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Evaluation of system quality of hospital information system: A case study on nurses' experiences

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Abstract. In this study, we aimed at measuring the nurses' experiences on the system quality of the hospital information system (HIS). This applied, cross-sectional study was conducted in a case hospital in Iran. We developed a three part questionnaire including demographic information, nurses' experiences and satisfaction about different factors of system quality of a HIS. We asked the participants to rate their responses using five-point Likert scale. A total of 120 questionnaires were sent out for all 120 eligible nurses, with 80 completed copies returned. The data was finally analyzed using descriptive statistics. Regarding the interface quality, the most of nurses (37.5%) stated that data entry through input devices was somewhat quick. We found that HIS developers should pay more attention to the technical aspects of HIS and their correspondence with the nurses' needs, especially in terms of documentation, online assistance, response time, system reliability and flexibility, integration with current and new duties, as well as ability of the system to prevent data lose and handle bugs.

Keywords. Hospital information system, System quality, Evaluation, Nurses' experiences, user satisfaction

Introduction

Hospital information systems (HIS) should be designed to support the hospitals' and users' needs. To this end, the regular and accurate evaluation of these systems (including user satisfaction) is necessary [1, 2]. According to Delone & McLean model usage of an IS and user satisfaction are completely dependent on three factors including information quality, service quality and finally system quality [3]. Ribiere has, also, emphasized that the system quality of a HIS should be studied regarding the interface, functions and performance of a system [4]. The previous researches have indicated that nurses play an important role in adopting and evaluating HISs [5]. According to the

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prior studies, the poor HIS design may cause nurses' resistance and reduce satisfaction [6]. Therefore, nurses' attitude towards using HIS and its design has significant impacts on the successful implementation of the HIS [7]. In this study, we aimed to measure the nurses' experiences on the system quality as a factor affecting nurses' satisfaction with a HIS.

1. Methods

This descriptive cross-sectional study was conducted in a teaching hospital affiliated with Mashhad University of Medical Sciences (East of Iran) in 2013. We developed a three part questionnaire with 38 questions regarding nurses' experiences about different factors of system quality of a HIS and their satisfaction. To determine the factors of system quality, we reviewed the related literature [4, 6, 7, 8]. We defined the "system quality" as the technical quality of the HIS including the quality of interfaces, functions and performance of the system [4, 6]. The nurses were asked to express their experiences about and satisfaction with these factors and sub factors at a five-point scale. (Very low=1, very high=5). To ensure the validity, relevant studies were reviewed to ensure whether a comprehensive list of measures was included. The questionnaire was then validated by a panel of three experts (one senior nurse and two experienced researchers in health information management and technology). Furthermore, a pilot study was conducted to test the questionnaire. The nurses were, also, invited to make comments on the clarity and comprehensibility of the questionnaire. The test-retest reliability was 85 percent.

We collected empirical data targeting nurses with over three years' experience in using the HIS. Totally of 120 questionnaires were sent out for all 120 eligible nurses, with 80 completed copies returned (response rate = 66.6%). Additionally information sheets describing the nature of the study, the anonymous nature of the questionnaire and confidentiality of data were given to all participants. The data regarding nurses' experiences were finally analyzed using descriptive statistics by the SPSS software. Additionally, we computed the mean score of the nurses' satisfaction.

2. Results

Most of the respondents were females (69%) and 49.4% of them were between 25 and 35 years old, and all respondents had bachelor's degrees or higher. The mean number of years working with the HIS was 7. The findings showed that most of nurses considered the importance of the HIS to do their job as "very important" (50%) and "important" (20%).

As for screen interface, most users (51.3%) believed that the volume of output per screen in the HIS is somewhat suitable. Online assistances' sufficiency was considered low (37.5%) and 42.5% of respondents expressed that these assistances were somewhat complete (Table 1). Based on this table, 55% of nurses stated that integration of functions with their daily tasks was somewhat suitable. Most nurses identified that the system reliability and its ability to handle bugs, to prevent losing data and to prevent losing time were low (47.5%, 51.3% and 38.8% respectively). As shown in Table 2, nurses had the highest satisfaction rate about the screen interface (mean= 4), and the lowest satisfaction rate (mean= 2.4) for functions of the HIS with their daily tasks.

Table 1. Nurses' experiences on quality of HIS

Factors	Sub factors	Characteristics	No(%) of Responses					
			Very high	High	Somewhat	Low	Very low	Missing
Interfaces' quality	Data entry devices	Reasonability	20(25)	35(43.8)	17(21.3)	2(2.5)	1(1.3)	5(6.3)
		Applicability	17(21.3)	46(57.5)	12(15)	2(2.5)	1(1.3)	2(2.5)
		Speed	11(13.8)	20(25)	30(37.5)	12(15)	1(1.3)	6(7.5)
	Format of printed output	Easy to read	17(21.3)	43(53.8)	14(17.5)	1(1.3)	0	5(6.3)
		Current	9(11.3)	42(52.5)	22(27.5)	1(1.3)	0	6(7.5)
		Appropriateness	15(18.8)	37(46.3)	16(20)	5(6.3)	2(2.5)	5(6.3)
		Easy to customize	4(5)	30(37.5)	20(25)	15(18.8)	4(5)	7(8.8)
	Screen Interface	Well -designed screen layout	9(11.3)	43(53.8)	26(32.5)	2(2.5)	0	0(0)
		Pleasant screen color	7(8.8)	42(52.5)	28(35)	3(3.8)	0	0(0)
		Readability of information	14(17.5)	57(71.3)	8(10)	1(1.3)	0	0(0)
		Easy to use menus	6(7.5)	51(63.8)	21(26.3)	2(2.5)	0	0(0)
		Suitability amount of information per screen	5(6.3)	23(28.8)	41(51.3)	10(12.5)	1(1.3)	0(0)
	Usability	Simplicity	15(18.8)	41(51.3)	17(21.3)	6(7.5)	1(1.3)	0(0)
		Intuitiveness	11(13.8)	39(48.8)	23(28.8)	4(5)	3(3.8)	0(0)
		User-friendly	13(16.3)	27(33.8)	28(35)	8(10)	3(3.8)	1(1.3)
	Language	Simplicity	21(26.3)	46(57.5)	5(6.3)	3(3.8)	2(2.5)	3(3.8)
		Understandability	28(46.7)	39(48.8)	12(15)	1(1.3)	0	0(0)
		Adapted	11(13.8)	35(43.8)	26(32.5)	4(5)	4(5)	0(0)
	Documentation	Clarity	12(15)	28(46.7)	30(37.5)	8(10)	1(1.3)	1(1.3)
		Availability	7(8.8)	27(33.8)	31(38.8)	13(16.3)	0	2(2.5)
		Completeness	4(5)	24(30)	40(50)	9(11.3)	1(1.3)	2(2.5)
		Current	5(6.3)	29(36.3)	38(47.5)	3(3.8)	2(2.5)	3(3.8)
	On-line assistance	Completeness	10(12.5)	22(27.5)	34(42.5)	11(13.8)	3(3.8)	0(0)
		Understandability	6(7.5)	31(38.8)	31(38.8)	4(5)	4(5)	4(5)
		Sufficiency	10(12.5)	11(13.8)	22(27.5)	30(37.5)	6(7.5)	1(1.3)
Functions' quality	Reversibility	Simplicity	9(11.3)	31(38.8)	25(31.3)	12(15)	3(3.8)	0(0)
		Security	2(2.5)	35(43.8)	29(36.3)	10(12.5)	2(2.5)	2(2.5)
		Speed	4(5)	26(32.5)	32(40)	9(11.3)	7(8.8)	2(2.5)
	Integration with current duties	appropriateness	11(13.8)	18(22.5)	44(55)	6(7.5)	1(1.3)	0(0)
	Integration of new functions/feature	appropriateness	3(3.8)	13(16.3)	42(52.5)	12(15)	8(10)	2(2.5)
Performance' Quality	Response time	Speed	6(7.5)	27(33.8)	35(43.8)	11(13.8)	1(1.3)	0(0)
		Reasonability	7(8.8)	31(38.8)	29(36.3)	5(6.3)	3(3.8)	5(6.3)
	Reliability	Security	2(2.5)	27(33.8)	39(48.8)	9(11.3)	1(1.3)	2(2.5)
		Ability to handle computer bugs or abrupt disconnection	1(1.3)	7(8.8)	13(16.3)	38(47.5)	20(25)	1(1.3)
		Ability to prevent losing Data	5(6.3)	15(18.8)	13(16.3)	41(51.3)	6(7.5)	0(0)
		Ability to prevent losing time	4(5)	13(16.3)	21(26.3)	31(38.8)	11(13.8)	0(0)
	Flexibility	Versatility	4(5)	33(55)	31(38.8)	11(13.8)	0	1(1.3)
		Sufficiency	4(5)	24(30)	36(45)	11(13.8)	1(1.3)	4(5)

Table 2. Nurses' satisfaction with system quality of HIS

Factors	Sub factors	Mean
User-Interface	Data entry devices	3.7
	Format of printed Output	3.8
	Screen interface	4.0
	Usability	3.7
	Language	3.4
	Documentation	3.4
	On-line assistance	3.4
Functions	Reversibility	3.1
	Integration with current duties	2.4
	Integration of new functions /features	2.6
Performance	Response time	3.5
	System reliability	2.6
	System flexibility	3.3

3. Discussion

As the findings show, most of nurses knew the documentation of HIS somewhat completely and expressed difficulties in documents availability. The system documentation is of a significant role to create user satisfaction and make working with it more efficient, to decrease expenditures and confusion, removing failures and improving management control [6], increasing users' skills to use the system, improving the efficiency, decreasing the user's dependence on IT departments, increasing the adoption and usage of a system and enhancing the end users' satisfaction [9]. The majority of our nurses considered the usability of HIS desirable. Freed introduces the lack of attractiveness of a HIS as the factor resulting in the failure of the system [10]. Previous researchers have shown that a poor HIS design, difficult-to-use interface and low usability of a HIS result in the nurses' dissatisfaction [7]. Therefore, nurses' feedbacks regarding the usability and user-friendliness of a HIS should be continually monitored.

The majority of nurses believed that the integration of HIS functions did not properly correspond with their daily tasks. Moreover, Brender says that the functions of a HIS should correspond with the duties and operations of users in their work environment; otherwise, the dissatisfaction and human errors are increased. He asserts that a HIS should be capable to support the users in their daily tasks efficiently [11].

The participating nurses consider the response time of the system somewhat fast. Friedman and Gustafson assert that the system should provide the users with fast and feasible access to their required data [12]. Chow et al. has, also, pointed out delayed log-in times and inefficient processes led to nurses' reduced efficiency while using the system in a busy ward environment [7]. Most nurses identified that the system's reliability and its ability to handle bugs, to prevent losing data and to prevent losing time is low. Furthermore, Sheild et al. pointed out that the greatest anxiety of the personnel in electronic documentation of patients' data originates from fear of losing the data [13]. Our findings indicate that the highest level of satisfaction belongs to screen interface and its lowest is related to the integration of system with the daily duties of users, the integration of new functions and features as well as system reliability. Chow et al., also, states that nurses' satisfaction was affected by system usability and usefulness. On the other hand, nurses' motivational attitudes to using the

computerized system are related to their enhanced satisfaction with the system [7]. As stated by Liu et al., deficiency in the HIS design will result in nurses' dissatisfaction [14]. Our findings are subject to some limitations. First, this study was conducted at only one teaching hospital, restricting its generalization to other hospitals. Future researches should explore different hospitals. Second, the data are derived from questionnaires provided for participants with more than three years' experience using HIS. In conclusion, the following suggestions are presented:

It is better to use menus and colored graphic pictures in the design of different parts of a system, which leads to the attractiveness and simplicity of the system as well as its usability for the nurses. Documentations and instructions for HISs should be made more practical, simpler and easily accessible for the nurses. Online assistance should be used as much as possible. To provide the nurses with the possibility of revising of the errors and wrong information, the system should be easily reversible and flexible in the shortest time. Moreover, in order to increase the system's response time, advanced hardware and proper communication line should be applied. The personnel supporting the HIS should constantly be available to the users so that losing the data is minimized. The designers of a system should pay attention to the possibility of adding new features to the system with regard to meeting new needs in future.

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