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Evaluation of Medication Errors in Teaching Hospitals

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ABSTRACT

Introduction:
Medication errors (MEs) are a common explanation for iatrogenic adverse events. This study appraised the incidence of MEs and identified the error types in the hospitals affiliated to Azad University of Medical Sciences, located in Tehran, Iran.
Materials and Methods:
This cross-sectional descriptive study was conducted on all patients admitted to the hospitals affiliated to Azad University of Medical Sciences. The data were collected by means of a drug safety checklist and then extracted and analyzed in SPSS software (version 22.0). Moreover, drug interaction was assessed based on the World Health Organization guidelines and Medscape application.
Results:
The mean MEs incidence was obtained as 43.38±5.25. Moreover, the mean numbers of errors in prescribing drugs and antibiotics were 4.71±2.93 and 1.02±0.95, respectively. According to the results, drug interactions occurred in 12.3% of the medicines. In addition, ME showed a significant correlation with education status, ward type, admission type, hepatic failure, hepatic enzymes, patient weight (when on antibiotics), antibiotic effect, and patient age (65> years).
Conclusion:
The results were indicative of a high prevalence of prescription errors. Moreover, it was found that most of MEs were made by doctors, mainly due to the lack of an electronic drug registration system. Therefore, physicians need to be educated on how to increase patient safety through drug safety.

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Introduction

Medication error (ME) is the most common type of medical errors (1), causing significant morbidity and mortality (2).
The ME mortality and morbidity are issue of significant importance. Accordingly, the World Health Organization (WHO) is committed to implement a global work program to reduce severe, avoidable medication-related harms by 50% by 2022 (3). It is well-accepted that promoting the rational use of medicines will lead to the improvement of the quality and efficiency of healthcare services (4). A healthcare organization is responsible for ensuring patient safety, when providing with health care services (5). In addition, approximately 60% of MEs occur during hospitalization, transfer, or hospital discharge (6). The use of

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medicine is a complex process given the involvement of different agents at various positions, including doctors, pharmacists, nurses, and patients. Medicine abuse can occur anywhere in the healthcare system. Pharmacists play an important role in the proper use of drugs; accordingly, they can facilitate the prevention of many MEs (7). Such errors can cause severe complications, prolonged hospital stay, unnecessary diagnostic tests, unnecessary treatments, and even death (3). Medical errors and, above all, pharmaceutical errors cause many problems for patients and health systems. Therefore, the detection of medical error dimensions based on regular and computerized systems can improve the overall conditions of hospitals and patients (8,9). According to the literature, an estimated 50% of MEs can be prevented (10). The risk of errors can be increased by such factors as the multiplicity of patients, reduced patient waiting time, a large number of chronic complex patients seeking care, and lack of detailed and accurate information on patient history (11,12). Despite this potential risk, little information is currently available on the risk factors leading to medication safety problems. This is while the prevalence of these errors is estimated at 4-20% (13,14). With regard to Iran, these errors are reported to have the prevalence of up to 50% (15). Medication errors can cause mild to moderate drug side effects in 70% of patients (16). However, this problem can be easily prevented by specific planning in health systems (17,18). Accordingly, some studies on MEs have been performed in Iran (15). For instance, Fahimi et al. reported transcription errors at a teaching hospital in Iran (19). Regarding the importance of this issue, the present study was conducted to investigate the frequency of drug safety problems in teaching hospitals affiliated to one of the medical universities in Tehran, Iran.

Materials and Methods

This cross-sectional study was implemented in the teaching hospitals affiliated to Azad University of Medical Sciences in Tehran, Iran. This university has two teaching hospitals (A and B) with 272 active beds. To carry out the study, an evaluation was performed on patients admitted to internal, surgical, intensive care unit (ICU), and coronary care unit wards of these hospitals in 2018 (n=300). The data collection was performed in a census manner. The inclusion criterion was patient hospitalization during the illness period. Moreover, the data were collected using a drug safety checklist composed of two parts.

The first part consisted of demographic information and background variables, such as age, gender, education level, underlying diseases, type of admission, weight, disease diagnosis, number of prescriptions, type of prescribed medications, and antibiotic prescription. The second part involved 53 items in four areas of prescribing, taking, storing, and managing medication.

The main part consisted of 51 yes-no questions, addressing the medicinal safety, in addition to extra 2 quality questions. The questionnaire contained 8 items which were reversely scored (items No. 23,24, 31,34,35,37,46, and 47), meaning that a negative score was given to a 'yes' answer. Therefore, in this instrument, the highest score would be 51 (i.e., 43 yes answers and 8 no answers).

The prescription errors considered in the study were as follows: 1) diagnosis, 2) Adaptation of diagnosis to patient profile, 3) Number of prescribed items on the first visit (polypharmacy rate) (20), 4) Correct spelling of the written medicine, 5) Abbreviated and not abbreviated prescribed medicines, 6) Clear and readable instructions, 7) Total number of prescribed medicines (20), 8) Total number of prescribed medicines (20), 9) Total number of prescribed medicines (20), 10) Number of prescribed antibiotic items (20) , 11) Injectable medicines (excluding serum) (20), 12) Number of generic medicines prescribed (9,20), 13) Reconciliation of prescribed drugs with diagnosis, 14) Accuracy dose of medicine (20), 15) Calculation of the prescribed amount based on weight, 16) Power of prescribed medicines (20), 17) Accuracy of drug concentration calculation, 18) Accuracy way of prescribing medicine, 19) Accuracy of prescription, 20) Accuracy of repeated times a day (20), 21) List of prescribed medication categories, 22) List of medicines with the same packaging (9), 23) List of medicines with similar phonetics (9), 24) Prescribed medicines with similar functions, 25) Drug interactions (20), 26) Accuracy of prescription during pregnancy, 27) Accuracy of prescription during lactation, 28) Accuracy of prescription in the elderly, 29) Accuracy of prescription in renal failure, 30) Accuracy of prescription in liver failure, 31) Side effects (20), 32) Medication treatment duration. In addition, the usage errors investigated in this research included: 1) Adherence to a cardiac prescription (incorrectly placing a physician's prescription in a cardiac arrest), 2) Simultaneous consumption of oral medications, 3) Forgotten medication, 4) Phonetic similarities between medication names, 5) Accuracy of electrolyte level calculation (9), 6) Accuracy of microdroplet adjusting, 7) Accuracy of pharmaceutical labeling (9), 8) Accuracy use date of prescribed medicine.

Additionally, the drug management errors consisted of: 1) Medication arrangement and maintenance, 2) No shortage of medicines (main medicine), 3) Status of the patient's medication, 4) Refrigerator status, 5) Lack of similar packaging for different medicines, 6) Alphabetical ordering (9) (by company or by category), 7) Medicine storage temperature, 8) Medicine storage humidity, 9) Hospital reporting and monitoring system, 10) Formation of pharmaceutical committees (9), 11) Responsibility for patient safety (9), 12) Electronic writing systems (9), 13) Documentation of physicians and staff training. The answers to the questions were collected through observation and evaluation of the information available in the file. Data analysis was performed using the rational use indicators proposed by the WHO (21,22). In this regard, the optimal values for each of the investigated variables were as follows: 1) percentage of prescriptions for antibiotics: < 30%, 2) percentage of prescriptions for injection: < 10%, 3) percentage of generically prescribed drugs: 100%, 4) percentage of drugs prescribed from the National Essential Medicines List (NEML): 100%, 5) and average number of drugs per prescription: < 4 cases. Furthermore, the rational drug intake was assessed using the criteria called the index of rational drug prescribing (IRDP), which were developed and used in the initial studies. Five indicators were used to calculate IRDP with the optimal level of 1 for each indicator. In this regard, the values close to 1 indicated more rational use. Regarding this value, the rational use of antibiotic index was calculated by dividing the optimal level (30%) by the percentage of the antibiotic prescriptions. Moreover, the safety injection index was calculated by dividing the optimal level (10%) by the percentage of the prescriptions comprising the injectable drug. The generic name and indexes of the essential medicines were measured through the calculation of the percentage of the drugs prescribed with their generic names and the percentage of the medications prescribed from NEML. The percentage of prescriptions with less than four drugs was also used to calculate the polypharmacy index.

Data analysis

The data were analyzed in SPSS software (version 22.0). Drug interaction was assessed based on the WHO guidelines and Medscape application. Statistical significance was determined by Chi-Square test, t-test, one-way ANOVA, and linear regression. Moreover, a p-value less than 0.05 was considered statistically significant.

Results

Table 1 demonstrates the demographic and clinical variables of the patients. The mean score of ME incidence was obtained as 43.38±5.25.

Based on the findings, most of the errors were related to the area of drug prescription (19.50±2.94; Figure 1). In this regard, the incorrect spelling of medicines was the most common error in the prescribing stage. The percentage of prescribed antibiotics was 33.34% (optimal: less than 30%), and the average number of drugs per prescription was 4.71 (optimal: less than 4 cases). The index of rational antibiotic prescription was calculated by dividing the optimal level (30%) by the percentage of antibiotic prescriptions as follows: 30%/33.34%=0.9

In addition, the percentage of prescribed generic drugs was obtained as 79.3% (optimal: 100%). The percentage of prescriptions containing less than four drugs was used to calculate the polypharmacy index (12.3).

The results revealed a significant relationship between MEs and ward type, admission type, hepatic enzymes, patient age (< 65 years), antibiotic effect, number of antibiotics used, and patient weight. Medication errors were higher in the illiterate patients, ICU ward, hepatic failure cases, subjects over 65 years old, and overweight patients. The antagonistic effects of antibiotics also resulted in a high rate of ME. The results also indicated a significant relationship between gender and drug interactions (P<0.05). This relationship was observed mostly in females than in males and indicated that patients over 65 years of age had more episodes of drug interactions (P<0.05).

This value was higher in hospitals A and B (P<0.05). In addition, there was a significant correlation between creatinine and liver failure (P<0.05), indicating a higher creatinine level in the cases with liver failure. Moreover, arbitrary interference and total error rate revealed a significant relationship (P<0.001); furthermore, the mean error was higher in cases with drug interference. Based on the results, drug interactions were significantly correlated with prescription, and the rate and effect of antibiotics (Table 2).

Table1: Demographic and clinical variables of patients

Variables		Variables	
Gender		Comorbidity	
Male	152 (50.7)	Yes	63 (21.0)
Female	148 (49.3)	Not	237 (79.0)
Total	300 (100)	Total	300 (100)
Educational level		Drug allergy	
Illiterate	113 (37.7)	Yes	20 (6.7)
Undergraduate	70 (23.3)	Not	280 (93.3)
Graduate	93 (31.0)	Total	300 (100)
Academic	24 (8.0)		
Total	300 (100)		
Hospital name		Pregnancy	
A	157 (52.3)	Yes	5 (1.7)
B	143 (47.7)	No	295 (98.3)
Total	300 (100)	Total	300 (100)
Ward name		Lactation	
Internal	139 (46.3)	Yes	4 (1.3)
Surgery	70 (23.3)	Not	296 (98.7)
Gynecology	8 (2.7)	Total	300 (100)
CCU	52 (17.3)		
ICU	6 (2.0)		
Pediatric	25 (8.3)		
Total	300 (100)		
Admission type		Antibiotic administration	
Emergency	131 (43.7)	Yes	133 (44.3)
Elective	169 (56.3)	Not	167 (55.7)
Total	300 (100)	Total	300 (100)
Diagnosis		Antibiotic effect	
Yes	295 (98.3)	Synergic	46 (15.3)
No	5 (1.7)	Nothing	42 (14.0)
Total	300 (100)	Antagonist	212 (70.7)
		Total	300 (100)
Renal failure		Number of antibiotics used	1.02±0.95
Yes	29 (9.7)		
No	271 (90.3)		
Total	300 (100)		
Creatinine		Number of administrated drugs	4.71±2.93
Yes	81 (27.0)		
No	219 (73.0)		
Total	300 (100)		
Hepatic failure		Creatinine level	0.57±1.13
Yes	12 (4.0)		
No	288 (96.0)		
Total	300 (100)		
Hepatic enzyme		Patient age	52.16±23.12
No	59 (19.7)		
Normal range	240 (80.0)		
Abnormal	1 (0.3)		
Total	300 (100)		
Age>65 years		Patient weight	69.77±22.26
Yes	104 (34.7)		
No	196 (65.3)		
Total	300 (100)		

CCU: coronary care unit; ICU: intensive care unit

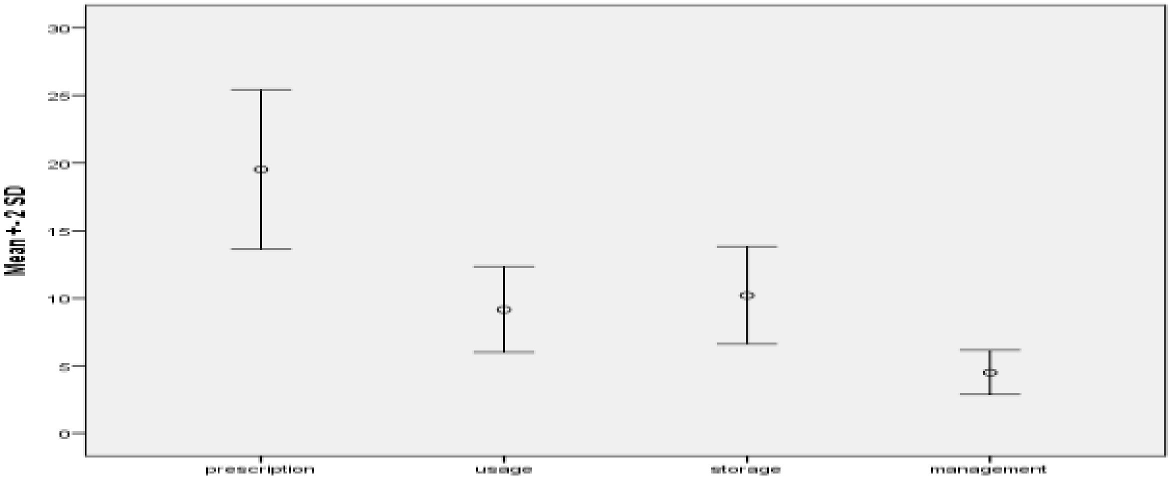

Figure1: Medication error types investigated in the given hospitals.

Table 2: Relationship of demographic and clinical variables with medication errors

Variables		Variables	
Gender Male Female Total	43.53±5.06 43.22±5.44 P=0.607	Comorbidity Yes No Total	43.03±4.66 43.47±5.40 P=0.554
Education level Illiterate Undergraduate Graduate Academic	43.39±4.65 43.70±5.65 42.66±5.67 45.38±4.65 P=0.170	Drug allergy Yes No Total	43.70±4.11 43.35±5.33 P=0.779
Hospital name A B	43.94±4.34 42.77±6.04 P=0.056	Pregnancy Yes No Yes	47.60±2.96 43.30±5.25 P=0.070
Ward name Internal Surgery gynecology CCU ICU Pediatric	43.26±5.59 42.18±6.05 46.37±1.06 42.78±4.05 47.83±0.40 46.56±0.65 P=0.001*	Lactation Yes No	48.25±2.62 43.31±5.25 P=0.062
Admission type Emergency Elective	42.32±4.66 44.21±5.54 P=0.002*	Antibiotic administration Yes No	44±4.82 42.89±5.53 P=0.073
Diagnosis Yes No	43.42±5.28 41±2.32 P=0.308	Antibiotic effect Synergic Nothing Antagonist	39.86±3.09 43.26±3.98 44.11±5.53 P≤0.001*
Renal failure Yes No	45.10±4.77 43.19±5.27 P=0.063	Number of antibiotics used	R=0.149 P=0.010*
Creatinine Yes No Total	42.46±5.21 43.70±5.23 P=0.072	Number of administrated drugs	R=-0.052 P=0.368
Hepatic failure Yes No	41.91±2.87 43.44±5.32 P=0.325	Creatinine level	R=-0.083 P=152
Hepatic enzyme No Normal range Abnormal	38.62±5.60 44.54±4.44 P=<0.001*	Patient age	R=-0.148 P=0.010*
Age>65 Yes No	42.37±5.25 43.92±5.18 P=0.015*	Patient weight	P=-0.160 P=006*

CCU: coronary care unit; ICU: intensive care unit

According to the linear regression test, the determinants of MEs in the investigated hospitals were hospital name, admission type, renal failure, amount of creatinine, hepatic failure, hepatic enzymes, antibiotic effect, and the number of antibiotics used (Table 3).

Table 3: Linear regression analysis of medication errors by selected variables

Variable	Unstandardized beta	Standardized beta	P-value
Hospital name	1.188	0.113	0.029
Admission type	1.217	0.115	0.037
Renal failure	-3.105	-0.176	0.004
Creatinine level	2.147	0.180	0.005
Hepatic failure	3.033	0.121	0.031
Hepatic enzymes	5.261	0.406	0.000
Antibiotic effect	2.121	0.296	0.000
Number of antibiotics used	0.951	0.173	0.004

a. Dependent Variable: total medication error

Discussion

Mean of medication error incidence

In the present study, the mean score of ME incidence was obtained as 43.38±5.25. The error rate may be even higher than our obtained value. However, it is not possible to accurately estimate the exact rate owing to such factors as the fear of punishment and lack of a proper reporting system. The overall reporting of MEs can be encouraged by providing incentives to healthcare practitioners; however, this may not be an acceptable measure in developing countries. Ross et al. emphasized that the impact of the fear of punishment on error reporting would have implications for disciplinary actions. Accordingly, they reported an increase in error reporting after the reduction of the punitive aspects of making errors in the system (23).

In a study, Chalasani et al. reported an ME prevalence of 6.4% in a medical center (24). In India, however, the ME prevalence had a range of 3-33.4%. Such a wide difference in the reported medical error rates may be related to the inequalities of the methods adopted to identify and report errors and variables. Some other factors accounting for this discrepancy could be due to the differences in the definition of ME, type of ME reporting, nature of the hospital under investigation, study duration, type of patients, labor force, workload, and employment rate (25). Medication errors can be highly reduced provided that medicine use is checked at any stage by those responsible in applying them compared to when the medicine is applied by any chance and accidental follow-up.

In another study, Vincer et al. noted a significant increase in ME reporting with the mitigation of punishment in the given system (26). In addition, Maaskant et al. concluded that a structured medication audit, followed by the use of clinical pharmacist feedback as a member of a multidisciplinary team, resulted in a significant reduction in ME incidence in a pediatric ward (27). In the current study, the highest and lowest rates of MEs occurred in the areas related to medication prescription and medication administration in hospitals, respectively. This indicates that most of MEs can be attributed to physicians and non-electronic medication administration records. Regarding this, doctors should be educated on how to increase patient safety by improving medication safety. In a couple of studies carried out by Massoud et al. at Kerman hospitals, Iran, (2005-2015) (28) and Härkänen et al. at the UK hospitals (2018) (29), it was found that MEs may occur at any stage, including medicine preparation, prescription, transcription, dispensation, and administration, with the most common errors taking place during the prescription and administration stages (30). In the current study, it was found that most of the errors occurred at the prescription stage.

Medication errors are the most common types of errors occurring in hospitalized patients (19-24%), especially during the administration phase (31, 32). Some other studies, such as those conducted by Chareonkul et al. in Cambodia (2002) (4), Yousef at the University of Damastus (2017) (18), and Sutherland (2020) (1), indicated that the highest number of MEs occurred during the drug administration phase. Moreover, in tow other studies performed in 2012 at 78 hospitals in Saudi Arabia and Ethiopia in 2016, the highest ME rate was reported in the prescribing phase (9, 33). In addition, Mendes et al. performing a study on 303 patients in Sao Paulo, Brazil (2017), revealed that 6.6% of MEs took place during the drug prescription phase (34).

Most of the studies performed in the Middle Eastern countries have evaluated MEs during the prescription stage. In the mentioned research, the prevalence of error during medication prescription has been reported to range from 7.1% to 90.5% (25). Dabaghzadeh et al. reported the prescription errors in the emergency department as the most common errors. This finding is consistent with those of some previous studies (15). According to the Pareto charts in a study performed by Yousef, the percentage of errors in the prescribing stage was 24.8%, while this percentage was obtained as 42.8% in the administration phase (i.e., 1.7 times greater than the prescribing step). This means that the errors at the prescription stage, especially those made due to prescription illegibility (i.e., 17.6% of them at this stage), are responsible for the subsequent errors occurring in the later treatment stages (18).

Pronovost et al. stated that the use of medication reconciliation was associated with a significant reduction in MEs in the patients transferred from ICU to an academic medical center. The medication reconciliation tool is now an integral part of electronic medication administration record and is used in all discharges (17). At the prescription stage of our study, in which most of MEs occurred, the average number of medicines per prescription was 4.71. However, in a study conducted by Ahmadi and Zarei, this number was 3.14, which is higher than the desired optimum level (≤3). The studies implemented in Iran have reported a range of 2.6-4.11 for this index (21). The findings obtained by Masoud et al., compared with our results and those reported in another study in Kerman, Iran, showed a better value for the average number of medicines per prescription than the national average over the study period (28).

In the current study, the percentage of medicines prescribed by generic name was 79.3%, whereas in the research by Sisay et al., this percentage was reported to reach 90.61% (20). Moreover, lower levels of generic prescriptions were registered in several healthcare settings, such as selected hospitals in Ethiopia (79.2%), military hospitals in Nigeria (49.3%), and secondary intensive care referral hospitals in southern India (42.9%) (20). In a study conducted by Gashaw et al., the prevalence of drugs prescribed with generic name from the list of essential medicines for Ethiopia was 89.02%. In a report performed at a tertiary hospital in Bangladesh, none of the drugs are prescribed under their generic name (33). In a study carried out by Ahmadi and Zarei, 95.1% of the medicines were prescribed under their generic names. This percentage was reported 46.3%, 57.1%, 61.2%, 64.1%, 68%, 71.6%, and 85.6% in Sudan, Eastern Mediterranean, Saudi Arabia, China, Africa, Pakistan, and Tanzania, respectively (21). These results are slightly lower than the ideal WHO standard (100%).

In low-income countries, such as Ethiopia, where resources are often scarce, generic prescription has many advantages, such as availability and relative affordability at commercial quantities (22). This gap may be partly due to such factors as changes in the healthcare system, the knowledge and experiences of prescribers, healthcare policies and regulations (e.g., public replacements), and sociological indicators of countries.

In this study, the percentage of prescriptions for antibiotics was obtained as 33.34%, while in the studies performed by Sisay et al. (20) and Ahmadi and Zarei (21), these percentages were reported as 57.87% and 52.1%, respectively, which are higher than the WHO standard (20-26.8%) (22). In the present study, this figure had a range of 38-45%. In 2011, the proportion of antibiotics used in each prescription was 45% in Kerman, which is consistent with the national average in the same year (28). Based on a report, the trend of antibiotic use in Iran is increasing (35). However, the rational use of antibiotics in many countries, especially in developing countries, has remained a major problem (36). Therefore, education regarding the rational use of medicines leads to a greater understanding of the considerations associated with the use of antibiotics. Moreover, such education will make doctors direct more attention when prescribing antibiotics (37).

Relationship between medication errors and age

In our study, there was a significant relationship between MEs and age, especially in patients aged over 65 years. The findings of a study performed by Dabaghzadeh et al. showed that the mean age was 7 years higher in patients with MEs than in patients without MEs (15). Härkänen et al. indicated that in order to prevent these serious errors in medication use, interventions should focus on dosage prevention, safe use of injectable anticoagulants, and antibacterial drugs, especially in patients aged over 75 years (29). In addition, Bian et al. indicated that age, information, and motivation had a direct effect on the rational use of medicine (38).

Relationship between number of antibiotics prescribed and medication errors. The results of the current study revealed a significant relationship between the number of antibiotics prescribed and MEs. Antibiotics with 19% of non-missing dose MEs were associated (39). Furthermore, the number of MEs was correlated with the number of ordered medications and length of hospital stay. Based on the evidence, interventions by clinical pharmacists reduce direct medication costs by 4.4% (40). According to Palmero et al., most of MEs are "automatic" errors which can be prevented by simplifying the medication process and performing interventions, as well as exercising a high concentration on the part of physicians and nurses (41).

Relationship between medication errors and ward type. The results of the present study were indicative of a significant relationship between MEs and ward type; in this regard, the number of errors was higher in the ICU. The incidence of MEs in this setting is primarily due to the amount of medication that is prescribed and administered by various means, including the intravenous route, which requires the addition of electrolytes and calculation of the rate of drop in the critical stages of care. Mendes et al. stated that in both preparation and prescription stages at the emergency department, most errors happened due to non-hygienic hands and the use of an aseptic technique. This finding indicates the need for developing and implementing patient-centered training programs (34). In another study, Vessal investigated the prescription errors detected by a clinical pharmacist in the nephrology department, highlighting the role of clinical pharmacists in preventing errors (42). Kopp et al. also found that MEs occurred predominantly during drug prescription in an ICU ward (34%) (43). Similarly, Ross reported that the highest rate of ME occurred in neonatal intensive care and medical wards (23).

Drug interactions

One of the most important issues in ME is drug interaction (30), which occurred in 12.3% of cases in our study. In recent years, serious drug interactions have been observed in relation to some common drugs. Therefore, it is required to revise drug interaction screening programs to make sure that these interactions are prevented and that relevant information is provided to health professionals (44). It has been shown that the overall prevalence of drug interaction in the ICU ward is between 44.3% and 87.9% (16).

Furthermore, our results revealed a significant relationship between gender and drug interactions; in this regard, drug interaction was more frequent in females than in males. Moreover, drug interactions occurred more prevalently in people aged over 65 years. Salwe et al. concluded that as several drugs in the elderly are unavoidable, they often suffer from common side effects, causing drug interactions; accordingly, proper administration is crucial to improve drug safety in this high-risk population (45). As stated by Alwhaibi et al., polyps are common in diabetic patients, especially in older patients. Healthcare providers can help identify multiple medications and make recommendations to simplify medication regimens and minimize the medicinal items to improve the outcome of diabetes care (46). As a general rule, healthcare providers should minimize the number of medications prescribed for the elderly, limit the number of frequent medication changes, and keep the dosage schedule as simple as possible. This should be carried out by periodic revisions at specific intervals.

Since drug interactions account for high morbidity and mortality, one of the most important goals in drug therapy is to minimize the incidence of this event. Healthcare providers, responsible for drug safety management, should avoid potential drug interactions that could lead to adverse reactions. Although electronic prescription and drug management systems are used to improve drug safety, the differences in nursing records are still increasing (47). One of the main necessities for reducing and preventing MEs and improving patient safety by pharmacists and clinical pharmacologists is to develop training programs for physicians and nurses in this regard. Several studies have indicated the crucial role of clinical pharmacists in developing training programs and skill assessment (7). One of the limitations of this study was related to the type of study which had a quantitative descriptive design. Since this research type cannot adequately address the underlying causes of this problem, it is required to perform further studies in this domain.

Conclusion

The high frequency of MEs in relation to medication administration highlights the need for reducing these errors in the hospitals under study. One of the most important technological interventions, which decreases the number of MEs, is to enter the doctor's prescription directly into the computer. To prevent prescription errors, hospitals should use a computerized system instead of a manual prescription method and encourage the use of the generic names of drugs. In addition, doctors should be more careful in writing the names of drugs and using them. Moreover, in order to reduce drug interactions, continuous education for prescribing and rationalizing drugs and reviewing prescriptions should be offered by universities and corresponding committees. These measurements can be performed by holding workshops and providing relevant feedback to physicians on the appropriate medicine prescription pattern, medication errors, and drug interactions. All healthcare professionals have a duty to identify the factors that lead to medication errors; therefore, they need to use this information to reduce the incidence of such errors. Although studies on MEs are relatively small in number, there is a wide difference in the reported error rates which may be due to the difference in their definition of MEs, settings, denominators, and applied methods.

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