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The effect of quality factors of hospital information systems on patient satisfaction

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Abstract
Hospital information systems (HIS) have brought significant changes in the way hospitals communicate with patients and add great value to the medical services provided by modern. Despite HIS long implementation in the public hospitals in the UAE, little is known about the quality aspects of HIS on patients. Accordingly, this study addresses this gap and assesses the effect of system quality, service quality, and information quality of HIS on patients' satisfaction. This study adopted a quantitative approach. The sample consists of 500 patients at public hospitals in Al-Sharjah city. Respondents were selected using a systematic sampling technique. Data were collected using the questionnaire and analyzed using Structural Equation Modeling. The results reveal that the quality attributes of HIS i.e. system quality, service quality, and information quality, have a significant effect on patients' satisfaction. Notably, these attributes are important measures of the success of every information system. Hence, HIS should be carefully designed to ensure these measures are well delivered for the users of these systems as well as hospital staff.

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1. Introduction

Today, patient-centred healthcare is undergoing a widespread transformation worldwide. Patients are demanding greater participation in their healthcare and expect their healthcare providers to give a specific level of service through effective systems that are characterized by simplicity and a high degree of information quality that satisfy the needs of users (Al-Damen, 2017). As a result, deploying specialized information systems to deliver better healthcare services for patients has become a prerequisite for modern hospitals around the world (Sangjae and Kun, 2020). Information systems play an important part in the quality of healthcare delivery in hospitals all over the world, including in the United Arab Emirates (UAE). Improving healthcare delivery quality is a global priority. Today, the goal of healthcare institutions is to ensure patient satisfaction, improve clinical effectiveness, and promote health information systems (Teshome et al., 2019), the successful implementation of Hospital Information Systems (HIS) in hospitals necessitates consideration of some system quality characteristics (Cacciabue and Vella, 2008; Zaineldeen et al., 2020). Furthermore, rising financial pressures and increased demand for improved healthcare quality push most hospitals today to implement HIS for handling almost all kinds of medical services (Kuo et al., 2018).

HIS automates patient administrative activities (e.g., patient profile information, appointment scheduling, records, and patient history) and clinical care documents, such as clinical notes, computerized prescriptions, online laboratory results, digital radiological imaging, and clinical referrals. HIS has the potential to reduce or eliminate paperwork processes in the clinical setting (Salgado et al., 2020). These objectives are to develop a more cost-effective, resource-efficient, and valued healthcare service that is available to all (Sherifali et al., 2017). In this sense, understanding HIS success factors is important to identify the interests of patients who use these systems and how quality attributes like system quality, information quality, and service quality contribute to patient satisfaction. Accordingly, this study examines the effects of these attributes of HIS in fostering clients' satisfaction.

2. HIS scenario in UAE

In recent decades, the UAE become a resort for local and foreign patients from abroad. Patients receiving both serious and minor medical treatment should adapt to the use of technology and information systems for tracking their medical progress. According to Kisekka and Giboney (2018), the healthcare service nowadays predominantly relies on information technologies such as electronic medical record systems, patient health record systems, and technical devices to provide patient care services. Despite the continuing proliferation of healthcare technologies within the healthcare sector, there is little theory in the UAE that can explain how the success of HIS contributes to patient satisfaction. By critically evaluating the influence of HIS on the healthcare service in UAE's hospitals, the managers and leaders of these hospitals could demonstrate the crucial components of HIS that satisfy the patients (Teshome et al., 2019). In the same vein, the intention to use HIS is an important aspect of evaluating information systems established in healthcare facilities. To improve the intention to utilize HIS for medical services, hospitals must take action from healthcare administrators, educators, and other stakeholders (Teshome et al., 2019). Almost every hospital in UAE emphasizes excellent healthcare service delivery to be in a better position in competing with hospitals (Li et al., 2015), this delivery has encouraged people to make the best decision when picking any hospital where HIS could be a determinant factor in this situation (Bleustein et al., 2014). As a result, one of the criteria that determine patients' satisfaction and intention to use HIS is the effectiveness of HIS; any flaws in these systems may impair patients' intention to use HIS in the hospital. However, the question is how the

quality of HIS affects the satisfaction of patients with the online medical service, this matter is important to determine the intention of HIS by them.

When it comes to integrating modern healthcare technology for its residents, the UAE is in a good position. Almost all hospitals in the UAE use HIS in-healthcare services, but certain studies, such as Shaikha (2014), indicated that failure rates are high owing to a variety of factors, including inadequate training of HIS workers and poor implementation tactics. While Moghaddasi et al. (2018) identified a lack of competence as one of the primary barriers to successfully implementing HIS in the healthcare industry in the UAE and other Middle Eastern nations. Furthermore, they advocated for the adoption of successful experiences in this field from other nations, as well as the development of a complete plan, in order to avoid wasting financial and human resources. The preceding arguments demonstrate the necessity for a comprehensive real-time health data management system, such as HIS, that allows patients, doctors, physicians, and external users to input medical and lifestyle data into the system, potentially improving healthcare services (Ismail et al., 2020). It is clear that a considerable number of HIS failures in the UAE have occurred in the past as a result of expenses and other resources in many hospitals. Another difficulty is poor HIS management and execution; due to its complexity, successful HIS adoption in healthcare companies has proven difficult (Abouzahra, 2011). In less developed nations, the literature on the usage of HIS is still sparse (Al-Damen, 2017). However, the same scenario is in the UAE. There is a dearth of empirical evidence to measure the influence of quality attributes of HIS on the patients registered in UAE hospitals for a long-term treatment schedule, particularly in public hospitals. Hence, this research project will address and assess the impact of quality attributes (system quality, information quality, service quality, intention to use HIS, patient satisfaction) on patients' satisfaction.

3. Literature review

HIS are often portrayed as precious tools which can enable better quality and safety of healthcare and make the whole process of patient treatment more efficient. As HIS, is responsible for assisting hospitals with the deployment of proper healthcare information technology. To increase the quality of their services and performances, hospitals are becoming increasingly reliant on HIS capabilities for diagnostic, administrative, and training activities (Barzekar et al., 2019). In this regard, studying the quality attributes of HIS should give a better picture of their role in the enhancement of users' satisfaction as explained below.

3.1. System quality

System quality measures the intended technical properties of a HIS, such as reliability, response time, and functionality (DeLone and McLean, 2003). These qualities have been demonstrated to be significant predictors of healthcare workers' system usage (Raymond et al., 2015). Unreliable HISs may have unforeseen consequences for healthcare providers, such as increased workload and poor user responsiveness (Chan et al., 2011). According to the findings of this study, system quality is an important component in patient satisfaction with HIS. System quality is defined as a human-made object's ease of use and functionality (Holm, 2006). A software application, an information system, or anything with which a human interacts can be the object of usage. The phrase "system quality" is commonly used in consumer electronics, communication, and knowledge transfer objects (such as a document or online help (Wickens, 2004). The ease of use of any system is an important factor in system quality. The display of information and choices in a clear and succinct manner, the absence of ambiguity, and the placement of critical elements in appropriate regions are all examples of system quality. Another major concern for system quality is that the portal of the system is suitable for all people and can be used by all ages and genders

(Nielsen, 2003).

3.2. Service quality

One of the most important success elements for information systems is service quality. In general, service quality is a tool used to measure the overall quality of an information system's services (Benmoussa et al., 2018). Pitt and Watson (1997) improved the newest model developed by Delone and McLean by including the "Service Quality" aspect in the model to improve the information system's effectiveness. While Petter and McLean (2009) proposed that service quality is user support received by the department in charge of running an information system. Service quality is concerned with the degree of assistance provided by the information system to physician users, such as availability, responsiveness, and training opportunities (DeLone and McLean, 2003). According to marketing literature, improved service quality can influence consumers' behavioral intentions (Nguyen, 2014). Similarly, treating physician users as internal customers and offering adequate assistance and training should encourage them to use HIS even if they encounter perceived problems. According to a prior study, there is also a correlation between service quality and HIS implementation and acceptance by users (Kuang-Ming et al., 2018). In sum, service quality is an important component of HIS and should be assessed empirically to understand its impact on patient satisfaction with HIS.

3.3. Information quality

Information quality refers to the standard of content delivered by an information system. It is commonly characterized by the richness and relevancy of content (Miller, 2011). Soo (2002) defined information quality as the amount of data to which users believe information is good, helpful, correct, and up to date, and to the extent that users believe the information can be trusted and reliable. The user-perceived information quality metrics include certain indicators, e.g., accuracy, relevance, adequacy, and sequencing (Masri, 2019). It is also defined as the system's ability to communicate with a user in a way that delivers useful information (Larry, 2009). Information quality is the characteristics of the content submitted to the user, such as sufficient detail, easy-to-read perception, and completeness (DeLone and McLean, 2003). Previous studies have demonstrated the usefulness of information to generate better diagnoses, treatment plans, and patient care (Tilahun and Fritz, 2015). By identifying these practical benefits, developers of HIS can realize the importance of information quality (Kuang-Ming et al., 2018). In other words, information quality is an important component of HIS.

3.4. Patient satisfaction

Patient satisfaction is typically measured for three reasons: (1) it is the primary goal of the healthcare practitioner; (2) it provides us with relevant information about the structure, method, and outcome of healthcare; and (3) satisfied and dissatisfied patients have different behavioral intentions (Kazemi, 2013). Highly satisfied patients, for example, are more likely to follow physician advice and suggest the healthcare practitioner to relatives and friends. The attitude of a user toward a computer system is characterized as computer user satisfaction. Doll and Torkzadeh (1988) describe user satisfaction with an information system as the user's perspective and position on an information system, such as a computer application utilized for various purposes. User satisfaction is an important indicator of the performance of an information system (DeLone and McLean, 2003). In the domain of healthcare, the physician users' affective response or attitude about HIS is affected by the attitude and the opinion of patients on HIS (Kuang-Ming et al., 2018). Lower levels of satisfaction, suggesting that HIS may not meet physician users' demands, can lead to physician users using HIS infrequently or not at all. Such inefficiencies in HIS usage in the

healthcare sector may disrupt healthcare delivery and increase the likelihood of errors, impacting the quality and safety of medical service (Kim and Magrabi, 2017). On the other hand, evidence suggests that a HIS, used by both physicians and patients, must provide the minimum qualifications in terms of system, service, and information to gain patient or user satisfaction (Garcia-Smith and Effken, 2013; Tilahun and Fritz, 2015).

4. Theoretical background

The literature reveals lots of models and theories for determining the success of information systems. The DeLone and McLean (D&M) success model is the most widely used and validated framework for assessing an information system, e.g., HIS. The D&M model was first proposed in 1992 and was revised in 2003. More than 30 years have passed since research on the use of information systems began. During this time, various theoretical models for assessing information systems were devised and deployed. Many academics, e.g., Saghaeiannejad et al. (2015) in the past used the D&M model as the base of analysis of quality factors (information, system, service). Kuo et al. (2018) used a review of 180 relevant studies to evaluate the effectiveness of the D&M (2003) model and its core elements. They discovered that this model has been widely implemented because it shows clearly how system quality, information quality, and service quality contribute to user satisfaction. Based on this conclusion, these constructs show a high degree of dependability in gauging patient satisfaction and intent to use HIS in hospitals.

Other frameworks are also used to assess HIS, e.g., the TOE framework, for example, was created utilizing three constructs: technology, environment, and organization. From an organizational standpoint, the environment design of TOE has been influenced by the involved idea of social influence, which includes various partners with varying organizational impacts. To be more comprehensive, another human estimation from HOT-fit has been integrated as a complement to the TOE (Mohd and Syed Mohamad., 2005). Importance-Performance Analysis (IPA) is another framework (Matzler, 2004). Martilla and James were the first to use the IPA technique in marketing writing (1977). It is fundamentally a quantitative method for recording analytic objective facts of client encounters by surveying singular success along a set of system characteristics (i.e., HIS qualities). The MCDM model (Ahmadi and Ibrahim, 2015) includes the assets and determines the importance degree of the selected components for HIS selection. This model is mostly used to create links between selection quality elements in an information system model (Ismail, 2013). Similarly, the Human-Organization-Technology (HOT) framework (Yusof et al., 2008) is related to the quality of data. The better quality of the information framework, the greater fit between innovative techniques, human resources, and organization (Ahmadi and Ibrahim, 2015). The Theory Acceptance Model (TAM) is an information systems theory that explains how customers and users come to recognize (accept) and apply innovation. TAM is a model that has been evaluated in healthcare to find user acceptance factors and the relationships between them. It is recommended that when customers are offered another innovation, numerous elements influence their decision about how and when they will use it. While the framework proposed by Delone and McLean (2003) have been identified by scholars to effectively assess an information system in term of quality attributes (service, system, information), precision, clarity, fulfilment, justifiable, opportuneness, and ease of use.

In addition, the TAM components were discovered to have a significant impact on staff and user behavioral intentions to embrace HIS in-healthcare services. According to the findings of Nadri et al. (2018), job relevance, output quality, and perceived ease of use were significant predictors of HIS intention, whereas social influence mechanisms (subjective norm, image, and voluntariness) had no significant link with users' behavior. Despite the fact that TAM has been used in the past to measure HIS, there are few criticisms of the D&M

model and more with adopting TAM in HIS context, as shown in Table 1. Among the information system models, Delone and McLean is a winning model and a standout among the most broadly referred to HIS. As a result, the quality attributes proposed by D&M (2003) model are used in this study to examine the deployment of HIS in UAE hospitals.

Table 1. Comparisons between information systems models in HIS context

Author/s	Delone and McLean model	Importance-performance analysis (IPA)	TOE Framework	Health Level Seven	Acceptance Model TAM Theory	Human-Organization-	MCDM model
Kuo et al., 2018	✓						
Mohd and Syed Mohamad, 2005			✓				
Matzler, 2004		✓					
Ahmadi and Ibrahim, 2015						✓	✓
Ismail, 2013							✓
Yusof et al., 2008						✓	
Nadri et l., 2018					✓		
Barzekar et al., 2019					✓		
Silvanus, 2020						✓	
DeLone and McLean, 2003	✓						
Kuang-Ming et al., 2018	✓						
Raymond et al., 2015	✓						
Tilahun and Fritz, 2015	✓						
Barzekar et al., 2019	✓						
Ross and Rajagopalan, 2016	✓						
Kuo et al., 2018	✓						
Kim and Magrabi et al., 2017	✓						

In brief, system, service, and information quality have been recognized to be important indicators of HIS success. As a result, it is critical that HISs be developed in such a way that they are simple to use, adaptable, and functional in order to perform their goal (Ojo, 2017). As a result, the D&M model can be used to evaluate the success of HIS. It is worth noting that the majority of research evaluating the D&M success model has been conducted in developed countries, with only a few expressly verifying the model in the context of HIS. As a result, the goal of this study is to validate the most recent D&M success model in the healthcare industry. According to evidence (Petter and McLean, 2009), HIS has gotten less validation overall in the form of single D&M theory-based research. Furthermore, because the use of a HIS is required in the subject hospitals, this study includes three constructs defined in the D&M model, i.e., system quality, information quality, and service quality (DeLone and McLean, 1992; DeLone and McLean, 2003).

5. Hypotheses development

System quality, information quality, and service quality all have a significant relationship with patient satisfaction. HIS implementation in hospitals has a significant

impact on increasing healthcare quality, which boosts patient happiness (Ross and Rajagopalan, 2016). System quality results in the production of perceived value for the user, and this perceived value then influences the user's satisfaction (Yanuar and Ari, 2018). When individuals utilize an information system with a good information system perceived value, they will feel that the system information used is extremely valuable to them and beneficial, giving them a sense of satisfaction (Chen and Cheng, 2009). Based on these arguments, the following hypothesis is tested in this study.

H1: System quality has a significant effect on patient satisfaction with HIS.

Moreover, information quality can influence system use, which in turn influences user attitudes towards the system in a way to raise their satisfaction (Shichao et al., 2020). The construction of perceived value to the user is caused by information quality, and this perceived value then affects the user's satisfaction (Yanuar and Ari, 2018). Several studies have previously confirmed the impact of information quality on patient satisfaction (Ho et al., 2019; Farzandipour et al., 2016). Further research revealed that HIS system quality is related to user (patient) satisfaction (Yu and Shih-Chieh, 2013; Maryam and Khaled, 2015; Gustavo and Antonio, 2015; Scheepers et al., 2006; Coombs et al., 2001; Teo and Wong, 1998). As a result, the following hypothesis is tested in this study.

H2: Information quality has a significant effect on patient satisfaction with HIS.

Finally, service quality causes the formation of perceived value and, then, this perceived value will affect user satisfaction (Yanuar, and Ari, 2018). Service quality causes the formation of perceived value to the user, and then, this perceived value will affect the user's satisfaction (Yanuar and Ari, 2018). The results show that the construct of service quality has a significant positive effect on user satisfaction when using HIS. Good quality of HIS service can meet or exceed employee expectations so that their satisfaction will be increased (Lenny and Kridanto, 2019). In other words, service quality can affect system use, which will further influence user satisfaction (Shichao et al., 2020). Based on these claims, this study tested the following hypothesis.

H3: Service quality has a significant effect on patient satisfaction with HIS.

As mentioned, and found in the literature, this study proposes that the quality attributes of an information system (i.e., system quality, information quality, service quality) have a direct effect on patient satisfaction. The D&M success model is the foundation of these hypotheses. Hence, HIS that have been implemented in UAE hospitals could be assessed and measured through these constructs as shown in Figure 1.

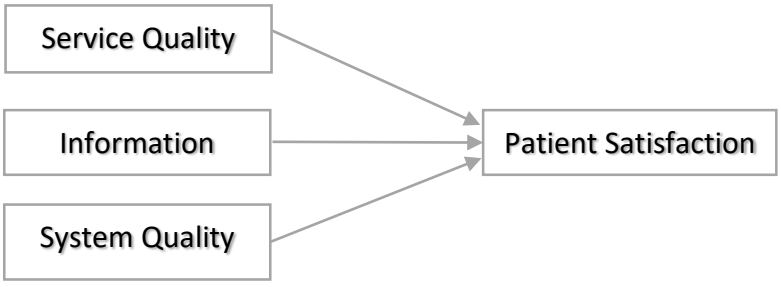

Figure 1. The multiple effects of HIS quality attributes on patient satisfaction

6. Methodology

The type of this study is based on examining causal relationships between the constructs

of the D&M success model. In addition to that, the use of quantitative methods will provide a concrete indicator of the hypotheses based on causal relationships between system quality, information quality, service quality, and patient satisfaction. In this study, the population is all the patients in Al-Sharjah public hospitals in UAE. There are two public hospitals in Al-Sharjah, namely: Al Qassimi Hospital and Kuwait Hospital. The average number of patients visiting these two hospitals is approximately 50,000 each month. These two hospitals are the largest public hospitals in Al-Sharjah (Hamad, 2010). Systematic random sampling was used to collect data from the study sample of 500 patients. Data were collected using questionnaires. Since the data collection process may include vulnerable subjects, the approval from the Human Research Ethics Committee was sought to ensure all the procedure followed in collecting the data would eliminate or at least minimize the risks to humans participating in research. The approval was received with reference 2021-0426-01. Data were analyzed using Structural Equation Modeling.

7. Results and discussions

A total of 500 questionnaires were distributed to a sample of 500 respondents (outpatients) registered in Al Qassimi Hospital and Kuwait Hospital. However, only 428 responses were considered for further analysis as 72 responses were removed as incomplete. Hence, the valid response rate is 85.6 per cent. Most of the respondents are male (51.17%), in the age range of 30 to 39 years old, possess a bachelor's degree (25.23%) and have been working for more than five years old.

The structural equation modeling (SEM) analysis involves two major stages i.e., validating the measurement model and the structural model. In validating the measurement model, the goodness of fit of the model was first examined, followed by assessing the validity and reliability. The model achieved a good data fit at the normed-ratio (CMIN/D) less than 3.0, CFI and TLI values above 0.90, and RMSEA values below 0.08 (Timothy, 2006; Tong, 2007; Lie & Wu, 2007; Hair et al., 2012). As depicted in Table 2, the convergent validity and composite reliability of the measurement model were also satisfied with the average variance extracted (AVE) and the composite reliability (CR) values above the threshold of 0.50 and 0.7, respectively. Further, the discriminant validity is also achieved as all the inter-construct correlation coefficients are less than the threshold of 0.70.

Table 2. Standardized regression weights and squared multiple correlations

Variable	Dimensions	Number of indicators	AVE ≥ 0.5	Composite Reliability
Information quality	Accuracy	4	0.516	0.808
	Completeness	4	0.518	0.810
System quality	Ease of use	4	0.528	0.815
	Navigation	4	0.620	0.866
Service quality	Responsiveness	4	0.702	0.904
	Reliability	4	0.509	0.805
Patient Satisfaction	Fulfilment	4	0.562	0.836
	Acceptance	4	0.502	0.801

To proceed with testing the hypotheses in the structural model, the GOF was first examined. The model fit is achieved CMIN/DF = 1.430 (≤ 3.00), CFI = 0.956 (≥ 0.90), TLI = 0.953 (≥ 0.90), and RMSEA = 0.032 (≤0.08). Based on the the significance value of 0.05 and critical value of 1.96, the results in Table 3 revealed the significant and positive effect of service quality (p-value=0.00<0.05; CR=2.96<1.96, β=0.396), system quality (p-value=0.00<0.05; CR=2.70<1.96, β=0.409), information quality (p-value=0.00<0.05; CR=2.98<1.96, β=0.331) on patient satisfaction (Hair et al., 2010). Hence, all the proposed

hypotheses are supported, indicating that the service, system, and information quality play a significant role to affect patient satisfaction. Specifically, the favorable perception that the patients have on the HIS with respect to service, system and information quality are more likely to induce their level of satisfaction towards HIS.

Table 3. Standardized regression weights and squared multiple correlations

Hypotheses	The direction of positive effects	Beta coefficient	C.R.	p-value (Sig.)
H1	Service Quality → Patient Satisfaction	0.396	2.96	0.00
H2	System Quality → Patient Satisfaction	0.409	2.70	0.00
H3	Information Quality → Patient Satisfaction	0.331	2.98	0.00

8. Conclusions

HIS has brought significant changes in the way hospitals communicate with patients and add tremendous value to the medical services provided by modern hospitals. The review of the literature shows that HIS could be assessed according to certain quality factors such as the success model proposed by McLean &Delon. As the UAE becomes a resort for local and foreign patients from abroad. The public hospitals in the UAE are very keen to implement HIS and encourage all patients who have long-term medical treatment courses to use HIS on regular bases. This study examined the effect of HIS quality factors on the satisfaction of patients who usually use HIS in public hospitals in Al-Sharjah. The result reveals that the identified quality factors have a significant effect on patients' satisfaction. In other words, the patients prefer to use HIS because it satisfies their needs in terms of system quality (ease of use, navigation), service quality (responsiveness, reliability), and information quality (accuracy, completeness). Notably, these attributes are important measures of the success of every information system. Thus, HIS should be carefully designed to ensure these measures are well delivered by the system.

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