

Original Article

## Usability evaluation of the user interface in electronic prescribing systems of Iran Health Insurance Organization and Social Security Organization

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### ABSTRACT

**Introduction:** The e-prescribing system is one of the basic technologies in the health system structure which was developed with the aim of properly managing healthcare resources and services, preventing common manual prescribing errors, and increasing patient safety. Given that the user interface of e-prescribing system is considered as the main factor of user acceptance, the purpose of the present study was to evaluate the user interface usability of the e-prescribing systems of Iran Health Insurance Organization (IHIO) and Social Security Organization (SSO) in Iran.

**Methods:** This descriptive-cross-sectional study was conducted in 2022. The research sample consisted of 150 physicians working in educational-therapeutic centers of Urmia University of Medical Sciences who were selected through stratified sampling with proportional allocation. The data collection tool was a researcher-made questionnaire. The validity and reliability of which were verified. The data were analyzed by means of descriptive statistics and independent t-test using SPSS software.

**Results:** No statistically significant difference was found between the user interface SSO and IHIO in general (terms, letters, icons and navigation) and specific (alert display, personalization, entering and displaying information, guidance and interactions) areas. However, there was a statistically significant difference in "color" (P=0.047) and "visibility" (P=0.049).

**Conclusion:** The user interface of two e-prescribing systems in Iran has an average status in terms of usability. Therefore, it seems necessary for system developers to use aesthetic elements, interaction in the user's language, presentation of useful information in a simple and clear format in the design of the user interface according to the principles of human-computer interaction.

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## Extended Abstract

**Introduction**

Electronic prescribing (e-prescribing) is a computer system that was created to record medical orders (medications prescription, laboratory tests, radiology images and other services) and facilitate interaction between physicians and other health care providers. [1, 2] The main goal of this system is to convert the manual prescription process into an electronic form. The e-prescribing can reduce many problems related to paper prescription errors by connecting to EHR and decision support systems. [3] Currently, in Iran, two main insurance organizations Iran Health Insurance Organization (IHIO) and Social Security Organization (SSO) have implemented the e-prescribing system with the aim of properly managing medical resources and services in order to prevent common errors in manual prescribing and increasing patient safety. [4] Both the designed systems have capabilities such as structured entry of medical orders and their transfer to other centers providing healthcare services, access to previous patient information, the possibility of creating commonly-used prescriptions by the doctor, and also providing necessary alterations (drug interactions, inappropriate dosage and ...). [3, 4] The user interface (UI) of the e-prescribing system plays an important role in its success and optimal performance [5]. In fact, the user interface is the only way for users to interact with the system [6] and it allows users to perform all their tasks through it. [7] In user interface design, features such as menus, icons, information density, position of messages on the screen and use of color directly affect the usability of the e-prescribing system. [8-10] Therefore, the user interface of this system should be designed using standard graphic symbols, simple interaction method, suitable navigation and user-friendliness in order to enable ease of learning and easy use and to help the physician create accurate and complete prescription for patients. [11-13] Currently, in all centers providing health care services, physicians simultaneously use two types of e-prescribing systems (IHIO and SSO) based on the type of insurance of the clients. Considering that the user interface is very effective in the acceptance and continuous use of the

e-prescribing system, therefore, its evaluation can be useful in improving the design and performance of the system. The purpose of this study was to evaluate the user interface usability of the e-prescribing systems of the IHIO and SSO in Iran.

**Methods**

This descriptive-cross-sectional study was conducted in 2022. The participants were physicians working in five medical training centers affiliated to Urmia University of Medical Sciences. The sample size calculated by the Cochran's formula ( $\alpha=0.05$ ) equaled 150 which were selected through stratified sampling with proportional allocation. The number of samples in each of the five centers was chosen according to the number of physicians of those centers who used both electronic prescribing systems of the IHIO and SSO for at least three months. A researcher-made questionnaire was used to collect the study data. The validity of the questionnaire was evaluated based on scientific text and comments of seven experts (three in medical informatics, two in health information management and two in medicine). The reliability of the questionnaire was calculated by the test-retest method after being delivered to 15 physicians two times with an interval of two weeks. The internal correlation coefficient and the Pearson correlation coefficient for the entire questionnaire was found to be 83% and 87%, respectively. The questionnaire consisted of three main parts. The first part was the demographic information of the respondents. The second part comprised general user interface criteria (24 questions) in six main categories including terminology (four questions), typography (three questions), color (three questions), icons (four questions), visibility (four questions) and navigation (six questions). The third part, i.e., specific user interface criteria (25 questions) in five main categories included alerting display (seven questions), customization (four questions), data input and display (six questions), help (six questions) and interactions (two questions). To evaluate the usability of the user interface in each of the items related to the general and specific criteria, a five-point Likert scale (very low=1, low=2, medium=3, high=4 and very

high=5) was used. The questionnaires were distributed in hard copy version by one of the researchers of the study in the educational and treatment centers and were collected during one month. The data were demonstrated using descriptive statistics through mean and standard deviation in tables and graphs. The independent t-test with alpha coefficient of 0.05 was used to compare the user interface of two prescribing systems of IHIO and SSO. The data was analyzed using SPSS version 22 software.

## Results

Out of 150 questionnaires distributed in medical training centers affiliated to Urmia University of Medical Sciences, 111 questionnaires were completed and collected (74% response rate). The physicians who participated in this study simultaneously used two types of e-prescribing systems (IHIO and SSO) based on the type of the patient insurance

to provide their own services. Most of the participants in this study (51.35%) were male and were in the age range of 40 to 49 years (36.04%). More than half of the participants (56.76%) had less than 10 years of work experience. Other findings included: the percentage of specialist physicians (65.76%) was higher than general physicians of Ayatollah Motahari Hospital (21.62%) showed the highest participation, and more than half of the physicians (50.45%) had used both systems for at least 10-16 months.

**General criteria:** The results of the usability evaluation of the e-prescribing system in general criteria showed that among the six main categories, the "typography" in both e-prescribing systems (IHIO and SSO) has the highest score ((3.8±1.14), (4.0±1.86)). Also, "color" ((3.08±1.08), (3.01±1.12)) and "navigation" ((3.1±1.45), (3.3±1.21)) had the lowest scores, respectively (Table 1)

Table 1. Evaluation of the general criteria of the e-prescribing systems

Category	Questions	IHIO	SSO
		Mean±SD	Mean±SD
Terminology	The terms used are common and familiar.	(3.4±1.21)	(3.6±0.93)
	The terms used are quite simple and clear.	(3.4±1.25)	(3.7±0.98)
	The terms used are same on all pages.	(3.5±1.41)	(3.8±0.92)
	The terms used are easily remembered.	(3.4±1.52)	(3.7±1.24)
	(P-value=0.062)	(3.4±1.35)	(3.7±1.02)
Typography	The words and sentences are easy to read.	(3.7±1.39)	(4.1±0.97)
	The common and readable fonts are used in the system.	(3.9±1.00)	(4.2±0.73)
	The same type of font is used for the same sections.	(3.8±1.03)	(4.0±0.87)
	(P-value=0.064)	(3.8±1.14)	(4.1±0.86)
Color	The appropriate color has been used to indicate the titles.	(3.1±1.30)	(3.5±1.25)
	There is appropriate color differentiation between different pages.	(2.9±0.97)	(3.4±1.07)
	There is a proper separation between the background color and elements.	(3.2±0.96)	(3.5±1.05)
	(P-value=0.047)	(3.0±1.08)	(3.5±1.12)
Icon	The same, suitable and related icon is used in the system pages.	(3.1±1.33)	(3.5±0.96)
	The icons used are familiar to the user.	(3.3±1.37)	(3.5±1.01)
	Icons and their meaning remain easily in the user's memory.	(3.3±1.47)	(3.6±1.15)
	The size of the icons is suitable for different users.	(3.3±1.19)	(3.7±1.04)
	(P-value=0.060)	(3.3±1.34)	(3.5±1.04)
Visibility	The system pages are concise and complete. (the page is not busy)	(3.3±1.48)	(3.8±0.88)
	The layout of the menus has a proper balance on the whole page.	(3.2±1.15)	(3.5±1.07)
	The pages have suitable length and do not need to be raised or lowered.	(3.0±1.35)	(3.4±1.29)
	Messages are presented in an appropriate place on the page that the eye is used to.	(3.0±1.28)	(3.5±0.97)
	(P-value=0.049)	(3.1±1.32)	(3.5±1.05)
Navigation	The system login is clear and convenient.	(3.9±1.42)	(3.9±1.01)
	The title of each page is clear and relevant.	(3.5±1.46)	(3.6±1.11)
	The user can reach the desired page from where he is.	(3.1±1.49)	(3.3±1.21)

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Table 1. Continue

Category	Questions	IHIO	SSO
		Mean±SD	Mean±SD
Navigation	The path to return to the previous steps and go to the next step is clear.	(2.8±1.44)	(3.2±1.07)
	Menus are designed to be easy to navigate.	(3.0±1.42)	(3.2±1.27)
	It is possible to reach specific goals through shortcut keys.	(2.4±1.44)	(2.9±1.59)
	(P-value=0.061)	(3.1±1.45)	(3.3±1.21)

The results of the statistical test comparing the mean of the two systems (independent t-test with an alpha value of 0.05) in general criteria indicated that there is no significant difference between the mean of the categories of "terminology" (p-value= 0.062), "typography" (p-value=0.064), "navigation" (p-value= 0.061) and "Icons" (p-value= 0.060). Only in "color" (p-value= 0.047) and "visibility" (p-value= 0.049) categories, there was a statistically significant difference, showing that the SSO system in these categories had a relatively higher score.

**Specific criteria:** The results of the usability evaluation of the e-prescribing system in specific criteria showed that among the five main categories, the "data input and display" in both e-prescribing systems (IHIO and SSO) has the highest score ((3.0±1.30), (3.3±1.30)). Also, the IHIO system in the "interactions" category (2.7±1.67) and the SSO system in the "help" category (2.8±1.42) received the lowest scores from the participants (Table2).

Table 2. Evaluation of the specific criteria of the e-prescribing systems.

Category	Questions	IHIO	SSO
		Mean±SD	Mean±SD
Alerting display	Prescription rollback and modification warnings are displayed correctly.	(2.6±1.25)	(3.0±1.47)
	Errors during prescription is accompanied by an appropriate alerting message.	(2.9±1.40)	(3.1±1.18)
	Alertings during prescription are such that the user can easily notice them.	(3.0±1.41)	(3.2±1.25)
	All types of warnings are displayed with appropriate symbols or colors.	(3.0±1.38)	(3.1±1.37)
	Alertings during prescription are such that the user cannot ignore them.	(2.8±1.20)	(3.0±1.00)
	Alerts have appropriate options for user response.	(2.9±1.21)	(3.2±1.25)
	The number of warnings during prescription is reasonable and appropriate.	(3.0±1.31)	(3.3±1.22)
	(P-value=0.065)	(2.9±1.31)	(3.1±1.25)
Customization	Individual information can be edited in the system.	(2.6±1.25)	(2.9±1.31)
	It is possible to set how to display warnings for the user.	(2.9±1.40)	(2.4±1.35)
	It is possible to save the list of commonly used drugs in the selected list.	(3.0±1.41)	(3.9±1.30)
	It is possible to create frequently used prescription in the user's selected list.	(3.0±1.38)	(3.6±1.59)
	(P-value=0.067)	(2.9±1.36)	(3.2±1.40)
Data input and display	Searching for drugs, tests, etc. in the system is bilingual.	(3.5±1.52)	(3.7±1.33)
	Entering and searching patient data in the system is done easily.	(3.4±1.01)	(3.6±0.93)
	Entering names and searching for drugs, tests, etc. is easy.	(3.2±1.53)	(3.5±1.34)
	The system is such that most of the commands are entered as options.	(2.7±1.58)	(3.0±1.18)
	Editing the entered data can be done easily in the system.	(2.4±1.08)	(2.8±1.46)
	Search results in the system are displayed in categories.	(2.6±1.09)	(2.9±1.20)
	(P-value=0.060)	(3.0±1.30)	(3.3±1.30)

Table 2.Continue

Category	Questions	IHIO	SSO
		Mean±SD	Mean±SD
Help	All medications, tests, etc. to prescribe are in the system.	(2.9±1.31)	(3.3±1.26)
	A multimedia help is available.	(2.4±1.32)	(2.4±1.58)
	The search help for different sections is available on all pages.	(2.9±1.18)	(2.9±1.01)
	The help on how to use the different sections is simple and understandable.	(3.0±1.47)	(3.2±1.37)
	The prescription help is presented step by step and in regular and same pages.	(3.1±1.67)	(3.1±1.38)
	How to correct common user errors is provided in the system manual.	(2.4±1.55)	(2.9±1.79)
	(P-value=0.077)	(2.8±1.42)	(3.0±1.40)
Interactions	The prescription steps provided in the system are in accordance with the user's workflow.	(2.3±1.71)	(2.8±1.84)
	The pattern of grouping information (pharmaceutical, etc.) is scientific and logical.	(3.1±1.62)	(3.4±1.47)
	(P-value=0.068)	(2.7±1.67)	(3.1±1.66)

The comparison of the mean of the two systems in specific criteria shows that although the SSO user interface has relatively higher scores in five main categories, the results of the statistical test (independent t-test with Alpha value 0.05) indicated that there is no significant difference between the mean of "alerting display" (p-value=0.065), "customization" (p-value=0.067), « input data and display" (p-value=0.060), "help" (p-value=0.077) and "interactions" (p-value=0.068).

## Discussion

The findings of the present study evaluating the general criteria of the e-prescribing systems showed that both systems in the "terminology" category (which included the design of the system with common and familiar, simple and clear, easy and memorable terms) had obtained a higher score than the other categories. Therefore, it can be acknowledged that in the development of the user interface of these systems, more attention has been paid to the use of appropriate terms. In this regard, Schadow et al [14]. have also emphasized the importance of using standard and common terms between prescribers and executors of orders in e-prescribing systems. Some studies showed that non-observance of terminology principles in the

design of electronic prescribing systems can cause different perceptions and as a result may increase errors related to patient safety. [15] Also, the results of the present study indicated that the IHIO e-prescribing system received the lowest score from the users in the "color" category. In this category, there was a statistically significant difference between the two systems, and the SSO e-prescribing system scored relatively higher. In a study that aimed to investigate the design aspects of e-prescribing systems on usability, workflow and medication orders, the "color" was considered as one of the most important factors affecting usability and reducing prescribing errors. In this study, it is mentioned that in e-prescribing systems, colors should be used accurately and with high sensitivity. Each color should be assigned to a thematic category. Besides, colors should be used to highlight important things that have an impact on correct prescription so that the prescriber's attention is easily drawn to important information and serious warnings. [16] The use of appropriate colors to attract the attention of users and reduce prescription errors has also been considered in other studies. [9,17] Therefore, it is necessary that the developers of e-prescribing systems pay more attention while applying colors in



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the future versions of the system. The results of the present study in the specific criteria showed that both systems received the most scores in the category of "data input and display" which indicates that from the point of view of the physicians, the entering data and representation the outputs of IHIO and SSO prescribing systems have appropriate usability. In other studies, the importance of designing user inputs in the e-prescribing system has been emphasized. [9,16,18] The findings of Miller et al's [19] study are also consistent with this finding. They have stated that a suitable user interface for drug administration should have sufficient, recognizable and editable inputs. On the other hand, the results of our study related to the evaluation of specific criteria showed that the e-prescribing system of the SSO has the lowest score in the "help" category. The help for using the system and the instructions related to the correct execution of the prescription process is one of the essential requirements in electronic prescription systems, which

has also been considered in most of the studies. [16,18] The e-prescribing system without help feature or system with weak help will cause user dissatisfaction. [18] The correct functioning of electronic prescribing system depends on the prescriber's step-by-step guidance during the prescription process. Therefore, it is important to pay attention to the characteristics of this category in the design of these systems. [16] The evaluation of user interface usability of the electronic prescribing systems in Iran showed that the user interface of the IHIO and SSO systems had an average status since the average scores obtained in most categories related to general and specific criteria were less than 3.5. Therefore, it seems necessary that the developers of these systems focus on the demands and needs of the physicians and consider principles of human-computer interaction while designing the user interface.

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