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## Investigation of utilising electronic medical records on the quality of healthcare services at hospitals in Saudi Arabia

Salem Saeed Alghamdi<sup>1</sup>, Abdulrahman Tajaldeem<sup>1</sup>, Ahmed Mohammed Alghamdi<sup>4</sup>, Rowa Aljondi<sup>1</sup>, Abdulzzag Alghamdi<sup>2</sup>, Mohammed Alqahtani<sup>5</sup>, Thair Habbosh<sup>5</sup> and Wala Alzahrani<sup>3</sup>

<sup>1</sup>Department of applied Radiologic Technology, College of Applied Medical Sciences, University of Jeddah, Jeddah, Saudi Arabia

<sup>2</sup>Radiology department, Dr Soliman Fakeeh hospital, Palestine, Al-Hamra'a, Jeddah 23323

<sup>3</sup>Department of Clinical Nutrition, College of Applied Medical Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

<sup>4</sup>College of Computer Science and engineering, University of Jeddah, Jeddah, Saudi Arabia

<sup>5</sup>Department of business administration, College of Business administration, University of Jeddah, Saudi Arabia

\*Correspondence: [ssalghamdi85@gmail.com](mailto:ssalghamdi85@gmail.com) Received: Sep., 12, 2024, Revised: November 20, 2024, Accepted: November 29, 2024 e-Published: December 05, 2024

This study aimed to evaluate the digitize connectivity of diagnostic health services on hospitals and healthcare centers in the Kingdom of Saudi Arabia from perspective of healthcare workers and patient's satisfactions. The total sample size was 201 participants from laboratory, radiology and pharmacy departments, and their ages were between 20-60 years. The questionnaire contained 10 questions that measure participants' perspective about the electronic medical records. The data were conducted through three departments (radiology, laboratory and pharmacy departments), (50%, n=176) were beneficent, (25.3% n= 89) were radiology staff, (12.5, n= 44) were laboratory staff and (12.2%, n= 43) were pharmacy staff. Regarding to beneficiaries responds, more than half of the answers to the statements were strongly agree, and this indicates that more than half of the beneficiaries support the idea of having electronic health care records to facilitate the communication between health care organizations for sharing patients' diagnostic information for better diagnose. The electronic medical records of data concerning patients play a vital role in the quality and accuracy of healthcare services. It improves disease diagnosis and treatment, reduce error and hospital costs, increase quality of health care system and provide faster healthcare decisions.

**Keywords:** Radiology, CT, MRI, US, electronic records

### INTRODUCTION

The diagnostic medical services quality and continuity are important elements to provide convenience healthcare services and affecting the degree of patient's satisfaction about healthcare system.<sup>1</sup> Recently, healthcare medical system in Saudi Arabia have undergone several changes such as transition of paper-based medical records to electronic medical records in order to improve the healthcare services quality.<sup>2,3</sup> This electronic medical records of data concerning patients including clinical information, medical history, patients review and management planning are important for disease registry in the Ministry of Health, clinical trials, epidemiological studies and drug safety surveillance, which improves compliance with best practices.<sup>2,4</sup> Incorporation of all patient's medical records data, detailed documentation of medical consultation and medical history as well as diagnostic medical data play a significant role in the quality and accuracy of healthcare services.<sup>5</sup> The implementation of

electronic patient's medical records has several benefits for patients including improved disease diagnosis and treatment, reduced error and hospital costs, increased quality of healthcare system and provide faster healthcare decision. This also beneficial for healthcare workers which facilitates the communication and workflow between administrators and healthcare workers, enhance the patient safety perceptions of healthcare providers, and reduce effort and time.<sup>2,6-10</sup> Medical diagnosis services such as clinical laboratory and radiological examination is a keystone of an accurate disease diagnosis and treatment plan, and support gathering systematic medical information of the patients.<sup>11</sup> Computerized decision support systems of screening or monitoring test ordering and communication for diagnosis could improve the overall outcome healthcare services in the kingdom of Saudi Arabia.

In radiology department, Picture Archiving and Communication System (PACS) is the electronic storage

of patients' identification information, imaging studies and reports.<sup>12</sup> The Radiology Information System (RIS) is usually integrated with PACS to support administrative tasks such as lab administrations, reporting, accounting and scheduling in hospitals.<sup>12,13</sup> Nowadays, Digital Imaging and Communication in Medicine (DICOM) is the standard for management and communication of medical imaging information and related data. However, most of the available commercial software distributed with expensive medical machinery for manipulation of DICOM images in hospitals.<sup>12</sup> Therefore, integrated of open-source software application for displaying medical imaging with electronic health records can improve the accuracy and accessibility of patient's data. Accessing personal health records is an important tool for transforming clinical information to connect with specialized physicians. This enabling patients to access their electronic health care records and diagnostic imaging data could help them to self-management of early disease diagnosis and better treatment.<sup>3</sup> Laboratory information system (LIS) also play a significant role in management information about patients laboratory results, examinations, and quality control. <sup>14</sup> Prescribing and medication administration systems (ePMA) are another form of electronic system that play a role in managing drug prescription in pharmacies <sup>15</sup>. Thus, connecting of electronic health records of radiology, laboratory and pharmacy information could improve diagnostic practice and facilitate delivery of clinical and radiological services to patients.

In Saudi Arabia, the majority of published papers have focused on hospital-based medical services and electronic health records, with little attention paid to diagnostic medical services, which are the first point of disease diagnosis and access to healthcare system.<sup>16</sup> While the Saudi Ministry of Health (MOH) attempt to provide a good healthcare service quality, there are some mid to long term challenges affect the diagnostic medical quality services in Saudi Arabia.<sup>17</sup> These challenges include decrease reliance on foreign workers, making a sustainable financing system, respond to changing disease patterns, demographic and growing population which required realignments of health services and providing of high quality training for local healthcare professionals.<sup>17</sup> Therefore, there is pressing need to digitize the Saudi healthcare system, especially for medical diagnostic services to provide solution for future sustainable public health care.

This study aimed to evaluate the digitize connectivity of diagnostic health services on hospitals and healthcare centers in the Kingdom of Saudi Arabia from perspective of healthcare workers and patient's satisfactions. In particular, it will explore the patient's satisfactions and healthcare workers experience of diagnostic medical services to conceptualize the practicality of electronic health records of patient's clinical and diagnostic

information in the Kingdom of Saudi Arabia.

## MATERIALS AND METHODS

This cross-sectional online questionnaire-based survey was designed using google form software to evaluate the necessity of using exchangeable electronic medical records in Saudi Arabia. The total sample size was 201 participants from laboratory, radiology and pharmacy departments, and their ages were between 20-60 years. The questionnaire contained 10 questions that measure participants' perspective about the electronic medical records. All questions were multiple choice and were free text. Items and their response followed a 5-point Likert-scale, where a positive statement is presented to participant, and they can choose one of these answers: strongly disagree, disagree, neutral, agree and strongly agree. In data, these answers were coded to 5,4,3, 2 and 1 respectively, in order to allow for quantitative analysis. For each participant, the average response scores were calculated. These scores will range between 1 and 3, where 1 indicates extremely low agreement, 2 indicates moderate agreement and 3 indicates extremely high agreement. Demographic data such as age, gender, nationality, qualifications, specialty, department's career, work experience and sector were also collected. After confirming the initial formula of the study scale, content validity of the final questionnaire was then tested and reviewed by a panel of expert in the field of radiology with more than 10 years experiences.

## Inclusion and exclusion criteria

The participants included male and female (Saudi and non-Saudi) employees in Saudi Arabia. The age of the participants ranged from 20 to 60 years. All healthcare workers including physicians, technologists, technicians, receptionists and nurses working radiology, laboratory and pharmacy departments in governmental or private healthcare centers in the Saudi Arabia and healthcare beneficiaries (patients). Other healthcare workers at hospitals such as physicians from different departments, dentists or physiotherapist were excluded from this study.

## Statistical analysis

All collected data were entered into an (Excel) sheet and then statistically analyzed using Package for Social Science (SPSS) statistical software, version 26. Descriptive statistic was used for frequency distribution to summarize the demographic variables and the results of the Likert-scale items. The mean response score was also used to summarize results of the Likert-scale items. Pearson's chi-square analysis will be done for comparisons of categorical data between groups. In this analysis,  $p < .05$  indicates significant results.

**Ethical consideration**

All participants were voluntary in this study and their personal information was anonymous for confidentiality. Electronic informed consent was obtained on the first page of the survey from agreement of each participant. All participants were asked to answer the questions honestly. The present study does not require ethical approval as the study does not involve any risk for the participant and did not deal with a vulnerable group. This study followed the checklist for reporting the results of internet E-surveys (CHERRIES) guidelines. It also followed the declaration of Helsinki principles revised in 2013.

**RESULTS**

The sample characteristics and demographics variables are presented in Table1. In total, 352 participants were included in this study. The majority of respondents (64%, n= 224) were male and

approximately half of the participants (47%) were between 20-25 years old, and this percentage decreases gradually as we move towards higher age groups. The majority of the participants were Saudi (96%). The sample were equally divided between staff and beneficiaries. The data were conducted through three departments (radiology, laboratory and pharmacy departments), (50%, n=176) were beneficent, (25.3% n= 89) were radiology staff, (12.5, n= 44) were laboratory staff and (12.2%, n= 43) were pharmacy staff. The biggest part of the participants (92.9%, n= 327) were working or benefiting from public healthcare facilities, and only (7.1%, n= 25) from private facilities. Most of the employed participants (77%) hold the bachelor's degree, (8%) had a diploma, and (11.4%) had a postgraduate qualification. Moreover, approximately half of the employed participants (53%) have worked for 5 or less years, while around one quarter (26%) have worked for 6 to 10 years; the rest have higher experience.

**Table1: The General Characteristics and Demographics**

Variable	Categories	Freq.	% (N = 352)
Participant category	Laboratory staff	44	12.5
	Pharmacy Staff	43	12.2
	Radiology staff	89	25.3
	<i>Total staff</i>	<i>176</i>	<i>50.0</i>
	Beneficent	176	50.0
Gender	Male	224	63.6
	Female	128	36.4
Age	20 - 25	164	46.6
	26 - 35	92	26.1
	36 - 45	64	18.2
	46 - 59	26	7.4
	60 & above	6	1.7
Nationality	Saudi	338	96.0
	Non-Saudi	14	4.0
Sector	Public	327	92.9
	Private	25	7.1
Qualification (staff only)	Diploma	14	8.0
	Bachelor	135	76.7
	Master	11	6.3
	PhD	9	5.1
	Other	7	4.0
Experience (years) - staff only*	5 or less	92	52.6
	6 - 10	45	25.7
	11 - 15	20	11.4
	16 - 20	13	7.4
	> 20	5	2.9

Table2 present the job distribution by departments, technologists constitute more than half of the lab staff (57%), while intern student/trainee constitutes 23%; the rest can be put in other various categories. For pharmacy department, approximately 3 quarters of the participating pharmacy staff are either pharmacists or intern-student/trainees (47% + 28% respectively). Also according to table2, 3 quarters of the participating radiology staff were either technologists or intern student/trainees (40% + 33% respectively).

**Table2: Job Title Distribution by Department (for Employees Only)**

Category	Sub-category	N	% within Category
Laboratory staff	Intern student/ trainee	10	22.7%
	Laboratory Director	1	2.3%
	Laboratory receptionist	1	2.3%
	Pathologist	2	4.5%
	Senior Technologist	4	9.1%
	Technician	1	2.3%
	Technologist	25	56.8%
	Total	44	100.0%
Pharmacy Staff	Consultant Pharmacist	4	9.3%
	Intern Student/ Trainee	12	27.9%
	Pharmacist	20	46.5%
	Pharmacy Technician	2	4.7%
	Senior Pharmacist	5	11.6%
	Total	43	100.0%
Radiology staff	Consultant Technologist	1	1.1%
	Intern student / trainee	29	32.6%
	Radiologist	10	11.2%
	Radiology nurse	2	2.2%
	Senior Technologist	5	5.6%
	Technician	6	6.7%
	Technologist	36	40.4%
	Total	89	100.0%

According to Table3, which represent the specialty of employee by department, the majority of the participating lab staff (80%) are roughly divided between those specialized in chemistry and those specialized in microbiology. For radiology department, more than half of the participating radiology staff (56%) are specialized in CT or general X-ray (30% + 26% respectively).

**Table3: Specialty of Employee by Department**

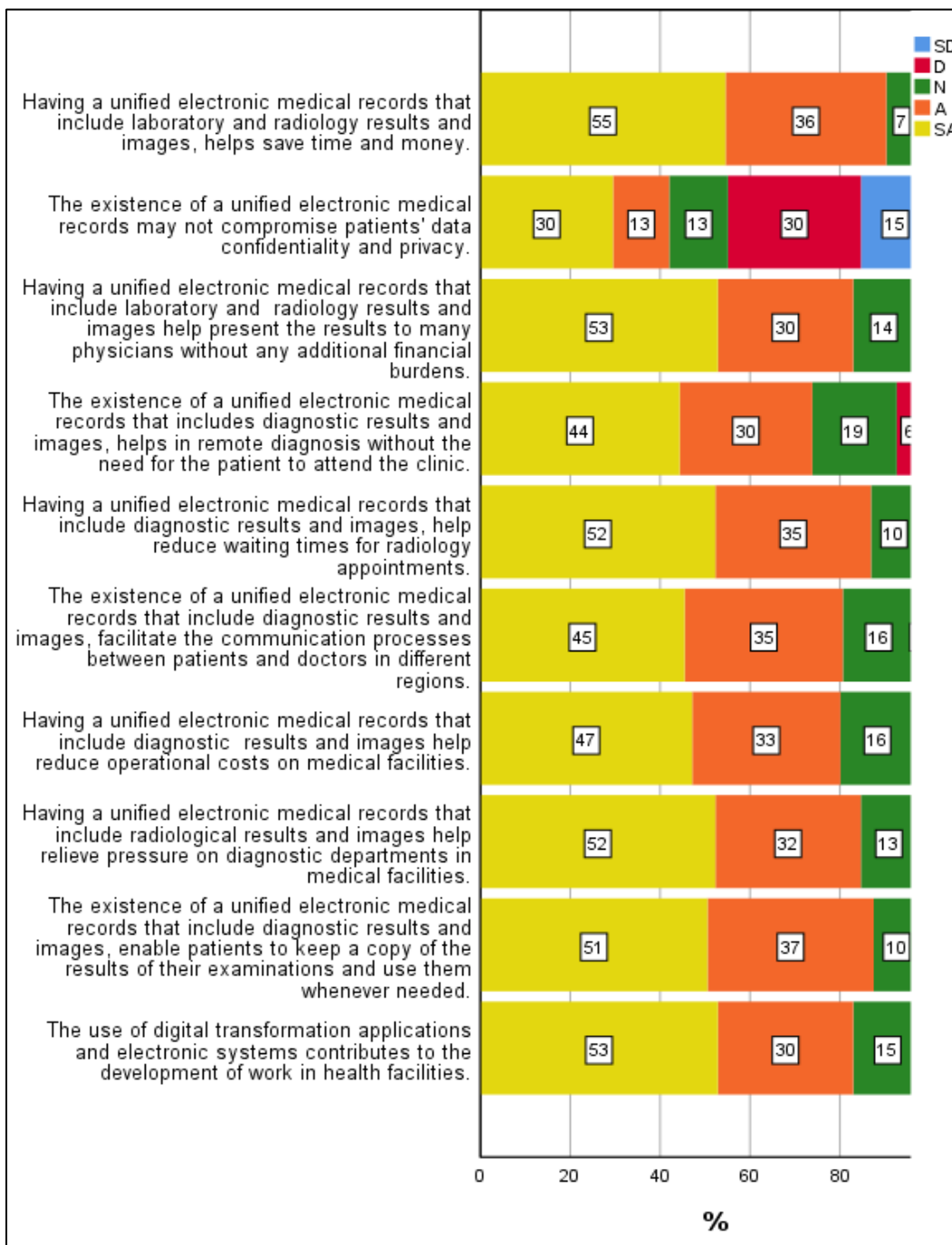
Category	Specialty	N	% within Category
Laboratory staff	Chemistry	17	38.6%
	Hematology	2	4.5%
	Histology	2	4.5%
	Immunology	1	2.3%
	Laboratory	4	9.1%
	Microbiology	18	40.9%
	Total	44	100.0%
Radiology staff	CT	27	30.3%
	General x-ray	23	25.8%
	MRI	16	18.0%
	Nuclear Medicine	2	2.2%
	Radiologist	13	14.6%
	Radiology nurse	1	1.1%
	Ultrasound	7	7.9%
	Total	89	100.0%

We looked first at the analysis of response to the main questions and score of agreement to the important of having electronic health care records as presented in Table4 and Table 5.

In term of employees responds, we found that the overall responses highly agree with the importance of having electronic health care records as more than half of the employees agrees or strongly agrees with almost all statements. However, in statement 2 which stated that " The existence of a unified electronic medical records may not compromise patients' data confidentiality and privacy," in purpose to agree to the hypothesis of this study respondents should agree/strongly agree with the statement. We found that more than half of the responds disagreed to the previous statement which present their fear of compromising confidentiality. Though the numbers are close to each other's as 43 of the employees agreed and 45 disagreed with the statement, as presented in Table4.

Regarding to beneficiaries responds, more than half of the answers to the statements were strongly agree, and this indicates that more than half of the beneficiaries support the idea of having electronic health care records to facilitate the communication between health care organizations for sharing patients' diagnostic information for better diagnose. In addition, more than half of the beneficiaries were also agreeing with the second statements about compromising confidentiality and privacy which is different than employee's idea as showed in Table5.

**Table 4: Analysis of questionnaire's main questions responded by employees:**



**Table 5: Analysis of questionnaire's main questions responded by beneficiaries:**

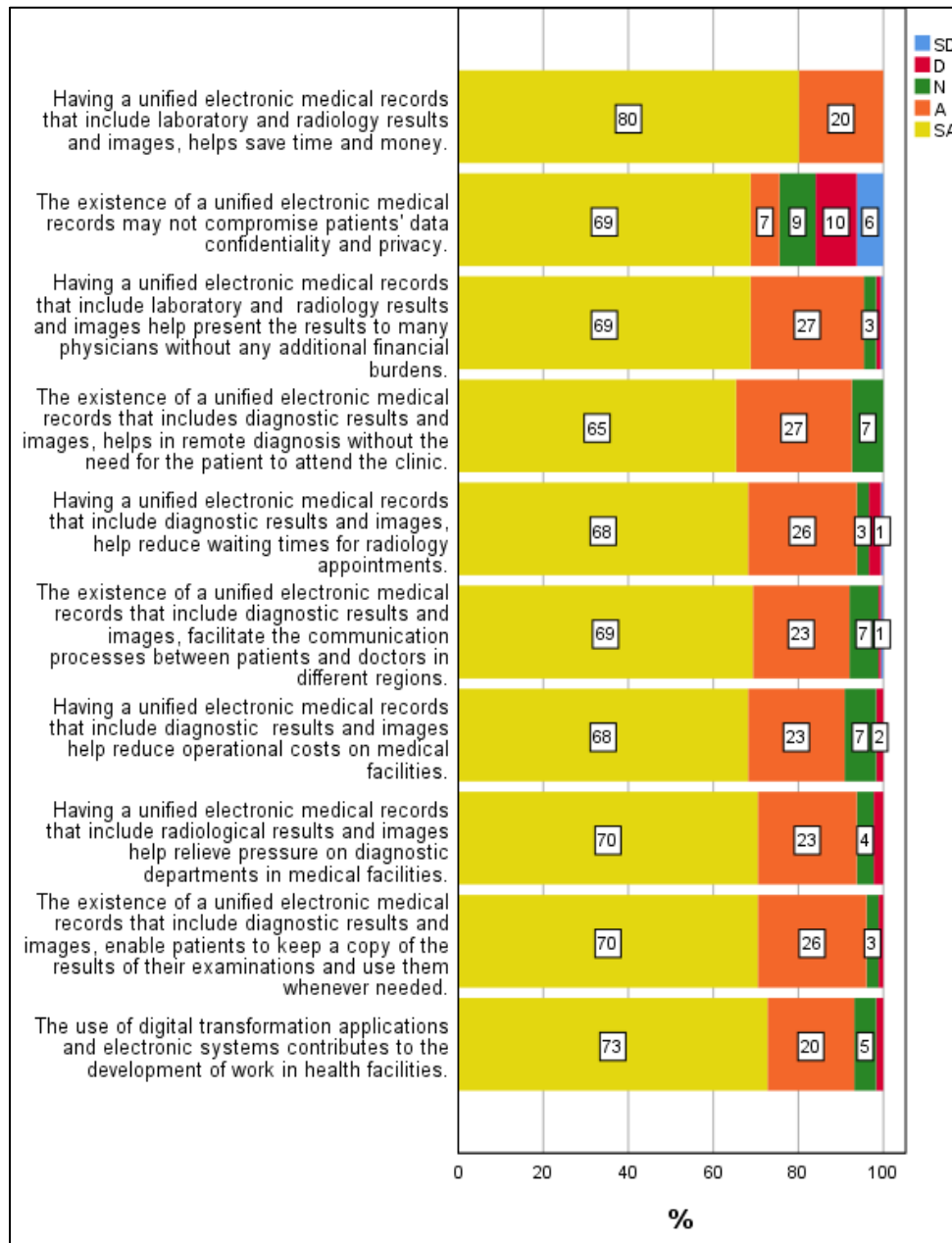


Table 6 shows the attitude score that were calculated based on respondents' answers to each attitudinal statement. Scores were calculated by averaging respondents' answers to the statements. The mean of the whole sample score was 33.82 (SD = 6.08, range:6-40), indicating positive attitude. For the staff the mean score was 31.76 (SD = 6.25, range: 6-40), and for the beneficiaries the mean score was 35.89 (SD = 5.15, range: 18-40). Considering the whole sample, we can see that the p-value of the t-test is 0.000. Since it is < 0.05, then we conclude that the mean attitude score

(which is estimated as 85%) has significantly exceeded 75. Also, for the sample of staff, we can see that the p-value of the t-test is 0.000. which is < 0.05, then we also conclude that the mean attitude score (which is estimated as 79%) has significantly exceeded 75. Lastly, looking at the sample of beneficiaries, we can see that the p-value of the t-test is also 0.000, and since it is < 0.05, then we conclude that the mean attitude score (which is estimated as 90%) has significantly exceeded 75. Therefore, we can say that the attitude score is high for the staff, beneficiaries or both combined.

**Table 6: Overall Attitude Score and Hypothesis Testing**

Sample	Tested Variable	Unit	Min	Max	Mean	SD	Hypothesis	Result of Hypothesis Testing (P-value)*
Whole sample	Attitude Score	The original score	6	40	33.82	6.08	Mean Att. Score > 40 (or 75 in 100%-scale)	0.000
		100%-scale	15	100	84.55	15.20		
Staff		The original score	6	40	31.76	6.25		0.000
		100%-scale	15	100	79.39	15.62		
Beneficent		The original score	18	40	35.89	5.15		0.000
		100%-scale	45	100	89.72	12.87		

We can also notice that the attitude is relatively higher within beneficiaries than the staff; mean attitude score for beneficiaries is 90%, compared to 79 % for the staff.

## DISCUSSION

In order to help the kingdom achieve its goal of standardizing healthcare systems as outlined in the Kingdom's Vision 2030; as healthcare sectors need to focus on utilizing technology.<sup>18</sup> it proved that there is low usage percentages reported for electronic health services related to medical eligibility, pathology and medical report and archiving; and this can be an indication of the failure to keep in line with new technologies in hospitals.<sup>18</sup> This study was developed with the aim of exploring patients' and workers' acceptance of the electronic healthcare record systems in Saudi Arabia.

First, according to the results showed in the previous section, the results shows an overall acceptance of the implementation of electronic health records for the radiology, laboratory and pharmacy departments in Saudi Arabia. It also shows that using a unified health care records' system help developing the healthcare sector. This results is similar to a study held in Saudi Arabia that studied the leverage of electronic health records to improve management of noncommunicable diseases at primary healthcare centers in Saudi Arabia, which imply that the interviewed physicians cleared the advantages of the EHR systems as well structured systems that provide and connect different physicians with the patients' data, and help the patients to be treated despite where he lives.<sup>3,20-22</sup> They also encouraged the idea of unify the system between public and private health facilities in order to achieve maximum productivity.<sup>3,23-25</sup> In another paper that studied patient satisfaction with the implementation of electronic medical Records in the Western Region, Saudi Arabia proved that participated patients agreed that implying EHR systems helped increasing quality of healthcare services in many different methods; as there was a huge development in accessing patients' information, potency,

quality, and overall patient contentment in healthcare services, which also agrees with another studies held in Kuwait and Australia.<sup>5,27,28</sup>

The majority of the responses (health care workers & beneficiaries) agreed with the necessity of having a unified electronic health care records' system that include laboratory and radiology results, and the prescribed medication. They agreed that the implementing of the system would help save time and money, help to present the information to different physicians with any further any financial burdens, help with remote diagnostic and therapeutic services, help to reduce time in appointments' delay, facilitate remote clinic services, relieve pressure on diagnostic departments in healthcare facilities, enable patients to always have a copy of their medical results and use them whenever needed. And this marvelous agreement with the study hypothesis strongly agree with another study held in Saudi Arabia that propose a Standardized Electronic Health Record for Kingdom of Saudi Arabia, in developing different aspects of the EHR systems in different aspects, such as: clinical documentation, quality, services following, and making the records mobile. Moreover, accessing patients' information quickly from the EHR systems is more effective and handy.<sup>29</sup> The study guarantee that EHR system as implement is a great productive method for following up with patients effortlessly without any concerns of losing or misplacement of documents.<sup>29</sup> Their results also suggested that EHR systems ease the treatment and care of patients' by accessing their encrypted records by only authorized healthcare providers from different facilities, to help physicians have more precise and absolute records from diagnostic and therapeutic department to give the most accurate care.<sup>29</sup>

Regarding information confidentiality, half of the employee responds presented their fear of compromising confidentiality of patients' data; however, beneficiaries showed less fear of compromising their medical information, as more than half of the them agreed that EHR systems may not compromise patients' information and privacy. A study that held in Greece which studied Image Management in an Integrated

Electronic Health Record Environment, proved that data protection is based relatively on the limitation and authorization of individual who can view and edit those information, and having adequate employing of authorized duties restricts compromising any confidential information.<sup>30</sup> Permission should be assigned by a superior to ensure there is no danger to those information.<sup>30</sup> Another study proposed a way to save data confidentiality by using blockchain technology as they are difficult to be used in low computing devices, this way also enables the system to save information with no storage, but by connecting the devices of the institution and uses secured passwords, and then store them in a cloud base network; therefore, no real storage needed and will be productive and safe system.<sup>31</sup>

## CONCLUSIONS

The electronic medical record of data concerning patients play a vital role in the quality and accuracy of healthcare services. It improves disease diagnosis and treatment, reduce error and hospital costs, increase quality of health care system and provide faster healthcare decisions. This study aims to evaluate satisfaction to the diagnostic medical services to conceptualize the practically of electronic health records of patient's clinical and diagnostic information in Saudi Arabia. This study may provide specialists with an immaculate idea in information archiving system for improving the quality of healthcare system and to clear away communications' burdens among healthcare facilities.

## Supplementary materials

The supplementary material / supporting for this article can be found online and downloaded at: <https://www.isisn.org/article/>

## Author contributions

All author contributed in all parts of the paper. All authors have read and agreed to the published version of the manuscript.

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## Institutional Review Board Statement

The study was approved by the Bioethical Committee of scientific and medical research UJ-REC-131

## Informed Consent Statement

Not applicable.

## Data Availability Statement

All of the data is included in the article/Supplementary Material.

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## Conflict of interest

The authors declared that present study was performed in absence of any conflict of interest.

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