Journal of Health Informatics in Developing Countries

http://www.jhidc.org/
Vol. 11 No. 2, 2017

Submitted: April 25th, 2017 Accepted: July 9th, 2017

Barriers to the Adoption of EHR Systems in the Kingdom of Saudi Arabia: An Exploratory Study Using a Systematic Literature Review

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Abstract – *Objective*: Electronic Health Records (EHRs) have become a key enabler to improving patient safety, improving healthcare quality, and increasing healthcare efficiency. Governments in various countries have moved beyond the local implementation of EHRs in different healthcare organizations to the national implementation and integration of EHRs. The Kingdom of Saudi Arabia (KSA) has lagged behind significantly in this regard, with only few hospitals have implemented the EHR. The purpose of this study is to identify barriers to the adoption of EHRs in the KSA using a systematic literature review. *Methods*: We searched for relevant articles using six search engines (PubMed, EBSCO Host, Web of Science, ACM, IEEE and Google Scholar). The search criteria focused on peer reviewed, empirical studies conducted in the KSA. The final set that met the inclusion criteria was twelve studies. The authors extracted, analyzed, summarized, and categorized empirical results related to EHR barriers in these studies. *Results*: After categorization and analysis, we identified the following twelve main barriers to EHR adoption: lack of computer experience by healthcare professionals (18%), lack of perceived usefulness by healthcare professionals (15%), lack of perceived ease of by healthcare professionals (15%), technical limitations of the software system (15%), lack of user support (9%), confidentiality concerns (9%), user resistance to change (6%), lack of quality in patients' information (3%), lack of EHR standards (3%), uncertainty about EHR vendors (3%), hospital size (3%), and hospital's level of care (3%). *Conclusion*: The findings of this study will be of great potential to policy makers and EHR vendors in the KSA. They can inform strategies to design systems and tailor implementation strategies toward factors that motivate adoption. A second important contribution of this study is that it provides evidence that the extant technology adoption theories like the Technology Acceptance Model (TAM) are not sufficient in explaining EHR adoption, as only 30% of identified barriers could be categorized according to TAM. There is a need for creating a new model for EHR adoption.

Keywords: Electronic Health Record (EHR); Electronic Medical Record (EMR); Barriers to implementation; Saudi Arabia; Systematic Literature Review.

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1. INTRODUCTION

The Institute of Medicine's (IOM's) report, *To Err is Human* [1], produced in 1999, raised an alarm about the failure of healthcare to recognize and reduce a large number of avoidable medical errors harming patients. According to the report, at least 44,000, and perhaps up to 98,000, people die in hospitals each year in the United States as a result of medical errors that could have been prevented. One of the IOM's main conclusions is that medical errors are commonly caused by faulty systems, processes, or conditions that lead people to make mistakes or fail to prevent them.

Healthcare experts and policymakers consider Electronic Health Records (EHRs) to be essential for improving patient safety, improving healthcare quality, and transforming the healthcare industry [2–4]. Evaluation studies have shown that an EHR that involves a Computerized Physician Order Entry (CPOE) system can reduce medical errors by as much as 55% [5], and by 86% when coupled with a Clinical Decision Support (CDS) system [6]. The benefits of an EHR have been well documented in the literature, including: optimizing the documentation of patient encounters [7], availability and timeliness of information [4], effective chronic disease management [8], improved quality of clinical decisions [4], supporting continuity of care and facilitating the exchange of up-to-date information among healthcare providers in distinct locations [9], reduction of redundant tests [10], and reduction of healthcare costs [11]. In addition, EHRs are considered to be central in achieving patient-centered healthcare [11].

Over the past several decades, many governments have been moving toward the national implementation of EHRs to enhance the healthcare systems and to more efficiently manage the healthcare needs of the populations [12]. The Kingdom of Saudi Arabia (KSA) has lagged behind significantly in this regard [13–15]. Most of the implemented IT systems in healthcare organizations are administrative systems rather than patient-care focus [14,15]. Only few hospitals have moved toward the EHR [16,17], and most of the implemented EHR systems are disparate with little interoperability between them [13,18]. In primary care centers, the uptake of EHRs and IT in general is rare [19].

Recently, there have been many policy initiatives by the Ministry of Health (MOH), which are attempting major reforms of healthcare services with EHR as an integral component [20]. Considering the vast amount of resources being dedicated to EHR implementation, identifying barriers to the adoption of EHR is essential for its successful implementation. Many studies have

been conducted to understand barriers to the adoption of EHRs in the KSA; however, there has been no systematic review of these studies.

Therefore, the aim of the study is to identify barriers to the implementation and adoption of EHRs in the KSA using a systematic literature review. The results of this study can inform strategies to policy makers and EHR vendors to design systems and tailor implementation strategies toward factors that motivate adoption.

1.1 Challenges to the Healthcare System in the KSA

The Ministry of Health (MOH) is the major government provider of healthcare services in the KSA, providing 60% of healthcare services, through 244 hospitals (33,277 beds) and 2037 primary healthcare centers [21]. The remaining 40% of provision is divided between other governmental institutions such as Security Forces Medical Services, and National Guard for Health Affairs (NGHA) (combined total of 39 hospitals, 10,822 beds), and the private sector with 125 hospitals (11,833 beds) [21]. Although the MOH was established in 1950, the healthcare system in the KSA has made tremendous improvements in a short time because of extensive investments [22]. In 2000, the World Health Organization ranked the healthcare system in the KSA as 26th among 190 healthcare systems in the world [23]. It appeared before many other healthcare systems, for example, Australia was ranked 32th, Canada 30th, New Zealand 41st. It also appears before several systems in the Middle East region, such as Qatar 44th, and the United Arab Emirates 27th [23].

However, in addition to the potential benefits of EHR, the healthcare system in KSA has specific challenges that make the movement toward EHR even a more promising solution. These are related to the misdistribution of healthcare services, rapid population growth, shortage of medical workforce, and increased rates of chronic diseases. A brief description of these challenges is provided below:

- **Misdistribution of healthcare services** – the KSA covers a large and diverse geographical area, with over 2,150,000 square kilometers – about one quarter the size of the US, with more than 150 cities and 2000 villages separated by large distances, which complicates the delivery of healthcare services [24]. Recent MOH statistics indicated that there is an uneven distribution of healthcare services and healthcare professionals across geographical areas [21]. This has resulted in long waiting lists for people to access many healthcare services and facilities, particularity those living in remote and border areas

[25]. EHR can improve the delivery of healthcare services to those medically underserved areas through various forms of telemedicine [4].

- **Rapid population growth** – according to the General Authority for Statistics [26], the Saudi population was 31 million in 2015, an increase from 22.6 million in 2004. The annual population growth rate for 2004 to 2015 was 3.2% [26]. It was estimated by the United Nations [27] that the Saudi population would be 39.8 million by 2025. This rapid population growth imposes tremendous financial pressures on the healthcare system [24]. Implementing EHRs would make substantial cost savings to the healthcare system, for example according to a RAND study [11], it was estimated that EHRs would make a potential efficiency savings of $77 billion per year in the US healthcare at a 90-percent level of adoption, adding the value for safety and health could double these saving.
- **Shortage of medical workforce** – a major challenge the Saudi healthcare system is facing is the shortage of Saudi healthcare professionals [25]. The majority of healthcare professionals are expatriates which leads to high levels of turnover and instability in the health workforce. As of 2014, the total number of physicians in in the KSA, including dentists, is 81532; only 23.3% of them were Saudis [21]. The total number of nurses was 165324; and only 37.2% of them were Saudi, and pharmacists were 22241, 20.6% of whom were Saudi [21]. Evaluation studies have shown that EHRs improved clinicians' productivity [28], and decreased time spent per patient visit by physicians [29], which is a good sign for the KSA and other developing countries with shortage of clinicians.
- **The need for effective Chronic Disease Management (CDM) programs** – the rates of chronic diseases in the KSA have been rising substantially in the recent decades [25]. For example, according to a recent study by the International Diabetes Federation regarding estimates of the prevalence of diabetes worldwide for 2011-2030, the KSA was ranked 6th among 110 countries [30]. Treatment of chronic diseases is a complicated and costly process and may even be ineffective in later stages [25]. Studies estimated an annual cost for diabetes treatment in the KSA of 7 Billion Saudi Riyals (1.87 Billion USD) [31]. Experts' belief that early prevention is the best effective way to reduce the prevalence of chronic diseases and cost associated with the treatment [25]. In this regard, EHR could assist in changing the health behavior of individuals, and could be used to track the delivery of recommended preventive care across primary healthcare centers [9,32].

1.2 E-Health Initiatives in the KSA

E-health in the KSA is considered to be a developing initiative, which has been ranked as Level 2 by the Economic and Social Commission for Western Asia in 2005 [33]. Recently, there have been several e-health initiatives in the KSA. In 2008, the MOH allocated 4 Billion Saudi Riyals (1.1 Billion USD) for the development of the National EHR project [18]. The project aims to build a central national database for EHRs, and to provide secure communication links with all MOH hospitals and primary healthcare centers [24]. The implementation of the project started in 2011 with a ten-year roadmap for full implementation [24]. Additionally, several policy initiatives have taken place to improve e-health programs and to enhance health informatics workforce. For example, an applied health informatics master program, which is considered to be the first of its kind in the Middle East region, has been launched by King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in 2005 [14]. Many other universities have incorporated similar programs into their curriculums to address the barrier of lack of national professionals in health informatics [18]. The Saudi Association for Health Informatics (SAHI) was also established in 2005 to promote scientific thinking in the field of health informatics in the KSA [13]. One of the main initiatives undertaken by SAHI is the Saudi e-Health conference, which was established in 2006, since when it has been held at roughly 2- yearly intervals in the capital, Riyadh [14,18]. The conference is considered the largest e-health conference in the region, aiming to promote regional cooperation on e-health development. Therefore, investigating barriers to EHR adoption and implementation in the KSA is a relevant and timely topic. It is crucial to understand such barriers so that possible interventions can be taken.

2. METHODOLOGY

The aim of this study is to identify barriers to widespread adoption EHRs in the KSA by analyzing the current academic literature. A Systematic Literature Review (SLR) is a defined and methodological way of identifying, assessing and analyzing published primary research for investigating a specific research question [34]. Systematic reviews differ from ordinary reviews in being formally planned and methodically executed [34]. They are considered to be essential tools for summarizing evidence published in primary research, and may provide a greater level of validity in the findings than might be possible in any one of the included primary studies

[34,35].

Kitchenham and Charters [35] identified three main steps for conducting systematic literature reviews: planning the review, conducting the review, and reporting on the results. The same approach was followed in this study, and we followed the same steps applied by a number of previous systematic reviews [34,36,37], as follows: i) Locating research resources, ii) Study selection, iii) Data extraction and synthesis, and iv) Reporting the results.

2.1. Information Sources

Studies on barriers to the adoption of electronic health records may come from various distinct disciplines including medical and biomedical sciences, computer and information systems sciences, and social sciences; therefore, in order for this study to reflect all relevant studies and be up-to-date and comprehensive, we selected six relevant search engines ("PubMed", "EBSCO", "Web of Science", "ACM", "IEEE", and "Google Scholar") to be used for the search. Moreover, to increase the likelihood of identifying all studies conducted in Saudi Arabia, two general search terms, separated by the "OR" operator, were used: "Electronic Health Record" AND" Saudi Arabia" OR "Electronic Medical Record" AND "Saudi Arabia".

2.2 Study Selection Criteria

In order to make sure that information used as the basis for this study are reliable, accurate and pertinent, the following selection criteria were used to qualify articles for eligibility and inclusion:

1. Articles published in scientific journals –such as conference articles and unpublished work were excluded.
2. Articles focusing solely on EHR or EMR, and not other electronic systems used in healthcare (for example on IT systems, or Personal Health Records (PHRs)).
3. Articles assessing barriers to the implementation and/or adoption of EHR/EMR, and not other issues (such as software engineering issues).
4. Articles based on empirical studies, and
5. Articles where the country of data collection is Saudi Arabia.

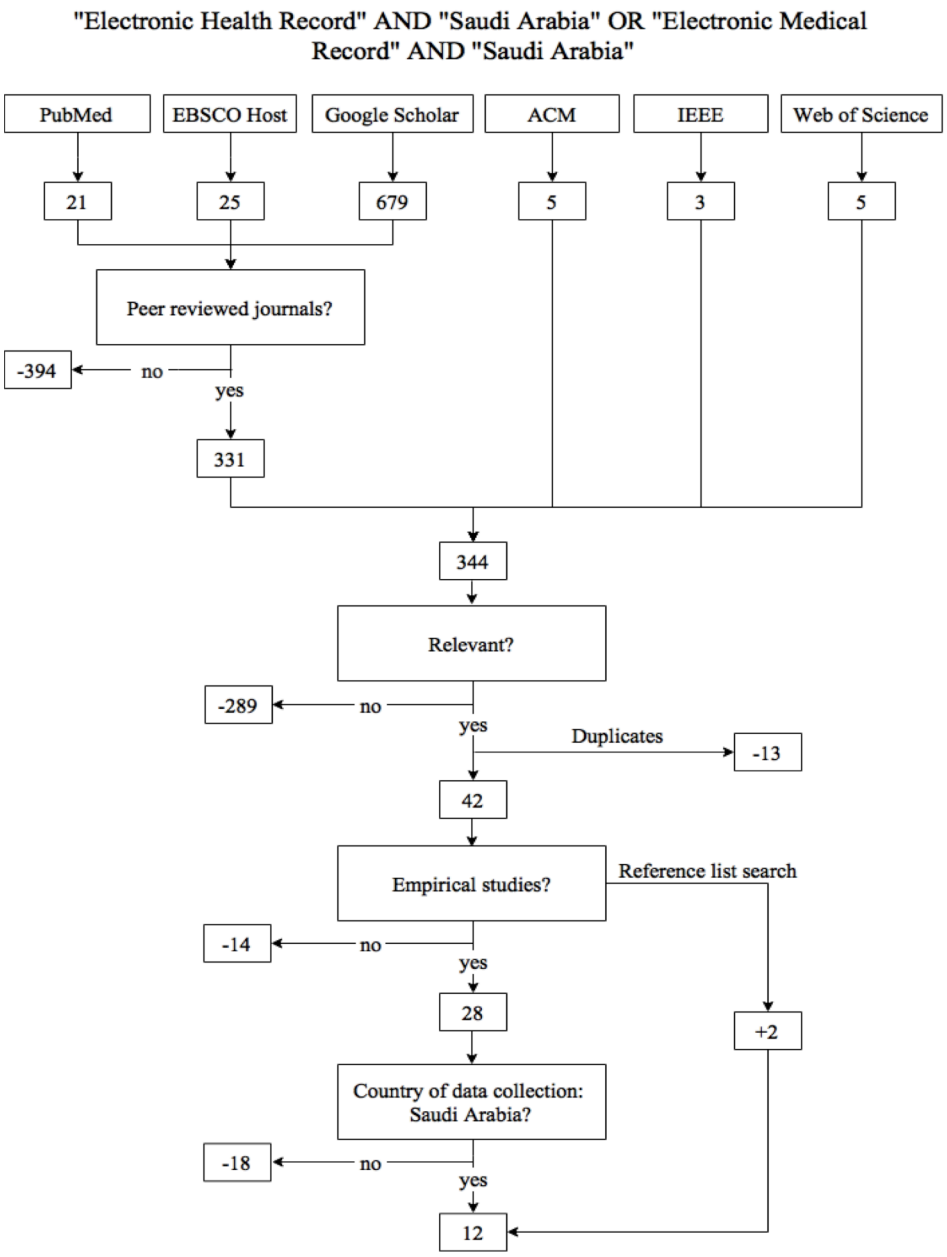

Figure. 1 The literature review process and the associated inclusion criteria

2.3 Study Selection Process

The literature review process is shown in Figure 1. The database search identified a total of 738 potentially relevant articles. Google Scholar alone identified 679 articles, and all the other engines identified 59 articles. As a large number of articles identified by Google Scholar were

not peer-reviewed journal articles, we picked criteria (1) as the first filter for the results. This criterion was also applied to PubMed and EBSCO Host results, as a number of articles identified were not journal articles. This filter removed a total of 394 articles, of which 384 articles were from Google Scholar and 5 from each of PubMed and EBSCO Host. The second filter was to "assess articles for relevancy" by applying criteria (2) and (3). Title and abstract screening and full text assessment for relevancy were applied at this stage, articles not specifically focusing on EHR or EMR, and that are not related to barriers to the adoption of EHR/EMR were excluded. This filter removed a total of 289 articles, of which 254 were from Google Scholar, 14 from EBSCO Host, 11 from PubMed, 3 from IEEE, 4 from ACM, and 3 from Web of Science. The remaining articles were checked for duplications; 13 duplicates were found and thus excluded. Then, criteria (4) was applied as the third filter, resulting in the exclusion of 14 non-empirical articles, of those 13 were commentaries or literature reviews, which were excluded as they lack primary empirical data. However, reference lists of these articles were searched for relevant articles, and we found two articles meeting all inclusion criteria, thus included directly in the final dataset. Finally, criteria (5) was applied as the final filter, which excluded 18 articles where the country of data collection was not Saudi Arabia. Therefore, at the conclusion of the selection procedure, 12 articles met the inclusion criteria. It is worth mentioning that 7 articles were exclusively identified through Google Scholar, including the articles identified by the reference list search.

2.4. Data Extraction and Analysis

Studies reported in the selected papers that met the inclusion criteria were further analyzed and the following items were extracted from each study: research methodology (quantitative, qualitative, mixed, etc.), data collection methods (interview, case study, survey, etc.), sample size and response rate, sample type (e.g. administrators, physicians, nurses, IT teams, etc.), region of data collection, number of hospitals involved in the data collection process, and types of hospitals involved (governmental or private). Then, the empirical results regarding barriers to EHR adoption were extracted from each study. Finally, the barrier focus of each study was identified to facilitate comparison between the studies.

Meta-analysis of the results was not attempted because of the variation among the studies in terms of research methods and sample types. For example, the study [16] employed a qualitative method to understand barriers and challenges to the adoption of EHRs, whereas the

remaining studies employed quantitative methods. Statistical inference based on the findings of [16] was not possible, and therefore meta-analysis was not possible. However, the analysis approach employed by Kruse and Goetz [37], and Khan et al. [34] was applied in this study. In this approach, barriers were analyzed according to the frequency of occurrence in the literature. This approach can produce reliable results in our case, as it can provide a clear picture of what barriers were identified empirically, by how many studies, and how much frequent are these barriers among the results.

3. RESULTS

Table 1 shows the analysis of the twelve studies. All studies used a quantitative research methodology, except one, which used a qualitative approach. Most researchers prefer to use a quantitative (questionnaire) approach to reach many participants and to cover a wide spectrum [36]. All of the twelve studies were conducted in three regions of the KSA: Makkah Province (4 studies [38–41]), Eastern Province (5 studies [16,42–45]), and Riyadh (3 studies [17,46,47]). This can be attributed to the fact that these are the three most advanced and populated regions in the KSA. All of the identified studies were published in recent years (2011 and after), except two [45,47], which reflects a new research trend in the KSA after the recent e-health initiatives undertaken by MOH. Moreover, all of the studies were conducted in hospital settings, and no previous study was conducted in primary healthcare centers.

Different user types were involved in the data collection process in the included studies. Eight studies involved a single sample type such as physicians [40–43,45,47], nurses [44], and IT managers [16]. The remaining studies involved a mix of medical and/or administrative staff such as EHR project team and IT managers [17], physicians and nurses [46], and all medical and administrative staff [38,39].

Table 1. Details of the included studies and the associated barriers

Study reference/ Year of publication	Type of research (Quantitative / Quantitative)	Methods of data collection	Number of participants/ Sampling strategy	Sample Type	Region of Data collection/ Number of hospitals involved/ Type of hospitals ownership	Barriers to EHR*	Barrier focus of the study
[16]/ 2011	Qualitative	Semi-Structured surveys	19/ Judgmental sampling	IT Managers	Eastern Province/ 19 Hospitals/ Governmental	• Healthcare professionals resistance to use the system	Top barriers to EHR
[17]/ 2014	Quantitative	Questionnaire	280/ Judgmental sampling	EHR project team and IT managers	Riyadh/ 22 Hospitals/ Governmental and private	• Hospital size – *Small and medium hospitals are less likely to adopt EHR systems* • Hospital's level of care – *Non-tertiary care organizations are less likely to be advanced in EHR implementation*	Hospital characteristics
[41]/ 2015	Quantitative	Questionnaire	317/ Random sampling	Physicians	Makkah Province/ 6 Hospitals/ Governmental	• Lack of perceived ease of use – *EHR is not comfortable for data entry, EHR increases workload* • Lack of perceived usefulness – *EHR disturbs workflow*	Perceptions of EHR
[40]/ 2013	Quantitative	Questionnaire	368/ Random sampling	Physicians	Makkah Province/ 6 hospitals/ Governmental	• Lack of computer experience	Computer skills
[44]/ 2015	Quantitative	Questionnaire	185/ Convenience sampling	Nurses	Eastern Province/ 3 Hospitals/ Governmental	• Confidentiality concerns • Technical limitations– *unplanned downtime, system hanging up problems, slow system performance, functional limitations* • Lack of perceived ease of use – *more time and workload for data entry, EHR is complex to use, lack of customizability* • Lack of perceived usefulness – *lack of perceived benefits of the system, EHR disturbs communication between the healthcare team* • Lack of user support	Barriers to EHR use
[42]/ 2014	Quantitative	Questionnaire	115/ Sampling strategy not provided	Physicians	Eastern Province/ 1 Hospital/ Governmental	• Lack of perceived usefulness of the system – *benefits to quality of care is less than expected* • Technical limitations – *slow system performance* • Lack of quality in patients' information – *incomplete, outdated patient information*	Barriers to satisfaction with EHR

[45]/ 2007	Quantitative	Questionnaire	142/ Sampling strategy not provided	Physicians	Eastern Province/ 1 Hospital/ Governmental	• Lack of computer experience • Technical limitations – *limitations with communication functions, inability to add important contents to patients' documentation* • Lack of user support	Barriers to EHR use
[46]/ 2014	Quantitative	Questionnaire	112/ Convenience sampling	Physicians and nurses	Riyadh/ 1 Hospital/ Governmental	• Lack of computer experience	Computer experience
[38]/ 2015	Quantitative	Questionnaire	333/ Sampling strategy not provided	Medical and administrative staff	Makkah Province/ 7 Hospitals/ Governmental	• Lack of computer experience	Computer experience
[39]/ 2014	Quantitative	Questionnaire	84/ Sampling strategy not provided	Medical and administrative staff	Makkah Province/ 6 Hospitals/ Governmental and private	• Lack of computer experience • Lack of perceived ease of use – EHR is complex to use • Technical limitations – *unplanned downtime* • User resistance to use the system • Confidentiality concerns • Uncertainty about EHR vendor • Lack of EHR standards	Barriers to EHR uptake
[43]/ 2015	Quantitative	Questionnaire	319/ Sampling strategy not provided	Physicians	Eastern Province/ 3 Hospitals/ Governmental	• Confidentiality concerns • Technical limitations – *unplanned downtime, frequent system hanging up problems, slow system performance, functional limitations* • Lack of perceived ease of use – *more time and effort for data entry, EHR is complex to use , lack of customizability, EHR is difficult to use during consultation with patients* • Lack of perceived usefulness – *lack of perceived benefits of EHR* • Lack of user support	Barriers to EHR use
[47]/ 2005	Quantitative	Questionnaire	150/ Random sampling	Physicians	Riyadh/ 1 Hospital/ Governmental	• Lack of computer experience • Lack of perceived usefulness – *EHR decreases productivity* • Lack of perceived ease of use – *EHR adds a burden to physicians, EHR requires special training*	Computer experience, and user perceptions

* Barriers are listed after categorization. Three terms were used to categorize the barriers: perceived usefulness, perceived ease of use, and technical limitations; each of these terms is followed by the original barrier term (instance) as mentioned in the original studies for reference. Barriers that could not be categorized under these categories were listed without categorization

Barriers are listed in Table 1 after categorization, that is, barriers that are linked to the same problem were grouped under a common term. The categorization of barriers was based on the theoretical concepts defined by the Technology Acceptance Model (TAM) [48,49]. TAM is well-established theory in the Information Systems (IS) domain and has proved its validity and applicability for a wide range of information technologies [50]. TAM defines two main factors that determine user acceptance and use of technology: perceived usefulness and perceived ease of use. In the IS context, *perceived usefulness* is "the degree to which a person believes that using a particular system would enhance his or her job performance" [49]. In the healthcare context, perceived usefulness of system not only focuses on personal productivity, but also incorporates increased efficiency, improved quality and safety, better workflow support, empowered patients and similar healthcare-specific measures of usefulness [51,52]. Based on this definition, the term lack of perceived usefulness was used to refer to the following instances of barriers: lack of perceived benefits of the system [43,44], benefits to quality of care is less than expected [42], EHR decreases productivity [47], EHR disturbs communication between the healthcare team [44], and EHR disturbs workflow [41].

Another term adapted from TAM to categorize barriers was *perceived ease of use*. TAM defines perceived ease of use as "the degree to which a person believes that using a particular system will be free of effort" [49]. In the healthcare context, perceived ease of use of a system refers to the ease of learning and mastering the system, clear and understandable system instructions, flexibility of the system, ease of performing tasks with the system, minimal extra workload, and ease of using the system during patient consultation [51,53]. Based on this definition, the term lack of perceived ease of use was used to refer to the following barriers: EHR is not comfortable for data entry [41], more time and effort for data entry [41,43,44], EHR is complex to use [39,43,44], lack of customizability [43,44], EHR is difficult to use during consultation with patients [43], EHR adds a burden to physicians [47], and EHR requires special training [47].

Although TAM provided a meaningful framework to categorize the barriers, there are still many barriers that could not be categorized under TAM constructs. This may be attributed to the complex contextual nature of healthcare information systems. The

remaining barriers were reported in this study as reported in the original studies without categorization, except one category introduced by the author, which is *technical limitations*. This category was used to refer to technical limitations of the software system such as unplanned downtime [39,43,44], frequent system hanging up problems [43,44], slow system performance [42–44], and functional limitations [43,45].

The analysis revealed a total of 12 barriers spread across the 12 studies, as shown in Table 2. These barriers are: lack of computer experience by healthcare professionals [38–40,45–47], lack of perceived usefulness by healthcare professionals [41–44,47], lack of perceived ease of use by healthcare professionals [39,41,43,44,47], technical limitations of the software system [39,42–45], lack of user support [43–45], confidentiality concerns [39,43,44], user resistance to change [16,39], lack of quality in patients' information [42], lack of EHR standards [39], uncertainty about EHR vendors [39], hospital size [17], and hospital's level of care [17].

Table 2. Barriers to the adoption of EHR in the KSA and the number of occurrences

No.	Barriers	References	Frequency (n=34)	%
1	Lack of computer experience by healthcare professionals	[38]–[40], [45]–[47]	6	18%
2	Lack of perceived usefulness by healthcare professionals	[41]–[44], [47]	5	15%
3	Lack of perceived ease of use by healthcare professionals	[39], [41], [43], [44], [47]	5	15%
4	Technical limitations of the software system	[39], [42]–[45]	5	15%
5	Lack of user support	[43]–[45]	3	9%
6	Confidentiality concerns	[39], [43], [44]	3	9%
7	User resistance to change	[16], [39]	2	6%
8	Lack of quality in patients' information	[42]	1	3%
9	Lack of EHR standards	[39]	1	3%
10	Uncertainty about EHR vendors	[39]	1	3%
11	Hospital size	[17]	1	3%
12	Hospital's level of care	[17]	1	3%

The twelve barriers are organized in Table 2 by the frequency of occurrences among the studies, with the most frequent listed first. The frequency rates of the 12 barriers are: the "Lack of computer experience by healthcare professionals" appeared in six of the twelve studies (50%), and six of the 34 instances of barriers (18%); "Lack of perceived usefulness by healthcare professionals", "Lack of perceived ease of by healthcare professionals", and "Technical limitations of the software system", each appeared in five of the twelve studies (42%) and five of the 34 instances of barriers (15%); "Lack of user support" and "Confidentiality concerns" each appeared in three of the twelve studies (25%) and three of the 34 instances of barriers (9%); "User resistance to change" appeared in two of the twelve studies (17%) and two of the 34 instances of barriers (6%); Five barriers, namely: "Lack of quality in patients' information", "Lack of EHR standards", "Uncertainty about EHR vendors", "Hospital size", and "Hospital's level of care" each appeared once in the twelve articles (8%), and once out of the 34 instances of barriers (3%).

4. DISCUSSION

The literature has shown that many barriers hinder the implementation of EHR systems in the KSA. This study revealed that the most frequent barriers reported in the literature are: lack of computer experience, lack of perceived usefulness, and lack of perceived ease of use by healthcare professionals, and technical limitations. These four barriers alone comprise 63% of the barriers reported in the literature.

Lack of familiarity of the medical staff with EHR was the most frequently mentioned barrier. This is consistent with the findings of many systematic reviews [36,54–57], which identified lack of healthcare professionals' computer experience and familiarity with EHR systems among the top most frequently reported barriers hindering EHR acceptance and use. In the study conducted by [40], it was demonstrated that physicians have "substantial" needs for computer literacy improvement including "word processing software skills", "medical database search skills", and "Internet search skills". Three studies reported that computer experience is significantly correlated with healthcare professionals' acceptance of EHR [38], healthcare professionals' utilization of EHR [45],

and healthcare professionals' satisfaction with EHR [46]. Gagnon et al. [53] demonstrated that healthcare professionals who have high competency in computer literacy have little difficulty in using EHRs. Consequently, training programs on computer literacy would increase healthcare professionals' adoption of EHR systems.

Issues related to the technical limitations of the EHR were frequently reported in the literature. This is in line with the findings of many systematic reviews [54,56], which identified design and technical limitations among the most frequently cited barriers to e-health and EHR adoption. In this study, the most frequently reported instances were slow system performance [42–44], and unplanned downtime [39,43,44]. Complaints about frequent system hanging up problems [43,44], and functional limitations [43,45] were also cited. Lack of perceived ease of use is another important issue. The significant influence of perceived ease of use on e-health and EHR adoption by healthcare professionals was supported by many systematic reviews [54,55,57]. EHR provides an enormous range of functionalities; a typical EMR system contains hundreds and hundreds of screens that require users to access them through the navigational scheme of the system using tabs, buttons, and hyperlinks [58]. Learning the right paths takes time [58]. This complexity can result in healthcare professionals having to allocate time and effort if they are to master them, which they may see as a burden [36]. It is also possible that lack of computer experience lead users to view EHRs as extremely complicated [36]. The most frequently reported instances of barriers in this category were: more time and effort for data entry [41,43,44], and complexity of use [39,43,44]. Complaints about lack of customizability were also reported [43,44].

In line with the findings of many systematic reviews [54,55,57], perceived usefulness was among the top most frequently reported barriers. According to TAM [49], perceived usefulness of a system is a critical determinant of its acceptance and use, and could be more important that perceived ease of use. Many studies reported that perceived usefulness is the strongest predictor of healthcare professionals' acceptance and use of EHR [50,51,54]. Therefore, to promote acceptance and use of EHR by healthcare professionals, the EHR must be perceived as useful. In the study conducted by Alharthi et al. [42], 85% of surveyed physicians reported lack of perceived benefits of EHR system, and 61% prefer to

totally abandon the system and go back to paper records. Other two studies demonstrated that at least 60% of surveyed healthcare professionals reported low utilization of the system due to lack of perceived usefulness of EHRs [43,44]. Gagnon et al. [54] pointed out that successful cases of e-health adoption were usually characterized by a clear understanding of the benefits of the e-health technology by its users.

Overall, the barriers identified in Table 2 can be classified into two categories based on the target of interventions to increase the adoption of EHRs: *individual-level adoption barriers*, and *organization-level adoption barriers*. Individual-level adoption barriers are those associated with the individual healthcare professional's decision to accept and use an EHR system (i.e. user-level adoption barriers), while organization-level adoption barriers are those associated with the healthcare organization's motivation to adopt and implement an EHR system (i.e. healthcare organization's authority-level adoption barriers). This classification is based on Eccles el al. [59] classification of levels at which interventions to improve quality of healthcare might be applied. Based on this classification, interventions to increase the adoption of EHRs can be designed at two levels: users or individual healthcare professionals, and healthcare organizations. In Table 2, factors hindering individual healthcare professional decision to accept and use an implemented EHR system are: lack of computer experience, lack of perceived usefulness of EHR, lack of perceived ease of use of EHR, technical limitations of the software system, lack of user support, confidentiality concerns, and lack of quality in patient information. Factors hindering healthcare organization's authority decision to purchase, implement, and move to higher levels of EHR implementation are: user resistance to change, lack of EHR standards, and uncertainty about EHR vendors, confidentiality concerns, hospital size, and hospital level of care [7, 36]. The barriers classified as individual-level adoption barriers provide answers to what affects user's resistance to change, which was classified as an organization-level adoption barrier.

The study reported in this paper is a reverse approach for applying TAM to understand the adoption factors of EHR. As only 30% of identified barriers could be categorized according to TAM, this shows that the extant technology adoption theories are not sufficient in explaining the adoption factors of EHRs and that there is a need for

creating a new model for EHR adoption. This study has several important limitations. Although the authors did a comprehensive search, only a limited set of articles (n=12) was identified. This may be attributed to the limited research on e-health in the KSA. A second important limitation is that three studies, forming one fourth of the included studies, focused mainly on assessing computer experience of healthcare professionals [38,40,46], which may have biased the findings. Finally, the results reported in this study summarize the findings of the current empirical studies. A further exploratory research using a qualitative approach may reveal other factors not considered in the previous studies.

5. CONCLUSION

Due to the recent MOH's National e-Health initiative, updating the state of knowledge regarding EHR barriers is of critical importance to policy makers, health informatics professionals, academics, clinicians, and EHR vendors. This study has identified these barriers using a systematic literature review. From a practical point of view, the findings of this study will assist policy makers in planning and designing policies to increase the adoption of EHRs. Also, the findings will help EHR vendors in system development and marketing. This study will help researchers in further investigating the reported barriers in different settings and regions (e.g. investigating types and frequencies of technical problems of EHR systems). As this study summarizes the current evidence with regard to EHR adoption barriers in the KSA, future research will build upon this current evidence and will focus on developing the appropriate framework for the adoption of EHRs in the KSA.

Funding: No funding was used for this review.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical Approval: For this type of review, formal consent is not required. This article does not contain any studies with human participants or animals performed by any of the authors

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