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How private are the electronic health records? Family physicians' perspectives towards electronic health records privacy

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Abstract

Background: The study intended to measure the family physicians' perspectives towards electronic health records (EHR) privacy and explore the factors determining these perceptions.

Methods: All the primary care physicians were invited to participate in the online survey using a validated Health Information Privacy Questionnaire (HIPQ). Four themes were evaluated - (i) ability of computers to keep health information private (ii) accessibility to outsiders use (iii) sharing of health information with other health professionals and (iv) benefits versus risk of computerized health information. Descriptive statistics were reported for categorical and continuous data while student-t test and ANOVA were used to quantify association.

Results: Majority perceived EHR to be more private than the paper-based records while some disagreed and expressed concern about data leakage. Senior physicians (p=0.05), non-Saudi's (p=0.029) and consultants (p= 0.004) well perceived the privacy of computerized information. Many physicians agreed to sharing of data with the Ministry of Health (53/89; 59.6%) and hospital-based research centers (49/89;55%) but did not favor data accessibility and sharing with insurance and pharmaceutical companies. Most of the respondents (48/89;54%) disagreed to the risk of possible loss of confidentiality using EHR. Higher age (p=0.018) and consultant rank (p=0.024) were strong predictors of higher scores for overall benefits of EHR and its usefulness in healthcare delivery planning.

Conclusion: The EHR does not compromise the privacy, safety and confidentiality of patient health data. The physicians acknowledged the perceived usefulness of e-health systems and advocate its implementation in larger hospitals across Saudi Arabia. However, there is a need to devise multiple strategies to prevent data leakage and breach in confidentiality by non-hospital sources.

Keywords: Ethics; Electronic health records; Privacy; Physicians perceptions; Saudi Arabia

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1. Introduction

Information technology has become an integral part of the healthcare system. With the advent of the digital revolution, paper-based patient health records have undergone a revolutionary transition into an electronic version. An electronic health record (EHR) is the systematized collection of patient medical and health information that is electronically stored in a digital format [1]. An EHR includes an extensive account of automated information about the patient's medical visits, health history, laboratory investigations, radiological imaging, diagnoses, medications, history of allergies, immunization, patient management and treatment plans, and hospitalization data with discharge summaries, facilitating quick access, exchange of information with other specialties and improved decision-making [2].

Although paper-based health records are still, without a doubt, the most common method of recording and storing patient data, the digital health systems have witnessed a rapid and intense upsurge in implementation over the last two decades especially in the developed world like the United States, Canada, and Western Europe [3-6]. National healthcare systems overtly adopt EHR making it a national priority. However, the implementation of EHR is a complex process involving a multitude of intricate factors related to human, technical and organizational elements on the forefront generating benefits and risks in terms of privacy, efficiency and cost-effectiveness. To summarize the benefits and risks associated with it, Black and her colleagues in their extensive review of the review stated data storage and functionalities like increased accessibility, manipulation, sharing of data, and preservation of confidentiality of the electronic data in addition to cost and organizational efficiency as principal analogous factors with empirical evidence pointing towards limited benefits [7]. Research has demonstrated conflicting reports of the positive and negative effects of the EHR systems [8,9]. Despite these drawbacks, the growing demand for EHR systems at the hospital's primary care settings is witnessing a steady rise even in the developing world.

The Kingdom of Saudi Arabia has been prerogative in the development of e-health systems and assigned supreme antecedence to its implementation in primary care settings. With huge budget allocation for development in e-health, application of information health systems began endorsement at the Ministry of Health hospitals, Armed Forces Services, University Hospitals, and at National Guard Health Affairs [10]. The EHR system at the King Saud University Medical City (KSUMC) is known by name, Electronic System for Integrated Health Information (e-SiHi). E-SiHi is a fully functional paperless electronic system maintaining complete patient health information. The transformation of health information management from a paper-based system to a computerized, electronic health record system has previously raised

concerns on data safety, compromised patient privacy and ethical violations in Saudi Arabia [11]. Although a subject of high interest in most of the countries, there are limited reports on the EHR privacy from the family physicians' perspective. Given the huge costs incurred in the establishment and implementation of EHR, it is imperative to evaluate the perceptions of consumers and stakeholders on the privacy aspects of EHR that might impact doctor-patient relationship and ultimately the healthcare quality. Hence this research investigated the physicians' perspectives towards the following issues: the ability of the computers to keep information private, accessibility of health information by outsiders, sharing of computerized health information, and the overall benefits of e-health over the risks.

2. Subjects and Methods

2.1 Study design and setting

A cross-sectional study design was adopted to accomplish the objective of evaluating physicians' perceptions towards electronic health records privacy. The study was conducted at KSUMC, which includes more than 1,300 full-time Physicians, 1,014 Residents and Fellows and approximately 2,072 allied health personnel, who collectively provide healthcare to more than 1,229,628 outpatient visits, 45,966 admissions, and perform around 14,231 procedures per year [12]. KSUMC underwent a massive transformation from paper-based health system to an electronic-based in 2014.

2.2 . Description of study participants

The study population largely comprised of the primary care Physicians and Family Medicine Residents at KSUMC. An updated list of the number of physicians serving at the primary care center contains 110 in total, forming the estimated sample.

2.3 Description of survey tool

The study outcomes were measured using a standardized and validated tool, Health Information Privacy Questionnaire (HIPQ) that was previously used by Perera and colleagues [13]. The instrument was divided into three parts, the first part containing the consent details, followed by the second part consisting of seven questions on sociodemographic characteristics. Furthermore, the third and main section of the tool had four themes containing 13 questions related to privacy, accessibility by outsiders, sharing, and benefits of computerized information on a 5-point Likert scale format ranging from strongly disagree to strongly agree.

2.4 Collection of data

Data collection was performed using Survey Monkey platform - www.surveymonkey.com. An

invitation email was sent to the official e-mail ID of all the primary care physicians and residents registered at the family medicine department requesting to participate in the survey. Two reminder emails were sent at a weekly interval to increase the response rate until the sample size was achieved.

2.5 Data analysis

Descriptive statistics were represented by frequency and percentage or mean and standard deviation for categorical and continuous variables as appropriate. Scores were awarded for the Likert scale responses and mean scores were calculated. Furthermore, bivariate analysis like Student's t-test & ANOVA was used to demonstrate the association between them using the IBM software Statistical Package for Social Sciences version 22.0 (SPSS Inc., Chicago, IL, USA). A two-tailed p-value of less than 0.05 was considered significant.

2.6 Ethical consideration

Approval for the conduct of the study was obtained by the Institutional Review Board (IRB) of the College of Medicine and from the Saudi Commission for Health Specialties (SCFHS), with reference number – 15/0246/IRB. Consent was obtained before data collection from every respondent by declaring privacy and confidentiality in the use of data.

3. Results

Of the total sample of 110 family physicians, the study received responses from 92 physicians. Three forms were excluded due to incomplete information. The final sample had 89 participants with a response rate of 81%. The socio-demographic credentials are displayed in table 1. The survey showed female predominance with a 43:57 male: female ratio. History of previous use of EHR was reported by 36 physicians (36/89;40.4%), of which 27/36; 75% had been using for less than two years.

Table (1): Socio-demographics of study participants

Characteristics		**Frequency (n) (N=89)**	**Percentage (%)**
Gender			
	Male	38	42.7
	Female	51	57.3
Nationality			
	Saudi	65	73.0
	Non-Saudi	24	27.0
Academic Rank			
	Resident	53	59.6

	Registrar	9	10.1
	Senior Registrar	13	14.6
	Consultant	13	14.6
	Professor	1	1.1
Country of Certification			
	United States	43	48.3
	Saudi Arabia	21	23.6
	United Kingdom	8	9.0
	Canada	1	1.1
	Australia	1	1.1
	Others	15	16.9
Previous use of EHR			
	No	53	59.6
	Yes	36	40.4
Duration of using previous EHR*			
	Less than 2 years	27	75.0
	2 years and more	9	25.0

* denominator = History of previous use of EHR=36

Furthermore, the Likert scale responses were averaged for all items, considering neutral as mean (neither agree nor disagree), followed by agreeing or disagreeing as extremes for all factors. The results of the four themes have been illustrated as a graphic representation for descriptive details of frequency and percentage, while the determinants observing associations have been tabulated.

3.1 Theme I: The ability of EHR to keep information private

The first theme of the questionnaire was concerning privacy, which measured the ability of computers to keep health information private. A major proportion of physicians (52/89;58.4%) showed satisfaction with the computers being able to maintain more privacy of health information than the paper-based sheets and 41.6% (37/89) disagreed on maintaining the privacy of health records on a computer to be hard. Furthermore, 38.2% (34/89) disagreed on worries of data leakage over the internet as illustrated in **Figure 1**.

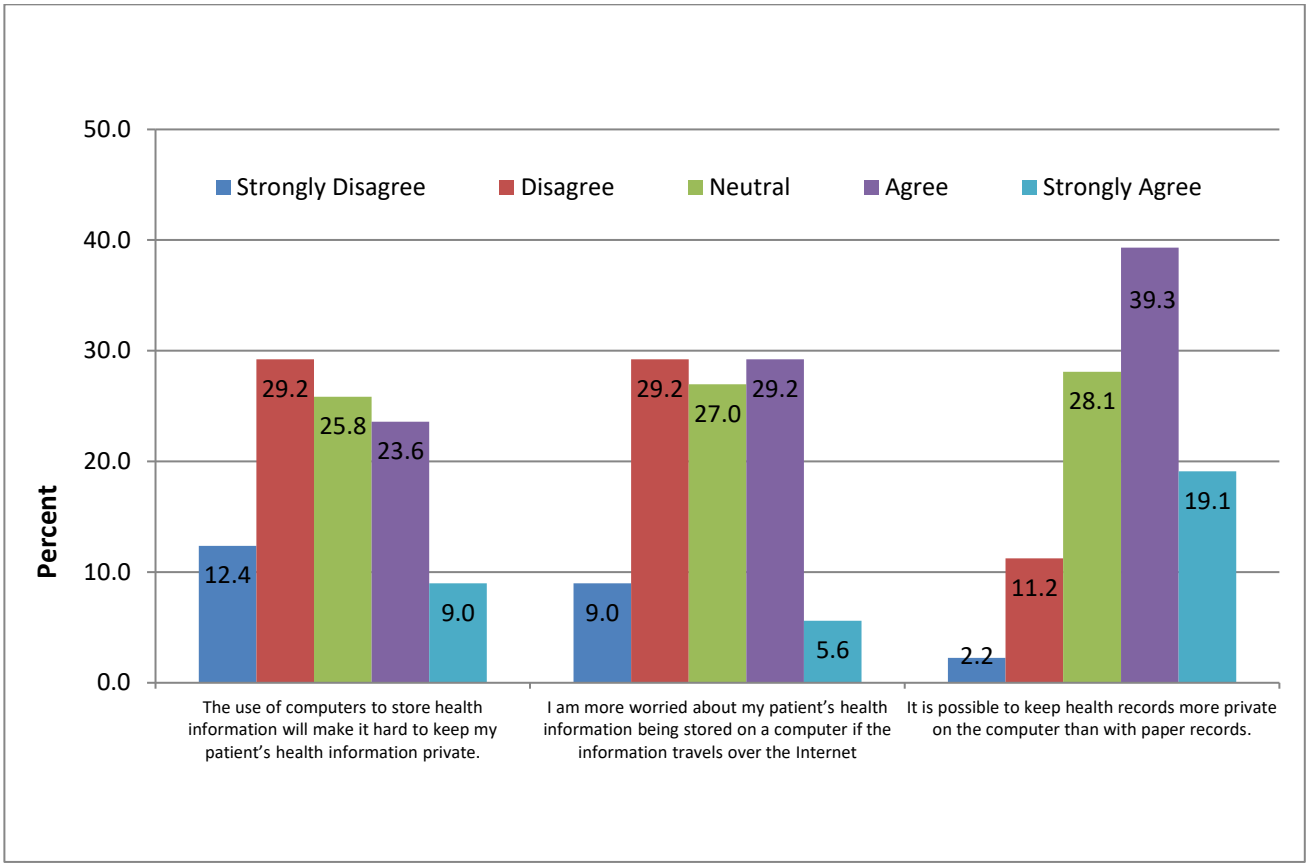

Figure 1: Ability of electronic health records to keep information private

Table 2 shows older physicians (p=0.05), non-Saudi's (p=0.029) and consultants (p=0.004) to have significant association with high-level perception of privacy of computerized information.

Table (2) Association of physicians' demographic variables with their perspective towards the ability of EHR to keep information private

Characteristics	N	Mean scores ± SD	t-test	p value
Gender				
Male	38	9.47±2.14	0.194	0.847
Female	51	9.39±1.82		
Age group				
25-34	63	9.08±1.93	5.691	**0.005**
35-44	12	9.50±1.51		
45+	14	10.93±1.77		
Nationality				
Saudi	65	9.15±1.91	2.219	**0.029**
Non-Saudi	24	10.17±1.90		

Academic Rank					
	Resident	53	9.26±1.87	5.808	**0.004**
	Registrar/Senior Registrar	22	8.86±1.86		
	Consultant	14	10.93±1.77		
Source of Certification					
	United States	43	9.23±2.03	0.619	0.605
	Saudi Arabia	21	9.29±2.22		
	United Kingdom	8	9.88±1.55		
	Others	17	9.88±1.58		
Use electronic health record					
	No	53	9.38±2.17	0.289	0.773
	Yes	36	9.50±1.61		
How long of Using electronic health record					
	Less than 2 years	27	9.52±1.58	0.118	0.907
	2 years & above	9	9.44±1.81		

3.2 Theme II: Outsiders' use of health information

In this theme, providing access to patient's health information to the Ministry of Health, insurance companies, the pharmaceutical industry and hospital-based researchers was evaluated. The frequencies are displayed in **Figure 2.**

The physicians mostly agreed to sharing the data with the Ministry (53/89;59.6%) and the hospital-based researchers (49/89;54.5%), while being indecisive towards the insurance and pharma companies.

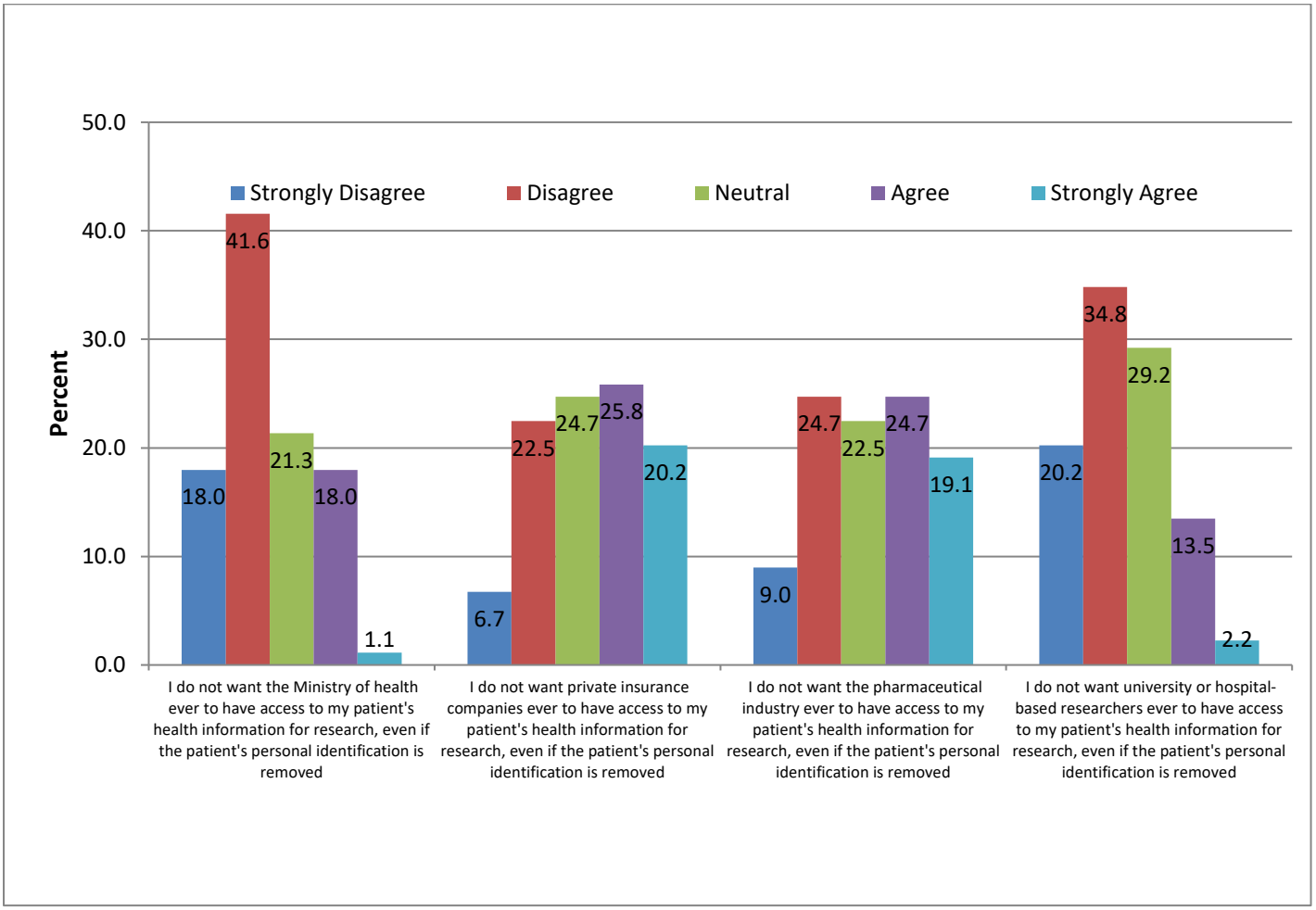

Figure 2: Perceptions on accessibility by third parties

3.3 Theme III: Sharing of health information with other health professionals

Theme III evaluated the perceptions related to the sharing of health information. As noted in **figure 3**, the physicians mostly (50/89;56.2%) agreed to keep health information of their patients between them, however, they likewise generally showed a high level of agreement to the ease of sharing information among the healthcare professionals (73/89;82%) using the computer.

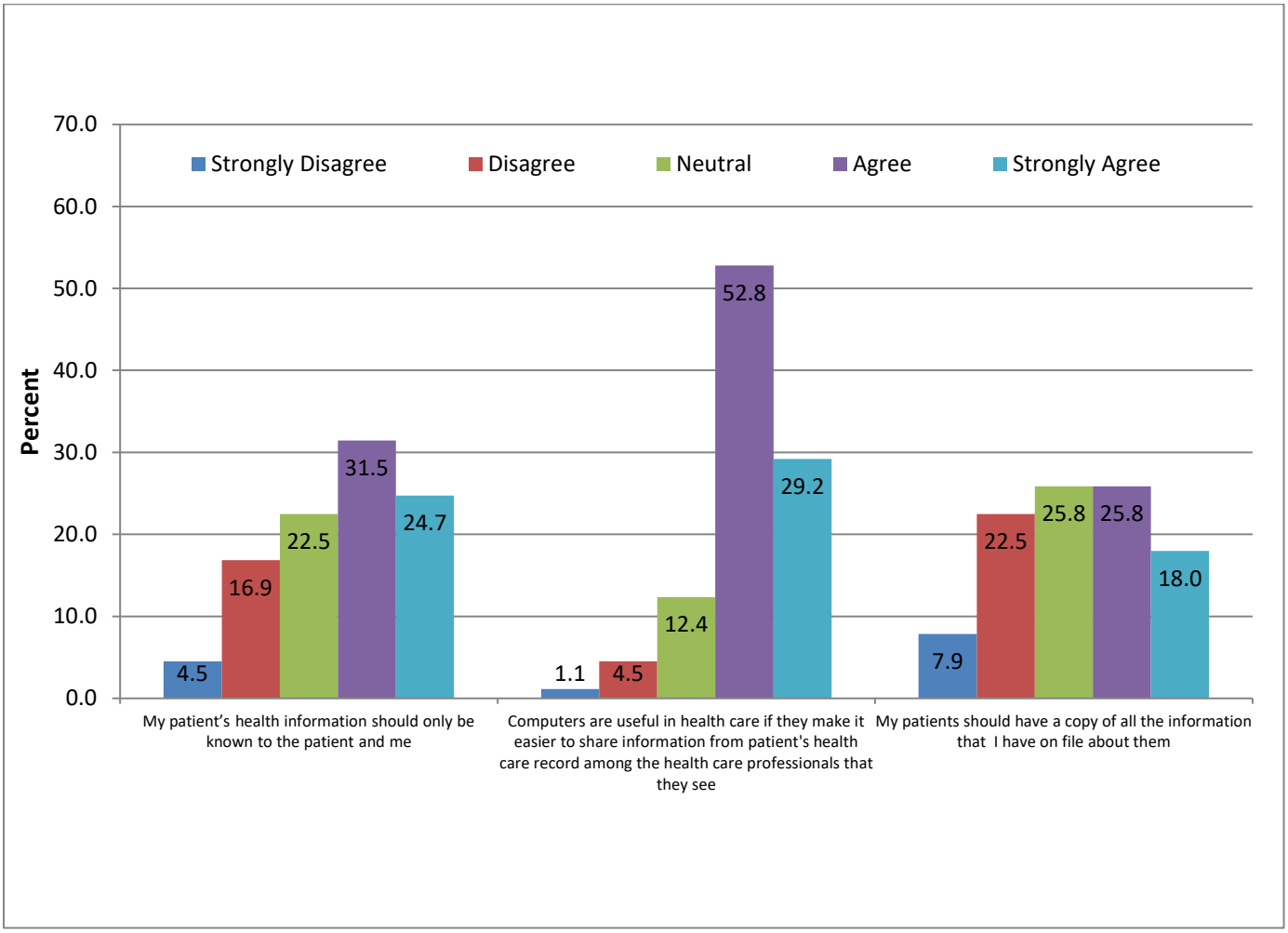

Figure 3: Perceptions on sharing electronic health record information with health professionals

3.4 Theme IV: Benefits versus the risk of computerized health information

Theme IV assessed the perceptions related to the usefulness of computers over the risk of losing confidentiality in terms of providing advice and feedback on patient health conditions and treatment of patients.

Weighing-in on benefits versus the risks of computerized healthcare information, majority of the respondents (75/89;84.3%) reported that computers are useful in healthcare as they can provide guidance and relevant advice concerning patient's health status on allergies or relevant drug interactions or lab tests. In addition, most of the physicians (70/89;78.7%) agreed to computers being useful in healthcare and capable of analyzing large information to provide feedback on how a condition can be treated as shown in **Figure 4**.

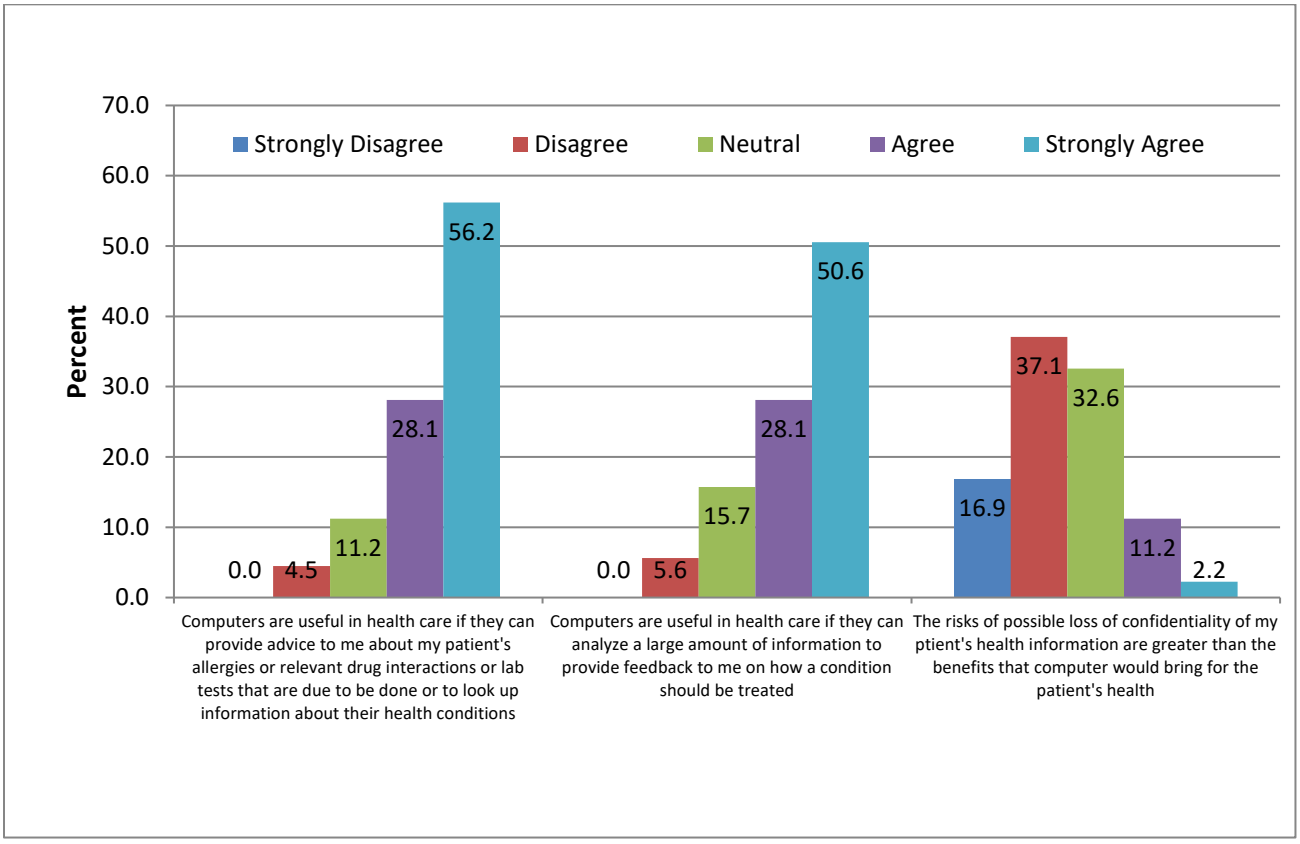

Figure 4: Benefits vs risk of computerized health information

Older physicians (p=0.018) and consultants (p=0.024) generally perceived the computerized health information well with higher scores and agreement towards benefits and usefulness of computers in health information as shown in Table 3.

Table (3) Association of physicians' demographic variables with their perception about overall benefits of an EHR system

Characteristics		N	Total mean ± SD	t-test statistic	p value
Gender					
	Male	38	43.11±5.39	0.696	0.489
	Female	51	42.33±5.01		
Age group-years					
	25-34	63	42.00±4.90	4.214	**0.018**
	35-44	12	42.00±5.24		
	45+	14	46.21±5.16		
Nationality					

	Saudi	65	42.05±5.01	1.881	0.063
	Non-Saudi	24	44.33±5.30		
Academic rank					
	Resident	53	42.13±5.08	3.899	**0.024**
	Registrar/Senior Registrar	22	41.77±4.66		
	Consultant	14	46.07±5.20		
Source of Certification					
	United States	43	42.16±5.21	1.209	0.311
	Saudi Arabia	21	42.33±5.62		
	United Kingdom	8	45.88±3.94		
	Others	17	42.82±4.79		
Use electronic health record					
	No	53	42.55±5.08	0.255	0.799
	Yes	36	42.83±5.35		
How long of using electronic health record					
	Less than 2 years	27	42.48±5.23	0.678	0.502
	2 years & above	9	43.89±5.88		

4. Discussion

The present study investigated the physicians' perceptions of EHR use one year after its implementation at KSUMC. A very limited number of studies have examined the benefits of EHR in Saudi Arabia. This study adds to the existing volume of literature by sharing the physicians' perceptions of EHR use. Policymakers may benefit from this study, encouraging the expansion of EHR at other major facilities. These positive perceptions could serve as a boon in facilitating the adoption of innovative technology thereby rendering improvised and efficient healthcare. The negative perceptions largely serve as an inherent means to overcome the barriers in successful implementation.

Data privacy is an issue of controversy worldwide, especially more so in the conservative Kingdom of Saudi Arabia. Yet our principal findings were in support of the EHR being instrumental in efficient healthcare delivery. An overwhelming majority of the physicians accepted to computers being more capable of safeguarding health data than the traditional paper-based records. The negative questions on the difficulty in storing the confidential information and risk of data leak yielded a mixed response although the majority disagreed to it. In addition, consultant, physicians older than 45 years, and physicians of non-Saudi nationality achieved higher mean scores reflecting positivism on EHR privacy. These findings however reflect on the changes in perception and behavior towards adopting modern systems for efficient healthcare management.

Privacy and security of health data by far remains a key concern even in Western nations. A Canadian Delphi study arrived at a consensus that privacy and security is one of the three chief identified concerns while implementing EHR in Canada [14]. Studies from the United States and European nations like Germany, Sweden, United Kingdom also project similar concerns over privacy [13,15,16]. Nevertheless, most of them have agreed that these issues can be easily and effectively addressed by various security measures and acts. Unlike the United States which safeguards health data by Health Insurance Portability and Accountability Act (HIPAA) and several other federal laws criminalizing breaches in health data, the Kingdom of Saudi Arabia (KSA) does not legislate any specific health data protection legislation. However, there are several other acts like the KSA Anti-cybercrime law, KSA Healthcare Practice Code that stipulates penalties for confidentiality violators [17]. Although there are reports of internet data leakage and hacking of centralized repositories with fear largely looming over security threats, the EHR-users have still by far ensured better data protection by computer systems [18]. Many studies have correlated higher satisfaction with electronic-based systems as being more secured than paper-based records in protecting data privacy and confidentiality [19-21]. Alzobaidi and his team assessed the Saudi physicians' attitudes towards EHR and found 57% of the physicians voiced strong agreement to electronic health records being more secure than the general paper record [22]. However, it is also important to note that privacy concerns are complex and ambivalent, producing chasm among the users and non-users [23,24]. Nevertheless, the EHR-users have found satisfaction in its ability to maintain the confidentiality of the patient's e-health information. It must however be noted that access control, encryption, and de-identification are some of the common methods that ensure system privacy that outweighs the risk of breach enhancing safety and security in EHR efficiency and use [25].

In addition, positivism was reflected in the sharing of patient health information for research purposes with the Ministry of Health and University-based research units. However, the participants were quite indecisive of sharing the vital patient data with neither the insurance nor the pharma sector. Almost 45% showed agreement while the rest being either neutral or disagreed with the data sharing meant for research even though the patient anonymity was considered. These findings reflect on the attitude of the EHR-user favoring disseminating health information with those liable for the improvement of services. Facilitating the sharing of health information with policymakers and among the healthcare providers largely improves the quality of healthcare services benefiting the population en-masse.

A previous study from Saudi Arabia demonstrated a mere 15.8% of the hospitals implementing EHR [26] but recent reports from National Health Information Center (NHIC) show highly commendable attempts and accomplishments in expanding the e-health services across the Kingdom. Given the

increasing demand with growing recognition of EHR, the overall benefits of the stakeholders' perspective is still a less explored subject. Our findings reveal a high degree of satisfaction and agreement in the usefulness of computer assisted feedback in health service delivery and decision-making processes. Furthermore, the physicians' positive perspective towards the overall benefits of the electronic health system is another important finding of the study. A significant association was observed between the demographic credentials of older age and consultants as academic rank with high levels of agreement in the overall benefits of EHR. Alanazi et al summarized the perceptions of EHR use in countries of Gulf Cooperation Council (GCC) in a recent systematic review in 2020 [27]. Consistent with our findings, they found age and computer skills as influential personal factors for positive perceptions of EHR.

Furthermore, there are reports stating managerial positions playing a major role in encouraging e-health systems. Darr et al conducted in-depth interviews to understand the physicians' views on electronic medical records implementation at an Israeli university hospital and found higher-level managers like consultants and senior physicians emphasizing the positive effects of EHR similar to our findings while the junior staff were concerned about the over-burdened work [28]. Similarly, another study from Saudi Arabia by Alasmary also correlated age to be a significant predictor of higher satisfaction with EHR systems [29].

The study does contain certain inherent weaknesses. The participants were enrolled from a single-center limiting the generalizability. Moreover, the study setting being a public institution has different financial and organizational implications compared to a similar-sized private healthcare center. Hence the applicability may again experience a setback. There is a possibility of response bias since the questionnaire was self-administered by the participants. Further studies are recommended involving a diverse population from multi-level healthcare settings with a wider focus on different functionalities of EHR. Despite the limitations, the findings provide a basis for understanding the EHR benefits that may enhance future expansion, in addition to rectification of identified discordance as barriers.

5. Conclusion

Majority of the participants perceived high satisfaction towards data protection, safety, and security of computerized patient health information, thus minimizing ethical concerns. The era of digital technology has revolutionized and impacted almost every aspect of our life. The transition of hospital records from paper-based to electronic-based is a major milestone in development. Nevertheless, ethical issues and privacy concerns related to data leaks, confidentiality breach, accessibility to non-hospital staff

are major issues concerning electronic health records. In countries with absence of data protection acts, it is vital to assess the physicians' perceptions on these issues. Our study has documented the physicians' views on EHR privacy in Saudi Arabia. The EHR are password-protected in special medical software that are accessible only to physicians and other clinical and laboratory staff involved in healthcare. The physicians agreed to EHR being more private and safe than the paper-based records and its benefits and usefulness are more than the risks involved. The overall usefulness of the computer in healthcare was perceived as highly beneficial favoring EHR implementation in large hospitals across Saudi Arabia. These findings may facilitate the policymakers to advocate EHR expansion.

6. Declarations

6.1 Acknowledgements:

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6.2 Declaration of conflicting interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

6.3 Authors' contributions

All listed authors have made substantial contributions to the manuscript and have approved the final submitted version of the manuscript. AA and AJ conceptualized the design and conduct of the study. ST wrote the manuscript.

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