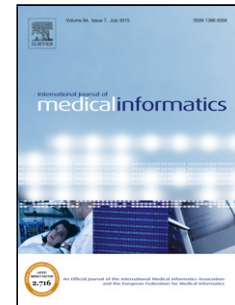


## Accepted Manuscript

Title: The Role of Electronic Medical Records in Improving the Quality of Health Care Services: Comparative Study

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PII: S1386-5056(19)30025-5

DOI: <https://doi.org/10.1016/j.ijmedinf.2019.04.014>

Reference: IJB 3853

To appear in: *International Journal of Medical Informatics*

Received date: 7 January 2019

Revised date: 9 April 2019

Accepted date: 17 April 2019

Please cite this article as: Ayaad O, Alloubani A, Abu ALhajaa E, Farhan M, Abuseif S, Al Hroub A, Akhu-Zaheya L, The Role of Electronic Medical Records in Improving the Quality of Health Care Services: Comparative Study, *International Journal of Medical Informatics* (2019), <https://doi.org/10.1016/j.ijmedinf.2019.04.014>

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# The Role of Electronic Medical Records in Improving the Quality of Health Care Services: Comparative Study

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## Highlights

- Encourages others to look at the effect of implementation of EHR's in their Country.
- identify the quality of health care services' differences between adopted Electronic Medical Record (EMR) and paper-based record hospitals
- Identify how the quality of electronic medical records affect the quality of health care services.
- Identifying the impact of the quality of electronic medical records on the quality of health care services is considered a crucial role in measuring the effectiveness of adopted EMRs.
- The research recommends increasing the awareness about domains and function of EMR and its role in improving the quality of health service
- The results indicate that the quality of health care services (expectation and perception) in EMRs adopted hospital is higher than the quality of health service in non-adopted.

- The gaps between the perception and expectation of quality of health service are lower in the EMR adopted hospital.

### **Abstract**

**Purpose:** The purpose of this study is to identify the quality of health care services' differences between adopted Electronic Medical Record (EMR) and paper-based record hospitals. Moreover, to identify how the quality of electronic medical records affect the quality of health care services.

**Methods:** A cross-sectional, descriptive, and comparative design was utilized between two groups in this study. The study was conducted in two public hospitals in Jordan. One hospital which had adopted the EMR system in their works and another hospital that had paper-based record. A convenience sampling technique was used to select 410 health professionals from the selected hospitals (205 participants from each hospital). SERVQUAL and E-S-QUAL questionnaires were adopted to collect the data about the quality of EMR and quality of health care service. Statistical Package for the Social Sciences (SPSS) Version 21 was deployed to analyze the collected data.

**Result:** The results indicate that the quality of health care services (expectation and perception) in EMRs adopted hospital is higher than the quality of health care services in the hospital using paper-based record. Quality of EMRs and its domains (efficiency, availability, fulfilment, and privacy) are high in both perception and expectation of health care professionals in EMR-adopted hospitals. Moreover, there is a significant relationship between the whole perception of the quality of electronic medical records and the quality of services, and between each domain of quality of EMRs and total perception of quality of services.

**Conclusion:** Adoption of a high quality of EMR has a significant impact on improving the quality of health care services.

**Keywords:** Quality of health care services; Quality of electronic medical records; SERVQUAL, E-S-QUAL.

## Introduction

The electronic medical records (EMRs) is considered the most used E-health applications worldwide, due to its impact on ensuring safe and high-quality health care services, through performing many functions such as documentation, medication management, practice management, and communication functions (Buvik et al., 2016). EMRs manage a wide range of patient data that is organized in digital forms such as demographic data, medical history, and radiology and laboratory results (Liu et al., 2013).

There are many considerations that affect the adoption of EMRs such as the quality of the information system and service of the application, costs of the application, levels of confidentiality and privacy when using the application, and the users (Purcărea, Gheorghe, and Petrescu, 2013). The quality of electronic medical records is measured by identifying efficiency, availability, fulfilment, and privacy. Efficiency is the accessibility and ease of use of the system. Availability is the correctness and functionality of EMRs. Fulfilment is the ability of the system to achieve and accomplish the orders, while privacy is the level of safety and protection of customer and patient data (Kang, Jang, & Park, 2016; Yaya & et al., 2015).

It is estimated that paper-based documentation does not meet the requirements of high-quality documentation and communication among health care providers, as it is time consuming, repetitive, and inaccurate (Yu, et al, 2013). In addition, several problems are inherited when thinking to obtain information from paper-based records, since it is considered labor intensive.

Many studies indicated the impact of EMR on enhancing work effectiveness by decreasing time and costs of conducting process (Vaghefi et al., 2016), which consequently improve the quality of service (Mountain et al., 2015). Contrarily, many studies showed that EMRs lead to

increase time waste in many EMRs functions such as data management and communication function (Alkureishi et al., 2016; McDonald et al., 2014).

The quality of health care services is described as the level of health care services in improving the health outcomes, which could be measured by identifying the patients' or health professionals' perception (WHO, 2017). Moreover, many factors play an important role in enhancing the perception of the quality of health care services such as reliability, responsiveness, tangibles, assurance, and empathy (Purcărea et al., 2013).

The existing paper-based health records is always a good pedestal for an enhanced EMR. However, it has been recommended that the implementation of EHRs documentation would result in greater accuracy and consent to the multi-professional use of all health care providers, compared to paper-based records (Collins et al., 2013). As a result, many hospitals worldwide adopt electronic medical records (Liu et al., 2013). However, the evidence is not quite clear which type of record is better (paper-based or Electronic Medical Record). Thus, identifying the impact of the quality of electronic medical records on the quality of health care services is considered a crucial role in measuring the effectiveness of adopted EMRs.

This study provides adequate information to health managers about the impact of the quality of electronic medical records on quality of health care services and helps to develop the required strategies and policies aimed to improve the quality of health care services. The findings of the study add to the current body of knowledge and enhance the understanding of EMR quality and its role in improving the quality of health care services. Finally, the results are considered as a baseline for future studies focusing on improving the quality of health care services.

This study aimed to identify the quality of health care services' differences between the adopted and non-adopted EMR in hospitals. Moreover, to identify how the quality of electronic medical records (EMRs) affect the quality of health care services.

## **Method**

### **Setting**

The study was conducted in two public hospitals in Jordan. One hospital which had adopted the EMR system, and another hospital that had not.

### **Design**

Cross-sectional, descriptive, and comparative designs were utilized. These designs were utilized to identify the impact of EMR adoption on health workers' perception of the quality of health care services. Two Jordanian hospitals were selected to perform the comparison based on the adoption of EMRs or not, and willingness to participate in the research.

### **Sample**

A convenience sampling method was used to select the participants; the minimum number of required participants is 364 participants, depending on the medium effect size for a two-tailed test with an alpha of .05 and a power of .8. However, 450 questionnaires were distributed to avoid any attrition. Of the distributed questionnaires (450), 410 questionnaires were returned (205 participants from each hospital). Therefore, the response rate was (91%). The inclusion criteria included health care providers whom are working in one of the two selected hospitals, have at least one-year experience, and at least a Diploma in one of the health field.

### **Data Collection**

The quality of health care services was measured in both hospitals using a service quality (SERVQUAL) questionnaire to evaluate the differences in users' expectation and perception levels

toward service quality in both hospitals. This questionnaire has 22 questions over five dimensions of service: 4 questions to capture tangibles dimension of services, 5 questions to capture reliability dimension, 4 questions for responsiveness dimension, 4 questions for assurance dimension, and 5 questions to capture empathy dimension. The questions are measured using a 5-point Likert scale from 1 indicating “strongly disagree” to 5 indicated “strongly agree.” Accordingly, the increase in mean showed that the perception of the quality of EMR is high. For the gap analysis, a gap score was measured by deducting the perception score from the expectation score. A negative gap shows that the actual service is less than what was anticipated, and the GAP has presented an area for enhancement. The Cronbach  $\alpha$  reliability for SERVQUAL was .92. Construct validity for SERVQUAL has been measured using factor loadings of items on dimensions to which they belong. The results showed that the factor loadings for all items were higher than .70 (Parasuraman, Zeithaml, & Berry, 1988). In this study, Cronbach  $\alpha$  reliability was .88. Moreover, a content validity of the questionnaire was assessed by five experts in health management.

The quality of EMR was only measured in the EMR adopted hospital using electronic service quality (E-S-Qual) questionnaire to measure how the quality of EMR affects the quality of health care services. This questionnaire has 22 questions cover four dimensions of electronic service: 8 questions to capture efficiency dimension of electronic services, 4 questions to capture availability dimension of electronic services, 7 questions for fulfillment dimension of electronic services, and 3 questions for privacy dimension of electronic services. The questions are measured using a 5-point Likert scale (poor to excellent). The Cronbach  $\alpha$  reliability for ES Qual was .96. Construct validity for ES Qual has been measured using factor loadings of items on the dimension to which they belong. The results showed that the factor loadings for all items were higher than .70 (Parasuraman, Zeithaml, & Malhotra, 2005). In this study, Cronbach  $\alpha$  reliability was .86.



Moreover, the content validity of the questionnaire was assessed by five experts in health management.

### **Procedure**

From January to February 2018, regular visits to both hospitals were performed by the researchers in order to distribute the study questionnaires to health care providers. The health care providers in the EMR-adopted hospital received two questionnaires that aimed to study the quality of EMRs and to study the quality of health care services. While the health care providers in the paper-based record hospital received only the questionnaire that aimed to study the quality of health care services. The questionnaires were distributed on both day and night shifts. They were asked at the beginning of the shifts to complete the questionnaires and return them at the end of the shifts. The managers at different departments were consulted before the distribution of questionnaires to assess the eligibility of their staff.

### **Data Analysis**

Statistical Package for the Social Sciences (SPSS) Version 21 for Windows was deployed to analyze the collected data. The differences between the selected hospitals regarding the study variables' perceptions were measured using *t*-test. Impact of EMR and its domains (efficiency, availability, fulfilment, and privacy) on quality of health care services (tangibles, reliability, responsiveness, assurance, and empathy dimensions) was measured using Pearson's correlation coefficient. In order to describe the participants' demographic data, descriptive statistics such as means, frequencies, and standard deviations were calculated.

### **Ethical Consideration**

The researcher was granted ethical approval by the Institutional Review Board to conduct this study. The ethical approval confirmed to take the consent form before distributing the

questionnaire, to ensure that the participants are voluntary participants in the study and have the right to withdraw from the study, and their data are managed confidentially and anonymously.

## Results

Data were collected from a total of 410 health professionals. 65% (n=266) of the participants aged between 20-29 years, 54% (n=222) are female, 86% finished the Bachelor's degree (n=277) and 70% (n=152) have work experience between 1-5 years. Of the participants, 63% (n=258) were nurses. Complete demographic information of the study participants is presented in Table 1.

Table 2 presents the results of health care providers' expectations, perceptions, and gaps between the expectations and perceptions which are calculated by subcontracting the perception mean from the expectation mean. The results showed that among the EMR adopted hospital, the mean of the total expectation of the quality of health care services was 4.83 (.13) and the expectation's mean in all dimensions ranged between 4.78 and 4.88. For the paper-based hospital, it was 4.78 (.12) and the expectations in all dimensions ranged between 4.72 and 4.85. Moreover, among the EMR adopted hospital, the mean of the total perception of quality of health care services was 4.70 (.17) and the perception in all dimensions ranged between 4.68 and 4.81. For the paper-based hospital, the mean of the total perception was 4.44 (.76) and the perception's mean in all dimensions ranged between 4.31 and 4.55.

The results also revealed that in the EMRs adopted hospital, the gaps between the expectation and perception of the quality services in all dimensions was negative (-.13), with the highest gap in the responsiveness dimension (-0.15). For the paper-based hospital, however, the gaps between the expectation and perception of the quality services in all dimensions were also

negative (-.34) but higher than EMR adopted hospital, with the highest gap also in the responsiveness dimension (-0.49).

Table 3 presents the results of the statistical differences in health care providers' perception of the quality of health care services. The results showed that there is a significant difference in the total mean of quality of health care services perception between study groups ( $t= 9.12$ ,  $p < .001$ ). Furthermore, the results indicated that there is a significant difference between study groups in all domains of quality of health care services (tangibles, reliability, responsiveness, assurance, and empathy) at  $p < .001$ . A statistical difference between study groups were seen in responsiveness and assurance domains  $t= 8.10$ ,  $p < .001$ ;  $t= 8.02$ ,  $p < .001$ , respectively.

Table 4 presents the health professionals' expectation and perception of the quality of EMRS in the EMR adopted hospital. The results showed that the total expectation's mean of the quality of EMR was 4.88 (.13) and the expectations' mean in all dimensions were ranged between 4.83 and 4.95. For the perception of the EMR quality, the total mean was 4.80 (.17) and for all dimensions the mean was ranged between 4.79 and 4.82. The gaps between the expectation and perception of total quality of EMR was (-.13), with the highest related gap was in fulfilment and responsiveness dimensions (-.15, -.13 respectively).

Moreover, the second part of Table 4 presents the relationship between the perception of Quality of EMR, and Perception Quality of health care services in the EMR adopted hospital using Pearson's correlation coefficient. A significant positive correlation was shown between the quality of EMRs and the quality of health care services ( $r=.659$ ,  $p < .001$ ). In addition, the strongest positive correlation was found between efficiency as well as availability dimensions with the quality of health care service ( $r = .731^{**}$  and  $.705^{**}$ ,  $p < .001$ ), respectively.

## Discussion

The electronic medical record has been introduced in Jordan during the last decade. Several institutions in Jordan are working on introducing the EMR in different healthcare settings, to cope with the expanding technology of information system with many modules. Currently, the EMRs in the public healthcare sector are an important part of a national initiative program called the Electronic Health Solution (EHS). However, in the private sectors the EMR is still not adopted.

The national EHS aims at increasing the effectiveness of medical management, reaching the best international standards and improving workflow procedures in hospitals and healthcare centers. It has several sub-systems that include Computerized Patients Record System (CPRS), patients' booking, laboratory, and pharmacy system among others. The EHS is based on a software application with a specific application for nurses.

Assessing the quality of documentation is crucial for effective patient care and health outcomes. In the current study, the researchers looked at the quality of the EMR and the quality of health care service at an adopted EMR hospital and paper-based hospital. Moreover, we looked at the correlation between the quality of EMRs and the quality of health care services.

The results indicated that the quality of health care services (expectation and perception) in EMRs adopted hospital is higher than the quality of health care service in the paper-based record. Additionally, the gaps between the perception and expectation of quality of health care services are lower in the EMR adopted hospital. Subsequently, health care providers in EMR adopted hospital scored higher level of quality of service. This finding is consistent with many studies discussed the role of EMR adoption on the quality of service (Alkureishi et al., 2016; Ratanawongsa et al., 2016; Vaghefi et al., 2016).

Moreover, the results showed that health care providers' perception and expectation of the quality of EMRs and its domains (efficiency, availability, fulfilment, and privacy) are higher, in EMR-adopted hospitals than the paper-based record hospital. In addition, the gaps between perception and expectation of the quality of EMRs was lower. This indicates that the EMR satisfies the needs of health care providers (Alkureishi et al., 2016; Ratanawongsa et al., 2016; Vaghefi et al., 2016).

Availability of a solid information system enhances the quality of health care and patients' outcomes. The results showed that EMR and its efficiency, availability, fulfilment, and privacy of EMR system have a significant impact on the perception quality of health care services. Accessing the EMR in a quick and easy way has a significant role in enhancing the responsiveness, reducing the time, effectiveness of work which can enhance the perception of quality of health care services.

Moreover, the level of order delivery and fulfilment by EMR improved the responsiveness to patient needs, saving the time for patient care, and organizing the work process which has a significant impact on improving the quality of health care services. The availability of EMR system to be used when needed concerning the privacy, and functionality of system to perform the required tasks such as medication management, documentation, and communication between health professionals play an important role in enhancing the quality of health care services.

The quality of EMRs and its domains could improve the tangible dimension of quality of health care services as results of EMRs role in increasing the positive perception of health professionals regarding the use up to date equipment that are available when needed, concerns with information confidentiality and privacy, correlates with task accomplishment and fulfillments (Vaghefi et al., 2016).

The quality of EMRs and its domains could improve the reliability dimension of quality of health care services as a result of the EMRs role in completing the tasks safely and low uncertainty, and reducing the variation in works by increasing the standardization of work process in different tasks such as documentation, medication management, practice management and documentation functions (Purcărea et al., 2013). In addition, the quality of EMRs and its domains could improve the responsiveness and dimension of quality of health care services as results of EMRs role in increasing the work efficiency, decreasing the time waste, increasing the separated time to patient care (Lau et al., 2012). Moreover, it plays a significant role in improving the assurance dimension of quality of health care services by enhancing trust, confidence, and improving the positive interaction between the health providers and patients (Purcărea et al., 2013).

## **Conclusion**

The results indicate that the quality of health care services (expectation and perception) in EMRs adopted hospital is higher than the quality of health care service in non-adopted. Moreover, the gaps between the perception and expectation of quality of health care service are lower in the EMR adopted hospital.

Quality of EMRs and its domains (efficiency, availability, fulfilment, and privacy) are high in both perception and expectation of health care professionals in EMR-adopted hospitals. Moreover, the gaps between them were low, which indicate the high quality of EMR.

There is a significant relationship between the total perception of quality of electronic medical records and the quality of services. Moreover, there is a significant relationship between each domain of quality of EMRs and total perception of quality of services.

There are many limitations that face the study such as generalizability of results to other than the hospitals are not possible because the study setting is hospitals. Moreover, the limited time for data collection restricts the increase in the sample size across different health sectors.

There are many recommendations raised such as an increase in the use of the high quality of EMR to enhance the quality of health care service. Moreover, the research recommends increasing the awareness about domains and functions of EMR and its role in improving the quality of health care service by providing well designed educational and training program used up to date learning techniques and tools. Moreover, the research recommends increasing the funding to utilize adequate and high quality of electronic medical records that satisfy the patients and health professionals' needs. Finally, the research recommends conducting researches to examine the impact of EMR on health institutions other than hospitals.

### **Summary Points**

- Adoption of the high quality of EMR has a significant impact on improving the quality of health care services.
- The research recommends increasing the awareness about domains and function of EMR and its role in improving the quality of health service
- The results indicate that the quality of health care services (expectation and perception) in EMRs adopted hospital is higher than the quality of health service in non-adopted.
- The gaps between the perception and expectation of quality of health service are lower in the EMR adopted hospital.

### **Conflict of Interest**

We hereby certify that this material, which we now submit for your Journal is entirely our own work and there is “No conflict of interest has been declared by the authors.”

### **Conflict of interest**

The authors acknowledge that this work is original and has not been published elsewhere nor is it currently under consideration for publication elsewhere.

There is no conflict of interest

## Acknowledgments

We would like to thank Manar Saleh (University of Houston; Teacher, Houston Independent School District) for her valuable assistance and support in editing and revising this manuscript. Our sincere thanks also go to the participants' in both hospitals for their cooperation during the study period. Lastly, thank you once again for your great support in the successful completion of this research.

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## Tables

Table 1: Demographic characteristics of Study Sample

Demographic Characteristics	EMR adopted Hospital n=205		Paper-Based Record Hospital n=205		Total N=410	
	Number	%	Number	%	Number	%
<b>Age</b>						
20-29	130	63%	136	66%	266	64.9%
31-39	65	32%	55	27%	120	29.3%
40-49	10	5%	14	7%	24	5.8%
<b>Gender</b>						
Female	120	59%	102	50%	222	54%
Male	85	41%	103	50%	188	46%
<b>Educational Level</b>						
Diploma	20	10%	28	14%	48	12%
B.S.N	132	64%	145	70%	277	68%
M.S	40	20%	30	15%	70	17%
Ph.D.	13	6%	2	1%	15	3%
<b>Work Experience in the Hospital</b>						
1-5 years	133	64.9 %	152	74%	285	69.5%
6-10 years	65	31.7%	33	16%	98	24%
11-15 years	6	2.9%	20	10%	26	6.3%
> 15 years	1	.5%	0	0%	1	0.2 %
<b>Profession</b>						
Nurses	130	63%	128	63%	258	63%
Physicians	55	27%	65	33%	120	29%
Lab technicians	8	4%	3	1%	11	3%
Pharmacists	8	4%	3	1%	11	3%
Others	4	2%	6	2%	10	2%

Table 2: The Results of Health Care Providers' Expectation and Perception of Quality of Health Service

Domains	EMR adopted Hospital				Gap (P-E)	Paper-Based Record Hospital				Gap (P-E)
	Expectation		Perception			Expectation		Perception		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Tangible	4.82	0.11	4.81	0.18	-0.01	4.81	0.16	4.51	0.77	-0.30
Reliability	4.83	0.12	4.70	0.15	-0.13	4.72	0.16	4.55	0.76	-0.17
Responsiveness	4.88	0.09	4.73	0.19	-0.15	4.80	0.16	4.31	0.77	-0.49
Assurance	4.82	0.16	4.70	0.10	-0.12	4.72	0.10	4.31	0.75	-0.41
Empathy	4.78	0.16	4.68	0.10	-0.10	4.85	0.09	4.51	0.78	-0.34
Total	4.83	0.13	4.70	0.17	-0.13	4.78	0.12	4.44	0.76	-0.34

Table 3: The Statistical Differences in Health Care Providers' Perception of Quality of Health Services

Quality of Health Service	EMR adopted Hospital		Paper-Based Record Hospital		t-test	P-Value
	Mean	SD	Mean	SD		
Tangible	4.81	0.18	4.51	0.77	7.09	< .001**
Reliability	4.70	0.15	4.55	0.76	6.69	< .001**
Responsiveness	4.73	0.19	4.31	0.77	8.10	< .001**
Assurance	4.70	0.10	4.31	0.75	8.02	< .001**
Empathy	4.68	0.10	4.51	0.78	4.12	< .001**
Total	4.70	0.17	4.44	0.76	9.12	< .001**

\*\* Significant at  $p$  value < 0.01

Table 4: The Results of Health Professionals' Expectation and Perception of Quality of EMRs and its relationship with Quality of Health Service in EMR adopted hospital

Domains (Quality of EMRs)	Expectation		Perception		Gap (P-E)	Relationship between Perception of Quality of EMR and Perception Quality of Health Service in EMR adopted hospital		
	Mean	SD	Mean	SD		<i>r</i>	<b>P value</b>	<b>N</b>
Efficiency	4.95	0.15	4.82	0.18	-0.13	.731**	< .001	205
Availability	4.83	0.15	4.82	0.15	-0.01	.705**	< .001	205
Fulfilment	4.88	0.13	4.80	0.20	-0.08	.659**	< .001	205
Privacy	4.89	0.10	4.79	0.19	-0.10	.595**	< .001	205
Total	4.88	0.13	4.80	0.17	-0.08	.659**	< .001	205

\*\*, Correlation is significant at the 0.01 level (2-tailed).