Development of a minimum data set for drug module of computerized physician order entry system

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ABSTRACT

Introduction: One way to reduce medication errors in the cardiovascular setting is to electronically prescribe medication through the computerized physician order entry system (CPOE). Improper design and non-compliance with users' needs are obstacles to implementing this system. Therefore, it is necessary to consider the standard minimum data set (MDS) of this system in order to meet the basic needs of its users. The aim of this study was to introduce MDS in the cardiovascular CPOE drug system to standardize data items as well as to facilitate data sharing and integration with other systems.

Material and Methods: This study was a survey study conducted in 1399 in Iran. The study population was all cardiologists in Iran. The data collection tool was a researcher-made questionnaire consisting of 33 questions. Data were analyzed in SPSS-24 using descriptive statistics.

Results: A total of 31 cardiologists participated in this study. The participants identified 19 of the 25 drug data items as essential for drug MDS. Five data items (Medication name, Medication dosage, Medication frequency, Medication start date and Patient medication history) were considered essential by more than 90% of the participants.

Conclusion: The results of this study identified drug MDS for the cardiovascular CPOE system. The results of this study can be a model for CPOE system designers to develop new systems or upgrade existing systems.

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INTRODUCTION

According to the American Medical Institute, on average, hospitalized patients experience at least one medication error daily [1]. Medication errors usually cause many problems for patients, which lead to harm to patients [2, 3], increase their length of stay in the hospital and increase hospital costs [4]. This institute estimates that incidences related to at least a quarter of medication errors are preventable, and recommends electronic prescribing of medications using the computerized physician order entry system (CPOE) as a way to reduce medication errors and harm to the patient [5] and reduce mortality [6]. The use of CPOE also reduces medication errors due to the illegible handwriting of physicians [7]. CPOE systems with Clinical Decision Support System (CDSS) capability reduce medication errors by providing warnings about medication interactions and incorrect dosage [8].

One of the applications of the CPOE system is to record medical orders in cardiovascular patients [9]. Cardiovascular disease is one of the most important causes of disability and death in the world [10]. According to the World Health Organization (WHO), cardiovascular disease is the number one cause of death in the world and 17.9 million people die every year due to cardiovascular disease, which accounts for 31% of all global deaths [11]. Despite the evidence that show the use of CPOE with CDSS, improves physician performance and patient outcomes as well as patient safety [8, 12], these systems are not widely and fully implemented in hospitals [13]. Improper design and non-compliance with user needs are the obstacles for the implementation of this system [14]. Studies have shown that systems that can meet the information needs of users are more accepted among users [15, 16]. Therefore, one of the things that should be considered in the design of information
systems is the compilation of a standard minimum data set (MDS) that can meet the basic needs of users [17]. In order to prescribe a medication in a CPOE system properly, it is necessary to collect the basic data that the service provider must consider when prescribing the medication, such as medication name, medication dosage, and other important data items. Developing a MDS leads to the recording of data items with the same format in the system and eliminates the variation of data in information systems [18].

Various studies have been performed to introduce standard MDS for different diseases [19, 20], but according to our knowledge, no studies have identified the data items and MDS required to design the drug module of the cardiovascular CPOE system. The aim of this study was to introduce MDS in the cardiovascular CPOE drug system to standardize data items as well as to facilitate data sharing and integration with other systems.

**MATERIAL AND METHODS**

This was a national survey conducted in 2021 in Iran. The study population was all cardiologists in Iran. The sampling method was snowball sampling. The data collection tool in this study was an online researcher-made questionnaire whose questions were taken from other studies [21-23]. This questionnaire consisted of 33 questions and three parts. The first part included demographic information of the participants (7 questions), the second part included drug data items of the CPOE system (25 questions) and the third part included a free text question for other proposed data items. The questions of the second part were in the form of a five-choice Likert scale. These options ranged from completely necessary to completely unnecessary. The answer to each question was scored from 5 (completely necessary) to 1 (completely unnecessary). The questionnaire was developed by Digitsurvey, a web-based questionnaire-making tool, and provided to participants through WhatsApp and Telegram to determine the necessity of each data item to design a CPOE drug module. The content validity of the questionnaire was assessed by two medical informatics specialists and two cardiologists. Cronbach’s alpha coefficient was used to evaluate the reliability of the questionnaire (α = 0.9). Data were analyzed using descriptive statistics in SPSS-24 and the frequency and percentage of each data item were calculated. Data items that were considered completely necessary or necessary by at least 65% of the participants were identified as essential to be included in the MDS of the CPOE system drug module.

This research was approved by the ethics committee of Kerman University of Medical Sciences with the ethics code IR.KMU.REC.1398.433. In order to comply with ethical standards, the objectives of the research were first explained to the participants and informed consent was obtained from the participants before completing the questionnaire. After completing the informed consent form, participants had access to the questions of the questionnaire.

**RESULTS**

The questionnaire was published in various specialized groups on social networks. A total of 31 questionnaires were completed. According to Table 1, 58% of the participants were female. Most participants had work experience between 1 and 5 years. About two-thirds of the participants were between 31 and 40 years old.

| Demographic information | Frequency (percent) |
|-------------------------|---------------------|
| Gender                  |                     |
| Female                  | 18 (58)             |
| Male                    | 13 (42)             |
| Age                     |                     |
| ≤30                     | 4 (13)              |
| 31-40                   | 21 (68)             |
| 41-50                   | 5 (16)              |
| >50                     | 1 (3)               |
| Work experience         |                     |
| <1                      | 3 (10)              |
| 1-5                     | 19 (62)             |
| 6-10                    | 6 (20)              |
| 11-15                   | 0                   |
| >15                     | 3 (10)              |
| Job                     |                     |
| Physician               | 25 (80)             |
| Resident                | 6 (20)              |

The participants identified 19 of the 25 drug data items as essential for drug MDS. Table 2 shows the list of drug MDS data items of the CPOE system. The results of Table 2 show that more than 75% of the data items were identified as necessary by the participants.

Fig 1 shows the percentage of participants’ agreement to consider each of the data items in the drug module of the CPOE system. According to this figure, 5 data items (Medication name, Medication dosage, Medication frequency, Medication start date, and Patient medication history) were considered necessary by more than 90% of the participants.

**DISCUSSION**

To the best of our knowledge, this is the first study that determines the drug MDS of the CPOE system. In this study, a national survey by cardiologists was used to determine the drug MDS of the CPOE system. This MDS was designed with 19 data items. Due to the fact that relevant studies were considered to develop the questionnaire of this study most of the data items proposed by these studies were approved by the participants.

MDS is a standard method for collecting key data items. Using of a standard MDS can improve the recording of essential data that leads to better
outcomes for the patient [24]. On the other hand, using a MDS that is approved by system users, will increase their efficiency and reduce their workload.

In this study, in accordance with previous studies, the opinion of experts was used in designing MDS and the data set was localized, which leads to a complete and comprehensive MDS [19, 20]. Studies have shown that if information systems are localized and adapted to the working conditions of users, it will be easier for users to accept these systems and eventually use them [24-26].

According to the results of this study, data items such as Medication name, Medication dosage, Medication frequency, Medication start date, and Patient medication history were considered necessary by almost all participants. Kuo, in his study [27] showed that most drug errors are related to drug dose errors, so it is necessary to record this data item in the drug module of the CPOE system to prevent drug dose-related errors by applying rules in the system. In this study, Patient medication history is one of the essential data items. Abbasi [28] showed that access to patients' medical and medication history from the early stages of treatment can reduce medical errors and drug side effects. Various studies have emphasized the importance of these data items [29, 30].

Table 2: Physicians overviews regarding the necessity of drug data items of MDS of the cardiovascular CPOE system

| Data element                                      | Absolutely necessary | Necessary | Moderate | Unnecessary | Absolutely unnecessary |
|---------------------------------------------------|----------------------|-----------|----------|-------------|------------------------|
| Medication name                                   | 19                   | 9         | 3        | 0           | 0                      |
| *Medication code                                  | 6                    | 9         | 12       | 4           | 0                      |
| Medication dosage (including unit)                | 17                   | 11        | 3        | 0           | 0                      |
| Daily maximum range                               | 10                   | 13        | 5        | 3           | 0                      |
| Medication frequency                              | 16                   | 12        | 3        | 0           | 0                      |
| Medication start date                             | 15                   | 13        | 3        | 0           | 0                      |
| Medication duration                               | 12                   | 15        | 3        | 1           | 0                      |
| Medication form                                   | 12                   | 13        | 5        | 1           | 0                      |
| Medication route                                  | 10                   | 10        | 8        | 3           | 0                      |
| Allergies                                         | 19                   | 8         | 2        | 2           | 1                      |
| *Medication preferences                           | 6                    | 12        | 10       | 3           | 0                      |
| * Dissolvent name                                 | 5                    | 10        | 13       | 3           | 0                      |
| *Dissolvent dosage                                | 5                    | 13        | 11       | 2           | 0                      |
| *Dissolvent dosage range                          | 5                    | 9         | 15       | 2           | 0                      |
| *Dissolvent dosage unit                           | 5                    | 11        | 13       | 2           | 0                      |
| Intravenous fluid order (Fluids name)             | 8                    | 16        | 6        | 1           | 0                      |
| Fluids rate and dose                              | 8                    | 18        | 5        | 0           | 0                      |
| Fluids additions (additives)                      | 6                    | 15        | 7        | 3           | 0                      |
| Fluids start date                                 | 7                    | 17        | 5        | 2           | 0                      |
| Total volume of fluids                            | 10                   | 14        | 5        | 2           | 0                      |
| Patient's own medications (current patient medications) | 11               | 16        | 4        | 0           | 0                      |
| Patient medication history                         | 12                   | 17        | 2        | 0           | 0                      |
| Discharge medication                              | 17                   | 9         | 4        | 1           | 0                      |
| Discharge medication instruction                   | 14                   | 9         | 6        | 2           | 0                      |
| Note regarding medication                         | 9                    | 15        | 6        | 1           | 0                      |

*Unapproved data items by experts
Medication errors are one of the common medical errors that have improper outcomes for the patient and health care centers. According to the results of this study and similar previous studies [31, 32], it is suggested that Allergy data be added to the drug MDS of the CPOE system. The availability of patient allergies in many cases can prevent medication errors and patient mortality [4]. According to previous studies, non-registration of drug allergies can lead to drug errors [4, 33], which can be easily prevented if allergies are known.

In this study, two data items, Discharge medication, and Discharge medication instruction were identified as essential. Previous studies [34, 35] showed that medication errors in prescribed drugs when patient discharged from the hospital are more than medication errors at the time of hospitalization, and the drug side effects of these errors are more severe due to lack of patient monitoring after discharge [35]. Therefore, ordering these data medication in the system can reduce medication errors and increase patient safety. This is especially important for patients with heart disorders due to their specific conditions.

CONCLUSION

The results of this study identified drug MDS for the cardiovascular CPOE system. This study identified 19 data items for drug MDS. To our knowledge, this is the first study regarding development of the drug MDS of the cardiovascular CPOE system. The results of this study can be a model for CPOE system designers to develop new systems or upgrade existing systems.

One of the strengths of this study is the assessment of the views of experts in the country who worked in various institutions. This makes the developed MDS usable in other institutions in the country. One of the limitations of this study is using an online questionnaire. However, due to the geographical size of Iran and the COVID-19 pandemic, it was not possible to access in person, and data collection was done through an online questionnaire. Therefore, we may lose the attitude of professionals who are not interested in completing online questionnaires. The next limitation of the study was the limited number of study participants. Of course, considering the participation of experts from different cities, it can be claimed that the results of this study can be generalized to the whole community.
AUTHOR’S CONTRIBUTION
All authors contributed to the literature review, design, data collection and analysis, drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

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