






Usability evaluation of emergency department information system: A case of discharge and admission sections of an educational hospital

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ABSTRACT

Introduction: The emergency department is amongst the most important parts of the hospital, which has a great impact on the performance of other departments. In this regard, Emergency Department Information System (EDIS) plays a vital role in providing effective and appropriate healthcare services.

Material and Methods: To evaluate the user-perceived usability of admission and discharge sections of the Emergency Department Information System of Shohada-e-Tajrish Educational Hospital, the study is carried out utilizing SUS and PSSUQ scales. Research participants include all users in the admission and discharge sections of the emergency department of the Hospital.

Results: The mean score of the system usability based on the results of the SUS scale was 49.62 ± 23.23 , which is lower than the acceptable level (score above 68). The results generated by the PSSUQ tool revealed that the information quality (4.79), interface quality (4.91), and system usefulness (4.42) of admission and discharge sections of the EDIS do not have appropriate scores and need to be improved in this regard. The worst usability score was related to system usefulness. There was no statistically significant correlation between the age of participants and usability scores. Moreover, there was no statistically significant difference between the user-perceived usability and the education level of participants ($p > 0.05$).

Conclusion: The study revealed that users are not satisfied with system usability. In the event that the usability of the system is suboptimal, the user fails to effectively utilize the system, thereby impeding the attainment of the intended ultimate objective for which the system has been designed. Regarding the importance of admission and discharge sections in the EDIS, strides need to be made to improve the usability of the system which is used at the emergency department of Shohada-e-Tajrish educational hospital.

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INTRODUCTION

Advances in information technology and computer systems have led to the development of information systems in various fields of science. In healthcare settings, these systems are known as health information systems which are utilized as supportive

tools for facilitating managerial and clinical tasks [1]. These systems play a vital role in providing effective and appropriate healthcare services. Moreover, the clinical decision-making process can be improved by utilizing such information systems which may result in better patient care and safety [2] due to decreasing mistakes, cutting costs, and improving service

delivery [3].

Concerning the importance of information system utilization in hospitals, each country uses special kinds of these systems according to their goals and missions. In this regard, several health information systems (HIS) have been developed in Iran. Despite the importance of HIS, several studies suggest that these systems may have some deficiencies, including usability issues [4-8]. Usability can affect the effectiveness, efficiency, and user satisfaction of a product in order to achieve predetermined goals [4] and is associated with the quality of an information system [9, 10]. In fact, the most prominent characteristic of user-perceived quality is represented by the usability of an information system [9]. Several studies have conducted assessments on the usability of different subsystems within HISs using a range of techniques including internationally recognized usability questionnaires based on standards and heuristic evaluation [11-13]. To date, a substantial number of studies have evaluated the usability of different healthcare information systems, consistently uncovering noteworthy usability issues. Consequently, these studies have concluded that such problems have negative implications for users' interactions with the systems [6, 14, 15].

Poor usability and system failure have been observed in many HISs implemented so far [16]. The emergency department is amongst the most important parts of a hospital, which has a great impact on the performance of other departments of the hospital as well as patient satisfaction [17]. The main function of this department is to admit and provide medical services quickly to patients who refer to this department with various emergency conditions [18].

The emergency department's performance is very important due to its direct effect on other departments' performance including the special care department. Similar to other departments, the use of information technology in this department is of great importance.

Given the paramount significance attributed to the evaluation of HIS usability, This study was undertaken with the objective of 1) assessing the perceived user satisfaction of the admission department's utilization of the emergency information system and 2) assessing the perceived user satisfaction of the discharge department's utilization of the emergency information system at Shohada-e-Tajrish educational hospital, utilizing the System Usability Scale (SUS) and the Post-Study System Usability Questionnaire (PSSUQ) scales.

MATERIAL AND METHODS

Standard tools have been designed to measure the user-perceived usability of an information system

[19]. In this study, the SUS and PSSUQ scales were applied to evaluate the user-perceived usability of the discharge and admission sections of the EDIS. Moreover, to obtain their general opinions about the system, each participant was also interviewed confidentially. Their opinion was summarized and documented. The data gathering process was conducted privately, rather than organizing focus group discussions, to ensure the trustworthiness of their view.

The SUS is a free reliable tool [20] that is being utilized to evaluate the usability of a wide variety of systems and software [21-23]. This scale consists of 10 questions with response choices presented in a Likert scale format. Each question has 5 possible responses (between 1 and 5 where 5=strongly agree). It generates a score between 0 and 100 that reflects the overall usability of the system, with a score above 68 representing an acceptable level of user-perceived usability [20]. SUS has been shown to detect differences at smaller sample sizes than other questionnaires. A study by Tullis et al. [24] revealed that it is possible to get reliable results with a sample of 8-12 users.

PSSUQ is another scale to appraise system usability which has been developed and applied extensively at IBM's design center [25]. This tool has been utilized in various studies [26-28], and a sample of 8-12 users will yield reliable results [24]. The PSSUQ tool consists of 16 queries that reflect overall system usability, system usefulness, information quality, and user interface quality. The PSSUQ is scored on a 7-point Likert scale that ranges from 1 ("strongly agree") to 7 ("strongly disagree"). A lower score indicates better system usability.

Study population

All users of the admission and discharge sections (13 users) participated in this study. It is of significance to highlight that the total number of individuals utilizing the system amounted to 13. Furthermore, it is noteworthy that the research encompassed all system users without employing any sampling techniques.

It should be noted that for the usability evaluation studies, a group size of 3-20 participants is typically valid [24]. Regarding reliable results and effective use of PSSUQ and SUS scales need a minimum of 8-12 participants [29, 30]. Thus, reliable results are derived from our study.

Data analysis

To analyze the data obtained from questionnaires, SPSS 18 software was used. It was assumed that there is a relationship between participant's age, education, and perceived usability. To test this relationship, the Spearman correlation test was applied to examine

the possible correlation between users` age and perceived usability generated by both SUS and PSSUQ scales. Furthermore, The Mann–Whitney test was applied to compare the user-perceived usability between different education levels.

Ethical considerations

The research objectives were verbally explained to all participants by a member of the research team, and after addressing their questions, if they expressed interest, the questionnaire was provided to them for completion. Additionally, at the beginning of the questionnaire, the research objectives, methodology, and confidentiality were explained again, and participants were given the option to withdraw from the study at any time. No private information regarding the participants, such as their full name, phone number, email address, or similar details, was collected or used. The confidentiality of the participant's responses was also ensured.

RESULTS

All the personnel of the discharge and admission sections (13 persons) participated in this study including 10 males and 3 females. The mean age of the participants was 38.45 ± 4.68 years and their average work experience with the studied information system was 23.43 months. Most of them hold bachelor's degrees (69.2%).

Based on the results generated by the SUS scale (Table 1), the mean score of the system usability was 49.62±23.23. The obtained score is lower than the acceptable level (a score above 68 represents an acceptable level of user-perceived usability). Moreover, the results generated by the PSSUQ tool revealed that this score is in the lowest grade F, and it is similar to the results derived from SUS [25]. Thus, the system's usability is not satisfactory from the user's point of view [21].

Table 1: The Sauro/Lewis curved grading scale [25]

SUS Score Range	Grade
84.1–100	A+
80.8–84.0	A
78.9–80.7	A-
77.2–78.8	B+
74.1–77.1	B
72.6–74.0	B-
71.1–72.5	C+
65.0–71.0	C
62.7–64.9	C-
51.7–62.6	D
0.0–51.6	F

SUS System Usability Scale

The usability score obtained by the system for each item of the PSSQU questionnaire is shown in Table 2. Findings show that item 5 (Q5) has obtained a better

score compared with other items and shows that the system is relatively easy to learn. On the other hand, Question 7 received the highest score amongst the other items indicating that error messages are not easily understood by users.

Table 2: System usability evaluation results based on PSSUQ

Subscales	Item	Scale Scoring Rule	Mean	SD
System usefulness	Q1	Overall, I am satisfied with how easy it is to use this system	4.58	2.39
	Q2	It was simple to use this system.	3.45	2.84
	Q3	I was able to complete the tasks and scenarios quickly using this system	5.18	2.40
	Q4	I felt comfortable using this system	5.27	2.33
	Q5	It was easy to learn to use this system.	2.91	2.43
	Q6	I believe I could become productive quickly using this system	5.09	2.55
Information quality	Q7	The system gave error messages that clearly told me how to fix problems	5.33	2.39
	Q8	Whenever I made a mistake using the system, I could recover easily and quickly.	5.00	2.57
	Q9	The information (such as on-line help, on-screen messages, and other documentation) provided with this system was clear	4.40	2.32
	Q10	It was easy to find the information I needed	5.00	2.63
	Q11	The information was effective in helping me complete the tasks and scenarios	5.00	2.54
	Q12	The organization of information on the system screens was clear	4.36	2.46
Interface quality	Q13	The interface of this system was pleasant	4.82	2.44
	Q14	I liked using the interface of this system	4.91	2.34
	Q15	This system has all the functions and capabilities I expect it to have	5.00	2.09
Overall	Q16	Overall, I am satisfied with this system	5.09	2.26
Total			4.56	2.03

PSSUQ Post-Study System Usability Questionnaire

The usability testing results derived from PSSUQ subscales as well as the overall satisfaction with the usability are presented in Table 3. The findings revealed that System usefulness has got the best score (mean=4.42) and interface quality has got the worst score (mean=4.91) among the three subscales of PSSUQ.

Table 3: Scores of the PSSUQ subscales

Subscales	Min	Max	Mean (SD)
System usefulness (SYSUSE)	1.00	6.68	4.42 (2.02)
Information quality (INFOQUAL)	1.17	7.00	4.79 (2.07)
Interface quality (INTERQUAL)	1.00	7.00	4.91 (2.21)
Total (OVERALL)	1.06	6.94	4.56 (2.03)

PSSUQ Post-Study System Usability Questionnaire

As shown in Table 4, the Spearman correlation test revealed that there is no statistically significant correlation between the age, work experience of participants, and scores obtained from the SUS and PSSUQ scales (p value>0.05).

Table 4: The association between age and usability scores

	Age	Work Experience
SUS	r= -.299 p value= .372	r=.055 p value = .907
PSSUQ	r= -.139 p value= .766	r= -.471 p value =.346

PSSUQ Post-Study System Usability Questionnaire, SUS System Usability Scale

Furthermore, according to the Mann-Whitney test results (Table 5), there is no statistically significant difference between the user-perceived usability, education level, and gender of the participants (p value>0.05).

Table 5: User-perceived usability association with participants` education and gender

Questioners	High school Diploma		Bachelor of Science		P value
	Mean	SD	Mean	SD	
SUS	55.00	30.48	47.22	20.97	.757
PSSUQ	4.94	1.73	4.36	2.29	.606
	Male		Female		
SUS	44.75	24.19	65.83	9.46	.127
PSSUQ	5.03	1.78	2.91	2.60	.38

PSSUQ Post-Study System Usability Questionnaire, SUS System Usability Scale

DISCUSSION

To our knowledge, the present study is the first one that evaluates the user-perceived usability of the emergency department subsystems of the software using a combination of two scales including the SUS and PSSUQ.

The study revealed that users are not satisfied with system usability in the discharge and admission sections of the emergency department of Shohada-e-Tajrish hospital. The evaluation by both SUS as well as PSSUQ scales represented that system is not usable enough to satisfy the users' needs. This finding is in line with the study on admission, discharge, and transfer Information system which has been carried

out by Ebnehoseini et al. [16]. However, a study on critical care clinical information systems using a multimethod evaluation of usability showed that most physicians are satisfied with system usability [31]. Furthermore, a cross-sectional study using the ISO 9241-10 standard to assess the usability of hospital information systems showed that 56% of HIS users in the hospitals examined expressed a level of satisfaction. According to the survey, to improve HIS usability and acceptance, web-based capabilities, flexibility, and ease of use are essential [32].

The most important part of a system is the interface [33] and the user's interpretation of system quality is directly impacted by it. A well-designed user interface assists users in easily learning how to use the system, increasing user acceptance of the system, reducing the training period, and finally decreasing user errors [34]. However, the results derived by PSSUQ showed that the system is highly unacceptable in terms of interface quality, especially in features and capabilities that users expect to exist. These results are in line with the findings of a study carried out by Shin et al. [31] on electronic medical record systems in an emergency department in Korea and also with a study carried out by Hudson et al [35]. Furthermore, in comparison with other items, the learnability of this system was in better situation which is similar to the findings derived from the usability study of electronic medical record systems implemented in Sub-Saharan Africa by Kavuma [16].

Users' overall appraisal of a system is defined by usefulness [36]. The results of the present study showed that the system usefulness obtained a better score and was acceptable rather than the interface quality and information quality subscales. Nevertheless, its acceptability is not at the optimum level. The findings revealed that system usability is undesirable regardless of the age and education of participants.

A quality user interface design has a considerable impact on the perceived quality of the system due to the importance of user perception of quality rather than the system itself [37]. Thus, some strides need to be made towards improving the quality of the software user interface to design a user-friendly system that has acceptable usability from the admission and discharge sections users' point of view.

CONCLUSION

In summary, the usability of the emergency information system of Shohada-e-Tajrish hospital in admission and discharge subsystems has not been acceptable from the users' point of view. Similarly, the sub-sections of information quality, user interface, and system usefulness do not have any appropriate usability and need to be improved in this

regard. Amongst the different subscales, the user interface has the worst condition and therefore needs serious intervention.

Based on several studies, there appears to be a reported low usability of health information systems. One possible explanation for this is the insufficient knowledge regarding the unique characteristics of health systems among software designers and engineers. Consequently, the design of these systems often neglects the opinions and specific needs of end users in the healthcare sector.

Hence, it is recommended that managers and designers of hospital information systems prioritize the final requirements of end users and incorporate their perspectives during the design phase. Such an approach would contribute to enhancing the usability of the software within the system.

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AUTHOR'S CONTRIBUTION

SR, SV: conception and design; SR, SV, FF: administrative support; MF, SR, SV, FF, ZK: provision of study materials or patients; SR, MF: collection and assembly of data; FF, SR, ZK, SV: data analysis and interpretation; All authors contributed to drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

FINANCIAL DISCLOSURE

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ETHICS APPROVAL

This research has been approved by the Ethics Committee of Shahid Beheshti university of medical sciences (Code: IR.SBMU.RETECH.REC.1398.174).

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