised parties in a secure manner. The US Centres for Medicare and Medicaid Services (2012) further defined an EHR as 'an electronic version of a patient's medical history, that is maintained by the provider over time, and may include all of the key administrative clinical data relevant to that person's care under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunisations, laboratory data, and radiology reports' (n.p). In line with this definition, Seymour, Frantsvog, and Graeber (2012) defined an EHR as an electronic version of the health record of a patient that was historically created, used, and stored in a paper chart.

Although the previous definitions have mainly focused on only individuals, populations are also included in the current definitions. For instance, Grossman et al. (2016) defined EHR as an electronic system that carries retrospective and concurrent healthcare information belonging to individuals and populations. Yanamadala et al. (2016) also defined EHR as a collection of electronic information about patients as well as populations. Therefore, a more comprehensive definition of an EHR should include both individuals and populations. Thus, the definition of EHR that has been adopted in this thesis is that an EHR is an electronic system for generating, processing, storing, managing and retrieving health information of individuals or populations.

2.2.2 User satisfaction

User satisfaction, also referred to as customer satisfaction, is a term that is commonly used in various contexts including technology. However, customer (user) satisfaction as a concept has varied definitions based on different approaches. Lee (2009) argued that the definition of customer (user) satisfaction can be based on two different approaches: process-oriented or outcome-oriented, which leads to two types of definition. In this regard, the process-oriented approach defines customer satisfaction as the difference between the expected and achieved satisfaction. Conversely, the outcome-oriented approach views satisfaction as an attribute derived from consumption of a product or service.

Regarding computer applications, user satisfaction can be defined as 'the user's comfort and acceptability of a computer application during the consumption of the content and the interaction with the system' (Olukayode & Lekan 2019, p. 2333). User satisfaction was also defined as the overall evaluation of the effectiveness of a computer or information system by an end-user based on their own experience, which is often measured with a Likert scale (Lee 2009). It is thus clear from these definitions that user satisfaction is the extent to which the users consider a system meets their needs, particularly in terms of its usefulness and ease of use.

2.2.3 Primary care

The concept of primary care appears to have varied definitions. According to the World Health Organization (WHO) (2019), primary care has been repeatedly interpreted and redefined. In some contexts, it is referred to as the provision of first-level personal or ambulatory care services, while in others it refers to a set of priority health interventions for low-income populations. Due to these differences, the WHO has provided a single definition based on three components, namely:

1. meeting the health needs of the people through the provision of comprehensive care (promotive, protective, preventive, curative, rehabilitative and palliative) throughout the lifetime by prioritising critical health services for individuals and families as well as population through primary care and public health functions respectively;
2. addressing the broader determinants of health that include social, economic, environmental and people's characteristics and behaviours through evidence-based public policies and actions across all sectors, and
3. empowering individuals, families and communities to be advocates for policies that promote health and well-being to optimise their health.

Thus, the WHO defines primary healthcare as 'a whole-of-society approach to health and well-being centred on the needs and preferences of individuals, families, and communities' (WHO 2019, n.p.). In contrast, the American Academy of Family Physicians (AAFP) narrows the definition of primary care to involve individuals and their primary care physicians and other healthcare providers (AAFP n.d.). The AAFP, therefore, defines primary care as a comprehensive first contact and continuing care provided to persons with any undiagnosed health problem by trained and skilled physicians. It also recognises that primary care involves health promotion and maintenance, disease prevention, counselling and patient education, as well as diagnosis and treatment of acute and chronic illnesses in a variety of healthcare settings. Another common definition is by the OECD (n.d.), which refers to primary care as the first level of contact for the population with the health care system addressing main health problems in the community and providing preventive, curative, and rehabilitative services. A characteristic feature of primary care from these definitions is that it focuses on the provision of both preventive and curative or therapeautic care. This involves different healthcare providers who work together in given setting to meet the health needs of both individuals and populations.

2.3 Electronic health records

2.3.1 Historical overview of health information capture

Prior to the introduction of computers in the 1960s, the earliest patient medical records were mainly narratives written by ancient Greeks (Malhotra & Lassiter 2014). These included brief case histories of successful cures that were maintained and shared for learning purposes. This would lead to the development of medical records, with the first known being the Papyrus text developed by Hippocrates of Egypt. This text contained 48 filed case reports of injuries, wounds, fractures, dislocations and tumours dating back to 1600 BC (Malhotra & Lassiter 2014; Doyle-Lindrud 2015). The case reports were used intermittently for many years by physicians; however, their retrospective documentation raised concerns in the 1880s as legal documents for medical records. Therefore, by 1898, the patient record was moved to the patient bedside to record cases reported in actual time. These medical records contained a variety of patient information including family history, patient habits, previous illnesses, present illness, physical examination, admission urine, blood analysis, progress notes, discharge diagnosis, and instructions.

Subsequently, in the 1920s, physicians started to carefully document observations and actions on paper while treating patients and sharing this information in order to teach other healthcare professionals how to improve the diagnosis and treatment of illnesses in advanced healthcare (Doyle-Lindrud 2015). The paper records in which medical records were written were then bound together into files and labelled based on patients' names and other identifying information such as social security number or admission number for inpatient records. The paper records contained information including diagnoses, lab reports, visit notes and medications (Marquez 2017).

The introduction of technology led to a shift in managing patient records from paper-based to electronic format. The first electronic system was created in the mid-1960s by Lockheed (Atherton 2011; Marquez 2017). This system was known as a clinical information system, taking the form of computer-supported applications with a relatively large and long-term database containing clinical data used to assist in managing patient care. Developed and maintained in-house, the system had centralised data processing on mainframe computers with large disk memories. They were mainly found in large hospitals and academic centres, their role being to perform administrative and financial functions.

With the advances in healthcare and development of technology, smaller computers that can support clinical functions such as pharmacy, clinical laboratory, patient registration and billing emerged (Evans 2016). However, their main disadvantage was that they only supported department-specific functions, limiting their accessibility by other departments. Thus, in the late 1960s, numerous hospitals and universities began developing more detailed EHR systems. These included Health Evaluation through Logical Processing (HELP), developed by the University of Utah in collaboration with 3M, and the Computer Stored Ambulatory Record (COSTAR) developed by Massachusetts General Hospital and Harvard in 1968 (Atherton 2011). The US federal government started using EHRs in the 1970s through the Department of Veteran Affairs. They implemented a system known as VistA that was initially called the Decentralized Hospital Computer Program (DHCP). These early systems were known as computer-based patient records whose goal was to deliver safe and quality patient-centred care (Gartee 2017).

Broader usage of EHRs only emerged in the 1980s and 1990s in developed countries, following the development of technology (Anthony & Campos-Castillo 2015). The Institute of Medicine in the US conducted an extensive analysis to develop the early EHR standards and sought to establish electronic healthcare systems to assist physicians and facilitate healthcare across the world (Gartee 2017). As a result, there has been a transition across the globe towards adopting EHRs, but this transition has been slow, particularly in certain health settings. Aldosari (2014) also observed that there are significant variations in terms of when and how different countries across the globe adopt EHRs.

The period between 2000 and 2010 was notably a critical period during which use of the EHR was recognised nationally in countries such as the US and the UK, and most countries across the world incorporated some components of EHR to help manage big medical data. This evolution of EHRs was to guarantee correct patients' medical records as well as safe, quality and sufficient healthcare to diverse patients across the world (Aldosari 2017).

Consequently, subject to these functionalities, various developing and developed nations have prioritised the adoption of EHRs. However, the functionalities and usefulness of EHR systems have not been fully exploited in most countries worldwide, particularly in those that are developing (Boonstra, Versluis & Vos 2014). Indeed, developed nations such as the UK and Canada have a universal EHR system, while developing countries such as Saudi Arabia face numerous challenges in adopting and implementing health information systems such as EHRs (Hasanain, Vallmuur & Clark 2015; Aldosari 2014). In order to address these challenges to ensure successful implementation, various studies have focused on identifying the barriers to EHR adoption and finding appropriate mitigation strategies.

2.3.2 Purpose of electronic health records

The purpose of EHRs is mainly derived from the Institute of Medicine's report that highlighted eight core functions of EHRs, namely health information and data, result management, order management, decision support, electronic communication and connectivity, patient support, administrative processes and reporting, and reporting and population health (Tang 2003). It is a critical component of strategic healthcare management capable of dynamically transforming the collection, processing and overall management of healthcare records and data (Hovenga & Kidd 2010).

According to Evans (2016), the EHR system is a crucial component of any contemporary healthcare system since it is a significant way through which healthcare providers can enhance their operation, improve collaboration between different agencies, and help monitor the patient's safety and overall care. Moreover, the expansion of healthcare systems means that most of them have to deal with vast volumes of data, and an EHR system provides an effective and efficient way of storing and managing such data (Fallon, Begun & Riley 2013).

Lastly, the EHR system is vital in the measurement and management of performance of healthcare facilities since they allow for collection and review of data from different healthcare entities such as primary care, home care, ambulance service, pharmacy, laboratory and hospitals (Calman et al. 2012; Wickramasinghe, Troshani & Tan 2016). Various bodies, such as the MoH in Saudi Arabia, can then use this information to get an overall picture of how their healthcare system is performing. According to Grossman et al. (2016), EHR systems are important as useful tools in administrative processes such as recording of patient identification and payment information. Overall, the EHR system can be used to document healthcare services for the purposes of making critical healthcare decisions and sharing such information amongst health care providers, government agencies, voluntary groups, and other healthcare-related associations for enhanced provision of care or policy directions.

2.3.3 Meaningful use of electronic health records

As healthcare systems became more complex, so then came the concept of 'meaningful use' (MU). The US government initiated the idea of MU, which refers to the use of certified EHR technology in a meaningful manner to improve the quality of healthcare process through the use of HIT (Department of Health and Human Services 2013). MU is defined by five key components involved in the use of EHR to:

1) improve quality, safety and efficiency of care and reduce health disparities;

2) engage patients and families in their health;

3) improve care coordination;

4) improve population and public health, and

5) maintain adequate privacy and security protection for patient health information.

In order to accelerate the adoption of EHRs and achieve these aims, the US government introduced an incentive program qualifying individual physicians and hospitals to receive incentive payments if they attained meaningful use of a certified EHR system through the Health Information Technology for Economic and Clinical Health (HITECH) Act 2009. This legislation also imposed penalties for providers who failed to meet the requirements of MU.

Since its inception when healthcare providers began using standardised computerised health records, MU has significantly transformed the provision of healthcare services in the US (Calman et al. 2012; Lammers & McLaughlin 2017). In an updated systematic review, Jones et al. (2014) noted that the adoption of EHRs has been on the rise since the implementation of the HITECH Act. This has been associated with positive impacts on quality, safety and efficiency outcomes. Bowes (2014) also noted that healthcare providers who had adopted certified EHRs reported improved delivery of care with MU. Thus, MU has the potential of enhancing effective use of EHR technology in other settings, such as the GCC areas, to improve the quality of care and reduce healthcare costs. As such, healthcare professionals may be provided with incentives to effectively adopt the systems through direct and indirect incentives such as rewards by hospitals, rewarding of overtime, and bonuses for the successful implementation of EHR.

2.3.4 Differences in the use of electronic health records in primary care and hospital settings

There are considerable variations in the use of EHR systems in primary care and hospital settings. As reported in section 2.2.3, primary care is a small setting that meets the undifferentiated health needs of a person, community or population. Conversely, hospitals refer to healthcare settings that meet more complex needs or secondary care that often cannot be addressed at a primary care level (Smeele et al. 2019). The EHRs used in these settings vary in a number of ways such as purpose, design and capacity. For example, hospital EHRs have a broad use and include both intranet and database level, while primary care is only intranet, meaning that it can only link different departments within a single organisation

(Rowley 2017). Moreover, hospital EHRs are used to create and share laboratory and radiologic reports; make evidence-based decisions such as diagnosis and treatment, and create physician notes and nursing assessments for patients in both inpatient and outpatient settings (Fallon, Begun & Riley 2013; Secginli, Erdogan & Monsen 2014).

Conversely, the EHR system used in primary care is mainly for preventative care purposes and these include collection and management of data such as on disease epidemiology and prevalence; improvement of ambulatory care, management of community-based primary care, provision of guidelines on issues such as nutrition management and lifestyle-related condition (Mantas, Househ & Hasman 2014). The EHR system in primary care is also utilised to provide healthcare education to patients and the general public, thus creating awareness with regard to health matters (Goveia et al. 2013; Wickramasinghe, Troshani & Tan 2016). In addition, primary care EHRs are extensively utilised in the development of policies concerning healthcare matters (Maki & Petterson 2013). More differences are summarised in Table 2.1.

Table 2.1: Differences between hospital and primary care EHRs

Primary care EHRs	**Hospital EHRs**
Single system	Multiple systems
Single log in	Multiple logins
One workstation	Multiple workstations
Multiple conditions	Multiple specialties
Workflow: Longitudinal care and planning	Workflow: Episode of care and acute care planning
Small budget systems	Larger budget systems
No or minimal digital strategy	Long-term digital strategy
Standalone system	Multiple-site system
Small number of users	Large number of users
Small security controls	Large security controls
Local billing services	Ministry funding reporting
Off-the-shelf or web-based products (limited modifications to the product)	Internally built, or vendor built by specification product
Tech support from a vendor	Tech support from an internal IT department

2.3.5 Benefits of electronic health records

There are several reported benefits when using EHRs. These benefits to healthcare providers, patients and healthcare organisations drive the adoption of EHRs. This section examines the reported perceived benefits of EHRs in the published literature.

2.3.5.1 Reduced paper-based documentation

The EHR system is an automated system that integrates all patient information from medical, nursing, laboratory, radiology and pharmacy departments (Tubaishat 2018). In achieving this purpose, EHRs use digital data, which is recorded in electronic databases and displayed across users' platforms. This results in the elimination of the paper-based record at different stages of care. Thus, the adoption of an EHR system could lead to reduced use of paperwork and filing (Al-Harbi 2011).

The reduced paper-based documentation due to the use of an EHR system has been reported to be associated with several benefits. The electronic storage is believed to reduce the risk of losing vital patient data and makes it easy to reconcile the patient's entire health information (Al-Harbi 2011; Menachemi & Collum 2011). It is also reported that EHRs allow the storage of printable data, which translates into simple offices with less storage space (Al-Harbi 2011). Cost savings in health data documentation is another area that is positively impacted by the use of EHRs (Menachemi & Collum 2011; Perera et al. 2011; Silow-Carroll, Edwards & Rodin 2012). For example, an examination of EHR use in nine leading hospitals in the US by Silow-Carroll, Edwards and Rodin (2012) showed that the use of EHRs led to significant reductions in paper-related costs. Specifically, Gundersen Hospital which was part of a multi-hospital integrated health system together with Metro Health Hospital reported a decrease of the expenses related to transcription and copy paper by 75% and 27% respectively. This evidence from the literature shows that the use of an EHR system could not only decrease paper-based documentation but could also lead to other benefits, such as better storage of data and reduced healthcare costs.

2.3.5.2 Better patient data management

EHRs also appear as an innovative and effective way in which to manage patient data. The adoption of EHRs has been reported to improve the capturing and quality of data, in turn leading to better delivery of patient care (Kern et al. 2015). Healthcare providers use EHR systems to collect, store and share vital patient information ranging from the patient’s medical history to laboratory results for the provision of quality care (Silow-Carroll, Edwards & Rodin 2012). With the EHR system, the data can be collected in real time, continuously processed and backed up, and stored in a single database that can be accessed anywhere for various purposes such as research and diagnosis. Thus, an EHR system provides better and quality data that are current, complete, accurate, plausible, concordant, reliable and reproducible (Kuo, Liu & Ma 2013; El Mahalli 2015; Van Hoeven et al. 2017). Furthermore, the use of EHRs can help hospitals to store, retrieve and use health information in formats, which are versatile and offer diverse functionalities for data manipulation (Al-Harbi 2011). These benefits of data management allow EHRs to provide a platform that supports healthcare professionals in delivering care informed by high-quality data.

2.3.5.3 Improved access to patient data

The EHRs have also been reported to enable easy access to health records by both the patients and their providers. As a single system, the EHR system makes it easy for the providers to access the stored data from anywhere without the restriction of the traditional physical location of paper files (Menachemi & Collum 2011; El Mahalli 2015). Gagnon et al. (2014) also asserted that EHRs allow quick access to patient data, including results, thereby avoiding duplication of examinations.

Furthermore, the EHR data can be retrieved in a simplified and faster manner through checklists, alerts and predictive tools of the system (Silow-Carroll, Edwards & Rodin 2012). The data are also printable in paperwork, making them available in different formats (Nguyen, Bellucci & Nguyen 2014). Kuo, Liu and Ma (2013) also noted that EHRs retain data quality while sharing this information across networks, which might rarely be achieved when using paperwork. The EHR sharing platform is also reported to be secure and easily accessible (Mantas, Househ & Hasman 2014). Thus, EHR systems enable faster access and sharing of a pool of patient data in a timely and quality manner.

These benefits of EHRs are even more crucial in integrated systems. According to Stanberry (2011) and Anthony and Campos-Castillo (2015), interconnected systems can allow simultaneous access to real-time patient information contained in the EHR by different healthcare providers at different locations. This is important in emergencies where different healthcare professionals in various departments need to access the patient's information and make urgent clinical decisions. Access and sharing of all the required patient information amongst authorised healthcare providers could facilitate informed decision-making by healthcare providers that result in better care (Maki & Petterson 2013; Gagnon et al. 2014).

Due to the ease of access to patient data, EHRs present a perfect opportunity for healthcare providers to diagnose, share and retrieve information (Cebul et al. 2011; Middleton et al. 2013). The additional information offered by EHR systems also empowers the physicians by helping them to better understand their patients and care services (Hibbard & Greene 2013). As such, the adoption of EHRs has led to a rise in the rate of access to past medical information, which facilitates the provision of care (Silow-Carroll, Edwards & Rodin 2012).

The ability of EHRs to promote access to patient data is not only beneficial to the providers but also the patients as EHR serves as an important platform for patient support (Goveia et al. 2013; Ardito 2014). Friedman, Parrish and Ross (2013) asserted that EHRs are used to communicate with patients regarding their care and to provide important educational materials besides enhancing sharing information among healthcare professionals. The US Agency for Healthcare Research and Quality (AHRQ) Health Care Innovations Exchange Team (2014) also reported that EHRs might assist patients in gaining access to their health information, especially if the data from EHRs are integrated into patient portals and personal health records. Similarly, a significant number of hospitals in Saudi Arabia have portals that give their patients access through a web-based platform in order to download their records (Al Alawi et al. 2014). Other health facilities give their patients electronic copies of their health records through storage devices such as USB flash drives. By allowing patients to access their files, EHRs enable them to take gain understanding of their health and take an active role in managing it (Hovenga & Kidd 2010; Mantas, Househ & Hasman 2014). The ability of patients to access their data could also help providers to meet a crucial requirement for patient engagement (AHRQ Health Care Innovations Exchange Team 2014).

2.3.5.4 Improved access to practice standards

Access to practice standards is another reported benefit of EHRs. Al-Harbi (2011) and Middleton et al. (2013) noted that some EHRs provide online access to practice standards or procedural guidelines that guide the diagnosis and treatment of various diseases and conditions. Some healthcare organisations, such as the American Nursing Association (ANA) and the WHO have integrated their care practice guidelines into EHR systems, thereby increasing access by healthcare providers (Cebul et al. 2011). Thus, EHRs act as critical tools for accessing various practice standards by health professionals. It is also worth noting that the systems also allow the providers to seek clarification or make suggestions about the guidelines easily.

2.3.5.5 Improved access to scientific data

EHRs also provide access to quick and reliable scientific data that facilitate scientific research. According to Cowie et al. (2017), EHRs facilitate clinical research as a source of primary data and participant selection for various studies. For example, EHRs have been used as a primary source of data for observational studies (Barnish & Turner 2017), randomised controlled trials (Aldosari 2014; Cowie et al. 2017), and comparative and embedded pragmatic studies (Aldosari 2014). In clinical trials, EHRs can help in assessing feasibility, facilitating the recruitment of participants, collecting baseline data, and streamlining data collection and aiding follow-up (King et al. 2014; Cowie et al. 2017). Thus, EHRs can help to overcome the recruitment challenges involved in the conventional methods that can lead to uncertain generalisability (Aldosari 2014).

EHRs can also help in monitoring and reporting data in clinical trial studies, such as adverse drug events (Anthony & Campos-Castillo 2015; Cowie et al. 2017). Furthermore, EHRs allow the collection of high-quality research data within short periods with high coding accuracies (Alqahtani, Crowder & Wills 2017). Altuwaijri (2008) noted that at higher levels, EHR records help in standardising of data and the overall healthcare process, which enables researchers and managers to access the combined data from numerous health centres to support research and carry out policymaking.

The role of EHRs in research has also been evidenced with its applications. For example, the Electronic Medical Record Search Engine (EMERSE) was reported to assist in the retrieval of medical records and reports that are useful in research (Hanauer et al. 2015). EHRs also provide opportunities for clinical data mining that is crucial in the retrieval and processing of data (Botsis et al. 2010). However, this can only be achieved with the use of efficient systems by incorporating new informatics technologies. Lastly, the data obtained from EHRs can be easily transferred to analysis software, such as STATA, SPSS, Excel, SAS and Google analytics, making it easy to analyse and present EHR data. Therefore, the use of EHRs offers a significant opportunity in research studies by aiding healthcare providers to carry out medical research.

2.3.5.6 Time-saving

EHRs are also believed to result in time-saving in undertaking care processes such as care documentation, storage and sharing of patient data. EHRs can be used during consultations to perform various functions such as ordering prescriptions through the system. This has been reported by healthcare providers to significantly save time compared to paper-based systems involving the use of pen and paper (Cornford, Hibberd & Barber 2014; Porterfield, Engelbert & Coustasse 2014; Evans 2016). While examining various processes undertaken in inpatient care, Kern et al. (2015) reported that EHR systems save time as much as two-fold compared to manual methods. The authors also noted that this is only a face value as time-saving is exhibited throughout the lifetime use of EHRs.

In addition to data documentation, EHRs are reported to save time in the retrieval of the stored data. Evans (2016) asserted that EHRs provide convenience in accessing the documented data within the shortest time possible by just a click of a button with the help of keywords. Kern et al. (2015) also noted that manual records are excessively time-consuming and unreliable in undertaking bulk data analysis to the extent that the cost of retrieving such data may outweigh the apparent benefits. Thus, an EHR has the capability of information management in providing data to users within the shortest period and with confidentiality and reliability, security, and high accuracy (Harman, Flite & Bond 2012; Senese 2015). This is attributed to the centralisation of data by the EHR and the ability of the system to provide universal connectivity, which offers adequate dependency and autonomy and significantly saves the health practitioner's time when accessing data. Therefore, the adoption of EHRs could be related to the system's ability to save time by enhancing speedy access, typing instead of handwriting, and retrieval of patient information.

EHRs also appear to save time in performing administrative tasks. Silow-Carroll, Edwards and Rodin (2012) reported that the use of an EHR resulted in significantly shorter time in billing, chart reviewing, abstracting patient information, patient scheduling, and notes' transcription. An example is where EHR systems integrated with an electronic pad-based patient signature system were used in NewYork–Presbyterian Hospital to capture patient signatures rather than manually scanning signatures written on paper. This ensured that patients' notes and signatures were captured in real time, thereby significantly saving time spent on documentation. Additional benefits were realised with the use of real-time medical dictation that automatically incorporates the notes into the EHR system, thus significantly enhancing the information bank and reducing lengthy typing of information. A meta-analysis by Campanella et al. (2015) also showed a positive association between the use of an EHR system and reduced time in data documentation.

2.3.5.7 Enhanced data transfer

Healthcare professionals have also reported ease of transferring data when using EHRs. While pen and paper have been the conventional means of sharing information, the use of electronic data format enhances the capabilities of modifying data, reducing bulkiness, sharing to multiple users, and offering better visuals (Sheikh et al. 2011). The use of the internet in EHR systems presents high-speed channels to share data in formats that can be decoded from any destination across the world, provided there is connectivity (Cresswell & Sheikh 2013). It enhances the capacity to upload, send and access bulky data conveniently within milliseconds across different destinations (Sheikh et al. 2011).

2.3.5.8 Enhanced following of test results

EHRs enable clinicians to follow up on test results that improve patient care (Menon et al. 2014b). An EHR system has various functionalities, such as dealing with queries arising from laboratory test results in addition to patients' historical data, thereby allowing clinicians to follow up on patients' test results (Nguyen, Bellucci & Nguyen 2014). After posting by the laboratory, the systems can notify the clinicians about available results as well as abnormal results, which enable caregivers to log into their EHR system and view the results (Perrotta & Karcher 2016). The systems also include audit trails that allow laboratory technologists to see when a clinician viewed a result and when they acknowledged receipt. Healthcare providers can then use the detailed record of medical test results to make adjustments or set appointments easily. Primary healthcare professionals have also reported that the use of EHRs improves follow-up with patients concerning their test results (Palabindala, Pamarthy & Jonnalagadda 2016).

Patients can also easily access their test results through the system, thus bridging the gap in notifying patients of their test results (Menon et al. 2014b). Patient access to health records can have positive impacts on healthcare. For example, Woods et al. (2013) noted that patients with access to their health information reported improved communication with their providers, enhanced knowledge of their health, and better self-care. Access to records also allows patients to actively participate in their care process such as following up on abnormal laboratory results and decision-making that improves the quality of care.

2.3.5.9 Improved quality of information

EHRs emerge as a source of high-quality data for healthcare professionals to make decisions on patient care, research and management of health facilities. Middleton et al. (2013) noted that healthcare professionals reported that EHRs offer highly reliable information which is collected firsthand from health professionals and is stored continually in a centralised online platform where it can be accessed conveniently. Thus, healthcare professionals access better quality information when using EHR systems that can be used in decision-making and consequently improving their performance (Blumenthal & Tavenner 2010). Overall, with improved data capturing, presentation and analysis along with the decision-making support, EHRs have improved the quality of information in healthcare.

2.3.5.10 Improved communication

Another important reason for adopting and using EHRs is to enhance communication in healthcare. According to Benson (2012), ‘healthcare communication and information flow patterns involve many people over a wide geographic area and diverse subject matter’ (p. 7). Such people may include specialists operating in different health facilities. With the use of EHRs, healthcare providers within the same or different organisations are able to consult each other and communicate a variety of issues that could be administrative or medical. For instance, healthcare professionals could use the EHR to share and exchange various patient-related data, such as medical histories, diagnosis, laboratory results and prescriptions, between themselves. This is crucial for enhanced and timely delivery of care. However, communication in healthcare can also be between healthcare professionals and their patients.

Past studies have reported that EHRs are essential tools for promoting communication and information sharing between health professionals (Gagnon et al. 2014; Bardach, Real & Bardach 2017). Chase et al. (2014) reported that most of the hospitals with comprehensive EHR systems had faster and more accurate communications between ambulatory and hospital settings as well as providers within the hospital. In the US, the primary care health professionals stated that the adoption of EHR systems results in improved communications between health professionals that is associated with enhanced ease of access to medical records, patient care plans, allergy lists, medical histories and notes, making complete medical history accessible from one professional to the other (Palabindala, Pamarthy & Jonnalagadda 2016). EHRs have also been shown to play a crucial role in handoff communication by helping in the structuring of quality handoff reports, which ensure effective and accurate communication between caregivers (Alghenaimi 2012). This enhances accessibility to patients' medical records and promotes effectiveness and efficiency in transition of care that ensures continuity of care. In supporting communication between healthcare professionals, Anthony and Campos-Castillo (2015) noted that this function is based on the systems' capabilities in providing a reliable and seamless exchange of clinical information between different users.

In addition to facilitating communication between providers, EHRs also enhance communication between the provider and the patient. They can help the provider to share with the patient their medical records (Rose, Richter & Kapustin 2014). The use of EHRs has significantly enhanced communication by ensuring a coordinated flow of information among providers and their patients, leading to increased patient involvement and better patient care (Silow-Carroll, Edwards & Rodin 2012). In a study by Middleton et al. (2013), healthcare professionals reported better communication with their patients with the use of EHRs. Similarly, Perera et al. (2011) indicated that better communication was achieved between patients and healthcare professionals with the use of EHR systems. Alqahtani, Crowder and Wills (2017) noted that most patients felt that they were updated on their health status conveniently without incurring additional expenses such as transport and having to waste time in queues waiting for health services. Therefore, EHRs make it easy for patients to reach their providers regarding the care provided. However, it should be noted that communication between providers and their patients is particularly enhanced by advanced EHR systems that have portals in which patients can interact with their healthcare providers to discuss their health, appointments and other health-related directions with comfort.

2.3.5.11 Enhanced clinical decision-making

The EHR also serves as a critical tool for healthcare professionals when making patient care decisions. Cresswell and Sheikh (2013) reported that EHRs could enhance health professionals' ability to make patient care decisions in various ways. First, the systems may have facilitating factors such as the creation of shortcuts to documents with abnormal examination results, drug administration, and prescriptions. They can also flag such data in order to warn physicians to provide quick feedback to patients or other healthcare providers, thus improving the quality of care provided.

Further, EHRs provide treatment goals through the provision of alerts and predictive statistics, thereby informing healthcare providers of the best approaches to managing a patient's health situation and resulting in better outcomes. Platforms with additional features such as Framingham calculators can help clinicians to calculate various patients' parameters, such as body mass index, resulting in the ability to inform healthcare providers on the best approaches to delivering healthcare (Menachemi & Collum 2011).

2.3.5.12 Reduced medical errors

Health professionals have also reported that the use of EHRs enables them to reduce the risk of medical errors that is associated with improved patient safety and quality of care (Gagnon et al. 2014; Palabindala, Pamarthy & Jonnalagadda 2016; Pelland, Baier & Gardner 2017). In their meta-analysis, Campanella et al. (2015) reported a low number of medical errors with the use of an EHR. A survey conducted by the US Office of the National Coordinator for Health Information Technology also showed that 51% of physicians felt positive about EHR alerts that helped them to avoid medication and laboratory errors that can potentially harm the patient and compromise patient safety (Hydari, Williams & Zimmer 2014).

These reduced medical errors have been associated with several factors when using an EHR. Menachemi and Collum (2011) argued that a reduction of medication errors is the result of standardisation in data format or communication in an EHR system that reduces data misinterpretation. Similarly, Aldosari (2012) asserted that EHR systems offer a standardised format under which electronic data are stored and retrieved effortlessly. Thus, EHR systems offer an effective platform for data integration as well as collaboration between healthcare providers that significantly reduces the risk of occurrence of errors. For example, a pharmacist can view a patient’s health information if in doubt about a prescription and electronically communicate with the physician if necessary, thus reducing errors related to prescription. Aldosari (2012) further observed that under EHRs, clinical information systems have capabilities to check for appropriateness of medication, such as drug allergies and dosage for various patients, thereby eliminating the need for physicians to enter such data in the conventional charts.

Compared to paper-based records, EHRs are also reported to be effective in medical error reduction. While acknowledging that an EHR system is far better than handwritten documents, Hartel et al. (2011) and Li et al. (2013) noted that the use of an EHR system could assist in addressing quality attributes such as illegible handwriting that has been identified as a major contributor of medication errors. Hibbard and Greene (2013) also reported that eligibility of standard fonts much favoured the reliability and understanding of information compared to handwritten documents. Therefore, EHRs can be used to address medical errors due to poor handwriting.

Medical errors could also result from typographical errors, which can be minimised by documentation in a computerised format. As noted by Cebul et al. (2011), the use of EHRs prevents typographical errors by providing grammatical checks while also underlining text that is ambiguous. The automation of the systems with error capture and prevention capabilities ensures the validity of spelling and accuracy of data entered into the system that could significantly help in reducing medical errors. As pointed out by López-Robledo, Torres-García and Santiago-Medina (2014), the electronic platform may be structured to ensure that the system only accepts data that have passed set data tests. This may include a rejection of invalid data or entry if important fields have not been filled. These capabilities ensure a reliability and accuracy of the information that could not be achieved in the paper-based processes, thus resulting in error reduction. For example, Perera et al. (2011) reported a significant decrease in grammatical errors when using EHRs due to autocorrect options and grammar checks. Almalki, FitzGerald and Clark (2011) also found a close association between the use of EHRs and reduced typing errors. Therefore, the adoption of an EHR system in primary care could help in error reduction, thereby further benefiting the patients.

2.3.5.13 Improved quality of care and patient safety

EHRs are a critical tool in providing quality and safe patient care. An analysis of inpatient data from a state inpatient database by Gesulga et al. (2017) showed that hospitals that had a full EHR system recorded the lowest mortality, readmission and complication rates as well as patient safety indicators compared to those that had partial EHRs or no EHRs at all. Yanamadala et al. (2016) also noted that EHRs have been crucial in improving efficiency in healthcare, but the need to increase integration and improve quality of healthcare has been the primary impetus behind investing in EHRs in some health facilities. The researchers showed that over one-third of the primary care health professionals who participated in American Hospital Association Survey responded that the adoption of EHR systems improved the overall quality care of patients. For example, the physicians could easily search for the records of a patient. The impact of this was reduced waiting times and an increased number of satisfied patients. Primary care providers in the US also stated that the adoption of EHR systems had improved the overall quality of care (Palabindala, Pamarthy & Jonnalagadda 2016).

Improved quality of care could be attributed to the benefits of using EHRs, with such benefits including enhanced preparation of health records, increased speeds in accomplishing work, decreased overall workload, and easier investigation of results (Hoover 2016). Further, EHRs can prevent the loss of patients' data, reduce medical errors, facilitate coordination among departments and healthcare professionals, and offer enhanced patient care decision-making, all of which significantly improve the quality of patient care (Kuo, Liu & Ma 2013). The use of EHRs also provides a platform to the healthcare providers through which they can give their feedback on the quality of the service provided based on attributes such as preventive target achievements and screening rates (Cebul et al. 2011).

With regard to patient safety, Bah et al. (2011) found that healthcare professionals perceive the use of EHRs as a contributing factor to patient safety by reducing medical errors when compared to paper-based methods. Gesulga et al. (2017) also noted that the reported reduced mortality and readmission rates in hospitals that had full EHRs were due to high patient safety indicators, which improve patient safety. Healthcare professionals utilise standard clinical guidelines under EHRs that significantly reduce redundancies and related errors.

Thus, EHRs serve as a tool for enhancing faster responses to inquiries from patients, thereby improving their overall safety (Kuo, Liu & Ma 2013). Improved patient safety is also associated with enhanced clinical decision-making, communication and documentation (Helwig & Lomotan 2016).

2.3.5.14 Improved professional practice

Healthcare professionals have also reported that the use of EHRs improves their professionalism. Aldosari (2012) found that health professionals and managers perceived the use of EHRs as an improvement in the practice of healthcare, thus enhancing their feeling of professionalism. Specifically, physicians reported increased self-esteem when using EHRs in their day-to-day duties, thereby boosting the sense of professionalism. Zwaanswijk et al. (2011) also found that the use of EHR systems increases the feeling of professionalism, with health professionals feeling that their job was restructured to meet global standards while also appreciating the role of information technology in healthcare professions. In general, the feeling of professionalism was attributed to autonomy, efficiency, ability to detect errors, higher levels of information control and pride that is associated with the use of EHRs.

2.3.5.15 Enhanced performance

There has been evidence of improved performance associated with the implementation of an EHR system. Altuwaijri (2008) noted that hospitals that have adopted EHRs had recorded higher performance. This was attributed to the system's ability to relieve the health management team of their endeavours in processing laboratory work, medication delivery, completion of radiology exams and scheduling, among many benefits. These benefits enable health facilities managers to increase their performance by exerting more authority in other areas that would otherwise have been neglected. A systematic review by Black et al. (2011) also noted that healthcare professionals using comprehensive EHRs reported increased performance with the use of EHR systems. While noting that the majority of healthcare professionals in South Korea were in favour of EHRs, Yi (2018) identified that 83.3% of medical staff reported that EHRs provided them with an effective means of performing daily work.

Kuo, Liu and Ma (2013) also noted that the implementation of EHR systems in hospitals had increased their performance in reporting and accountability. Moreover, for ancillary departments, EHRs could significantly reduce the time needed for performing the administrative tasks of entering records, thereby allowing them to focus on the provision of care of higher value. Holroyd-Leduc et al. (2011) observed that the use of EHRs has positively influenced administrative functions such as accounting applications, which automate the costing process and other financial processes.

2.3.5.16 Increased efficiency and flexibility in healthcare

The use of EHRs has also been linked with efficient healthcare processes. Kuo, Liu and Ma (2013) noted that healthcare professionals in primary care mostly embrace the use of IT since it is perceived to be of greater efficiency. The improved efficiency afforded by the use of EHRs has helped to overcome the long process of coordinating information for patients with complex conditions (Yanamadala et al. 2016). Increased efficiency has also been noted in relation to the ease of documenting, accessing and sharing patient information (Zwaanswijk et al. 2011).

Further, the system enables healthcare providers to report patient data in real time thereby facilitating patient care processes, especially in coordinated care where patient data are shared across all critical points of care (Morton et al. 2015). The efficiency of an EHR has also been reported to result from its time-saving benefit during an information search (Alqahtani, Crowder & Wills 2017). The time-consuming and labour-intensive process of data retrieval that was previously undertaken manually is now able to be carried out in a seamless process.

EHRs have also been found to streamline patient care processes such as bed management, booking appointments, and patient follow-up during hospitalisation, thereby facilitating all of these processes (Silow-Carroll, Edwards & Rodin 2012; Ajami & Bagheri-Tadi 2013). With regards to bed management, EHRs have led to higher predictability, resulting in a reduction of the time patients spend at PCCs, while bed turnover rates have increased due to efficient reassignment processes that have in the past been lengthy and tedious (Silow-Carroll, Edwards & Rodin 2012). EHRs with related capabilities such as a staff scheduling system have further enhanced the efficiency of healthcare workers. With regard to patient admission, McCarthy and Klein (2011) indicated that the use of EHRs reduced patient admission time by as much as 90% and also achieved a 90-minute reduction in the time taken to reallocate beds to patients. This is attributed to an automatic process that would otherwise have been done manually by staff. Such capabilities enable a health facility to economically schedule work for its employees, leading to maximisation of the output with regard to its full-time employees. Thus, with increased coordination and streamlined workflow, the use of EHRs has improved patient outcomes (Holroyd-Leduc et al. 2011).

EHRs have also led to efficient billing processes in a system that was able to capture orders and admissions automatically, thereby generating charges and greatly enhancing the billing experience (Khalifa 2013). Efficiency was witnessed with regard to complex calculations that incorporate the role of insurance in covering costs, wherein the system beeps in order to notify the patient on the status of billing whether one gets a waiver or not. The system, therefore, could additionally change the fee to a Medicare-covered procedure or obtain payment from a patient. In this example, the use of EHRs enhanced the billing process, making the EHR system an important aspect of the overall care experience.

Efficiency can also help to reduce healthcare costs, with Farzianpour, Amirian and Byravan (2015) noting that stakeholders have continued to acknowledge the role of EHRs in lowering healthcare costs in addition to improving the overall quality of healthcare. A 2005 RAND study in the US indicated that efficiency savings amounting to 77 billion dollars could be saved at a 90% level of adoption of the EHR system (Hillestad et al. 2005). There is a potential for this saving to increase, thus presenting an opportunity for providing better health for the populace. Khalifa (2013) also established that the capability of the system to provide billing services while at the same time keeping documentation and administrative costs to minimum presented a significant aspect of efficiency.

These efficiencies in reporting and accessing patient data across healthcare systems have also increased flexibility in patient care. This flexibility has been achieved to a considerable level considering that an EHR ensures standardisation of practices. Bah et al. (2011), however, affirmed that a higher degree of efficiency automation in health facilities could only be achieved by adhering to the standards of EHR usage by health professionals.

2.3.5.17 Enhanced public health decisions

EHRs also play a crucial role in public health. Ajami and Bagheri-Tadi (2013) reported that epidemiologists and physicians, as well as other clinicians and researchers, could extract information from an EHR system to address the health concerns of the greater population by undertaking an informed investigation in the prevention and control of infectious diseases. EHR systems are also an essential platform through which different healthcare providers can directly submit information to relevant local and state departments (Yanamadala et al. 2016).

For example, Fallon, Begun and Riley (2013) and Ardito (2014) noted that EHRs could be used by healthcare facilities to alert pharmaceutical companies of potential drug interactions.

2.3.6 Challenges, risks and obstacles of adopting and using EHR

Despite the immense benefits of adopting EHRs in healthcare, it has also been reported that the use of these systems is associated with several challenges that may negatively affect their successful adoption and implementation. This section examines some of the problems, risks and obstacles reported in the literature.

2.3.6.1 Privacy and security concerns

Whilst the use of EHRs has increased access to patient information, there are concerns in some quarters about its ability to ensure data security. Healthcare professionals are reported to be reluctant to use EHRs in sharing their patients' medical records due to ethical concerns of information disclosure and fear that the system may not guarantee data security (Blumenthal & Tavenner 2010; Cebul et al. 2011; Middleton et al. 2013; Hollis 2016). A comparison of EHR implementation in Australia and Slovenia by Cripps, Standing and Prijatelj (2011) identified that privacy and security remained a major issue in these two countries that must be addressed in order to ensure successful implementation. A study by Alqahtani, Crowder and Wills (2017) also identified that 9% of the participants had concerns about EHR systems with regard to their ability to ensure confidentiality of patient data. Moreover, Nguyen, Bellucci and Nguyen (2014) found that most healthcare professionals perceived the EHR system as lacking data security features, which considerably undermined their professionalism. Most of the healthcare professionals (52.1%) in Saudi Arabia have also reported privacy and security concerns with regards to the use of and access to EHRs as a significant barrier to the EHR implementation in Saudi hospitals (Alghamadi 2015).

The inability of an EHR system to provide data security could be attributed to the lack of centralised use of the system, which makes it prone to misuse. For instance, Caine and Tierney (2015) reported that hacking, phishing, spamming and password tracing have been amongst the major fears in the adoption of EHRs. Healthcare professionals fear loss or disclosure of classified information in the event viruses and other malicious intentions attack the systems, especially because it is necessary for healthcare professionals to keep patient information secure from access by unauthorised persons. McLeod and Dolezel (2018) similarly noted that data breaches risk exposing personal details to unintended persons, thus limiting the adoption of EHRs.

In the wake of these threats posed to data security by the use of EHRs, several recommendations have been put forward. Menon et al. (2014a) cautioned that with the increase in access to medical records due to the adoption of EHRs, the administrators should use collaborative filters to control and detect inappropriate access. McLeod and Dolezel (2018) also recommended that governments and other legal institutions should formulate laws at the national level that govern the use of EHRs in order to protect patient data. Additionally, hospitals should come up with procedures and policies to control access to and use of EHR information by focusing on confidentiality, accountability and privacy. However, this should not create barriers to access to care information and override the initially intended benefits, with Perera et al. (2011) noting that a system restriction might limit access to some patient information such as radiology and laboratory results. Further, users should be educated on the effective use of EHRs with caution in order to avoid legal problems such as lack of accountability (Perera et al. 2011).

2.3.6.2 Increased time consumption

Although the long-term use of EHRs has been associated with time-saving, some healthcare providers have also complained that the use of EHR systems leads to increased time compared to paper-based systems. Kern et al. (2015) reported that the use of EHRs increased the time under which a patient was served in the hospital as opposed to a situation where the EHR system was not in use. In studies by Kuo, Liu and Ma (2013) and El Mahalli (2015), nurses were reluctant to use EHRs, citing increased time usage compared to paper-based records.

The use of EHRs could lead to increased time in various ways. For instance, EHR features, such as pop-up reminders, cumbersome menus, and poor user interfaces, can make EHRs far more time consuming than paper charts (Vimalachandran et al. 2018). Also, downtime such as when there is poor connectivity, server problems or lack of power might increase the time taken to complete serving patients as EHRs depend on these factors. Increased time could also result during the interaction between physicians and patients and entering data into the system (Hibbard & Greene 2013). Alqahtani, Crowder and Wills (2017) also noted that increased documentation in the EHR system had resulted in unintended consequences, which resulted in inefficiencies despite the benefits outweighing the challenges.

2.3.6.3 Interrupted provider-patient interaction

The communication between physician and patient is essential in the provision of care. However, the use of EHR systems is reported to reduce interaction between the healthcare provider and the patient. Ajami and Bagheri-Tadi (2013) reported that the patients were not able to interact with the physicians on a one-on-one basis because EHRs had replaced the manual system that required both to be present. Middleton et al. (2013) also identified that the use of EHRs had led to decreased interaction between healthcare providers and patients since the use of the system requires engaging the patient while at the same time entering patient data. Most healthcare professionals have also reported that EHRs reduce their interaction time with patients, thus undermining their job performance (Almalki, FitzGerald & Clark 2011; Woods et al. 2013). According to Middleton et al. (2013), the reduced interaction time between healthcare professionals and patients could make patients feel disengaged and consider their physicians to be less attentive. Healthcare providers have also reported that EHRs reduce the quality of patient interactions, leading to more extended visits by patients (Palabindala, Pamarthy & Jonnalagadda 2016). Approximately half of the respondents in a study by Yanamadala et al. (2016) reported that EHR systems reduced the quality of the interactions between the patient and physician.

This problem has been reported even with innovative EHR systems such as those with patient portals that support remote patient care. King et al. (2014) noted that despite remote patient care providing several benefits such as cost savings to a health facility, healthcare professionals had reported dissatisfaction as a result of reduced interaction with their patients. These concerns are shared by participants in Almalki, FitzGerald and Clark’s (2011) study indicating that EHRs with patient portals have significantly reduced interaction with patients.

2.3.6.4 Increased provider workloads

It has also been argued that EHRs increase unnecessary workload for the healthcare providers, which in turn increases demand for their time while interacting with computers. A study by Sinsky et al. (2016) showed that physicians in ambulatory care who were doing clerical and administrative tasks such as order entry, coding and billing on an EHR system spent almost twice the time on these tasks than that they spent interacting with a patient on a face-to-face basis. Specifically, 49.2% of the time was spent on clerical and administrative tasks as opposed to only 27% on interacting with patients. The majority of physicians in

Middleton et al.'s (2013) study also reported that EHRs generate additional workload resulting from entering data into the system.

Increased workload had adverse consequences on the maximum use of the EHR systems, with Buntin et al. (2011) and Perera et al. (2011) noting that physicians may fail to create customised patient charts but rather copy-paste charts in the form of copy-pasted notes if they feel that the system would create additional workload for them. However, these shortcuts may result in the ambiguity of patient data, thereby posing significant risk to patient care. It is, therefore, necessary to find effective strategies in overcoming this problem. For instance, Kuo, Liu and Ma (2013) suggested that healthcare organisations should redesign their processes to suit the new workflow processes to prevent overloading healthcare professionals. Another recommendation was that software developers should create systems that are relevant to clinicians' workflow in order to increase acceptance and adoption. This may include automated systems with capabilities of reducing administrative tasks.

2.3.6.5 Decreased productivity

Whilst the use of EHRs has been reported to increase the productivity of healthcare providers, there are also concerns that it decreases users' productivity as an unintended consequence. For example, Reid Jr (2016) noted that primary care physicians in the US reported that they experienced reduced productivity in their work while adapting to a new EHR system in their practice. Reduced productivity associated with the adoption of EHRs could be attributed to several factors. The most reported is lost time related to training and the implementation process (Reid Jr 2016) or an increase in clinicians' face-to-face time with the patient during a clinical visit (Bae & Encinosa 2016). Thus, healthcare professionals who feel that the use of EHRs would lead to loss in their productivity are less likely to adopt the system.

2.3.6.6 Compromised patient safety

In as much as EHRs are found to have a critical application in today's healthcare systems, there is also a need to address the role of this technology in patient safety, with some arguing that they pose a threat to patient safety. An examination of safety issues in Veterans' Affairs hospitals by Meeks et al. (2014) identified several safety issues related to the use of EHRs. Out of 100 voluntary patient safety incidents, 74 cases were attributed to unsafe EHR systems, while 25 were due to unsafe use of the system. Only one case was reported due to the failure to use an EHR system, suggesting that EHRs could negatively impact patient safety. Most of the reported errors due to unsafe use of the system were due to human factors coupled with workflow issues that were imminent in all integrated EHR systems.

The major identified factors that could be detrimental to patient safety included inadequate patient health data to aid healthcare providers in patient care decision-making (36 cases), poor patient matching that affects integration and exchange of patient data between different hospitals (17 cases), and unintended errors resulting from technical challenges experienced in the modification of software through processes such as configuring upgrades and un-updated software (24 cases) (Meeks et al. 2014). Others include hidden dependence within the system which results in an unintended action during the execution of a given task (17 cases). For instance, Meeks et al. (2014) reported 17 cases in which a patient's inpatient medication information was deleted when they were moved to the outpatient unit and then back to inpatient.

While the majority of nurses and physicians in Ireland agreed that the adoption of EHR systems improved patient safety, communication and patient care, they expressed serious issues regarding the confidentiality of patients (Ajami & Bagheri-Tadi 2013). They claimed that patient privacy could be compromised because of the unintentional sharing of detailed clinical information concerning them.

Sittig and Singh (2012) also noted that patient safety issues might arise from errors in reporting of test results, poor coordination during patient transitioning from one level of care to another, and mislabelling of specimens. Furthermore, Woods et al. (2013) reported that EHR systems could affect patient safety if the system contains compromised data due to misappropriation of values, errors in data entry, misattributions of a patient's data to another patient, the copy-pasting of results from one database to another, missed data, mixing of paper and EHR systems and delayed delivery of data.

2.3.6.7 Workflow disruption

In a study by Pereira et al. (2012), a majority of physicians complained that the screens had a lot of information, such as hyperlinks and tabs that disrupted their workflow, and therefore they lost too much time entering data into the system. In another study, Steininger et al. (2014) raised the issue that physicians received over 100 notifications every day through the EHR system. Due to this, they were overburdened. The alerts made it challenging to filter out essential information, such as patients' test results.

Noteboom et al. (2014) also reported that healthcare providers expected disruption of their workflow due to the slow response time of the EHR systems caused by a lot of information, such as hyperlinks and tabs. For example, hyperlinks can take the users to different pages rather than keeping them on one page and that makes it challenging to navigate patient information in the system. As such, the users wanted the hospital to develop an efficient system that would reduce the response time to enable serving as many patients as possible in a day.

2.3.6.8 Costs

The adoption of EHRs has mostly been low in some settings due to high costs. Reid Jr (2016) identified cost as a barrier to adopting EHRs in primary care practice among office-based physicians in the US, with 39% of the participants reporting that the costs of purchasing and maintaining an EHR system were too high. In a study by Alghamdi (2015), cost of EHR systems was also reported by the majority of healthcare professionals (55.2%) as a barrier to the adoption of EHRs in hospitals in Saudi Arabia.

Similarly, Woods et al. (2013) noted that the adoption of a comprehensive EHR system is a lengthy and costly process These costs can be incurred at various stages of EHR implementation, and include initial, operating and maintenance costs (Boonstra & Broekhuis 2010). Additional costs can be incurred from the need to train existing staff on how to use the systems. Further, Boonstra, Versluis and Vos (2014) noted that the need for healthcare facilities to employ an IT team to work with EHR vendors to customise the system to suit the needs of the facility presents increased costs in implementing EHR systems. The EHRs also present the need for IT-focused clinicians who are essential in bridging the gap between technology and practice. Apart from creating new roles, it increases healthcare costs in employing additional staff (Cresswell & Sheikh 2013). Whilst additional and sustained training could be of high priority through offering short courses to improve awareness of EHR systems, these processes can also lead to increased costs in implementing EHR systems (Khalifa 2013; Woods et al. 2013).

Although some hospitals have reported that return on investment was very high, which is witnessed in substantial cost savings to a medical institution, with the implementation of EHRs (Cresswell & Sheikh 2013), it has also been noted that EHRs pose uncertainties in returns on the investment (Boonstra & Broekhuis 2010). This has a negative impact as it could discourage the adoption and use of EHRs in healthcare. Furthermore, Minghella (2013) observed that high costs of the internet could also lead to increased costs.

While acknowledging that cost is a significant barrier to the adoption of EHRs that can discourage healthcare professionals from using them, Singh and Muthuswamy (2013) noted that the challenges with the cost is non-uniform since large hospitals with adequate resources tend to spend more on technology compared with the small ones. However, Salleh, Zakaria and Abdullah (2016) argued that the cost factor in adopting EHRs should be viewed from the perspective of customer benefit because it reduces the cost of treatment to patients.

Since high costs of EHRs is likely to affect the adoption and use in primary care and other healthcare settings, effective strategies are required to overcome this challenge. According to Khalifa (2013), hospitals and other health facilities should allocate adequate funding for EHR implementation. The health facilities' managers should tailor their hospital budgets in line with spending in EHRs so as not to overburden the already overwhelmed healthcare resources (Middleton et al. 2013). With different EHR systems available, a health facility should undertake a feasibility study to determine if the EHR system being purchased meets their expectations in terms of its benefits versus costs (Khalifa 2013).

2.3.6.9 Complexity and poor user interface

EHRs have been reported to be too complicated and not user-friendly, making them difficult to use. Kuo, Liu and Ma (2013) noted that most healthcare professionals were reluctant to adopt an EHR system because they perceived the system as complex and having a poor user interface. This challenge presents a significant hindrance to EHR systems' adoption across several care settings. Yanamadala et al. (2016) established that complexity in EHR systems has adversely affected its successful implementation. Blumenthal and Tavenner (2010) also noted that the majority of health professionals cite EHR systems' complexity as a vital barrier towards their adoption. However, Yanamadala et al. (2016) argued that this problem is usually experienced with more advanced systems during the initial phase of adoption which results in counter-productivity.

Additionally, Buntin et al. (2011) noted that most EHR systems ranked poorly among healthcare professionals with regard to their user interface, mainly due to issues associated with unfamiliarity, which present drawbacks in terms of their adoption and successful implementation. Thus, healthcare settings require less complicated systems with user-friendly interfaces to promote acceptance and use by healthcare professionals in order to realise their intended benefits. Moreover, they should adopt flexible EHR modules that allow for feature customisation to meet users' needs. This requires collaborative efforts between the system creators, administrators and users.

2.3.6.10 Frequent updates and breakdowns

Technology is associated with challenges such as breakdown and frequent updates. EHRs are similarly prone to these factors, and this may affect their application in healthcare settings. For example, Al-Harbi (2011) identified that the system being down frequently was a significant barrier to EHR adoption by healthcare professionals in Saudi Arabia. EHRs usually require updates in order to improve their performance. However, this has been associated with challenges that result in suboptimal performance. Healthcare professionals in Saudi Arabia reported that EHR maintenance was a significant barrier to adopting EHRs in hospitals (Alghamdi 2015). Reid Jr (2016) noted that frequent upgrades, optimisation and maintenance are necessary for an EHR system's performance however, these are often costly and associated with downtime. Specifically, regular updates have been found to undermine reporting, with hospitals reporting frustrations in regard to the system (Buntin et al. 2011).

These issues cause several challenges, such as inability to generate reports as required, creation of many free-text fields and mismatches between reporting requirements and used data formats. The frequent updates were also found to cause delays in the entry of data, with this issue therefore emerging as a noncompliance challenge that significantly undermines the standards employed in EHR systems. Kuo, Liu and Ma (2013) also found that EHRs' unreliability in the notification of results to patients and practitioners pose enormous technical challenges. Buntin et al. (2011) noted that the drawbacks necessitated the manual translation of such data, which further undermines performance reporting.

These problems indicate that governments should create stronger databases that can significantly help health vendors deliver within a specified standard to facilitate clinical information exchange and to minimise uncertainties from unreliable health systems. Buntin et al. (2011) argued that there is a need to continually redesign and standardise the care protocols within the system. This would help to address the challenges ranging from the design, quality and relevance of the system in order to maximise its performance.

2.3.6.11 Poor connectivity

For the continuous operation of EHR systems, internet connectivity is essential. Lack of or poor internet connectivity renders the system less functional, thereby disrupting patient care processes and healthcare delivery in general (Woods et al. 2013). According to Minghella (2013), an EHR system outage can affect and compromise the operations of almost the entire system of a healthcare facility, thus negatively impacting the expectations of healthcare professionals with regard to the use of EHRs. Raposo (2015) also argued that limited bandwidth leads to congestion that affects the speed of sharing data as well as the quality of files, including image data.

Although internet connectivity has significantly improved in developing countries, EHR systems in these settings have not yet achieved their potential in the digital age, with many EHR projects prone to many challenges of interruptions in internet connectivity (Achampong 2012). These countries should, therefore, invest more in network infrastructure to ensure there is good internet connectivity when introducing EHRs systems. Minghella (2013) also proposed that healthcare organisations should have adequate contingency plans in order the mitigate the risk of frequent internet outages of the EHR system.

2.3.6.12 Lack of technical support and staff training

Lack of technical support and training has also been identified as a significant obstacle to EHR adoption. Bah et al. (2011) noted that the adoption of electronic patient records had been slowed down by several social factors, such as inadequate computer use knowledge among hospital workers. Lack of adequate computer knowledge has been identified as a significant problem in developing nations, especially where is no adequate technical support (Huryk 2010; Alghamdi 2015). A phenomenological study by Reid Jr (2016) also noted that despite EHR implementation being a federal requirement in the US, most primary care physicians had not adopted the system, citing various challenges, including lack of staff training on the new system. In addition to reporting that the system was challenging to use, the respondents also reported that there was no technical support after implementing the system, and this presented a significant barrier to adopting the EHR system in primary care.

Given these challenges, there is a pressing need for effective measures directed towards the change of employees' perception and improvement of workers' capacity to use computers in order for the adoption of EHRs to be successful. Reid Jr (2016) suggested that healthcare organisations should continuously train their staff about EHRs as a means of addressing this implementation barrier as training would improve the healthcare providers' mastery and confidence in using the system. From the professionals' perspective, the organisation should provide them with adequate training that meets their needs. Whereas this training could be undertaken by IT staff, the respondents reported that they could also rely on colleagues with extensive training and knowledge of EHRs as well as engaging in self-training (Reid Jr 2016).

2.3.6.13 Staff resistance

Resistance by staff has also been identified as a common barrier to implementing a new EHR system. A good proportion (42%) of primary care physicians in the US reported that staff resistance was a common problem in adopting EHRs in primary care practices (Reid Jr 2016). Bah et al. (2011) also noted that resistance to change, which is the most common cause of resistance in organisations, has slowed down the adoption of EHRs by hospital staff. However, Reid Jr (2016) noted that staff resistance could also be related to other concerns with the system, such as cost and reduced productivity. For example, Alghamdi (2015) identified that adaptation and resistance to new technology were some of the barriers cited by healthcare providers in implementing EHRs across hospitals in Saudi Arabia. Thus, addressing this problem requires consideration of all factors that may lead to rejection of EHRs by healthcare providers and education of the providers about the EHR system and its benefits such as improved efficiency, enhanced clinical decision-making and improved quality of patient care could significantly improve knowledge of EHRs, thereby reducing resistance.

2.3.7 Satisfaction with the EHR system

According to Heselmans et al. (2012), EHR systems play a significant role in supporting health professionals with potential benefits, including improved quality of care, improved efficiency of the health record service, advanced patient safety, improved communications between health professionals, and appropriate use of resources. These benefits could act as a measure of user satisfaction with an EHR system.

User satisfaction has been of immense interest in information system research, where it is considered to be an essential indicator of success in this field (Vaezi et al. 2016). Whilst several measures such as system use, performance and effectiveness have been used as indicators of information system success, user satisfaction is the most widely used single measure and indicator. Thus, an effective system should be able to add value to the firm or organisation and produce some positive influence on the users' behaviour such as improved productivity and decision-making. Similarly, user satisfaction or subjective judgement of the information system by the user can be used as a measure of the success or effectiveness of an information system (DeLone & McLean 2016). It is against this background that this thesis relies on user satisfaction to evaluate the success of adoption of EHRs in PCCs in Riyadh city.

Healthcare professionals have been found to have varied satisfaction with EHRs across different settings. While evaluating user satisfaction in primary care, Blumenthal and Tavenner (2010) reported high satisfaction with the EHR system among healthcare professionals. Other researchers have also reported that a higher percentage of healthcare providers had a positive perception towards the use of EHR systems in primary care (Buntin et al. 2011; Hibbard & Greene 2013; Nguyen, Bellucci & Nguyen 2014).

Satisfaction with the EHR system is mainly attributed to the system's benefits, such as cost-saving efficiency, improved performance, better care outcomes for the healthcare system, and high returns (Kuo, Liu & Ma 2013; Al Alawi et al. 2014). Cebul et al. (2011) reported that healthcare professionals perceived EHRs positively in the sense that the system helps them to deliver better patient care. Friedberg et al. (2014) reported that the potential of EHRs to remotely access patient information and their ability to improve the quality of care had boosted satisfaction with the system amongst caregivers. Similarly, Ajami and Bagheri-Tadi (2013) found positive perceptions of EHRs by healthcare professionals due to their attribute in guiding the management system with regard to scheduling patients, which makes bed management, appointments and patient follow-up during hospitalisation easier. In the United Arab Emirates, healthcare professionals reported high levels of satisfaction with the benefit of an EHR system in that the system allows documentation of patient data such as changes in orders or notes and incident reports in case of medication error (Bani-issa et al. 2016). Almalki, FitzGerald and Clark (2011) also observed that EHRs have led to high rates of satisfaction among Saudi healthcare providers due to their ability to help in providing consistent and evidence-based care through embedded clinical guidelines in hospital EHRs. This also enables the hospitals to follow extremely structured processes in their consideration and selection of optimal practices, thereby creating a widely accepted practice among the clinicians and general staff as well as achieving high levels of consistency across all of their constituent hospitals.

Healthcare managers have also reported increased satisfaction with EHRs due to positive performance for their facilities in terms of productivity and accountability (Menachemi & Collum 2011). Comprehensive EHRs with additional programs for quality reporting enable hospitals to generate their performance reports based on various trends or benchmarks (Silow-Carroll, Edwards & Rodin 2012). This approach has resulted in high satisfaction rates among healthcare professionals, which is facilitated through a multidimensional approach, including shared clinicians' records, hospital departments, physicians and various hospital levels. All of these combinations result in support for quality improvement and enhance accountability by presenting such results to executives, board directors and joint quality committees. Cresswell and Sheikh (2013) also reported that a majority of EHR system adopters stated that they had achieved a meaningful return on investment. While the majority had not yet recouped significant gains from the use of the system, a majority of health facility managers were optimistic that the system presented better returns on investment.

Due to satisfaction with the EHRs, health professionals perceive EHR systems as useful and important systems for primary care settings, which is worth the time and effort to use. Silow-Carroll, Edwards and Rodin (2012) found that health professionals perceived EHR systems an essential part of primary healthcare systems because of their various benefits, such as a reduction in redundancies in PCCs. For instance, Almalki, FitzGerald and Clark (2011) found that healthcare professionals perceived the EHR system as an important component of the primary healthcare system because they have patient status boards which led to better coordination. For instance, Yanamadala et al. (2016) noted that even though several respondents perceive the use of EHRs to lead to increased time in documenting care, such time is compensated through other avenues whenever an EHR system is used instead of manual records.

Al Alawi et al. (2014) and Kern et al. (2015) also reported that healthcare professionals perceive EHR systems to be worth the time and effort because of significant gains, such as cost-saving efficiencies that can be accrued from the adoption of EHRs. Similarly, Alqahtani, Crowder and Willis (2017) argued that EHR systems could be of great value in effectively managing the increasing chronic diseases in Saudi Arabia the treatment of which is costly and complicated. Specifically, they can help in tracking the delivery of preventive care in most PCCs and thus provide benefits that justify the time required to use them.

2.3.8 Factors influencing the users' perceptions and adoption of EHRs

Technology is considered to be an essential requirement for the growth of many organisations as it results in increased access to information, increased productivity, higher processing speeds, and a more competitive edge. However, acceptance of technology remains a critical factor in the successful implementation and utilisation of information technology and information systems (Gagnon et al. 2014). The perceptions of the users have been shown to have a significant influence on the acceptance that determines the adoption. Furthermore, perceptions are influenced by several factors that need to be addressed.

In healthcare, the adoption of EHRs is also influenced by healthcare providers' perception of the system. However, this perception is also under the influence of external factors related to the individual user, the system or the environment, among others that determine whether a user accepts or rejects the use of EHRs in their practice. The factors that influence the perceptions, adoption, implementation and use of EHRs across various health settings have been widely investigated in the literature.

An integrative review by Cresswell and Sheikh (2013) identified that the successful implementation of HITs is affected by three main inter-related factors, namely social, technical, and organisational factors. Some of the social factors that were reported include the users' attitudes towards the EHR system, concerns with its use, and values and motivations of the user. On the other hand, the technical factors are issues related to the system, such as performance, stability, reliability, accessibility, usability and cost, while organisational aspects include factors such as leadership and management, planning and communication.

These factors have been shown to affect the users' perceptions of HITs and hence the adoption. However, Cresswell and Sheikh (2013) acknowledged that the factors influencing the adoption of EHRs are not only limited to these factors as there are other variables such as industry players and policies that involve a wider socio-political environment.

These arguments by Cresswell and Sheikh (2013) are supported by other researchers. For instance, in addition to technical and organisational factors, Najaftorkaman and Ghapanchi (2014) identified that user adoption of EHRs is influenced by an additional six factors, namely individual, psychological, behavioural, environmental, financial and legal factors. Whereas individual, psychological and behavioural factors are related to the users' attributes such as age, attitude and behavioural changes, environment, financial and legal are mainly external factors, such as vendors, EHR-related costs, and legal concerns that may arise with the adoption of EHRs.

An integrated framework of factors influencing the acceptance and adoption of EHRs by physicians in primary care settings in the context of Saudi Arabia derived from extensive literature and empirical findings by AlJarullah et al. (2018) also showed that the EHR acceptance by physicians is influenced by eight significant factors, namely attitude, perceived usefulness, perceived ease of use, social influence, computer self-efficacy, perceived threat to physician autonomy, confidentiality concerns, and physician participation. For instance, the authors noted that perceived usefulness was a major obstacle to the adoption of EHR in Saudi Arabia, contributing to 15% of the barriers. Thus, they asserted that policymakers should consider these factors in order to achieve a successful and smooth transition to EHR systems. Similarly, Alghamdi (2015) showed that EHR acceptance and implementation in Saudi Arabia is influenced by six main factors, namely lack of computer skills, cost of EHR systems, adaptation to new technology, privacy and security concerns regarding the use and access of the systems, EHR maintenance, and resistance to technology.

It emerges from the literature that there are several factors that influence the adoption and implementation of EHRs in healthcare. However, those related to the individual user, the healthcare organisation and EHR system appear to be the most common factors influencing adoption, as discussed below.

2.3.8.1 Individual factors

The relationship between various individual factors and healthcare professionals' perceptions and adoption of EHRs has been investigated in the literature. Examples of these factors include age, race/ethnicity, profession, computer literacy, and professional norm. Some studies have shown a positive relationship between these factors and users' perceptions of EHRs. For instance, occupation has been shown to have a significant influence on the benefits of EHRs, with different professionals having varied perceptions of the system. Hoover (2016) noted that while nurses had the highest agreement with the EHR benefits such as enhanced preparation of health records and decreased overall workload, other staff including physicians mostly agreed that EHRs are useful in preventing loss of patients' data, improving the quality of patients' care and saving paperwork, among other benefits. Gender and EHR experience have also been shown to be significant predictors of users' perception of EHRs' usefulness among nurses in Jordan (Tubaishat 2018).

Gagnon et al. (2016) showed that individual characteristics such as professional norms, perceived ease of use, perceived usefulness and computer self-efficacy were significantly correlated with intention to use EHRs in primary healthcare. Tubaishat (2018) also showed that professional rank and computer skills of nurses were positively associated with the systems' perceived usefulness and perceived ease of use as well as acceptance of EHRs. Also, while noting that the individual factors affecting user satisfaction with an EHR system are mainly physician issues, Al Alawi et al. (2014) identified computer skills, training and initial impression of the system. These factors appear to facilitate the adoption and implementation of EHRs by positively influencing users' attitude towards the system. It is for this reason that Alqahtani, Crowder and Wills (2017) identified lack of computer experience, lack of perceived usefulness, and lack of perceived ease of use of an EHR system as individual or user-level adoption barriers to EHR adoption in Saudi Arabia. Similarly, Al Alawi et al. (2014) noted that patient-related factors that affect doctor-patient relationships such as lack of eye contact and increased waiting time harm EHR acceptance and adoption.

Despite most studies finding a significant relationship between individual characteristics and users' perceptions of EHR, others have shown contradictory results. For example, Morton (2008) noted that there was no positive correlation between the individual characteristics of US physicians (age, clinical specialty, health system affiliation, prior computer use, and prior EHR system use) and their attitude towards an institutional EHR system. However, these characteristics were shown to influence perceived usefulness and perceived ease of use with organisational contextual factors including management support, physician involvement in the selection of the system, adequate training, physician's autonomy, and doctor-patient relationship mediating this process.

2.3.8.2 Organisational factors

Several factors related to organisation such as practice size, management support, adequate training, physician's involvement, physician's autonomy, and doctor-patient relationship have also been reported to influence perceptions and adoption of EHRs. For example, Ouheda et al. (2019) identified seven main organisational factors, including management support, organisational size, organisational culture such as acceptance of change, technology readiness, employee's knowledge, and organisational strategies to affect the adoption of EHRs in the Australian context. Najaftorkaman and Ghapanchi (2014) also identified several organisational factors such as management support, cultural changes, and level of user involvement to affect EHR adoption across various settings.

Morton (2018) and Abdekhoda et al. (2015) showed that management support, physician's involvement, physician's autonomy, and doctor-patient relationship were significant predictors of physician's attitude towards perceived usefulness, perceived ease of use and EHR usage. In Iran, Alipour et al. (2013) found a high level of agreement with management support, physician involvement, adequate training, physician autonomy, and doctor-patient relationship as organisational factors influencing acceptance of EHRs by physicians. Conversely, there was no significant relationship between insufficient training and physician's attitude towards EHR adoption (Morton 2008; Abdekhoda et al. 2015). These factors, including staff training, technical support, the provision of new/durable IT applications, and change of hospital's work procedures could act as motivators to use IT in healthcare (Al-Harbi 2011).

However, these factors have also been identified as barriers to EHR adoption. Lack of staff training has been reported as a significant barrier to implementing EHRs (Al-Harbi 2011; Reid Jr 2016). Others include lack of technical support and lack of management support as the main factors related to organisation that act as barriers to adopting EHRs in hospitals in Saudi Arabia. Alqahtani, Crowder and Wills (2017) also identified lack of user support, user resistance to change, lack of EHR standards, uncertainty about EHR vendors, confidentiality concerns, hospital size, and hospital's level of care as the organisational-level barriers to adopting EHRs in healthcare organisations in Saud Arabia. In addition, Isemeck et al. (2019) found that organisational factors including lack of adequate financial resources, inadequate training support by the hospital department, inadequate technical expertise, non-user involvement, and lack of harmonised standard legal enforcement contributed to a low rate of EHR adoption.

2.3.8.3 System factors

These are factors that are related to the EHR system and which affect its adoption and use based on users' perceptions. In particular, system factors are associated with the benefits, challenges or risks of using the EHR system and have been shown to influence adoption. For instance, Kruse et al. (2015) noted that there are several factors that affect the adoption of EHRs in long-term care facilities. Broadly categorised as facilitators and barriers, facilitators are the system's benefits such as reduced medical errors, improved clinical and administrative efficiency, better access and transfer of information, and time savings. Conversely, the barriers include high costs, system problems, security issues, implementation challenges, and negative user perceptions.

In relation to system benefits, these could be regarded as perceived usefulness and perceived ease of use, which have been shown to be associated with positive perceptions and acceptance of EHRs by healthcare professionals. For example, Bahadori et al. (2017) identified perceived usefulness and perceived ease of use to have significant positive effects on physicians' attitudes towards the implementation of EHR in Iran. Abdekhoda et al. (2015) also demonstrated a positive and significant relationship between adoption and use of the EHR system and its perceived usefulness and perceived ease of use. Vitari and Ologeanu-Taddei (2018) also identified perceived usefulness and ease of use as good predictors of intention to use an EHR system. Morton (2008) showed that these technical factors contribute to acceptance of EHRs in primary care practice.

In a qualitative study of physician satisfaction with EHRs in PCCs in Al Ain in the United Arab Emirates, Al Alawi (2014) reported that the physicians' perceptions and adoption of EHRs were influenced by several system-dependent factors. These included the system's benefits such as quality documentation, enhanced referral, and improved prescription, ordering, and viewing of results. The disadvantages and challenges with the system, such as complexity, lack of interconnectivity, increased time, and lack of confidentiality were also found to affect users' perceptions. Isemeck et al. (2019) also found that technical factors, including inadequate and non-functional EHR-related infrastructure, weak internet connectivity, and unreliable power supply were significantly related to the EHR adoption levels.

Other technological factors such as system reliability, compatibility, communication tools, technical system features, system usability, security and cost have also been reported to influence perceptions and adoption of EHRs (Najaftorkaman & Ghapanchi 2014; Ouheda et al. 2019). While cost emerged as a significant system factor affecting EHR adoption, Ouheda et al. (2019) noted that it covers numerous aspects ranging from infrastructure to user training. Thus, cost considerations should be taken into account with respect to cost savings and effectiveness of implementing EHRs.

In general, the literature shows that the users' perceptions and adoption of EHRs are influenced by several factors; however, the most common are related to the attributes of the user, system or organisation that can motivate the users to adopt the system. These factors appear to influence the adoption of EHRs in various ways. For instance, psychological factors have been reported to affect the emotional feeling of the users towards technology, while behavioural factors influence the users' behaviour in relation to accepting or rejecting a system (Najaftorkaman & Ghapanchi 2014). Individual characteristics have also been reported to influence the attitude of healthcare professionals towards EHRs. For instance, physicians were reported to be less likely to use an EHR system mainly due to their autonomy in making the best judgement for patients' treatment (Morton & Wiedenbeck 2010). These factors are also inter-related; for example, perceived ease of use was shown to be significantly correlated with management support and physician involvement, while physician autonomy and doctor-patient relationship significantly influenced perceived usefulness (Bahadori et al. 2017). Physician involvement and physician autonomy had a direct effect on attitude about EHRs' usage together with perceived usefulness and perceived ease of use.

It is also apparent that these factors can act either as facilitators or barriers to EHR adoption. Facilitators are mainly associated with EHR benefits, while barriers are related to limitations of using EHRs, as noted by Alqahtani, Crowder and Wills (2017). Thus, these factors such as organisational contextual factors should be of utmost importance to health organisations and policymakers when introducing new technology.

2.4 Adoption of EHRs in Saudi Arabia

2.4.1 Overview of the Saudi healthcare system

The Saudi Arabian government has highly prioritised the healthcare services within the country. Over the last few decades, the Saudi government has focused on improving the quality of people's health as well as the quality and quantity and health services (Al-Hanawi 2017). Compared with other nations around the world, Saudi Arabia has mainly achieved incomparable milestones within the recent past in terms of the availability of care to almost all segments of the country's expansive population (Almalki, FitzGerald & Clark 2011). Given the developments in the healthcare system in the country, it has been ranked the 26th among 190 nations around the world, coming in front of countries such as Canada, New Zealand and Austria, among others (WHO 2000). The developments in the Saudi healthcare system have been driven by ambitious government strategies implemented by the MoH and substantive efforts aimed at the provision of services by ministries of Defence, Interior, and Higher Education, as well as research centres and the National Guard (Al Otaibi 2017).

The current success can be attributed to humble beginnings started in the year 1926 when a health department was created through a decree by the then ruler, King Abdulaziz Al-Saud (Yusuf 2014). It was the beginning of a modernisation drive and the organisation of the healthcare system in the country. It was followed by closer coordination between the offices of the Bureau of the Attorney General and that of the General Directorate for Health and Aid (Albejaidi 2010). After the establishment of the health department, several other hospitals and dispensaries were built to serve the health needs of the Saudi citizens as well as the yearly pilgrim visitors.

Despite these efforts, Saudi Arabia continued to experience epidemic incidences during *hajj*, prompting another royal decree for the formation of the MoH in 1950 (Al Otaibi 2017; Rahman & Alsharqi 2019). The establishment of a five-year National Development Plan two decades later was meant to introduce critical reforms to the entire range of national strategies, with significant effects on the country's healthcare system (Al Asmri et al. 2019). Reforms were introduced in the healthcare system, creating the foundation of the country's current primary care, research centres, hospitals, as well as the overall essential infrastructure (Al

Otaibi 2017). The government supplemented these developments by making use of expatriate medical personnel services, leading to the growth of the healthcare system as it embarked on a serious development of the country's internal human resources through scholarships and capacity building (Yusuf 2014).

Over the years, the Saudi Arabian healthcare system has been transforming from the traditionally curative approach that focused on providing treatment, to the more desired preventive approach (Al Hanawi 2019). The curative model was found to be more costly when many health problems could instead be prevented or minimised. The MoH then developed several preventive measures through the health offices as well as maternal and child health centres (Al Otaibi 2017). Also developed were disease control measures that were implemented through vertical programming for diseases such as TB and malaria. From 1980 onwards, the MoH continued to adopt and strengthen its efforts in relation to the WHO proposals on prevention by activating the primary care approach as a key strategy in its masterplan (Al Otaibi 2017). Small health practices were developed into PCCs which focused on enhancing public education of prevention, provision of basic sanitation and clean water services, enhancement of population nutrition, promotion of maternal health and childcare, child immunisation, minimisation of the effects of local endemic diseases, treatment of health problems, and making much needed drugs available to the local populations (Rahman & Alsharqi 2019).

For purposes of effective management, Saudi Arabia's healthcare services are classified into three main levels: primary, secondary, and tertiary (Alkadi 2016). The primary care involves the provision of basic healthcare services encompassing preventive and curative treatments as well as rehabilitative services (Almasabi 2013). These include health education, environmental health, vaccinations, and dental care. These primary care services were initially offered in Saudi MoH health clinics and maternity and childhood health centres, which are today referred to as PCCs. These PCCs are managed by the General Directorate of Health Affairs in the MoH (Almasabi 2013). With the PCCs providing only basic care, patients with complex cases that require further treatment and care are referred to the MoH general hospitals for secondary care (Alkadi 2016). The hospitals are well-equipped with advanced medical technology and skilled medical staff. Similarly, patients who need complex medical expertise, especially those with illnesses or diseases at advanced stages are referred for tertiary care at tertiary hospitals known as central or specialist hospitals (Alkadi 2016). This organisation shows that the Saudi health sector is consolidated from top to bottom, with the MoH ensuring that all of these levels are properly regulated and have the required resources provided by the government in a bid to ensure universal access to healthcare for the citizens as well as the emigrant workers in the country (Alraga 2017).

The MoH is given the primary responsibility of monitoring the provision of healthcare by the public and private sector, providing the framework and guidance to all players in the industry for the achievement of the health objectives set out by the government. Today, the ministry supervises approximately 20 regional Directorates-General of Health around the country (Alraga 2017). Each directorate at the provincial level further oversees several health sectors and hospitals within their regions which then take care of the various PCCs (Almasabi 2013). Through the directorates, the ministry oversees the implementation of its various programs, policies and goals as set out by the government. Considered as the primary healthcare services provider, the MoH is responsible for at least 244 hospitals as well as 2,037 PCCs today (Alkadi 2016). The governance structure is organised as shown in Figure 2.1

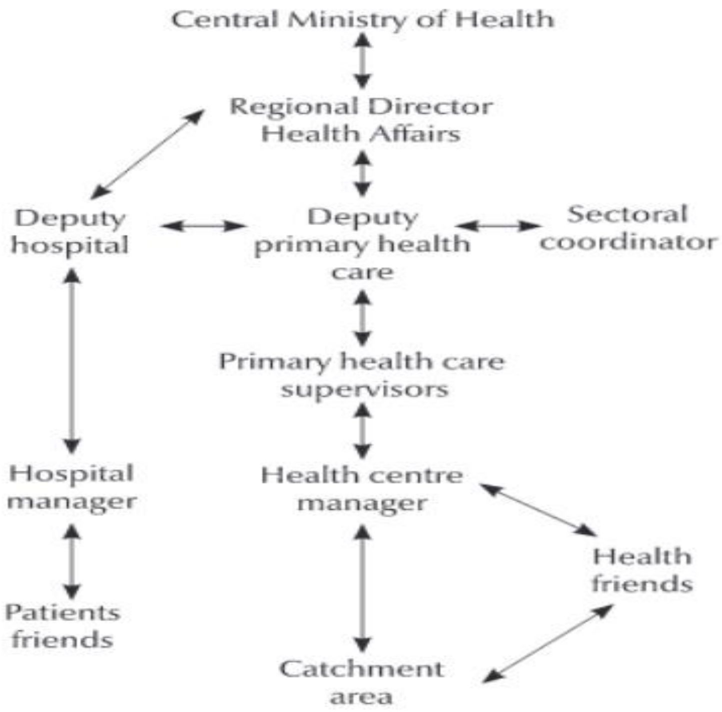

Figure 2.1: Saudi Arabia's healthcare system organisational structure (Almaki, FitzGerald & Clark 2011, p. 788)

Of the PCCs spread across the 13 geographical regions of Saudi Arabia, Riyadh has the highest number (MoH 2017). It also has the highest number of healthcare professionals distributed in its districts, as presented in Table 2.2.

Table 2.2: Distribution of PCCs and primary healthcare professionals in the Riyadh region (MoH 2017)

Riyadh Region	**Southern**	**Eastern**	**Northern**	**Western**	**Central**	**Total**
Number of PCCs	21	23	30	22	18	**114**
Number of healthcare professionals	315	345	450	330	270	**1710**

With the goal of ensuring continuous improvement of the country's healthcare system, the government authorised the involvement of private enterprises in the provision of care to

Saudi Arabia's citizens. However, the government remains the ultimate provider of healthcare in the country, offering more than 60% of the total services provided (Alraga 2017). The ministry achieves these responsibilities by collaborating with other hospitals run by other ministries such as the Ministry of Higher Education Hospitals and the Security Forces Medical Services run by the Ministries of Education and Defence. Collectively, the Saudi government runs about 39 hospitals that accommodate a total of 10,822 beds across the country (Alraga 2017). These facilities are supplemented by investments by the private sector, which have a total of 125 hospitals translating to 11,833 beds and 2,218 dispensaries mostly concentrated in the cities and big towns (Alraga 2017). The different representations are shown in Figure 2.2.

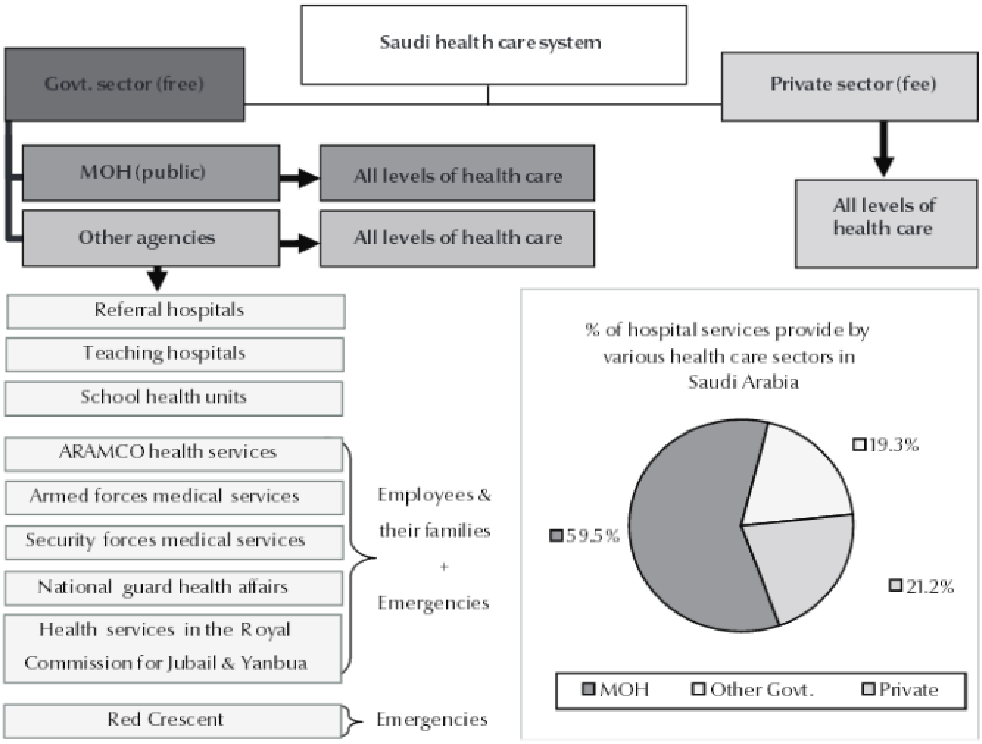

Figure 2.2: Saudi Arabia's healthcare system design and functioning (Almaki, FitzGerald & Clark 2011, p. 786)

Despite making significant strides in providing efficient and effective healthcare to its citizens, the government of Saudi Arabia continues to grapple with several challenges that affect its healthcare system. There is a shortage of Saudi health professionals, including physicians, pharmacists and nurses, with most being foreigners (Al-Mutairi 2015). This imbalance in health workforce composition is associated with high turnover rates and instability in the Saudi healthcare system. Thus, attracting and retaining more Saudis into medical and health professions remains a priority for the government of Saudi Arabia. The changing disease patterns, pressure on health services due to the growing population, and poor accessibility to some healthcare facilities have also been reported to pose significant challenges to the Saudi healthcare system. Saudi Arabia is also reported to lack a national health information system, and electronic health strategies, including EHRs, remain underutilised. This challenge is likely to adversely affect the overall adoption and use of EHR systems in health facilities in Saudi Arabia.

2.4.2 Status of EHR use in Saudi healthcare

In 2010, the WHO called for more studies on the use of EHR systems in developing countries, including Saudi Arabia (Al-Shorbaji 2013). The goal was to advance the adoption of information technologies by encouraging governments in these settings to adopt new data management approaches to address the health needs of their growing populations. As such, the research aimed to obtain answers to the following questions:

(1) What are the current EHR system practices?

(2) What is the current and emerging EHR systems' challenge?

(3) What are some of the recommendations that can be given to enhance EHR systems?

These questions have put a lot of emphasis on the current state of EHR adoption in Saudi Arabia, considering that today health information systems and associated technologies are being used to increase hospital efficiency as well as the delivery of quality care to the patients (Cesnik & Kidd 2010). These technologies enable healthcare organisations to maintain important patient information and improve the provision of care. With the inception of the use of electronic records in the healthcare industry in the 1960s, many countries around the world have continued to explore ways of incorporating these technologies within their healthcare systems, and Saudi Arabia is no exception.

The introduction of health technologies in the Saudi healthcare system began in 1988 to enhance the country's healthcare service provision and meet its growing demands of healthcare services (Hasanain, Vallmuur & Clark 2015). However, interest in e-health increased with the initiation of Saudi Vision 2030 that focuses on developing and improving public health services as part of Saudi's strategy of diversifying its economy (Noor 2019). In line with this Vision and the National Transformation Program (NTP) 2020, the Saudi MoH has undertaken numerous strategies to improve health systems and services in Saudi Arabia to the global standards. Specifically, the MoH's Vision Realisation Office (VRO) is responsible for the management of healthcare transformation programs under the Health Transformation Strategy (MoH, 2018). The strategy identifies e-health that involves tools such as EHRs as one of the critical areas for improving health and care services (Noor 2019). E-health has resulted in easy and effective provision of health services in various ways, such as helping healthcare providers in making care decisions and improving conduct of research.

Significant milestones in the computerisation of medical systems have been made in some health facilities in Saudi Arabia but not in others (Noor 2019). For example, King Faisal Specialist Hospital and Research Centre has intensified its efforts towards the development of e-health programs. It has implemented electronic resource planning systems, picture archiving and communication systems as well as robust electronic medical records programs that have transformed its operations (Alsulame, Khalifa & Househ 2016). The Ministry of National Guard Health Affairs, which offers medical services to employees of the National

Guard and their families, as well as specialised care for Saudi Arabian citizens in general, has also made significant milestones in its bid to automate processes. It has adopted information technology systems in all its hospitals and runs efficient EHR systems together with other technological solutions. Another example is the Security Forces Hospital, which has implemented an integrated system to manage its patient information (Altuwaijri, Bahanshal & Almehaid 2011).

Although several healthcare organisations have continued to adopt e-health programs to enhance service quality, there have been insufficient efforts towards the creation of an integrated national network for health records (Altuwaijri 2010). The MoH has not managed to bring all the different players under a single framework for the automation of patient health records. However, the ministry, which has the majority of health facilities, has continued to work on the connection of public hospitals to one another and the establishment of a national plan for e-health (Alsulame, Khalifa & Househ 2016; Noor 2019). The King Faisal Specialist Hospital and Research Centre, for instance, has linked up with more than 12 other MoH hospitals in the implementation of the King Faisal Specialist Hospital and Research Centre's telemedicine network.

Although the Saudi Arabian healthcare industry has continued to adopt EHRs in increasing numbers, the overall trend showed a slow uptake (Alsulame, Khalifa & Househ 2016). Further, uptake has been generally unbalanced across the country. Riyadh region seems to have made more progress in the adoption of EHRs compared with the Eastern Province, with Bah et al. (2011) reporting that only three out of the 19 hospitals from the Eastern Province had adopted EHRs. Conversely, 11 out of 22 hospitals in Riyadh had fully implemented their EHR plans and had begun to realise the benefits of these technologies, eight (8) were on course to have their EHR systems in place, and only three (3) had not yet rolled out EHR plans (Aldosari 2014). Among other reasons, this imbalance may have been brought about by the fact that Riyadh is the capital of the country and can, therefore, access the necessary support and infrastructure required for the implementation of these technologies.

However, a more recent study by Jabali and Jarrar (2018) showed development in the Eastern Province as well. Out of the 15 hospitals included in the study, seven (46.6%) reported that they had implemented and commissioned an EHR system. The responses indicated that these EHR systems were mainly used for order entry (51.11%), followed by chart review (41.11%). Therefore, the uptake of EHRs continues across the country, driven by the MoH's 2011 National E-health Strategy that was designed to promote the transformation of the healthcare industry from the traditional paper-based to the new electronic platform (MoH 2013). Despite the challenges experienced along the way, the ministry has continued to source funds and resources and made clear its intention to have a national health information system that includes the development of robust EHR systems.

With these interventions, Saudi Arabia's hospitals stand to gain from a cleaner environment once all the facilities adopt EHR systems for recording and updating patient information. In the traditional setting, the management of hospitals and healthcare centres used a lot of paper, including books, which eventually translated to huge expenses and an untidy environment. By using EHRs, these organisations can significantly reduce paper wastage and enhance their record-keeping operations (Menachemi & Collum 2011). By adopting more innovative approaches, the EHR systems can be used to improve service delivery by including links that can send notifications to patients about their medical plan. For instance, the National Guard Health Affairs in Saudi Arabia developed an initiative that expanded its electronic system to improve quality for its Ambulatory Care Centre (ACC) at the King Abdulaziz Medical City (Hasanain, Vallmuur & Clark 2015). Through these services, the electronic system offered a facility whereby a short message could be sent to patients as a reminder about scheduled appointments, which resulted in positive outcomes for the hospital as it recorded improved efficiency through reduced numbers of missed outpatient appointments (Hasanain, Vallmuur & Clark 2015). If other Saudi healthcare facilities adopt such transformational interventions as part of the electronic systems, the entire sector will reap great benefits from EHR.

2.4.3 EHR in primary care in Saudi Arabia

The WHO has encouraged the use of health information technologies (HITs) in PCCs to improve the quality of service provision and reduce the costs associated with health care (Almaiman et al. 2014). While there has been an increased uptake of these systems in hospitals in Saudi Arabia, with 40% of MoH hospitals reported to currently have EHRs, PCCs are still in transition to adopt HITs and so they still rely on paper-based systems (Al-Shorbaji et al. 2018).

The PCCs in Saudi Arabia that have adopted EHR systems have seen several benefits, such as easy storage and retrieval of patients' information thus helping to review diseases in order to provide quality of diagnosis and medication (Almalki, FitzGerald & Clark 2011). This has seen an improvement in healthcare in primary care in the National Guard Health Affairs hospitals, the King Faisal Specialist Hospital, and the Armed Forces hospital (Hasanain, Vallmuur & Clark 2015). Currently, there have been increasing concerns about the underutilisation of EHR systems in regions of Saudi Arabia, including Riyadh city. A lot of electronic medical services are not integrated at the local and national levels, and this has therefore resulted in duplication, incomplete data entry, and a negative effect on the quality and safety of health care as well as cost (Almaiman et al. 2014). Alnuem et al. (2011) and

Almalki, FitzGerald and Clark (2011) support this description of the state of current electronic medical services, stating that there was no evidence found showing their integration. They stated that the electronic medical systems in PCCs, such as EHRs, are currently not connected to each other or other healthcare service providers. Due to this, it has presently become challenging to integrate the medical services from one PCC to another.

There are several reasons for the challenges facing EHR adoption in PCCs in Saudi Arabia. It is reported that while the aim of implementing an EHR system is to improve the quality of care, the adoption has met barriers, including privacy concerns, unavailability of skilled personnel, weakness of information infrastructure, and lack of data standards among others (Ajami & Bagheri-Tadi 2013; Almaiman et al. 2014; Gesulga et al. 2017). Another challenge that is common to any new system is resistance to change from employees (Delaney & D'Agostino 2015). The employees of the hospitals and PCCs in the country have been resistant to the introduction of EHR systems because this would mean going through rigorous training (Alsulame, Khalifa & Househ 2016). The problem is that there is a lack of motivation and training in preparation to use an EHR system. For example, they have not been given any incentive to use such a system, and thus they are not interested in even trying to use it. Another reason is the issue of confidentiality and interoperability. A majority of the physicians did not want to adopt an EHR system because they thought it exposes the information of patients without their consent (Almaiman et al. 2014; Alsulame, Khalifa & Househ 2016). Some of the physician respondents fear that the system will not integrate with other ones, and therefore will not offer updated information concerning patients.

However, some recommendations have been made to improve the current system in Saudi Arabia. The first one is enhancing the adoption of EHR systems through motivation. As

Alsulame, Khalifa and Househ (2016) suggested, physicians need to be motivated in different ways, such as providing rewards. In doing so, they will want to understand how to use the new system to provide patients with quality healthcare. In addition, Noteboom et al. (2014) suggested that improvements need to be made to help physicians to access information easily. The effect of such an improvement is that they would have the opportunity to review patients' information in the comfort of their own home. If implemented, Almaiman et al. (2014) stated that these recommendations would help physicians in hospitals to take care of a lot of issues, including lack of data standards, weakness of information infrastructure, unavailability of skilled personnel, and privacy concerns. Al Alawi et al. (2014) also acknowledged that the application of EHR systems has performed below par despite the high rate of satisfaction reported among physicians, which emerges as a positive perception. The researchers noted that further initiatives should be undertaken to increase the adoption of the system in Saudi Arabia.

2.5 Chapter summary

This chapter reviewed the previous literature on the adoption of IT in general and EHRs in particular. The review identified that the adoption and use of EHRs are associated with several benefits as well as challenges in healthcare. It also identified that adoption is influenced by several factors that could facilitate or hinder the adoption process. User perception emerged as a significant factor, however this has not been widely investigated in relation to EHR adoption in primary care contexts in Saudi Arabia and the rest of the GCC countries. It was also shown that the users' perception of an EHR system is affected by several factors that could be related to the individual, organisation or system. In the next chapter, a model that could help explain users' perceptions towards the adoption of EHRs is discussed.

CHAPTER 3 : TECHNOLOGY ACCEPTANCE MODEL AND DRAFT CONCEPTUAL MODEL

3.1 Introduction

The previous chapter established that there are various factors that may have an impact on the adoption and implementation of new technology. This chapter explores the theories and models that allow us to measure and evaluate how these factors influence technology acceptance. It provides an overview of the TAM and its basis as a theoretical framework for the conceptual model proposed in this thesis. This chapter explores the development of the TAM and its modified version, TAM2, and the components of the model. Applications and criticisms of the model are also presented.

3.2 Theories and models about technology acceptance

As result of the challenges associated with the introduction of technology, several theories or models have been developed in both the information technology and information system fields in order to predict, determine, explain and adequately understand user acceptance (or lack thereof) of technology and systems across various settings. This section explores the development of most common theories and models over time.

3.2.1 Theory of Reasoned Action

Considered the earliest theory of technology acceptance, the Theory of Reason Action (TRA) was developed in 1967 by Martin Fishbein and Icek Ajzen to explain the relationship between perception and behaviours of human action in the field of social psychology (Fishbein & Ajzen 1975). TRA theorised that people plan to engage in a specific behaviour or demonstrate certain behavioural patterns based on their expectations or experiences. Therefore, the theory focused on attributes based on an individual’s behavioural intentions, such as the measure of the strength of intention, the stability of intentions, and degree of conducting the intentions. The fundamental concept of TRA, as shown in Figure 3.1, is that behaviour is influenced by the intention behind the act, the behavioural intention (BI).

Fishbein and Ajzen (1975) further argued that the BI is influenced by two moderating factors: person's attitude (A) toward behaviour and subjective norm (SN) concerning that behaviour. Thus, TRA has three general constructs that explain behaviour: attitude, subjective norm, and behavioural intention.

Although TRA was developed for social psychology research in order to predict, explain and influence human behaviour, the model has been used extensively in predicting and explaining behaviour across diverse settings (Davis, Bagozzi & Warshaw 1989). For example, the behavioural intention was found to positively influence the adoption and use of Green Information Technology (GIT) by IT professionals (Mishra, Akman & Mishra 2014). Specifically, IT practitioners in both the public and private sectors with positive intentions towards issues of GIT were actually practising GIT in their work to promote environmental conservation.

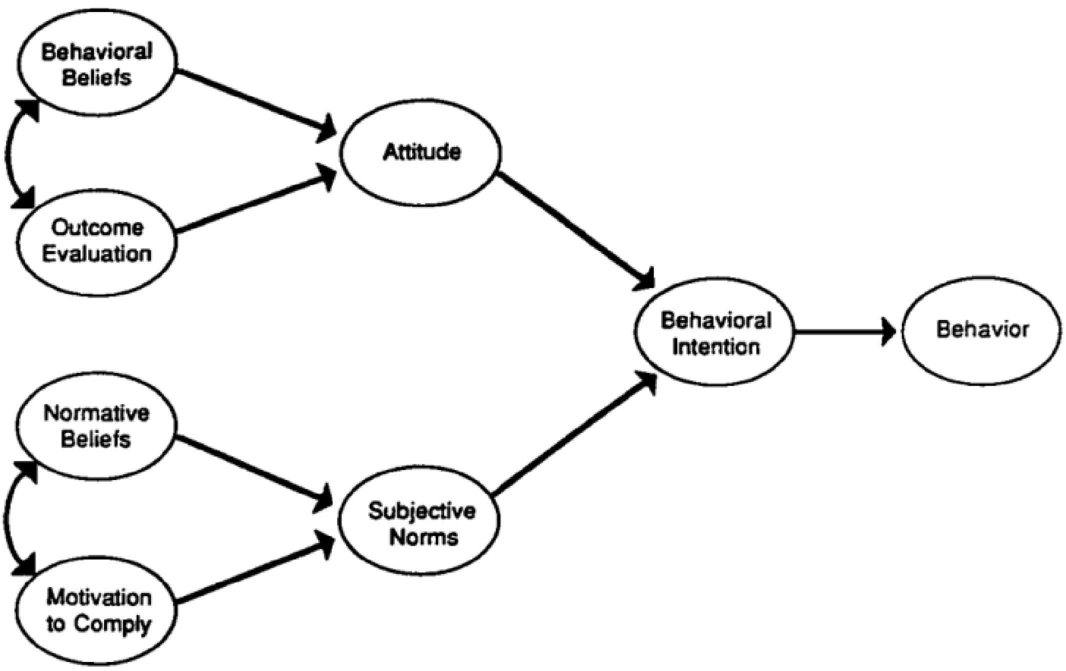

Figure 3.1: Theory of Reasoned Action (Fishbein & Ajzen 1975)

However, there have been criticisms of the use of this model in exploring technological acceptance. The first limitation is that TRA does not investigate any specific beliefs; thus, a researcher using the model must first identify the salient subject’s beliefs for investigation (Davis, Bagozzi & Warshaw 1989). Hagger (2019) also argued that TRA poses a significant risk of confusion between attitudes and norms since attitudes can always be reframed as norms and vice versa. Moreover, intention to act might not translate to actual action as this may be affected by other factors such as limited ability, time and organisational factors. These limitations have led to the development of extended theories to explain the use of new technology and role of individual behavioural intent as described below.

3.2.2 Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB), which was developed by Ajzen (1985), originates from TRA to predict intention to engage in a particular behaviour at a specific time and place. The theory posited that individuals could exert self-control while participating in a particular behaviour. Thus, it has an additional construct, that of ‘perceived behavioural control’, which refers to a person’s perception of the ease or difficulty of performing behaviour of interest and it varies across situations and actions. Thus, perceptions of behavioural control vary depending on the situation.

Ajzen (1985) argued that intention and behaviour were also determined by a person’s perceived behavioural control. Therefore, TPB is moderated by three constructs: attitude toward behaviour, subjective norm, and perceived behavioural control. Similar to TRA, Momani and Jamous (2017) observed that TPB had been successfully used to understand the acceptance and usage of different technologies. Nchise (2012) found TBP to be effective in predicting human behaviour towards the adoption of e-democracy. In particular, inherent (attitude) and environmental (subjective norms—social pressure and perceived behavioural control—controllability, and self-efficacy) were found to be enablers of participation in e-democracy in poor-resource settings such as sub-Saharan Africa. Citizens' attitudes towards e-democracy positively influenced their intention to adopt e-democracy. Environmental subjective norm positively influenced people's attitude to adopting e-democracy as well as behavioural control.

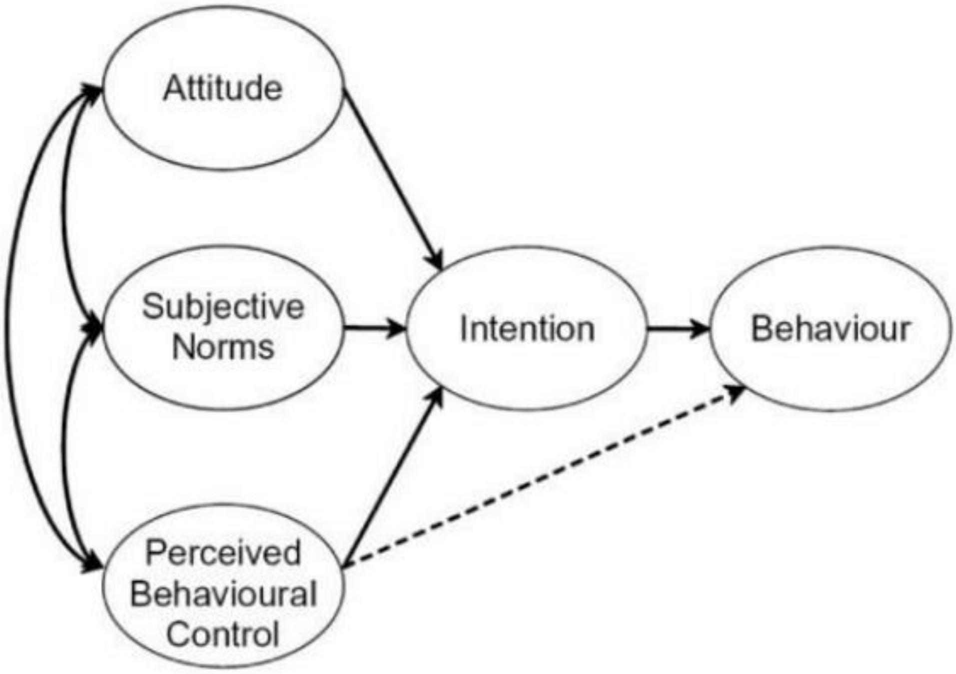

Figure 3.2: Theory of Planned Behaviour (Ajzen 1985)

Similar to TRA, TPB also has its limitations. The theory is based on the assumption that a person has the opportunities and resources required to successfully perform the desired behaviour regardless of intention (LaMorte 2016). Further, it does not account for other variables that affect behavioural intention and motivation, such as personal factors (fear, anxiety, threat and experience, among others), environmental or economic factors. Sniehotta, Presseau and Araújo-Soares (2014) also noted that TPB fails to recognise that behaviour can change over time rather than being a result of a linear decision-making process. The researchers further argued that the added construct behavioural control does not say anything about actual control of behaviour. The final limitation of the theory is that it fails to address the time frame between intent and behaviour. Due to these limitations, the addition of elements to the basic model has been suggested in order to gain a better understanding of complex human behaviour.

3.2.3 Technology Acceptance Model

TAM has been one of the most significant models commonly referred to when explaining technology usage and widely cited in the literature due to its sufficient theoretical framework and supporting empirical evidence (Chuttur 2009; Surendran 2012). TAM was first proposed in 1985 by Fred Davis in his doctoral thesis at the Massachusetts Institute of Technology (MIT) to explain the determinants of users' behaviour towards accepting various computer technologies. According to Davis (1985), the acceptance of technology and its subsequent use is influenced by the motivation levels of the user, which is also influenced by the features and capabilities of the system or technology in question.

Davis's (1989) development of TAM was informed by the concept of TRA that actual behaviour is influenced by the intention to perform the behaviour. In the proposed model, Davis (1985) modified TRA by eliminating the construct of 'subjective norms' and introducing two measures of technology acceptance: perceived usefulness and perceived ease of use which were hypothesised to influence attitude toward a system considered as the major determinant of whether a user will accept or reject a system. It was also argued that perceived ease of use could indirectly influence attitude toward usage by directly influencing perceived usefulness. Furthermore, the two main constructs: perceived usefulness and perceived ease of use, were believed to be influenced by the design characteristics of the system represented by X1, X2, and X3 as shown in Figure 3.3. Even though TAM was developed from TRA, it was considered less general and only applied to human behaviour in relation to computer usage.

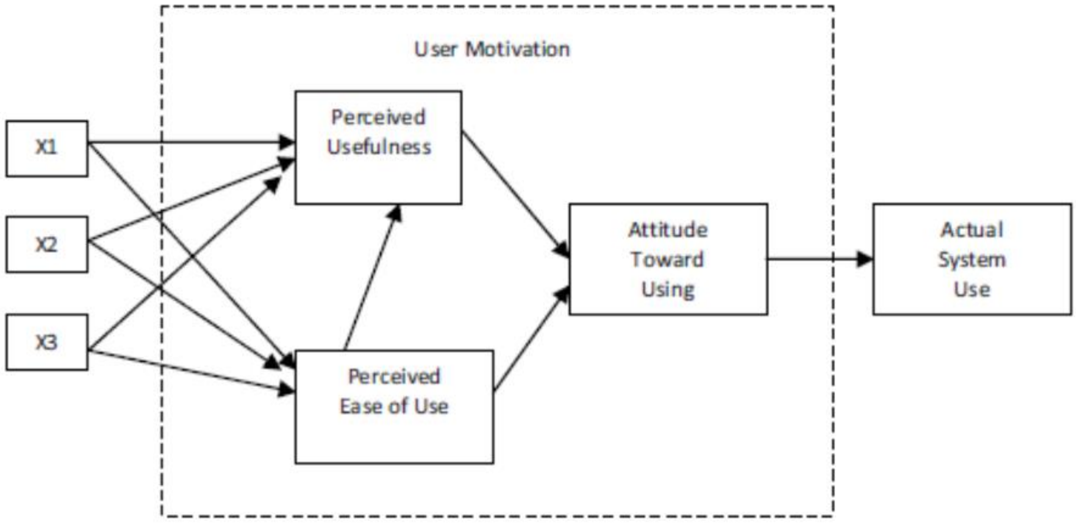

Figure 3.3: Original TAM (Davis 1985, p. 24)

Over time, TAM has been developed in various phases of adoption, validation and extension. After development, Davis (1989) first validated the model in two studies that evaluated the impact of the constructs—namely measures of perceived usefulness and perceived ease of use—on the users' acceptance of computers. A total of 152 users and four application programs (PROFS electronic mail and XEDIT file editor in the first study and Chart-Master and Pendraw graphics systems in the second study) were involved. In both studies, the measures were found to have high validity and good reliabilities of 0.98 and 0.94 for perceived usefulness and perceived ease of use, respectively. Other researchers have also adopted, tested and validated TAM through numerous applications of information technology in which it has been established to accurately measure the acceptance behaviour of the users in different technologies and IT settings (Momani & Jamous 2017; Jokonya 2015; Napitupulu, Kadar & Jati 2017). Currently, TAM is in the third phase whereby it is being extended by adding new variables and relationships between its constructs.

In 1989, Davis et al. (1989) redeveloped the original model and used it to explain behaviour towards computer usage. The researchers noted that the perception of a person towards a computer technology or system might be influenced by other factors which they referred to as 'external variables' which affect the perceived usefulness and perceived ease of use. In the first modified version of TAM in Figure 3.4, the 'intention to use' attribute is introduced as a moderating factor influencing actual usage. It is directly influenced by both attitude towards use and perceived usefulness of a system. Davis, Bagozzi and Warshaw (1989) argued that an individual might show an intention to use if they perceived it to be useful without developing attitude towards use.

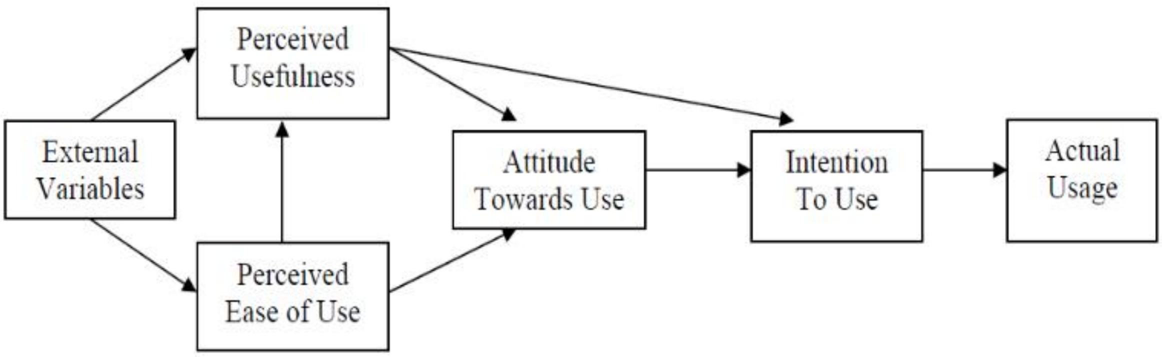

Figure 3.4: First modified version of TAM (Davis, Bagozzi & Warshaw 1989, p. 985)

The model was further redeveloped by Davis, Bagozzi and Warshaw (1989) who used it in a longitudinal study involving 107 MBA students to determine their intention to use a word processing application, namely Write One, after one hour of introducing the system and later after 14 weeks. In this study, both perceived usefulness and perceived ease of use were found to have a direct influence on the behaviour intention in both cases. Whereas the perceived usefulness had a strong impact on intention to use the technology application, the influence of perceived ease of use was lesser but still significant. The attitude construct did not mediate the two constructs fully, thereby leading to its removal from the model. Therefore, the final version of TAM, which lacks the attitude construct as shown in Figure 3.5 and used today, was obtained. The model has two main constructs: perceived usefulness and perceived ease of use influencing behavioural intention and actual computer usage.

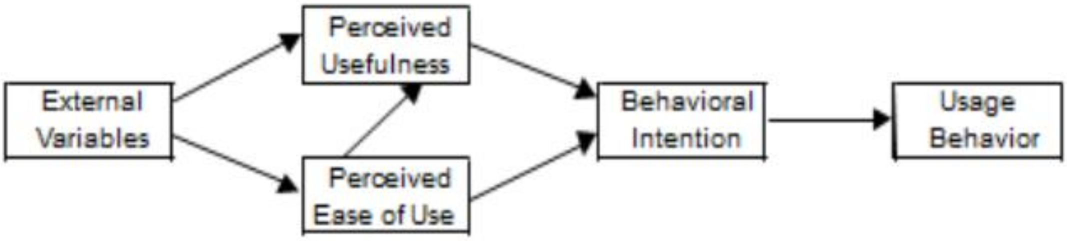

Figure 3.5: Final version of TAM (Venkatesh & Davis 1996, p. 453)

3.2.4 Technology Acceptance Model 2

TAM2 is a culmination of further research on the final version of TAM leading to its replication, testing of its hypotheses and limitations, comparing it with other models such as TRA and TPB, adapting it in various settings, and extending it to include other variables such as extrinsic motivations (Chuttur 2009). As one of the most important extensions of the final version of TAM, TAM2 was proposed by Venkatesh and Davis (2000) who observed that TAM had some limitations in its explanation for the perceived usefulness construct. The researchers noted that the perceived usefulness of a system could also be influenced by other factors related to the time at which the technology is to be introduced. Therefore, Venkatesh and Davis (2000) proposed the addition of more variables as influencing factors of the perceived usefulness as shown in Figure 3.6. The authors also evaluated the performance of the proposed TAM2 in a mandatory setting through a field study involving 156 knowledge workers using four different systems: two for voluntary use and the other two for mandatory use.

The user perceptions and self-reported use were also evaluated at three different times, namely pre-implementation, one month after implementation, and three months after implementation (Chuttur 2009). Using the model, Venkatesh and Davis (2000) provided more reasons as to why a user might perceive a particular system to be useful. It was established that TAM2 performed well in both mandatory and voluntary settings. However, the subjective norm did not influence perceived usefulness in voluntary environments as opposed to the mandatory settings where it had an influence. In general, TAM2 hypothesised that an individual's perception of the usefulness of a system is based on the decision between meeting important work goals and the results obtained when the system is used to perform a job task.

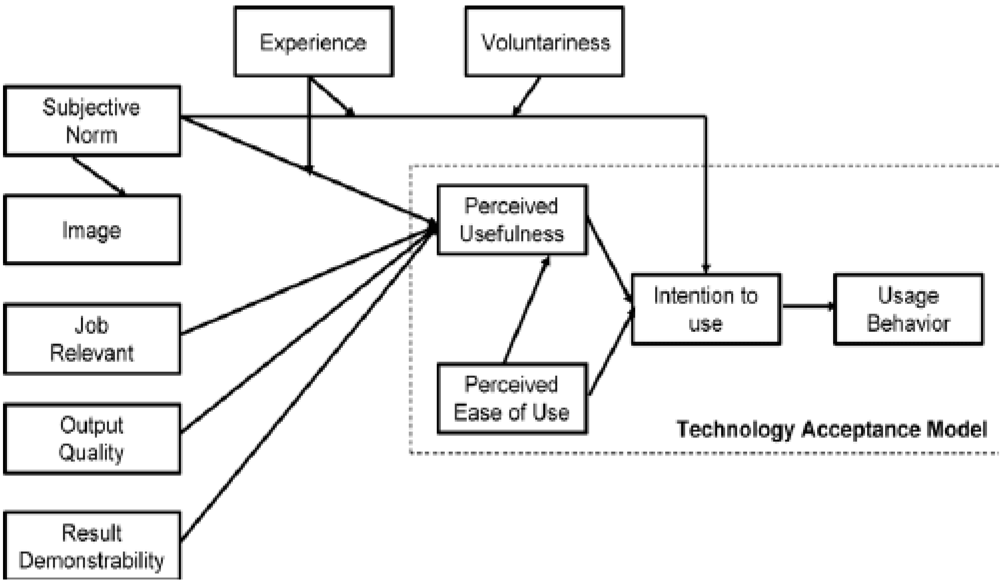

Figure 3.6: TAM2 (Venkatesh & Davis 2000, p. 188)

It is important to note that TAM2 has also undergone extension. For instance, Venkatesh and Bala (2008) combined it with another model of the determinants of ease of use that had been developed by Venkatesh (2000) to form an integrated model of technology acceptance known as TAM3 that incorporates four types of constructs that determine both the perceived usefulness and perceived ease of use. They included individual differences, system characteristics, social influence, and facilitating conditions. The inclusion of perceived ease of use in TAM3 was considered important because TAM2 focused on only the perceived usefulness variable of the original TAM.

3.3 Adoption of TAM for thesis

This thesis adopted the first modified version of TAM by Davis, Bagozzi and Warshaw (1989) as the model for developing a theoretical framework used in this research. Various reasons led to this decision, including that first of all, TAM was developed in the IT field with a particular focus on computer technologies, as opposed to TRA and TPB which were developed in the field of psychology. This is in line with the scope of this study that evaluated the perceptions of healthcare professionals in primary healthcare settings towards EHRs which use computer technology for managing patients' health records. Secondly, in the case of the final version of TAM and TAM2, the first has the attitude construct that concurs with the study's aim of evaluating the perceptions of healthcare professionals towards the adoption of EHR in PCCs in Riyadh city, Saudi Arabia. In particular, the study examines the influence of individual and system characteristics, which the model refers to as 'external variables', on the perceptions of benefits and obstacles of adopting EHRs. The thesis hypothesised that the use of an EHR system in primary care settings is influenced by its perceived usefulness and perceived ease of use, which are the main constructs of TAM and of utmost importance in the use of an EHR system. Therefore, it will be critical in answering the research question of this study.

Further, the model has been applied in the evaluation of several technology applications in different voluntary and mandatory environments and in all cases was found to have good predictability, simplicity, and ease of understanding (King & He 2006). It has also demonstrated good performance, peculiar validity and robustness across several settings

(Venkatesh & Davis 2000; King & He 2006; Phatthana & Mat 2011; Bahadori et al. 2017; Napitupulu, Kadar & Jati 2017). Using a sample of 278 university professors, Shahrabi et al. (2013) also established that TAM measurements had sufficient content validity and reliability with perceived usefulness and perceived ease of use constructs, yielding reliabilities of 0.89 and 0.87 respectively. This evidence implies that TAM could easily be applied not only in the Western context but also in a Middle Eastern context such as Saudi Arabia. Lastly, TAM was selected in this research because it has been specifically designed to address factors that could influence technology acceptance by users in line with the objectives of this research.

3.4 Elements of TAM

As shown in Figure 3.5, the final version of TAM has five constructs. Two of the elements, namely the perceived usefulness and perceived ease of use, are critical as they influence the intention to use as well as acceptance and actual use of technology by influencing the attitude (Davis, Bagozzi & Warshaw 1989; Holden & Karsh 2010). As later demonstrated in the final version of TAM, it is postulated that the two variables have a direct effect on the behavioural intention to use technology (Venkatesh & Davis 1996). It is also established that they are influenced by other factors (external variables) such as pedagogical beliefs, levels of competency, organisational barriers and technological barriers that produce indirect effects on the intention to use technology or the system (Venkatesh & Davis 1996; Davis, Bagozzi & Warshaw 1989). The variables have also been suggested to be measurable, with Davis (1989) proposing various measurement tools for the perceived usefulness and perceived ease of use.

Perceived Ease of Use

The creation of the construct perceived ease of use by Davis (1989) was informed by the belief that an application is more likely to be accepted if it is perceived to be easy to use. Holden and Karsh (2010) defined perceived ease of use as the level to which a potential user presumes a system to be devoid of effort that could be mental, physical, or both. To some extent, it predicts the perceived usefulness, and jointly they determine attitude towards use as postulated in the earlier models. The final version, however, acknowledges that perceived ease of use could have a direct influence on behavioural intention. Therefore, a user would be more inclined to adopt a system if they perceive it to be easy to use. Holden and Karsh (2010), on the other hand, assert that the perceived ease of use is not always the most critical determinant of accepting technology by a prospective user but rather the perceived usefulness, which is discussed below. As noted earlier, perceived ease of use is measurable and could be measured through various ways such as the time taken to learn operational techniques, getting an application to do as one wants, the flexibility of the technology during operation, and overall ease of use.

Perceived Usefulness

This construct was based on the expectation that a system is perceived to be useful if it has a positive relationship between use and performance (Davis 1989). The perceived usefulness refers to the user's subjective probability that using a specific application system will increase his or her job performance within an organisational context (Holden & Karsh 2010). According to Davis (1989), usefulness is more reliable in predicting usage than perceived ease of use. The author also argued that perceived usefulness is the most influential factor for judging a person's intention leading to an acceptable level of internal consistency. Therefore, technology is more likely to be embraced if it is presumed to be useful, convenient and socially appealing despite not being able to be enjoyed. Perceived usefulness has been most commonly assessed by increased productivity, job performance, job effectiveness, and overall usefulness with an acceptable threshold of internal consistency from the given measurement tools used to determine perceived usefulness (Holden & Karsh 2010).

External Variables

TAM also has 'external variables' as a construct, which refers to other factors that might affect a person's belief towards a system (Davis 1989). Ranging from system characteristics, user participation in the system design and user training, to the nature of the implementation process, the influence of external variables on behavioural intention is mediated by perceived usefulness and perceived ease of use of a system (Venkatesh & Davis 1996). Therefore, they must be taken into consideration while designing and introducing new technology.

Behavioural Intention

Behavioural intention refers to the intention of the user to use a system. According to Venkatesh and Davis (1996), behavioural intention has been found to be a better predictor of system usage than other factors such as expectations, motivation, and user satisfaction. In so doing, it moderates the influence of two fundamental TAM beliefs of perceived usefulness and perceived ease of use on actual usage of a system. The final TAM also theorises that a user can show an intention to use a system without developing an attitude towards use, provided the system is perceived to be useful and easy to use.

3.4 Applications of TAM in healthcare and other fields

TAM-based models have been applied across various settings to predict user acceptance and adoption of technology. In so doing, they allow the implementers to understand better the factors that may influence the successful implementation of a technology. Some of the contexts in which TAM has been applied include education, hospitality and healthcare.

3.4.1 General applications

Several previous researchers have shown that TAM and its related models could be a good predictor of technology acceptance in various fields. In education, Ng, Shroff and Lim (2013) used a modified TAM to analyse the factors that influence the implementation of an e-portfolio known as *Mahara* by student teachers in field placements in Hong Kong. The study demonstrated that the user acceptance of the e-portfolio system, which is a critical factor in its implementation, was influenced by the three key TAM variables, namely perceived usefulness, perceived ease of use, and attitude toward using the system. The participants provided positive comments with regard to the system's perceived usefulness but not perceived ease of use. With regard to perceived usefulness, the majority of respondents reported that Mahara helped them to keep a record of a file they created during their field experience and to provide and receive feedback. Conversely, there was a negative perception of the system's ease of use with all the participants reporting that Mahara was too complicated and difficult to use, with its interface being different from other familiar platforms. In addition to names of the features of the platform being very confusing, it was reported to be restrictive in allowing uploading of animations and sophisticated content. The researchers further showed that attitude towards the e-portfolio was a significant predictor of behavioural intention to use and the actual usage of the system. Thus, the study shows that attitude towards usage could be a significant determinant of intention to use technology. However, training emerged as a significant predictor of both perceived usefulness and perceived ease of use.

The TAM variables have also been shown to influence the intention to continue using a system that is critical in system implementation. While using TAM to predict users' intention to continue using an e-payment system in Nigeria, Tella and Olasina (2014) identified that there was a significant positive correlation between perceived usefulness and perceived ease of use and attitude towards the use of the system. Similarly, perceived ease of use was significantly positively correlated with perceived usefulness, as postulated by Davis (1989). The authors also evaluated the influence of other factors, including perceived enjoyment and speed on continuance intention and actual use respectively, and showed a significant positive relationship. The authors, therefore, concluded that perceived benefits, user satisfaction, actual use, and attitude are good predictors of e-payment continuation.

Further, Sánchez-Franco and Roldán (2005) noted a strong relationship between perceived usefulness and behavioural intention among goal-driven individuals in their study that analysed web acceptance and usage between experiential and goal-directed web users using TAM. A strong relationship was also found between perceived usefulness and perceived ease of use and actual usage in both groups of web users.

3.4.2 Applications in healthcare

TAM has been extensively utilised in healthcare because the several technology acceptance models tested in ordinary business settings might not be able to produce valid results in professional contexts such as healthcare (Chau & Hu 2001). Thus, the authors investigated the validity of TAM, TBP and a disintegrated TPB model in predicting the acceptance of a telemedicine technology by tertiary hospital physicians in Hong Kong. The models were found to be presumably adequate in the context of technological adoption in Hong Kong healthcare, meaning that TAM can be used to predict users' behaviour towards the adoption of new healthcare innovations.

Similarly, an examination of factors that could influence the adoption of a new telemonitoring system among the healthcare professionals, Gagnon et al. (2012) used a modified TAM with four additional constructs: habits, compatibility, facilitators, and subjective norm. 'Habits' was added to the technological context of the original TAM, which had both perceived usefulness and perceived ease of use, and it was hypothesised to influence the perceived ease of use. Conversely, 'compatibility' was grouped with the attitude construct in the individual context and was hypothesised to influence perceived usefulness. Both ‘facilitators’ and ‘subjective norm’ were put together in an additional context of organisational, and assumed to directly influence intention to use. ‘Facilitators’ were also assumed to have an indirect influence on intention to use by directly affecting attitude. Although the original model was established to be a good predictor of intention to use a telemonitoring system with the perceived usefulness the only significant predictor, the additional construct of ‘habits’ resulted in a more robust model (Gagnon et al. 2012). Nevertheless, the ‘facilitators’ construct was the only significant predictor in the new model. They concluded that TAM is a useful model for predicting intention to use telemonitoring by doctors and nurses, but more focus should be on the perception of ‘facilitators’ in order to increase the intention of usage.

Helia et al. (2018) also evaluated the factors that influence users’ adoption of a hospital information system using a modified TAM and found the perceived usefulness to be a key element of the seven variables. The other variables included perceived ease of use, subjective norm, user satisfaction, attitude toward using, behaviour intention to use, and actual system usage. The subjective norm variable had a positive and significant relationship with both perceived usefulness and behaviour intention. User satisfaction also had a positive and significant relationship with perceived ease of use but not with perceived usefulness. Moreover, perceived ease of use had an insignificant relationship with perceived usefulness and attitude toward using. A good correlation was also found between perceived usefulness and attitude toward using, followed by attitude toward using and behaviour intention to use, and finally behaviour intention to use and actual system usage.

Mathai et al. (2018) also used TAM (Davis 1989) in a pilot study to investigate the factors affecting consumer perceptions towards the adoption of EHRs in Australia. They examined the core constructs of TAM, including perceived usefulness, perceived ease of use, subjective norms and attitude. The additional external variables included perceived health literacy, perceived computer anxiety, perceived self-efficacy, and perceived barriers. The authors conceptualised perceived usefulness as the degree to which the users would believe that the use of EHRs improve their performance, while perceived ease of use was construed as the degree to which the use of an EHR system would be effortless. Linear regression showed that perceived usefulness, perceived ease of use, subjective norms, perceived self-efficacy, and resource availability were significantly associated with attitude as a dependent variable.

Abdekhoda et al. (2015) also applied a conceptual path model of TAM to study the impacts of organisational factors on physicians' attitudes towards EHR adoption in Iran. The model explained about 56% of the variance in EHRs' adoption (R2 = 0.56). Bahadori et al. (2017) also showed that perceived usefulness and perceived ease of use TAM variables could explain 51% of variations in physicians' attitudes towards EHRs, while in Vitari and Ologeanu-Taddei's (2018) study they explained 34% variance in intention to use an EHR system Aldosari et al. (2018) found a significant positive correlation between perceived usefulness and perceived ease of use ($p = 0.000$, correlation coefficient = 0.538). Perceived ease of use was also positively significantly correlated with perceived usefulness ($p = 0.000$, correlation coefficient = 0.538). These findings suggest that these TAM factors are positively related and influence the acceptance of EHRs.

Evaluation of extended TAM and related models has also achieved similar results. For example, Gagnon et al. (2014) established that TAM and extended TAM, as well as the other two theoretical models, namely Psychosocial Model and Integrated Model, determined physicians' acceptance of EHRs and were good predictors of physicians' intention to use

EHRs. The Integrated Model was found to be the best predictor of intention to use the systems. However, its prediction was also attributed to the variables, including perceived ease of use. Dutta, Peng and Sun (2018) used an extended TAM with gender and healthcare technology self-efficacy as external variables to examine individuals' intention to use a medical information exchange system, known as the personal health record (PHR) system. The model explained 40.6% of the variance of intention to use PHRs. It also showed that healthcare technology self-efficacy and gender were significant variables in TAM.

From the literature, it is evident that the acceptance of a technology system is influenced by its perceived usefulness and perceived ease of use, with the latter demonstrating a more significant impact. It could also be deduced that the actual usage of a system is preceded by the intention of use that may be influenced by the attitude of the user. Although Venkatesh and Davis (1996) argued that attitude is not a significant determinant of intention to use a technology system and subsequently eliminated it in the final model of TAM, under normal circumstances, an individual may need to first develop a positive attitude before intending to use and actually using a system. Therefore, it remains a crucial factor that cannot just be ignored while implementing a technology system such as EHRs. Other factors, whether intrinsic (related to the system itself) or extrinsic (related to the user and referred to as 'external variables' in TAM) are also believed influence acceptance and use of technology by influencing its perceived usefulness and/or perceived ease of use. These factors remain to be evaluated in this study in order to establish whether they affect the acceptance of EHR systems in primary healthcare centres in Riyadh city, and their ultimate implementation.

3.5 Technology acceptance with regard to the adoption of EHR in primary care

It is imperative to note that despite a rise in the global trend in adopting EHRs in health settings, their widespread use has been hindered by a number of implementation and adoption barriers (Ajami et al. 2011; Jones & Blavin 2013). Failure of the users to adopt a system has been widely cited in the literature as a significant factor in the failure of clinical system implementations. The ability of the users to accept or reject EHRs could be well explained by technology acceptance theories and, in this research context, the first modified version of TAM (Davis, Bagozzi & Warshaw 1989). This section discusses the factors that may influence the adoption of EHRs in primary care with a focus on individual, organisational, and system characteristics.

3.5.1 Individual characteristics

These are mainly demographic factors that affect the adoption and implementation of EHRs, such as occupation, age and gender of the respondents. The influences of these factors on technology acceptance have been widely investigated in the literature. This section examines some of the individual characteristics reported in the literature and how they affect the adoption and use of EHRs.

3.5.1.1 Occupation

Jones and Blavin (2013) and Zheng and Yu (2015) reported that the global change in the landscape of healthcare from a predominantly paper-based practice to a paper-light or electronic environment in order to improve the efficiency and effectiveness in healthcare delivery affects the occupation of various health professionals. Zheng and Yu (2015) regarded an EHR system as an enterprise information system that comprises a range of ITs affecting data, individuals and workflow in an organisation. The adoption of EHRs is expected to result in changes in the healthcare workforce through changes in role, additional expertise required, and obsolete practices. For instance, the implementation process would require an IT-support specialist to provide user support to allow a smooth transition of technological operations to achieve the desired goals (Ward et al. 2011). The trainers are also required to deliver training programs to healthcare professionals once system software is dispatched (Zheng & Yu 2015). As a result, the adoption of an EHR system might result in the creation, changes to or abolition of professionals' roles and practices.

Different groups of healthcare professionals are also likely to interact differently with EHR systems, which is likely to affect their acceptance or rejection of EHRs. For instance, Vitari and Ologeanu-Taddei (2018) showed that physicians had a higher intent regarding the use of EHRs than paraprofessionals and administrative staff, and this was attributed to their medical responsibility and professional autonomy. Hoover (2016) similarly observed that occupation has a significant influence on healthcare professionals' perceptions of the benefits of EHRs with nurses reporting highest satisfaction with the benefits that the use of EHRs results in enhanced preparation of health records, increased speeds in accomplishing work, decreased the overall workload, and led to easier investigation of results, thereby significantly improving the quality of care. These results differ from other staff who indicated that EHRs helped prevent the loss of patients' data, improved the quality of patient care as a result of reduced medical errors, saved on paperwork, greatly facilitated the coordination among departments, and maintained patients' privacy. Thus, it appears that occupation is an explanatory variable to the adoption of EHRs in primary care settings.

3.5.1.2 Age

Age is also a factor that has been shown to influence human behaviour towards technology. Kipturgo et al. (2014) found age to contribute mainly to nurses' attitudes directed towards information system acceptance or rejection in work contexts. It had been shown in some studies that younger nurses have more favourable attitudes than those of older colleagues (Alquraini et al. 2007; Kipturgo et al. 2014; Salameh et al. 2019). Conversely, other studies indicated that age has no significant bearing in the attitude adopted towards adopting an information system (Shoham & Gonen 2008; Aggelidis & Chatzoglou 2009; Holden & Karsh

2010; Ifinedo 2016). For example, Ifinedo (2016) found that the nurses' ages had no significant effects as a moderating factor in adopting information systems. Specifically, age was not a significant moderator in nurses' perceived usefulness and perceived ease of use, and therefore did not affect attitude towards implementing an information system. Thus, it appears that age has very little significance on attitude towards an information system; it barely influences the behavioural intention to use an information system in a work environment. Despite this evidence, sufficient literature investigating the moderating effects of age on the perceived usefulness and perceived ease of use of information systems is still lacking; thus, it is an important factor for consideration.

3.5.1.3 Gender

Gender has been considered in behavioural models since the inception of the Gender Schema Theory (Bem 1981) and other TAM-based models (Venkatesh et al. 2003). Venkatesh and Morris (2000) pointed out that men and women have different decision-making processes and varying socially established cognitive facilities. Findings from the literature on social psychology indicate that men are more grounded and task-oriented as compared to women (Hofstede 2011). Thus, it could be argued that men are more likely to adopt technology to accomplish tasks.

Previous research has similarly shown that gender influences can predict the usage behaviour of information systems (He & Freeman 2010; Goswami & Dutta 2015). In relation to TAM, gender has been found to have a significant influence on perceived usefulness, perceived ease of use, behavioural intention, and attitude towards usage (Venkatesh et al. 2003). Moreover, studies have indicated that gender influences the relationship between behavioural intentions and normative beliefs such that the impact is more profound in women (Huang, Hood & Yoo 2012). Tarhini, Hone and Liu (2014) conducted an empirical study to find out the moderating effect of gender on TAM variables and found no significant relationship between perceived usefulness and behavioural intention to be moderated by gender. However, the perceived ease of usefulness affected behavioural intention for women. Additionally, normative beliefs heavily affected the behavioural intention of women more so than with men, similar to various previous studies (Venkatesh & Morris 2000; He & Freeman 2010). Therefore, due to the impact that gender has on influencing the variables of perceived usefulness of technology, it could serve as an explanatory variable for the adoption of EHRs.

3.5.1.4 Geographical context

EHR systems are a rising trend across the globe due to the tremendous opportunities they offer in increasing efficiency and access to patient records (Blavin & Buntin 2013). Many developed nations are moving towards paper-light systems in order to improve the coordination of healthcare and, generally, the quality of services provided (Evans 2016). These developed nations already have significantly developed education, awareness of and infrastructure in ICT. Therefore, moving to an electronic platform is a smooth transition. In contrast, developing nations (such as those in sub-Saharan Africa) have monumental barriers preventing the widespread implementation of these systems (Odekunle, Odekunle & Shankar 2017). First, in the region of sub-Saharan Africa, implementation and maintenance of EHR systems are costly. The authors also noted that there is a poor supply of electricity, poor internet connectivity and lack of primary knowledge in the use of information systems in these regions. Moreover, in different countries, the primary perspective or reasons behind EHR implementation vary and, therefore, contribute to its adoption (Odekunle, Odekunle and Shankar 2017). Therefore, region is considered to be an explanatory variable in contributing towards assessing the adoption of EHR and its subsequent use in order to improve the quality of care.

3.5.1.5 Experience in technology use

Prior experience in using information systems is determined by the degree of interaction with a particular system in the past. Some empirical studies have provided findings that there is a stronger link to perceived usefulness and behavioural intentions among experienced users than those lacking experience (Houser & Johnson 2008). According to Boonstra, Versluis and Vos (2014), a user's view of efficacy and usefulness of a system grows more as experience increases, and the more experienced users are better suited in terms of efficacy and capabilities of an information system than those who lack prior experience. A systematic review by Ludwick and Doucette (2009) established that previous experience of the user significantly affected the implementation outcomes of health information systems. A study conducted by Irani (2000) on the adoption of internet communication tools also found that relevant prior experience increased the perceived usefulness of the technology. Moreover, they were able to determine that the integration of perceived usefulness and prior experience were the most impactful predictors of behavioural intent and attitude towards using internet communication tools. Therefore, it is evident that prior experience could influence the perception of a system's users and is hence an important explanatory variable in information system adoption.

3.5.1.6 Training in HIT

Bredfelt et al. (2013) acknowledged that training is significant in HIT implementation. EHRs have been considered as instrumental information systems in the improvement of quality, safety, and reduction of errors in the medical field. However, Sittig et al. (2016) showed that there had been increasing frustration due to unintended results such as a reduction in the duration of patient encounters, constraints in the management of supportive care, and technical malfunctions in implementation. Despite these facts, the importance of training in EHRs cannot be underestimated. For instance, Marshall, Mills and Olsen (2008) indicated that people who have been trained are more inclined to finding technology easier to utilise.

Training could also impart the users with necessary skills, with Gagnon et al. (2016) reporting a significant correlation between computer self-efficacy and intention to use EHR.

3.5.2 Organisational characteristics

Several studies have investigated the influence of organisational factors on the adoption of EHRs in healthcare settings. Whilst some have identified these factors as having a significant influence on users' perception, others have not. The most emerging organisational factors are discussed below.

3.5.2.1 Management and IT support

A study by Abdekhoda et al. (2015) showed that management support had a significant effect on the physicians' attitudes towards the adoption of an EHR system. While examining the factors that influence the adoption of EHRs by Iran physicians, Alipour et al. (2013) identified management support as one of the factors that had a significant influence on the acceptance of EHRs. Aldosari et al. (2018) also found a significant positive correlation between management and IT support, as well as both perceived usefulness and perceived ease of use of EHRs among Saudi nurses in National Guards Health Affairs. Due to the significant influence of management support on adoption of EHRs, collaborative effort between the hospital management and healthcare providers is required for successful implementation of these systems. Further, adequate technical support is required.

3.5.2.2 Staff training

Healthcare organisations are also increasingly focusing on end-user training as a way to improve the acceptance of EHRs. This is due to the extensive evidence showing that training has a significant impact on users' perceptions of EHR systems. For example, Marshall, Mills and Olsen (2008) identified a positive correlation between training and performance and effort expectancy of healthcare providers. Although this evidence shows that end-user training should be embraced in order to improve acceptance of technology, Kim, Coiera and

Magrabi (2017) showed that the bulk of training in the EHR curricula is founded on mastery of software functionality as opposed to the optimisation of patient care. This is in addition to EHR training that is not conducted during the span of medical education but only provided in limited, guarded sessions. Further, EHR training is not regarded as a professional competency but more of a human resource construct.

3.5.2.3 Users' involvement and autonomy

The involvement and autonomy of the users in making healthcare decisions have also been shown to influence their perceptions of EHRs. In Iran, Alipour et al. (2013) noted that physician involvement significantly influenced the acceptance of EHRs by physicians. With regard to users' autonomy, Abdekhoda et al. (2015) reported a significant relationship between physicians' autonomy and attitudes towards the adoption of an EHR system in that physicians felt inclined to adopt the system if they felt that it would improve their work. Alipour et al. (2013) also identified that physician autonomy had a significant influence on the acceptance of EHRs among physicians in Iran.

Despite these reported significant impacts of organisational factors on acceptance and adoption of EHRs, some have been reported to have insignificant influence. For instance, a multilevel modelling based on an integrated theoretical framework in a prospective cross-sectional study among physicians in primary care organisations in Canada showed that there was no significant relationship between organisational characteristics (size, region, climate, receptive to change, and innovation value-fit) and intention to use EHRs (Gagnon et al. 2014). Similarly, Abdekhode et al. (2015) showed that training did not have a significant impact on perceived usefulness and perceived ease of use of EHRs among physicians in Iran.

3.5.3 System characteristics

Various factors related to the system's use have been identified in the literature as influencing the adoption of technology, including EHRs in healthcare. These factors range from the benefits to challenges associated with the use of EHRs. In relation to TAM, these are broadly categorised as perceived usefulness and perceived ease of use of a technology system.

3.5.3.1 Perceived usefulness

Perceived usefulness relates to the benefits of adopting an EHR system in healthcare (as detailed in Chapter 3, Section 2.3.5). A study by Aldosari et al. (2017) evaluating the EHR acceptance level by Saudi nurses showed that the perceived usefulness significantly correlated with the acceptability of the system. Specifically, the majority of the respondents reported that EHR systems provide them with access to all the information they need, including research data hence they would adopt the technology in their practice. In a related study, Aldosari et al. (2014) had shown that perceived usefulness had a significant effect on the physicians' attitudes towards the adoption of an EHR system. Both office-based and hospital-based physicians in a qualitative analysis by Pelland, Baier and Gardner (2017) also reported a high adoption of EHRs because they had a positive perception of the system to improve access to patient information, thereby achieving better patient care. Physicians who had adopted EHR in the US, especially before the HITECH Act, said that they were motivated by the ability of the system to allow sharing or exchanging of health information with other healthcare providers.

Similarly, clinicians would be more likely to adopt EHR interventions due to their benefit in collecting, storing and sharing vital patient information for the provision of quality care (Silow-Carroll, Edwards & Rodin 2012). Gajanayake, Sahama and Iannella (2013) found the benefit of EHRs in making information sharing easier and effective as a construct of perceived usefulness to be positively associated with intention to use the system. Other benefits that have been found to be related to acceptance of EHRs, including time-saving (Tubaishat 2018), ease of data transfer (Lakbala & Dindarloo 2014), quick return on investment (Cresswell & Sheikh 2013), and improved quality of care (Cebul et al. 2011).

Conversely, lack of perceived usefulness of EHRs has been associated with the rejection of the system by the users. For instance, a rejection of the system has been reported because users believed that it consumed more time than paper-based records such as during data entry (Pizziferri et al. 2005; Shabbir et al. 2010). Similarly, most physicians lamented that EHRs complicate their relationships with patients as they spend most of their time on computers rather than interacting with the patients (Pelland, Baier & Gardner 2017). As a result, they did not adopt EHR systems to facilitate their communication with the patients. Further, nurses have been reported to be reluctant to use EHRs because they feared that would require more time to learn the system and process data, which requires strict adherence to set policies (Kuo, Liu & Ma 2013; El Mahalli 2015).

Bah et al. (2011) noted that healthcare professionals' perceptions that EHRs increased workloads have negatively affected the adoption of the systems. The majority of physicians were reluctant to adopt EHRs, citing changes in their day-to-day activities and anticipated upheavals despite being optimistic about the systems (Pires et al. 2012). Silow-Carroll, Edwards and Rodin (2012) also noted that due to the extra workload in feeding and clarifying the data, most healthcare centres have not yet integrated the systems with outpatient providers. Other factors that have been demonstrated to affect the adoption and acceptance of EHRs negatively are poor system design making it prone to errors (Bowman 2013; Heisey-Grove & Patel 2014) and weak or unreliable internet connectivity (Minghella 2013). These factors result in negative perception of the EHR system, leading to rejection by the users.

This literature evidence shows that the acceptance of EHR systems by healthcare professionals at the primary care level could be affected by the perceived benefits of EHRs in providing care such as access to patient formation, enhanced communication between providers, aiding clinical decision-making, and reduced medical errors. Thus, health professionals will most likely accept EHR technology due to its perceived usefulness. It also shows that the risks or challenges of using an EHR system could discourage healthcare professionals from adopting the systems.

3.5.3.2 Perceived ease of use

Similar to the perceived usefulness of EHRs, perceived ease of use has also been linked to their adoption. However, these links are mainly related to the system design and interface that makes it easy or difficult to use.

While evaluating the factors that affect physicians' attitudes towards the adoption of an EHR system, Aldosari et al. (2014) identified that perceived ease of use had a significant effect on the attitudes. Tubaishat (2017) found that Jordanian nurses had a positive perception of not only EHRs' usefulness but also their ease of use, and those perceptions improved the acceptance of the technology. Similarly, a study by Gagnon et al. (2016) showed that perceived ease of use was significantly correlated with intention to use EHRs. Gajanayake, Sahama and Iannella (2013) also noted that health professionals perceived EHRs to be easier to work with than paper records, thus leading to high acceptance.

Conversely, Kuo, Liu and Ma (2013) reported that most healthcare professionals were reluctant to adopt EHR systems because they perceived the system as complex and of a poor user interface. This challenge presents a major hindrance to EHRs' adoption across several care settings, with Yanamadala et al. (2016) noting that complexity in the system has adversely affected its successful implementation. Blumenthal and Tavenner (2010) also pointed out that the majority of health professionals cite systems' complexity as a vital barrier towards their adoption. Other studies have also shown that frequent revisions associated with EHRs have led to resistance towards the adoption of the systems by medical practitioners due to increased workload, downtime, and overall decreased efficiency (Holden & Karsh 2010; Hibbard & Greene 2013).

3.6 Draft conceptual framework based on the literature

This thesis proposes a conceptual framework, built on the modified TAM by Davis, Bogozzi and Warshaw (1989), for factors influencing the adoption of EHR systems in primary care contexts in the GCC setting. This is in light of the little available evidence about the perceptions of healthcare professionals with regard to the adoption of EHRs in primary care settings, with the evidence being available only in relation to hospital settings. Secondly, the studies that have focused on primary care have mostly been conducted in developed nations. Third, TAM acts as a theoretical basis for exploring the research question in general and does not include the specific factors that may influence EHR adoption in primary care settings in Saudi Arabia and the GCC areas as a whole. Thus, the proposed conceptual framework in this thesis is an extension of TAM, showing the factors that influence EHR adoption in the GCC areas.

Several factors that include individual, organisational and system characteristics have been reported to influence the adoption of EHRs at the individual, organisational or system level. For personal characteristics at the individual level, Morton (2008) noted that age, years in practice, prior computer use, and prior EHR system use affected healthcare professionals' perceptions of the EHR system through perceived usefulness and perceived ease of use.

These processes were mediated by organisational factors such as management support. In addition to these factors, Asiri, Aldosari and Saddik (2014) reported that ethnicity had a significant relationship with users' perceptions and adoption of EHRs. Furthermore, Msiska, Kumitawa and Kumwenda (2017) noted that gender and job title influenced healthcare professionals' attitudes towards EHRs in Malawian hospital settings. These factors are mainly providers' characteristics and have a significant influence on the adoption of EHRs. They have been shown to influence the adoption of EHRs and other health technologies through two main pathways. First of all, they can have an indirect effect on the perceived usefulness and perceived ease that, in turn, influence attitude and actual use of a system (Asiri, Aldosari & Saddik 2014). Secondly, individual characteristics can have a direct influence on attitude of the users towards a system. Thus, it was hypothesised that individual characteristics have both direct and indirect impact on Saudi healthcare professionals' attitudes towards EHRs in PCCs.

Various organisational factors have also been reported in the literature to influence users' perceptions and adoptions of EHRs. Aldosari (2003) identified organisational support and professional values as affecting Saudi health professionals' attitudes towards EHRs. The organisational support involved three main factors, namely management support, physicians' involvement, and adequate training. These organisational factors were found to be significant determinants of EHR acceptance and usage in Saudi Arabia. Specifically, organisational support had a significant effect on attitude towards usage through professional values, perceived ease of use and perceived usefulness. However, the professional values had a significant negative relationship with perceived usefulness and perceived ease of use.

Morton (2008) also showed that organisational contextual factors including management or organisational support, physician involvement in physician selection, adequate training, physician's autonomy, and doctor-patient relationship had a significant influence on users' attitudes towards EHRs. Further, they acted as mediating factors through individual physician characteristics influencing perceived usefulness and perceived ease of use of an EHR system. It was therefore hypothesised that organisational factors have a direct impact on healthcare professionals' perceptions towards the adoption of EHR. It was also assumed that organisational factors have an indirect influence on perceptions through perceived usefulness and perceived ease of use of EHRs in primary care settings.

Similarly, several system factors have been shown to influence the users' attitude and adoption of EHRs. However, these have been grouped into two main categories: perceived usefulness and perceived ease of use. Handy, Whiddett and Hunter (2001) examined the influence of several factors related to perceived usefulness on users' attitudes towards EHRs. These were mainly related to the system's ability to improve job performance, accomplish tasks more quickly, improve quality, improve communications, improve seamlessness, decrease work, make work easier to perform, meet goals, protect against litigation, hold people accountable, and provide documents suitable for legal use. Other perceived usefulness factors reported in the literature include improving the quality of the provider's work in providing better patient care, giving professionals greater control over their work, enabling professionals to accomplish tasks more quickly, making it easier for professionals to perform their job and enhancing overall job effectiveness (Aldosari 2003; Tubaishat 2017). These perceived usefulness factors have been shown to influence healthcare providers' attitudes towards EHRs. Abdekhoda et al. (2015) also reported the benefits that EHRs improve job performance, result in quicker accomplishment of tasks, lead to easier performance of work, and are helpful in clinical job are associated with perceived usefulness of the EHR system. They had a positive and significant relationship with physicians' attitudes towards usage and acceptance of EHRs. While evaluating the factors that affect physicians' attitudes towards the adoption of an EHR system, Aldosari et al. (2014) identified that perceived ease of use had a significant effect on the attitudes.

A study by Handy, Whiddett and Hunter (2001) reported that healthcare professionals' perceived ease of use were related to an EHR system that is clear, easy to remember, always available, user-friendly, and easy to learn. Similarly, Aldosari (2003) identified user-friendliness, learning to use the system, and skills at using the system as the factors related to perceived ease of use of the system influencing physicians' attitude about medical information system acceptance and usage in Saudi Arabia. Aldosari (2003) also noted that perceived ease of use had a positive and significant relationship with physicians' attitudes towards acceptance and usage of EHR. On the other hand, perceived lack of ease of use, such as a complex and non-user friendly system, is associated with negative perceptions that lead to reluctance in adopting EHR systems (Kuo, Liu &Ma 2013).

With regard to this evidence from the literature, this thesis hypothesised that system factors have a positive relationship with healthcare professionals' perceptions towards the adoption of EHRs. However, this relationship was only through perceived usefulness and perceived ease of use of EHRs in primary care. Further, these factors were assumed to influence the users' perceptions at different levels of individual, organisational, and system.

These findings can be summarised as the elements of the proposed conceptual framework, as shown in Table 3.1. In the context of TAM, the proposed framework has four main variables, namely external variables, perceived usefulness, perceived ease of use, and attitude towards EHR adoption, which affect the users' perceptions towards and acceptance of EHRs in primary care at the individual, organisational, and system levels. The individual, organisational and system characteristics refer to external variables. These are assumed to affect technical factors, including perceived usefulness and perceived ease of use that in turn influence attitude toward adopting and actual use of EHRs by primary care professionals in the GCC countries. However, by extending TAM, the external variables are also assumed to influence perceptions directly.

Table 3.1: Elements of the draft conceptual framework

TAM	**Context**	**Factors influencing users' perceptions of EHR identified from the literature**
External variables	Individual	Age
		Occupation
		Gender
		Length of work experience
		Ethnicity
		Computer/EHR experience
		Training in computer/EHRs
		Country of training
	Organisational	Adequate training
		Management support
		Physicians' involvement/end-user involvement
		Physicians' autonomy
		Doctor-patient relationship
	System	Implemented EHR system
Perceived usefulness	Individual	Gives provider greater control of their work
		Improves job performance/accomplishes more work
		Accomplishes tasks more quickly/works quicker
		Improves the quality of the provider's work
		Improves communications
	Organisational	Improves quality
		Improves communications
		Improves seamlessness
	System	Improves the quality of the provider's work
		Improves communications
		Decreases work
		Makes work easier to perform
Perceived ease of use	Individual	Easy to gain skills to use
		Easy to learn
	Organisational	Address providers' job-related needs

	System	Easy to use
		User friendly
Attitude	Individual	Enhances overall job effectiveness
	Organisational	Enhances overall job effectiveness
	System	Perceived usefulness
		Perceived ease of use

To further inform the development of a conceptual framework for the adoption of EHRs in primary care settings in the GCC countries, the following four main assumptions were made:

1. Perceptions of healthcare professionals towards the adoption of EHRs in primary care settings in the GCC countries are influenced by individual, organisational and system characteristics.
2. Individual characteristics have both direct and indirect influence on healthcare professionals' perceptions towards the adoption of EHRs in primary care settings in the GCC countries.
3. Organisational characteristics have both direct and indirect influence on healthcare professionals' perceptions towards the adoption of EHRs in PCCs in the GCC countries.
4. System characteristics had an indirect influence on healthcare professionals' perceptions towards the adoption of EHRs in primary care settings in the GCC countries.

These assumptions are shown in the draft conceptual framework (Figure 3.7). The proposed framework has four levels as follows:

Level 1: TAM variables

This level of the framework is comprised of four components of the adopted TAM, as shown in column 1 of Table 3.1.

Level 2: Context

The second level shows the three contexts under which the factors influencing healthcare professionals' perceptions towards the adoption of EHRs in the primary care setting will be examined. They include individual, organisational and system levels for each TAM variable under investigation in this thesis.

Level 3: Factors

This level applies to factors related to the individual user, organisation or system that influence the perceptions of healthcare professionals towards EHRs in different settings as identified in the literature review (Chapter 2). Various individual factors, including age, gender, occupation, length of work experience, prior computer experience and previous training in EHRs were identified as affecting the users' attitude towards and adoption of EHRs. Some of the organisational factors included management support, staff training, and user-involvement in EHR implementation Lastly, system characteristics were mainly benefits and challenges associated with use of the system such as improved access to patient data, decreased paper-based documentation, improved communication between providers and patients as well as between the providers themselves, better quality of data, enhanced decision-making, reduction in medical errors, improved quality of care and patient safety. Some of the challenges include complexity of the system and confidentiality and privacy issues.

Level 4: Empirical findings

Whilst the third level of the framework applies the literature about the healthcare professionals' perceptions towards the adoption of EHRs in PCCs to the TAM, it does not include the perspective from a GCC context. Therefore, data needed to be collected and analysed to explore if there are any unique attributes in this context that should be added to the framework. This forms the fourth level of the framework (see Chapter 7) that applies to the factors that may influence perceptions in the context of primary care in Saudi Arabia and the GCC countries.

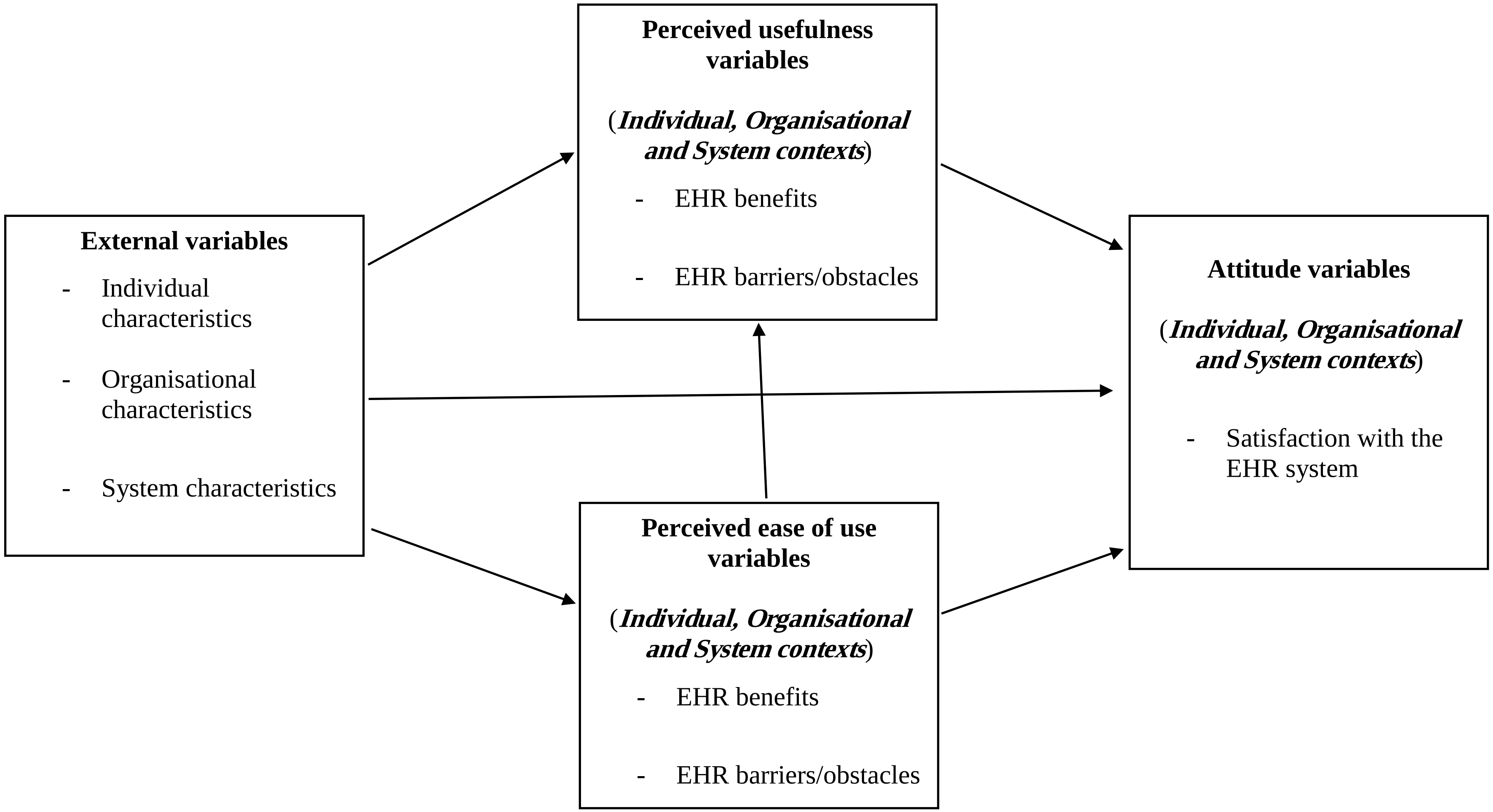

Figure 3.7: Draft conceptual framework

The framework is expected to help to identify the potential benefits that may be realised with the adoption of EHR systems in primary care in GCC countries such as Saudi Arabia and similar settings globally. It will also be critical in identifying the challenges that may derail the adoption process. Specifically, the developed model will help improve the understanding of factors that may influence the adoption and use of EHRs in primary care contexts in the GCC. However, it is imperative to note that this framework does not represent all the pathways through which individual, organisational, and system characteristics could be linked to users' attitudes towards an EHR system, but it instead provides a foundation for future research. The factors identified in the third level of the framework should be used to guide the data collection. Therefore, the next chapter describes the thesis methodology for addressing this part of the research.

3.7 Chapter summary

This chapter discussed TAM, which forms the theoretical basis of this research. It examined the development and application of this model in relation to the adoption and acceptance of technology in healthcare and other general settings. The chapter also discussed and presented the draft conceptual framework developed from the literature that forms the foundation of the final conceptual model. In the next chapter, the research methodology is presented.

CHAPTER 4 : METHODOLOGY

4.1 Introduction

The previous chapter proposed a draft conceptual framework built upon the Technology Acceptance Model (TAM). However, whilst this framework is informed by the literature, including the Saudi context, Chapter 2 identified that there is a gap in the literature with regard to healthcare professionals' perceptions about the adoption of EHRs in primary care settings in the GCC countries. This chapter details the methods that were used in the study to capture the empirical evidence in order to address this gap and inform the conceptual framework. First of all, the research aim and objectives are restated. Philosophical assumptions and design are then discussed. Next, the sample and the sampling procedures are described. The chapter also discusses the data collection instruments and their validity and reliability, data collection and management plan, and analysis. Lastly, the chapter discusses the ethical considerations that were taken into account in the study.

4.2 Research aim and objectives

This research aims to explore healthcare professionals' perceptions towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia.

The objectives of this study in meeting the above aim are to:

1. Explore healthcare professionals' perceptions of the benefits and obstacles of adopting EHRs in PCCs in Riyadh city, Saudi Arabia.
2. Determine healthcare professionals' satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia.
3. Assess the influence of sociodemographic characteristics on healthcare professionals' perceptions of benefits, obstacles and satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia.
4. Determine the relationship between perceived benefits, obstacles and satisfaction with EHRs in PCCs in Riyadh city, Saudi Arabia.
5. Develop an empirically derived conceptual model, based on the literature and real-world perceptions in Saudi Arabia that can be applied across the GCC areas.

4.3 Philosophical assumptions

Researchers often employ different research paradigms ranging from broad assumptions to specific methods in order to collect, analyse and interpret their data. Jonker and Pennink (2010) defined the research paradigm as a set of fundamental assumptions and beliefs about perceptions of the world that influences the behaviour of a researcher. The philosophical background impacts the research practice by guiding and influencing the choice of research method to achieve the research aims (Wahyuni 2012; Creswell & Creswell 2017). Thus, they enable one to understand the researcher's beliefs and assumptions as to what constitutes acceptable knowledge.

Research paradigms can be distinguished by two main philosophical dimensions: ontology and epistemology. These philosophies differ in their definition and development of knowledge (Arghode 2012; Scotland 2012). Whereas ontology views perceptions of reality, epistemology is a view on what constitutes acceptable knowledge. The proponents of ontology argue that the existence and interpretations of reality are external and independent of social actors (objectivist/realist viewpoints) or dependent on social actors (subjectivist/nominalist) (Wahyuni 2012). These arguments usually need no empirical evidence to prove them because they are believed to be logically satisfying (Oppy 2018). However, this lack of proof is a major limitation of ontological assumptions since one or more false prior premises will render the whole argument inaccurate. This is where the epistemological arguments come in. Al-Saadi (2014) noted that epistemology focuses on the creation, understanding and use of knowledge which is acceptable and valid. The philosophy can guide the researcher in evaluating knowledge based on facts by focusing on sources, nature, possibilities and limitations of what is thought to constitute knowledge in a particular field of study. Thus, epistemological approaches form a key foundation for explaining a phenomenon for knowledge creation.

There are four main epistemological assumptions in research that can help a researcher to address a problem, namely interpretivism, positivism, pragmatism, and critical theory. However, interpretivism and positivism are the most common research paradigms (Dieronitou 2014). These paradigms also differ in various ways. Interpretivism paradigms help researchers to understand a phenomenon based on subjective experiences (Scotland 2012; Wahyuni 2012; Dieronitou 2014). As such, they are important in the conduct of qualitative research where subjective information about events is collected and interpreted in order to draw inferences. In an attempt to understand the world based on meanings assigned to them by people, interpretivism relies on inductive logic to interpret the arguments spanning from specific to general viewpoints. Thus, the objective knowledge developed is dependent on the thinking and reasoning of humans.

Conversely, positivism differs from interpretivism in that it emphasises the use of deductive reasoning to generate knowledge from valid general conclusions that are derived from prior premises (statements, findings or conditions) that must also be valid (Dieronitou 2014). Positivists rely on scientific evidence that can be generated through observations or experiments to explain human behaviour. Thus, the positivism research paradigm is often employed in quantitative research. However, most studies also include an element of inductive reasoning at some stage of quantitative research (Soiferman 2010).

This study was guided by the positivist research paradigm. The thesis aims to fill a gap in the literature with regard to the healthcare professionals' perceptions about the adoption of EHRs in primary care settings in the GCC context. Based on the paradigm, this thesis involved the collection of objective data through a prospective survey capturing quantitative and qualitative responses from selected participants (primary healthcare professionals in Riyadh city) draw conclusions about the general population (primary care providers in the GCC countries).

4.4 Research design

Research design is crucial for addressing the research problem effectively. It could be defined as the overall strategy in which different components of a study are integrated coherently and logically (Labaree 2009). These include the process of data collection, measurement, and analysis. There are several research designs, and the common feature in all of them is that the type of design is determined by the research question to be addressed. However, this prospective survey employed a cross-sectional design to collect, analyse and integrate both quantitative and qualitative data in order to explore the research question. A cross-sectional approach was deemed appropriate in this study for three main reasons.

First of all, the study fits the three distinctive characteristics of cross-sectional designs described by Labaree (2009). These include lack of time dimension, exploration of existing differences rather than changes occurring after an intervention, and selection of groups based on existing differences rather than random allocation. Similarly, this study aimed to examine the perceptions of healthcare providers towards the adoption of EHRs in primary care settings at a certain point in time. The participants were also not randomly selected, and there was no intervention. The second reason is that this study was a survey of primary health professionals in Riyadh city with regard to their attitudes towards the adoption of EHRs, and cross-sectional designs can employ survey techniques to examine relationships between variables at a point in time (Sedgwick 2014; Lau & Kuziemsky 2016). The use of survey techniques to collect data also makes cross-sectional studies relatively inexpensive and faster to be conducted compared with prospective studies (Sedgwick 2014). Further, cross-sectional surveys are ideal for evaluating perceptions, attitudes, beliefs or knowledge within a clear predetermined sample of a population (Paradis et al. 2016). Lastly, cross-sectional designs can be useful for planning, monitoring and evaluation by generating data for making inferences by policymakers or generating a hypothesis on a topic for further research, thus making it useful in research.

This study not only explored the perceptions of healthcare towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia, but also examined the relationships between the perceptions and sociodemographic characteristics of the respondents. Thus, it also used both descriptive and correlational designs. According to Nassaji (2015), descriptive research designs are crucial in addressing the who, what, when, where and how questions related to a research problem. This type of research design is used to obtain information about the current status of a phenomenon and to describe 'what exists' with respect to variables or conditions in a situation (Labaree 2009). Conversely, correlational designs aim to establish the kind of relationships between two or variables. As asserted by Crano, Brewer and Lac (2014) that the term 'correlational' in correlational studies does not imply causal relationship but the design only allows the researcher to assess the relationships without manipulating independent variables or randomly assigning participants to different conditions, this study also did not investigate causal relationships between the variables of interest. It is important to note that the research design was also informed by the hypothesis that there were relationships between variables of interest that could be determined by statistical analysis.

4.5 Sampling procedures and response rate

4.5.1 Sampling method

Sampling is important in quantitative research because it enables the researcher to collect a reasonable amount of data from a representative sample of a population (Rahi 2017). The collected data can then be conveniently processed and analysed in order to make inferences. The process involves selecting a study sample that is representative of the entire population of interest to make inferences about a larger group. Various approaches can be used to choose a sample to represent a population that is too large to be able to survey all of its members (Lohr 2019). However, the entire population can also be included in a study if it is sufficiently small, and this approach involving every member of a population is referred to as a census (Banerjee & Chaudhury 2010; Martínez-Mesa et al. 2016). This study selected all 1,710 healthcare professionals working in PCCs in Riyadh city, hence it was a census survey. It also employed an element of a non-probability technique of purposive sampling since the researcher targeted a specific group of participants who are the healthcare providers working in PCCs in Riyadh city in order to achieve the research objectives.

4.5.2 Response rate

Pedersen and Nielsen (2016) defined a study response rate as the percentage of individuals in a sampled group who took part in a survey. Together with the choice of sampling methods and the measurement errors, the response levels have been established to influence the validity and reliability of survey findings (Mindell et al. 2015). A high response rate is desirable as it reduces sampling bias and increases the validity of research work (Fincham 2008; Pedersen & Nielsen 2016). On the contrary, a high level of non-responses could reduce the effective sample size and negatively affect the representativeness of the population of interest, which in turn influence reliability and generalisability of survey findings (Mindell et al. 2015; Phillips, Reddy & Durning 2016). Fincham (2008) however noted that there is no response rate accepted across the board and it tends to vary depending on the type of research. For instance, the researcher should aim to obtain a response rate of at least 60% in order to reduce bias, but some studies such as email surveys can have a low average response rate of 25%–30% (Fincham 2008). Although this study also employed the use of email to survey the healthcare professionals in Riyadh city, it aimed for a response rate of at least 60% in order to improve the validity of the results.

4.6 Participant selection and recruitment

4.6.1 Participant selection

The selection of participants is an important process in a research study but it is often underestimated (Martínez-Mesa et al. 2016). The selection process involves identifying the best-suited population that can provide the required information for achieving the research objectives. This study selected the Riyadh city population because the highest number of PCCs and healthcare professionals are located there as compared to other geographical regions of Saudi Arabia (MoH 2017) (as identified in Chapter 2, section 2.4.3), with the most diverse workforce compared to other regions. Therefore, 1,710 healthcare professionals were invited to complete the survey (see Table 2.2 for regional breakdown). This group includes physicians, nurses, technicians, pharmacists and other health professionals who interact with EHRs daily in order to generate health information through the provision of either direct patient care or services such as pharmaceutical or diagnostic services. Thus, they are better suited to providing opinion on the adoption of EHRs in primary care. Conversely, other employees in primary care settings in Riyadh city, such as administrative personnel, clerks, office assistants, drivers and supporting staff were not included because of their lack of or limited involvement with EHRs.

4.6.2 Participant recruitment

DePoy and Gitlin (2015) observed that participant recruitment is a critical step in a study as it allows a researcher to obtain an adequate number of participants in order to achieve the study objectives. Moreover, a good recruitment strategy is instrumental in making a research process effective by enabling a researcher to define their sampling approach, screen the sample, obtain informed consent, recognise, examine and enrol participants in their study which then ensures the validity of the research findings (Mindell et al. 2015).

After identifying the target population, the participants were invited to participate in this study via email in a two-step process involving the General Directorate of Health Affairs in Riyadh region and the Human Resource (HR) department of each PCC in Riyadh city. The recruitment process was as follows:

- First, the General Directorate of Health Affairs in Riyadh region, which is a government agency responsible for managing health affairs in the region of Riyadh was asked for support in conducting the study after obtaining the required ethics approval (1438-2155598—see letter of support in Appendix 10).

- The General Directorate of Health Affairs was then asked to inform the HR departments of all the 114 PCCs within its jurisdiction (see Table 2.2) about the study and to invite their healthcare providers to participate. The General Directorate of Health Affairs in Riyadh region was also chosen to facilitate the distribution of emails to the participants because it has the contact details of all the PCCs in Riyadh region. In so doing, an email was sent to the General Directorate of Health Affairs containing the following:
    - an email template that was to be sent to the HR departments providing details regarding the purpose of the study and identifying the target participants (see Appendix 13);
    - a letter of invitation containing a link to the online survey to be forwarded to the healthcare providers by their respective HR departments (see Appendix 14);
    - the study information sheet with the participant invitation letter and providing information about the study including the purpose of the study, participation procedures and how the collected data would be handled (see Appendix 15); and
    - a template of the survey questionnaire, including the consent form (see Appendix 16).

4.7 Survey questionnaire

The survey aimed to address the gap in knowledge by examining the factors identified through the draft conceptual framework, within the Saudi context and related to the adoption of EHRs in primary care settings in the GCC context. In order to achieve this aim, a survey questionnaire was chosen for this study because of its several advantages. Survey questionnaires are considered ideal tools for collecting research data as they allow a researcher to collect both quantitative (numerical) data and qualitative information through closed and open-ended questions respectively (Jones, Baxter & Khanduja 2013). They can also allow easy collection of data from a large number of people in a relatively cost-effective manner. In addition, they provide answers that can be quantified and can be easily analysed while at the same time ensuring the anonymity of the responses.

However, survey questionnaires also have disadvantages. Blair, Czaja and Blair (2013) argued that surveys are not the best way of collecting information, especially if there is little previous information on a topic. Researchers may also not ask the right questions that give new insight into a research topic. Further, the items may allow a limited choice of responses. With regard to respondents, they may provide varied answers to a question, thereby making it difficult to analyse the data, or misunderstand the questions, which introduces mistakes.

4.7.1 Development of the survey questionnaire

The development of the questionnaire used in this survey was informed by both the philosophical underpinnings of the study and the research aim. In exploring healthcare professionals' perceptions about EHRs in primary care, the study aimed to obtain both objective and subjective data for enhanced validity. Tekin and Kotaman (2013) noted that objectivity is an important aspect of epistemology that helps to avoid potential bias due to personal factors such as attitude, especially in quantitative research, however objectivity can be achieved by controlling external factors that might affect the results or by acknowledging those that cannot be avoided. Thus, the questionnaire had both closed and open-ended questions related to the perceived benefits and obstacles to EHR adoption. The objective of including open-ended questions was to obtain more information about the respondents' true feelings, attitudes and understanding of EHRs in primary care. Overall, the collected data were to directly address the first three research sub-questions of the thesis. These questions were as follows:

Research sub-question 1: What are the healthcare professionals' perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

Research sub-question 2: What are the healthcare professionals' perceptions of obstacles to adopting EHRs in PHC centres in Riyadh city, Saudi Arabia?

Research sub-question 3: Are healthcare professionals satisfied with the EHRs in PHC centres in Riyadh city, Saudi Arabia?

An extensive literature review was undertaken in order to find an existing survey that would address the study objectives. The review identified the survey tool developed and used by Secginli and colleagues in Turkey to evaluate the attitude of healthcare professionals towards EHRs in family health centres, which are similar to the primary care settings in Saudi Arabia

(Secginli, Erdogan & Monsen, 2014). The tool had three measurement domains for healthcare professionals' perceptions, namely benefits, barriers to EHR systems, and user satisfaction. It had a total of 33 items for direct measurement of the attitudes of healthcare professionals: 14 for benefits subscale, 9 for barriers to EHR systems subscale, 9 for satisfaction subscale, and 1 for global measure subscale. The original questionnaire also had 3 sections as follows:

- Section 1 had 12 demographic questions about general background: age, gender, education level, length of employment, length of working in family health centre, previous location of workplace, having a computer, computer typing ability, place of computer use, training in EHR systems, daily time expenditure in EHR use, and previous EHR use experience.
- Section 2 contained the 33 items measuring the respondents' attitude towards EHR on benefits, barriers, and satisfaction subscales. Each of the items in the benefits and barriers subscales had five options ranging from 1 to 5 for strongly disagree to strongly agree. The items for the satisfaction subscale also had five options ranging from 1 for not all to 5 for great.
- Section 3 had open-ended questions in order to receive respondents' comments and concerns about EHRs.

This tool was modified to fit into the context of this study. Therefore, the survey used in this study (Appendix 16) was structured, as shown in Table 4.1.

Table 4.1: Structure of the survey used in this study

Sections	TAM variables	Research question (s) addressed	Data element	Question	Data type	Response options	Comment/Reason for including the questions in the questionnaire
1	**External variables**	***Question 4:*** What is the influence of sociodemographic characteristics of healthcare professionals towards their perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia? ***Question 5:*** What is the influence of sociodemographic characteristics of healthcare professionals towards their perceptions of obstacles to adopting EHRs in PCCs in Riyadh city, Saudi Arabia? ***Question 6:***	Sociodemographic information	Occupation?	Nominal	Physician/Nurse/Pharmacist/Technician/Other	Sociodemographic questions were included to determine the influence of the selected sociodemographic characteristics on healthcare professionals' perceptions about EHR adoption in PCCs; thus, answering research questions 4, 5 and 6. The demographic questions in the original questionnaire were modified to fit the context of primary care in Saudi Arabia. They were also reduced from 12 to 8.
				Years of birth?	Continuous	Open	
				Nationality?	Nominal	Saudi/Non-Saudi	
				Gender?	Nominal	Female/Male	
				Length of time (years) working in primary health care centres in Riyadh city?	Continuous	Open	
				Do you have experience outside the KSA?	Dichotomous	Yes/No	
				Do you have training in electronic health records in primary healthcare?	Dichotomous	Yes/No	
				Do you have previous electronic health records experience in primary healthcare?	Dichotomous	Yes/No	

		What is the influence of the sociodemographic characteristics of healthcare professionals towards their satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia?					
2	**Part A: Perceived usefulness and perceived ease of use**	***Question 1:*** What are the healthcare professionals' perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia? ***Question 2:*** What are the healthcare professionals' perceptions of obstacles to adopting EHRs in PCCs in Riyadh city, Saudi Arabia?	Perceived benefits of adopting EHRs in PCCs: Items 1–14 Perceived obstacles to adopting EHRs in PCCs: Items 15–23	From your experience in primary healthcare, to what extent do you agree or disagree with the following statements regarding electronic health records systems?	Ordinal	Strongly disagree, disagree, neutral, agree and strongly agree.	The inclusion of this survey question was to determine the healthcare professionals' perception of the selected benefits and barriers to adopting EHRs in PCCs in order to address research questions 1 and 2. There was no modification made to the original questionnaire in respect to this question.
	Part B: Attitude towards using EHRs and behavioural intention	***Question 3:*** Are healthcare professionals satisfied with the	Satisfaction with the EHRs in PCCs: Items 1–10	From your experience in primary healthcare, to	Ordinal	Strongly disagree, disagree, neutral, agree and strongly agree.	This question was included in the questionnaire to determine

		EHRs in PCCs in Riyadh city, Saudi Arabia?		what extent do you agree or disagree with the following statements regarding the electronic health records system and the quality of services?			healthcare professionals' satisfaction with EHRs in PCCs and to address research question3. The original questionnaire had different responses for satisfaction subscale items ranging from not at all to great.
3	**Perceived usefulness and perceived ease of use**	***Question 1:*** What are the healthcare professionals' perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?	Personal views on the benefits of adopting EHRs in PCCs: Item 11	From your experience in primary healthcare, what do you think are the benefits of the electronic health records system in primary health care in Riyadh city?		Open-ended question	This question was to allow the healthcare professionals to report the benefits of EHRs in PCCs based on their experience of using the systems; thus, it would help to corroborate the responses to question 1. The question in the original questionnaire was modified to fit the context of PCCs in Riyadh.

		Question 2: What are the healthcare professionals' perceptions of obstacles to adopting EHRs in PCCs in Riyadh city, Saudi Arabia?	Personal views on obstacles to adopting EHRs in PCCs: Item 12	From your experience in primary healthcare, what do you think are the challenges to implementation of the electronic health records system in primary health care in Riyadh city?		Open-ended question	This question was to allow the healthcare professionals to report the obstacles to adopting EHRs in PCCs based on their experience of using the systems; thus, it would help to corroborate the findings to question 2. The question in the original questionnaire was modified to fit the context of PCCs in Riyadh.

4.7.2 Validity and reliability of the questionnaire

Whilst questionnaires are ideal tools for collecting data in surveys (Jones, Baxter & Khanduja 2013), they can be a source of bias in research. Lameck (2013) noted that there are validity and reliability concerns with a self-administered questionnaire in terms of how they are worded can influence the participants' responses. In addition, the validity of research may be affected by other factors such as the method of data collection and the context of the questions as well as the response scale (Bolarinwa 2015; Mohajan 2017). Therefore, care should be taken to ensure that the tools are developed in a manner that upholds validity and reliability (Zohrabi 2013). The researcher undertook the following measures to ensure the validity and reliability of the survey instruments.

4.7.2.1 Validity

Bolarinwa (2015) defined validity as the degree to which a research test represents the reality that it is intended to reflect. Validity is important in research in order to allow research instruments to provide valid results that answer the research questions. One of the ways of ensuring validity is by minimising or eliminating bias. Smith and Noble (2014) described five common types of bias that can occur across research designs and how to reduce them. These are bias related to the study design, participant selection, data collection and measurement, analysis, and publication. Others less common types of bias include procedural bias and response bias. This study employed various strategies to eliminate these types of bias.

In order to eliminate design bias, the researcher ensured that the chosen design was congruent with the study aim and objectives. Selection bias was eliminated by recruiting participants who would help to achieve the research aim. This process of selection was guided by predefined inclusion criteria. Selection bias was also eliminated by including the entire population in the study in order to improve the response rate and enhance the validity of the results. With regard to data collection and measurement bias, the researcher did not influence the data collection in any way. The survey questionnaire was also evaluated for validity and reliability before use. Procedural bias was eliminated by opening the survey for two months in order to give the respondents enough time to complete their responses without undue pressure. Response bias was minimised by limiting the amount of information given to the subjects so that they could not provide responses that they felt suited the expected findings. Lastly, the analysis of the collected data was undertaken based on the analysis plan and only the established results were presented without manipulation.

4.7.2.2 Reliability

Reliability refers to the extent to which an evaluation tool yields results that are stable and consistent or the extent to which the outcomes of the selected measurements and procedures can be replicated (Bolarinwa 2015). A tool may produce unreliable results when there is a divergence between measurement instruments or instability of the attribute being measured (Lameck 2013). Although the reliability of a questionnaire could be assessed in three major forms, namely test-retest reliability, alternate-form reliability, and internal consistency reliability (Bolarinwa 2015), this study did not evaluate the reliability of the survey questionnaire. The tool was assumed to be reliable based on the original authors' evaluation that found the instrument's reliability, with Cronbach's alphas of 0.92, 0.74, and 0.93 for benefits, barriers, and satisfaction subscales respectively (Secginli, Erdogan & Monsen 2014). Thus, it was determined that this tool would meet the study objectives and is a valid instrument. However, validation of the collected data was undertaken (see Chapter 5, section 5.3) using Cronbach's test and confirmatory factor analysis (CFA).

4.7.3 Survey deployment platform

The survey was deployed through an online platform, Research Electronic Data Capture (REDCap). REDCap is a web application designed according to the Health Insurance Portability and Accountability Act (HIPAA) recommendations to collect and store data for clinical research as well as to create databases and projects (Patridge & Bardyn 2018). The platform was chosen for this study because it ensures flexibility in the research process in various ways. REDCap is a customisable tool that can be used to collect virtually any type of data with ability to accommodate numerous study conditions, events, and data collection fields (Cleland 2018). It also offers the researcher a variety of project types such as longitudinal or single surveys. Harvey (2018) also noted that REDCap housed in one institution can be accessed from any part of the world by authorised individuals. Moreover, REDCap data can be downloaded and directly used in most common statistical programs such as STATA, SPSS and SAS. For the participants, it is easy to use and offers convenience in that they can schedule and complete the study in their own time and at their own pace, which is likely to enhance the study response levels (Patridge & Bardyn 2018).

4.8 Data collection procedure

After obtaining the necessary ethics approval from the Social Sciences Human Research Ethics Committee at the University of Tasmania (ethics approval number H0016730, see Section 4.11 for further information) and the Research Saudi Arabia Ministry of Health (ethics approval number 1438-2155598, the respondents were invited to participate in the study through the procedure outlined in section 4.6.2. The survey was open between 30 November 2017 and 30 January 2018, which was considered to be adequate time for all the interested respondents to complete and submit their responses. A link for accessing the survey questionnaire was provided to the participants with the invitation email. The participants were asked to complete the survey online, requiring 10–15 minutes of their time, with the appropriate responses. A reminder email to participate was sent to all the healthcare professionals by their respective departments (see Appendix 17). Once a survey was submitted, it could not be edited.

4.9 Data management

As part of enhancing participants' confidence in the study, they were assured of the confidentiality and security of their responses. To achieve this goal, data were collected anonymously and stored in a password-protected electronic format on a secure UTAS network, and the student researcher's UTAS HDR student cloud storage with only the researcher and his supervisors having access to the data. The participants were also informed that the data would be kept for five years before destruction, as per the best management of research data.

4.10 Data analysis procedures

4.10.1 Data preparation

Judd et al. (2011) defined data analysis as a process of converting, inspecting and modelling data. However, Chu et al. (2016) noted that the data collection process often introduces errors in data in various forms such as misspellings, missing values, replications, mixed formats, and typos. Therefore, raw data must be cleaned through the use of effective and efficient data cleaning techniques in order to correct detectable errors. This study used various methods to clean, code and refine the collected data before analysis. The data which were available in an electronic format were first downloaded from the REDCap survey site and saved as raw data in an Excel sheet. This was then imported into IBM® SPSS software (version 20.0) for cleaning, coding and refinement.

4.10.1.1 Data cleaning

The data were cleaned by means of the two steps of data cleaning process described by Chu et al. (2016). The steps are: detecting the errors and repairing the errors. The detection phase may involve the use of statistical techniques or descriptive approaches for quantitative and qualitative data respectively to identify patterns that show discrepancies and inconsistencies. After error identification, the errors must be corrected using an appropriate strategy. In this study, the researcher cleaned the data by checking for the appropriateness of responses and their legibility within the context of the survey questionnaire. They were also checked for possible contradictions and incompleteness. Inconsistent and incomplete responses were removed and the remaining data coded.

Although the study invited all healthcare professionals working in PCCs in Riyadh city, the data were categorised into five professional groups, namely physicians, nurses, technicians, pharmacists, and others representing other health professionals such as dentists, nutritionists, dieticians, anaesthetists and physiotherapists. The Likert-scale responses for perceived benefits and obstacles and satisfaction with the EHRs in PCC in Riyadh city were also summarised from five to three categories for easier presentation and enhancing the clarity of the data. In particular, strongly disagree and disagree responses were combined to obtain ‘disagree’, and agree and strongly agree responses were combined to form ‘agree’. The neutral responses were not affected. In order to determine the agreement level from this new scale (1 – disagree; 2 – neutral; 3 – agree), a mean score of 1.00 to 1.99 was considered as a low agreement level with most respondents strongly disagreeing or disagreeing with the benefit items. A mean score of 2.00 was considered as neutral, and the majority of the respondents were assumed to have given neutral responses. Lastly, the agreement level with the benefit items was considered if the mean score was 2.01 to 3.00, indicating that most respondents agreed with the statements.

4.10.1.2 Coding and labelling variables

Various techniques were used to define the study variables, which included demographic characteristics and the measurement subscales (EHR benefits, obstacles and satisfaction). These variables were coded depending on the type of data (continuous, ordinal or nominal), as shown in Table 4.2. However, two demographic characteristics, namely age and length of working experience, were not coded because they are continuous variables.

Table 4.2: Structure of the survey used in this study

Section	Data element	Data type	Response options	Code for options
1	**Demographic information**			
	Occupation	Nominal	Physician/Nurse/Pharmacist/Technician/Other (please specify)	1 – Physician 2 – Nurse 3 – Pharmacist 4 – Technician 5 – Other health professions
	Age in years	Continuous	Open	Not coded
	Nationality	Nominal	Saudi/Non-Saudi	1 – Saudi 2 – Non-Saudi
	Gender	Nominal	Female/Male	4 – Female 5 – Male
	Length of time (years) working in PCCs in Riyadh city	Continuous	Open	Not coded
	Previous experience outside the Kingdom of Saudi Arabia	Dichotomous	Yes/No	0 – No 1 – Yes
	Previous training in EHRs in primary healthcare	Dichotomous	Yes/No	0 – No 1 – Yes
	Previous EHR experience in primary healthcare	Dichotomous	Yes/No	0 – No 1 – Yes
2	**Perceived benefits and obstacles and satisfaction with the EHRs**			
	Benefits variables • 14 items **Obstacles variables** • 9 items **Satisfaction variables** • 10 items	Ordinal	Strongly disagree/disagree/neutral/agree/strongly agree	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree

4.10.2 Data screening

Data screening was also performed in order to ensure that the available data for analysis were accurate and complete, with incomplete questionnaires and inapplicable cases being eliminated. For instance, data screening allowed the identification of mismatching responses between the age of respondents and their experience years. The screening process involved checking for normality of distribution of each variable and presence of outliers.

Checking the normality of each variable

Normality refers to the 'normal distribution' of data. The assumption of normality should be checked for many statistical analyses, particularly parametric tests, which rely on a normal distribution of data because it affects their validity (Ghasemi & Zahediasl 2012). There are several tests for assessing normality. However, the three most common tests, namely Kolmogorov-Smirnov (K-S), skewness and kurtosis, were used in this study to check the normality of variables other than age and length of working experience which are continuous variables and were checked using histograms. According to Blanca et al. (2013), skewness and kurtosis are measures of data distribution whereby the former refers to a measure of symmetry or lack of symmetry while the latter refers to a measure of data tailing (heavily tailed or light-tailed) relative to normal distribution. Skewness is also referred to as a measure of probability distribution of a value taken randomly about the mean.

Checking for outliers

Some tests are very sensitive to outliers (Kwak & Kim 2017). Therefore, the researcher checked outliers using the comparison technique of the value of 5% trimmed mean with the means values of all the variables for healthcare professionals' perceptions. Beliakov (2011) defined 5% trimmed mean as the new mean value after removing 5% of all the cases at the top and bottom. Similar values of 5% trimmed mean and the original mean of any variable indicates that there are no outliers, and values of that variable are not significantly different from the remaining distribution.

4.10.3 Data analysis

4.10.3.1 Quantitative data

Descriptive and inferential statistical analysis of the quantitative data was organised in accordance with the research sub-questions. Descriptive statistics included mean, standard deviation, median and range for summarising the data. Inferential analysis was used to investigate the relationship between variables using one-sample t-test of means, a chi-square test of independence, and canonical correlation.

One sample t-test is a statistical procedure to determine if the mean of a sample is statistically different from a known hypothesised population mean. Specifically, it compares a sample mean to a pre-specified value to test for a deviation from that value. One sample t-test was performed in this study to compare the means from the Likert scale responses on the perceived benefits and obstacles to adopting EHRs in primary care with the hypothesised means (detailed in section 4.10).

The chi-square test of independence measures the relationship that exists between categorical variables in a given sample (Du Prel et al. 2010). In this study, a chi-square test was employed to determine the relationships between healthcare professionals' sociodemographic characteristics and perceptions of benefits, obstacles and satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia. Conversely, canonical correlation is a measure that is applied to test the degree of association between two variables and also indicate the direction which they take (Malacarne 2014). This was performed in order to determine the extent and direction of relationship between perceptions of the EHR benefits, obstacles, and satisfaction with EHRs in PCCs in Riyadh city, Saudi Arabia. In all of the analyses, the significance value was set at $p < 0.05$.

4.10.3.2 Qualitative data

It is important to note that the questionnaire also had two open-ended questions for perceived benefits and obstacles to adopting EHRs in order to obtain additional information on healthcare professionals' personal and professional perceptions. The data were analysed through a series of steps. First, the researcher read and re-read the data in order to familiarise himself with the data and look for meaning as well as determining parts of the data that had value. The data were then grouped into two categories based on two research questions. The responses were then critically analysed in order to identify the themes and categorise similar themes together. Lastly, the themes were summarised using frequencies.

4.11 Ethical considerations

Ethical approval is a critical requirement of research involving human subjects. The International Conference on Harmonisation (ICH) guidelines under the Declaration of Helsinki as well as other applicable laws and regulations pertaining to human research advocate for the safety and well-being of humans participating in research. Resnik, Rasmussen and Kissling (2015) also posited that observing ethical norms is important in research because they promote the attainment of research aims, enhance collaboration among research stakeholders such as researchers, participants and regulators, promote accountability especially in government-funded research, and gain public trust and support. Therefore, the researcher ensured that this study met the required ethical requirements outlined in the Australian Code for the responsible conduct of research, National Statement on Ethical Conduct in Human Research 2007 (National Health and Medical Research Council 2007), as well as the applicable local laws and regulations.

Ethics approval was obtained from both the University of Tasmanian Social Sciences Human Research Ethics Committee (approval number: H0016730) (see Appendix 6) and the Saudi Arabia Ministry of Health (approval number: 1438-2155598) (see Appendix 10). In addition to informing the participants that by completing and submitting the survey, one would be assumed to have consented to participate in the survey, written informed consent was also obtained by signing the consent form. The participants were also informed about the study, including the purpose and importance of participation. They were informed that the participation was voluntary and one could withdraw at any time during the survey without providing any explanation or facing any consequences. They were also informed that there were no direct benefits gained from participating in the study; however, the study would benefit all the stakeholders involved in EHR implementation. Moreover, they were informed that there were no potential risks associated with participation as the survey was non-experimental.

The invitation letter contained instructions with regard to answering the questions in order to minimise cases of incomplete surveys, the expected time to fill the questionnaire, and the contact details of the researcher in case of need for any clarification or queries. The letter also had the contact details of the University of Tasmanian Social Science Human Research Ethics Committee for any concerns or complaints about the conduct of the study. Lastly, the researcher maintained academic integrity throughout the process of writing this thesis by acknowledging all the used sources.

CHAPTER 5 : RESULTS

5.1 Introduction

This chapter presents the results of the survey in order to address the study objectives, with the results presented according to each of the research sub-questions. The chapter begins by presenting the results of the data screening process, followed by the response rate and demographic characteristics of the respondents. The findings for each of the research sub-questions are also presented. The chapter ends with a summary of the main findings.

5.2 Data screening results

5.2.1 Normality of data

Normality tests, namely skewness, kurtosis and Kolmogorov-Smirnov for benefit, obstacle and satisfaction data showed that all of the items had a significant value ($p < 0.05$) (Table 5.1). This indicates that the data were not normally distributed.

Table 5.1: Normality test for benefits, obstacles and satisfaction with EHRs results (n= 1127)

EHR statements	**Skewness**	**Kurtosis**	**Kolmogorov-Smirnov**	
			Df	**Sig**
Provides quick and reliable access to scientific research	-1.764	1.952	1127	0.0
Enables easy access to information from past medical records	-1.588	1.124	1127	0.0
Provides access to patient data and analysis	-1.805	2.010	1127	0.0
Provides better data	-1.624	1.243	1127	0.0
Makes it easy to transfer data	-1.637	1.366	1127	0.0
Provides access to practice standards	-1.576	1.113	1127	0.0
Enables following test results	-1.632	1.172	1127	0.0
Saves time in documenting health data	-1.609	1.057	1127	0.0
Decreases paper-based documentation	-1.711	1.375	1127	0.0
Improves the feeling of professionalism	-1.677	1.303	1127	0.0
Improves communication between health professionals and patients	-1.565	1.019	1127	0.0
Contributes to health professionals' ability to make patient care decisions	-1.542	1.155	1127	0.0
Improves communication between health professionals	-1.602	1.290	1127	0.0
Reduces medical errors	-1.119	-0.058	1127	0.0
Is too complicated and not user-friendly	0.683	-0.940	1127	0.0
Compromises patient safety	0.713	-0.998	1127	0.0
Decreases interaction between the health professional and patient	0.562	-1.165	1127	0.0
Increases health professionals' workloads	0.489	-1.316	1127	0.0
It is difficult to provide data security in EHRs	0.664	-1.070	1127	0.0
Consumes more time than paper-based systems	0.566	-1.352	1127	0.0
Is 'down' frequently	0.409	-1.208	1127	0.0
Is costly	0.302	-1.360	1127	0.0
Needs frequent revisions related to technological developments	-0.331	-1.504	1127	0.0
I feel EHR is useful	-1.974	2.805	1127	0.0
I feel EHR is an important system for primary health care centres	-1.787	1.833	1127	0.0
I feel EHR has been successful in primary health care centres	-1.297	0.367	1127	0.0
I feel EHR is worth the time and effort required to use it	-1.370	0.429	1127	0.0
I feel the EHR improves the quality of healthcare services in primary health care centres	-1.653	1.383	1127	0.0
I feel the quality of my work has improved	-1.315	0.384	1127	0.0
I feel the quality of information has improved due to EHR	-1.433	0.676	1127	0.0
I feel my performance has improved due to EHR	-1.217	0.157	1127	0.0
I feel patient safety has improved due to EHR	-1.218	0.204	1127	0.0
Overall, I am satisfied with the EHR system in primary healthcare centres	-1.351	0.463	1127	0.0

Normality results for the continuous variables

The two continuous variables included age and length of experience working in PCCs in Riyadh city.

1) Age had a normal distribution with a mean of 35 years (standard deviation (SD) = 7 years) (Figure 5.1).

2) Length of working experience did not follow a normal distribution but instead skewed to the right (Figure 5.2).

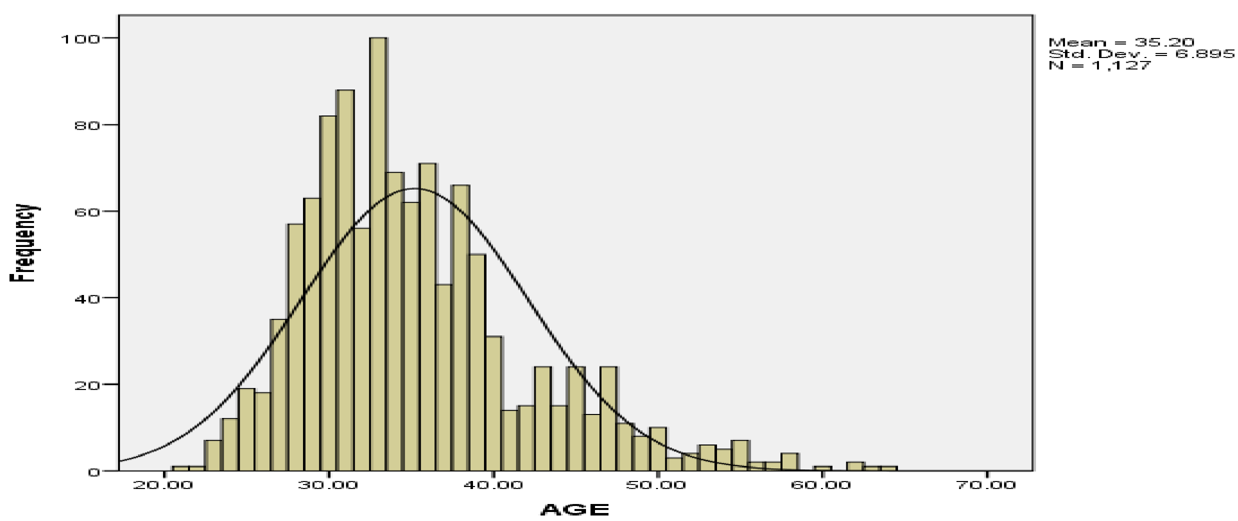

Figure 5.1: Data distribution for age in years

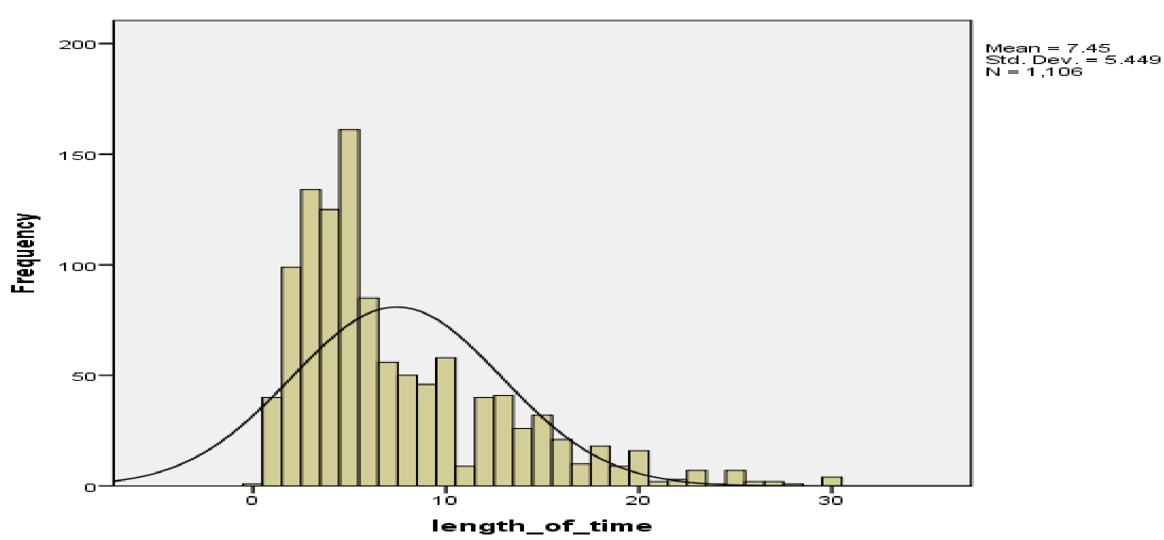

Figure 5.2: Data distribution for length of time working in PCCs in Riyadh city

5.2.2 Outliers results

Screening also showed that the data had no outliers with the means values and 5% trimmed mean of each item in the benefits, obstacles and satisfaction with EHR domains being similar, as shown in Table 5.2.

Table 5.2: 5% trimmed mean and mean value of benefits, obstacles and satisfaction with EHR results (n=1127)

EHR Domains ***Benefits of adopting EHR***	**Mean**	**5% Trimmed mean**
Provides quick and reliable access to scientific research	2.691	**2.768**
Enables easy access to information from past medical records	2.640	2.711
Provides access to patient data and analysis	2.692	2.769
Provides better data	2.648	2.720
Makes it easy to transfer data	2.656	2.729
Provides access to practice standards	2.639	2.710
Enables following test results	2.644	2.716
Saves time in documenting health data	2.637	2.708
Decreases paper-based documentation	2.658	2.732
Improves the feeling of professionalism	2.653	2.726
Improves communication between health professionals and patients	2.633	2.703
Contributes to health professionals' ability to make patient care decisions	2.643	2.715
Improves communication between health professionals	2.651	2.724
Reduces medical errors	2.525	2.584
Obstacles to adopting EHR		
Is too complicated and not user-friendly	1.648	1.609
Compromises patient safety	1.644	1.605
Decreases interaction between the health professional and patient	1.709	1.677
Increases health professionals' workloads	1.749	1.721
It is difficult to provide data security in EHRs	1.665	1.628
Consumes more time than paper-based systems	1.720	1.688
Is 'down' frequently	1.775	1.750
Is costly	1.836	1.818
Needs frequent revisions related to technological developments	2.171	2.190
Satisfaction with EHR		
I feel EHR is useful	2.729	2.810
I feel EHRs is an important system for primary health care centres	2.682	2.758
I feel EHR has been successful in primary health care centres	2.576	2.640
I feel EHR is worth the time and effort required to use it	2.584	2.649
I feel the EHR improves the quality of healthcare services in primary health care centres	2.657	2.730
I feel the quality of my work has improved	2.578	2.642
I feel the quality of information has improved due to EHR	2.605	2.672
I feel my performance has improved due to EHR	2.553	2.614
I feel patient safety has improved due to EHR	2.558	2.620
Overall, I am satisfied with the EHR system in primary health care centres	2.586	2.651

5.3 Validation

The reliability and validity of the collected data were assessed because the survey tool had not been previously used in the Saudi context. Thus, the internal consistency of the scales for each of the three domains, namely benefits, obstacles and satisfaction with the EHRs, was evaluated. Internal consistency of a scale or test refers to the extent to which every item in a test measures a similar concept and therefore indicates the inter-relatedness of these items within the test (Tavakol & Dennick 2011). This is established by measuring Cronbach's alpha, which is expressed as a number between 0 and 1, and values > 0.70 are required to demonstrate that the items within the subscales are inter-related (Tavakol & Dennick 2011; Taber 2018). However, Cronbach's value > 0.95 suggests that the measurement instrument might be containing too many items assessing the same underlying construct (Scholtes, Terwee & Poolman 2011). Therefore, a good Cronbach's alpha should range from 0.70 to 0.95. Analysis of the study data showed that the constructs of the questionnaire used in this survey had excellent reliability, with Cronbach's alpha values above 0.70 (Table 5.3). However, the analysis suggests that benefit and satisfaction subscales were having too many items demonstrated by Cronbach's alpha values of more than 0.95.

CFA was also used to determine the dimensional structure of the survey tool. The factor loadings were determined for each of the 33 items in the measurement scale of the survey questionnaire: 14 subscales for the benefit factor, 9 subscales for the obstacle factor, and 10 subscales for the satisfaction factor. The analysis showed that the items were consistent with the constructs measured, with all 14 items for the benefit subscale loading on Factor 1, 9 items for the obstacles subscale loading on Factor 2 (obstacles), and 10 items for the satisfaction subscale loading on Factor 3 (Table 5.3). All of the indicators had a factor loading of more than 0.3, indicating that they were significant. Furthermore, the CFA had a root mean square error of approximation (RMSEA) of 0.03 and a comparative fit index (CFI) of 0.99 which indicates a good fit.

Table 5.3: Factor loadings and Cronbach's alpha

Item contents	Factors			Cronbach's alpha (95% CI)
	Factor 1	Factor 2	Factor 3	
EHR benefits				
Provides quick and reliable access to scientific research	0.838			0.97 (0.96 – 0.97)
Enables easy access to information from past medical records	0.854			
Provides access to patient data and analysis	0.881			
Provides better data	0.845			
Makes it easy to transfer data	0.831			
Provides access to practice standards	0.820			
Enables following test results	0.850			
Saves time in documenting health data	0.839			
Decreases paper-based documentation	0.890			
Improves the feeling of professionalism	0.855			
Improves communication between health professionals and patients	0.849			
Contributes to health professionals' ability to make patient care decisions	0.819			
Improves communication between health professionals	0.780			
Reduces medical errors	0.569			
EHR obstacles				
Is too complicated and not user-friendly		0.614		0.89 (0.88 – 0.90)
Compromises patient safety		0.701		
Decreases interaction between the health professional and patient		0.693		
Increases health professionals' workloads		0.779		
It is difficult to provide data security in EHRs		0.884		
Consumes more time than paper-based systems		0.789		
Is 'down' frequently		0.709		
Is costly		0.658		
Needs frequent revisions related to technological developments		0.372		
Satisfaction with EHR				
I feel EHR is useful			0.891	0.96 (0.96 – 0.97)
I feel EHR is an important system for primary health care centres			0.909	
I feel EHR has been successful in primary health care centres			0.793	
I feel EHR is worth the time and effort required to use it			0.787	
I feel the EHR improves the quality of healthcare services in primary health care centres			0.888	
I feel the quality of my work has improved			0.870	
I feel the quality of information has improved due to EHR			0.866	
I feel my performance has improved due to EHR			0.865	
I feel patient safety has improved due to EHR			0.848	
Overall, I am satisfied with the EHR system in primary health care centres			0.843	

5.4 Response Rate

Of the 1,710 healthcare providers invited to complete the survey, a total of 1,127 surveys were completed through REDCap. This represents a 65.9% response rate.

5.5 Demographic characteristics of the participants in the study

The demographic characteristics of the respondents were examined in order to determine if the research participants were a representative sample of the target population for generalisation purposes. The results showed that nurses were the majority, comprising 32.6% of the respondents. Technicians represented the minority among all the respondents, contributing 10.2%. Physicians and pharmacists had equal representation of 18.5% each.

In relation to gender and nationality of the respondents, the majority were females and Saudi nationals contributing to 55.4% and 72% respectively. In terms of age, slightly more than half of the respondents, representing 53.9%, were aged 20 to 34 years, followed by 41.8% of the respondents who were aged 35–49 years. The healthcare professionals aged 50 years and above were the minority, contributing to only 4.3% of the total respondents.

In terms of length of time working in PCCs in Riyadh city, the majority (77.2%) of the respondents had less than 10 years of work experience. Only 2.8% had worked in the same settings for more than 20 years, while the rest had worked for between 11 and 20 years. In terms of experience outside the Kingdom of Saudi Arabia, the majority (60.9%) of the respondents had not worked as a health care provider outside the country. Similarly, 59.8% of the respondents reported they did not have prior training in EHRs in primary health care, and the majority (60.9%) also did not have previous experience using an EHR system. These demographic characteristics are summarised and compared with the total population in Riyadh city in Table 5.4.

Table 5.4: Demographic characteristics of the respondents and population (n = 1127)

Demographic characteristics of participants		**Respondents (N = 1127)**	**All (N = 1710)**	**Response rate per demographic**
Occupation	Physician	209 (18.5%)	369 (21.5%)	56.6%
	Nurse	367 (32.6%)	543 (31.7%)	67.6%
	Pharmacist	208 (18.5%)	256 (14.9%)	81.3%
	Technician	228 (20.2%)	368 (21.5%)	62%
	Other	115 (10.2%)	174 (10.1%)	66%
Gender	Male	503 (44.6%)	795 (46.5%)	63.3%
	Female	624 (55.4%)	915 (53.5%)	68.2%
Nationality	Saudi	811 (72.0%)	1103 (64.5%)	73.5%
	Non-Saudi	316 (28.0%)	607 (35.5%)	52%
Age in years [M (SD) = 35.2 (9.9), Range = 21.0–64.0]	20–34	608 (53.9%)	803 (47.0%	75.7%
	35–49	471 (41.8%)	665 (38.9%)	70.8%
	50+	48 (4.3%)	242 (14.2%)	19.8%
Length of time in years working in PHCCs in Riyadh city [M (SD) = 7.5 (5.4), Range = 0.0–30.0]	0–10	870 (77.2%)	1065 (62.2%)	81.7%
	11–20	226 (20.1%)	420 (24.6%)	53.8%
	21+	31 (2.8%)	225 (13.2%)	13.8%
Previous health experience outside the Kingdom of Saudi Arabia	No	686 (60.9%)	978 (57.2%)	70.1%
	Yes	441 (39.1%)	732 (42.8%)	60.4%
Previous training in EHRs in primary healthcare	No	674 (59.8%)	966 (56.5%)	69.8%
	Yes	453 (40.2%)	744 (43.5%)	60.9%
Previous EHR experience in primary healthcare	No	686 (60.9%)	978 (57.2%)	70.14%
	Yes	441 (39.1%)	732 (42.8%)	60.2%

5.6 Generalisability of results

The study showed that nurses comprised the highest level of respondents at 32.6%, followed by technicians (20.2%) and closely by physicians and pharmacists each contributing to 18.5% of the total. The findings reflect the composition of the Saudi healthcare workforce in which nurses comprise the majority of healthcare providers in all sectors of healthcare (MoH 2017). The Saudi MoH report showed that the nurses' rate in the Kingdom of Saudi Arabia is 50.7 per 10,000 population compared to 30.1, 8.7, and 34.5 for physicians (including dentists), pharmacists, and allied health professionals respectively. Females represented more than half of the respondents (55.4%) which could be attributed to the higher number of nurse respondents, with nursing being a female-dominated career worldwide (Ashkenazi et al. 2017). For example, a study by Bani-issa et al. (2016) involving nurses in the United Arab Emirates showed that females formed the majority (430, 85.1%) of the total 505 nurse respondents. In Aldosari et al.'s (2018) study females also represented 96.7% of nurses working Saudi hospitals. Al-Harbi (2011) also indicated that nurses (65.5%) and females (86.2%) were the majority healthcare professionals in the Saudi healthcare system. However, El Mahalli's (2015) study that focused only on physicians showed that males represented the majority (63.3%) of respondents.

With regard to nationality, Saudis were the majority of respondents (72.0%) in this study suggesting that mostly Saudis are employed in the PCCs in Saudi Arabia. This finding is similar to that of El Mahalli (2015) which showed that most (52.4%) of healthcare providers in public hospitals in Saudi Arabia are Saudis. The higher proportions of Saudis in government-owned healthcare facilities in Saudi Arabia could be attributed to the MoH's involvement in employing about 54% of the Saudi health workforce (Elsheikh et al. 2018). However, it is reported that despite the Saudisation process having led to an increase in educational capacity in order to boost the number of trained health professionals, the foreign experts still dominate the Saudi health sector in general due to the inadequate number of Saudi healthcare professionals to serve the expansive Saudi population (Elsheikh et al. 2018). Other countries of the GCC also appear to have foreigners as the majority of healthcare providers, with Ban-issa et al. (2016) noting that in their study non-Emiratis represented the majority of respondents (555, 81.6%) as compared to Emiratis.

In terms of age and years of working experience, more than 50% of the respondents were aged 20–34 years, which is consistent with Elsheikh et al.'s (2018) research revealing that most of the Saudi health workforce were aged less than 35 years. A study by El Mahalli (2015) conducted in Saudi hospitals also showed that most (42.0%) of the respondents were aged less than 30 years. Furthermore, the respondents' mean age of 35.2 (SD = 9.9) years in this study corresponds with that of healthcare professionals (36.2, SD = 9.6) and physicians (35.4 ± 9.7 years) reported by Al-Harbi (2011) and El Mahalli (2015) respectively. This finding shows that most healthcare professionals are young, and this could explain why majority of the respondents (77.2%) had experience of fewer than 10 years working in PCCs in Riyadh city. This is consistent with the findings of El Mahalli's (2015) study showing that most (59.6%) physicians working in Saudi hospitals had less than 10 years of experience. Elsheikh et al. (2018) also showed that most of the Saudi healthcare professionals have less than 10 years of work experience. In addition, Al-Harbi (2011) showed that most (42.7%) of the respondents had less than five years of work experience while Aldosari et al. (2018) showed that most (31.8%) of the nurse respondents had 6–10 years of experience in nursing practice. This study also showed that the mean length of time working in PCCs in Riyadh city was 7.5 (5.4) years, which is similar to 7.1 years, SD = 5.5

reported by Al-Harbi (2011), close to 10.5 ± 8.9 years of medical practice reported by El Mahalli (2015).

The majority of the respondents (60.8%) did not have previous experience outside the Kingdom of Saudi Arabia. Even though there are no known previous studies reporting this finding, a possible explanation for the higher proportion of healthcare professionals who did not have experience outside Saudi Arabia is that the majority of the respondents were Saudis, and the government encourages its professionals, including healthcare providers, to stay in the country in order to address the problem of over-reliance on expatriates. The findings also showed that most of the healthcare professionals in Riyadh city did not have previous training and experience in EHRs in primary healthcare, which could be due to the recent introduction and limited use of EHRs in the Saudi healthcare system. This finding is supported by Almaiman et al. (2014) who reported that the use of HITs in Saudi PCCs is growing, however it is still in its early stages. Further, the lack of experience in EHRs could be related to the high number of professionals with no experience outside Saudi Arabia which might have exposed them to countries that had implemented EHRs.

5.7 Research sub-question 1: What are the healthcare professionals' perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

This research sub-question, related to the perceived usefulness of TAM constructs, examined the perceived benefits of EHRs by healthcare professionals (see Table 4.1). It was answered by two survey questions: one with Likert-scale items and an open-ended question. The findings were as follows:

5.7.1 Perceptions of the benefits of adopting EHRs in PCCs

The analysis of the results showed that the respondents perceived the adoption of EHRs to have several benefits in PCCs in Riyadh city, Saudi Arabia. There was a high agreement level with all 14 items related to the benefits of adopting EHRs in PCCs. The highest level of agreement (77.1%) was with the statement that an EHR system 'decreases paper-based documentation' while the benefit that an EHR system 'reduces medical errors' had the lowest agreement level of 63.5%. Other statements that an EHR system 'provides access to patient data and analysis', 'improves the feeling of professionalism', 'provides quick and reliable access to scientific research', 'enables following of test results', and 'saves time in documenting health data' also had a high agreement level of more than 75%.

Conversely, there was a low disagreement level with all the benefit items, with the statement that an EHR system 'saves time in documenting health data' having the highest disagreement level of 11.5%. The statement that an EHR system 'provides quick and reliable access to scientific research' had the least disagreement level of 6.8%. The items also had a low level of neutral responses. The statement that an EHR system 'reduces medical errors' which had the lowest agreement level, had the highest neutral answers of 25.5%. Similarly, the statement that an EHR system 'decreases paper-based documentation' which had the highest agreement level had the lowest neutral responses of 11.6%. However, all 14 items had a higher level of neutral responses than that of disagreement. These findings on healthcare professionals' perceptions of benefits of adopting EHRs in PCCs are presented in Figure 5.3.

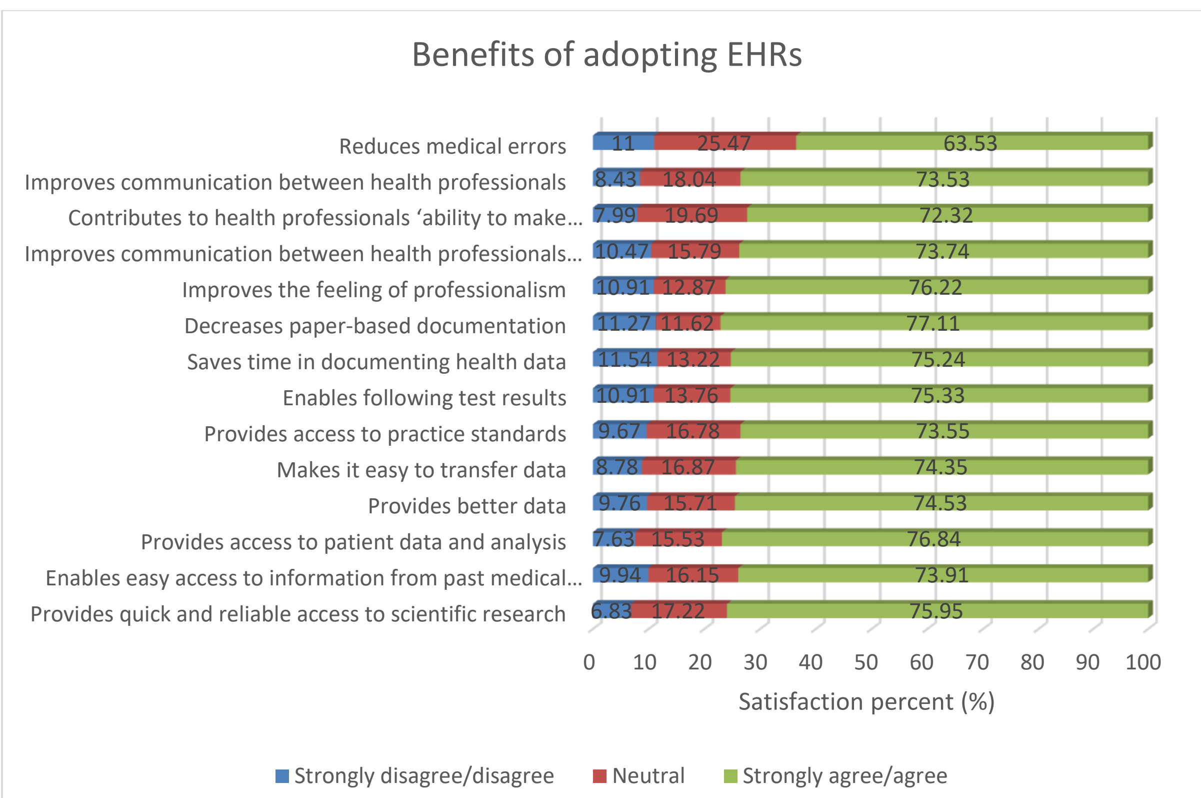

Figure 5.1: Healthcare professionals' perceptions of the benefits of adopting EHRs

Applying the scoring system outlined in section 4.10.1, the average score out of three was calculated for each benefit, with a higher score being indicative of a high level of agreement. With a 95% confidence interval (CI), all the means had a lower limit in the 2s, indicating that 95% of respondents had a high level of agreement across all 14 benefits. All the means had a negative skewness of less than -1, meaning that the data were not normally distributed and highly skewed to the left. This could be related to the assumptions of one sample t-test, including continuity and normal distribution of data as well as random sampling.

Further, using the average score showed that the statements that an EHR system 'provides quick and reliable access to scientific research' and 'provides access to patient data and analysis' had the highest level of agreement with an average score of 2.69 (SD = 0.59) and 2.69 (0.61) respectively. The use of the scoring system also found that the statement that an EHR system 'reduces medical errors' had the lowest agreement level [mean = 2.53 (SD = 0.69)] as shown in Table 5.5.

Table 5.5: Mean responses on the perceived benefits of adopting an EHR system

Benefits of an EHR system	**Mean (SD)**	**Skewness**	**95% C.I for mean**	
			Lower	**Upper**
Provides quick and reliable access to scientific research	2.69 (0.59)	-1.764	2.66	2.73
Enables easy access to information from past medical records	2.64 (0.66)	-1.588	2.60	2.68
Provides access to patient data and analysis	2.69 (0.61)	-1.805	2.66	2.73
Provides better data	2.65 (0.65)	-1.624	2.61	2.69
Makes it easy to transfer data	2.66 (0.63)	-1.637	2.62	2.69
Provides access to practice standards	2.64 (0.65)	-1.576	2.60	2.68
Enables following test results	2.64 (0.67)	-1.632	2.61	2.68
Saves time in documenting health data	2.64 (0.68)	-1.609	2.60	2.68
Decreases paper-based documentation	2.66 (0.67)	-1.711	2.62	2.70
Improves the feeling of professionalism	2.65 (0.67)	-1.677	2.61	2.69
Improves communication between health professionals and patients	2.63 (0.67)	-1.565	2.59	2.67
Contributes to health professionals' ability to make patient care decisions	2.64 (0.62)	-1.542	2.61	2.68
Improves communication between health professionals	2.65 (0.63)	-1.602	2.61	2.69
Reduces medical errors	2.53 (0.69)	-1.119	2.49	2.57

5.7.2 Responses to an open-ended question

In order to obtain additional information on healthcare professionals' perception of the benefits of adopting EHRs in primary care, the respondents were also given the opportunity to highlight what they perceived as benefits of EHRs based on their own experience in primary care: 'From your experience in primary healthcare, what do you think are the benefits of an electronic health records system in primary health care in Riyadh city?' A total of 21.7% (245) of respondents responded. These were thematically grouped into sixteen (16) themes (Table 5.6). The most commonly reported benefit was 'better health care by improving all aspects of patient care' (112 respondents, 45.7%). Two other common themes were 'sharing information' (65, 26.5%) and 'increasing productivity and efficiency' (65, 26.5%), followed by 'easy access to past medical history' (59, 24.1%). Conversely, the least reported benefits were 'decrease repetition of investigation' (7, 2.9%) and 'improve future research' (5, 2.0%).

Table 5.6: EHR benefits identified from the responses to an open-ended question

EHR benefits	**Respondents**	
	Number	**Per cent**
Better health care by improving all aspects of patient care	112	45.7%
Sharing information	65	26.5%
EHRs increase productivity and efficiency	65	26.5%
Easy access to past medical history	59	24.1%
Saves time and effort	46	18.8%
Easy to save information	34	13.9%
Accuracy of decisions and feedback	33	13.5%
Reduces medical error	29	11.8%
Keeps patients' files updated	21	8.6%
User-friendly	17	6.9%
Reduces operational costs	14	5.7%
Paperless	13	5.3%
Improves privacy and confidentially	11	4.5%
Accurate statistics	10	4.1%
Decreases repetition of investigation	7	2.9%
Improves future research	5	2.0%

5.8 Research sub-question 2: What are the healthcare professionals' perceptions of obstacles to adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

This research sub-question relates to the perceived usefulness and perceived ease of use of EHRs within a primary care setting (see Table 4.1). It was examined by two questions in the survey questionnaire: one based on a Likert-scale and an open-ended question. The findings were as follows:

5.8.1 Perceptions of obstacles to adopting EHRs in PCCs in Riyadh

There was a low agreement level with all 11 obstacle items except the statement that an EHR system 'needs frequent revisions due to technological developments' which came across as the most common barrier to adopting EHRs in primary care in Riyadh city, with a 45.3% agreement level. However, the item that an EHR system ‘is too complicated and not user-friendly’ had the lowest agreement level of 17.0%.

The item that an EHR system ‘compromises patient safety’ had the highest disagreement level of 54.4%. Three other items had a disagreement level of more than 50%. These include the statements that an EHR system ‘consumes more time than the paper-based system’ (53.2%), ‘it is difficult to provide data security in an EHR system (53.1%), and ‘it is too complicated and not user-friendly’ (52.3%). The statement that an EHR system ‘needs frequent revisions due to technological developments’ which had the highest agreement level also had the lowest disagreement level of 28.1%. In general, the disagreement levels were higher than the agreement levels for all items except the statement that an EHR system ‘needs frequent revisions due to technological developments’.

The items also had a low level of neutral responses. The statement that an EHR system ‘reduces medical errors’ which had the lowest agreement level had the highest neutral responses of 25.5%. Similarly, the statement that an EHR system ‘decreases paper-based documentation’ which had the highest agreement level had the lowest neutral responses of 11.6%. However, all 14 items had a higher level of neutral responses than that of disagreement. These findings on healthcare professionals’ perceptions of obstacles to adopting EHRs in PCCs are presented in Figure 5.4.

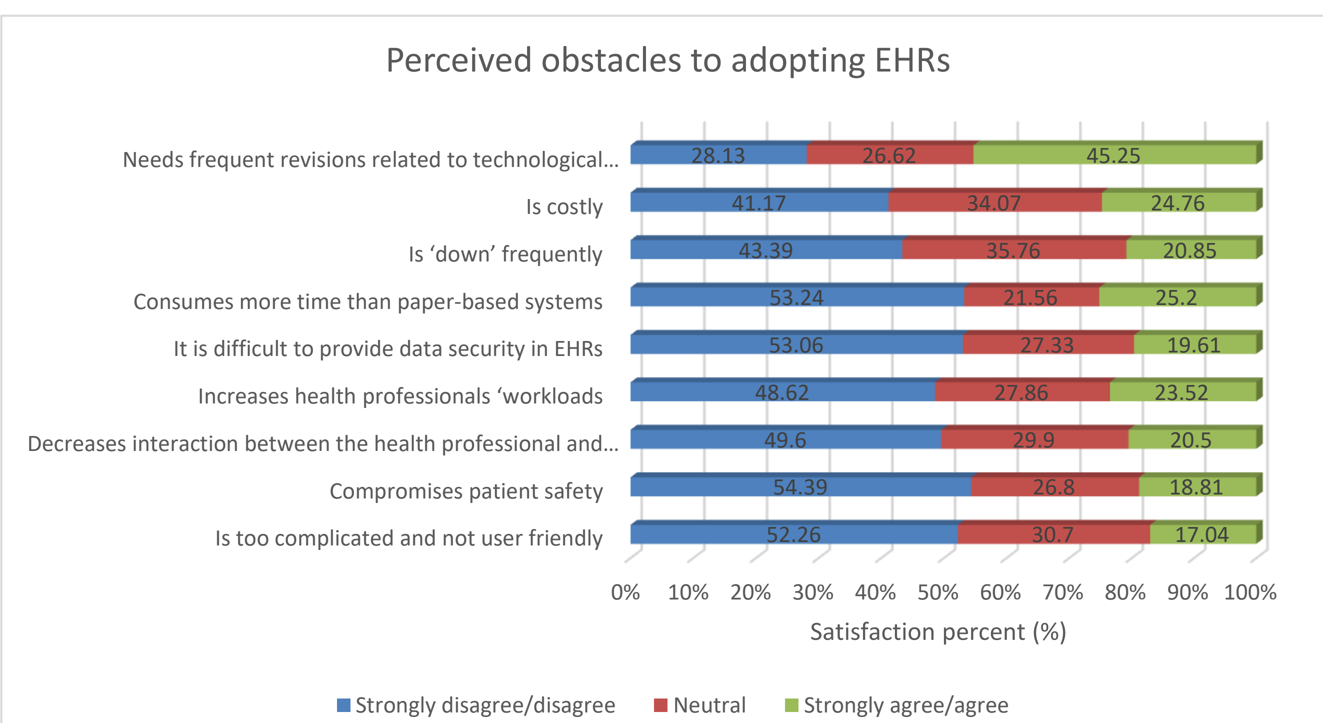

Figure 5.2: Healthcare professionals' perceptions of obstacles to adopting EHR in primary care

Applying the scoring system outlined in section 4.10.1, the average score out of three was calculated for each obstacle, with a higher score indicative of a high level of agreement. With 95% CI, all the means except that of the statement that an EHR system 'needs frequent revisions due to technological developments' had an upper limit in the 1s, indicating that 95% of respondents had a low level of agreement across eight obstacles. The need for frequent revisions related to technological developments had a mean score of 2.17 (SD = 0.84) with a lower limit of 2.12, suggesting that it had a high level of agreement.

Further, all the means except that of need for frequent revisions had a positive skewness of less than 1, meaning that the data were moderately skewed to the right. The statement that an EHR system 'needs frequent revisions related to technological developments' had a negative skew of -0.331, which is moderate skewness to the left. The skewness could be attributed to non-uniform distribution of the data.

The average scoring system also showed that the statements that an EHR system 'needs frequent revisions due to technological developments' had the highest level of agreement with an average score of 2.17 (SD = 0.84). This was followed by the statements that an EHR system 'is costly' and 'is 'down' frequently' with agreement level mean score of 1.77 (0.77) and 1.72 (0.84) respectively. The statement that an EHR system 'compromises patient safety' had the lowest agreement level [mean = 1.64 (SD = 0.79)] (see table 5.7).

Table 5.7: Means responses on perceived obstacles to EHR adoption in primary care

Obstacles to adopting EHRs in primary care	**Mean (SD)**	**Skewness**	**95% C.I. for Mean**	
			Lower	**Upper**
Is too complicated and not user-friendly	1.65 (0.76)	0.683	1.60	1.69
Compromises patient safety	1.64 (0.79)	0.713	1.59	1.68
Decreases interaction between the health professional and patient	1.71 (0.78)	0.562	1.66	1.75
Increases health professionals' workloads	1.75 (0.81)	0.489	1.70	1.79
It is difficult to provide data security in EHRs	1.67 (0.78)	0.664	1.61	1.71
Consumes more time than paper-based systems	1.72 (0.84)	0.566	1.67	1.76
Is 'down' frequently	1.77 (0.77)	0.409	1.72	1.81
Is costly	1.84 (0.80)	0.302	1.78	1.88
Needs frequent revisions related to technological developments	2.17 (0.84)	-0.331	2.12	2.22

5.8.2 Responses to an open-ended question

The respondents were also asked to provide their personal views on the obstacles to adopting EHRs in primary care in order to obtain additional information based on their own experience, 'From your experience in primary healthcare, what do you think are the challenges to implementation of the electronic health records system in primary health care in Riyadh city?' A total of 21.7% (245) of respondents provided a response that identified 12 main themes (Table 5.8). 'Staff training' was the most commonly reported obstacle to adopting EHRs in primary care (96, 39.2%). Two other common themes were 'poor IT infrastructure' (38, 15.5%) and 'reduces practice productivity and disturbs workflow' (33, 13.5%). Conversely, the least reported obstacles were 'staff resistant' (9, 3.7%) and 'time-consuming' (6, 2.4%).

Table 5.8: Identified obstacles to EHR adoption in primary care in Riyadh city

Obstacles to adopting EHRs in primary care	**Responses**	
	Number	**Percent**
Staff training	96	39.2%
Poor IT infrastructure	38	15.5%
Reduces practice productivity and disturbs the workflow	33	13.5%
Required technical support	24	9.8%
Low-quality services provided in primary care centres	23	9.4%
Regular maintenance	21	8.6%
High cost	19	7.8%
Missed communication between practitioners	16	6.5%
No privacy and confidentially	13	5.3%
Not user-friendly and limited capabilities	11	4.5%
Staff resistance	9	3.7%
Time consuming	6	2.4%

5.9 Research sub-question 3: Are healthcare professionals satisfied with the EHRs in PCCs in Riyadh city, Saudi Arabia?

This research sub-question relates to the attitude of the healthcare professionals towards the EHR and their behavioural intention of adopting the system within a primary care setting (see Table 4.1). The satisfaction with the EHR system was examined from only the Likert-scale responses.

There was a high agreement level with all 10 items related to the satisfaction with the EHR system in primary care. The statement that 'I feel EHRs are useful' had the highest agreement level of 78.8% while 'I feel patient safety has improved due to EHRs' had the least agreement level of 65.8%. The agreement level for the statement 'Overall, I am satisfied with the EHR system in PHC' was 69.1%. Other statements with agreement level of more than 70% were 'I feel EHR is an important system for primary healthcare centres' (77.0%), 'I feel EHRs improve the quality of healthcare services in primary healthcare centres' (74.8%), 'I feel the quality of information has improved due to the EHR system' (70.9%), and 'I feel EHR is worth the time and effort required to use it' (70.1%). Conversely, there was a low disagreement level with all the satisfaction items with the statement that 'I feel my improvement has improved due to EHRs' having the highest disagreement level of 10.7% while 'I feel EHR is useful' had the least disagreement level of 6.0%.

The items also had a low level of neutral responses. The statement that 'I feel patient safety has improved due to EHRs' which had the least agreement level, also had the highest neutral responses of 24.3%. The statement that 'I feel EHR is an important system for primary healthcare centres' had the least neutral responses at 14.2%.

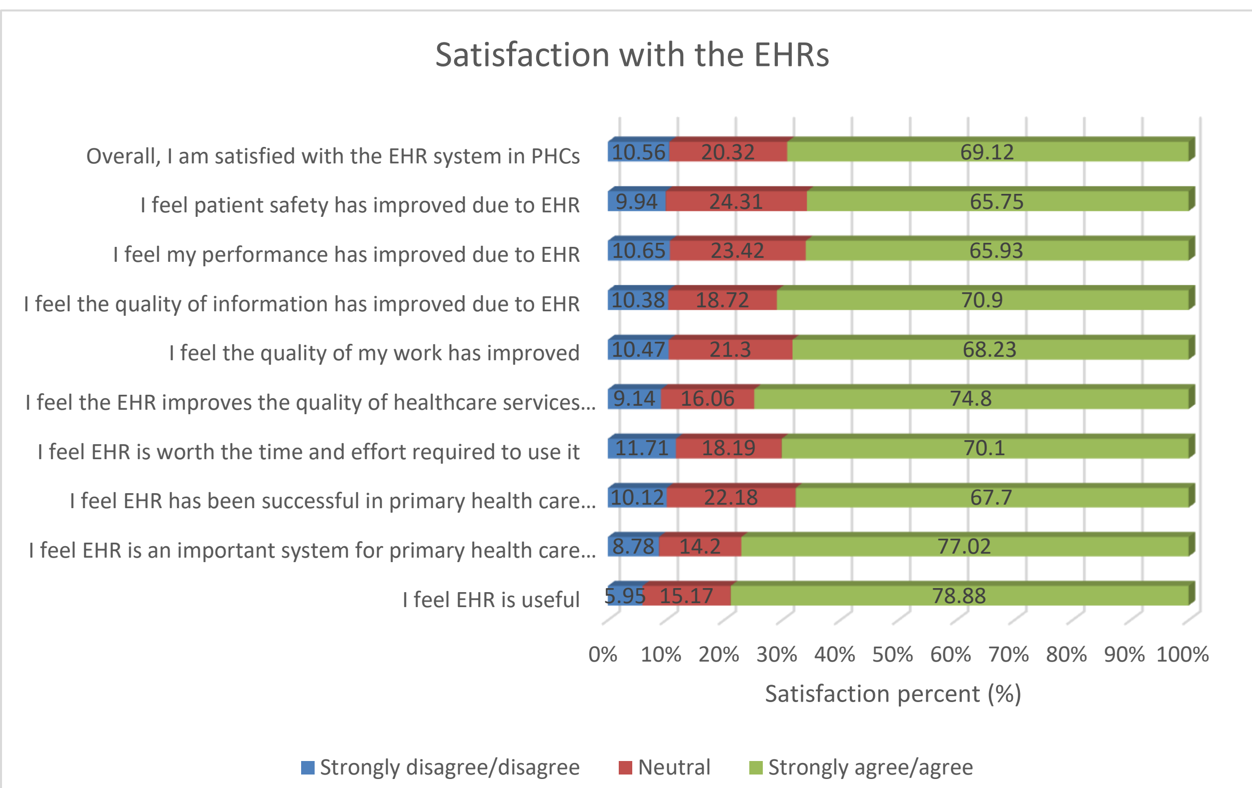

Figure 5.3: Satisfaction with EHRs in primary care

Applying the scoring system outlined in section 4.10.1, the average score out of three was calculated for each item related to satisfaction with the EHRs, with a higher score indicative of a high level of agreement. With 95% CI, all the means had a lower limit in the 2s, indicating that

95% of respondents had a high level of agreement across all 10 satisfaction items (Table 5.9). All the means had a negative skewness of less than -1, meaning that the data were not normally distributed and highly skewed to the left which could be attributed to the data analysis assumptions using the one-sample t-test.

However, using the average score showed that the statements that 'I feel EHR is useful' had the highest agreement with a mean score of 2.73 (SD = 0.56), while the statement 'I feel my performance has improved due to EHR' had the lowest agreement level with a mean score of 2.55 (0.68). The agreement level for the overall satisfaction with EHRs in primary care had a mean score of 2.59 (SD = 0.67).

Table 5.9: Means responses on the satisfaction with EHRs in PCCs

Satisfaction with EHRs in primary care	**Mean (SD)**	**Skewness**	**95% C.I. for Mean**	
			Lower	**Upper**
I feel EHR is useful	2.73 (0.56)	-1.97	2.70	2.76
I feel EHR is an important system for primary health care centres	2.68 (0.63)	-1.79	2.65	2.72
I feel EHR has been successful in primary health care centres	2.58 (0.67)	-1.30	2.54	2.61
I feel EHR is worth the time and effort required to use it	2.58 (0.69)	-1.37	2.54	2.62
I feel the EHR improves the quality of healthcare services in primary healthcare centres	2.66 (0.64)	-1.65	2.62	2.69
I feel the quality of my work has improved	2.58 (0.67)	-1.31	2.54	2.62
I feel the quality of information has improved due to EHR	2.61 (0.67)	-1.43	2.57	2.64
I feel my performance has improved due to EHR	2.55 (0.68)	-1.22	2.51	2.59
I feel patient safety has improved due to EHR	2.56 (0.67)	-1.22	2.52	2.60
Overall, I am satisfied with the EHR system in primary healthcare centres	2.59 (0.67)	-1.35	2.55	2.63

5.10 Research sub-question 4: What is the influence of sociodemographic characteristics of healthcare professionals towards their perceptions of the benefits of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

Relating to the external variables and perceived usefulness and perceived ease of use of TAM, this question examines the influence of sociodemographic variables on the attitude of healthcare professionals towards EHRs in primary care. The influence of eight (8) sociodemographic characteristics (see Table 4.1) on the perceptions of the benefits of adopting EHRs in primary care were examined. The findings were as follows:

5.10.1 Relationship between respondents' occupation and perceptions of the benefits of adopting EHRs in primary care

There was a significant relationship between the occupation of the respondents and their perceptions of each item related to the benefits of adopting EHRs in primary care ($p < 0.001$) (table 5.10). Physicians had the highest agreement level with all the benefit items. They were followed by other occupational groups in the order of pharmacists, nurses, other healthcare professionals and technicians for agreement with six (6) items related to EHR benefits. These include the statements that EHR 'provides better data' [$\chi^2(8) = 65.712$, $p < 0.001$], 'provides access to practice standards' [$\chi^2(8) = 55.983$, $p < 0.001$], and 'enables following test results' [$\chi^2(8) = 49.825$, $p < 0.001$]. Other statements included that EHR 'improves the feeling of professionalism' [$\chi^2(8) = 31.427$, $p < 0.001$], 'improves communication between health professionals and patients' [$\chi^2(8) = 41.032$, $p < 0.001$], and 'improves communication between health professionals' [$\chi^2(8) = 50.297$, $p < 0.001$].

For the remaining statements, either nurses had a higher agreement level than pharmacists, or technicians had a higher agreement than other healthcare professionals. For instance, nurses had a higher agreement level with two (2) benefit items than pharmacists including 'enables easy access to information from past medical records' [$\chi^2(8) = 69.722$, $p < 0.001$] and 'reduces medical errors' [$\chi^2(8) = 42.855$, $p < 0.001$]. However, nurses and pharmacists had the same level of agreement of 73.6% with one (1) statement that EHR 'contributes to health professionals' ability to make patient care decisions' [$\chi^2(8) = 36.607$, $p < 0.001$].

Similarly, technicians had a higher agreement level with five (5) statements related to the benefits of adopting EHRs in primary care than 'other' healthcare professionals. These included the statements that EHR 'provides quick and reliable access to scientific research' [$\chi^2(8) = 128.44$, $p < 0.001$], 'provides access to patient data and analysis' [$\chi^2(8) = 112.35$, $p < 0.001$], and 'makes it easy to transfer data' [$\chi^2(8) = 53.001$, $p < 0.001$]. Other statements included EHR 'saves time in documenting health data' [$\chi^2(8) = 32.47$, $p < 0.001$] and 'decreases paper-based documentation' [$\chi^2(8) = 51.876$, $p < 0.001$].

There was also variation in the level of agreement with all the benefits. The statement that EHR 'provides access to patient data and analysis' had the highest agreement level of 91.4% and

80.8% among the physicians and pharmacists, respectively. The statement that EHR ‘provides quick and reliable access to scientific research’ had the highest agreement level of 79.0% among the nurses, while EHR ‘decreases paper-based documentation’ had the highest level of agreement among the technicians (67.5%). The statement that EHR ‘improves the feeling of professionalism’ had the highest agreement level of 68.7% among other healthcare professionals. The statement that EHR ‘reduces medical errors’ had the lowest level of agreement across all the occupational groups.

These findings suggest that physicians were more likely to agree with all the benefits statements compared to other occupational groups. Conversely, technicians were more likely to disagree compared to other occupational groups. Healthcare professionals are more likely to agree with some benefits more than others, depending on their occupation.

Table 5.10: Relationship between occupation and agreement with the perceived benefits of adopting an EHR (n=1127)

Perceived benefits of an EHR	Occupation					
	Physicians n = 209	Nurses n = 367	Pharmacists n = 208	Technicians n = 228	Others n = 115	p-value
Provides quick and reliable access to scientific research	187 (89.5%)	290 (79.0%)	165 (79.3%)	145 (63.6%)	69 (60.0%)	< 0.001
Enables easy access to information from past medical records	181 (86.6%)	282 (76.8%)	157 (75.5%)	140 (61.4%)	73 (63.5%)	< 0.001
Provides access to patient data and analysis	191 (91.4%)	284 (77.4%)	168 (80.8%)	149 (65.4%)	74 (64.3%)	< 0.001
Provides better data	186 (89.0%)	274 (74.7%)	160 (76.9%)	143 (62.7%)	77 (67.0%)	< 0.001
Makes it easy to transfer data	179 (85.6%)	268 (73.0%)	164 (78.8%)	151 (66.2%)	76 (66.1%)	< 0.001
Provides access to practice standards	181 (86.6%)	273 (74.4%)	156 (75.0%)	144 (63.2%)	75 (65.2%)	< 0.001
Enables following test results	180 (86.1%)	285 (77.7%)	164 (78.8%)	143 (62.7%)	77 (67.0%)	< 0.001
Saves time in documenting health data	175 (83.7%)	282 (76.8%)	163 (78.4%)	152 (66.7%)	76 (66.1%)	< 0.001
Decreases paper-based documentation	187 (89.5%)	288 (78.5%)	165 (79.3%)	154 (67.5%)	75 (65.2%)	< 0.001
Improves the feeling of professionalism	179 (85.6%)	285 (77.7%)	165 (79.3%)	151 (66.2%)	79 (68.7%)	< 0.001
Improves communication between health professionals and patients	175 (83.7%)	273 (74.4%)	163 (78.4%)	146 (64.0%)	74 (64.3%)	< 0.001
Contributes to health professionals' ability to make patient care decisions	171 (81.8%)	270 (73.6%)	153 (73.6%)	146 (64.0%)	75 (65.2%)	< 0.001
Improves communication between health professionals	175 (83.7%)	275 (74.9%)	160 (76.9%)	144 (63.2%)	75 (65.2%)	< 0.001
Reduces medical errors	154 (73.7%)	240 (65.4%)	131 (63.0%)	124 (54.4%)	67 (58.3%)	< 0.001

5.10.2 Relationship between the respondents' age and perception of benefits of adopting EHRs in primary care

There was a significant relationship between the age of the respondents and their perceptions of benefits of adopting EHRs in primary care ($p < 0.05$). Older healthcare professionals (>50 years) had a higher agreement level with all the benefits of EHRs compared to other age groups (Table 5.11). They were followed by the younger professionals aged 20 to 34 years and lastly those aged 35 to 49 years for all benefit items. For instance, the statement that EHR 'provides quick and reliable access to scientific research' had an agreement level of 85.4% by those aged 50 years and above, 79.4% by those aged 20–34 years and 70.5% by those aged 35–49 years [$\chi^2(4) = 17.382$, $p = 0.002$).

There was also a variation in the level of agreement across all benefits with age groups. The statement that EHR 'provides access to patient data and analysis' had the highest agreement level of 82.7% among the respondents aged 20–34 years. Individuals aged 35–49 years had the highest agreement level of 70.5% with the statement that EHR ‘provides quick and reliable access to scientific research’. Conversely, individuals aged 50 years and above had the highest agreement level with two (2) statements, namely that EHR ‘provides access to patient data and analysis’ and ‘enables easy access to information from past medical records’ with each having an agreement of 91.7%. Conversely, the statement that EHR ‘reduces medical errors’ had the lowest level of agreement across all the age groups. These findings suggest that healthcare professionals aged 50 years and above were more likely to agree with all the benefits statements compared to other age groups. Conversely, those aged 35–49 years were more likely to disagree compared to other age groups. Healthcare professionals are more likely to agree with some benefits more than others, depending on their age groups.

Table 5.11: Relationship between age and agreement with the perceived benefits of adopting an EHR (n=1127)

Perceived benefits of an EHR	**Age in years**			
	20 – 34 n = 608	**35 – 49 n = 471**	**50+ n = 48**	**p-value**
Provides quick and reliable access to scientific research	483 (79.4%)	332 (70.5%)	41 (85.4%)	0.002
Enables easy access to information from past medical records	467 (76.8%)	322 (68.4%)	44 (91.7%)	< 0.001
Provides access to patient data and analysis	503 (82.7%)	319 (67.7%)	44 (91.7%)	< 0.001
Provides better data	478 (78.6%)	320 (67.9%)	42 (87.5%)	< 0.001
Makes it easy to transfer data	471 (77.5%)	327 (69.4%)	40 (83.3%)	< 0.001
Provides access to practice standards	476 (78.3%)	314 (66.7%)	39 (81.3%)	< 0.001
Enables following test results	496 (81.6%)	311 (66.0%)	42 (87.5%)	< 0.001
Saves time in documenting health data	500 (82.2%)	306 (65.0%)	42 (87.5%)	< 0.001
Decreases paper-based documentation	501 (82.4%)	325 (69.0%)	43 (89.6%)	< 0.001
Improves the feeling of professionalism	497 (81.7%)	321 (68.2%)	41 (85.4%)	< 0.001
Improves communication between health professionals and patients	483 (79.4%)	307 (65.2%)	41 (85.4%)	< 0.001
Contributes to health professionals ‘ability to make patient care decisions	470 (77.3%)	305 (64.8%)	40 (83.3%)	< 0.001
Improves communication between health professionals	482 (79.3%)	305 (64.8%)	42 (87.5%)	< 0.001
Reduces medical errors	422 (69.4%)	259 (55.0%)	35 (72.9%)	< 0.001

5.10.3 Relationship between the respondents' gender and perception of benefits of adopting EHRs in primary care

There was a mixed result with a significant relationship found between gender and perception of some benefits of adopting EHRs in primary care and not others. A significant relationship was found between gender of the respondents and their perceptions of eight (8) benefits of adopting EHRs in primary care. These included that EHR 'provides quick and reliable access to scientific research' [$\chi^2(2) = 14.958$, $p = 0.001$], 'enables easy access to information from past medical records' [$\chi^2(2) = 8.6717$, $p = 0.013$], 'provides access to patient data and analysis' [$\chi^2(2) = 6.1663$, $p = 0.046$], 'provides better data' [$\chi^2(2) = 13.833$, $p = 0.001$], 'makes it easy to transfer data' [$\chi^2(2) = 9.2756$, $p = 0.010$], 'provides access to practice standards' [$\chi^2(2) = 7.4376$, $p = 0.024$], 'decreases paper-based documentation' [$\chi^2(2) = 8.4359$, $p = 0.015$] and 'reduces medical errors' [$\chi^2(2) = 11.369$, $p = 0.003$].

Conversely, there was no significant difference between males and females in their perceptions of six (6) EHR benefits, including that EHR 'enables following test results' [$\chi^2(2) = 0.032836$, $p = 0.984$], 'saves time in documenting health data' [$\chi^2(2) = 0.24058$, $p = 0.0887$], 'improves the feeling of professionalism' [$\chi^2(2) = 5.0954$, $p = 0.078$], 'improves communication between health professionals and patients' [$\chi^2(2) = 0.56065$, $p = 0.756$], 'contributes to health professionals' ability to make patient care decisions' [$\chi^2(2) = 3.106$, $p = 0.212$], and 'improves communication between health professionals' [$\chi^2(2) = 2.7126$, $p = 0.258$].

Female respondents had a higher agreement level with all the statements related to benefits of adopting EHRs in primary care than male respondents except for one benefit, namely that EHR 'enables following test results' in which males had a higher agreement level than females [female – 75.2% and male, 75.5%; $\chi^2(2) = 0.032836$, $p = 0.984$]. However, the benefit that EHR 'enables following test results' had the highest agreement level of 75.5% among males while 'improves the feeling of professionalism' had the highest agreement level of 78.4% among females. The statement that EHR 'reduce medical errors' had the lowest agreement level among both male and female respondents.

These findings suggest that female respondents were more likely to agree with all the benefit items than male respondents except for one benefit, namely that EHR 'enables following test results' where males had a slightly higher agreement level than females. Of all benefits, males are more likely to agree with the statement that EHR 'enables following test results' while females are more likely to agree with 'improves the feeling of professionalism'.

Table 5.12: Relationship between gender and agreement with the perceived benefits of adopting an EHR (n=1127)

Perceived benefits of an EHR	**Gender**		
	Male n = 503	**Female n = 624**	**p-value**
Provides quick and reliable access to scientific research	374 (74.4%)	482 (77.2%)	0.001
Enables easy access to information from past medical records	365 (72.6%)	468 (75.0%)	0.013
Provides access to patient data and analysis	378 (75.1%)	488 (78.2%)	0.046
Provides better data	370 (73.6%)	470 (75.3%)	0.001
Makes it easy to transfer data	367 (73.0%)	471 (75.5%)	0.010
Provides access to practice standards	358 (71.2%)	471 (75.5%)	0.024
Enables following test results	380 (75.5%)	469 (75.2%)	0.984
Saves time in documenting health data	375 (74.6%)	473 (75.8%)	0.887
Decreases paper-based documentation	374 (74.4%)	495 (79.3%)	0.015
Improves the feeling of professionalism	370 (73.6%)	489 (78.4%)	0.078
Improves communication between health professionals and patients	367 (73.0%)	464 (74.4%)	0.756
Contributes to health professionals' ability to make patient care decisions	359 (71.4%)	456 (73.1%)	0.212
Improves communication between health professionals	362 (72.0%)	467 (74.8%)	0.258
Reduces medical errors	303 (60.2%)	413 (66.2%)	0.003

5.10.4 Relationship between the respondents' nationality and perception of EHR benefits

There was a significant relationship between respondents' nationality and perceptions of the benefits of adopting EHRs. This was demonstrated by significant differences between the Saudi and non-Saudi healthcare professionals in their perception of all benefit items except for the two statements that EHR 'decreases paper-based documentation' [$\chi^2(2) = 5.1043$, p = 0.078] and 'reduces medical errors' [$\chi^2(2) = 0.92563$, p = 0.630]. The non-Saudi healthcare respondents had a higher agreement level with all the statements related to the benefits of adopting benefits than their Saudi counterparts except for three benefits. These were the statements that EHR 'improves the feeling of professionalism' [Saudi: 76.3%, non-Saudi: 75.9%, $\chi^2(2) = 12.374$, $p = 0.002$], 'contributes to health professionals' ability to make patient care decisions' [Saudi: 72.6%, non-Saudi: 71.5%, $\chi^2(2) = 9.4384$, $p = 0.009$], and 'reduces medical errors' [Saudi: 63.6%, non-Saudi: 63.3%; $\chi^2(2) = 8.1522$, $p = 0.630$]. For all the statements related to the benefits of adopting EHRs in primary care, the statement that EHR 'improves the feeling of professionalism' had the highest agreement level of 76.3% among Saudis while 'provides quick and reliable access to scientific research' had the highest agreement level of 84.5% among non-Saudi healthcare professionals. The statement that EHR 'reduces medical errors' had the lowest agreement level among both Saudi and non-Saudi healthcare professionals. These findings suggest that non-Saudis were more likely to agree with most benefits statements compared to other Saudis. Both non-Saudis and Saudis are more likely to agree with some benefits more than others.

Table 5.13: Relationship between nationality and agreement with the perceived benefits of adopting EHRs (n=1127)

Perceived benefits of an EHR	**Nationality**		
	Saudi n = 811	**Non-Saudi n = 316**	**p-value**
Provides quick and reliable access to scientific research	589 (72.6%)	267 (84.5%)	< 0.001
Enables easy access to information from past medical records	583 (71.9%)	250 (79.1%)	0.004
Provides access to patient data and analysis	611 (75.3%)	255 (80.7%)	0.002
Provides better data	599 (73.9%)	241 (76.3%)	0.002
Makes it easy to transfer data	597 (73.6%)	241 (76.3%)	0.004
Provides access to practice standards	584 (72.0%)	245 (77.5%)	0.005
Enables following test results	604 (74.5%)	245 (77.5%)	< 0.001
Saves time in documenting health data	608 (75.0%)	240 (75.9%)	0.009
Decreases paper-based documentation	618 (76.2%)	251 (79.4%)	0.078
Improves the feeling of professionalism	619 (76.3%)	240 (75.9%)	0.002
Improves communication between health professionals and patients	595 (73.4%)	236 (74.7%)	< 0.001
Contributes to health professionals' ability to make patient care decisions	589 (72.6%)	226 (71.5%)	0.009
Improves communication between health professionals	591 (72.9%)	238 (75.3%)	0.017
Reduces medical errors	516 (63.6%)	200 (63.3%)	0.630

5.10.5 Relationship between the respondents' length of time working in primary healthcare and perception of EHR benefits

There was a significant relationship between respondents' length of working experience and perception of all EHR benefits except one benefit, namely that EHR 'reduces medical errors' [$\chi^2(4) = 6.812$, $p < 0.146$]. Healthcare professionals with 11–20 years of working experience had the highest agreement level with 10 statements, followed by those with over 20 years and finally, the providers who had less than 10 years of working experience. Some of the statements included that EHR 'provides quick and reliable access to scientific research' [$\chi^2(4) = 38.037$, $p < 0.001$], 'provides access to patient data and analysis' [$\chi^2(4) = 37.802$, $p < 0.001$], and 'provides better data' [$\chi^2(4) = 40.726$, $p < 0.001$].

Conversely, healthcare professionals with more than 20 years of experience had the highest level of agreement with four (4) statements, including that EHR 'enables easy access to information from past medical records' [$\chi^2(4) = 58.726$, $p < 0.001$], 'makes it easy to transfer data' [$\chi^2(4) = 47.262$, $p < 0.001$], 'improves communication between health professionals and patients' [$\chi^2(4) = 27.88$, $p < 0.001$] and 'reduces medical errors' [$\chi^2(4) = 6.812$, $p < 0.146$]. Healthcare professionals with less than 10 years of working experience had the lowest agreement level with all benefit items.

The statement with the highest agreement level varied across the length of work experience groups. The statements that EHR 'provides access to patient data and analysis' and 'decreases paper-based documentation' had the highest agreement level with each having 72.6% among the respondents with 0 to 10 years of working experience. The respondents with 11 to 20 years of experience working in primary healthcare in Riyadh city had the highest agreement level of 92.5% with the statement that EHR 'decreases paper-based documentation'. Lastly, the statement that EHR 'makes it easy to transfer data' had the highest agreement level of 96.8% among the respondents with more than 20 years of experience working in primary healthcare. The benefit item that EHR 'reduces medical errors' had the lowest agreement across all the three categories of length of working experience.

These findings suggest that healthcare professionals with 11–20 years of working experience were more likely to agree with most benefits statements compared to other groups. Healthcare professionals are more likely to agree with some benefits more than others depending on their length of working experience.

Table 5.14: Relationship between the length of working years in primary care and agreement with the perceived benefits of EHRs (n=1127)

Perceived benefits of an EHR	**Length of time (years) working in primary health care centres in Riyadh**			
	0-10 n = 870	**11-20 n = 226**	**21+ n = 31**	**p-value**
Provides quick and reliable access to scientific research	624 (71.7%)	205 (90.7%)	27 (87.1%)	< 0.001
Enables easy access to information from past medical records	596 (68.5%)	208 (92.0%)	29 (93.5%)	< 0.001
Provides access to patient data and analysis	632 (72.6%)	206 (91.2%)	28 (90.3%)	< 0.001
Provides better data	610 (70.1%)	203 (89.8%)	27 (87.1%)	< 0.001
Makes it easy to transfer data	605 (69.5%)	203 (89.8%)	30 (96.8%)	< 0.001
Provides access to practice standards	611 (70.2%)	193 (85.4%)	25 (80.6%)	< 0.001
Enables following test results	622 (71.5%)	201 (88.9%)	26 (83.9%)	< 0.001
Saves time in documenting health data	623 (71.6%)	199 (88.1%)	26 (83.9%)	< 0.001
Decreases paper-based documentation	632 (72.6%)	209 (92.5%)	28 (90.3%)	< 0.001
Improves the feeling of professionalism	626 (72.0%)	205 (90.7%)	28 (90.3%)	< 0.001
Improves communication between health professionals and patients	609 (70.0%)	195 (86.3%)	27 (87.1%)	< 0.001
Contributes to health professionals 'ability to make patient care decisions	594 (68.3%)	196 (86.7%)	25 (80.6%)	< 0.001
Improves communication between health professionals	616 (70.8%)	188 (83.2%)	25 (80.6%)	0.004
Reduces medical errors	537 (61.7%)	156 (69.0%)	23 (74.2%)	0.146

5.10.6 Relationship between the respondents' experience outside the Kingdom of Saudi Arabia and the perception of EHR benefits

There was a significant relationship between respondents' experience outside the Kingdom of Saudi Arabia and their attitudes towards all the EHR benefits ($p < 0.001$). Healthcare professionals who had no experience outside the Kingdom of Saudi Arabia had a higher agreement level with all the statements related to the benefits of adopting EHRs than those who had experience outside the country. For instance, 80.5% of healthcare professionals with no experience outside the Kingdom of Saudi Arabia agreed that EHR 'provides quick and reliable access to scientific research' compared to 68.9% of respondents with experience outside the country [$\chi^2(2) = 36.516$, $p < 0.001$].

For all the statements, 'decreases paper-based documentation' had the highest agreement level of 85.9% among the healthcare professionals with no experience outside the Kingdom of Saudi Arabia while 'provides quick and reliable access to scientific research' had the highest agreement level of 68.9% among the professionals who had experience outside the country. However, the statement that EHR 'reduces medical errors' had the lowest agreement level among both the groups.

These findings suggest that healthcare professionals who had no experience outside the Kingdom of Saudi Arabia were more likely to agree with all the benefits statements compared to those who had experience elsewhere. Healthcare professionals were more likely to agree with some benefits more than others, depending on their experience outside the Kingdom of Saudi Arabia.

Table 5.15: Relationship between experience outside the Kingdom of Saudi Arabia and agreement with the perceived benefits of adopting EHRs (n=1127)

Perceived benefits of an EHR	**Experience outside the Kingdom of Saudi Arabia**		
	No **n = 686**	**Yes** **n = 441**	**p-value**
Provides quick and reliable access to scientific research	552 (80.5%)	304 (68.9%)	< 0.001
Enables easy access to information from past medical records	553 (80.6%)	280 (63.5%)	< 0.001
Provides access to patient data and analysis	577 (84.1%)	289 (65.5%)	< 0.001
Provides better data	562 (81.9%)	278 (63.0%)	< 0.001
Makes it easy to transfer data	559 (81.5%)	279 (63.3%)	< 0.001
Provides access to practice standards	549 (80.0%)	280 (63.5%)	< 0.001
Enables following test results	570 (83.1%)	279 (63.3%)	< 0.001
Saves time in documenting health data	572 (83.4%)	276 (62.6%)	< 0.001
Decreases paper-based documentation	589 (85.9%)	280 (63.5%)	< 0.001
Improves the feeling of professionalism	584 (85.1%)	275 (62.4%)	< 0.001
Improves communication between health professionals and patients	565 (82.4%)	266 (60.3%)	< 0.001
Contributes to health professionals' ability to make patient care decisions	562 (81.9%)	253 (57.4%)	< 0.001
Improves communication between health professionals	561 (81.8%)	268 (60.8%)	< 0.001
Reduces medical errors	488 (71.1%)	228 (51.7%)	< 0.001

5.10.7 Relationship between the respondents' previous training in EHRs and perception of EHR benefits

There was a significant difference in the perception of all EHR benefits between healthcare providers who had previous training in EHRs and those who did not ($p < 0.05$). The providers with training in EHRs had a higher agreement level with all the benefit items than those who did not have training. For instance, the agreement level with the statement that EHR 'provides quick and reliable access to scientific research' was 83.7% and 70.8% for individuals with and without training in EHRs respectively [$\chi^2(2) = 24.729$, $p < 0.001$].

There was variation in the agreement with the benefits between the individual groups. Of all the benefits, the statement that EHR 'decreases paper-based documentation' had the highest agreement level of 72.6% among the professionals with no previous training in EHRs. Conversely, the professionals with training in EHRs had the highest agreement (85.5%) with the statement that EHR 'improves the feeling of professionalism'. The statement that EHR 'reduces medical errors' had the lowest agreement by both healthcare professionals with and without previous training in EHRs. These findings suggest that healthcare professionals with prior training in EHRs were more likely to agree with all the benefits statements compared to those without. Healthcare professionals are more likely to agree with some benefits more than others depending on their training in EHRs.

Table 5.16: Relationship between previous training in EHRs and agreement with the perceived benefits of adopting EHRs (n=1127)

Perceived benefits of an EHR	**Previous training in EHR**		
	No n = 674	**Yes n = 453**	**p-value**
Provides quick and reliable access to scientific research	477 (70.8%)	379 (83.7%)	< 0.001
Enables easy access to information from past medical records	462 (68.5%)	371 (81.9%)	< 0.001
Provides access to patient data and analysis	483 (71.7%)	383 (84.5%)	< 0.001
Provides better data	484 (71.8%)	356 (78.6%)	< 0.001
Makes it easy to transfer data	471 (69.9%)	367 (81.0%)	< 0.001
Provides access to practice standards	463 (68.7%)	366 (80.8%)	< 0.001
Enables following test results	476 (70.6%)	373 (82.3%)	< 0.001
Saves time in documenting health data	474 (70.3%)	374 (82.6%)	< 0.001
Decreases paper-based documentation	489 (72.6%)	380 (83.9%)	< 0.001

Improves the feeling of professionalism	471 (69.9%)	388 (85.7%)	< 0.001
Improves communication between health professionals and patients	467 (69.3%)	364 (80.4%)	< 0.001
Contributes to health professionals' ability to make patient care decisions	456 (67.7%)	359 (79.2%)	< 0.001
Improves communication between health professionals	463 (68.7%)	366 (80.8%)	< 0.001
Reduces medical errors	402 (59.6%)	314 (69.3%)	0.002

5.10.8 Relationship between the respondents' previous experience in EHRs and perception of EHR benefits

There was no significant difference between respondents who had and who had no previous experience in EHRs and perceptions of all the EHR benefits except EHR 'improves communication between health professionals' [$\chi^2(2) = 6.5169$, $p = 0.038$]. Although there were no significant differences, there was a mixed result in the agreement with the benefits by those who had and had no previous experience. The healthcare providers who had previous experience in EHRs in primary care had a higher agreement level with six (6) benefits than those who had no previous experience. These include EHR 'provides quick and reliable access to scientific research' [$\chi^2(2) = 2.851$, $p < 0.240$], 'enables easy access to information from past medical records' [$\chi^2(2) = 0.71114$, $p < 0.701$], 'provides access to practice standards' [$\chi^2(2) = 0.30823$, $p < 0.857$], 'enables following test results' [$\chi^2(2) = 4.7361$, $p < 0.094$], 'improves the feeling of professionalism' [$\chi^2(2) = 0.65749$, $p < 0.720$] and 'improves communication between health professionals [$\chi^2(2) = 6.5169$, $p = 0.038$]. Healthcare professionals without previous experience in primary care had a higher agreement level with the remaining eight (8) statements related to the benefits of adopting EHRs in primary care. The benefit item that EHR 'improves the feeling of professionalism' had the highest agreement level of 77.1% among healthcare professionals who had previous experience in EHRs in primary healthcare while 'provides access to patient data and analysis' and 'decreases paper-based documentation' had the highest agreement level of each 77.3% among the respondents without previous experience in EHRs. The statement that EHR 'reduces medical errors' had the lowest agreement in both the respondents with and without previous experience in EHRs in primary healthcare. These findings suggest that healthcare professionals without previous experience in EHRs were more likely to agree with most benefits statements compared to those with experience. Healthcare professionals are more likely to agree with some benefits more than others, depending on their previous experience with EHRs in primary care.

Table 5.17: Relationship between previous experience in EHRs and agreement with the perceived benefits of adopting EHRs (n=1127)

Perceived benefits of an EHR	**Previous experience in EHR in primary health care**		
	No n = 686	**Yes n = 441**	**p-value**
Provides quick and reliable access to scientific research	521 (75.9%)	335 (76.0%)	0.240
Enables easy access to information from past medical records	502 (73.2%)	331 (75.1%)	0.701
Provides access to patient data and analysis	530 (77.3%)	336 (76.2%)	0.293
Provides better data	517 (75.4%)	323 (73.2%)	0.090
Makes it easy to transfer data	513 (74.8%)	325 (73.7%)	0.134
Provides access to practice standards	503 (73.3%)	326 (73.9%)	0.857
Enables following test results	516 (75.2%)	333 (75.5%)	0.094
Saves time in documenting health data	520 (75.8%)	328 (74.4%)	0.449
Decreases paper-based documentation	530 (77.3%)	339 (76.9%)	0.110
Improves the feeling of professionalism	519 (75.7%)	340 (77.1%)	0.720
Improves communication between health professionals and patients	510 (74.3%)	321 (72.8%)	0.309
Contributes to health professionals ‘ability to make patient care decisions	501 (73.0%)	314 (71.2%)	0.118
Improves communication between health professionals	500 (72.9%)	329 (74.6%)	0.038
Reduces medical errors	440 (64.1%)	276 (62.6%)	0.805

5.11 Research sub-question 5: What is the influence of sociodemographic characteristics of healthcare professionals towards their perceptions of obstacles of adopting EHRs in PCCs in Riyadh city, Saudi Arabia?

This research question examines the relationship between the external variables (sociodemographic variables) and perceived usefulness and perceived ease of use (EHR obstacles) (see Table 4.1). The findings were as follows:

5.11.1 Relationship between the respondents’ occupation and perceived obstacles to adopting EHRs in primary health care

There was a significant relationship between the occupation of the health care professionals and their perceptions of each item related to obstacles of adopting EHRs in primary care. Physicians had the lowest level of agreement with six (6) obstacle items. These included EHR ‘is too complicated and not user friendly' [$\chi^2(8) = 49.69$, $p < 0.001$], 'compromises patient safety' [$\chi^2(8) = 53.597$, $p < 0.001$], 'increases health professionals 'workloads' [$\chi^2(8) = 28.204$, $p < 0.001$], 'it is difficult to provide data security in EHRs' [$\chi^2(8) = 47.389$, $p < 0.001$], 'consumes more time than paper-based systems' [$\chi^2(8) = 39.365$, $p < 0.001$], and 'is costly' [$\chi^2(8) = 38.211$, $p < 0.001$]. Except for the statements that EHR 'increases health professionals' workloads', 'it is difficult to provide data security in EHRs', 'consumes more time than paper-based systems', and 'is costly', physicians were followed by pharmacists, technicians, other healthcare providers and finally nurses in the level of agreement. However, nurses had a lower agreement level than other healthcare providers with the statements that EHR 'increases health professionals' workloads', 'is "down" frequently' and 'is costly'. They also had a lower agreement with the one obstacle item that EHR 'consumes more time than paper-based systems' compared to technicians. Technicians had a lower agreement level with three (3) statements that 'it is difficult to provide data security in EHRs', 'consumes more time than paper-based systems' and 'needs frequent revisions related to technological developments' than other healthcare professionals. Conversely, pharmacists had the lowest level of agreement with three (3) items, including EHR 'decreases interaction between the health professional and patient' [$\chi^2(8) = 39.562$, $p < 0.001$], 'is "down" frequently' [$\chi^2(8) = 47.737$, $p < 0.001$], and 'needs frequent revisions related to technological developments' [$\chi^2(8) = 55.9$, $p < 0.001$]. Across all of the occupational groups, the statements that EHR 'needs frequent revisions related to technological developments' and 'is too complicated and not user-friendly' had the highest and lowest agreement levels respectively compared to other obstacle items.

Table 5.18: Relationship between occupation and agreement with perceived obstacles to adopting EHRs (n=1127)

Perceived obstacles to adopting EHRs in primary care	**Occupation**					
	Physicians n = 209	**Nurses n = 367**	**Pharmacists n = 208**	**Technicians n = 228**	**Others n = 115**	**p-value**
Is too complicated and not user-friendly	20 (9.6%)	88 (24.0%)	23 (11.1%)	36 (15.8%)	25 (21.7%)	< 0.001
Compromises patient safety	26 (12.4%)	90 (24.5%)	27 (13.0%)	45 (19.7%)	24 (20.9%)	< 0.001
Decreases interaction between the health professional and patient	31 (14.8%)	95 (25.9%)	30 (14.4%)	46 (20.2%)	29 (25.2%)	< 0.001
Increases health professionals' workloads	40 (19.1%)	98 (26.7%)	40 (19.2%)	54 (23.7%)	33 (28.7%)	< 0.001
It is difficult to provide data security in EHRs	21 (10.0%)	92 (25.1%)	32 (15.4%)	54 (23.7%)	22 (19.1%)	< 0.001
Consumes more time than paper-based systems	40 (19.1%)	102 (27.8%)	43 (20.7%)	68 (29.8%)	31 (27.0%)	< 0.001
Is 'down' frequently	29 (13.9%)	99 (27.0%)	28 (13.5%)	45 (19.7%)	34 (29.6%)	< 0.001
Is costly	36 (17.2%)	111 (30.2%)	37 (17.8%)	58 (25.4%)	37 (32.2%)	< 0.001
Needs frequent revisions related to technological developments	102 (48.8%)	186 (50.7%)	75 (36.1%)	98 (43.0%)	49 (42.6%)	< 0.001

5.11.2 Relationship between the respondents' age and perceived obstacles to adopting EHRs in primary health care

There was a significant association between the respondents' age and their perception of obstacles to adopting EHRs in primary care ($p < 0.001$) (Table 5.19). Older respondents (>50 years) had the lowest agreement level with the all of the items related to obstacles to adopting EHRs in primary care followed by those aged 20–34 years and finally 35–49 years except for two (2) items, namely that EHR 'increases health professionals' workloads' [$\chi^2(4) = 30.673$, $p < 0.001$] and 'needs frequent revisions related to technological developments' [$\chi^2(4) = 25.329$, $p < 0.001$]. Conversely, individuals aged 35–49 years had the highest agreement level with all the statements except one, that EHR 'needs frequent revisions related to technological developments' in which older professionals (> 50 years) had the highest agreement level.

For all obstacle items, EHR 'needs frequent revisions related to technological developments' had the highest agreement level across all age groups while 'is too complicated and not user-friendly' had the lowest level of agreement.

Table 5.19: Relationship between age and agreement with perceived obstacles to adopting EHRs (n=1127)

Perceived obstacles to adopting EHRs in primary care	**Age**			
	20 -34 n = 608	**35 -49 n = 471**	**50+ n = 48**	**p-value**
Is too complicated and not user-friendly	93 (15.3%)	98 (20.8%)	1 (2.1%)	<0.001
Compromises patient safety	98 (16.1%)	111 (23.6%)	3 (6.3%)	<0.001
Decreases interaction between the health professional and patient	101 (16.6%)	125 (26.5%)	5 (10.4%)	<0.001
Increases health professionals' workloads	108 (17.8%)	148 (31.4%)	9 (18.8%)	<0.001
It is difficult to provide data security in EHRs	96 (15.8%)	119 (25.3%)	6 (12.5%)	<0.001
Consumes more time than paper-based systems	133 (21.9%)	142 (30.1%)	9 (18.8%)	<0.001
Is 'down' frequently	111 (18.3%)	121 (25.7%)	3 (6.3%)	<0.001
Is costly	130 (21.4%)	141 (29.9%)	8 (16.7%)	0.002
Needs frequent revisions related to technological developments	251 (41.3%)	229 (48.6%)	30 (62.5%)	<0.001

5.11.3 Relationship between the respondents' gender and perceived obstacles to adopting EHRs in primary care

There was no significant association between the gender of the respondents and their perception of six (6) statements related to the obstacles to adopting EHRs in primary care. These included that EHR 'is too complicated and not user-friendly' [$\chi^2(2) = 2.0732$, $p = 0.355$], 'compromises patient safety' [$\chi^2(2) = 1.1221$, $p = 0.571$], 'decreases interaction between the health professional and patient' [$\chi^2(2) = 5.9578$, $p = 0.051$], 'increases health professionals 'workloads' [$\chi^2(2) = 0.83983$, $p = 0.657$], 'it is difficult to provide data security in EHRs' [$\chi^2(2) = 5.0261$, $p = 0.081$], and 'is costly' [$\chi^2(2) = 2.2789$, $p = 0.320$].

Conversely, there was a significant difference between male and female healthcare professionals in their perceptions of three (3) items related to the EHR implementation obstacles. These were that EHR 'consumes more time than paper-based systems' [$\chi^2(2) = 9.17$, $p = 0.010$], 'is "down" frequently' [$\chi^2(2) = 6.4418$, $p = 0.040$] and 'needs frequent revisions related to technological developments' [$\chi^2(2) = 6.393$, $p = 0.041$]. Male respondents had a lower agreement level with all obstacle items than females except one which is that EHR 'decreases interaction between the health professional and patient'. For all of the statements, the statement that EHR 'need frequent revisions related to technological developments' and 'is too complicated and not user-friendly' had the highest and lowest agreement levels respectively in both genders.

Table 5.20: Relationship between gender and agreement with perceived obstacles to adopting EHRs (n=1127)

Perceived obstacles to adopting EHRs in primary care	**Gender**		
	Male n = 503	**Female n = 624**	**p-value**
Is too complicated and not user-friendly	79 (15.7%)	113 (18.1%)	0.355
Compromises patient safety	89 (17.7%)	123 (19.7%)	0.571
Decreases interaction between the health professional and patient	106 (21.1%)	125 (20.0%)	0.051
Increases health professionals' workloads	116 (23.1%)	149 (23.9%)	0.657
It is difficult to provide data security in EHRs	96 (19.1%)	125 (20.0%)	0.081
Consumes more time than paper-based systems	117 (23.3%)	167 (26.8%)	0.010
Is 'down' frequently	90 (17.9%)	145 (23.2%)	0.040
Is costly	116 (23.1%)	163 (26.1%)	0.320
Needs frequent revisions related to technological developments	208 (41.4%)	302 (48.4%)	0.041

5.11.4 Relationship between the respondents' nationality and perceived obstacles to adopting EHRs in primary care

There was a significant association between nationality and perception of the obstacles in the implementation of EHRs for all the items related to obstacles except one which states that EHR 'is too complicated and not user-friendly' [$\chi^2(2) = 3.6526$, $p = 0.161$). The non-Saudi healthcare professionals had a lower agreement level with all the statements related to obstacles to EHR implementation in primary care than Saudis.

The statement that EHR 'needs frequent revisions related to technological developments' had the highest agreement of all the items among both Saudi and non-Saudi healthcare providers. Conversely, the two groups differed on the statement with the lowest agreement level. For non-Saudis, it was that EHR 'Is "down" frequently' with an agreement level of 11.1% while for Saudis it was 'is too complicated and not user-friendly' with an agreement level of 18.4%. These findings are presented in Table 5.21.

Table 5.21: Relationship between nationality and agreement with perceived obstacles to adopting EHRs (n=1127)

Perceived EHR obstacles	**Nationality**		
	Saudi n = 811	**Non-Saudi n = 316**	**p-value**
Is too complicated and not user-friendly	149 (18.4%)	43 (13.6%)	0.161
Compromises patient safety	168 (20.7%)	44 (13.9%)	0.027
Decreases interaction between the health professional and patient	182 (22.4%)	49 (15.5%)	0.015
Increases health professionals' workloads	215 (26.5%)	50 (15.8%)	< 0.001
It is difficult to provide data security in EHRs	179 (22.1%)	42 (13.3%)	0.003
Consumes more time than paper-based systems	233 (20.1%)	51 (16.1%)	< 0.001
Is 'down' frequently	200 (24.7%)	35 (11.1%)	< 0.001
Is costly	232 (28.6%)	47 (14.9%)	< 0.001
Needs frequent revisions related to technological developments	403 (49.7%)	107 (33.9%)	< 0.001

5.11.5 Relationship between the respondents' length of time working in primary healthcare and perception of obstacles to adopting EHRs in PCCs

There were significant associations between length of working experience and perception of four (4) obstacles. These included that EHR 'decreases interaction between the health professional and patient' [$\chi^2(4) = 9.9328$, $p = 0.042$], 'consumes more time than paper-based systems' [$\chi^2(4) = 20.993$, $p < 0.001$], 'is costly' [$\chi^2(4) = 12.568$, $p = 0.014$], and 'needs frequent revisions related to technological developments' [$\chi^2(4) = 64.421$, $p < 0.001$]. Conversely, there were no significant differences between healthcare professionals' years of experience and perceptions of five (5) items related to the obstacles to EHR implementation. These included that EHR 'is too complicated and not user-friendly' [$\chi^2(4) = 2.311$, $p = 0.679$], 'compromises patient safety' [$\chi^2(4) = 6.8587$, $p = 0.144$], 'increases health professionals' workloads' [$\chi^2(4) = 9.1079$, $p = 0.058$], 'it is difficult to provide data security in EHRs' [$\chi^2(4) = 3.7862$, $p = 0.436$], and 'is "down" frequently' [$\chi^2(4) = 8.6541$, $p = 0.070$].

Healthcare professionals with a shorter period of work experience (0–10 years) in primary care had the lowest agreement level with all of the obstacle items followed by those with 11–20 years of work experience and finally over 20 years of experience except for three (3) items. These included 'it is difficult to provide data security in EHRs' and that EHR 'is "down" frequently' in which healthcare providers with 11 to 20 years of experience in primary healthcare and over 20 years of experience had the lowest agreement level respectively. The statement that EHR 'is costly' had the same lowest level of agreement of 22.6% across professionals with less than 10 and over 20 years. The healthcare providers with more than 20 years of experience had a lower level of agreement with three (3) obstacles, namely 'is "down" frequently', 'is costly', and 'needs frequent revisions related to technological developments' than those with 11–20 years of work experience.

The statement that EHR 'needs frequent revisions related to technological developments' had the highest level of agreement of all the obstacles across all the experience groups. However, the professionals differed in the least perceived obstacle. The item that EHR 'is too complicated and not user-friendly' had the lowest agreement level among the healthcare professionals with 0 to 10 years and more than 20 years of work experience in primary care settings while 'it is difficult to provide data security in EHRs' had the lowest agreement level among those with 11 to 20 years. The statement that EHR 'is "down" frequently' also had the lowest agreement level 0f 19.4% among professionals with more than 20 years.

Table 5.22: Relationship between the length of working and perceived obstacles to adopting EHRs (n=1127)

Perceived obstacles to adopting EHRs in primary care	Length of time (years) working in primary health care centres in Riyadh			
	0-10 n = 870	11-20 n = 226	21+ n = 31	p-value
Is too complicated and not user-friendly	143 (16.4%)	43 (19.0%)	6 (19.4%)	0.679
Compromises patient safety	159 (18.3%)	44 (19.5%)	9 (29.0%)	0.144
Decreases interaction between the health professional and patient	173 (19.9%)	49 (21.7%)	9 (29.0%)	0.042
Increases health professionals' workloads	191 (22.0%)	65 (28.8%)	9 (29.0%)	0.058
It is difficult to provide data security in EHRs	172 (19.8%)	41 (18.1%)	8 (25.8%)	0.436
Consumes more time than paper-based systems	208 (23.9%)	63 (27.9%)	13 (41.9%)	< 0.001
Is 'down' frequently	183 (21.0%)	46 (20.4%)	6 (19.4%)	0.070
Is costly	197 (22.6%)	75 (33.2%)	7 (22.6%)	0.014
Needs frequent revisions related to technological developments	338 (38.9%)	153 (67.7%)	19 (61.3%)	< 0.001

5.11.6 Relationship between the respondents' experience outside the Kingdom of Saudi Arabia and perceived obstacles to adopting EHRs in primary care

There was a significant relationship between the respondents' experience outside the Kingdom of Saudi Arabia and perceptions of all obstacles to implementing EHRs in primary healthcare except two (2) in which there were no significant differences. These included the statement that an EHR system 'is "down" frequently' [$\chi^2(2)$ = 2.2134, p = 0.331] and 'is costly' [$\chi^2(2)$ = 3.8278, p = 0.148].

Respondents with experience outside the Kingdom of Saudi Arabia had a lower agreement level with all the obstacle items than their counterparts who did not have previous experience outside the country except for one obstacle, namely that 'it is difficult to provide data security in EHRs' [Experience: 20.0%, No experience: 19.4%; $\chi^2(2)$ = 10.046, p = 0.007].

The statement that EHR 'need frequent revisions related to technological developments' had the highest agreement by both healthcare professionals who had and did not have experience outside the Kingdom of Saudi Arabia. Conversely, they varied in their perceptions of the least obstacle with the item that EHR 'is too complicated and not user-friendly' having the lowest agreement level of 12.9% by those who had experience outside the Kingdom of Saudi Arabia. The statement that ‘it is difficult to provide data security in EHRs’ had the lowest agreement level of 19.4% by the respondents who did not have experience outside the Kingdom of Saudi Arabia.

Table 5.23: Relationship between experience outside the Kingdom of Saudi Arabia and agreement with perceived obstacles to adopting EHRs (n=1127)

Perceived obstacles to adopting EHRs in primary care	**Experience outside Saudi Arabia**		
	No n = 686	**Yes n = 441**	**p-value**
Is too complicated and not user-friendly	135 (19.7%)	57 (12.9%)	<0.001
Compromises patient safety	143 (20.8%)	69 (15.6%)	<0.001
Decreases interaction between the health professional and patient	155 (22.6%)	76 (17.2%)	0.004
Increases health professionals’ workloads	165 (24.1%)	100 (22.7%)	0.004
It is difficult to provide data security in EHRs	133 (19.4%)	88 (20.0%)	0.007
Consumes more time than paper-based systems	185 (27.0%)	99 (22.4%)	<0.001
Is ‘down’ frequently	145 (21.1%)	90 (20.4%)	0.331
Is costly	183 (26.7%)	96 (21.8%)	0.148
Needs frequent revisions related to technological developments	355 (51.7%)	155 (35.1%)	<0.001

5.11.7 Relationship between the respondents’ previous training in EHRs and perceived obstacles to adopting EHRs in primary care

There was no significant difference between providers with and without training in EHRs in their perception of all obstacles except three (3), including that EHR ‘consumes more time than paper-based systems’ [$\chi^2(2) = 7.7398$, p = 0.021], ‘is down frequently’ [$\chi^2(2) = 7.5718$, p = 0.023], and ‘needs frequent revisions related to technological developments’ [$\chi^2(2) = 10.163$, p = 0.006]. The healthcare professionals with training in EHRs had a lower agreement level with all the obstacles than those without training except that EHR ‘increases health professionals’ workloads’ [training: 24.3%, no training: 23.0%, $\chi^2(2) = 4.301$, p = 0.116].

The items that EHR ‘is too complicated and not user-friendly’ and ‘needs frequent revisions related to technological developments’ had the lowest and highest agreement levels respectively by healthcare professionals both with and without training in EHR.

Table 5.24: Relationship between previous training in EHRs and agreement with perceived obstacles to adopting EHRs (n=1127)

Perceived obstacles to adopting EHRs in primary care	**Previous training in EHR**		
	No n = 671	**Yes n = 453**	**p-value**
Is too complicated and not user friendly	121 (18.0%)	71 (15.7%)	0.177
Compromises patient safety	131 (19.4%)	81 (17.9%)	0.572
Decreases interaction between the health professional and patient	143 (21.2%)	88 (19.4%)	0.712
Increases health professionals' workloads	155 (23.0%)	110 (24.3%)	0.116
It is difficult to provide data security in EHRs	141 (20.9%)	80 (17.7%)	0.284
Consumes more time than paper-based systems	177 (26.3%)	107 (23.6%)	0.021
Is 'down' frequently	149 (22.1%)	86 (19.0%)	0.023
Is costly	165 (24.5%)	114 (25.2%)	0.065
Needs frequent revisions related to technological developments	313 (46.4%)	197 (43.5%)	0.006

5.11.8 Relationship between the respondents' previous experience in EHRs and perceived obstacles to adopting EHRs in primary care

There were no significant differences between healthcare professionals with and without previous experience in EHRs in primary care in their perception of all obstacle items. However, healthcare professionals with previous EHR experience in primary health care had a lower agreement level with all the obstacle items than their colleagues who did not have previous experience in EHRs except for two (2) items. namely 'increases health professionals' workloads' [experience in EHR: 24.5%, no experience in EHR: 22.9%; $\chi^2(2) = 3.7752$, p = 0.151] and 'is costly' [experience in EHR: 26.1%, no experience in EHR: 23.9%; $\chi^2(2) = 1.3105$, p = 0.519].

The obstacle items that EHR 'is too complicated and not user-friendly' and 'needs frequent revisions related to technological developments' had the lowest and highest agreement levels respectively by both the healthcare professionals who had and did not have previous EHR experience in primary healthcare. Table 5.25 shows the relationship between previous experience in EHRs and the respondents' perceptions of the obstacles to implementing EHRs in primary healthcare.

Table 5.25: Relationship between previous experience in EHRs and agreement with perceived obstacles to adopting EHRs

Perceived obstacles to adopting EHRs in primary care	Previous experience in EHR		
	No n = 686	Yes n = 441	p-value
Is too complicated and not user friendly	126 (18.4%)	66 (15.0%)	0.281
Compromises patient safety	133 (19.4%)	79 (17.9%)	0.460
Decreases interaction between the health professional and patient	143 (20.8%)	88 (20.0%)	0.713
Increases health professionals' workloads	157 (22.9%)	108 (24.5%)	0.151
It is difficult to provide data security in EHRs	137 (20.0%)	84 (19.0%)	0.230
Consumes more time than paper-based systems	178 (25.9%)	106 (24.0%)	0.118
Is 'down' frequently	145 (21.1%)	90 (20.4%)	0.635
Is costly	164 (23.9%)	115 (26.1%)	0.519
Needs frequent revisions related to technological developments	327 (47.7%)	183 (41.5%)	0.127

5.12 Research sub-question 6: What is the influence of sociodemographic characteristics of healthcare professionals towards their satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia?

This research question examines the relationship between the external variables (sociodemographic factors) and attitude towards EHRs and behavioural intention (satisfaction) to use the system. The findings were as follows:

5.12.1 Relationship between the respondents' occupation and satisfaction with the EHRs in primary care

There was a significant relationship between respondents' occupation and perception of each item related to satisfaction with the EHRs in primary care. Physicians had the highest agreement level with all the items related to satisfaction with EHRs in PCCs. They were followed by nurses, pharmacists, other health care professionals and finally technicians in agreement with six (6) statements related to satisfaction with EHRs and one (1) global measure of satisfaction. These were 'I feel EHR has been successful in primary healthcare centres' [$\chi^2(8) = 59.18$, $p < 0.001$], 'I feel the EHR improves the quality of healthcare services in PCCs' [$\chi^2(8) = 56.379$, $p < 0.001$], 'I feel the quality of my work has improved' [$\chi^2(8) = 45.871$, $p < 0.001$], 'I feel the quality of information has improved due to EHR' [$\chi^2(8) = 42.079$, $p < 0.001$], 'I feel my performance has improved due to EHR' [$\chi^2(8) = 49.374$, $p < 0.001$], 'I feel patient safety has improved due to

EHR' [$\chi^2(8) = 53.232, p < 0.001$], and 'Overall, I am satisfied with the EHR system in PCCs' [$\chi^2(8) = 52.687, p < 0.001$].

For the remaining items, pharmacists had a higher agreement level with the statement that 'I feel EHR is worth the time and effort required to use it' than nurses [$\chi^2(8) = 54.72, p < 0.001$]. Technicians also had a higher agreement level with two (2) items for quality improvement of healthcare services than other healthcare professionals, namely 'I feel EHR is useful' [$\chi^2(8) = 115.7, p < 0.001$] and 'I feel EHR is an important system for primary healthcare centres' [$\chi^2(8) = 83.942, p < 0.001$].

The level of agreement with each item for improved quality due to the use of EHRs in primary healthcare varied across the occupational groups. The statement that 'I feel EHR is useful' had the highest agreement level among physicians, nurses, pharmacists and technicians, while 'I feel the EHR improves the quality of healthcare services in PCCs' had the highest level of agreement among other healthcare professionals. The statement that 'I feel patient safety has improved due to EHR' had the lowest level of agreement among physicians and nurses while 'I feel my performance has improved due to EHR' among pharmacists and technicians. 'I feel EHR has been successful in primary healthcare centres' had the lowest agreement level among other healthcare professionals. In overall, physicians were more satisfied with EHR in primary healthcare than other healthcare professionals, followed by nurses, pharmacists, other health professionals and finally technicians, in that order.

Table 5.26: Relationship between occupation and satisfaction with EHRs (n=1127)

Satisfaction with the EHRs	Occupation					
	Physicians n = 209	**Nurses n= 367**	**Pharmacists n = 208**	**Technicians n = 225**	**Others n= 115**	**p-value**
I feel EHR is useful	189 (90.4%)	302 (82.3%)	166 (79.8%)	157 (68.9%)	75 (65.2%)	< 0.001
I feel EHR is an important system for primary healthcare centres	184 (88.0%)	296 (80.7%)	160 (76.9%)	152 (66.7%)	76 (66.1%)	< 0.001
I feel EHR has been successful in primary healthcare centres	156 (74.6%)	269 (73.3%)	142 (68.3%)	129 (56.6%)	67 (58.3%)	< 0.001
I feel EHR is worth the time and effort required to use it	174 (83.3%)	262 (71.4%)	152 (73.1%)	132 (57.9%)	70 (60.9%)	< 0.001
I feel the EHR improves the quality of healthcare services in PCCs	180 (86.1%)	287 (78.2%)	153 (73.6%)	146 (64.0%)	77 (67.0%)	< 0.001
I feel the quality of my work has improved	162 (77.5%)	267 (72.8%)	141 (67.8%)	129 (56.6%)	70 (60.9%)	< 0.001
I feel the quality of information has improved due to EHR	172 (82.3%)	266 (72.5%)	149 (71.6%)	139 (61.0%)	73 (63.5%)	< 0.001
I feel my performance has improved due to EHR	152 (72.7%)	263 (71.7%)	139 (66.8%)	121 (53.1%)	68 (59.1%)	< 0.001
I feel patient safety has improved due to EHR	149 (71.3%)	256 (69.8%)	143 (68.8%)	123 (53.9%)	70 (60.9%)	< 0.001
Overall, I am satisfied with the EHR system in PCCs	164 (78.5%)	268 (73.0%)	140 (67.3%)	137 (60.1%)	70 (60.9%)	< 0.001

5.12.2 Relationship between the respondents' age and satisfaction with the EHRs in primary care

There was a significant relationship between the respondents' age and satisfaction with the EHRs in primary care. Older healthcare professionals (>50 years) had the highest level of agreement with six (6) items related to satisfaction with EHRs. These included 'I feel EHR is useful' [$\chi^2(4) = 35.626$, $p < 0.001$], 'I feel EHR is an important system for primary healthcare centres' [$\chi^2(4) = 42.946$, $p < 0.001$], 'I feel the EHR improves the quality of healthcare services in PCCs' [$\chi^2(4) = 41.286$, $p < 0.001$], 'I feel the quality of information has improved due to EHR' [$\chi^2(4) = 35.613$, $p < 0.001$], 'I feel my performance has improved due to EHR' [$\chi^2(4) = 36.818$, $p < 0.001$], and 'I feel patient safety has improved due to EHR' [$\chi^2(4) = 30.152$, $p < 0.001$]. Younger professionals (20–34 years) had the highest agreement level with three (3) items and one (1) global measure. These include 'I feel EHR has been successful in primary healthcare centres' [$\chi^2(4) = 45.811$, $p < 0.001$], 'I feel EHR is worth the time and effort required to use it' [$\chi^2(4) = 21.799$, $p < 0.001$], 'I feel the quality of my work has improved' [$\chi^2(4) = 33.299$, $p < 0.001$] and 'Overall, I am satisfied with the EHR system in PCCs' [$\chi^2(4) = 29.293$, $p < 0.001$]. The healthcare professionals aged 35 to 49 years had the lowest agreement with all the items related to the satisfaction with the EHRs.

The healthcare professionals differed in their perceptions of statements related to satisfaction with the EHRs in primary care. The statement that 'I feel EHR is useful' had the highest agreement level among health professionals aged 20 to 34 years and 35 to 49 years, while 'I feel EHR is an important system for primary healthcare centres' had the highest agreement level among health professionals aged 50 years and above. The item 'I feel patient safety has improved due to EHR' had the lowest agreement level among respondents aged 20–34 years while the statement 'I feel my performance has improved due to EHR' had the lowest agreement level among healthcare professionals aged 35 to 49 years old. In older professionals aged 50 years and above, two statements were with the lowest agreement level, and they were 'I feel EHR has been successful in primary healthcare centres' and 'I feel the quality of my work has improved'.

Table 5.27: Relationship between age and satisfaction with EHRs (n=1127)

Satisfaction with EHRs in primary care	**Age**			**p-value**
	20 – 34 n = 608	**35 – 49 n = 471**	**50+ n = 48**	
I feel EHR is useful	514 (84.5%)	332 (70.5%)	43 (89.6%)	< 0.001
I feel EHR is an important system for primary healthcare centres	505 (83.1%)	319 (67.7%)	44 (91.7%)	< 0.001
I feel EHR has been successful in primary healthcare centres	455 (74.8%)	273 (58.0%)	35 (72.9%)	< 0.001
I feel EHR is worth the time and effort required to use it	459 (75.5%)	295 (62.6%)	36 (75.0%)	< 0.001
I feel the EHR improves the quality of healthcare services in PCCs	486 (79.9%)	314 (66.7%)	43 (89.6%)	< 0.001
I feel the quality of my work has improved	450 (74.0%)	284 (60.3%)	35 (72.9%)	< 0.001
I feel the quality of information has improved due to EHR	460 (75.7%)	299 (63.5%)	40 (83.3%)	< 0.001
I feel my performance has improved due to EHR	440 (72.4%)	266 (56.5%)	37 (77.1%)	< 0.001
I feel patient safety has improved due to EHR	427 (70.2%)	278 (59.0%)	36 (75.0%)	< 0.001
Overall, I am satisfied with the EHR system in PCCs	456 (75.0%)	290 (61.6%)	33 (68.8%)	< 0.001

5.12.3 Relationship between the respondents' gender and satisfaction with EHRs in primary care

There was a significant association between gender and perception of all items related to satisfaction with the EHRs in primary care except for one item, 'I feel my performance has improved due to EHR' [$\chi^2(2) = 5.9564$, $p = 0.051$]. Females had a higher agreement level with all of the items more than males, including the global measure of satisfaction, 'Overall, I am satisfied with the EHR system in PCCs'.

The statement 'I feel EHR is useful' had the highest agreement level among males and females. However, they differed on the item with the lowest agreement level. The statement for male respondents was 'I feel patient safety has improved due to EHR' while for female respondents it was 'I feel my performance has improved due to EHR'. Table 5.28 presents detailed findings of the relationship between the gender of the respondents and their perceptions of the role of EHRs in improving the quality of healthcare services in primary health care.

Table 5.28: Relationship between gender and satisfaction with EHRs (n=1127)

Satisfaction with EHRs in primary care	Gender		
	Male n = 503	**Female n = 624**	**p-value**
I feel EHR is useful	389 (77.3%)	500 (80.1%)	< 0.001
I feel EHR is an important system for primary healthcare centres	375 (74.6%)	493 (79.0%)	< 0.001
I feel EHR has been successful in primary healthcare centres	326 (64.8%)	437 (70.0%)	0.006
I feel EHR is worth the time and effort required to use it	351 (69.8%)	439 (70.4%)	0.019
I feel the EHR improves the quality of healthcare services in PCCs	368 (73.2%)	475 (76.1%)	0.006
I feel the quality of my work has improved	325 (64.6%)	444 (71.2%)	0.014
I feel the quality of information has improved due to EHR	345 (68.6%)	454 (72.8%)	0.029
I feel my performance has improved due to EHR	318 (63.2%)	425 (68.1%)	0.051
I feel patient safety has improved due to EHR	311 (61.8%)	430 (68.9%)	< 0.001
Overall, I am satisfied with the EHR system in PCCs	334 (66.4%)	445 (71.3%)	0.001

5.12.4 Relationship between the respondents' nationality and satisfaction with the EHRs in primary care

Nationality of the respondents was significantly correlated with the healthcare professionals' perceptions of items related to satisfaction with the EHRs in primary care. Non-Saudi respondents had a higher agreement level with all the items more than Saudi healthcare professionals. However, Saudi healthcare professionals had a higher agreement level with the global measure of satisfaction, 'Overall, I am satisfied with the EHR system in PCCs' (Saudi: 69.2%, non-Saudi: 69.0%, $\chi^2(2) = 15.232$, $p < 0.001$).

The item, 'I feel EHR is useful' had the highest agreement level among both Saudi and non-Saudis. Conversely, 'I feel patient safety has improved due to EHR' had the lowest agreement among Saudi healthcare professionals while 'I feel my performance has improved due to EHR' had the lowest among non-Saudi professionals.

Table 5.29: Relationship between nationality and satisfaction with EHRs (n = 1127)

Satisfaction with EHRs in primary care	**Nationality**		
	Saudi n = 811	**Non-Saudi n = 316**	**p-value**
I feel EHR is useful	626 (77.2%)	263 (83.2%)	< 0.001
I feel EHR is an important system for primary healthcare centres	611 (75.3%)	257 (81.3%)	0.005
I feel EHR has been successful in primary healthcare centres	530 (65.4%)	233 (73.7%)	0.003
I feel EHR is worth the time and effort required to use it	558 (68.8%)	232 (73.4%)	< 0.001
I feel the EHR improves the quality of healthcare services in PCCs	596 (73.5%)	247 (78.2%)	< 0.001
I feel the quality of my work has improved	533 (65.7%)	236 (74.7%)	0.002
I feel the quality of information has improved due to EHR	559 (68.9%)	240 (75.9%)	0.001
I feel my performance has improved due to EHR	521 (64.2%)	222 (70.3%)	0.003
I feel patient safety has improved due to EHR	518 (63.9%)	223 (70.6%)	0.001
Overall, I am satisfied with the EHR system in PCCs	561 (69.2%)	218 (69.0%)	< 0.001

5.12.5 Relationship between the respondents' length of time working in primary care and satisfaction with the EHRs in primary care

There was a significant association between healthcare professionals' length of time working in primary healthcare and their perceptions of the items related to satisfaction with the EHRs in primary care as shown in Table 5.30. Respondents with more than 20 years of experience had the highest agreement level with all items related to satisfaction with EHRs in primary care except for two (2) items in which those with experience of between 11 and 20 years had the highest agreement. These included 'I feel EHR has been successful in primary healthcare centres' [$\chi^2(4) = 12.814$, $p = 0.012$] and 'I feel EHR is worth the time and effort required to use it' [$\chi^2(4) = 43.233$, $p < 0.001$]. The respondents with 10 years of experience and below had the lowest agreement level with all the items related to satisfaction with the EHRs in primary care.

The item 'I feel EHR is useful' had the highest agreement of all items among the healthcare professionals with 0 to 10 years and 11 to 20 years of experience. However, for respondents with more than 20 years of experience, the statement with the highest agreement was 'I feel EHR is an important system for primary healthcare centres'. For the statement with the lowest level of agreement, it was 'I feel patient safety has improved due to EHR' and 'I feel my performance has improved due to EHR' and for healthcare professionals with 0 to 10 years and experience of 11–20 years respectively. The professionals with over 20 years of experience had the lowest agreement with two (2) items, including 'I feel EHR has been successful in primary healthcare centres' and 'I feel EHR is worth the time and effort required to use it' with each having an agreement level of 74.2%.

Table 5.30: Relationship between the length of working experience and satisfaction with EHRs (n=1127)

Satisfaction with EHRs in primary care	**Length of time (years) working in primary health care centres in Riyadh**			
	0 – 10 n = 870	**11 – 20 n = 226**	**21+ n = 31**	**p-value**
I feel EHR is useful	646 (74.3%)	213 (94.2%)	30 (96.8%)	< 0.001
I feel EHR is an important system for primary healthcare centres	628 (72.2%)	209 (92.5%)	31 (100.0%)	< 0.001
I feel EHR has been successful in primary healthcare centres	569 (65.4%)	171 (75.7%)	23 (74.2%)	0.012
I feel EHR is worth the time and effort required to use it	570 (65.5%)	197 (87.2%)	23 (74.2%)	< 0.001
I feel the EHR improves the quality of healthcare services in PCCs	612 (70.3%)	203 (89.8%)	28 (90.3%)	< 0.001
I feel the quality of my work has improved	571 (65.6%)	172 (76.1%)	26 (83.9%)	< 0.001
I feel the quality of information has improved due to EHR	584 (67.1%)	186 (82.3%)	29 (93.5%)	< 0.001
I feel my performance has improved due to EHR	547 (62.9%)	169 (74.8%)	27 (87.1%)	< 0.001
I feel patient safety has improved due to EHR	538 (61.8%)	175 (77.4%)	28 (90.3%)	< 0.001
Overall, I am satisfied with the EHR system in PCCs	569 (65.4%)	182 (80.5%)	28 (90.3%)	< 0.001

5.12.6 Relationship between the respondents' experience outside the Kingdom of Saudi Arabia and satisfaction with the EHRs in primary care

There was a significant difference between healthcare professionals who had experience outside the Kingdom of Saudi Arabia and those who did not in the perceptions of all the items related to satisfaction with the EHRs in primary care ($p < 0.001$) as shown in Table 5.31. Respondents with no experience outside the Kingdom of Saudi Arabia had a higher agreement level with all the items more than their counterparts who had experience outside the Kingdom of Saudi Arabia.

Moreover, they were more satisfied with the EHR system in primary care than their counterparts who had experience outside the country.

Of all the items related to satisfaction with the EHRs in primary care, the item 'I feel EHR is useful' had the highest agreement level among both healthcare professionals who had and did not have experience outside the Kingdom of Saudi Arabia. Conversely, the item 'I feel patient safety has improved due to EHR' had the lowest agreement. The item 'I feel my performance has improved due to EHR' also had the lowest agreement level of 55.3% by healthcare professionals who had experience outside the Kingdom of Saudi Arabia.

Table 5.31: Relationship between experience outside the Kingdom of Saudi Arabia and satisfaction with EHRs (n=1127)

Satisfaction with EHRs in primary care	**Experience outside the Kingdom of Saudi Arabia**		
	No n = 686	**Yes n = 441**	**p-value**
I feel EHR is useful	591 (86.2%)	298 (67.6%)	< 0.001
I feel EHR is an important system for primary healthcare centres	586 (85.4%)	282 (63.9%)	< 0.001
I feel EHR has been successful in primary healthcare centres	508 (74.1%)	255 (57.8%)	< 0.001
I feel EHR is worth the time and effort required to use it	535 (78.0%)	255 (57.8%)	< 0.001
I feel the EHR improves the quality of healthcare services in PCCs	564 (82.2%)	279 (63.3%)	< 0.001
I feel the quality of my work has improved	512 (74.6%)	257 (58.3%)	< 0.001
I feel the quality of information has improved due to EHR	534 (77.8%)	265 (60.1%)	< 0.001
I feel my performance has improved due to EHR	499 (72.7%)	244 (55.3%)	< 0.001
I feel patient safety has improved due to EHR	497 (72.4%)	244 (55.3%)	< 0.001
Overall, I am satisfied with the EHR system in PCCs	540 (78.7%)	239 (54.2%)	< 0.001

5.12.7 Relationship between the respondents' previous training in EHRs and satisfaction with the EHRs in primary care

There was a significant relationship between previous training in EHRs and perception of the items related to satisfaction with the EHRs in primary care. Healthcare providers with previous training in EHRs had a higher agreement with all the items related to satisfaction with the EHRs than their counterparts with no previous training in EHRs. Furthermore, healthcare providers who had training in EHRs were more satisfied with EHRs in primary healthcare than those who did not have prior training.

Of all the items, 'I feel EHR is useful' had the highest agreement level among both healthcare providers with and without experience in EHR training. Conversely, 'I feel patient safety has improved due to EHR' had the lowest agreement level among healthcare professionals who did not have previous training in EHR while the item 'I feel my performance has improved due to EHR' had the lowest agreement level among health care professionals with prior training in EHR.

Table 5.32: Relationship between previous training in EHRs and satisfaction with EHRs (n=1127)

Satisfaction with EHRs in primary care	Previous training in EHR		
	No n = 674	Yes n = 453	p-value
I feel EHR is useful	499 (74.0%)	390 (86.1%)	< 0.001
I feel EHR is an important system for primary healthcare centres	483 (71.7%)	385 (85.0%)	< 0.001
I feel EHR has been successful in primary healthcare centres	403 (59.8%)	360 (79.5%)	< 0.001
I feel EHR is worth the time and effort required to use it	433 (64.2%)	357 (78.8%)	< 0.001
I feel the EHR improves the quality of healthcare services in PCCs	471 (69.9%)	372 (82.1%)	< 0.001
I feel the quality of my work has improved	415 (61.6%)	354 (78.1%)	< 0.001
I feel the quality of information has improved due to EHR	432 (64.1%)	367 (81.0%)	< 0.001
I feel my performance has improved due to EHR	405 (60.1%)	338 (74.6%)	< 0.001
I feel patient safety has improved due to EHR	390 (57.9%)	351 (77.5%)	< 0.001
Overall, I am satisfied with the EHR system in PCCs	416 (61.7%)	363 (80.1%)	< 0.001

5.12.8 Relationship between the respondents' previous experience in EHRs and satisfaction with the EHRs in primary care

There were no significant differences between healthcare providers who had and did not have previous experience in EHRs in their perceptions of items related to satisfaction with the EHRs in primary care for all the items except for two (2). These included 'I feel EHR has been successful in primary healthcare centres' [$\chi^2(2) = 6.1014$, $p = 0.047$] and 'I feel the EHR improves the quality of healthcare services in PCCs' [$\chi^2(2) = 10.659$, $p = 0.005$].

Healthcare providers with previous EHR experience in primary care had a higher agreement level with all the items than their counterparts who did not have previous experience in EHR except for one (1) item in which they had equal agreement level: ‘I feel EHR is worth the time and effort required to use it’ (experience: 70.1%, no experience: 70.1%, $\chi^2(2) = 3.103$, $p = 0.212$).

For all the items, the statement that ‘I feel EHR is useful’ had the highest agreement level among both the healthcare professionals with and without previous experience of EHR in primary care. However, the items ‘I feel patient safety has improved due to EHR’ and ‘I feel my performance has improved due to EHR’ had the highest agreement level among those with no previous EHR experience and with previous EHR experience respectively.

Table 5.33: Relationship between previous experience in EHRs and satisfaction with EHRs (n=1127)

Satisfaction with EHRs in primary care	**Previous experience in EHR**		
	No n = 686	**Yes n = 441**	**p-value**
I feel EHR is useful	540 (78.7%)	349 (79.1%)	0.346
I feel EHR is an important system for primary healthcare centres	520 (75.8%)	348 (78.9%)	0.312
I feel EHR has been successful in primary healthcare centres	447 (65.2%)	316 (71.7%)	0.047
I feel EHR is worth the time and effort required to use it	481 (70.1%)	309 (70.1%)	0.212
I feel the EHR improves the quality of healthcare services in PCCs	512 (74.6%)	331 (75.1%)	0.005
I feel the quality of my work has improved	451 (65.7%)	318 (72.1%)	0.076
I feel the quality of information has improved due to EHR	470 (68.5%)	329 (74.6%)	0.080
I feel my performance has improved due to EHR	441 (64.3%)	302 (68.5%)	0.212
I feel patient safety has improved due to EHR	436 (63.6%)	305 (69.2%)	0.051
Overall, I am satisfied with the EHR system in PCCs	463 (67.5%)	316 (71.7%)	0.184

5.13 Research Sub-question 7: What is the relationship between perceived benefits, obstacles and satisfaction with the EHRs in PCCs in Riyadh city, Saudi Arabia?

This question examines the influence of perceived usefulness and perceived ease of use of EHRs on the satisfaction with the system. It is examined in two parts as follows:

5.13.1 Relationship between perceived benefits and satisfaction with the EHRs in PCCs in Riyadh city

A canonical correlation was performed between benefit items from healthcare professionals’ perceptions as independent variables and items for satisfaction as dependent variables to test the hypothesis that there is a positive relationship between the healthcare professionals’ perceptions of the benefit items and satisfaction with the EHRs in primary care. The analysis in Table 5.34

shows that all the items for satisfaction with the EHRs in primary care in Riyadh city were indexed by the benefits of EHRs. Of the items related to satisfaction, ‘I feel EHR is an important system for primary healthcare centres’ had the highest canonical correlation co-efficient, r of 0.94 while ‘I feel EHR has been successful in primary healthcare centres’ had the least canonical correlation coefficient of 0.78. Similarly, the benefit items that EHR ‘decreases paper-based documentation’ and ‘reduces medical errors’ had the highest and least canonical correlation coefficient of 0.91 and 0.57 respectively. The variance between items related to satisfaction in the canonical variates was 73.6% while the percentage of variance for EHR benefits was 69.8%.

Overall, the results of the canonical correlation between healthcare professionals’ perceptions towards EHR benefits and satisfaction with the EHRs in PCCs in Riyadh city showed positive and strong correlations between the canonical variates (canonical correlation coefficient = 0.91). Therefore, the findings of the canonical correlation analysis support the hypothesis that there is a positive relationship between the healthcare professionals’ perceptions of the benefit items and satisfaction with the EHRs in primary care.

Table 5.34: Canonical correlation between the healthcare professionals' perceptions of the EHR benefits and satisfaction with EHRs in primary health care

Variable	**Canonical variate**		
	R		**Standardised canonical coefficient**
Satisfaction with the EHRs			
I feel EHR is useful	0.92		0.27
I feel EHR is an important system for primary healthcare centres	0.94		0.27
I feel EHR has been successful in primary healthcare centres	0.78		0.00
I feel EHR is worth the time and effort required to use it	0.80		0.06
I feel the EHR improves the quality of healthcare services in primary healthcare centres	0.89		0.17
I feel the quality of my work has improved	0.86		0.07
I feel the quality of information has improved due to EHR	0.87		0.10
I feel my performance has improved due to EHR	0.85		0.14
I feel patient safety has improved due to EHR	0.84		0.02
Overall, I am satisfied with the EHR system in primary healthcare centres	0.83		0.02
% of variance		73.6	
Benefits of using EHRs			
Provides quick and reliable access to scientific research	0.84		0.05
Enables easy access to information from past medical records	0.87		0.10
Provides access to patient data and analysis	0.90		0.16
Provides better data	0.86		0.10
Makes it easy to transfer data	0.85		0.10
Provides access to practice standards	0.81		-0.01
Enables the following test results	0.87		0.13
Saves time in documenting health data	0.84		0.02
Decreases paper-based documentation	0.91		0.20
Improves the feeling of professionalism	0.87		0.10
Improves communication between health professionals and patients	0.84		0.04
Contributes to health professionals 'ability to make patient care decisions	0.82		0.05
Improves communication between health professionals	0.80		0.08
Reduces medical errors	0.57		0.02
% of variance		69.8	
Canonical Correlation		0.91	

5.13.2 Relationship between perceptions of obstacles to adopting EHRs and satisfaction with the EHRs in primary care

A canonical correlation was performed between obstacle items from healthcare professionals' perceptions (independent variables) and items for satisfaction with the EHRs (dependent variables) to test the following hypothesis: There is a negative relationship between obstacle items from healthcare professionals' perceptions and items for satisfaction from the perceptions. From the analysis presented in Table 5.35, it was found that satisfaction with the EHRs in primary care in Riyadh city was oppositely indexed by EHR obstacles. For satisfaction with the

EHRs, the item ‘I feel the EHR improves the quality of healthcare services in primary healthcare centres’ had the highest negative correlation with a canonical correlation co-efficient of – 0.92 while ‘I feel EHR has been successful in primary healthcare centres’ had the least negative correlation with a canonical correlation coefficient of – 0.77. On the other hand, the correlations for the EHR obstacles were positive with ‘it is difficult to provide data security in EHRs’ having the highest canonical correlation of 0.88 while ‘needs frequent revisions related to technological developments’ had the least canonical correlation coefficient of 0.21. It was also found that the satisfaction variables had a percentage of variance of 68.8% while obstacles to EHR implementation had a variance of 43.4%.

In summary, the results of the canonical correlation between healthcare professionals’ perceptions towards EHR obstacles and satisfaction with the EHRs in Riyadh city showed negative and medium correlations between the canonical variates (canonical correlation coefficient = 0.45). The hypothesis that there is a negative relationship between obstacle items from healthcare professionals’ perceptions and items for satisfaction with the EHRs was therefore supported by the study.

Table 5.35: Canonical correlation between the healthcare professionals' perceptions of the EHR obstacles and satisfaction with EHRs in primary care

Variable	Canonical variate		
	R		**Standardised canonical coefficient**
Satisfaction with the EHRs			
I feel EHR is useful	-0.91		-0.45
I feel EHR is an important system for primary healthcare centres	-0.85		0.07
I feel EHR has been successful in primary healthcare centres	-0.77		-0.08
I feel EHR is worth the time and effort required to use it	-0.73		0.08
I feel the EHR improves the quality of healthcare services in primary healthcare centres	-0.92		-0.44
I feel the quality of my work has improved	-0.85		-0.12
I feel the quality of information has improved due to EHR	-0.81		0.12
I feel my performance has improved due to EHR	-0.84		-0.34
I feel patient safety has improved due to EHRs	-0.78		0.17
Overall, I am satisfied with the EHR system in primary healthcare centres	-0.81		-0.08
% of variance		68.8	
Obstacles to EHR adoption			
Is too complicated and not user-friendly	0.57		0.04
Compromises patient safety	0.68		0.21
Decreases interaction between the health professional and patient	0.62		-0.01
Increases health professionals' 'workloads	0.67		-0.09
It is difficult to provide data security in EHRs	0.88		0.54
Consumes more time than paper-based systems	0.76		0.19
Is 'down' frequently	0.70		0.25
Is costly	0.64		0.30
Needs frequent revisions related to technological developments	0.21		-0.35
% of variance		43.4	
Canonical Correlation		0.45	

5.14 Research sub-question 8: How do the perceptions of healthcare professionals in Saudi Arabia differ from elsewhere in the Gulf Cooperation Council and the world at large?

This question aimed to compare the perceptions of benefits and obstacles to adopting EHRs as well as satisfaction in PCCs in Saudi Arabia with the reported findings in other parts of the world.

5.14.1 Perceptions of the benefits of adopting EHRs compared to the literature

Several perceived benefits of adopting EHRs in primary care in different settings have also been reported in the literature. However, the extent to which these benefits have been investigated in the literature tend to vary, with some more reported than others. For example, the identified studies in this thesis (Table 5.36) showed that the benefit that EHRs improve access to patient information from past medical records was the most reported. This was examined in eight studies (Al-Harbi 2011; Goetz et al. 2012; Jamoom et al. 2014; Secginli, Erdogan & Monsen 2014; Bani-issa et al. 2016; Meigs & Solomon 2016; Thomas 2016; Pelland, Baier & Gardner 2017). Conversely, the benefits of EHRs that were least reported in the literature were the provision of access to scientific data for research, better transfer of data and improved feeling of professionalism (Secginli, Erdogan & Monsen 2014). This shows that these benefits have not been widely investigated in the literature. Overall, the studies identified a high agreement level and positive perceptions of EHRs in primary care.

Due to the differences in study design (quantitative or qualitative), some studies reported their findings quantitatively as shown by percentages, while others only provided qualitative accounts of the respondents. This latter group of studies are represented by a tick (√) as shown in Table 5.36. Further, the quantitative studies presented the agreement levels with the benefits either as percentages, mean or both. Specifically, four studies used percentages only (Jamoom et al. 2014; King et al. 2014; Meigs & Solomon 2016; Robinson 2017), two studies used means (Al-Harbi 2011; Bani-issa et al. 2016) and only one used both percentages and means (Secginli, Erdogan & Monsen 2014) similar to this current study.

Table 5.36: Healthcare professionals' perceptions of EHR benefits in PCCs from this study and the literature

Criteria	This Study	Al-Harbi (2011)	Jamoom et al. (2014)	Secginli, Erdogan & Monsen (2014)	Ramdoss (2014)	King et al. (2014)	Bani-issa et al. (2016)	Meigs & Solomon (2016)	Robinson (2017)	Goetz et al. (2012)	Pelland, Baier & Gardner (2017)	Schacht (2014)	Thomas (2016)
Setting	**EHRs in PCC, Saudi Arabia**	**HITs in hospital, Saudi Arabia**	**EHRs in PCC, US**	**EHR in PCC (FHC), Turkey**	**EHRs in PHC, U.S**	**EHRs in PCC, US**	**EHRs in hospital, UAE**	**EHR in PCC, US**	**EHRs in CHC, US**	**EHR in PCC, US**	**EHR in hospitals and PCC, US**	**EHRs in PCC, Netherlands and Germany**	**EHRs in PCC, South Africa**
Population	**Physicians, nurses, pharmacists and technicians**	**Physicians, nurses and others**	**Physicians (adopters and non-adopters)**	**Physicians and nurses/midwives**	**Doctors and nurses (non-adopters)**	**Physicians**	**Physicians, nurses, pharmacists and technicians**	**Office-based physicians (adopters, partial adopters and non-adopters)**	**Physicians, physician assistants and nurses**	**Clinicians and administrative staff**	**Hospital-based and office-based physicians**	**Office-based physicians (adopters, partial adopters and non-adopters)**	**Physicians and nurses**
Provides quick and reliable access to scientific research	76.0% - Agreement M(SD) 2.69 (0.59)	-	-	94.2% - Agreement M (SD) = 4.4 (0.8)	-	-	-	-	-	-	-	-	-
Enables easy access to information from past medical records	73.9% 2.64 (0.66)	M(SD) = 4.4 (0.61)	Adopters – 91% Non-adopters – 86%	96.0% 4.4 (0.8)	-	-	M(SD) = 4.08 (0.52)	75%	-	✓	✓	-	✓
Provides access to patient data and analysis	76.8% 2.69 (0.61)	-	-	95.1% 4.4 (0.7)	-	81%	-	-		✓	-	-	-
Provides better data	74.5% 2.65 (0.65)	-	-	92.9% 4.3 (0.8)	-	-	-	-	67%	✓	-	-	-
Makes it easy to transfer data	74.4% 2.66 (0.63)	-	-	93.2% 4.3 (0.8)	-	-	-	-	-	-	-	-	-
Provides access to practice standards	73.6% 2.64 (0.65)	-	-	92.0% 4.2 (0.8)	-	45%	-	-	-	-	-	-	-

Enables following test results	75.3% 2.64 (0.67)	4.4 (0.62)	68%	88.9% 4.1 (0.9)	-	37%	-	-	-	-	-	-	✓
Saves time in documenting health data	75.2% 2.64 (0.68)	-	77%	84.3% 4.0 (1.1)	-	-	-	-	-	-	-	-	✓
Decreases paper-based documentation	77.1% 2.66 (0.67)	4.0 (1.01)	-	82.2% 3.9 (1.1)	-	-	-	-	-	-	-	-	✓
Improves the feeling of professionalism	76.2% 2.65 (0.67)	-	-	73.2% 3.8 (1.1)	-	-	-	-	-	-	-	-	-
Improves communication between health professionals and patients	73.7% 2.63 (0.67)	-	-	53.5% 3.4 (1.2)	-	30%	-	-	-	✓	✓	✓	-
Contributes to health professionals' ability to make patient care decisions	72.3% 2.64 (0.62)	4.0 (0.86)	-	62.2% 3.5 (1.1)	-	-	-	-	-	-	-	✓	-
Improves communication between health professionals	73.5% 2.65 (0.63)	-	-	56.6% 3.4 (1.2)	-	-	-	-	67%	✓	✓	✓	-
Reduces medical errors	63.5% 2.53 (0.69)	3.9 (0.70)	-	53.5% 3.3 (1.2)	3.60	65%	-	-	60%	-	-	✓	-

5.14.2 Perceptions of obstacles to adopting EHRs from this study and the literature

Similarly, several studies have examined the perceived obstacles or barriers to adopting EHRs in primary care. These are mainly related to the challenges or risks of using an EHR system. The obstacle that EHR is too complicated and not user-friendly was the most commonly reported by 11 of the 15 identified studies shown in Table 5.37. The risk of EHRs compromising patient safety was the least reported by only one study (Secginli, Erdogan & Monsen 2014). Most of these studies had also examined the providers' perceptions of the benefits of adopting an EHRs in which they identified a high agreement level with EHR benefits. Conversely, the studies showed mixed results in relation to the obstacles to adopting EHRs in primary care. Similar to the findings of this current study, some studies reported a low agreement level with the perceived obstacles or barriers to adopting EHRs in primary care (Secginli, Erdogan & Monsen 2014; Reid Jr 2016). Others reported a high agreement level (Jamoom et al. 2014; El Mahalli 2015; Meigs & Solomon 2016). Overall, the findings from the literature on the perceptions of obstacles to adopting EHRs in primary care significantly varied with the geographical setting. These findings are summarised in Table 5.37.

Table 5.37: Healthcare professionals' perceptions of obstacles to adopting EHRs in PCCs from this study and the literature

Criteria	**This Study**	**Al-Harbi (2011)**	**Jamoom et al. (2014)**	**Secginli, Erdogan & Monsen (2014)**	**Singh & Muthuswamy (2013)**	**El Mahalli (2015)**	**Sinsky et al. (2016)**	**Reid Jr (2016)**	**Ramdoss (2014)**	**Goetz et al. (2012)**	**Schacht (2014)**	**Meigs & Solomon (2016)**	**McAlearney et al. (2013)**	**Pelland, Baier & Gardner (2017)**	**Mason et al. (2017)**	**Thomas (2016)**
Setting	**EHRs in PHC, Saudi Arabia**	**HITs in a hospital, Saudi Arabia**	**EHRs in PHC, U.S**	**PCC (FHC), Turkey**	**EHRs in hospital, India**	**EHRs in hospitals, Saudi Arabia**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, Netherlands and Germany**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHR in Hospitals and PHC, US**	**EHRs in PCC, US**	**EHRs in PCC, South Africa**
Population	**Physicians, nurses, pharmacists and technicians**	**Physicians, nurses and others**	**Physicians (adopters and non-adopters)**	**Physicians and nurses/midwives**	**Nurses**	**Physicians**	**Physicians in Ambulatory Care**	**Primary care physicians**	**Doctors and nurses (non-adopters)**	**Clinicians and administrative staff**	**Office-based physicians (adopters, partial adopters and non-adopters)**	**Office-based physicians (adopters, partial adopters and non-adopters)**	**Ambulatory care physicians and healthcare organisation representatives**	**Hospital-based and office-based physicians**	**Rural primary care physicians and physician assistants**	**Physicians and nurses**
Is too complicated and not user-friendly	17.0% - Agreement M(SD) = 1.65 (0.76)	-	-	84.9% - Disagreement M(SD) = 2.3 (1.0)	6.32%	74.0 - Agreement	-	12% - Agreement	48% - Agreement M(SD) = 3.74	✓	✓	✓	✓	-	✓	✓
Compromises patient safety	18.8% 1.64 (0.79)	-	-	81.8% 2.3 (1.1)	-	-	-	-	-	-	-	-	-	-	-	-
Decreases interaction between the health professional and patient	20.5% 1.71 (0.78)	-	Adopters – 52% – Agreement Non-adopters – 65%	72.0% 2.6 (1.1)	-	71.2%	-	-	-	-	-	✓	✓	✓	-	-
Increases health professionals' workloads	23.5% 1.75 (0.81)	-	-	71.1% 2.6 (1.2)	-	-	-	-	63.3% 4.24	-	-	92%	-	-	-	-
It is difficult to provide data	19.6% 1.67 (0.78)	-	-	69.2% 2.7 (1.2)	3.16%	-	-	-	60% agreement	-	✓	-	-	-	-	✓

security in EHRs									4.0							
Consumes more time than paper-based systems	25.2% 1.72 (0.84)	3.4 (1.18)	Adopters – 76% Non-adopters – 77%	62.5% 2.8 (1.4)	-	83.4%	✓	-	63.3% agreement 4.33	✓	✓	-	-	✓	-	✓
Is 'down' frequently	20.9% 1.77 (0.77)	3.1 (1.12)	-	58.5% 2.9 (1.2)	-	86.5%	-	27%	-	✓	-	-	✓	-	✓	-
Is costly	24.8% 1.84 (0.80)	-	Adopters – 52% Non-adopters – 73%	41.2% 3.4 (1.2)	17.89%	-	-	39%	53.3% 3.70	✓	✓	✓	-	-	✓	✓
Needs frequent revisions related to technological developments	45.3% 2.17 (0.84)	-	-	24.0% 3.9 (0.9)	-	-	-	-	-	✓	-	-	✓	-	-	-

5.14.3 Satisfaction with the EHRs in primary care from this study and the literature

The literature review also identified 14 studies that examined healthcare professionals' satisfaction with the EHRs in primary care. Five studies conducted in different settings reported high overall satisfaction with the EHRs among primary care providers (Schacht 2014; Secginli, Erdogan & Monsen 2014; Bani-issa et al. 2016; Reid Jr 2016; Robinson 2017). Most healthcare professionals were also satisfied with the benefits of EHRs in improving the quality of healthcare services (Al-Harbi 2011; Jamoom et al. 2014; King et al. 2014; Secginli, Erdogan & Monsen 2014), quality of professionals' work (Ramdoss 2014; Secginli, Erdogan & Monsen 2014; Tubaishat 2017), quality of information (Schacht 2014; Secginli, Erdogan & Monsen 2014) and patient safety (Ramdoss 2014; Secginli, Erdogan & Monsen 2014). Further, the studies identified that most healthcare professionals felt that an EHRs are useful in primary care (Jamoom et al. 2014; Secginli, Erdogan & Monsen 2014; Tubaishat 2017) and worth the time and effort required to use them (Secginli, Erdogan & Monsen 2014). The findings of the individual studies are summarised in Table 5.38.

Table 5.38: Healthcare professionals' satisfaction with EHRs from this study and the literature

Criteria	**My Study**	**Al-Harbi (2011)**	**Jamoom et al. (2014)**	**Bani-issa et al. (2016)**	**Secginli, Erdogan & Monsen (2014)**	**Reid Jr (2016)**	**Tubaishat (2017)**	**Ramdoss (2014)**	**Robinson (2017)**	**King et al. (2014)**	**Meigs & Solomon (2016)**	**Goetz et al. (2012)**	**Thomas (2016)**	**Schacht (2014)**	**Mason et al. (2017)**
Setting	**EHRs in PCC, Saudi Arabia**	**HITs in a hospital Saudi Arabia**	**EHRs in PCC, US**	**EHRs in hospital, UAE**	**PCC (FHC), Turkey**	**EHRs in PCC, US**	**EHRs in hospital, Jordan**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, US**	**EHRs in PCC, South Africa**	**EHRs in PCC, Netherlands and Germany**	**EHRs in PCC, US**
Population	**Physicians, nurses, pharmacists and technicians**	**Physicians, nurses and others**	**Physicians (adopters and non-adopters)**	**Physicians, nurses, pharmacists, and technicians**	**Physicians and nurses/midwives**	**Primary care physicians**	**Nurses**	**Doctors, nurses and upper management (non-adopters)**	**Physicians, physician assistants and nurses**	**Physicians**	**Office-based physicians (adopters, partial adopters and non-adopters**	**Clinicians and administrative staff**	**Physicians and nurses**	**Office-based physicians (adopters, partial adopters and non-adopters**	**Rural primary care physicians and physician assistants**
I feel EHR is useful	78.9% - Agreement M(SD) = 2.73 (0.56)	-	Adopters – 84% - Agreement Non-adopters – 69%	-	99.7% - Agreement M(SD) = 4.2 (0.7)	-	M(SD) = 3.4 (1.17)	-	-	-	-	-	-	-	-
I feel EHR is an important system for primary healthcare centres	77.0% 2.68 (0.63)	-	-	-	97.5% 4.1 (0.9)	-	-	-	-	-	-	-	-	-	-
I feel EHR has been successful in primary health care centres	67.7% 2.58 (0.67)	-	-	-	96.0% 3.9 (1.0)	-	-	-	-	-	-	-	-	-	✓
I feel EHR is worth the time and	70.1% 2.58 (0.69)	-	-	-	97.2% 3.9 (0.9)	-	-	-	-	-	-	-	-	-	-

effort required to use it															
I feel the EHR improves the quality of healthcare services in primary healthcare centres	74.8% 2.66 (0.64)	3.9 (0.91)	Adopters - 71% Non-adopters – 54%	-	73.8% 3.8 (1.1)	-	-	40% agreement 3.8	-	78%	17%	-	✓	✓	-
I feel the quality of my work has improved	68.2% 2.58 (0.67)	-	-	-	94.8% 3.8 (1.1)	-	3.2 (1.14)	2.80	-	-	-	-	-	-	-
I feel the quality of information has improved due to EHR	70.9% 2.61 (0.67)	-	-	-	93.2% 3.7 (1.1)	-	-	-	-	-	-	-	-	✓	-
I feel my performance has improved due to EHR	65.9% 2.55 (0.68)	-	-	-	93.2% 3.6 (1.1)	-	3.2 (1.19)	30% disagreement 2.63	-	-	-	-	-	-	-
I feel patient safety has improved due to EHR	65.8% 2.56 (0.67)	-	-	-	91.1% 3.5 (1.2)	-	-	2.90	-	-	-	-	-	✓	-
Overall, I am satisfied with the EHR system in primary healthcare centres	69.1% 2.59 (0.67)	-	-	46.6% 4.02 (0.89)	97.2% 3.9 (0.9)	61.5%	-	-	53%	-	-	-	-	✓	-

5.15 Chapter summary

This study evaluated the perceptions of healthcare professionals including physicians, nurses, pharmacists, laboratory technicians and others towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. This chapter presented the study findings with regard to the healthcare providers' perceptions of the benefits of EHRs, obstacles to the implementation of EHRs, and satisfaction with the EHRs in primary care. It was found that healthcare professionals had a high agreement with the items for benefits of EHRs and satisfaction with the EHRs in primary care. Conversely, there was a low agreement with items related to the obstacles to adopting EHRs in primary care. The health care professionals' perceptions of most items were found to be affected by sociodemographic variables. The relationship between perceptions of EHR benefits and satisfaction as well as the relationship between perceptions of the obstacles and satisfaction with the EHRs were determined. It was found that the perceptions of EHR benefits were strongly and positively associated with satisfaction with the EHRs in primary care. However, the perceptions of the obstacles were negatively associated with satisfaction. The literature also showed that healthcare providers had a positive perception of the EHR benefits; however, the perceptions of the obstacles to adopting and using EHRs varied across different settings such as adopters vs non-adopters and country. In the next chapter, these findings will be discussed in relation to the previous research.

CHAPTER 6 : DISCUSSION

6.1 Introduction

The objective of this study was to evaluate the perceptions of healthcare professionals towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. In this chapter, the findings of the study are critically discussed in relation to the published literature on the topic from the GCC countries and other regions to allow the application of the findings from this study in the GCC region. The chapter is organised into six sections. The first section provides an introduction to the chapter. In the next three sections, the findings of the first three research sub-questions which examine the perceptions of the healthcare professionals towards the benefits and obstacles to adopting EHRs, and satisfaction with the EHRs in primary care are discussed. The influences of individual, organisational and system characteristics on the healthcare professionals' perceptions and satisfaction with the EHR are then discussed. The last section presents a summary of the chapter.

6.2 Healthcare professionals' perceptions of the benefits of adopting EHRs in primary care

The first research sub-question was to explore the views of healthcare professionals working in PCCs in Riyadh city on the benefits that could be realised with the adoption of EHRs in primary care. The respondents showed a high agreement level of at least 60% with all the statements related to the benefits of adopting EHRs, suggesting that the primary care providers in Saudi Arabia have a positive perception of EHRs and are more likely to accept and use the systems in primary care practice.

Specifically, the majority (77.1%) of the respondents agreed that EHRs decrease paper-based documentation which is consistent with the findings of the previous research (Secginli, Erdogan & Monsen 2014; Thomas 2016). The majority (82.2%) of the Turkish health professionals in family health centres also agreed with this benefit (Secginli, Erdogan & Monsen 2014). In a thesis by Thomas (2016), primary healthcare professionals in South Africa also reported that the adoption of an EHR system minimises paper files, thereby reducing the time taken to search for patient's medical records, avoiding work duplication in re-registering patients in the next visit, and reducing costs incurred in files. Thus, it is apparent that healthcare professionals in Saudi Arabia are more likely to adopt EHRs in their practice because it reduces paperwork, which is associated with several benefits, such as improved availability of information, elimination of cases of lost files, improved time efficiencies, improved productivity and enhanced patient care.

This study also found a high agreement level with the statements related to improved access to patient information, practice standards, and scientific research data. These findings are concurrent with those of the previous studies (Jamoom et al. 2014; King et al. 2014; Secginli, Erdogan & Monsen 2014; Bani-issa et al. 2016). Among the office-based physicians in the US, the majority of the respondents who had adopted EHRs (91%) and had not adopted (81%) agreed that the use of EHRs results in easy access to patient data by making medical records more readily available at the point of care (Jamoom et al 2014). King et al. (2014) also showed that 81% of the adopters reported that the use of an EHR system helped them to access patients' charts remotely such as from home. Similarly, the majority of healthcare professionals in family health centres in Turkey agreed that EHRs provide quick and reliable access to scientific research (94.2%), enable easy access to information from past medical records (96.0%), provide access to patient data and analysis (95.1%), and provide access to practice standards (92.0%) (Secginli, Erdogan & Monsen 2014). A study conducted in the United Arab Emirates, a GCC country, also identified a high level of agreement with the EHR benefit that EHRs improve access/viewing of patient information and related health data such as laboratory tests and medication lists and orders (M = 4.08/5, SD = 0.52) (Bani-issa et al. 2016). With regard to practice standards, Goetz et al. (2012) identified that EHRs were used to provide clinical guidelines in two (33.3%) of the participating six primary care practices in the US. These findings suggest that the healthcare professionals, particularly those working in PCCs in Riyadh city, are more likely to adopt an EHR system in primary care due to the system's positive impacts on enhancing access to patient health data, practice standards and research data.

Another area in which this study found a positive perception of EHR systems by primary care providers is the systems' benefit that improves communication between healthcare professionals themselves (73.5%) and between healthcare professionals and patients (73.7%). This study supports the findings of Secginli, Erdogan and Monsen (2014) who showed that more than half of the respondents agreed that the use of EHRs improves communication between health professionals and patients (53.5% agreement level) and between health professionals (56.6%).

Healthcare providers in primary care practices in the US also reported that EHRs facilitated communication between physicians, staff and patients through various tools, including patient problem and to-do lists, and task assignment functions. However, this result contradicts the study by King et al. (2014) indicating that only 30% of office-based physicians in the US agreed that the use of an EHR system facilitates direct communication between them and patients using channels such as email and secure messaging. This difference could be attributed to the variation in the types of EHR system deployed in these two settings. The PCCs in Riyadh city could use a single type of EHR system since they are outsourced by the government as opposed to private practitioners who may purchase different EHR systems. Further, the experiences of the respondents in King et al.'s (2014) study were sought at a time when EHRs had just been introduced into the US healthcare system following the enactment of the HITECH Act in 2009 and these EHRs might have been lacking essential features for facilitating communication. The high agreement levels with EHRs' perceived role in improving communications could facilitate the adoption of EHRs by healthcare professionals in PCCs in Riyadh city and similar settings, such as in the GCC context.

The majority (75.3%) of the respondents also agreed that EHRs enable following test results which is consistent with the finding of Goetz et al. (2012) showing that practitioners in all the six (100%) primary care practices included in their study used EHRs to transfer, access and view radiology and laboratory findings. This finding implies that primary healthcare professionals in Saudi Arabia are likely to adopt and use EHRs in sending and receiving laboratory data to aid in clinical diagnosis during patient care.

There was also a high agreement level with the benefit items that EHRs provide in both access to patient data and analysis (76.8%) and better data (74.5%). These benefits could be related to the system's ability to collect and store comprehensive data about a patient, which could be used by both the healthcare professionals and organisations to inform the provision of high-quality care. This in line with the high agreement level that EHRs contribute to the healthcare professionals' ability to make patient care decisions (72.3%). Moreover, healthcare organisations could use the collected care data in order to analyse performance at both the practice and clinical levels as reported by two practices in Goetz et al.'s (2012) study.

The statement that EHRs 'reduce medical errors' had the lowest agreement level of 63.5% compared to other EHR benefits. However, this level of agreement shows that the majority of healthcare providers in PCCs in Riyadh city perceived the use of EHRs to result in the reduction of medical errors. This finding supports that of Secginli, Erdogan and Monsen (2014) showing that most (53.5%) Turkish healthcare professionals agreed that EHRs reduce medical errors despite being the least ranked amongst EHR benefits. This result suggests that healthcare providers in PCCs in Saudi Arabia are less likely to adopt EHRs in their practice due to their role in reducing medical errors compared to other benefits. However, this is unexpected because other EHR benefits, such as improved communication and enhanced access to patient data that had high agreement levels have been shown to be associated with a reduction of medical errors (Rajasekar 2015). A possible explanation for the lowest agreement level with this EHR benefit is the fear that the use of an EHR system could potentially introduce errors in healthcare practice rather than reduce them as has been identified in the literature (McCoy et al. 2013; Comandé, Nocco & Peigné 2015). For example, McCoy et al. (2013) identified a high percentage of records with matching patient identifiers resulting in duplicate records that pose significant risks to patient safety.

In general, the findings of this study show that healthcare professionals in PCCs in Saudi Arabia have a positive attitude towards EHRs with regards to their clinical value in primary care. A previous study by Al-Harbi (2011) also showed that Saudi health professionals, including physicians, nurses and clinical/paramedical staff perceived IT applications to be important and beneficial to both the patients and the hospitals. This study also suggests that the primary care providers are more knowledgeable about EHR benefits; hence, they are more likely to adopt and use EHRs in their practice in order to improve the care that is provided to patients. These findings were corroborated by the responses from open-ended questions, which highlighted several benefits of adopting EHRs in primary care. Specifically, the participants reported that the use of EHRs results in better health care by improving all aspects of care, providing easy access to past medical records, and enhancing tracking of test results, which is strong evidence supporting the results of the first research sub-question. Considering that Saudi Arabia still has limited utilisation of HITs in its PCCs (Almaiman et al. 2014), the positive perception of EHR benefits is a good indication that the healthcare providers would be more likely to embrace the EHR systems and promote their adoption in Saudi PCCs.

6.3 Healthcare professionals' perceptions of obstacles to adopting EHRs in primary care

Despite the high agreement levels with the EHR benefits in PCCs, the respondents also acknowledged that the adoption of EHRs is associated with some obstacles that could affect the successful adoption and implementation of the system in these settings. Of the nine statements related to the obstacles to EHR adoption, 'need for frequent revisions due to technological developments' appeared as the most perceived obstacle with an agreement level of 45.3%. This finding has also been reported in other studies conducted in different countries (Goetz et al. 2012; Secginli, Erdogan & Monsen 2014). EHR upgrades together with system failures were reported by physicians and staff in primary care practices in the US as a major problem causing disruptions in patient care and office operations, especially in settings where there is no adequate technical support (Goetz et al. 2012). Secginli, Erdogan and Monsen (2014) also identified that the majority of healthcare providers perceived the need for frequent revisions related to technological advancements as major barrier to adopting EHRs in family healthcare centres in Turkey with only a few respondents (24.0%) disagreeing with the barrier. These findings suggest that the perception of the need for frequent revisions could act as a significant impediment to the adoption of EHRs in primary care settings.

The remaining statements had a low agreement level of less than 30%, suggesting that they were not considered as major obstacles to adopting EHRs in primary care by the providers. For instance, the statement that EHR "consumes more time than paper-based systems' had a low agreement level of 25.2%, which supports Secginli, Erdogan and Monsen's (2014) study that reported a higher disagreement level of 62.5% with the obstacle. Al Harbi (2011) also found that only 3.4% of healthcare providers in Saudi Arabia agreed that EHRs consume more time than paper-based systems. The result suggests that the majority of healthcare providers in PCCs in Riyadh city do not agree that EHRs consume more time than paper-based systems but rather save time in patient data documentation and retrieval. Thus, healthcare professionals are more likely to use the system to record patient data. However, this finding contradicts the findings of other studies that have been conducted in Saudi Arabia and other countries reporting this barrier as a major concern to the majority of healthcare providers (Jamoom et al. 2014; El Mahalli 2015;

Sinsky et al. 2016). El Mahalli (2015) identified that most (83.4%) hospital physicians reported that EHRs consume more time in data entry, which is a significant barrier to the adoption of EHRs in these settings. The majority of the US physicians who had adopted (76%) and had not adopted (77%) EHRs also agreed that the use of EHRs results in increased time in planning review order and documenting care. Furthermore, Sinsky et al. (2016) reported that physicians spent 49.2% and 37.0% of their time on EHRs and deskwork in office and clinical examination room respectively, which is more than time spent on other activities such as direct clinical face-to-face and administrative works.

The cost of an EHR system in primary care was also not a concern for the majority of healthcare providers in PCCs in Riyadh city, with less than a quarter (24.8%) of the respondents agreeing with the statement that EHR 'is costly'. These findings are consistent with those of Singh and Muthuswamy (2013) indicating that relatively few (18%) nurses in India perceive the cost as a barrier to EHR adoption. In a thesis by Reid Jr (2016), only 39% of respondents identified cost related to the purchase and implementation of an EHR system as a major problem in implementing EHRs in primary care. Only 3% of Korean health professionals also reported that EHRs are not cost-efficient (Yi 2018). This low agreement with cost as a barrier to adopting EHRs in PCCs in Riyadh city could be due to the government's involvement in the purchase and implementation of EHR systems in all public healthcare centres and hospitals.

In contrast, previous studies that have examined the perceptions of cost among healthcare providers in private practice have identified cost as a major barrier to EHR adoption (Jamoom et al. 2014; Ramdoss 2014; Secginli, Erdogan & Monsen 2014; Alghamadi 2015). More than half (41.2% disagreement level) of respondents in Secginli, Erdogan and Monsen's (2014) study agreed with the statement that EHR 'is costly.' Furthermore, 53.3% of the respondents in a thesis by Ramdoss (2014) perceived EHR implementation to be costly, which outweighs the potential benefits of use. A thesis by Alghamdi (2015) also showed that most participants (55.2%) reported cost of the EHR system as a barrier to adopting and implementing EHRs in Saudi hospitals. The high costs of EHRs could be related to the system's purchase, installation and maintenance as well as users' training and support. For example, Jamoom et al. (2014) identified a high purchase cost of EHRs as a significant barrier to adopting EHRs by office-based physicians in the US, with 73% and 52% of non-adopters and adopters respectively agreeing with this obstacle. In these studies, the healthcare providers bear the entire cost of EHRs implementation as opposed to the PCCs in Saudi Arabia, hence their perception of cost as a barrier to adopting EHRs.

Most respondents also did not agree that the use of EHRs increases healthcare professionals' workloads, with an agreement level of 23.52%. This finding is supported by Secginli, Erdogan and Monsen (2014) who also reported a low agreement with this barrier (71.1% disagreement level). The reported increased workloads could be related to additional time required to enter data into the EHR system especially during the initial entry (El Mahalli 2015). On the contrary, Meigs and Solomon (2016) reported that the majority of US office-based physicians who had adopted (88%), partially adopted (100%), and not adopted (75%) EHRs agreed that using an EHR system increases their workloads and time mainly due to the administrative work involved. A study by Ramdoss (2014) also showed that 63.3% of respondents, including doctors and nurses in primary care who had not adopted EHRs, agreed that the use of an EHR system would increase their overall workload. The high approval of this obstacle among the non-adopters could be attributed to unconfirmed fears as opposed to this study in which the respondents had actually experienced EHRs and did not find that the system increased their workloads.

Only 20.9% of the respondents agreed that the EHR system is down frequently, which is similar to the findings of Secginli, Erdogan and Monsen (2014) that showed that most (58.5%) of healthcare providers disagreed with this obstacle item. Reid Jr (2016) also identified that downtime as well as cost associated with frequent upgrades, maintenance and optimisation were concerns to only 27% of the primary care physicians in their study. Further, only 12% of the participants perceived technical issues and system failures as barriers to EHR implementation in primary care practices. The low perception of frequent breakdown implies that the PCCs in Saudi Arabia could be deploying robust systems that are well maintained and have limited risk of breaking down which can adversely affect the process of patient care delivery. Weber et al. (2017) also noted that there are increased investments in EHR infrastructure by the Saudi government and this could lead to the adoption of efficient and high-performance EHR systems. Conversely, Bani-issa et al. (2016) found a high level of lack of trust in the reliability of EHRs due to potential failure (M = 3.47/5, SD = 1.06) among hospital healthcare professionals in the United Arab Emirates. El Mahalli (2015) also noted that the problem of the system hanging up was the most frequently cited barrier (86.5%) to adopting EHRs in hospitals in the Eastern province of Saudi Arabia. Healthcare professionals at King Abdul-Aziz Medical City in Saudi Arabia also reported that the system being down frequently was a significant barrier to adopting EHRs. The difference between these studies and the current findings could be attributed to the use of different types of EHR in hospital and primary care settings, with the latter being smaller and simpler (Mantas, Househ & Hasman 2014).

The impact of EHRs on decreasing the interaction between healthcare providers and patients was also identified in this study as an obstacle to adopting EHRs in primary care albeit by the minority (20.5%) of the respondents. This finding is in contrast with the previous studies that have reported this impact as a significant challenge to EHR adoption by healthcare professionals. For example, Goetz et al. (2012) noted that most physicians in their study were concerned by the patients' feelings that they are doing impersonal activities of entering data into the EHR system during medical exams. In Saudi Arabia, the majority (71.2%) of healthcare professionals also perceived the disturbance of doctor-patient communication as a barrier to adopting EHRs in Saudi hospitals (El Mahalli 2015). Thus, the result suggests that healthcare providers in PCCs are less likely to be deterred from adopting the EHR system due to its perceived negative effect on the interaction between providers and their patients.

Security of the patient data was also a concern that appears to present a challenge to the adoption of EHRs by healthcare providers in PCCs in Riyadh city. However, the majority of the respondents seemed to be contented with EHRs' ability to provide data security, with only 19.6% agreeing with the statement that 'it is difficult to provide data security in EHRs'. The low level of agreement with this obstacle is similar to the findings of Secginli et al. (2014) in which most respondents (69.2%) disagreed with the statement. Vitari and Ologeanu-Taddei (2018) found that 92.63% reported that they felt that EHRs provide security to patients' medical records. In South Korea, Yi (2018) identified that only 38% of healthcare professionals had an issue with EHRs' ability to provide security and privacy of patient data. Another study by Singh and Muthuswamy (2013) found that only 3.16% of nurses felt that EHRs pose a significant threat to patient data privacy and security. The result also supports that of Jamoom et al. (2014) revealing that 67% of US physicians who had adopted EHRs reported that they believed their EHR system enhances data confidentiality. These findings suggest that healthcare professionals in Riyadh city perceive EHRs to provide data security better than paper-based records which are considered as easier and faster to steal (Schacht 2014). However, the concern with the EHRs' ability to provide data privacy and security could vary across various PCCs due to disparities in allocation and utilisation of IT infrastructure in these settings. For example, PCCs with huge investment in IT infrastructure are more likely to put in place adequate security measures that improve healthcare professionals' confidence in the EHR system's ability to provide safeguards to patient's data as opposed to PCCs that have not paid much attention to ensuring data security (Kruse et al. 2017). These may include physical safeguards such as physical access controls to network servers, technical safeguards such as use of data encryption and decryption, firewall protection and virus checking, and administrative safeguards such as implementation of comprehensive education and security plans, establishing security agreements with cloud partners, and system security evaluation (Harman, Flite & Bond 2012; Kruse et al. 2017). Thus, all PCCs should allocate adequate resources to develop, deploy and maintain EHRs with advanced techniques covering vast threats to address healthcare providers' concerns and improve acceptance and adoption of EHRs in these settings.

In contrary to these results, some prior studies have identified digital security as a major obstacle to the adoption of EHRs. In a thesis by Ramdoss (2014), 60% of the respondents had concerns with the ability of an EHR system to ensure privacy or confidentiality of patient information. The majority (63.3%) of the respondents also feared that the use of an EHR system would infringe upon their privacy. In Saudi Arabian hospitals, it has also been shown that most (68.3%) healthcare professionals noted that it is difficult to ensure confidentiality, security and data privacy in EHRs, and this is perceived as a barrier to adopting the system (El Mahalli 2015). Alghamdi (2015) also showed that privacy and security concerns were a significant obstacle to the implementation of EHRs in hospitals in Saudi Arabia, with more than half of healthcare professionals (52.1%) citing this barrier. This limitation mainly results from the privacy-sensitive nature of the system and ability to be accessed from anywhere either intentionally or through attacks.

Fewer (18.8%) respondents also agreed with the statement that EHRs compromise patient safety. Consistent with the findings of a study by Tubaishat (2019), nurses perceived EHRs to directly or indirectly improve patient safety through reducing medical errors, improving data documentation, and enhancing the quality of data in terms of completeness and sustainability. However, some respondents had concerns that EHRs can compromise patient safety by introducing errors during data entry and improper use of communication channels. These findings suggest that healthcare professionals in Saudi Arabia perceive EHRs to have great potential in improving patient safety; hence, they are more likely to adopt the system for this purpose.

The item that EHR 'is too complicated and not user-friendly' had the lowest agreement level of 17.0%, which is similar to the findings by other studies (Singh & Muthuswamy 2013; Secginli, Erdogan & Monsen 2014; Reid Jr 2016). This statement had the highest disagreement level (84.9%) among other obstacles as perceived by the respondents in Secginli, Erdogan and Monsen (2014) study. Further, only 6.32% of Indian nurses in a hospital setting reported that the EHR system they were using lacked a user-friendly interface (Singh & Muthuswamy 2013). In the US, 15% of respondents in a thesis by Reid Jr (2016) reported that lack of an EHR system that meets the specific needs of the users is the main usability issue. A study by Aldosari et al. (2018) also noted that the majority (80.8%) of Saudi nurses reported that they found EHRs to be easy to use. These findings suggest that that most of the healthcare providers in PCCs in Riyadh city had no problem in using the adopted EHR system which could be attributed to adequate knowledge of the system which in turn increases their confidence in using the system. The low agreement level with this obstacle could also be a result of deployment of simpler and easier EHRs in primary care as opposed to those used in hospitals. For instance, a study conducted in a hospital setting in Saudi Arabia by El Mahalli (2015) found that most physicians (74.0%) perceived technology to be complex, thus affecting EHR utilisation.

In addition to these barriers, staff training, technical support and staff resistance were also identified as barriers to adopting EHRs in PCCs in Riyadh city despite being less frequently cited. Of all the responses from open-ended questions, staff training was the most frequently

(39.2%) cited barrier. This is similar to the finding by Bani-issa et al. (2016) in which lack of adequate training (M = 3.71, SD = 1.52) was reported by healthcare professionals as a barrier to the implementation of EHRs in public hospitals in the United Arab Emirates. El Mahalli (2015) also noted that lack of continuous training/support from IT staff in the hospital was cited as a barrier to adopting EHRs in hospitals by the majority (79.3%) of providers. These findings suggest that staff training could play a significant role in the EHR system's adoption in primary care settings and lack thereof could have a detrimental impact on the adoption and implementation efforts.

Lack of technical support was also perceived as a barrier to adopting EHRs in primary care. Similar to this finding, Al-Harbi (2011) noted that a lack of technical support was a significant organisational barrier to the adoption of EHRs in Saudi hospitals. Bani-issa et al. (2016) also showed that healthcare professionals in the United Arab Emirates had a moderate perception of lack of administrative support (M = 2.80, SD = 1.17) as a barrier to EHR adoption. These findings suggest that adequate technical support is required to ensure effective implementation of EHRs in primary care settings. Technical support could help the providers in overcoming the challenges such as complexity that are associated with the use of EHRs and thus motivate providers to accept and adopt EHRs.

Staff resistance was also cited as a barrier to adopting EHRs in PCCs, which is concurrent with the findings of Alghamdi (2015) reporting resistance to technology as one of the barriers to adopting EHRs in hospitals in Saudi Arabia. Further, staff resistance has been reported as a common barrier to implementing EHRs in the US primary care practices, with 42% of the respondents citing this barrier (Reid Jr 2016). These findings show that healthcare professionals in primary care settings are less likely to adopt EHRs due to staff resistance. However, it was not established whether the resistance was due to change or EHRs which is a new technology in Saudi healthcare system. Regardless, all issues that may lead to resistance, such as the system's cost, should be adequately addressed in order to ensure successful implementation of EHRs in PCCs in the GCC countries.

Overall, the findings of this study on the perceptions of obstacles to EHR adoption suggest that most healthcare professionals did not perceive most of the disadvantages of EHRs as obstacles to adopting the system in primary care. The low agreement levels with these perceived obstacles to adopting EHRs in PCCs in Riyadh city were supported by participants' responses to the open-ended question, 'From your experience in primary healthcare, what do you think are the challenges to implementation of the electronic health records system in primary health care in Riyadh city?' Specifically, a thematic analysis of the responses identified that various impacts of EHRs, such as reduction in practice productivity and disturbance of workflow (13.5%), miscommunication between providers (6.5%), lack of privacy and confidentiality (5.3%), time-consuming (2.4%) and low quality of services provided in PCCs (9.4%) were less frequently cited as barriers to adopting EHRs in primary care. Poor IT infrastructure (15.5%), need for regular maintenance (8.6%), not user-friendly and limited capabilities (4.5%), and high cost of the EHR system (7.8%) were also less reported by the respondents based on their personal experiences of using the system. The findings are also in tandem with the perceptions of the EHR benefits, suggesting that the respondents generally have a positive attitude towards EHRs. Nevertheless, the concerns of the few healthcare providers who perceived the EHR challenges as obstacles to adopting EHRs cannot be taken for granted as this is likely to adversely affect the overall implementation strategy.

6.4 Satisfaction with EHRs in primary care

This study found that most of the respondents were satisfied with the EHR system in PCCs, as demonstrated by a high level of agreement with all the statements related to the satisfaction with EHRs in primary care. The majority (74.8%) of the respondents reported that they felt that EHRs improve the quality of healthcare services in PCCs in Riyadh city. This finding is supported by that of Meigs and Solomon (2016) in which only 25% of physicians who had adopted EHRs reported that they believed the use of EHRs would negatively affect the quality of care. However, those who felt that the use of EHRs does not improve the quality of care among partial adopters and non-adopters were equal to those who believed otherwise. This contradictory finding could be attributed to their inexperience with the use of the system which is similar to close to half (40%) of healthcare providers in Ramdoss's (2014) study who had not adopted an EHR system and also reported that they believed the use of EHRs would improve the quality of care provided to patients.

Similarly, the majority of the respondents agreed that the use of EHRs had improved the quality of their work, similar to the findings of Morton (2008) in which the respondents reported that EHRs would improve the quality of their work (M = 3.70/5, SD = 1.058). Further, the majority of Jordanian nurses agreed (40.2% agree and 20.4% strongly agree) that EHRs improve the quality of their work (Tubaishat 2017). Thus, primary healthcare providers are more likely to adopt EHRs because of its perceived importance in improving the quality of their work.

Similarly, the majority (65.9%) of the respondents also reported that they felt EHRs had improved their job performance, which supports the finding of Tubaishat (2017) in which most of the Jordanian nurses (48.2%) agreed that the use of EHRs improves their job performance. Conversely, the finding contradicts that of Ramdoss (2014) in which majority did not agree. However, Ramadoss's study involved healthcare professionals who had not adopted an EHR system and thus their feedback was based on expectations rather than experience of using the EHR system as in this present study and others.

Further, the high agreement with the statement that 'I feel EHR is useful' is consistent with the findings of Tubaishat (2017) showing that the majority of the nurses in Jordan (65.3%) responded that they found the EHR system to be useful in their job. Vitari and Ologeanu-Taddei (2018) also showed that the majority of the respondents (92.9%) agreed that EHRs are useful in caring for patients. The findings suggest that healthcare professionals are more likely to accept EHRs if they perceive the system to be useful to them in providing care in primary care settings. The usefulness could be attributed to various system benefits such as access to patient data and enhanced following of test results.

In general, this study found a high overall satisfaction with EHRs among healthcare professionals in PCCs in Riyadh city and this has been reported in several previous studies conducted in different countries and settings (Schacht 2014; Secginli, Erdogan & Monsen 2014; Bani-issa et al. 2016; Reid Jr 2016; Robinson 2017). Schacht (2014) noted that the majority of healthcare professionals in the Netherlands who had adopted EHRs reported a positive attitude towards EHRs. The majority (61.5%) of the respondents in Reid Jr's (2016) study also reported a positive overall experience with the EHRs in primary care with only 15% reporting a negative experience. King et al. (2014) similarly found that 85% of office-based primary care providers in the 2013 National Ambulatory Medical Care Survey (NAMCS) were satisfied with EHRs. Robinson (2017) found overall satisfaction with EHRs that was experienced by 53% of healthcare providers in a community health centre. Among healthcare providers in family health care centres in Turkey, there was high overall satisfaction with the EHR system, with a 97.2% agreement level with all the items related to user satisfaction and with the EHR system itself having a high agreement level of greater than 90% (Secginli, Erdogan & Monsen 2014). Yi (2018) also found that the majority (65%) of medical staff in hospitals in South Korea had a high favourability towards EHRs. Bani-issa et al. (2016) also identified a high overall satisfaction with the EHR system [M = 4.02/5, SD = 0.89) among healthcare professionals in the United Arab Emirates despite less than half (46.6%) of the respondents reporting high levels of satisfaction with the EHR system.

The healthcare professionals' satisfaction with the EHR system reported in this study could be related to the reported benefits in primary care as demonstrated with a positive correlation found between perceived benefits and satisfaction with the EHRs in primary care. For instance, most respondents (74.8%) agreed that EHRs improve the quality of healthcare services in PCCs which could be due to the clinical benefits of EHRs in primary health care, such as reduced medical errors, better data and improved access to information that result in improved quality care. Similar to these findings, Schacht (2014) noted that the general practitioners in the Netherlands reported overall improved satisfaction with EHRs because of their benefits, including the provision of patient data that aid in care decision-making, improved efficiency, decreased duplication of data and enhanced communication that lead to improved quality of care. Reid Jr (2016) also found that the reported positive experience with EHRs was associated with the system's clinical benefits, including increased efficiency and productivity and easier access to patient records as opposed to the negative experience which was associated with the disadvantages. These disadvantages included reduced productivity, data documentation errors, system usability issues, reduced doctor-patient interaction, increased doctor's time and lack of cost-effectiveness. Secginli, Erdogan and Monsen (2014) also found a positive attitude towards EHRs, mainly due to the system's positive impacts on clinical care. The positive attitude towards

EHRs suggests that healthcare professionals in Saudi Arabia are more likely to accept and use EHRs in primary care practice to improve the quality of healthcare services provided to the patient.

It could be because of these benefits of adopting EHRs that most respondents reported that an EHR system is a useful and an important system for primary care settings, thus worth the effort and time required to use it despite the obstacles. Jamoom et al. (2014) also found that the majority of healthcare providers involving both adopters and non-adopters of an EHR system felt that the system is useful in primary care. Thus, the reported high satisfaction with the EHR system suggests a positive perception of EHRs that could facilitate the adoption and implementation of EHRs in primary care settings.

6.5 Factors influencing healthcare professionals' perceptions towards the adoption of EHRs in primary care

This study showed that the attitude of healthcare professionals in Riyadh city towards EHRs is influenced by several factors that are related to the benefits or obstacles to adopting EHRs in primary care. These factors could be related to the individual users who are healthcare professionals working in primary care settings, the EHR system, and primary healthcare organisation. These could affect perceptions at various levels of individual, organisational or system. Further, the factors could act as facilitators or barriers to the adoption of EHRs in primary care settings in Saudi Arabia and the GCC context as well as in other countries around the world with similar settings.

6.5.1 Effects of individual characteristics on healthcare professionals' perceptions of EHRs

The personal factors that affect the adoption of EHRs at the individual level were mainly the sociodemographic characteristics of the participants. These included occupation, age, nationality, gender, length of work experience, previous training in EHRs, previous experience in EHRs and previous experience outside the Kingdom of Saudi Arabia. These characteristics influenced the professionals' perceptions of the benefits and obstacles of EHRs as well as satisfaction with the system.

6.5.1.1 Occupation

There was a significant relationship between healthcare professionals' occupation and perception of benefits and barriers to adopting EHRs and satisfaction with EHRs in primary care ($p < 0.05$).

Physicians had higher agreement levels, with all the statements related to the benefits of adopting EHRs compared to other healthcare providers. Ramdoss (2014) also showed that doctors were more likely to agree with the items related to the benefits such as improved job performance [Odds ration (OR)= 5.625] and increased patient safety in healthcare organisation (OR = 1.33). However, the finding that physicians were more likely to agree that the use of an EHR system reduces medical errors contradicts Ramdoss's (2014) results in which nurses were more likely to agree with this benefit than doctors (OR = 0.22). Al-Harbi (2011) also found significant mean differences in perceptions of IT benefits, however this varied with occupation of healthcare provider (physicians, nurses and other staff). Nurses had a higher positive perception than physicians and other staff in five benefits, namely the provision of speed to accomplish work, making it easier to find investigation results, helping in preparing hospital reports, improving decision-making process, and decreasing workload. On the other hand, other staff had a higher perception of the benefits 'easier to access patient records', 'saving paperwork', 'helping in managing patients', 'facilitating coordination among departments', 'preventing loss of patients' data', 'reducing medical errors', 'ensuring patients' privacy,' and 'improving quality of patients' care'. Vitari and Ologeanu-Taddei (2018) similarly showed in their study that the intent of use of EHRs varied among three categories of clinical staff, namely physicians, paraprofessionals and administrative staff, with physicians having a higher intent mainly due to professional autonomy and medical responsibility.

Conversely, physicians had lower agreement levels with all the statements related to the obstacles of adopting EHRs compared to other healthcare providers. Comparing these findings with the previous research, Ramdoss (2014) found that nurses were more likely to agree with the obstacles to adoption such as the EHR systems are too complex to use (Odds ratio = 0.32), would result in spending more time with patient (OR = 0.3), and would increase professionals' workload (0.034) compared to doctors. Bani-issa et al. (2016) also showed that healthcare professionals in the United Arab Emirates significantly differed in their perceptions of most barriers to EHR implementation. Specifically, there was a significant difference between the professionals in their belief that the EHR system lacks usefulness and lack of trust in the reliability of the system in which nurses had the highest agreement level compared with physicians and other healthcare groups (p = 0.001) as well as lack of computer skills (p = 0.01) and lack of support from administration ($p = 0.03$) which were mostly perceived by physicians rather than nurses and others healthcare providers. These findings suggest that physicians had a more positive perception of EHRs than other providers, which are associated with more likelihood of adoption and use of EHRs in a primary care setting. However, a study by Secginli, Erdogan and Monsen (2014) did not find a significant difference in perceptions of EHR benefits and obstacles between physicians and nurses/midwives in Turkish healthcare centres. Similarly, Bani-issa et al. (2016) did not find a significant difference between physicians, nurses and other healthcare providers in their perceptions of lack of adequate training as a barrier to implementation of EHRs in hospitals in the United Arab Emirates.

A higher agreement with the EHR benefits but a lower agreement with the obstacles correlates well with the reported high satisfaction with EHRs by physicians compared to other healthcare professionals. This is consistent with Bani-issa et al.'s (2016) study showing that physicians were more satisfied with EHRs ($M = 4.8/5$, $SD = 0.64$) than nurses ($M = 4.2$, $SD = 0.95$) and other healthcare providers ($M = 4.0$, $SD = 0.01$) ($p = 0.001$). Also supporting this finding is a study by Kim et al. (2015) that identified higher satisfaction scores with a mobile EHR system among doctors than nurses despite both occupational groups having a good overall satisfaction of 60%. The majority of nurses (58.3%) disagreed that the use of EHRs would improve their performance as opposed to 30.8% of doctors (Ramdoss 2014). Conversely, Ramdoss (2014) showed that only 30.8% of physicians strongly agreed that the use of EHRs would improve the quality of care provided to patients compared to 50% of nurses. It is important to note that Ramdoss's study involved healthcare providers who had not adopted EHRs in their practice. Overall, the higher positive perception and satisfaction with the EHR system among physicians could be due to a better understanding of the system. Specifically, physicians are more likely to accept an EHR system in their practice due its perceived usefulness and ease of use as compared to other healthcare professionals. This is contrary to the low level of agreement with the EHR benefits by technicians which could be due to the lack of adequate knowledge and/or limited usage or interaction with the EHR systems.

However, it is important to note that the perceptions and satisfaction with the EHR system for the individual items related to perceived benefits, obstacles and satisfaction with the EHR system varied across the occupational groups. For example, the benefit that EHR provides access to patient data and analysis had the highest agreement among physicians and pharmacists while nurses had the highest agreement with the statement that EHR provides quick and reliable access to scientific research and decreases paper-based documentation. These variations could be related to the purpose for which the EHR system is used by the respective healthcare professionals. For example, Kim et al. (2015) identified that doctors reported that they mainly used an EHR system to retrieve laboratory results as opposed to nurses who primarily used it to retrieve nursing notes.

6.5.1.2 Gender

There were significant differences between male and female respondents in their perceptions of most benefits of adopting EHRs and satisfaction with the EHR system, with females demonstrating a higher agreement level. Females also had higher overall satisfaction with the EHR system in primary care. Tubaishat (2017) also found that gender had a significant influence on the perceptions of usefulness of EHRs by Jordanian nurses, with male nurses having a perceived usefulness score of 0.19 than females (Beta = 0.19, t = 3.55, $p < 0.001$). However, this did not have significant influence on perceived ease of use of EHRs (Beta = 0.03, t = 0.94, $p > 0.05$). A prior study by Hamid and Cline (2013) also found a significant difference between males and females in their rating of perceived ease of use, with females having a higher rating (m = 3.70 vs 3.22; t = 2.18, p = 0.035). Similar to these findings, Al-Harbi (2011) also reported significant variations in EHR perceptions between male and female healthcare providers, with females showing higher agreement with most benefits and not others. For instance, the benefit items that EHRs ‘provide speed to accomplish work’, ‘easier to find investigation results’, ‘facilitate coordination among departments’, and ‘improve quality of patients’ care’ were more highly rated by female than male. On the other hand, males were more likely to agree on the items ‘prevent loss of patients’ data’, ‘help in preparing hospital reports’, and ‘improve decision-making process’ than their female counterparts. No significant differences were observed in the perception of items ‘easier to access patient records’, ‘prevent loss of patients’ data’, ‘help in managing patients’, ‘ensure patients privacy’, ‘reduce medical errors’, and ‘improve quality of patients’ care’. Significant differences were noted in perceptions of benefits ‘easier to find investigation results’, ‘help in preparing hospital reports’, ‘provide speed to accomplish work’, ‘save paperwork’, ‘facilitate coordination among departments’, ‘improve decision-making process' and 'decrease workload'. Further, Aldosari et al. (2018) showed that male and female nurses significantly differ in perceived usefulness of an EHR system ($P = 0.022$) but not perceived ease of use of an EHR system ($p = 0.062$). These findings are contradicted by a study by Tubaishat (2018) who found that males had a higher score of an EHR system's perceived usefulness than females ($\beta= 0.19$, $t = 3.55$). A related study in Malawi by Msiska, Kumitawa and Kumwenda (2017) found that gender has no influence on EHR usage compared to paper-based records ($p = 0.35$) due to equal exposure to technology by both males and females.

In relation to perceived obstacles, there were no significant differences in perceptions of most of the items between the female and male participants. However, females had a higher agreement level with all the statements related to obstacles to adopting EHRs except one, that EHR 'decreases interaction between the health professional and patient' with agreement levels of 21.1% and 20.0% by males and females respectively. These findings are consistent with those of Al-Harbi (2011) who found a higher agreement level with 50% of barrier items by females than males. Specifically, females were more likely to agree with the barriers, including 'low system performance', 'system being down frequently', 'incapability of the system' and 'lack of management support' than male respondents. However, both male and female respondents did not differ in their perceptions of 'lack of training for the hospital staff' ($p = 0.880$) and 'lack of technical support' ($p = 1.000$).

In general, the findings of this study showed that female respondents demonstrated more positive attitudes towards EHRs than their male counterparts. They appear to be more knowledgeable about the EHR systems and find them easy to use. Due to higher satisfaction, female healthcare professionals were more likely to adopt and use the systems in primary care.

6.5.1.3 Nationality

The nationality of the respondents was also significantly correlated with the healthcare professionals' perception of benefits, obstacles and satisfaction with the EHRs in primary care ($p < 0.05$). The non-Saudis had a higher positive attitude of EHRs compared to Saudi healthcare professionals, suggesting that they were more likely to recognise the benefits associated with EHRs and accept the EHR system in their practice. The reason is that non-Saudi healthcare professionals could be more knowledgeable about EHR systems and appreciate their usefulness in PCCs than their Saudi counterparts. Further, a better understanding could be attributed to prior exposure or training considering that EHRs are a new concept that is currently being implemented in Saudi Arabia and most of the respondents were of Saudi origin.

However, the Saudis and non-Saudis varied in their perceptions of some benefit items. For example, Saudis had a higher rating of benefits, such as increased access to patient data and analysis, than non-Saudis. This latter group mostly perceived EHRs as providing quick and reliable access to scientific data. These differences could be explained by differences in using EHRs by the two groups of healthcare professionals.

6.5.1.4 Age

Age was also significantly correlated with the healthcare professionals' perceptions of the EHR benefits and obstacles to adoption in primary care and satisfaction with the EHRs in primary care ($p < 0.05$). Older professionals aged 50 years and above had the highest agreement with EHR benefits and satisfaction but the lowest with the obstacles. These findings are consistent with Alasmary et al. (2014) who found a weak but significant correlation with age ($R= 0.263$, $p < 0.05$). On the contrary, Aldosari et al. (2018) did not find a significant relationship in perceived usefulness ($p=0.731$) and perceived ease of use ($p=0.117$) of EHRs between nurses of different age groups. Hamid and Cline (2013) also showed that younger professionals had a higher perception of EHR usefulness. The possible explanation for this difference is that EHRs were recently introduced into the Saudi PCCs, with the older professionals being the initial users hence having a better knowledge of the systems.

However, the younger professionals had the highest overall satisfaction with the EHR system in primary care, which is consistent with the finding of a more positive attitude towards EHRs among younger professionals than older ones (Hamid & Cline 2013). Another study by Azmi et al. (2014) also reported higher satisfaction with EHR benefits in increasing efficiency, improving performance and improving communications by younger healthcare professionals than their older counterparts. The high overall satisfaction despite lower agreement levels with most items for EHR benefits and satisfaction could be due to the perceived ease of use mainly due to the techno-savvy nature that makes them find computer systems such as EHR systems easy to use. This is also supported by the highest disagreement with the obstacle that an EHR system 'is too complicated and not user-friendly' compared to older professionals. Duarte and Azevedo (2017) also found that younger professionals reported that it is easier to use EHRs and they were more satisfied with EHRs than older physicians. Ologeanu-Taddei and Vitari (2018) showed that age had a strong impact on perceived ease of use, however younger staff were found to be less comfortable with technology than older staff which is inconsistent with the literature. However, Msiska, Kumitawa and Kumwenda (2017) did not find significant association between age and EHR usage ($p = 0.93$).

6.5.1.5 Length of experience in primary care practice

The length of experience working in PCCs in Riyadh city was also significantly associated with the professionals' perceptions of EHR benefits and obstacles as well as satisfaction with the EHRs in primary care ($p<0.05$). There was a significant variation in perceptions of benefits and obstacles between healthcare professionals with 11–20 and less than 10 years of working experience. The former group had a higher level of agreement with the benefits rather than the latter which had a higher disagreement level with the obstacles. Robinson (2017) also showed that varying degrees of clinical experience could contribute to healthcare professionals' perceptions of EHR use. For example, the majority of the respondents (75%) with 1–5 years of experience agreed that EHRs improve coordinated care between staff compared to 67% and 50% of those with 5–10 years' experience and more than 10 years' experience. These findings suggest that professionals with only a few years of experience are more likely to adopt EHRs due to their perceived usefulness and perceived ease of use. Further, the highest disagreement level with the obstacles among professionals with less than 10 years of experience could be related to this group being techno-savvy. However, these findings are not supported by Aldosari et al. (2018) who showed that there was no significant difference in perceived usefulness ($p = 0.086$) and perceived ease of use ($p = 0.132$) of EHRs among nurses with differing years of experience.

Healthcare professionals with many years of experience (> 20 years) were most satisfied with EHRs compared to those with less experience. Although this finding suggests that healthcare professionals with more years of working experience are more positive about EHRs and hence more likely to adopt them compared to those with only a few years of experience, it contradicts the finding of Robison (2017) which showed that healthcare professionals with fewer years of experience (1–5 years) were more satisfied (63%) with the EHRs than those with 5–10 years' experience (33%) and more than 10 years' experience (50%).

6.5.1.6 Previous training in EHRs

There were significant relationships between healthcare professionals' training in EHRs and their perceptions of benefits and satisfaction with the EHRs in primary care but not obstacles to adopting EHRs in primary care. The respondents with previous training in EHRs had a higher agreement level with the EHR benefits and satisfaction. Concurrent with the findings of Tubaishat (2018) who found that nurses with computer training had a higher perception of EHRs in terms of perceived usefulness and perceived ease of use compared with those who had no training, this study suggests that training results in a positive perception of a new technology hence increased likelihood of acceptance and use. Similarly, Gagnon et al. (2016) found a positive relationship between computer self-efficacy and intention to use EHRs among Canadian physicians in primary care. Training could also improve knowledge of the users about a system, with Al-Harbi (2011) finding that healthcare professionals with training in IT had good knowledge of IT applications. Thus, training in computer and related technologies, such as EHRs, could improve the knowledge and skills to operate the system that in turn improves the confidence of the user to adopt and use the EHR system to enhance the quality of service provision in healthcare. The increased knowledge about EHRs could also lead to increased satisfaction with the system as well as higher acceptance levels. Therefore, healthcare providers with good training in EHRs would be more likely to use the system due to their perceived usefulness and ease of use. This underscores the importance of training in adopting EHRs by healthcare providers. However, Aldosari et al. (2018) did not find a significant relationship in perceived usefulness ($p = 0.937$) and perceived ease of use ($p = 0.538$) of an EHR system between nurses with formal computer training and those without.

6.5.1.7 Previous experience in EHRs

This study did not find a significant difference between healthcare professionals who had previous experience in EHRs and those who did not in their perceptions of most EHR aspects. However, respondents with experience in EHRs tend to have a higher perception of EHRs than those with no previous experience. This finding contradicts a study by Tubaishat (2018) which showed that previous experience in EHRs significantly influenced nurses' perception of EHRs' usefulness and ease of use, however this perception depended on the length of the experience.

King et al. (2014) also identified that the length of EHR experience had a significant effect on the healthcare professionals' perceptions of EHRs' clinical benefits. Specifically, physicians with two or more years of EHR experience were 25.4, 16.4, and 9.7 percentage points more likely than those with one year or less experience in EHRs to report that EHR use results in enhanced patient care, help in remotely accessing patient's chart, and facilitating direct communication with a patient ($p < 0.05$). Physicians with more EHR experience were also more likely to report that EHRs could alert the user about a potential medication error (16.0 percentage points) and critical laboratory values (12.1) as well as helping in identifying needed laboratory tests (12.5). Conversely, the physicians did not significantly differ in their perceptions that the use of an EHR system could help in ordering fewer tests due to better availability of laboratory results despite those with longer EHR experience being 9.0 percentage points more likely to report this benefit ($p > 0.05$). Experience in EHRs could be positively associated with better knowledge of EHR systems and their use, hence healthcare providers who have previous experience are more likely to accept EHR systems.

6.5.1.8 Previous experience outside the Kingdom of Saudi Arabia

There were significant differences in perceptions of EHR benefits and satisfaction with EHRs between healthcare professionals who had experience outside Saudi Arabia and those who did not ($p < 0.05$). However, the latter group were more positive about EHRs than those who had experience outside the country. The finding was unexpected because it was expected that experience outside Saudi Arabia would result in a higher perception of EHRs probably due to exposure to such systems considering that EHR implementation is still in its formative stage in Saudi Arabia. However, the reason could be that respondents had not interacted with EHRs in other countries in which they had practised.

6.5.2 Effects of organisational characteristics on healthcare professionals' perceptions of EHRs

This study showed that healthcare professionals' perceptions of EHRs in PCCs in Riyadh city are also affected by organisational factors. These included staff training, technical support, staff resistance, poor IT infrastructure, regular maintenance and cost associated with the system implementation. However, these factors were reported by the respondents as obstacles to adopting EHRs in primary care; thus they can be considered as organisational related barriers to EHR adoption which is associated with negative perceptions.

6.5.2.1 Staff training

The healthcare professionals' report that staff training was an obstacle to adopting EHRs in primary care settings in Riyadh city showed that lack of adequate staff training negatively affected their attitude towards EHRs. Similarly, El Mahalli (2015) identified the lack of continuous training from the IT department as a significant barrier to implementing EHRs in Saudi hospitals, as reported by the majority (85.9%) of the respondents. A prior study by Asiri, Aldosari and Saddik (2014) showed that adequate training was weakly related to nurses' attitude and acceptance of an EHR system, and this relationship was positive and significant (Beta = 0.1645, $p < 0.05$). Further, adequate training was directly and significantly correlated with perceived usefulness ($B = 0.35$, $p < 0.05$) and perceived ease of use ($B = 0.47$, $p < 0.05$).

These findings suggest that staff training in EHRs could help to improve the adoption and acceptance of EHRs in primary care settings, with most respondents in a study by Al-Harbi (2011) reporting that the provision of training would motivate them to use IT applications in healthcare. Training could address the challenges associated with the system's use such as complexity and navigation of the interface which in turn would help to improve the user's confidence about system usage (Msiska, Kumitawa & Kumwenda 2017). Further, training could help to improve the knowledge of healthcare professionals about the system's benefits in improving the quality of care in primary care settings. Thus, staff training should be a priority for all healthcare managers prior to the introduction of a new HIT in order to improve acceptance and adoption. However, training should continue even during and after the implementation, with the majority of healthcare professionals in a study by Bredfeldt et al. (2013) reporting that they preferred additional training after implementation. Bredfeldt et al. (2013) further noted that EHR training post-implementation helps to improve the effectiveness of healthcare professionals with EHR use, such as patient information management and clinical documentation.

6.5.2.2 Organisational support

Technical support was also cited as an obstacle to adopting EHRs in PCCs in Riyadh city. Previous studies have shown that organisational support involving both management and technical support is associated with users' perception of EHRs. McAlearney et al. (2013) also identified healthcare professionals' perceived insufficient support for EHR use as personal barriers to EHR adoption in primary care. Aldosari et al. (2018) showed that top management and IT support had a positive significant relationship, with perceived usefulness ($p = 0.000$, correlation coefficient = 0.485) and perceived ease of use of EHRs (p = 0.000, correlation coefficient = 0.480) among nurses in Saudi Arabia. However, Morton (2008) showed that management support had a significant positive relationship, with only perceived ease of use but not perceived usefulness, which is related to the technical aspect of EHRs. These findings suggest that there was no adequate technical support in PCCs in Riyadh city to help healthcare professionals in using the EHR system, yet Al-Harbi (2011) identified that the provision of technical support is a key motivator to the adoption and use of IT applications in Saudi Arabia. The results thus show that PCCs in Riyadh city should provide adequate technical and management support to healthcare professionals in Riyadh city in order to improve their perceptions and acceptance of EHRs. Specifically, good organisational support would improve perceived usefulness, perceived ease of use and overall satisfaction with the EHRs in primary care.

6.5.2.3 Staff resistance

Staff resistance, which could involve resistance to technology, could also be associated with healthcare professionals' perceptions of EHRs in primary care settings. Specifically, staff resistance could be due to negative perceptions of the EHRs that lead to rejection and act as a barrier to adopting the system as reported in this study. McAlearney et al. (2013) also showed that staff resistance was a personal barrier to EHR adoption in primary care. In this regard, healthcare professionals in Saudi Arabia are more likely to resist the adoption of EHRs due to negative perceptions of the system. Hence, this challenge should be adequately addressed in order to ensure the successful implementation of EHRs in primary care settings.

6.5.2.4 Poor IT infrastructure and maintenance

The respondents also reported that poor IT infrastructure and regular maintenance were obstacles to adopting EHRs in PCCs in Riyadh city. Poor infrastructure and poorly maintained EHRs could present enormous challenges to healthcare professionals in using the system, and this is likely to have negative effects on the users' attitude. Aldosari et al. (2018) also noted that poor IT infrastructure was reported as an obstacle to adopting EHRs in healthcare centres in Saudi Arabia. These findings suggest that healthcare professionals in Saudi Arabia are less likely to adopt EHRs due to poor infrastructure and lack of regular maintenance. Thus, the government should increase investment in robust systems in PCCs and undertake regular maintenance to ensure optimal performance to motivate the users to adopt the systems.

6.5.2.5 High costs of the EHR system

Although cost was also reported to be a barrier to adopting EHRs in PCCs in Riyadh city, this finding was unexpected because the government of Saudi Arabia through the MOH is responsible for the implementation of EHRs in these settings. However, high costs which could be related to the purchase, installation or maintenance of the system has been shown to be negatively associated with perceptions of EHRs in various settings such as private practices (Jamoom et al. 2014; Reid Jr 2016) and in small organisations with limited resources (Singh & Muthuswamy 2013). Thus, cost may not have a significant influence on users' perceptions of EHRs in primary care centres in Riyadh city and similar settings. However, healthcare professionals should be involved at every stage of EHR implementation so that they understand the cost implications of such a process as well as its importance in order to improve adoption.

6.5.3 Effects of system characteristics on healthcare professionals' perceptions of EHRs

The two main system factors that were found to influence healthcare professionals' perceptions of EHRs in primary care settings were perceived usefulness and perceived ease of use, which are also the key components of TAM.

6.5.3.1 Perceived usefulness

Perceived usefulness involved factors related to the system's benefits at the individual, system or organisational level. At the individual level, this study identified a high level of agreement with various survey statements related to EHRs' usefulness to the individual healthcare professionals, such as the provision of access to practice standards, enabling following test results, saving time in documenting health data, improving the feeling of professionalism, improving communication among healthcare professionals themselves as well as between professionals and patients, and enhancing professionals' ability to make patient care decisions. Similarly, the benefits at the system level included the ability of an EHR system to provide quick and reliable access to scientific research data and enabling easy access to patient information from past medical records. The EHR system was also reported to be useful to the organisation by providing access to patient data and analysis, providing better data, making it easy to transfer data, decreasing paper-based documentation, reducing medical errors, improving the quality of healthcare services in PCCs, improving quality of information, and improving patient safety.

These system benefits were associated with positive perceptions and satisfaction with the EHRs as shown by the strong positive relationship between perceived benefits and satisfaction with EHRs in primary care (canonical correlation coefficient = 0.91). This positive perception of EHR usefulness in a primary care setting is consistent with prior research based on TAM (Morton 2008; Morton & Wiedenbeck 2010; Al-Harbi 2011; Asiri, Aldosari & Saddik 2014; Gagnon et al. 2016; Tubaishat 2017).

Al-Harbi (2011) showed that healthcare professionals in Saudi Arabia perceived IT applications to be valuable and beneficial, as demonstrated by high agreement levels with all the benefit items such as it is ‘easier to access patient records’ [M = 4.4, SD = 0.61], ‘easier to find investigation results [M = 4.4, SD = 0.62], and ‘facilitates coordination among departments’ [M = 4.0, SD = 0.99]. In the US, Morton (2008) identified a significant positive relationship between perceived usefulness and attitude toward EHR usage among physicians in primary care practices ($p < 0.001$). Gagnon et al. (2016) identified a positive relationship between perceived usefulness and intention to use EHRs by physicians in primary care organisations in Canada. Tubaishat (2017) also showed that Jordanian nurses had a positive perception of perceived EHR usefulness, such as increasing the providers’ productivity and saving time. The perceived usefulness was also positively and significantly correlated with intention to use an EHR system (Beta = 0.41, $t = 2.70$, $p < 0.001$). Asiri, Aldosari and Saddik (2014) also showed that perceived usefulness had a positive moderate and significant relationship with users’ attitude towards EHR acceptance and usage (Beta = 0.51, $p < 0.05$). In the National Guards Health Affairs Hospital in Saudi Arabia, Aldosari et al. (2018) showed that perceived usefulness was strongly positively correlated with nurses’ acceptance of EHRs. Specifically, nurses were more willing to accept the system if it would improve the quality of patient care. These findings show that healthcare providers in PCCs in Saudi Arabia were more satisfied with EHRs because they perceived the system to be useful both to them as the users and to the PCCs. The positive perception of EHRs due to perceived usefulness also implies that healthcare professionals are more likely to accept the EHR system which could facilitate the adoption of EHRs in primary care settings.

However, it is imperative to note that this study also identified factors related to the lack of perceived usefulness of an EHR system that could negatively affect the adoption of these applications in primary care. These factors were mainly related to the disadvantages, challenges or risks of using an EHR system such as decreased interaction between the healthcare professionals and patients, increased professionals' workloads, compromised patient safety, and difficulty in providing data security. The healthcare professionals had a negative perception of EHRs with regard to these factors, as evidenced by a medium negative relationship between perceived obstacles and satisfaction with EHRs in primary care (canonical correlation coefficient = 0.45). Similarly, McAlearney et al. (2013) showed that EHR impacts such as loss of productivity and loss of ability to document in detail were system-related barriers affecting the adoption of EHRs by primary care providers in the US at the provider level. Other factors that could indicate lack of perceived usefulness and have negative impact on EHR adoption by healthcare professionals include perceptions that EHRs consume more time than paper-based systems, are down frequently, and need frequent revisions due to technological advancements. In support of these findings, the US primary care physicians had a negative perception of EHR challenges such as the system going down and the system's limitations as well as updates which they perceived as system-related barriers to the adoption of EHRs at the organisational level (McAlearney et al. 2013). The negative perceptions of EHRs due to lack of usefulness could lead to low adoption levels of EHRs by healthcare professionals working in primary care settings.

6.5.3.2 Perceived ease of use

This study also identified various factors related to perceived ease of use of an EHR system in primary care. Specifically, the respondents reported that it is easy to access past medical information, transfer data, and save information. Further, only a few respondents agreed with the obstacle statement that an EHR is too complicated and not user-friendly. These findings show that healthcare professionals in Saudi Arabia perceived EHRs in primary care to be easy to use, which is consistent with the results of Tubaishat (2017) in which the majority of the nurse respondents (63.4%) agreed that EHRs are easy to use.

The perceived ease of use could be related to the system design and features that make it easy to navigate, and this has been associated with positive perceptions and acceptance of a technology system as reported in prior studies (Asiri, Aldosari & Saddik 2014; Gagnon et al. 2016; Hamid et al. 2016; Tubaishat 2017; Aldosari et al. 2018, AlJarullah et al. 2018). Asiri, Aldosari and Saddik (2014) also identified a positive moderate significant relationship between perceived ease of use and nurses' attitude towards EHRs (Beta = 0.19, $p < 0.05$). Perceived ease of use was also found to be positively associated with intention to use EHRs by physicians in primary care organisations in Canada (Gagnon et al. 2016). Furthermore, Tubaishat (2017) showed that perceived ease of use was significantly associated with nurses' intention to use an EHR system (Beta = 0.34, t = 2.55, $p < 0.001$). In Saudi Arabia, Aldosari et al. (2018) showed that perceived ease of use was strongly positively correlated with nurses' acceptance of EHRs in the National Guards Health Affairs Hospital.

These findings suggest that healthcare professionals in primary care settings in Saudi Arabia have a positive attitude towards EHRs and are more likely to adopt EHRs in primary care due to perceived ease of use that allows them to save and access patient information easily. TAM also hypothesises that perceived ease of use is a significant predictor of technology acceptance (Davis, Bagozzi & Warshaw 1989). The EHR system was also reported to be user-friendly which could improve acceptance and use, with Aldosari et al. (2018) noting that nurses were willing to learn an EHR system if they perceived it to be more user-friendly. A more user-friendly system could lead to less resistance to the technology thus healthcare organisations should implement EHR systems that are not only easy to use but also user-friendly in order to improve acceptance and adoption by healthcare professionals.

Although the respondents in this study generally perceived EHR systems to be easy to use, some had concerns with the system's complexity and user-friendliness which cannot be taken for granted because this is likely to affect their attitude towards EHRs in primary care. This is important because a system with poor design and which is difficult to use indicates lack of perceived ease of use which could prevent the users from adopting and using it, as noted by Msiska, Kumitawa & Kumwenda (2017). Specifically, the researchers noted that the majority (75.9%) of healthcare professionals in Malawi reported that they only considered an EHR system to be beneficial if it is easier and faster to use than paper-based systems despite being useful in healthcare.

In general, perceived usefulness and perceived ease of use are important system factors in EHR adoption as they have a significant influence on the healthcare professionals' attitude as postulated by Davis's (1989) TAM. The positive relationships between both perceived usefulness and perceived ease of use and satisfaction with the EHR system imply that the system attributes have a significant influence on the healthcare professionals' perceptions of EHRs in primary care that in turn affects acceptance and adoption. However, it appears that perceived usefulness had a greater positive impact on perceptions as compared with perceived ease of use, with respondents reporting higher agreement levels with perceived benefit factors. Morton (2008) also showed that there was a significant difference between perceived usefulness and perceived ease of use in their impacts on users' attitude towards EHRs, with the latter having a greater impact (Path Coefficients: perceived usefulness = 0.63, perceived ease of use = 0.34; $p < 0.001$). Furthermore, it could be argued that perceived ease of use had both a direct and indirect effect on healthcare professionals' perceptions of EHRs, with TAM hypothesising that perceived ease of use has a direct impact on attitude towards EHRs and an indirect effect on attitude towards EHRs by influencing perceived usefulness that in turn affects acceptance or rejection of system by the healthcare professionals. In light of this, EHR systems implemented in primary care settings should be both useful in improving the quality of health service provision and easy to use by healthcare professionals in order to improve adoption levels.

6.6 Summary of the discussion

This discussion supports the findings of this study which show that healthcare professionals generally perceive the adoption of EHRs in primary care to be beneficial. Healthcare professionals in other settings have also reported several benefits of EHRs in primary care such as increased access to patient records, provision of better data and reduction in paper documentation. The perceptions of these benefits are associated with high satisfaction that makes healthcare professionals more likely to accept and use EHR systems in primary care practice. Thus, the perceived benefits and satisfaction with EHRs in primary care could act as facilitators in adopting these systems in primary care settings in the GCC context. Conversely, several challenges that result in low satisfaction that were acknowledged by healthcare professionals across different settings to be associated with the adoption of EHRs could act as barriers to EHR adoption. This discussion also showed that the healthcare professionals' perceptions of the benefits and obstacles as well as satisfaction with the EHRs are affected by several factors that could be individual, organisational or related to system. The individual factors are mainly occupation, age, gender, nationality, length of work experience, previous experience with EHRs, previous training in EHRs, and prior experience outside Saudi Arabia and they had significant influence on the healthcare professionals' perceptions and satisfaction with the EHRs. The organisational factors influencing perceptions include staff training, organisational support, poor IT infrastructure and maintenance, and high costs of the EHR system. System characteristics were mainly perceived usefulness and perceived ease of use. Thus, these factors should be adequately addressed in order to ensure successful adoption and implementation. Further, this study emphasises the need for health administrators to address not only the technical issues with a health information technology, in this case the EHR system, but also the individual and organisational factors that may influence the users' attitudes towards the adoption of such systems, as acknowledged by Bakheet (2003).

CHAPTER 7 : FINAL CONCEPTUAL MODEL

7.1 Introduction

This chapter provides and discusses the final conceptual model developed based on the study findings and extensive literature review. First, the main findings of this thesis are highlighted. The survey statements, as well as responses from open-ended questions, are then categorised based on four TAM variables, namely external variables, perceived usefulness, perceived ease of use and attitude. The items under each category are further classified into three groups based on whether they influence healthcare professionals' perceptions and adoption of EHRs at individual, organisational or system levels. The relationships between the TAM variables are then discussed in order to form the basis of the conceptual model for the adoption of EHRs in the GCC context. The developed conceptual framework is finally presented and discussed.

7.2 Study results

This thesis examined healthcare professionals' perceptions of the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia based on their experience of using the system. Specifically, it evaluated the perception of the benefits and obstacles to adopting EHRs as well as satisfaction with the system in primary care through using TAM. This study showed that healthcare professionals in PCCs in Riyadh city had a positive perception of EHRs with regard to the system's benefits, as demonstrated by a high level of agreement with statements related to the benefits. The positive perception was also evidenced by high agreement level with statements related to the satisfaction with EHRs in primary care which also indicates high satisfaction levels with the system. Conversely, the challenges and risks of using EHRs were associated with negative perceptions and they were cited as obstacles to adopting EHRs in primary care. However, the perceived obstacles had low agreement levels, further showing that healthcare professionals in PCCs in Riyadh city generally had a positive perception towards the adoption of EHRs in primary care settings.

This thesis also investigated the factors that influence the healthcare professionals' perceptions of EHRs in primary care settings in Saudi Arabia and other GCC countries. Several factors that could be categorised as individual, organisational and system characteristics based on their level of influence were identified. Thus, they are likely to affect the adoption and implementation of

EHRs in primary care settings in the GCC context, as presented in the conceptual framework (Figure 7.1).

7.3 Study context and TAM

This thesis was based on the first modified version of TAM as the theoretical model. TAM has five key elements: external variables, perceived usefulness, perceived ease of use, attitude towards using, behavioural intention to use, and actual system use. The model hypothesises that the intention to use that determines whether a user would use or not use a system (actual usage of a system) is influenced by the user's attitude toward using (Davis, Bagozzi & Warshaw 1989). Further, the attitude is influenced by perceived usefulness and perceived ease of use which are considered as the main factors influencing acceptance and actual use of technology. Perceived ease of use could have a direct effect on perceived usefulness and attitude toward using, while perceived usefulness has a direct impact on attitude only. Lastly, perceived usefulness and perceived ease of use are also postulated to be affected by external variables.

Similarly, it was hypothesised in this thesis that the adoption and use of EHRs in PCCs in the GCC countries is influenced by the healthcare professionals' perceptions of the system which is also influenced by several factors. The main factors under consideration were the perceived usefulness and perceived ease of use of EHRs in primary care settings. Other factors included external variables, which were also hypothesised to influence the perceived usefulness and perceived ease of EHRs. Apart from influencing these two attributes, external variables were also assumed to have a direct effect on the providers' perceptions of the EHRs.

With respect to the study variables, the external variables of TAM corresponded to factors that influenced the healthcare professionals' perceptions of EHRs. They were broadly categorised as individual, organisational and system characteristics. The perceived usefulness and perceived ease of use corresponded to the statements related to the system's perceived benefits and obstacles to EHR adoption in primary care. Finally, the perceptions of the healthcare professionals towards the adoption of EHRs in primary care corresponded to items for satisfaction with EHRs in PCCs. Thus, this thesis focused on four main TAM variables, namely external variables, perceived usefulness, perceived ease of use and attitude. These are summarised as follows:

A. External variables

Individual characteristics

Individual characteristics were the sociodemographic factors of the healthcare professionals that affect the perceptions towards adoption and use of EHRs. Specifically, this study examined their influence on healthcare professionals' perceptions of EHR benefits and obstacles as well as satisfaction in primary care. There were eight individual provider characteristics examined in the survey, namely:

- Occupation
- Age
- Gender
- Nationality
- Length of time working in PCCs in Saudi Arabia
- Previous training in EHRs
- Previous experience with EHRs
- Previous experience outside Saudi Arabia

Organisational characteristics

Organisational characteristics refer to organisational-related factors that were shown to influence the perceptions of healthcare professionals towards EHR adoption in PCCs in Riyadh city. These were mainly identified from the responses to the open-ended questions and they are:

- Staff training
- Technical support
- Staff resistance
- Poor IT infrastructure
- Regular maintenance

System characteristics

These are factors related to the intrinsic characteristics of the EHR system. There were three factors that were derived from the survey obstacle statements and qualitative responses:

- Is 'down' frequently
- Is costly/system's cost
- Needs frequent revisions related to technological developments

B. Perceived usefulness

This TAM component involved statements related to the system's benefits as perceived by the respondents. There were 14 statements in this category, namely:

- Provides quick and reliable access to scientific research data
- Enables easy access to information from past medical records
- Provides access to patient data and analysis
- Provides better data
- Makes it easy to transfer data
- Provides access to practice standards
- Enables following test results
- Saves time in documenting health data
- Decreases paper-based documentation
- Improves the feeling of professionalism
- Improves communication between health professionals and patients
- Contributes to health professionals' ability to make patient care decisions
- Improves communication between health professionals
- Reduces medical errors

The open-ended question for the perceived benefits of EHRs also identified the following factors related to the perceived usefulness of EHRs in primary care:

- Better health care by improving all aspects of patient care
- Enhanced sharing information
- Increased productivity and efficiency
- Save time and effort
- Enhanced accuracy of decisions and feedback
- Reduced medical errors
- Keep patient's file updated
- Reduced operational costs
- Paperless
- Provide accurate statistics
- Improve privacy and confidentiality

- Decrease repetition of investigation
- Improve future research

From the satisfaction with the EHRs in PCCs in Riyadh city, the perceived usefulness items included:

- I feel EHR is useful
- I feel the EHR improves the quality of healthcare services in primary healthcare centres
- I feel the quality of my work has improved
- I feel the quality of information has improved due to EHR
- I feel my performance has improved due to EHR
- I feel patient safety has improved due to EHR

Whereas most obstacle statements imply perceived lack of usefulness of EHRs, they were related to perceived usefulness as indicated by low agreement levels. They included:

- Compromises patient safety
- Decreases interaction between the health professional and patient
- Increases health professionals' workloads
- Consumes more time than paper-based systems
- It is difficult to provide data security in EHRs

Qualitative responses also identified the following factors:

- Reduces practice productivity and disturbs workflow
- Low-quality services provided in primary care centres
- Miscommunication between practitioners
- Lack of privacy and confidentiality
- Time-consuming

C. Perceived ease of use

The following benefit statements were related to perceived ease of use of EHRs in primary care:

- Enables easy access to information from past medical records
- Makes it easy to transfer data

Similarly, the qualitative responses identified the following responses:

- Easy access to past medical history

- Easy to save information
- User-friendly

There was only one perceived obstacle related to perceived ease of use, demonstrated by low agreement level from both the survey and open-ended question:

- Is too complicated and not user-friendly

D. Attitude

These included nine statements and one global measure of satisfaction as follows:

- I feel EHR is useful
- I feel EHR is an important system for primary healthcare centres
- I feel EHR has been successful in primary health care centres
- I feel EHR is worth the time and effort required to use it
- I feel the EHR improves the quality of healthcare services in primary healthcare centres
- I feel the quality of my work has improved
- I feel the quality of information has improved due to EHR
- I feel my performance has improved due to EHR
- I feel patient safety has improved due to EHR
- Overall, I am satisfied with the EHR system in primary healthcare centres

This grouping shows that the external variables are mainly related to the users' characteristics, as well as the system and organisational factors. Perceived usefulness and perceived ease of use are mainly system characteristics associated with benefits, challenges and risks of use, while attitude was measured as satisfaction with the EHRs. This can be summarised as shown in Table 7.1

Table 7.1: TAM variables and the corresponding study factors

TAM variables	**Factors**
External variables (Independent)	Individual characteristics
	Organisational characteristics
	System characteristics
Perceived usefulness (Intermediate variable)	System's benefits/obstacles
Perceived ease of use (Intermediate variable)	System's design and features
Attitude (Dependent variable)	Satisfaction with the system

7.4 Level of influence of perceptions

These factors influence users' perceptions of an EHR system at different levels, including the individual, organisation or system levels. For example, the occupation was classified as an external variable in the individual context because it is a provider characteristic influencing healthcare professionals' perceptions of EHRs. However, some factors were put in more than one group if they influence perceptions and adoption of EHRs at different levels. For example, the benefit that an EHR system provides access to patient data and analysis was considered to belong to both individual and organisational contexts because it applies to individual healthcare professionals and the healthcare organisation. Specifically, healthcare providers can access patients' data and analyse it for the purposes of providing quality care to their patients while at the same time the organisation can use the data for planning purposes. In this regard, all of the factors under the external variables, perceived usefulness, perceived ease of use and attitude could be categorised as individual, organisational or system contexts, as shown in Table 7.2.

Table 7.2: Context of the data items

TAM variable	Context	Data item
External variables	Individual	Occupation
		Age
		Gender
		Nationality
		Length of time working in PCCs in Saudi Arabia
		Previous training in EHRs
		Previous experience with EHRs
		Previous experience outside Saudi Arabia
	Organisational	Staff training
		Technical support
		Staff resistance
		Poor IT infrastructure
		Regular maintenance
	System	Is 'down' frequently
		Is costly/system's cost
		Needs frequent revisions related to technological developments
Perceived usefulness	Individual	Enables easy access to information from past medical records
		Provides access to patient data and analysis
		Provides better data
		Makes it easy to transfer data
		Provides access to practice standards
		Enables following test results
		Saves time in documenting health data
		Decreases paper-based documentation
		Improves the feeling of professionalism
		Improves communication between health

		professionals and patients
		Contributes to health professionals' ability to make patient care decisions
		Improves communication between health professionals
		Reduces medical errors
		Enhances sharing information
		Increases productivity and efficiency
		Saves time and effort
		Enhances accuracy of decisions and feedback
		Keeps patients' files updated
		Reduces operational costs
		Paperless
		Improves privacy and confidentiality
		Decreases repetition of investigations
		Improves future research
		I feel EHR is useful
		I feel the quality of my work has improved
		I feel the quality of information has improved due to EHR
		I feel my performance has improved due to EHR
	Organisational	Provides access to patient data and analysis
		Provides better data
		Makes it easy to transfer data
		Decreases paper-based documentation
		Reduces medical errors
		Better healthcare by improving all aspects of patient care
		Enhances sharing information
		Increases productivity and efficiency
		Enhances accuracy of decisions and feedback
		Keeps patients' files updated
		Reduces operational costs
		Paperless
		Provide accurate statistics
		Improves future research
		I feel the EHR improves the quality of healthcare services in primary healthcare centres
		I feel the quality of information has improved due to EHR
		I feel patient safety has improved due to EHR
	System	Provides quick and reliable access to scientific research
		Enables easy access to information from past medical records
Perceived ease of use	Individual	Enables easy access to information from past medical records/Easy access to past medical history
		Makes it easy to transfer data
		Easy to save information
	Organisational	Makes it easy to transfer data
	System	Enables easy access to information from past medical records
		User-friendly
Attitude	Individual	I feel EHR is useful
		I feel EHR is worth the time and effort required to use it
		I feel the quality of my work has improved

		I feel the quality of information has improved due to EHR
		I feel my performance has improved due to EHR
		Overall, I am satisfied with the EHR system in primary healthcare centres
	Organisational	I feel EHR is useful
		I feel EHR is an important system for primary healthcare centres
		I feel EHR has been successful in primary healthcare centres
		I feel the EHR improves the quality of healthcare services in primary healthcare centres
		I feel the quality of information has improved due to EHR
		I feel patient safety has improved due to EHR
	System	

From this table, the individual-level factors included the sociodemographic characteristics of the respondents, perceived EHR benefits to the healthcare professionals, ease of use by the user, and satisfaction with the EHR system in PCCs at personal level. Various factors were also categorised under organisational context if they are related to the organisation. These include activities that can be undertaken by the organisations such as staff training, provision of technical support, and providing as well as maintaining proper EHR infrastructure in order to improve adoption. They also include factors associated with perceived benefits to the organisation of adopting EHRs such as making it easy to transfer data and improved patient safety. Items related to the satisfaction with the EHRs at the organisation level such as improved quality of healthcare services at PCCs also fall under this category. The system-level factors were mainly related to the ability of the EHR system to provide clinical benefits to the user, patients, and the organisation. They also related to attributes that make the system easy to use, such as not too complicated, being user-friendly and easy to learn, and easy to save information. Furthermore, high cost, need for frequent revisions and being down frequently are system-related factors that influence healthcare professionals' perceptions of EHRs. It is also worth noting that some factors fall under more than one group because they can be attributed to individual users, organisation or system.

7.5 Relationship between the TAM variables

In order to evaluate the effect of these factors on healthcare professionals' perceptions of EHRs in primary care, a relationship was determined between the 'external variables' as the independent variables and perceived usefulness and perceived ease of use as dependent variables. Further, a relationship between perceived usefulness and perceived ease of use and attitude (satisfaction) with EHRs in primary care was determined. It was hypothesised that external factors would have a significant influence on perceived usefulness and perceived ease of use of EHRs. It was also hypothesised that perceived usefulness and perceived ease of use have a significant influence on attitude that would, in turn, affect the acceptance and use of EHR systems in primary care settings in the GCC context. Further, it was hypothesised that both individual and organisational factors have a direct influence on users' attitudes towards EHRs. The findings for these relationships were as follows:

7.5.1 Individual characteristics

7.5.1.1 Occupation

Occupation had a significant correlation with all of the statements related to the TAM variables of perceived usefulness and perceived ease of use. Physicians had a higher agreement with the perceived EHR benefits and satisfaction but a lower agreement with the obstacles to adopting EHRs in primary care compared to other occupational groups. These findings show that occupation influences perceived usefulness and perceived ease of use of EHRs in primary care, with physicians having a more positive perception than other professionals.

7.5.1.2 Gender

Gender was significantly correlated with most statements for perceived usefulness, but it did not have a significant relationship with perceived ease of use. Female respondents had a higher level of agreement with the perceived EHR benefits and satisfaction than their male counterparts. Furthermore, females had a lower agreement level with obstacles to adopting EHRs in primary care, including the statement that EHR 'is too complicated and not user-friendly'. However, there was no significant difference between female and male respondents in their agreement with this statement, which corresponds to perceived ease of use of EHRs. Therefore, gender has a significant influence on the perceived usefulness of EHRs but not perceived ease of use, with female users having a more positive perception than males.

7.5.1.3 Age

Age had a significant association with all of the statements related to perceived usefulness and perceived ease of use of EHRs in primary care. Older professionals (>50 years) had a higher agreement level with most benefit statements than younger healthcare professionals. They also had a lower agreement with most statements for obstacles to adopting EHRs. However, younger healthcare professionals had a lower agreement with the obstacle item that EHR ‘is too complicated and not user-friendly’. The findings suggest that age has a significant influence on both perceived usefulness and perceived ease of use, with older professionals having a more positive perception of EHRs’ usefulness and younger professionals having a more positive perception of ease of use.

7.5.1.4 Nationality

Nationality was significantly correlated with most statements related to perceived usefulness but not with perceived ease of use. Non-Saudi healthcare professionals had a higher level of agreement with benefit statements than Saudis and a lower agreement with obstacles to adopting EHRs. The findings imply that the nationality of the respondents had a significant influence on the perceived usefulness of EHRs but not perceived ease of use. Further, it suggests that non-Saudis had a more positive perception of EHRs than Saudis hence are more likely to accept EHRs in primary care practice.

7.5.1.5 Length of experience

Length of time working in PCCs had a significant relationship with most statements for perceived usefulness. However, it had no significant relationship with the item for perceived ease of use. Healthcare professionals with more years of experience working in PCCs had a higher agreement level with benefits and satisfaction with EHRs but a lower agreement with the obstacle that EHR ‘is too complicated and not user-friendly.’ However, the agreement with this obstacle did not significantly differ with length of work experience. Thus, length of experience influences perceived usefulness of EHRs but not perceived ease of use. The finding also suggests that healthcare professionals with longer work experience were more positive towards EHRs than those with fewer years of experience thus more likely to accept EHRs due to its perceived usefulness rather than perceived ease of use.

7.5.1.6 Previous experience with EHRs

Prior experience with EHRs was not significantly correlated with most statements for perceived usefulness. Similarly, it had no significant correlation with the statement for perceived ease of use. These findings suggest that previous experience with EHRs did not influence perceived usefulness and perceived ease of use of EHRs in a primary care setting.

7.5.1.7 Previous training in EHRs

Previous training in EHRs had a significant relationship with most statements for perceived usefulness but not with the statement for perceived ease of use. Healthcare professionals with training in EHRs had a higher level of agreement with EHR benefits but a lower one with the obstacles as compared to those without training. The findings suggest that training in EHRs influences perceived usefulness but not perceived ease of use with healthcare providers, with training in EHRs having a more positive perception of EHRs with regard to the system's perceived usefulness than those without training.

7.5.1.8 Previous experience outside Saudi Arabia

Prior experience outside Saudi Arabia was significantly correlated with all statements related to perceived usefulness but not with the statement for perceived ease of use. Healthcare professionals with experience outside Saudi Arabia had a higher agreement level with the EHR benefits than those who did not. Thus, previous experience outside Saudi Arabia has a significant influence on perceived usefulness but not perceived ease of use. Further, the findings suggest that healthcare professionals with experience outside Saudi Arabia are more likely to accept and use EHRs due to their perceived usefulness.

In general, this study shows that the characteristics of healthcare professionals in Riyadh city influence their perception of EHRs' usefulness and ease of use in PCCs. Specifically, three characteristics (occupation, age and previous experience) had a significant relationship with both perceived usefulness and perceived ease of use. Gender, nationality, length of work experience, and training in EHRs had a significant relationship with only perceived usefulness and not perceived ease of use. Previous experience using EHRs did not have a significant relationship with perceived usefulness nor with perceived ease of use. These results are summarised in Table 7.3.

Table 7.3: Relationship between healthcare professionals' characteristics (external variables) and perceived usefulness and perceived ease of use

External variables	**Perceived usefulness**	**Perceived ease of use**
Occupation	< 0.05	< 0.05
Age	< 0.05	< 0.05
Gender	< 0.05	> 0.05
Nationality	< 0.05	> 0.05
Length of work experience	< 0.05	> 0.05
Previous experience with EHRs	> 0.05	> 0.05
Previous training in EHRs	< 0.05	> 0.05

Prior experience outside Saudi Arabia	< 0.05	< 0.05

7.5.2 Organisational characteristics

The organisational aspects influencing perceptions in this study included staff training, technical support, staff resistance, and establishing and maintaining IT infrastructure. These factors were reported from qualitative findings, and thus their associations with healthcare professionals' perceptions and adoption of EHRs were not evaluated. However, evidence from the literature shows that they have a significant influence on healthcare providers' perceptions of a new EHR technology (Asiri, Aldosari & Saddik 2014; El Mahalli 2015; Aldosari et al. 2018). Thus the perceptions of healthcare professionals towards the adoption of EHRs in the context of this study were considered to be affected by these organisational factors.

7.5.3 System characteristics

These were mainly perceived usefulness and perceived ease of use factors.

7.5.3.1 Perceived usefulness

The canonical correlation analysis between perceived benefits and satisfaction with EHRs showed a strong positive relationship between the statements related to these variables (canonical correlation = 0.91). These statements were related to perceived usefulness and attitude towards the adoption of EHRs, indicating that perceived usefulness was positively associated with healthcare professionals' attitudes towards EHRs in primary care settings. Thus, it appears the perceived usefulness attributed to EHR benefits to the individual healthcare professionals or primary care organisations have a significant influence on healthcare professionals' perceptions towards EHR adoption in primary care settings in the GCC countries.

7.5.3.2 Perceived ease of use

Similarly, factors related to perceived ease of use, such as easy access to information from past medical records and easy transfer of data were also associated with satisfaction with EHRs. This shows that perceptions towards the adoption of EHRs by healthcare professionals working in PCCs in Riyadh city are also influenced by perceived ease of use, which is a key system characteristic in technology acceptance.

7.6 Final conceptual framework

Overall, this study showed that the healthcare professionals' in Riyadh city have a positive perception of EHRs in primary care settings. However, this perception was found to be influenced by various factors, including individual characteristics, organisational characteristics and system characteristics. Forming part of external variables, the individual and organisational aspects were related to the characteristics of the respondents who are the main users of the EHR system and organisational factors respectively, with both having direct and indirect influence on perceptions of EHRs. Conversely, system characteristics were related to perceived usefulness and perceived ease of use of EHRs, which had a direct influence on healthcare professionals' perceptions.

These findings could be relevant to the context of the other GCC countries, including Oman, United Arab Emirates, Kuwait, Qatar and Bahrain, owing to the several similarities between the member states. The GCC countries have similar settings and share common characteristics in their social, economic and political factors as well as history and culture (Alkraiji, Osama & Amin 2014; Weber et al. 2017). For instance, they have similar healthcare systems that are usually fragmented and differ across regions (Alkraiji, Osama & Amin 2014). This has resulted in the variation of quality of care provided at different levels in different regions.

In relation to the adoption and implementation of HITs, Alkraiji, Osama and Amin (2014) noted that all of these countries are newcomers in the field of health informatics and still lag in the use of advanced health information systems compared to developed nations. Alkraiji, Osama and Amin (2014) identified five main factors that affect the effective delivery of health services in GCC countries thus making health information management systems to be important in these settings. These are financial issues, decline of quality of care, inequities of medical devices, lack of manpower, and population growth. The governments of the GCC countries, which bear almost 80% of the costs of health services provided to citizens, perceive increased investment in HITs as one of the ways of reducing high healthcare costs, with currently up to 10% of annual budgets allocated to healthcare.

The citizens are dissatisfied with not only the availability but also the quality of healthcare services provided to them and there is increased threat from medical areas due to lack of managerial skills and control required to manage healthcare facilities by the public healthcare providers. Most of the advanced healthcare services in these countries are also located in urban cities, resulting in disparity between urban and rural areas. The GCC countries also face a shortage in healthcare professionals and related science fields. Lastly, the GCC countries experience high rates of population growth, which is estimated to be 3% per annum. However, they have made substantial investments in electronic health infrastructure since 2000 owing to the increased economic growth (Weber et al. 2017).

Due to these similarities, the findings with regard to the adoption of EHRs in primary care settings in Saudi Arabia could be used to predict the acceptance of the EHRs in the GCC context as a whole. Thus, the elements (Table 7.4) can be used to develop the final conceptual framework that predicts the usage of EHRs in primary care in the GCC context.

Table 7.4: Elements of the final conceptual framework

TAM variable	Context	Literature findings	Study data items	GCC context
External variables	Individual	Occupation	Occupation	Physicians in the GCC are more likely to accept and use EHRs in PCCs than other groups of health professionals.
		Age	Age	Older professionals (> 50 years) are more likely to accept and use EHRs in PCCs than younger professionals.
		Gender	Gender	Female healthcare professionals in the GCC countries are more likely to accept and use EHRs in PCCs than males.
		Ethnicity	Nationality	Healthcare professionals from other countries are more likely to accept and use EHRs in PCCs than those from the GCC countries.
		Length of work experience	Length of time working in PCCs in Saudi Arabia	Healthcare professionals in the GCC countries with a longer length of work experience are more likely to accept and use EHRs than those with less experience.
		Computer/EHR experience	Previous experience with EHRs	Both healthcare professionals in the GCC countries with or without previous experience with EHRs are likely to accept and use EHRs in primary care in a similar manner.
		Training in computers/EHRs	Previous training in EHRs	Healthcare professionals in the GCC countries who have previous training in EHRs are more likely to accept and use EHRs in PCCs than someone who has not received training.
		Country of training	Previous experience outside Saudi Arabia	Healthcare professionals in the GCC countries with experience working in a foreign country are more likely to accept and use EHRs in PCCs than those who have only worked in the GCC countries.

	Organisational	Organisational factors such as training, management/technical support, end-user involvement and autonomy, and doctor-patient relationship	Staff training	Healthcare professionals in the GCC countries are less likely to accept and use EHRs in PCCs due to lack of adequate staff training by the organisation.
			Technical support	Healthcare professionals in the GCC countries are less likely to accept and use EHRs in PCCs due to lack of adequate technical support from the organisation.
			Staff resistance	Healthcare professionals in the GCC countries are less likely to accept and use EHRs in PCCs due to staff resistance in the organisation.
			Poor IT infrastructure	Healthcare professionals in the GCC countries are less likely to accept and use EHRs in PCCs due to poor IT infrastructure provided by the organisation.
			Regular maintenance	Healthcare professionals in the GCC countries are less likely to accept and use EHRs in PCCs due to perceived need for regular maintenance by the organisation.
	System	Implemented EHR system	Is ‘down’ frequently	Healthcare professionals in the GCC countries perceive the EHR system has frequent down time.
			Is costly/system’s cost	Healthcare professionals in the GCC countries perceive the EHR system has high costs.
			Needs frequent revisions related to technological developments	Healthcare professionals in the GCC countries perceive the EHR system requires frequent updates.
Perceived usefulness variables	Individual	Perceived benefits to the individual providers	Enables easy access to information from past medical records	Healthcare professionals in the GCC countries perceive the EHR system to be useful in accessing patients’ past medical history at the provider level.
			Provides access to patient data and analysis	Healthcare professionals in the GCC countries perceive the EHR system to help in accessing patient data and analysis at the individual level.
			Provides better data	Healthcare professionals in the GCC countries perceive the EHR system to provide better data to the individual providers.
			Makes it easy to transfer data	Healthcare professionals in the GCC countries perceive the EHR system to help in transferring data between the individual providers.
			Provides access to practice standards	Healthcare professionals in the GCC countries perceive the EHR system to provide the individual users with access to practice standards.
			Enables following test results	Healthcare professionals in the GCC countries perceive the EHR system to help the individual providers to follow test results.

			Saves time in documenting health data	Healthcare professionals in the GCC countries perceive the EHR system to help the individual providers to save time during health data documentation.
			Decreases paper-based documentation	Healthcare professionals in the GCC countries perceive the EHR system to reduce paper use in documenting health data by care providers.
			Improves the feeling of professionalism	Healthcare professionals in the GCC countries perceive the EHR system to improve feeling of professionalism of healthcare providers.
			Improves communication between health professionals and patients	Healthcare professionals in the GCC countries perceive the EHR system to improve communication between providers and their patients.
			Contributes to health professionals' ability to make patient care decisions	Healthcare professionals in the GCC countries perceive the EHR system to contribute to provider decision-making during patient care.
			Improves communication between health professionals	Healthcare professionals in the GCC countries perceive the EHR system to improve communication between healthcare providers.
			Reduces medical errors	Healthcare professionals in the GCC countries perceive the EHR system to help individual providers in reducing medical errors.
			Enhances sharing information	Healthcare professionals in the GCC countries perceive the EHR system to help in sharing information between healthcare providers.
			Increases productivity and efficiency	Healthcare professionals in the GCC countries perceive the EHR system to increase productivity and efficiency of providers.
			Saves time and effort	Healthcare professionals in the GCC countries perceive the EHR system to save the providers' time and effort in patient care.
			Enhances accuracy of decisions and feedback	Healthcare professionals in the GCC countries perceive the EHR system to improve the accuracy of providers' decisions and feedback.
			Keeps patients' files updated	Healthcare professionals in the GCC countries perceive the EHR system to help healthcare providers in keeping updated patients' files.
			Improves privacy and confidentiality	Healthcare professionals in the GCC countries perceive the EHR system to improve privacy and confidentiality of the patients at the provider level.
			Decreases repetition of investigations	Healthcare professionals in the GCC countries perceive the EHR system to help providers to avoid repeating clinical investigations.
			I feel EHR is useful	Healthcare professionals in the GCC countries perceive the EHR system to be useful to individual healthcare providers.

			I feel the quality of my work has improved	Healthcare professionals in the GCC countries perceive the EHR system to improve the quality of providers' work.
			I feel my performance has improved due to EHR	Healthcare professionals in the GCC countries perceive the EHR system to improve performance of the individual providers.
	Organisational	Perceived benefits to the organisation	Provides access to patient data and analysis	Healthcare professionals in the GCC countries perceive the EHR system to help in accessing patient data and analysis at the organisational level.
			Provides better data	Healthcare professionals in the GCC countries perceive the EHR system to provide primary care organisations with better data.
			Makes it easy to transfer data	Healthcare professionals in the GCC countries perceive the EHR system to enhance the transfer of data at the organisational level.
			Decreases repetition of investigations	Healthcare professionals in the GCC countries perceive the EHR system to decrease repetition of investigations of clinical incidents by primary care organisations.
			Decreases paper-based documentation	Healthcare professionals in the GCC countries perceive the EHR system to reduce the use of paper-based records by primary care organisations.
			Reduces medical errors	Healthcare professionals in the GCC countries perceive the EHR system to health primary care organisations in reducing medical errors.
			Better healthcare by improving all aspects of patient care	Healthcare professionals in the GCC countries perceive the EHR system to help primary care organisations to improve health care.
			Enhances sharing information	Healthcare professionals in the GCC countries perceive the EHR system to enhance sharing of information at the organisational level.
			Increases productivity and efficiency	Healthcare professionals in the GCC countries perceive the EHR system to increase efficiency of primary care organisations.
			Keeps patients' files updated	Healthcare professionals in the GCC countries perceive the EHR system to help primary care organisations to keep updated patients' files.
			Reduces operational costs	Healthcare professionals in the GCC countries perceive the EHR system to help primary care organisations to reduce operational costs.
			Provide accurate statistics	Healthcare professionals in the GCC countries perceive the EHR system to provide accurate statistics to primary care organisations.
			I feel EHR improves the quality of healthcare services in primary healthcare centres	Healthcare professionals in the GCC countries perceive the EHR system to improve the quality of healthcare services provided by primary care organisations.
			I feel patient safety has improved	Healthcare professionals in the GCC countries perceive the EHR system

			due to EHR	to help primary care organisations to improve patient safety.
	System	Perceived benefits related to the system	Provides quick and reliable access to scientific research	Healthcare professionals in the GCC countries perceive the EHR system to have ability of enhancing access to scientific research.
			Enables easy access to information from past medical records	Healthcare professionals in the GCC countries perceive the EHR system to enhance access to information from past medical records.
			Paperless	Healthcare professionals in the GCC countries perceive the EHR system to eliminate the use of paper.
			Improves future research	Healthcare professionals in the GCC countries perceive the EHR system to improve future research.
			I feel the quality of information has improved due to EHR	Healthcare professionals in the GCC countries perceive the EHR system to improve the quality of information.
Perceived ease of use variables	Individual	Perceived ease of use by the individual providers, such as easy to gain skills to use and easy to learn	Enables easy access to information from past medical records/Easy access to past medical history	Healthcare professionals in the GCC countries perceived the EHRs to be easy to use by healthcare providers while accessing past medical records.
			Makes it easy to transfer data	Healthcare professionals in the GCC countries perceive the EHR system to be easy to use to transfer data by healthcare providers.
			Easy to save information	Healthcare professionals in the GCC countries perceive the EHR system to be easy to use to save information by healthcare providers.
	Organisational	Perceived ease of use related to the organisation, such as addressing providers' job-related needs	Makes it easy to transfer data	Healthcare professionals in the GCC countries perceive the EHR system to be easy to use to transfer data at the organisational level.
	System	Perceived ease of use related to the system, such as easy to use and user friendly	Enables easy access to information from past medical records	Healthcare professionals in the GCC countries perceive the EHR system to be easy to use for accessing information from past medical records.
			User-friendly	Healthcare professionals in the GCC countries perceive the EHR system to be user-friendly.
Attitude variables	Individual	Enhance overall job effectiveness	I feel EHR is useful	Healthcare professionals in the GCC countries have a positive perception towards the usefulness of the EHR system to the individual providers.
			I feel EHR is worth the time and effort required to use it	Healthcare professionals in the GCC countries have a positive perception towards the use of the EHR system by healthcare providers.
			I feel the quality of my work has improved	Healthcare professionals in the GCC countries have a positive perception of the EHR benefit of improving the quality of work of individual providers.

			I feel my performance has improved due to EHR	Healthcare professionals in the GCC countries have a positive perception of the EHR benefit of improving performance of the individual providers.
			Overall, I am satisfied with the EHR system in primary healthcare centres	Healthcare professionals in the GCC countries have an overall positive perception towards the adoption of the EHR system in primary care organisations.
	Organisational	Enhance overall job effectiveness	I feel EHR is useful	Healthcare professionals in the GCC countries have a positive perception towards the usefulness of the EHR system to primary care organisations.
			I feel EHR is an important system for primary healthcare centres	Healthcare professionals in the GCC countries have a positive perception towards the importance of the EHR system for primary care organisations.
			I feel EHR has been successful in primary healthcare centres	Healthcare professionals in the GCC countries have a positive perception towards the success of the EHR system in primary care organisations.
			I feel the EHR improves the quality of healthcare services in primary health care centres	Healthcare professionals in the GCC countries have a positive perception towards the impact of the EHR system in improving the quality of healthcare services in PCCs.
			I feel patient safety has improved due to EHR	Healthcare professionals in the GCC countries have a positive perception of the EHR benefit of improving patient safety in PCCs.
	System		I feel the quality of information has improved due to EHR	Healthcare professionals in the GCC countries have a positive perception of the ability of the EHR system to improve the quality of information in PCCs.

The framework is unique to the GCC context due to the countries' shared characteristics. It shows that the adoption of EHRs in primary care settings in the GCC countries could be influenced by the perceptions of healthcare professionals towards the system. The perceptions are also influenced by external factors related to the healthcare professionals, the organisation and the EHR system. Further, the framework conceptual framework shows that these factors could influence the perceptions and adoption of EHRs at individual, organisational or system levels. Thus, primary healthcare organisations in the GCC countries should take into consideration these factors when implementing EHRs in order to ensure successful adoption. This is represented in Figure 7.1.

Specifically, the framework identifies that healthcare administrators in PCCs in the GCC countries should address the individual factors, namely occupation, age, gender, nationality, length of work experience, previous training and experience in EHRs because of their influence on the healthcare professionals' perceptions of EHRs that may in turn affect acceptance and use of the systems in primary care. The framework also highlights the need for primary care organisations to provide adequate training, management and technical support, and proper IT infrastructure to improve perceptions of healthcare professionals towards the adoption of the EHRs in PCCs. Lastly, the organisations could apply this framework to identify the specific system characteristics that influence the perceptions of the healthcare providers in the GCC countries towards the EHR system in primary care. These are mainly perceived benefits of and obstacles to adopting the system at the individual, organisational or system level. Overall, adequately addressing these individual, organisational and system characteristics will significantly improve the perceptions of healthcare professionals in the GCC countries towards the EHRs and hence acceptance, adoption and use.

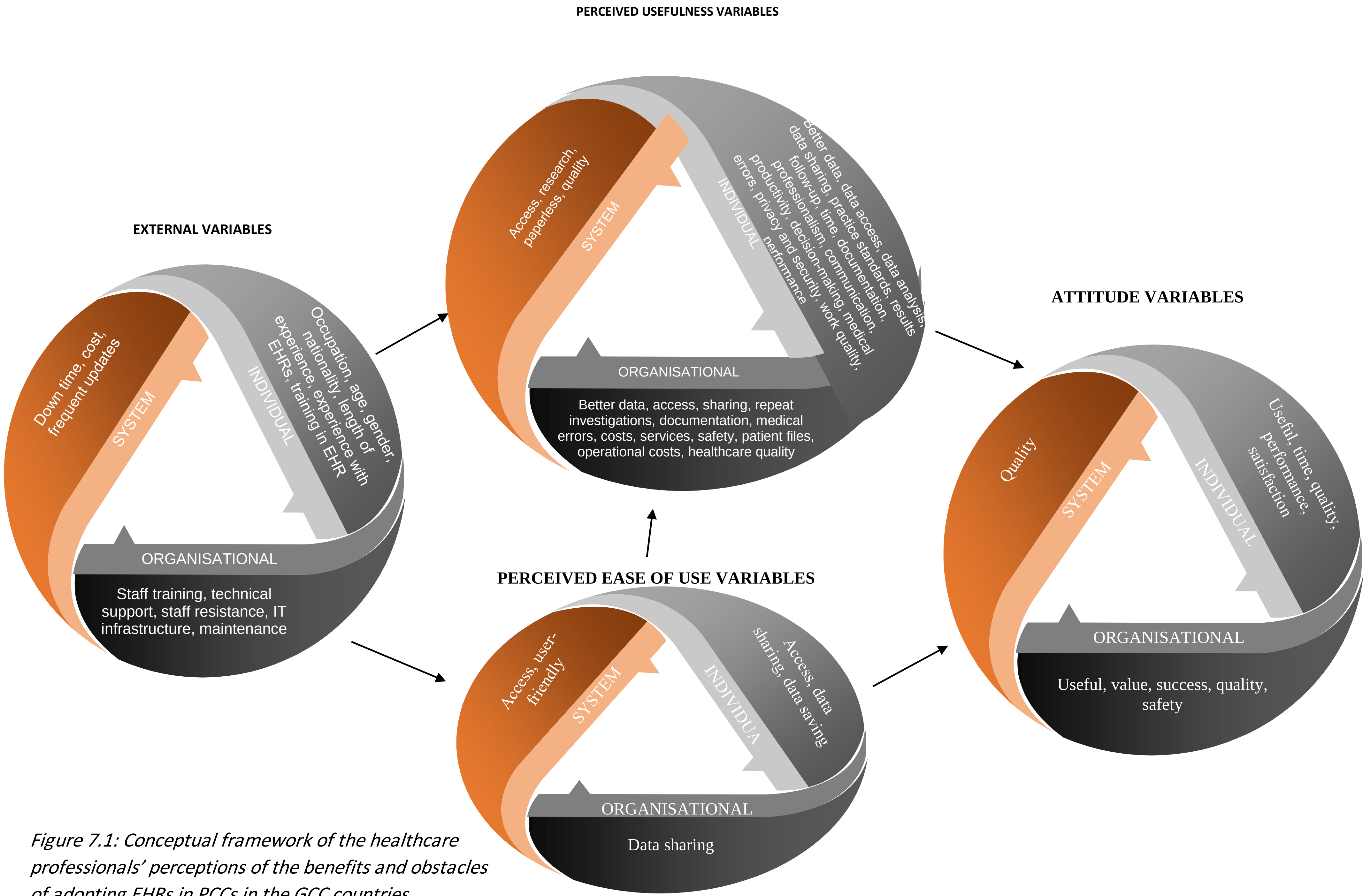

Figure 7.1: Conceptual framework of the healthcare professionals' perceptions of the benefits and obstacles of adopting EHRs in PCCs in the GCC countries

CHAPTER 8 : CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This is the final chapter of this thesis. It presents a summary of the findings and discusses the developed conceptual framework. The chapter also discusses the contribution of the study to the literature and implications for practice, education and future research. It concludes by discussing the limitations of the study and providing recommendations for future research.

8.2 Summary of the main points

This thesis aimed to evaluate the healthcare professionals' perceptions towards the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. In order to achieve this aim, a large-scale survey exploring the perceptions of healthcare providers towards the benefits and obstacles to adopting EHRs as well as satisfaction with the system in primary care was undertaken in Riyadh city. Factors influencing these perceptions and satisfaction with the EHRs in primary care were also examined. Lastly, a conceptual framework for the adoption and use of EHRs in primary care in the GCC context was developed from the study findings and theoretical knowledge from the literature. The findings of this thesis are summarised below.

This study found a positive perception of EHRs by healthcare professionals working in PCCs in Riyadh city, Saudi Arabia, as demonstrated by high agreement levels with benefits of adopting EHRs and low agreement levels with the obstacles. All the statements related to the benefits of adopting EHRs in primary care setting had a high agreement level of over 60%. The statement with the lowest agreement level was that EHR 'reduces medical errors' (63.5%) and that with the highest agreement level was that an EHR 'decreases paper-based documentation' (77.1%). The respondents also reported several benefits of EHR in primary care based on their own experience. These include improved health care delivery (45.7%), enhanced information sharing (26.5%) and increased productivity and efficiency (26.5%) among others.

With regard to obstacles to adopting EHRs in primary care, all the related statements except one that an EHR system ‘needs frequent revisions due to technological developments’ had a low agreement level of less than 30%. The need for frequent revisions due to technological developments was the most commonly perceived barrier to adopting EHRs in primary care, with an agreement level of 45.3%. The statement that an EHR system ‘is too complicated and not user-friendly’ had the lowest agreement level of 17.04% hence the least perceived obstacle to adopting EHRs in PCCs in Riyadh city. The healthcare professionals’ also identified other obstacles based on their experience and some of these included lack of staff training (39.2%), poor IT infrastructure (15,5%), and reduced productivity and disruption of workflow (13.5%).

The healthcare professionals’ positive perception towards EHRs was also evidenced by satisfaction with the system in primary care. All of the statements related to satisfaction with EHRs had a high agreement level of more than 65%. The overall satisfaction with EHRs in PCCs was 69.1%, with the majority of the respondents agreeing that an EHR system is useful (78.9%), is an important system for PCCs (77.0%), and is worth the time and effort required to use it (70.1%). The high satisfaction and positive perceptions of EHRs in primary care settings in Riyadh city could be related to the perceived usefulness and perceived ease of use. Conversely, perceived obstacles to adoption resulted in negative perceptions. The benefits of EHRs that result in positive attitudes could act as facilitators to adopting EHRs in primary care settings as opposed to the challenges or risks of use of EHRs that create negative perceptions hence acting as barriers to EHR adoption by healthcare professionals.

The healthcare professionals' perceptions of EHR benefits were also strongly positively correlated with satisfaction with EHRs in PCCs (canonical correlation coefficient, r = 0.91). Conversely, the perceptions of the obstacles to adopting EHRs had a weak negative correlation with satisfaction (canonical correlation coefficient, r = 0.45). In general, healthcare professionals in PCCs were more likely to accept and adopt EHRs in their practice due to positive perceptions of the system's benefits. They were also likely to reject the system due to negative perceptions of the obstacles, including challenges and risks of using an EHR system. Thus, primary care settings in the GCC countries should introduce EHR systems that are not only useful to the user and the organisation but also easy to use in order to improve acceptance and adoption due to positive perceptions. The challenges and risks that lead to barriers to adopting EHRs in primary care settings in the GCC countries should also be identified early and appropriately addressed.

This study also showed that the perceptions of EHRs in primary care in Riyadh city were influenced by various factors that could be categorised as the individual, organisational and system characteristics. The individual characteristics were mainly sociodemographic factors that were found to affect the perceptions of EHRs at the individual level of the user. These included occupation, age, gender, nationality, length of time working in PCCs in Riyadh city, experience outside the Kingdom of Saudi Arabia, previous training in EHRs, and previous experience in EHRs. All these factors except previous experience in EHRs had a significant influence on healthcare professionals' perceptions of benefits to adopting EHRs in primary care ($p < 0.05$). For instance, physicians had a higher positive perception of EHRs in PCCs than other healthcare professionals. Similar findings were found with females, older professionals, non-Saudis, longer experience, training in EHRs and experience outside Saudi

Arabia. However, the perceptions of obstacles were influenced by four factors, including occupation, age, nationality, and experience outside the Kingdom of Saudi Arabia. The remaining characteristics (gender, length of time working in PCCs in Riyadh city, previous training in EHRs, and previous experience in EHRs) did not have significant influence on perceptions of most items related to obstacles of adopting EHRs in primary care ($p > 0.05$). Similar to the perceptions of EHR benefits, satisfaction with the system was also significantly influenced by all of the sociodemographic characteristics except previous experience in EHRs. System characteristics were technical factors including the system's benefits, challenges, and risk of use such as enhanced access to patient data, complexity, and difficulty in ensuring data security associated with positive or negative perceptions of EHRs. These factors also influenced perceptions at the individual, organisational or system level. For example, the statements that an EHR system 'saves time in documenting health data', 'enables easy access to information from past medical records', and 'provides access to patient data and analysis' are perceived benefits at the individual, organisational and system levels respectively. Lastly, the organisational characteristics involved organisational factors such as staff training, technical support and poor IT infrastructure that may influence users' perceptions of an EHR in primary care settings. This study, therefore, showed that EHR implementers, including the governments, private sector, and healthcare organisations must address all of the factors that may influence the successful adoption and implementation of EHRs in primary care settings. Within the context of the GCC, much emphasis should be placed on the individual, organisational and system factors as they have been shown to have a significant influence on healthcare professionals' perceptions of EHRs in these settings.

8.3 Conceptual framework for EHR adoption in GCC countries

For the development of the TAM-based conceptual framework for the adoption and use of EHRs in primary care settings in the GCC context, the individual, organisational and system characteristics were examined under each of the four TAM variables (external variables, perceived usefulness, perceived ease of use, and attitude towards EHR adoption) investigated in this thesis. External variables included individual factors, mainly characteristics of healthcare professionals, system characteristics such as costs, and organisational characteristics such as staff training. Perceived usefulness and perceived ease of use were mainly technical factors, including perceived benefits and obstacles to adopting EHRs in primary care, such as the provision of better data, enhanced communication, and complexity and user-friendliness of the system. Attitude involved factors associated with items for satisfaction with EHRs in primary care. Finally, the factors under each TAM variable were grouped based on the level of their effect. These results among healthcare professionals in Saudi Arabia together with the findings from the literature are presented as a final conceptual framework to predict EHR adoption by healthcare professionals working in PCCs.

The framework showed that the perceptions of healthcare professionals towards the adoption of EHRs in primary care settings in the GCC countries are influenced by individual, organisational and system factors. The individual factors, including occupation, age, gender, nationality, length of experience in primary care in Riyadh city, prior experience outside the Kingdom of Saudi Arabia, and previous training in EHRs influenced perceptions both directly and indirectly through perceived usefulness and perceived ease of use of EHRs. These two main system characteristics had a direct influence on perceptions. The framework also showed that organisational characteristics, including staff training, technical support, IT infrastructure, and staff resistance have both direct and indirect impact on users' perceptions towards EHR adoption in primary care settings in the GCC countries.

8.4 Contribution of the study

This study makes a significant contribution to the literature by advancing and expanding the existing knowledge on factors influencing users' behaviour towards EHR systems in primary healthcare. The literature evidence shows that user and system characteristics are critical factors that affect behaviour of the user towards a technology. These impacts have been widely investigated in different settings with different technologies with the help of TAM. However, the previous studies have provided conflicting results mainly due to variations in settings and technologies. In the wake of these limitations, this study developed a conceptual model based on TAM that is applicable to the GCC context that would help to explain healthcare professionals' behaviour in relation to accepting, adopting and using EHRs in primary healthcare in these settings. Moreover, the study provides broad insights into factors influencing perception and in turn the adoption of EHRs specific to primary care settings. The findings have been reported as research and conference papers and/or presentations; thus, facilitating knowledge transfer and sharing with other researchers and stakeholders in EHR implementation in primary care settings. Specifically, these include:

1. The findings of the influence of age, experience and EHR training on the healthcare professionals' perception about EHR role in reducing medical errors published and presented as a conference paper entitled 'An exploration of the effect of age, experience and training on the EHR role in reducing medical errors: perceptions of health professionals' in Proceedings of the HIMAA/NCCH 35th National Conference, Health Information Management: Engaging the Next Generation, 31 October–2 November 2018 (Appendix 1).

2. The findings of the healthcare professionals' perception about the benefit of EHR in improving communication between health professionals in primary healthcare centres in Riyadh. This was published and presented as a conference paper entitled 'The role of electronic health records in improving communication between health professionals in

primary healthcare centres in Riyadh: perception of health professionals' in MEDINFO 2019: The 17th World Congress on Medical and Health Informatics Health and wellbeing e-networks for all 25-30 AUGUST, 2019 - LYON FRANCE (Appendix 2).

3. The influence of nationality on the healthcare professionals' perception of EHR role in improving the quality of healthcare services presented as a conference paper entitled 'Electronic health records and healthcare quality: perception of Saudi and non-Saudi healthcare professionals during the 19th IFHIMA International Congress 17th – 20th November 2019, Intercontinental Hotel – Dubai Festival City, Dubai, United Arab Emirates (Appendix 4).

A systematic review also resulted in two papers that have already been accepted for publication as follows:

1. The manuscript entitled 'Factors influencing healthcare professionals' perception towards EHR/EMR systems in Gulf Cooperation Council Countries: a systematic review' has been accepted for publication by Oman Medical Journal (Appendix 3).

2. A related paper entitled 'Perceptions of healthcare professionals about the adoption and use of EHR in Gulf Cooperation Council countries: A systematic review' has also been accepted for publication by BMJ Health & Care Informatics (Appendix 5)

The outcome of this study, therefore, bridges a gap in knowledge, in different facets. There are several areas to which this study adds value and contributes significantly to knowledge, including multiple uses of various research methodologies to answer the research questions. The contribution of the thesis can be summarised within two perspectives: the practical and the theoretical, as presented below.

8.4.1 Practice perspective

The results of this study can help the General Directorate of Health Affairs in Riyadh Region management and other stakeholders such as the MoH to better understand the adoption of EHRs specific to primary care settings, which could help develop better implementation plans in the future. From the views expressed by the healthcare professionals in this study, healthcare leaders should recognise the significant role of users' levels and needs in a successful EHR implementation, such as training, adequate technical support and good IT infrastructure. The managers should also recognise the importance of healthcare professionals' involvement before, during and long after implementation since they are the primary users of the system. In order to achieve these goals, the MoH leaders might establish programs, orientation days and policy adjustments, to involve healthcare professionals in primary healthcare decisions regarding adoption of EHRs. This would enhance healthcare professionals' commitment to adopting the systems and increase their productivity and efficiency.

EHR developers could also draw from the findings of this study to develop systems that accommodate the different specialities and needs of the users. This is particularly important considering that an EHR system in a hospital setting might not be suitable for a primary care centre. Different healthcare providers might also have different levels of knowledge and skills in using EHRs. Although this study found that the majority of primary healthcare providers in Riyadh city did not perceive an EHR system to be complicated and not user-friendly, developers should always develop a system that is not only beneficial to the users but also simple and easy to use.

8.4.2 Theoretical perspective

This study shows that the healthcare professionals in PCCs in Riyadh city had a positive attitude and were generally satisfied with the EHR system in a primary care setting. The findings contribute to the existing body of knowledge in the fields of perception of the healthcare professionals towards adoption of EHRs in primary care settings. Specifically, the study improves our understanding of the benefits of adopting EHRs in PCCs as well as obstacles to the adoption and satisfaction with the EHR system in PCCs in Saudi Arabia, which has not been adequately addressed in previous studies. The previous studies have primarily focused on EHRs' usage in hospital settings, and those conducted in primary care settings have not been able to yield sufficient knowledge on the subject of healthcare professionals' perception on the adoption of EHRs in primary care.

This study has also identified factors that could influence the adoption of EHRs in PCCs in Saudi Arabia from user, system and organisational perspectives. These findings are incorporated into a conceptual model based on TAM that can be applied across the countries of the GCC to explain healthcare professionals' behaviour in relation to accepting and using the EHR system in primary care. Thus, this thesis merges the fragmented literature by generating new knowledge and contributes to our understanding of the perception of health professionals on the adoption of EHRs in PCCs in Saudi Arabia and the GCC countries at large where such studies are scarce. Finally, the findings of this study provide new directions for further research.

8.5 Limitations of the study

This study had some limitations that could affect the credibility of its results. First, it is limited in the scope of factors that influence perceptions of healthcare providers towards EHRs. The study mainly focused on the individual, organisational and system characteristics, yet other factors such as pedagogical beliefs, user participation in the system design, and the nature of the system's implementation process have been shown to influence the adoption and use of technology systems. Secondly, the findings of this study may not be generalisable to private PCCs since it was conducted in only public PCCs. These two facilities differ in several ways, such as infrastructure and other resource availability as well as management system. Third, due to the nature of the study, it only examined the healthcare professionals' perceptions towards the adoption of EHRs in primary care without demonstrating the causal link between the variables, such as individual characteristics, perceived usefulness, and perceived ease of use as well as attitude. It was, therefore, not possible to determine the actual impact of these factors on the perceptions of the healthcare providers. Lastly, the study was based on a survey that may lead to the collection of false data as it is difficult to verify the accuracy of the obtained data or limit the amount of information collected.

8.6 Implications for practice and future research

8.6.1 Practice implications

The use of EHRs is associated with several clinical benefits that improve patient safety and the quality of healthcare services provided to the patients. Thus, EHRs are perceived to be important tools in healthcare. However, their adoption and use in order to achieve these outcomes are influenced by the perceptions of the users. This study found a positive perception of EHRs by healthcare professionals in PCCs in Riyadh city, Saudi Arabia that imply that primary care providers in Saudi Arabia and other similar settings in the GCC countries and the world are more likely to adopt EHRs in their practice. The positive perception was mainly attributed to the systems' usefulness and ease of use. Thus, perceived usefulness and perceived ease of use could be significant predictors of EHR adoption in primary care settings. The perceived usefulness suggests that all PCCs should adopt and implement appropriate EHR systems that provide the desired clinical benefits in their contexts to improve the quality of care. Further, the deployed systems should be easy to use and user-friendly in order to promote their acceptance and use in primary care.

Similarly, the perceptions of healthcare professionals were influenced by several factors that involve individual, organisational and system characteristics. These factors have a direct impact on perceived usefulness and perceived ease of use that in turn influences the attitude and behavioural intention to use an EHR system. Further, the individual and organisational factors have a direct effect on the providers' perceptions. The findings, therefore, suggest that the implementation of EHRs in primary care settings should take into account the external factors such as the demographic variables of the healthcare professionals in order to realise their benefits in healthcare. Specifically, the system should be adaptable to individual clinic workflow requirements and user needs.

Lastly, the organisational factors, such as technical support and staff training that may affect the perceptions of healthcare providers towards EHRs. With evidence that training in EHRs is significantly associated with perceived usefulness of EHRs, healthcare managers should employ training as an effective strategy for facilitating and improving the capacity of their healthcare professionals to adopt and effectively use EHRs in clinical practice. Training in computer and related technologies could improve the users' knowledge, skills and experience in the design and use of EHRs which is likely to reduce resistance and improve adoption. In Saudi Arabia, the training should mainly target the laboratory technicians, Saudi professionals, and those with fewer years of experience in order to enhance their knowledge and skills. Overall, the individual, organisational and system related factors that may influence the adoption of EHRs in primary care should be taken into account in primary care settings in the GCC countries so as to facilitate the adoption of the system.

8.6.2 Future research

Future research should evaluate the perceptions about the developed conceptual framework through more robust research methods, such as in-depth interviews with healthcare professionals, executive and managers, policy makers and peak bodies. Through in-depth interviews, much comprehensive information could be obtained since interviews can help to explain, better understand and explore the opinions, thoughts, behaviour and experiences of healthcare professionals in relation to the adoption and use of EHRs in PCCs. In-depth interviews can also unearth new issues and provide a more complete picture of what is going in EHR adoption and reasons for the same. This approach might also help to find more information about the framework and its application in PCCs in the GCC countries. Secondly, the framework should be tested in PCCs by comparing GCC and non-GCC environments where an EHR system has been implemented in a PCC. Lastly, future studies should attempt to evaluate the perceptions of healthcare professionals in PCCs in rural or remote areas since this study was conducted in an urban setting yet there are noticeable disparities in allocation and utilisation of HIT infrastructure between these areas (Almaiman et al. 2014).

8.7 Recommendations

Based on the above findings, the following three main recommendations can be made from this thesis.

1. Saudi MoH should use this framework to inform their EHR implementation across all PCCs in the country as part of the Health Sector Transformation Strategy spearheaded by the Vision Realisation Office to attain value-based healthcare envisioned in the Saudi Vision 2030.

2. Any organisation or jurisdiction seeking to implement an EHR system into a PCC in the GCC context may use this framework to inform their implementation strategy, including consideration of the following factors:
    - Provide adequate training as lack of staff training emerged as a potential obstacle to adopting EHRs in primary care. In this regard, the primary care organisations should adequately train their staff about EHRs in order to improve their knowledge about the importance of adopting and using EHRs in primary care practice as well as enhancing their technical skills in using the system to minimise the digital divide. Improved knowledge and ability to use the EHR system due to staff and users' training could also significantly reduce resistance and increase acceptance by healthcare professionals.
    - Provide adequate technical support to the providers that may include guidance on how to use the system and address challenges that may arise with the use of EHRs such as frequent breakdowns. This support should be provided at all stages of the EHR adoption process, including during the pre-implementation, implementation, and post-implementation periods in order to ensure that the users' concerns with the system are adequately addressed as they arise.
    - Maintain effective communication during the whole phase of implementation. This communication should focus on the reasons for the adoption of the system and to obtain the views of the users regarding the intended system. Further, continuous communication with the users of the system would allow the organisations to obtain adequate feedback that may inform future implementation or improvement plans.
    - Putting in place appropriate contingency measures for addressing unintended consequences of EHRs such as disruption of workflow and provider-patient

interaction as well as a security threat to patient data. This is important because these factors are likely to discourage users from using EHR systems which is detrimental to successful implementation.

3. There should be continued research in this area from different perspectives including other stakeholders involved in the EHR implementation and adoption process. The research should also focus on non-GCC settings that have implemented an EHR system.

8.8 Summary of the thesis

This thesis evaluated the healthcare professionals' perceptions about the adoption of EHRs in PCCs in Riyadh city, Saudi Arabia. It was shown that healthcare professionals in Riyadh have an overall positive perception towards EHRs in primary care. The positive perceptions were associated with the benefits of adopting EHRs in primary care, such as enhanced access to past medical records, improved communications, reduced medical errors, and improved quality of care. These perceived benefits were positively associated with satisfaction with EHRs. Conversely, the respondents had a negative perception of EHRs related to the challenges or risks of adopting and using an EHR system, such as need for frequent revisions, privacy and security violations, and lack of adequate staff training. These factors act as barriers to the adoption of EHRs in primary care settings. This thesis also showed that the perceptions of healthcare professionals in Riyadh city were influenced by several factors ranging from individual to system characteristics. Thus, the developed conceptual framework for the adoption of EHRs in PCCs in the GCC countries suggests that the adoption of EHRs in these settings is influenced by users' perception that is also influenced by individual, organisational and system characteristics broadly categorised as external variables, perceived usefulness, perceived ease of use and attitude toward using as postulated by TAM. Further, these factors were shown to exert their influence at different levels, including the user, organisation or system. In view of this thesis finding, administrators of primary care organisations in the GCC countries should implement the EHR systems that meet the needs of healthcare professionals related to perceived usefulness and perceived ease of use in order to increase acceptance and adoption.

APPENDICES

Appendix 1: Abstract of paper 1 derived from the thesis

An Exploration of the Effect of Age, experience and training on the EHR Role in Reducing Medical Errors: Perception of Health professionals

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Abstract

Introduction: *The demand for quality health services has increased tremendously over the years. The government has been under intense pressure to increase the level of efficiency in service delivery. However, this pressure on health professionals has resulted in numerous medical errors.*

Aim/Objectives: *The aim of this study was to probe the effect of age (years of working), experience (use) and training of healthcare professionals on the role of electronic health records (EHR) in reducing medical errors.*

Method: *An online questionnaire was used by professionals working in primary healthcare centres in Riyadh City, Saudi Arabia.*

Results: *There were 1127 respondents particularly younger and older professionals (years of working as health professionals) perceived that EHR could have an important role in reducing medical errors. Respondents aged 20–30 years of working in health profession had the highest (73.3%) level of satisfaction in using EHR to reduce medical errors. The 30–40 years (61.7%) experienced group (EHR use) agreed that experience with the EHR use in medical field has a significant impact in reduction of medical errors, followed by those 20-30 years of experience. Similarly, 63.3% of the participants agreed that training in EHR usage in medical practice has a major impact in reduction of medical errors and its impacts is evenly distributed among all the health professionals.*

Conclusion: *Age, experience and training are statistically significant in influencing the attitude of healthcare professionals towards the adoption of electronic health records in reducing medical errors.*

Keywords. Electronic health records, EHR, medical errors, healthcare professionals

Appendix 2: Abstract of paper 2 derived from the thesis

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The Role of Electronic Health Records in Improving Communication Between Health Professionals in Primary Healthcare Centres in Riyadh: Perception of Health Professionals.

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2 King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.

Abstract

Improving communication among healthcare providers is one of the critical components of safe and quality patient care. The study objective is to examine how occupation and training of health professionals in Riyadh, Saudi Arabia influence professionals' perception of the role of electronic health records (EHRs) in improving communication between healthcare providers in primary healthcare centres. A survey-based study method employing a descriptive, cross-sectional design was used. Health professionals' occupation and training were found to influence their perception of the role of the EHR in improving interprofessional communication. Physicians and professionals with training on EHRs had the highest rating for the system's role in improving communication between healthcare professionals. All healthcare providers should embrace EHR systems in their practice to promote interprofessional communication and collaboration in the patient care process.

KEYWORDS: Electronic health records; Health personnel; Primary health care

PMID: 31437973 DOI: 10.3233/SHTI190272

[Indexed for MEDLINE]

Appendix 3: Abstract of paper 3 derived from the thesis

Factors Influencing Healthcare Professionals' Perception towards EHR/EMR Systems in Gulf Cooperation Council Countries: A Systematic Review

Bander Alanazi[1], Dr Kerryn Butler-Henderson[2], Dr. Mohammed R. Alanazi [3]

[1] *Tasmanian School of Business & Economics, Launceston, TASMANIA, Australia,*
[2] *Tasmanian School of Business & Economics, Launceston, TASMANIA, Australia,*
[3] *King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.*

ARTICLE INFO

Keywords:
Perception,
Efficacy,
EHR/ EMR,
Quality healthcare services,
Gulf Cooperation Council Countries
Electronic health information system (HIS)

A B S T R A C T

Electronic health and medical records are widely adopted in many healthcare settings around the world to improve the quality of care. The users' perception is a significant factor influencing the successful implementation and use of e-health technologies. The aim of this systematic review was to identify factors influencing the perceptions of healthcare professionals towards the adoption and use of electronic health and medical record systems to improve the quality of healthcare services in the countries of the Gulf Cooperation Council. We identified primary studies evaluating the perception of healthcare professionals towards electronic health record and/or electronic medical record in the Gulf region. Seven electronic databases including Medline, CINAHL, Informit Health Collection, Science Direct, Proquest, PubMed and Scopus were used to search for the relevant articles published between January 2007 and December 2016. Thirteen articles met the inclusion criteria and were included in this systematic review. Both individual and system-related factors were found to positively or negatively influence the perceptions of healthcare providers towards the systems. Understanding the impact of healthcare professionals' perception of health information technology is important for policymakers involved in the implementation programs to ensure their success. Future studies should evaluate other individual characteristics such as age, gender and profession of the healthcare providers on their perceptions towards the e-health technologies.

Appendix 4: Part of abstract of paper 4 derived from the thesis

ELECTRONIC HEALTH RECORDS AND HEALTHCARE QUALITY: PERCEPTION OF SAUDI AND NON-SAUDI HEALTHCARE PROFESSIONALS

Abstract

Background

Improving healthcare quality is one of the core objectives for implementing electronic health record (EHR) in a healthcare setting. However, EHRs are not extensively used in primary care in Saudi Arabia. The objective of this paper is to examine the influence of nationality on healthcare professionals' perception of EHR role in improving healthcare quality in primary care practices. This was part of a study undertaken to explore the perceptions of healthcare providers in the primary health setting in Riyadh City, Saudi Arabia on the effect of EHRs on the quality of service provision.

Methods

All healthcare professionals (1710) working in primary healthcare centres (PHCCs) in Riyadh, Saudi Arabia were invited via email to complete an online survey, deployed using the Research Electronic Data Capture (REDCap) web application. Consent was obtained at the start of the survey, and no identifying information was captured, ensuring responses were anonymous.

Results

A total of 1127 surveys were completed, representing a response rate of 66%. The majority (72%) of respondents identified themselves as Saudi nationals. In general, 74.8% of the healthcare providers agreed that the use of EHR improves the quality of healthcare services in PHCCs. However, Saudi (n=811) and non-Saudi (n=316) healthcare professionals significantly differed in their perceptions of EHR effect on healthcare quality with the latter group reporting a higher level of agreement that the use of EHRs positively impacted the quality of service provision. Compared to Saudis, more non-Saudi providers agreed that a EHR provides quick and reliable access to scientific research (Non-Saudi: 84.5%, Saudi: 72.6% agreement; $p < 0.001$), enables following test results (Non-Saudi: 77.5%, Saudi: 74.5%; $p < 0.001$), provides access to patient data and analysis (Non-Saudi: 80.7%, Saudi: 75.3%; $p = 0.002$), provides better data (Non-Saudi: 76.3%, Saudi: 73.9%; $p = 0.002$), and enables easy access to information from past medical records (Non-

Appendix 5: Part of paper 5 derived from the thesis

Perceptions of healthcare professionals about the adoption and use of EHR in Gulf Cooperation Council countries: A systematic review

Bander Alanazi[1], Dr. Kerryn Butler-Henderson[2], Dr. Mohammed R. Alanazi [3]

[1]College of Health and Medicine, University of Tasmania, Launceston, TASMANIA, Australia.
[2] College of Health and Medicine, University of Tasmania, Launceston, TASMANIA, Australia.
[3] College of Public Health & Health Informatics, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia,

Address for correspondence

Bander Dowahi Alanazi,

Postal address

Email: bander12@live.com

Telephone: 00966503250950

Word count: 3757

Appendix 6: Ethics Approval by the Tasmanian Social Sciences Human Research Ethics Committee

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

27 July 2017

Dr Kerryn Butler-Henderson
Tasmanian School of Business and Economics
University of Tasmania

Student Researcher: Bander Alanazi

Sent via email

Dear Dr Butler-Henderson

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0016730 - Healthcare Professionals Perception on The role of Electronic Health Records in Improving the Quality of Healthcare Services in Primary Healthcare centres in Riyadh City**

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 27 July 2017.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics

Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES

Appendix 7: Principal Supervisor's Letter Directed to the Acting Director for the General Administration of Research and Studies, Ministry of Health

UNIVERSITY *of* TASMANIA

TASMANIAN SCHOOL OF BUSINESS AND ECONOMICS

Athari Faisal Alotaibi
Research Capacity Building Project Manager
Acting Director for the General Administration of Research and Studies
Ministry of Health
Kingdom of Saudi Arabia

9 May 2017

Dear Athari Faisal Alotaibi

Re: PhD Study Mr Bander Alanazi

Mr Alanazi is undertaking his Doctor of Philosophy with me as his primary supervisor at the University of Tasmania. His study, titled "Healthcare professionals perception on the role of electronic health records in improving the quality of healthcare services in primary healthcare centres in Riyadh" seeks to survey healthcare professionals in primary healthcare centres in Riyadh. The survey responses will be analysed understand their perceptions towards the role the electronic health record (EHR) plays in improving the quality of healthcare services.

Mr Alanazi wishes to distribute the information about his survey through the General Directorate of Health Affairs. He is seeking your permission or advice on how he can achieve this. Mr Alanazi can provide a copy of his research proposal and will be able to provide his letter of approval from our University Ethics Committee once received.

Please do not hesitate to contact Mr Alanazi at Bander.Alanazi@utas.edu.au or telephone 05 should any further information be required.

Yours Sincerely

Dr Kerryn Butler-Henderson
Senior Lecturer
Health Information Management
University of Tasmania
Kerryn.Butlerhenderson@utas.edu.au

University of Tasmania
Locked Bag 1317
Launceston Tasmania
7250 Australia

T 1800 030 955
F +61 3 6324 3369
utas.edu.au/business-and-economics
ABN 30 764 374 782 / CRICOS 00586B

Appendix 8: Principal Supervisor's Letter to General Directorate for Research and Studies

UNIVERSITY *of* TASMANIA

University of Tasmania

Australian Institute of Health Service Management Tasmanian School of Business & Economics
Locked Bag 1317 Launceston Tasmania AUSTRALIA 7250 **Date: 2 August 2017**
Phone No: +613 6324 3329

To whom it may concern

General Directorate for Research and Studies
GDRS-MoH- KSA

Dear Sir,

I write to bring to your kind attention that PhD student Bander Alanazi is a candidate in the Tasmanian School of Business & Economics, University of Tasmania.

The research topic is "Healthcare professionals' perception on the role of electronic health records in improving the quality of healthcare services in primary healthcare centres in Riyadh".

With permission of the Ministry of Health in Saudi Arabia, he may collect data from all Ministry primary health care centres.

He has pre-approved explanatory statements for those interested in participating. The main instrument for data collection will be a survey.
On completion of the study, the GDRS-MoH-KSA will be provided with the findings of the study through a final report and a copy of the thesis, and data will be shared according to the Data Share Agreement with GDRS-MoH, KSA.

If you have any questions please do not hesitate to contact me.

Yours sincerely

Dr Kerryn Butler-Henderson

Australian Institute of Health Service Management

Kerryn.Butlerhenderson@utas.edu.au

Appendix 9: General Administration of Research and Studies, Ministry of Health Approval Letter

Kingdom of Saudi Arabia
Ministry of Health
General Directorate for Research and Studies
(GDRS)

Preliminary Approval Letter

Date: 16/05/2017

University of Tasmania
School of Business and Economics
Australia

Subject: To facilitate the mission of Ms. Bander Dowahi Alanazi
Academic No.: 424652

To whom it may concern

Dear Sir/Madam,

This is a preliminary approval letter to ***Ms. Bander Dowahi Alanazi,*** who submitted an application to ***The General Directorate for Researches and Studies, Ministry of Health, Kingdom of Saudi Arabia (GDRS-MoH)*** to conduct his research project titled ***"Healthcare Professionals Perception on the role of Electronic Health Records in Improving the Quality of Healthcare Services in Primary Healthcare centers in Riyadh City"*** as a part of his Ph.D degree thesis at PHC centers, Riyadh, KSA to be started from **(30/11/2017)** to **(30/1/2018)**.

Please note that according to our rules and regulations, the proposal needs to be accepted by MoH scientific and ethical reviewing committees prior conducting the study at MoH facilities.

Yours Faithfully,,,,,

Assistant Director
General Directorate for Research and Studies

Athari F. Alotaibi

Phone: +966114735038 Fax: +966114735039 P.O. Box: Riyadh 2775 Postal Code: Riyadh 11176
e-mail: research@moh.gov.sa

Appendix 10: General Directorate of Health Affairs approval letter

Kingdom Of Saudi Arabia
Ministry Of Health
General Directorate Of Health Affairs
In Riyadh
P.H

وزارة الصحة
Ministry of Health

المملكة العربية السعودية
وزارة الصحة
مديرية الشؤون الصحية في منطقة الرياض
إدارة الصحة العامة
١٠٠/٢٧٥

<u>تعميم</u>

سعادة / مشرف القطاع الصحي(داخل وخارج الرياض) المحترمين

السلام عليكم ورحمة الله وبركاته

تجدون بطيه خطاب سعادة مساعد المدير العام للتخطيط والتطوير رقم ٢١٥٥٩٨-١٤٣٨وتاريخ ١٤٣٨/١٢/٢٦هـ المبني على صورة خطاب سعادة مساعد مدير عام الإدارة العامة للبحوث والدراسات بالوزارة رقم ٢١٥٥٥٩٨-١٤٣٨ وتاريخ ١٤٣٨/١٢/٢١هـ وكامل مشفوعاته بشأن البحث المقدم من الطالب/ بندر بن ضويحي العنزي بسجل مدني رقم (١٠٤٣٦٦٢٥٨٠) المبتعث لدراسة درجة الدكتوراه في جامعة تسمانيا باستراليا برقم أكاديمي (٤٢٤٦٥٢) وعنوان البحث (تصور الممارسين الصحيين حول دور السجلات الصحية الإكترونية في تحسين جودة الخدمات الصحية في مراكز الرعاية الصحية الأولية في مدينة الرياض)

نحيطكم علماً بأن الباحث قد استوفى كافة المستندات المطلوبة وتمت مراجعتها من قبل الإدارة العامة للبحوث والدراسات بوزارة الصحة ولجنة الأخلاقيات بمدينة الملك فهد الطبية، وعليه فقد تمت الموافقة على تسهيل مهمة إجراء هذا البحث وحيث أن الدراسة ستنفذ في مراكز الرعاية الصحية الأولية بمنطقة الرياض.

وعليه نأمل من سعادتكم التفضل بالاطلاع والإيعاز لمن يلزم بتسهيل مهمة الباحث لجمع البيانات اللازمة و مساعدة الباحث في تعبئة الاستبيان على الرابط الإلكتروني التالي: https://redcap.utas.edu.au/surveys/?s=LDAYNC98AW

، بما يضمن أن لايكون هناك أي تأثير على خدمة المراجعين خلال قيامه بمهام بحثه مع العلم بأن وزارة الصحة تضمن حقوقها في نتائج هذه الأبحاث من خلال اتفاقية المشاركة في البيانات والتي تم توقيعها بين الباحث والإدارة العامة للبحوث والدراسات.

وتقبلوا أطيب تحياتي،،،،

مدير إدارة شؤون المراكز الصحية
والقطاعات الإشرافية

١٤٣٩هـ

الأخصائي / أحمد بن حمد السعد

وحدة الموارد البشرية (عبد العزيز الخلف)

Appendix 11: Primary healthcare centres management approval letter

٢٠١٧/٩/١٢ sahel.moh.gov.sa/web/...
وزارة الصحة
12-09-2017 21-12-1438
1438-2155598
http://sahel.moh.gov.sa/web/R... 1/1

المملكة العربية السعودية
وزارة الصحة
الإدارة العامة للبحوث والدراسات

الموضوع: بحث الطالب/ بندر بن ضويحي فنيطل العنزي.

سعادة/ مدير عام الشؤون الصحية بمنطقة الرياض المحترم

السلام عليكم ورحمة الله وبركاته، ، ،

إشارة إلى موضوع الطالب / بندر بن ضويحي فنيطل العنزي، مبتعث من وزارة التعليم العالي برنامج خادم الحرمين الشريفين، لدراسة درجة الدكتوراه في جامعة تسمانيا باستراليا، ورقم السجل المدني (١٠٤٣٦٦٣٥٨٠) والرقم الأكاديمي (٤٢٤٦٥٢) وعنوان البحث:

" تصور الممارسين الصحيين حول دور السجلات الصحية الإلكترونية في تحسين جودة الخدمات الصحية في مراكز الرعاية الصحية الأولية في مدينة الرياض "

نحيطكم علماً بأن الطالب قد إستوفى كافة المستندات المطلوبة وتمت مراجعتها من قبل اللجان المعنية بالإدارة العامة للبحوث والدراسات ولجنة الأخلاقيات بمدينة الملك فهد الطبية بوزارة الصحة (مرفق صورة)، وتمت الموافقة على تسهيل مهمة إجراء هذا البحث، وحيث أن المذكور سينفذ دراسته في مراكز الرعاية الصحية الأولية في منطقة الرياض.

وعليه، نأمل من سعادتكم التفضل بالإطلاع والإيعاز لمن يلزم بتسهيل مهمته لجمع البيانات اللازمة بما يضمن أن لا يكون هناك أي تأثير على خدمة المراجعين خلال قيامها بمهام بحثها، مع العلم بأن وزارة الصحة تضمن حقوقها في نتائج هذا البحث من خلال إتفاقية المشاركة في البيانات والتي تم توقيعها بين الباحث والإدارة العامة للبحوث والدراسات.

وتفضلوا بقبول خالص تحياتـي ، ، ،

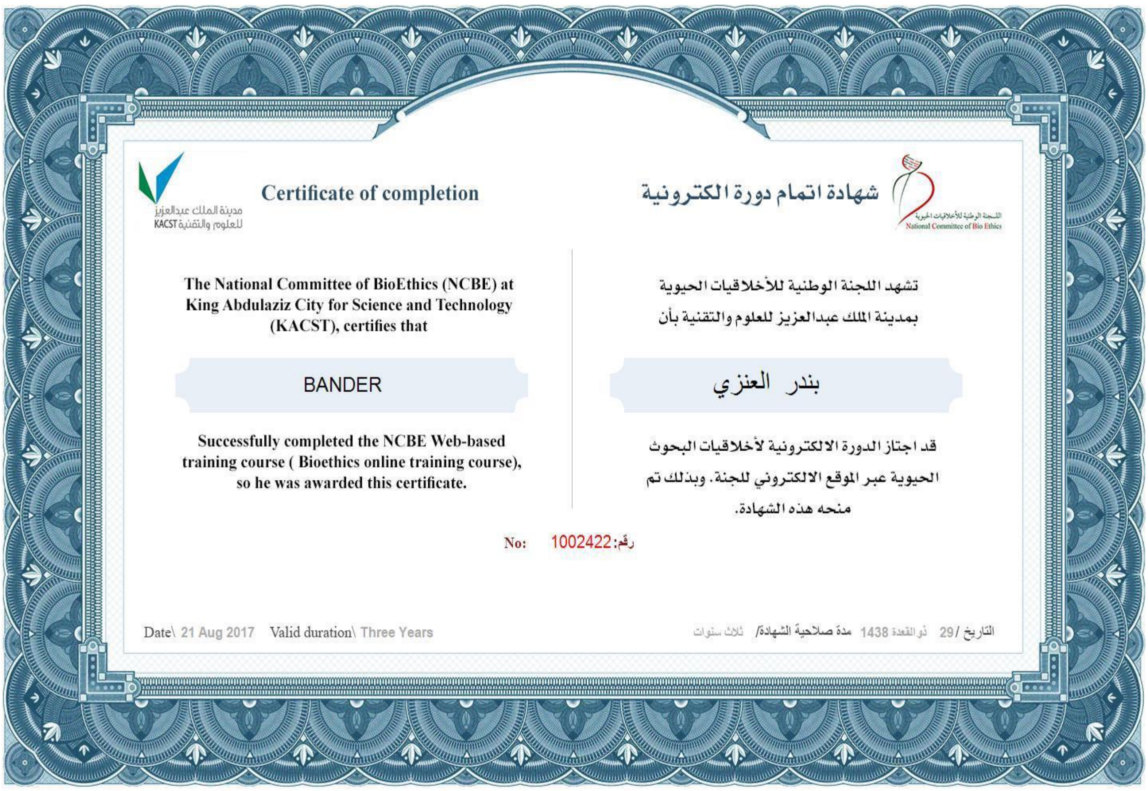
مرفق صورة مستندات وملخص المقترح البحثي، ، ، ،

مساعد مدير عام الإدارة العامة للبحوث والدراسات

ص. عذارى فيصل العتيبي

الرمز البريدي: ١١١٧٦ ص.ب الرياض: ٢٧٧٥ فاكس: ٠١١٤٧٣٥٠٣٨ هاتف: ٠١١٤٧٣٥٠٣٩
e-mail: research@moh.gov.sa

Appendix 12: Certificate in Bioethics



Appendix 13: General Directorate of Health Affairs in Riyadh Region email to HR Departments

Dear General Directorate of Health Affairs in Riyadh Region

As previously agreed, we would be grateful if you could please email the below and attached invitation to the Human Resource Departments of all primary health care centres in Riyadh City within the next week.

Yours sincerely

Bander Alanazi	Dr. Kerryn Butler-Henderson
PhD Candidate	Supervisor
Bander.Alanazi@utas.edu.au	Kerryn.Butlerhenderson@utas.edu.au
University of Tasmania, Australia	University of Tasmania, Australia

Email template to be sent to Human Resource Departments:

Dear Human Resource Department

The University of Tasmania, Australia is undertaking a project to explore the perceptions of healthcare providers towards the use of electronic health records in primary healthcare in Riyadh City.

Could you please send the attached email and information sheet to all healthcare professionals, including physicians, nurses, laboratory technicians and pharmacists, who are employed by your organisation. This will be anyone who generates health information through either direct patient care provision or the provision of services such as pharmaceutical or diagnostic. This is not an employee who provides administrative duties for the organisation, including Managers and clerical assistants, who do not meet the above criteria.

Should you have any questions, please contact the University of Tasmania research team:

Bander Alanazi	Dr Kerryn Butler-Henderson
PhD Candidate	Supervisor
Bander.Alanazi@utas.edu.au	Kerryn.Butlerhenderson@utas.edu.au
University of Tasmania, Australia	University of Tasmania, Australia

Yours sincerely

[INSERT DETAILS]

General Directorate of Health Affairs

Appendix 14: HR Department to participants

Dear healthcare professionals

We have received a request from the University of Tasmania, Australia, to invite you to participate in a research study examining the perceptions of healthcare providers on the impact of electronic health records on the quality of service provision in primary healthcare centres in Riyadh City. This study has been approved by the University of Tasmania Human Research Ethics Committee and the Saudi Arabia Ministry of Health.

This study invites you to complete a short survey that should take you 10-15 minutes to complete. You can complete this survey online at:

https://redcap.utas.edu.au/surveys/?s=LDAYNC98AW

By completing this survey, you are providing the research team with consent to use your responses. You cannot be identified by your responses and the research team is not affiliated with your organisation. Your responses will remain confidential and stored in a secure location.

The survey will be available from the [INSERT DATE] until the [INSERT DATE].

Should you have any questions, please contact the University of Tasmania research team:

Bander Alanazi	Dr Kerryn Butler-Henderson
PhD Candidate	Supervisor
Bander.Alanazi@utas.edu.au	Kerryn.Butlerhenderson@utas.edu.au
University of Tasmania, Australia	University of Tasmania, Australia

Yours sincerely
[INSERT]
Human Resource Department

Appendix 15: Study information sheet

Healthcare professional's perception on the role of electronic health records in improving the quality of healthcare services in primary healthcare centres in Riyadh.

Version 1, 24 May 2017
Participation Information Sheet

Invitation

You are invited to participate in a study about your perceptions of the role of electronic health records (EHRs) in improving the quality of healthcare services in primary healthcare centres in Riyadh City. This study is being conducted to fulfil the requirements for the award of a Doctor of Philosophy for Bander Alanazi from the University of Tasmania in Australia. Dr. Kerryn Butler-Henderson is the primary supervisor, and Prof. David Greenfield and Dr. Nazlee Siddiqui are co-supervisors.

What is the purpose of this study?

The purpose of this study is to explore healthcare professionals' perceptions towards EHRs in improving the quality of healthcare services in primary healthcare centres in Riyadh City. This information will inform health organisations when commencing the EHR implementation process.

Why have I been invited to participate?

You have been invited to this study because of your role as a healthcare professional and your knowledge of healthcare services in primary healthcare centres in Riyadh City.
Participation in this study is voluntary. If you do not wish to participate in this study, please do not complete the survey. This study does not collect any identifying information about you and there will be no consequences should you decide not to participate in this study.

What will I be asked to do?

You will be asked to complete an online survey that will take approximately 10-15 minutes to complete. You can access the online survey at the link provided below between the [30 November 2017] and the [30 December 2017].
At the beginning of the survey, you will review the requirements of this survey and tick if you consent to participating in this study. You will then be asked your level of agreement with a number of statements about the EHR. The survey starts with some demographic questions to ensure we have received a representative sample of replies to this survey.

Are there any possible benefits from participation in this study?

There may be no direct benefit to you as a respondent to this research. However, if you decide to participate, the findings will inform health organisations when commencing the EHR implementation process the considerations they need to take into account.

Are there any possible risks from participation in this study?

The researchers do not foresee any potential risks to you or the other participants.

What if I change my mind during or after the study?
If you consent to participate in this study, you are free to withdraw or change your mind at any time, and can do so without providing an explanation. You will not be able to withdraw your data after submitting the survey as responses have been collected anonymously.

What will happen to the information when this study is over?
To ensure that data collected is protected, electronic data will be password protected and stored on the student researcher's secure university cloud storage and on the primary supervisor's secure university network. Only the researchers will have access to the data. Data will be kept securely at University for a period of five years before being destroyed.

How the results of the study will be published?
After the completion of the data collection at the end of 2019, the student researcher, will produce a thesis and associated journal articles. You and your individual results will not be identifiable in the publication of the results.

What if I have questions about this study?
If you have any questions about this study, please contact either:
Bander Dowahi AL-ANAZI (University of Tasmania) (PhD candidate
Bander.Alanazi@utas.edu.au +96...........
Dr. Kerryn Butler-Henderson (University of Tasmania) (Primary Supervisor). Kerryn.Butlerhenderson@utas.edu.au or +613 6324 3329.
Professor David Greenfield (University of Tasmania)
David.Greenfield@utas.edu.au
Nazlee.Siddiqui@utas.edu.au or +612 ....

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +613 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H0016730.

Please keep a copy of this information sheet for your records. Once you are satisfied that your questions have been answered, should you wish to participate in this study, please go to the following webpage to review the consent information and complete the questionnaire.
[INSERT LINK]

Appendix 16: Survey, including Consent

UTAS

[SCREEN 1]

<u>The Healthcare professionals' perception on The role of electronic health records in improving the quality of healthcare services in primary healthcare centres in Riyadh.</u>

Version 2, 7 April 2017

<u>Consent Form</u>

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.
4. I understand that the study involves participation in the following questionnaires to provide feedback about the dataset, and completion of another questionnaire on the online minimum dataset at a later date.
5. I understand that participation involves a time commitment of 15 minutes for each of the activities.
6. I understand that all research data will be securely stored on the secure network drive at the University of Tasmania for five years from the publication of the study results, and will then be destroyed.
7. Any questions that I have asked have been answered to my satisfaction.
8. I understand that the researchers will maintain confidentiality and that any information I supply to the researchers will be used only for the purposes of the research.
9. I understand that the results of the study will be published so that I cannot be identified as a participant.

10. I understand that my participation is voluntary and that I may withdraw at any time without any effect. 11. I understand that I will not be able to withdraw my data after participating in the questionnaire as responses have been collected anonymously.

Please tick the following box that you understand the above and consent to participating in this study:

☐

(this item is mandatory – participant cannot move on with the survey unless this is ticked)

By completing and submitting this survey; you consent to participate in this study. If you no longer consent to participate in this study, please close your internet browser.

[SCREEN 2]

The Healthcare professionals' perception on The role of electronic health records in improving the quality of healthcare services in primary healthcare centres in Riyadh.

1. Demographic information:

To ensure we receive a representative sample of responses, we would like to collect some non-identifying information. Please tick the response that closest aligns to you.

1. Occupation: □Physician □Nurse □Pharmacist □Technician □Other (please specify)
2. Years of birth __________
3. Nationality: □ Saudi □ Non-Saudi.
4. Gender: □ Male □ Female.
5. Length of time (years) working in primary health care centres in Riyadh.
6. Do you have experience outside the K.S.A? □ Yes: □ No
7. Do you have training in electronic health records in primary healthcare □ Yes: □ No
8. Do you have previous electronic health records experience in primary healthcare □ Yes: □ No

For each of the following, please indicate your level of agreement with the statement, from Strongly Disagree to Strongly Agree.

2. From your experience in primary healthcare, to what extent do you agree or disagree for the following statements regarding Electronic Health Records systems?

№	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Provides quick and reliable access to scientific research					
2	Enables easy access to information from past medical records					
3	Provides access to patient data and analysis					
4	Provides better data					
5	Makes it easy to transfer data					
6	Provides access to practice standards					
7	Enables following test results					
8	Saves time in documenting health data					
9	Decreases paper-based documentation					
10	Improves the feeling of professionalism					
11	Improves communication between health professionals and patients					
12	Contributes to health professionals 'ability to make patient care decisions					
13	Improves communication between health professionals					
14	Reduces medical errors					

15	Is too complicated and not user friendly					
16	Compromises patient safety					
17	Decreases interaction between the health professional and patient					
18	Increases health professionals 'workloads					
19	It is difficult to provide data security in EHRs					
20	Consumes more time than paper-based systems					
21	Is 'down' frequently					
22	Is costly					
23	Needs frequent revisions related to technological developments					

From your experience in primary healthcare, to what extent do you agree or disagree for the following statements regarding Electronic Health Records system and the quality of services?

№	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I feel EHR is useful					
2	I feel EHR is an important system for primary health care centres					
3	I feel EHR has been successful in primary health care centres					
4	I feel EHR is worth the time and effort required to use it					
5	I feel the EHR improves the quality of healthcare services in Primary health care Centres					
6	I feel the quality of my work has improved					
7	I feel the quality of information has improved due to EHR					
8	I feel my performance has improved due to EHR					
9	I feel patient safety has improved due to EHR					
10	Overall, I am satisfied with the EHR system in primary health care centres					

11 - From your experience in primary healthcare, what do you think are the benefits of Electronic Health Records system in primary health care in Riyadh City?

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12 - From your experience in primary healthcare, what do you think are the challenges to implementation of Electronic Health Records system in primary health care in Riyadh City?
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Thank you for completing this survey

Appendix 17: Reminder e-mail invitation

Dear healthcare professionals

You may have already received an e-mail inviting you to participate in this survey. If you have already completed and returned the questionnaire, please accept our thanks and delete this e-mail as no further involvement is required. If you have not completed the questionnaire, please take the time to consider helping us with this important research.

This study invites you to complete a short survey that should take you 10-15 minutes to complete. You can complete this survey online at:

[INSERT LINK]

By completing this survey, you are providing the research team with consent to use your responses. You cannot be identified by your responses and the research team is not affiliated with your organisation. Your responses will remain confidential and stored in a secure location.

The survey will be available from the [INSERT DATE] until the [INSERT DATE].

Should you have any questions, please contact the University of Tasmania research team:

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Yours sincerely
[INSERT]
Human Resource Department

REFERENCE LIST

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