

The Role of a Computerized System of Medical Order Registration on the Reduction of Medical Errors

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Abstract

Background: Medication errors are the most common medical errors, and are one of the major challenges threatening the health-care system, which is inherently susceptible to error.

Objectives: In this study, we aimed to compare the occurrence of errors between two methods of entering orders: manual and digital.

Patients and Methods: In this perspective study, 350 files in the Baqiyatallah hospital in Tehran, Iran, were evaluated in 2014. The files were divided into two groups, including manual and digital methods, with 175 members each. In both groups, the presence of errors in the administration, registration, and execution of orders was compared.

Results: Overall, 350 cases underwent analysis; 175 files were evaluated manually and 175 were evaluated digitally. Of the 69 errors (19.7%) that occurred, 65 errors (18.6%) were in the manual files versus 4 (1.1%) in the digital files ($P < 0.001$). The mean age of the nurses making errors was 32.42 ± 7.13 years old, and for the others it was 35.15 ± 7.76 years old ($P = 0.008$). Additionally, the mean age of the physicians with errors was 37.52 ± 7.97 years old versus 34.48 ± 6.82 years old in the others. Moreover, significant differences were observed between the two groups in terms of age ($P = 0.002$). Of the 69 errors, 80% were because of bad handwriting ($P < 0.001$), 50 errors (14.3%) were pharmaceutical, 2 errors (0.6%) were related to the procedure, and 17 (4.9%) were related to the tests.

Conclusions: It can be concluded that electronic health records lead to a reduction in medication errors and increase patient safety.

Keywords: Medical Errors, Reduction, Safety

1. Background

Medication errors are the most common medical errors, and are one of the major challenges threatening the healthcare system, which is inherently susceptible to error, but designing a system free of errors is impossible (1, 2). The hospital is the most important institution in the field of healthcare, and patient safety is one of the most important aspects of healthcare (3-5). Medical errors are common in hospitals, causing a lot of danger to patients; for example, approximately 3 to 17 percent of patients in hospitals suffer from medical errors (6, 7). The results of several studies have indicated that most errors are caused by failures in the design of processes, tasks, and working conditions (8, 9).

2. Objectives

Few studies have been done on the role of computer system administration in the reduction of medical errors in Iran; therefore, we decided to compare the occurrence

of errors between two methods of entering orders: manual and digital.

3. Patients and Methods

In this perspective study, after receiving ethical approval and the patients' informed consent, 350 patients referred to the emergency ward of the Baqiyatallah hospital in Tehran, Iran, during 2014 were selected by random sampling. The files were randomized into two groups via a computer-generated randomization list with 175 members. For the first group, the orders were written manually, and for the other group they were written digitally. In both groups, the presence of errors in the administration, registration, and execution of orders was compared.

3.1. Questionnaire Design

A questionnaire was designed by the researchers and validated by 3 emergency medicine specialists. The reliability of the questionnaire was also checked using 30 files

with a one-week interval. To check the questionnaire's reliability, fifteen files were used to complete the questionnaire twice, with a one-week interval. The questionnaire consisted of: order types (manual or digital), occurrence or non-occurrence of the error, cause of the error (bad handwriting, non-routine orders, nurse's inability to read the orders, and mistakes in reading the orders), orders in which errors occurred (medication, procedures, tests, and imaging), and physicians' and nurses' information (age and level of education).

The content validity ratio ($CVR = (n_e - N/2) / (N/2)$) and relevance, clarity, and simplicity content validity index (R-CVI, C-CVI, and S-CVI) were used for the instrument validation. The internal consistency of the questionnaire was checked using the pretest-posttest and Cronbach's alpha. In addition, the reliability of each question was also checked by the McNemar and Kappa tests.

The questionnaire items were scored for necessity, relevance, clarity, and simplicity by three emergency medicine specialists, and the CVR, R-CVI, C-CVI, and S-CVI were measured. The level of significance was considered to be 0.75 according to Lawshe's and none of the items had CVRs or CVIs lower than 0.75. Fifteen patients completed the questionnaire twice within a one-week interval to determine the questionnaire's reliability. The internal consistency was approved (overall $\alpha = 0.788$, knowledge part $\alpha = 0.755$, attitude part $\alpha = 0.769$, and practice part $\alpha = 0.845$), and there were no significant differences between the first and second answers in any of the questionnaire items ($P > 0.05$). The Kappa index was not lower than 0.2 in any item.

The data were analyzed using the statistical package for social sciences (SPSS) version 20 (SPSS Inc., Chicago, IL) for windows. The normal distribution variables (approved by the one-sample Kolmogorov-Smirnov test) were compared using an independent sample t-test between the groups, and a paired sample t-test within the groups. The chi-square test was also used to compare the categorical variables in the two groups. A $P < 0.05$ was considered to be statistically significant.

4. Results

The total number of patient files was 350; 175 (50%) were checked using the manual method and 175 (50%) were checked using the digital method.

Table 1 shows the demographic data for the nurses and physicians. Of the 350 total files, 201 files (57.4%) were created by male nurses and 149 cases (42.6%) were created by females.

According to this table, there were no significant differences between the two groups in terms of the gender and age distributions in the nurses' and physicians' groups.

Table 1. Demographic Data

Variable	Manual	Digital	P Value
Gender of nurses^a			0.91
Male	100 (28.6)	101 (28.9)	
Female	75 (21.4)	74 (21.1)	
Mean age of nurses^b	34.44 (8.25)	34.78 (7.15)	0.67
Academic degree of nurses^a			0.77
BA	169 (48.3)	168 (48)	
MA	6 (1.7)	7 (2)	
Gender of physicians^a			0.26
Male	139 (40.2)	150 (43.4)	
Female	32 (9.2)	25 (7.2)	
Mean age of physicians^b	35.89 (7.2)	34.27 (7.04)	0.03
Academic degree of physicians^a			0.80
Intern	15 (4.3)	11 (3.1)	
Resident	139 (39.7)	141 (40.3)	
Specialist	17 (4.9)	20 (5.7)	
Above	4 (1.1)	3 (0.9)	

Abbreviations: BA, bachelor of arts; MA, master of arts.

^aValues are expressed as No. (%).

^bValues are expressed as mean (SD).

Of the 350 total cases, 69 errors (19.7%) occurred; 65 errors (18.6%) in the manual files versus 4 (1.1%) in the digital files. There was a significant difference between the two groups in the distribution of the occurrence of errors ($P < 0.001$). Table 2 shows the distribution based on the error by the gender and academic degree of the nurses and physicians. The mean age of the nurses with errors was 32.42 ± 7.13 years old, and for the others it was 35.15 ± 7.76 years old. Significant differences were observed between the two groups in terms of age ($P = 0.008$). The mean age of the physicians with errors was 37.52 ± 7.97 years old, and for the others it was 34.48 ± 6.82 years old. Significant differences were also observed between these two groups in terms of age ($P = 0.002$).

There were significant differences between the two groups in terms of the distribution of errors according to the age and gender of the nurses, and the age of the physicians ($P = 0.008$, $P = 0.011$, and $p = 0.002$, respectively). In the other cases, there was no significant relationship.

Of the 69 errors (19.7%), 55 errors (15.7%) were because of bad handwriting. A total of 21 nurses (6.0 %) were unable to read the orders, and all 21 were in the manual group. There was a significant difference between the two groups in the distribution of the occurrence of errors ($P < 0.001$). The numbers of errors in bad handwriting were the great-

Table 2. Distribution Based on Error by Gender and Academic Degree

Variable	Error ^a	P Value
Gender of nurses		0.011
Male	49 (14)	
Female	20 (5.7)	
Gender of physicians		0.51
Male	55 (15.9)	
Female	13 (3.8)	
Academic degree of nurses		0.26
BA	68 (19.4)	
MA	1 (0.3)	
Academic degree of physicians		0.40
Intern	4 (1.1)	
Resident	54 (15.4)	
Specialist	8 (2.3)	
Above	3 (0.9)	

Abbreviations: BA, bachelor of arts; MA, master of arts.

^aValues are expressed as No. (%).

est, and there was a significant difference between the two groups in the inability to read prescriptions ($P < 0.001$).

In the manual group, 6 errors (1.7%) resulted in an additional cost. Moreover, there was a significant relationship between the groups in the errors that led to additional costs ($P = 0.030$). In addition, 2 errors lead to morbidity (0.6%), and both of them occurred in the manual group. However, there was no significant difference between the groups in term of the errors related to mortality ($P = 0.499$), but there was a significant relationship between these errors and the errors related to mortality ($P = 0.038$).

Of the 69 total errors (19.7%), 50 errors (14.3%) were pharmaceutical, 2 errors (0.6%) were related to procedure, and 17 cases (4.9%) were related to tests. Overall, there was a significant relationship between the errors and the type of request ($P < 0.001$).

5. Discussion

We found that the error rate was associated with several factors including the type of order registration, staff gender, and the ages of the staff. Our findings also showed that the greatest number of errors were due to bad handwriting. Our study showed that a computerized system of medical order registration had a significant effect on the reduction of medical errors. However, the limitations of

this study were administrative, financial, and facility related.

Fontan et al. (10) reported that out of every 15 patients admitted to the hospital, medication errors occur in one. In the current study, this rate was about one out of every 20 patients. In another study, Cassiani (11) showed that medication errors including mistakes in reading medical orders and errors in execution are the most common medical errors. In our study, the highest error was also related to medication. According to Mahmood et al. (12) the most common predisposing causes of medication errors were bad physicians and unreadable handwriting. In our study, the main cause of medical errors was bad handwriting. In addition, the role of bad handwriting in medical errors has been reported in some other studies (13). Moreover, the study by Bates and Gawande (7) reported that integrating the information sources into the patient's electronic health record, including laboratory, pharmacy, and radiology, led to the improved identification of medical errors and adverse effects. The results of our study showed that this was reasonable to conclude.

Hospital information systems integrating technology and electronic health records leads to a reduction in prescription medication errors and an increase in patient safety. Moreover, developing a mechanism for preventing medical errors, with the aim of improving the quality of the healthcare system, is suggested. It is also recommended to use electronic health records to reduce prescription medication errors and increase patient safety with regard to medication.

Footnote

Authors' Contribution: Study conception and design: Shahverdi, Javadzadeh; acquisition of data: Shahverdi, Javadzadeh; analysis and interpretation of data: Shahverdi, Javadzadeh; drafting of manuscript: Shahverdi, Javadzadeh; critical revision: Shahverdi, Javadzadeh.

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