END-USERS' SATISFACTION WITH THE QUALITY OF INNOVATIVE HEALTHCARE TECHNOLOGIES IN BAHRAIN: A CASE STUDY OF HOSPITAL INFORMATION SYSTEMS

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ABSTRACT

Purpose: The purpose of this study is to measure end-user satisfaction with the quality of the existing Hospital Information Systems (HIS) implemented in public and private hospitals in Bahrain, employing Delone and McLean's framework.

Design/methodology/approach: A quantitative method was adopted, using a self-administered questionnaire distributed to 615 participants of a convenience sample from seven hospitals, including physicians, nurses, laboratory technicians, pharmacists, admin and IT staff of hospitals who are regular daily users of the HIS system.

Finding/expected outcome: Statistical analysis of 324 valid questionnaires indicated that in Bahrain, system quality, information quality and service quality are primarily positively related to end-user satisfaction, and the end-users are generally fairly satisfied and have a good impression of the technical quality of the HISs they are using.

Practical Implications/social implications: The study underlines the need for improvements in end-user training, system availability, response time, interface and remote accessibility.

Originality/value: This study contributes to the understanding of medical informatics experiences within the Middle East.

Keywords: healthcare innovative technologies; hospital information systems; success model; user satisfaction; system quality; information quality; service quality; Bahrain; HIS

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INTRODUCTION

Innovative technologies have notably progressed during the previous 20 years, and are utilised a great deal in all areas of life, including health care. Hospitals are one field that operate in the most complex of settings, which mandates adminis- trations to manage and control this convoluted setup. Hospital Information Systems (HIS) are one of these innovative technologies, and they have used by medical experts in their daily prac- tice. They are defined as "a complete, integrated and specialized information system designed to manage the administrative, financial and clinical domains of hospitals and healthcare organiza- tions" (Khalifa and Alswailem, 2015).

In general, the principle point of an HIS is to manage data required by health care profession- als to increase efficiency (Mehraeen et al., 2014); however, the success of any information system is only achieved by tailoring it to meet the precise needs of its end-users (Prasad, 2000). In addition, the productivity, proficiency, effectiveness, and accomplishment of the employees rely a great deal on the technical quality of the HIS imple- mented and utilised in the organisation (Aggelidis and Chatzoglou, 2008). Quality is vital for the suc- cess of any HIS (Perez, 2010), and this is reflected by System Quality (SQ) (ease of use, safety, speed, features, and flexibility), Information Quality (IQ) (content, sufficiency, relevance, completeness, and timeliness), and Service Quality (SerQ) (support carried out by an IT department or the system ven- dor) (Zikos et al., 2011; Aggelidis and Chatzoglou, 2012). Quality evaluation by the end-user is crucial to assess the performance and effectiveness of the HIS and to recognise the probable drawbacks in the system with the intention of improving its per- formance and effectiveness. Quality evaluation is expected to result in better personnel and overall performance, the lack of which leads to HIS imple- mentation failures (Al-Hashimi, 2004).

Decision makers in hospitals worldwide have made tremendous efforts to purchase and install these systems so they can deliver health care that is productive and successful. Bahrain is not an exception; the Ministry of Health (MoH), the Min- istry of Interior (MoI), and the private sector have assigned extensive efforts and costs to enhance the health care delivery processes by the introduction of trending health technologies and automating

health records in various hospitals and primary health care centres throughout the country.

Nevertheless, no evaluation studies explore whether the end-users of the currently installed HISs in Bahrain are satisfied, or if these systems have succeeded in meeting their daily practice requirements. The HIS itself is considered a signifi- cant quality and cost element; the data processing quality is a vital element that affects the success of health care organisations (Ammenwerth et al., 2007). However, the satisfaction of the users, who are the real customers, is the most important measure when it comes to evaluating an HIS. Therefore, dis- covering the elements that affect users' satisfaction and analysing them will contribute to improving the quality of the system, and will probably enhance the quality of patient care delivered by hospitals (Ribiere et al., 1999).

The main aim of this paper is to evaluate the quality of HISs in Bahrain, and to investigate end- users' satisfaction with the quality of the existing HISs in public and private hospitals in Bahrain based on DeLone and McLean's updated informa- tion system success model.

This study contributes to understanding medi- cal informatics experiences in the Middle East, and is important for managers and decision makers in the health care sector with regard to the decisions made for the implementation of existing HISs in Bahrain, importance of their quality, and whether they have succeeded in satisfying the needs of health care professionals. In addition, it gives the opportunity for end- users to be involved in the implementation and upgrading of processes, eventually allowing, therefore, for an improved hospital system that is competent and effective.

LITERATURE REVIEWS

User satisfaction is "the recipient reaction to using the output of an IS" (DeLone and McLean, 1992), and is described as "the extent of satisfaction of the users while making use of an IS" (Urbach and Muller, 2012). User satisfaction is considered one of the most imperative measures of IS suc- cess and is thought to be a multi-aspect concept and related to numerous failed experiences with Electronic Health Records (EHR) (Buntin et al., 2011). Ribière et al. (1999) have contended that measuring end- users' perceptions and evaluating their satisfaction toward the HISs they use is more

significant than assessing the technical characteristics of the system. This is because, from their perspective, the client's opinion is more important than the developers' in such a case. User Satisfaction (US) is mainly indicated by capabilities, ease of use, and overall satisfaction (Kuipers, 2016). However, in medical services, indicators of US are determined by job satisfaction (Chang et al., 2012; Han et al., 2012; Kim et al., 2011) in view of the end-user satisfaction with work performance, work load reduction, work environment improvement, medical services enhancement (Cho et al., 2015), and general satisfaction with the system (Tilahun and Fritz, 2015).

Some of the literature has shown that reasons for end-user dissatisfaction can be associated with a growing workload, expended time, increased effort, unmet end- user requirements (Khalifa, 2014), weak system integration, slow response time, incomplete and inaccurate data, inadequate training, poor access to computers, inappropriate service quality, and the mutual usage of paper-based and system-based records (Alharthi et al., 2014). In contrast, some research has demonstrated end-users' overall satisfaction towards the HIS resulting from its advanced functionalities (Jaspers et al., 2008), adequate response speed, dependable and consistent data, and proper support and performance (Bossen et al., 2013).

Hospital Information System User Satisfaction (HIS US) in a hospital surrounding can be accomplished when it is specifically designed to fulfil the requirements of its end- users (Kuipers, 2016). This takes into consideration diversity among HIS users (doctors, other health professionals, and administrative staff), with a specific end goal of enhancing the quality of the system from its end-users' perspective (Amin et al., 2011). An inability to satisfy the end-users' expectations may be credited to their weak participation in the implementation process (Farzandipour et al., 2011).

DeLone and McLean (1992) defined "system quality" as "the characters that measure the IS output" and as "the technical quality of the IS itself" (DeLone and McLean, 2003). System Quality (SQ) determines whether the system has the important capabilities and usefulness needed by its users to bolster their work (Tilahun and Fritz, 2015). The most commonplace determinants of SQ are, ease of use, user interface (layout), system speed, reliability, safety, privacy and stability (Petter et al.,

2008; Cho et al., 2015; Chang et al., 2012; Hsiao et al., 2011).

The existing literature demonstrates that even the pioneer end-users have found HISs with multiple screens, choices, and "navigational aids" difficult and challenging to use (Khalifa and Alswailem, 2015). Ease of use issues among HISs, including notes documentation and other work related additives, have led doctors to spend excessive amounts of time to find the best ways of successfully utilising the system (Khalifa and Alswailem, 2015). Many preceding studies have demonstrated a direct positive relationship between the system quality and end-user satisfaction, where a higher system quality will build end-user satisfaction, in light of the fact that the system will be more easy to understand and viable in its utilisation (Kuipers, 2016; Tilahun and Fritz, 2015).

Information quality (IQ), also called "clinical data quality" in some health care research (Yu Su et al., 2008), is the desired characteristics of the information and its input and output in the system (Wallace, 2015; Petter et al., 2008). It is usually measured by accuracy, relevance, integration, completeness, accessibility, timeliness, and reliability of the information (Gable et al., 2008; Petter et al., 2008; Tilahun and Fritz, 2015); however, content, accuracy, format, and timeliness have been observed to impose an essential and noteworthy effect on the satisfaction of end-users (Aggelidis and Chatzoglou, 2012).

Information is highly important in HISs for delivering good patient care (Kuipers, 2016), and high information quality is required for evidence-based decision making (Hahn et al., 2013). In some studies, data quality showed a more potent effect on end-user satisfaction than the system quality, particularly if it is updated, reachable when required, complete, and accurate (Chin and Lee, 2000; Alharthi et al., 2014; Ibrahim et al., 2016).

When the users are happy with the IQ of the system, they will perceive the data as more beneficial and applicable to their workflow. As a result, when introducing a new HIS, decision makers must stress the availability of adequate, accurate, and updated information, together with comprehensible and usable report formatting that can be employed on a regular basis by health care specialists (Tilahun and Fritz, 2015).

Service quality (SerQ) was defined as "the overall support delivered by the service provider, applies

regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an Internet service provider (ISP)" (DeLone and McLean, 2003). SerQ is observed to be a vital component to improving and boosting end-user satisfaction and, in the end, in achieving complete overall performance of the IS (Cho et al., 2015). Service quality is most commonly described by end-user training, hotline services (or online support), frequency of system downtime, availability of user guides and help function (Chang et al., 2012; Urbach and Muller, 2012; Kuipers, 2016), and error reductions through alerts and reminders (Safdari et al., 2014). Distinguishing the advantages from an HIS may be accomplished only if the system is utilised fully by its end-users (Kuipers, 2016). Training of the end-users has been acknowledged in previous evaluation research as an important factor for an HIS to succeed (Rahimi et al., 2008; Terry et al., 2008; Ajami and Bertiani, 2012). As indicated by Ajami and Bertiani (2012), users who do not receive optimal training on brand new applied technology will experience dread at potentially losing their employment, and therefore, they might oppose the change.

Furthermore, in their evaluation research of an implemented HIS, Palm et al. (2010) have observed that the system SerQ, inclusive of training and support quality, influenced the way users perceived the system's ease of use positively, and consequently had a positive direct effect on their general satisfaction. Conversely, studies undertaken by Aggelidis and Chatzoglou (2012) and Yu Su et al. (2008) have demonstrated that the quality of the training and support indirectly affected the end-user satisfaction, interceded by means of their statistically significant relationship with the system quality and by using the system. Moreover, one of the studies has shown that service quality had a stronger effect on end-user satisfaction than the system and information quality, and, in their opinion, when users receive proper service quality, whether internally or externally, they will be more satisfied and ready to use the system (Tilahun and Fritz, 2015). However, in another study, the service quality showed no significant relationship with the satisfaction of end-users, as they indicated that the study took place a month after the system's implementation, which is not enough time to decide on the system use and users' satisfaction (Cho et al., 2015).

RESEARCH METHODOLOGY

Despite the fact that there may be no general framework to assemble all the significant success attributes of a viable HIS (Alali et al., 2014), DeLone and McLean's model was observed to be the most extensively recognised model for the estimation of IS success (Manchanda and Mukherjee, 2013; Safdari et al., 2014). The three attributes of IS that it measures (SQ, IQ, and SerQ) are viewed as more helpful in evaluating the HIS by examining the impact of the system itself as opposed to examining other outer attributes, including management and human and organisational factors (Maamoum et al., 2015). This study was based on DeLone and McLean's (2003) upgraded IS success model, as shown in Figure 1. In any case, usage of the system and net benefits were excluded in this study because it is only concentrating on end-user satisfaction and how the quality of the system can influence it.

The indicators used in this study are as follows:

Variables	Indicators
System Quality (SQ)	Ease of use, user interface, and system speed
Information Quality (IQ)	Accuracy, conciseness, completeness, relevance, sufficiency, and accessibility
Service Quality (SerQ)	Reliability, responsiveness, training, availability of user guides and help functions, downtime, and remote access
User Satisfaction (US)	Usefulness and overall satisfaction

Source: Devised by authors

Three hypotheses will be tested based on the conceptual model (Figure 1).

H1. System quality will positively affect user satisfaction.

H2. Information quality will positively affect user satisfaction.

H3. Service quality will positively affect user satisfaction.

The study took a quantitative cross-sectional design, employing a completely structured survey primarily based on the theoretical framework created by
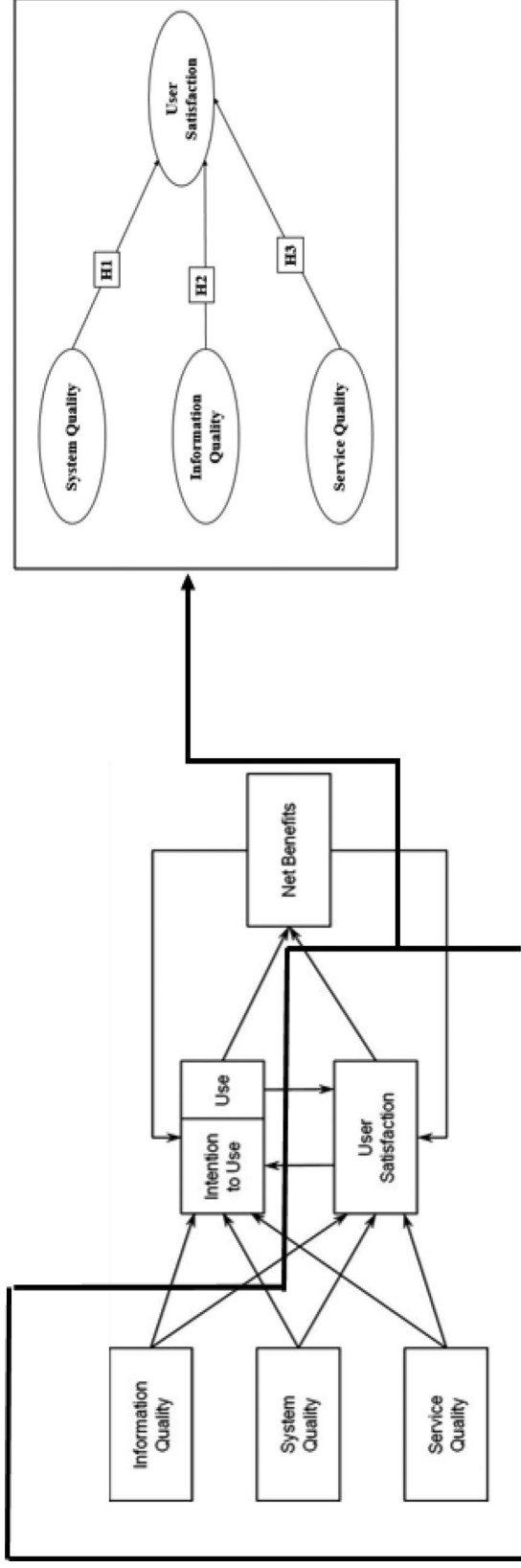
Figure 1 Conceptual Framework (Delone and Mclean, 2003)

Source: Devised by authors

DeLone and McLean (2003), including seven hospitals in Bahrain from the public and private sectors with a wide spectrum of specialties, number of beds, and utilising diverse HISs. The population comprises physicians, nurses, technicians, pharmacists, administrative staff, and information technology staff, in addition to other staff members who use the system regularly to complete their daily tasks. A convenience non-probability sampling technique was used to select the respondents. The survey was distributed through the human resources department in each hospital to a constrained pre-described number of respondents selected by hospital management. SurveyMonkey® was used to circulate the survey electronically to acquire as many responses as possible.

A five-point Likert scale was used to measure the system, information, and service quality, in addition to the end-user satisfaction, providing responses ranging between "strongly disagree = 1" to "strongly agree = 5", in order to measure the quality determinants and the user satisfaction employing the indicators mentioned earlier. A total of 615 questionnaires were distributed by hand; 359 were returned (58.3% response rate), and 308 questionnaires were used for the data analysis. In addition, 16 fully completed questionnaires were electronically retrieved from one hospital through SurveyMonkey®, resulting in a total of 324 questionnaires. The low response rate is probably due to the nature of respondents' professions, which makes it hard to find time in their schedules to complete surveys. SPSS v23 software was used for data analyses and results demonstration.

RESULTS AND DISCUSSION

Reliability test

Cronbach's Alpha Coefficient (CA) was used to test the reliability of the study measuring tool variables. Alluding to previous research, to be reliable, the scale value of CA must be equal to or more than 0.7. As shown in Table 1, the alpha values for the variables used to measure the quality and satisfaction determinants are all greater than 0.7, which assures the high reliability of the measuring scale.

Respondent's demography

Table 2 shows that the majority of respondents were female (70.7%). The highest percentage of respondents were aged between 30 and 39 years

Table 1   Result of Reliability Test

Variable Name	Abbreviation	CA	N. of Items
System Quality	SQ	0.848	4
Information Quality	IQ	0.891	6
Service Quality	SerQ	0.773	4
User Satisfaction	US	0.914	4
Overall		0.938	18

Source: Devised by author.

Table 2   Respondent Demographics

		Frequency	Percent
Gender	Male	95	29.3
	Female	229	70.7
	Total	**324**	**100.0**
Age	20–29	114	35.2
	30–39	148	45.7
	40–49	51	15.7
	50–59	8	2.5
	60 and above	3	.9
	Total	**324**	**100.0**
Nationality	Bahraini	108	33.3
	Non Bahraini	216	66.7
	Total	**324**	**100.0**
Job Position	Physician	64	19.8
	Pharmacist	13	4.0
	Nurse	176	54.3
	Lab technician	22	6.8
	Administrative Staff	10	3.1
	IT Staff	11	3.4
	Head of IT department	1	.3
	Others	27	8.3
	Total	**324**	**100.0**

Source: Devised by authors

(46%), followed by 20–29 (35.2%). Participation among non-Bahrainis (67%) was higher than Bahraini participation (33.3%). Respondents who were nurses were the highest (55%), followed by doctors (19.8%).

Usage of HIS

Table 3 indicates that approximately 80% of the respondents have been using the system for 1–5 years, and only 5.2% has less than one year of experience. In addition, the table demonstrates that, for most respondents (70%), training took place only at the beginning of using the system. This indicates insufficient end- user training, resulting in a potentially negative perception on system ease of use, advantages, and the way they manage, comprehend, and utilise the system. As cited in the literature, training, continuous support, and appropriate and sufficient training updates are important success determinants in the implementation process of an HIS.

The usage of paper records in parallel with the system was investigated to measure the health care professionals' dependency on paperwork. Table 3 indicates that the majority of the respondents are either partially (60%) or completely (29.3%) dependent on paper records along with the HIS.

Table 3   His Usage

		Frequency	Percent
Years of Use	<1 year	17	5.2
	1–5 years	259	79.9
	6–10 years	48	14.8
	Total	**324**	**100.0**
Training	Never	15	4.6
	Only at the beginning	229	70.7
	Continuous training	80	24.7
	Total	**324**	**100.0**
Reliance on paper records.	No	38	11.7
	Sometimes	191	59.0
	Yes Always	95	29.3
	Total	**324**	**100.0**

Source: Devised by authors

Rating of HIS quality and user satisfaction by end-users

Table 4 shows that the mean scores of variables SQ1 to SQ4, describing the system quality indicators, range between 3 and 4; this suggests that respondents have generally agreed that the HISs are easy to use (3.69), with friendly user interface (3.53), and good response time (3.35), which indicates a positive perception towards the system quality. Likewise, variables from IQ1 to IQ6 (information quality indicators) indicated similar means. These variables reflect accuracy, relevance, conciseness, completeness, sufficiency, and timeliness of the data. Furthermore, the mean scores of variables SerQ1 to SerQ3 (reflecting service quality indicators) involving reliability, error alerts, and online support, respectively, are also between 3 and 4, except for item SerQ4 with a score below 3 (2.78); this indicates a lack of remote accessibility. Lastly, variables measuring user satisfaction (US1 to US4) also showed a range of between 3 and 4 mean scores. This indicates general participant satisfaction with the quality of the available systems and a positive perception on improved performance, workload reduction, and enhancing teamwork.

Table 4   Descriptive Statistics of Model Constructs

	Mean	St. Mean %
SQI (Ease of use 1)	3.69	73.8
SQ2 (Interface)	3.53	70.6
SQ3 (Ease of use 2)	3.4	68
SQ4 (System speed)	3.35	67
IQ1(accuracy)	3.7	74
IQ2 (relevance)	3.65	73
IQ3 (conciseness)	3.65	73
IQ4 (Completeness)	3.58	71.6
IQ5 (Sufficient)	3.48	69.6
IQ6 (timeliness)	3.44	68.8
SerQ1 (Reliability)	3.16	63.2
SerQ2 (alerts)	3.38	67.6
SerQ3 (online help)	3.06	61.2
SerQ4 (remote Conn.)	2.78	55.6
US1 (work performance)	3.5	70
US2 (Workload reduction)	3.32	66.4
US3 (Teamwork)	3.48	69.6
US4 (General satifaction)	3.4	68

Source: Devised by author.

Regression analysis

A multiple regression analysis was applied to test the research hypotheses and the relationships

Table 5 Regression Results for User Satisfaction (US)					
Dependent Variable: User Satisfaction (US)					
F$=$141.339 (p$=$0.000$<$0.01), R^2$=$0.570, Adjusted R^2$=$0.566.					
Model	Unstandarized Coefficients		Std. Coef.	t	Sig
	B	Std. Error	Beta		
(Constant)	$-$.203	.185		$-$1.100	.272
System Quality (SQ)	.367	.062	.314	5.898	.000
Information Quality (IQ)	.393	.076	.292	5.194	.000
Service Quality (SerQ)	.303	.051	.272	5.931	.000
Source: Devised by authors					

among the variables. Regression analysis is applied to test the effect and the relationships of the dependent variable, US, in this study, with one or more independent variables (SQ, IQ, and SerQ). Table 5 shows that SQ, IQ, and SerQ are all significantly positively related to US, indicating that improvements in the SQ, IQ, and SerQ will probably lead to more satisfied users of an HIS in Bahrain. The value of the beta coefficient shows that SQ has the strongest effect on US (B$=$0.314), whereas the weakest effect on US among health care professionals in Bahrain is the SerQ effect (B$=$0.272). This indicates that for users of HISs in Bahrain, it is more important to deal with a system that is easy to understand and use, and that has a good user interface and quick response time to help reduce their workload and increase their productivity.

Based on Table 5, the study hypotheses were accepted and supported for HIS users in Bahrain. Despite the fact that respondents' perspectives of the quality of the HISs evaluated in this study were generally positive, some suggested the need for improvements, such as simplifying the system, enhancing web availability and system response time, providing wards with more computers, providing end-users with satisfactory and adequate training, giving prompt support at system shutdown times, installing genuine software and upgrading the servers.

CONCLUSIONS

This study was conducted to evaluate the quality of HISs in Bahrain and to measure the satisfaction of health care professionals and health care staff.

The measurement tool was developed based on DeLone and McLean's (2003) IS model. The results showed that the total mean scores for the variable indicators of each quality determinant indicated a positive perception of the end users toward the quality determinants (SQ, IQ, and SerQ). However, the remote connectivity of an HIS has gained a low total mean score (2.78), indicating that HISs are not accessible for most remote users; this suggests a need to improve this connectivity.

The study hypotheses regarding the effect of the quality dimensions of the HISs were all supported and accepted in this study, showing significant positive relationships among the quality dimensions and user satisfaction of the system in Bahrain. Hence, there is a need to continuously improve the performance of these systems to enhance health care professional satisfaction and guarantee the success of health care initiatives in Bahrain hospitals. Moreover, the study results show that additional and continuous training on using the system is needed. In addition, participants' workloads made by the dual system usage indicate that users are still not fully confident in using the system and need more training and awareness to fully replace paperwork with the system. There were some suggestions from the participants to enhance the quality and services provided by HISs in hospitals in Bahrain.

Study Limitations and Recommendations

The convenience sampling technique used in this study can limit the generalizability of the study sample to properly characterise the target population in Bahrain; hence, other sampling techniques

should be used in further studies. Moreover, there was limited participation from some hospitals due to administrative rules restricting the researcher's access. The study focuses only on the technical factors of the existing HISs and not others, such as organisational, managerial, etc., that might affect end- user satisfaction. Some hospitals' HISs are still newly implemented and modifications are still taking place, which makes the users vague with regard to their use. A multiple period study design is recommended in the future. More in-depth studies of HISs in each hospital are recommended to give a comprehensive picture of its quality dimensions.

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BIOGRAPHICAL NOTES

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