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Research Article

EMERGENCY DEPARTMENT MEDICATION ERRORS IN A LARGE TEACHING HOSPITAL IN CENTRE OF IRAN

Amir H Zargarzadeh [1], Sarah Mousavi [1]*, Roya Omranian [2]
[1]Department of Clinical Pharmacy and Pharmacy Practice, Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran
[2]Pharm. D. Candidate, Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran
*Corresponding Author Email: s.mousavi@pharm.mui.ac.ir

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ABSTRACT

Aim: This study was conducted with the purpose of determining the frequency of Medication errors (MEs) occurring in an Emergency Department (ED) of a large teaching hospital in Iran. Methods: In this descriptive cross-sectional study, the frequency of MEs was determined through the disguised direct observation method conducted by a trained observer. Demographic data of patients and types of medication error were recorded as follows: Prescription errors, transcribing errors, administration errors and dispensing errors. Results: 32% of patients encountered with at least one ME. The rate of MEs was 0.7 errors per patient and 2.5 errors per ordered medication. In a total of 621 medication orders for 150 patients, 466 MEs occurred in 135 patients at prescribing stage. More than 60% of prescribing orders were incomplete and did not have all six parameters (name, dosage form, dose and measuring unit, administration route, and intervals of administration). The most missed parameters were as follows: dosage form (N=90; 57.3%) and administration route (67; 42.7%). Of total 141 medication administrations (50 patients), 113 medication error occurred which the most common type was documentation error (N=44; 65.7%) followed by wrong-time error (N=30; 44.8%). The most common medication classes associated with MEs were analgesics (30/27; >100%), neurologic class (55/56; 98.2%), and cardiovascular drugs (39/55; 70.9%). Conclusion: The leading causes of MEs in our ED were incomplete medication orders, and inadequate documentation by nurses. Strategies such as an educational intervention, reporting of medication errors, medication reconciliation, and involvement of pharmacists in the ED could the errors.

Key words: Emergency Department, Medication Errors, Frequency

INTRODUCTION

The National Coordinating Council for Medication Error Reporting and Prevention defines a "medication error" as follows: "A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer"[1]. The Institute of Medicine (IOM) has reported that at least 1.5 million Americans are injured by medication errors (MEs) every year, which lead to 44000-98000 annual deaths in the United States [2].

Medication error can occur at any stage of the medication use process, including prescription (29.8-47.8%), transcription (10-51.8%), dispensing (11.3-33.6%) and administration (14.3-70%) [3-7]. Increased length of hospital stays, and error-related costs are the important effects of MEs [2, 5].

The emergency department (ED) experiences a high frequency of MEs, affecting up to 4-14% of patients (as high as 39% in pediatric ED setting) [8-10]. Causes of MEs of ED are multifactorial and include: overcrowding, undifferentiated and unfamiliar patients, 24-hour nature of services, critical and emergent nature of care provided, reliance on verbal orders, dispensing and administering the medications without pharmacist double check, under staffing of personnel and absence of standardized handoff communication. Finally, three-quarters of ED visits are associated with medications being prescribed or administered; this spread, and complexity of medication use further contributes to these high rates of errors in ED [8, 9, 11, 12].

Some published studies exist about the MEs in ED in Iran [13, 14]. Dabaghzadeh, et al., recorded 203 medication errors during 180 hours in the 24 bed ED in a teaching hospital in Tehran, Iran [15]. The incidence of MEs was 50.5% at various levels in the ED. Most recorded errors were made by nurses (44.5%) and occurred in administrating stage (36.6%). In another study by Vazin et al., a total of 1031 medication doses administered to 202 patients were observed over a course of 54, 6-hour shifts. 707 (68.5%) medication errors were recorded in total. The highest errors occurred during the administration phase (37.6%) [16].

Al-Zahra Hospital, affiliated to Isfahan University of Medical Sciences, is an 850-bed teaching hospital in the City of Isfahan, the third largest city in Iran. The ED of this hospital has 60 beds and treats patients at five triage levels. It is the busiest ED in the City of Isfahan. In the second half of 2016, 19922 patients visited the ED of this hospital. Currently, there is no pharmacist or clinical pharmacist at this department. Considering this problem and also overcrowding of the ED, the possibility of ME occurrence seems high. Regarding the importance of MEs consequences in the ED and lack of data about the error types and severity of ED, this study was performed to determine the frequency and types of medication errors and related factors among patients attending the ED of the Al-Zahra teaching hospital.

METHODS

The study was conducted in Al-Zahra Hospital ED from March to September 2017. The study is carried out as per the Declaration of Helsinki guidelines. The research project was approved by the Ethics Committee of Isfahan University of Medical Sciences. The ED has four different divisions, including triage and admission, one surgical unit, one internal medicine and one intensive care unit. Patients staying longer than 6 hours who were administered at least one medication (not including an intravenous solution) were entered into this study. In order to assess the error frequency, the disguised direct observation method was used by a trained observer (a Doctor of Pharmacy Candidate). The ED staff were unaware of the objectives of the study.

According to the classification and definition provided by the National Coordinating Council for Medication Error Reporting and Prevention system [1], MEs categorized as a prescription, transcription, dispensing and administration errors. This council classifies an error according to the severity of the outcome from A to I, which was used in our study too.

For error evaluation of prescribing and transcribing stage, the following data were gathered in pre-designed forms included patient's demographic data (age, sex), chief complaint, admission diagnosis, past medical and drug history, patients' medication ordered at the ED (name, dosage form, dose, frequency and route of administration), patients' laboratory data including kidney and liver function tests and levels of electrolytes. The medication orders were recorded "as ordered" from patients' chart and "as given" from patient's drug Kardex. The data were recorded at the time of admission and the patients' conditions were monitored through the end of the work shift.

The administration errors were administered by disguising observation of admixed drugs, dilution of parenteral medications, storage conditions and administration routs by nurses. Also, the five types of errors during the stage of administration, including, wrong dose, wrong drug, wrong route, wrong time and missed medication was evaluated. Observation shifts included two 6-hour morning and evening shifts from 8 AM to 2 PM and from 2 PM to 8 PM, respectively. Observed shifts were equally divided between the morning shifts and the evening ones.

In prescribing stage, some important factors examined were the selected medications, lack of contraindications, drug-drug interactions, clinical and laboratory data, patient's current condition, allergies, disease and medication history and family history and also considering the issues of the right dosage, dosage frequency, dosage form and route of administration and appropriate monitoring of the medications using credible references. For transcription stage, the congruence of data from nursing charts and physician orders was used.

The discrepancy between a medication order and the medicine sent by the pharmacy to the ED was evaluated to address dispensing error.

Validation of the MEs at each stage was done by the two clinical pharmacists. The definition of each type of medication error was adapted from the American Society of Hospital Pharmacists guideline on preventing medication error in hospitals [17] and as the followings:

Prescribing errors: selecting an improper drug (based on indications, contraindications, known allergies, drug-class duplications and drug-drug interactions), dose, dosage form, quantity, route of administration, concentrations, and rate of administration or instruction for use of a drug product by a physician. Also, if the medication order lacked one of the following parameters, it was considered as not complete and as a prescribing error: Name, dosage form, dose and measuring unit such as mg, administration route, intervals of administration.

Definition of Administration errors was as follows:

1-Wrong dose: Administration of a drug in a dose above or below the prescribed order.
2-Wrong dosage form: Administration of a drug in a pharmaceutical form that is different from the prescribed.
3-Wrong time: Administration of a dose more than 30 minutes before or after the scheduled administration time, unless there is an acceptable reason.
4-Wrong administration technique: Improper technique in the administration of a drug
5-Unauthorized drug: Giving a non-prescribed drug
6-Wrong frequency: When the dosing interval ordered by the physician was not the same as one reached to the patient.
7-Omission error: The prescribed drug was not given to the patient
8-Documentation error: The administration was not recorded
9-Wrong route: A medication is administered to the patient using a different route than was ordered.
10-Wrong monitoring: Failure to monitor the clinical and laboratory data before, during and after a product administration to assess the patient's response to the prescribed medication.
11-Other medication errors: Any other errors not described above.

The rate of MEs was calculated by dividing the number of medication errors by the number of patients and the number of ordered medications.

Data was analyzed using the SPSS software version 23.0 (SPSS; Chicago, Illinois, USA). Percentage and mean ± standard deviation were used to present the categorical and continuous variables, respectively. The data were analyzed by descriptive statistics, chi-square test or fisher's exact test where appropriate. P-value are 2-tailed, and P values <0.05 was considered as statistically significant.

RESULTS

A total of 210 patients were studied over a 7-month period. 150 patients for error evaluation at prescribing and transcribing stage, 50 patients at administration stage and 10 patients at dispensing stage. The demographic data recorded only for 150 patients at prescribing stage and on the other stage, the medications were evaluated.

We observed 150 patients for evaluation of prescribing and transcribing errors. The mean (±SD) age of the patients was 60.4 ± 18 years (range: 16-94 years); of them, 84 (53.5%) were male. Most of the patients aged from 61-80 years (38.8%), 23 patients (14.6%) were older than 80 years. Of the total of 621 ordered medications, the majority, 466 orders were related to 135 patients. These results show that 18.5% of patients encountered with at least one medication error at these stages.

Median of 4 drugs (range: 1-8) was prescribed for each patient. The most common prescribed medications were antimicrobials (N=181; 29.1%) followed by gastrointestinal drugs (N=101; 16.3%), anticoagulants (N=56; 9%), neurologic drugs (N=56; 95), and cardiovascular drugs (N=55; 8.8%). The most common medication classes associated with MEs were analgesics (30/27; >100%), neurologic drugs (55/56; 98.2%), cardiovascular drugs

(39/55; 70.9%), respiratory drugs (21/30; 70%), gastrointestinal drugs (51/114; 44.7%), anticoagulants (25/56; 44.6%), and antimicrobials (58/181; 32%).

The most common type of medication errors at the prescribing stage were incomplete medication orders. The most missed parameters were dosage form (N=90; 57.3%) and administration route (67; 42.7%). Other types of prescribing errors were as follows: improper drug selection (e.g. indication and contraindications) (N=36; 22.9%), drug-drug interaction (N=29; 18.5%), wrong monitoring (N=25; 15.9%) and wrong dose (no adjustment for renal or liver dysfunction) (N=16; 10.2%).

The wrong dose error was detected in 8.3% (15/181) of antibiotics. The MEs in 66% of analgesics (18/27) and 40% of neurologic drugs (22/56) was missing dosage form. The most common drug-drug interaction was observed in cardiovascular drugs (10/55; 18.2%) followed by neurologic class (9/56; 16.1%).

There was no significant difference between the genders and the age of patients in the incidence of MEs (P= 0.09 and P= 0.4, respectively) at prescribing stage. The mean age of patients with and without ME was 60.1 and 64.3 years, respectively, and not significant (P>0.05).

Transcription errors occurred in 3.4% (N=21) of 621 ordered medications. Omission errors (no documentation of ordered medication in the nursing medication sheet, in the stat medications occurred in 7 cases. Other types of transcription error were as follows: wrong frequency (N=6) and wrong route (not documented in the nursing medication sheet) (N=9).

For evaluation of administrating errors, a total of 141 medication administrations (in 50 patients) was observed during the study period. The dosage forms of observed medications were as follow: injections (N=40; 59.7%), spray and inhalers (N=14; 20.9%) and oral dosage form (N=13; 19.4%). Of the total 141 administered medications in 50 patients, 113 MEs were detected, one medication error in 26.9% of patients. The most common medication errors by nurses during administration were documentation error (N=44; 65.7%) followed by wrong-time error (N=30; 44.8%) and omission error (N=18; 26.9%).

The most common dosage form associated with administration errors were oral dosage forms (N=13; 100%) followed by spray (N=13; 92.9%) and injections (N=31; 77.5%). Among the different types of administration error, the most common were: omission error in spray administration (N=8; 57.1%), documentation error and wrong time error in injection administration (N=28; 75.7% and N=20; 55.6%, respectively).

In total, 7 morning shifts (42 hours) and 5 evening shifts (30 hours) were observed during the study. The rate of medication errors was higher in the evening shifts compared to the morning shifts, but not significantly (P= 0.13).

The frequency of medication error at dispensing stage was 7.4% (7 cases with evaluation of 95 dispensed medications). In 3 cases, medication was dispensed less than that requested and in 4 cases; medications were not in the request list of the ED.

In total, 32.4% of patients encountered with at least one ME. The rate of MEs was 0.7 errors per patient and 2.5 errors per ordered medication. All the recorded MEs were judged as insignificant. There were no errors in the study that resulted in permanent harm to the patient or contributed to initial or prolonged hospitalization.

DISCUSSION

Incomplete medication orders and documentation error are major key findings in our study. In an overcrowded setting like ED, these items could easily lead to medication errors which results in harm to patients.

Medication orders were handwritten in our ED and we have not computerized provider-order entry system (CPOE) which shows that this system could eliminate error from handwritten and verbal orders [18]. The ED setting is first-paced and require quick thinking and broad depth of knowledge about many medical conditions. Often, patients are presenting to a hospital ED for the first time, with incomplete medical records. Any of these situations alone can lead to an adverse event. Also, the wide range of medications used in the ED with different doses and routes of administration. Considering all of these factors, the high rate of MEs (up to 60%) in EDs is not surprising. As we reported, 20% of our patients experience at least one medication error in ED.

The incomplete medication orders with bad hand written could complicate this situation. We found that few physicians' orders met all the 6 parameters as explained before. Incomplete orders lead to more medication errors because of assumptions (sometimes wrong), which have to be made by the nursing or pharmacy personnel. For example, if a physician does not clarify the quantity of the medication ordered, this could be interpreted as 1 or 2 or any other quantity, which inherently could lead to error. Fortunately, most of these errors do not result in an immediate patient harm but have the potential to lead to harm. This shows that physicians may not be aware of or obey laws or regulations governing prescribing and re-educating them may be necessary. One study looking at prescribing errors in a pediatric emergency department developed a pediatric medication "quick list" that was added to the CPOE system. The authors found that when the list was used, the error rate dropped from 18.3 errors per 100 orders to 1.9. They also found that errors of wrong formulation, allergy and drug-drug interaction were eliminated [19]. Although we should consider that CPOE system can eliminate handwriting errors, but in a busy Ed where the majority of orders are verbal, even the best CPOE system may be circumvented.

Ebrahimpour et al., [20] evaluated 530 nurses about the occurrence and reporting of medication errors in a teaching hospital. The most prevalent medication errors by nurses was wrong time error (early or late administration of medication) (43.7%). This error along with documentation error was very high in our study too. In the mentioned study, the most significant cause of medication errors was hospital ward patient crowding. Ehsani et al., [21] explored the medication error reporting rate, error types and their causes among 94 nurses of a large ED in Tehran, Iran. 46.8% of nurses had committed medication errors in the past year. 72.7% (N=32) of nurses had not reported medication errors. The most prevalent types of medication errors were related to infusion rates (37.3%) and administering two doses of medication instead one (23.8%). The authors reported that high patient to nurse ratio in the ward, insufficient pharmacological knowledge, fatigue and use of abbreviated names were the most prevalent causes of MEs.

It seems that understaffing, fatigue and poor communication between physicians and nurses resulted in higher rate of administration error in our study. Zeraatchi et al., [22] assessed 500 patients attending to the ED for incidence and types of MEs. 22% of patients experienced at least one medication error. Among 204 recorded medication errors, 60.8% were prescription error, 15.2% transcription type and 24% administration type. The most common administration error was the omission error (ordering drug not given) (16.2%) and unauthorized drugs (6.4% of errors).

Nighttime shift works (P: 0.001), first days of the week (P: 0.7) and fall season (P: 0.2) which is the first semester of educational year of new trainee were the most common times of medication error occurrence.

Weant et al., [23] reported that some strategies included medication-error analysis, CPOE, automated dispensing cabinet, bar-coding systems, medication reconciliation, standardizing medication-use processes, education and emergency-medicine clinical pharmacists could limit and mitigate medication errors in ED. According to the limited availability of resources in our country, it seems that some interventions such as CPOE or bar-coding system are not feasible currently. Medication error reporting is an essential aspect of limiting MEs occurrence. Although, we didn't evaluate this aspect in our study, but local evidence shows that the rate of error-reporting is low and most of the time, nurses reported the errors and other health care staffs especially physicians are not involved or do not take responsibility to report MEs. One of the reasons that encourage us to perform this study was low-rate of error reporting. Our results showed that the rate of MEs was high in our ED; therefore, at first step, we should encourage and educate the personnel to report the errors to recognize the errors and then find the way to minimize them. In Ehsani et al., [21] study, 72.2% of the nurses working in ED never reported medication errors. This underreporting can be quite worrisome for the therapeutic system. Traditional paper-based prescription system is still used in our medication orders. As currently, we couldn't utilize CPOE systems, therefore educational intervention to improve prescribing habits and documentation is necessary in our system. Blank et al., [24] conducted a 3-month educational intervention trial in an ED. The authors found a significant improvement in the knowledge test, pre and post intervention (69% vs. 92%). "Intravenous fluid ordered, but not given" (4.9% vs. 1.4%) and "incomplete documentation "(14% vs. 7.4%) were two MEs that did show a significant change after an educational intervention. Educational intervention about the different pharmacological aspects of drug classes, especially neurologic drugs, analgesics and antibiotics, which are prescribed in our ED is an essential intervention.

Therefore, regarding the types of MEs originate at the prescribing stage in our study; education activities directed at physicians may prove more impactful at overall medication-error reduction.

A prospective, multicenter study conducted at four US EDs to investigate the activities of pharmacists that led to medication error interception. Over a total of 1000 hours of recorded time and 16446 patients seen, pharmacists intercepted 364 MEs. The most common activities that contributed to medication-error interception were "involvement in consultative activities" (51.4%) and "review of medication orders" (34.9%). This study demonstrated that clinical pharmacist in the ED can have a significant impact on medication-error interception. In our center, pharmacists are not involved in the ED [25]. Involvement of pharmacists in the ED at the bedside could have a significant impact on MEs reduction and be a reasonable approach to support safe and effective patient care.

CONCLUSION

In this study at least 40% of patients experienced MEs. The leading causes of MEs were incomplete medication orders, inadequate documentation and poor communication between physicians and nurses. Strategies such as encouraging staff to report MEs, medication reconciliation, education and hiring a clinical pharmacist could limit and mitigate these errors. The ED is a unique clinical environment that is especially at risk of MEs. The ultimate goal should be to make the occurrence of MEs a rare event and the ED a safe environment for the patients.

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