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Original Research

Associated factors and evaluation of interventional medication errors among inpatients in a hospital setting in Vietnam

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Abstract

This study aimed to determine factors associated with medication errors, and evaluate the results of interventions to reduce medication errors in inpatients treatment at Hoan My Minh Hai General Hospital, Vietnam. Methods: A single-blind, before-and-after and interventional study was conducted on 442 medical records of inpatients in the pre-intervention stage and 442 medical records of inpatients in the post-intervention stage at the Department of Pediatrics, Department of General Internal Medicine, Department of Cardiology - Endocrinology, Department of Surgery, Department of Obstetrics of Hoan My Minh Hai General Hospital from July 1, 2021, to March 31, 2022. Data were collected and processed using Excel 2016 and SPSS 26.0 software. Results: The medication errors rate decreased from 7.70% in the pre-intervention stage to 5.70% in the post-intervention stage, the difference was statistically significant ($p<0.001$). Medication errors before intervention occurred most often in the preparation and implementation stage (2.04%), after the intervention, the rate decreased to 1.81%. The replication stage had a high rate of medication errors (2.04%), after the intervention it decreased to 1.81%. The most common medication errors before intervention were wrong doses and wrong drugs (1.58%), after intervention, wrong dose errors rate decreased to 1.36%, the rate of wrong drug errors rate decreased to 1.13%. The total number of diseases ≥2 was significantly related to the occurrence of medication errors ($p<0.05$). Conclusion: Medication errors could occur at different stages of medication use processes. Pharmacist interventions appear to decrease the incidence of medication errors.

Keywords: medication errors (MEs); inpatient; intervention; prescription; transcription

INTRODUCTION

Medication errors (MEs) are preventable, and preventing and reducing MEs has become an important goal in the drug safety policy of each country as well as health care facilities.[1-3] In fact, MEs still frequently occur, affecting the health and life of patients, but monitoring and reporting have not been focused.[4] Individuals affected by MEs can include doctors, pharmacists, nurses or the patients and the patient's famillies. MEs occur at different stages in the medication use process and can cause considerable patient harm, disease recurrence or lead to death, prolong length of hospital stay, and increase healthcare costs.[5,6] In the United States, it was estimated that up to 500,000 MEs occur every day, and the mortality rate from this cause was higher than that in the traffic accidents or breast cancer. Medication errors were responsible for between 5.0% and 41.3% of all hospital admissions and 22.0% of post-discharge relapses worldwide.[7]

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Most MEs are preventable if the hospital has good prevention measures and a tight control system to detect and prevent them. Pharmacists play a particularly important role in overseeing the entire drug distribution chain, from prescribing, selecting drugs to dispensing, storing and monitoring drug use, and contributing to the reduction of errors.[1,8-10] However, most hospitals have not paid enough attention to the problem of medication errors, therefore, many cases of MEs occur and seriously affect the health and life of patients. A culture of fear of reporting, as well as the fear of responsibility, affect the number of reported drug-related errors.[11]

The World Health Organization aims to reduce medication errors by 50% by 2022.[12] Studies on MEs are still limited in Vietnam. There is a growing understanding that MEs are essential, and may be preventable due to pharmacists who play an important role in reducing medication errors.[1] Understanding and implementing interventions on MEs helps hospitals in particular, and the health system, in general, identify the causes of MEs and find ways to overcome and improve high treatment efficiency. Therefore, this study was conducted with the objective of determining factors associated with medication errors, and evaluating the results of interventional medication errors in inpatient treatment at Hoan My Minh Hai General Hospital.

METHODS

Study design

The study design used was a single-blind, pre-comparative intervention study. We conducted an intervention study with

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pre-intervention (from July 2021 to September 2021) and post-intervention (from January 2022 to March 2022) measurement assessments at Hoan My Minh Hai general hospital, Vietnam. We collected all medical records of inpatients at the Department of Pediatrics, Department of General Internal Medicine (Internal Medicine), Department of Cardiology - Endocrinology, Department of Surgery, Department of Obstetrics and Gynecology. We excluded prescriptions by medical records of hospital duration ≤ 2 days, and medical records of patients transferred or died.

This study was performed following the ethical principles for medical research outlined in the Declaration of Helsinki 1964 as modified by subsequent revisions (World Medical Association, 2020). Ethical approval for the study was obtained from the Medical Ethics Council of Can Tho University of Medicine and Pharmacy, Can Tho city, Vietnam (approval number 442/HĐĐĐ-PCT, July 15, 2021).

Data analysis

The following formula was used to calculate the sample size to estimate a population proportion:

Where, n: sample size; Z: the value of the normal distribution (choose 95%, then Z was 1.96); α: the confidence interval; p: we use p=0.09 (there is no similar study on MEs in Vietnam, we conducted a trial on 100 medical records of inpatients and calculated the percentage of medical records with MEs was 9%); d: the error margin (we use d = 0.03).

Substituting the value of z, α, p, and d into the formula, we had n = 349.58. To minimize the error, we collected 442 medical records pre-intervention and 442 medical records post-intervention as samples.

Sampling methods: filtered case reports from July 2021 to September 2021 in pre-intervention stage and from January 2022 to March 2022 in post-intervention stage, of inpatients under 5 years of age, who were treated at Hoan My Minh Hai general hospital in Ca Mau City, Vietnam fulfilled with sampling criteria and eliminated criteria. Case reports were taken by applying k constant interval. Calculate k from the formula k=n/442. Chose a random number x with 1 ≤ x ≤ k. The first case report was x. The next case reports were respectively x + k, x + 2k, x + 3k, etc.

Study method

In the first part, the study collected information about patient characteristics in the sample including gender (male and female), age group (< 60 and ≥ 60), number of diagnosed diseases (< 2 and ≥ 2) and treatment departments (General Internal Medicine Department, Cardiology - Endocrinology Department, Obstetrics Department, Surgery Department, Pediatrics Department), the number of drugs (< 5 and ≥ 5).

The second part aims to identify the MEs. MEs was defined as any deviation in drug use processes from the guidelines, recommendations and protocols of the hospital, the Ministry of Health and the manufacturer's instructions.[13-16] The research team recorded MEs in the follow-up sheet attached to the medical records. The variables to be investigated include: MEs in medical records, MEs by stage (prescribing, transcribing, dispensing, preparation and administration, monitoring) , description of MEs (wrong route, wrong dose, wrong time, wrong drug, lack of drug, excess of drug).

The first part and the second part were similarly applied to post-intervention data collection. Regarding the form of MEs intervention: the MEs intervention form, the research team reported the situation of MEs pre-intervention, provided information leaflets on medication instructions, a list of drugs with the same shape-name, drug administration process at the hospital and presentation at departmental meetings or review hospital-wide medical records in the first month (from October 1, 2021 to October 31, 2021). The research team sent information files via internal email to all departments or sent printed copies to physicians, pharmacists, nurses at the clinic and at the clinical department in the second month (from November 1, 2021 to November 30, 2021). Organize seminars and invite experts to present MEs for medical staff at the hospital in the third month (from December 1, 2021 to December 31, 2021). During the intervention period, medical staff who had questions about MEs would ask directly or call the research team, depending on each problem, the research team would answer immediately or call to answer after finding all complete information required by medical staff. The intervention period was 3 months from October 1, 2021 to December 31, 2021.

Statistical methods

Data were analyzed using Microsoft Excel 2019 and SPSS statistics 26.0 software. Qualitative variables (patient characteristics, MEs types) were expressed in frequency and percentage. We compared the differences in pre and post-intervention of pharmacist by using chi-square tests with 95% confidence. The difference was considered statistically significant when $p < 0.05$. Therefore, to determine the impact of pharmacists' intervention on the occurrence of MEs, we used a multivariate logistic regression model, the variable Enter method.

The dependent variable were MEs in medical records, MEs in medication process (prescription, prescription copies, dispensing, preparation, administration, and monitoring), and MEs description (incorrect route of administration, improper dose, wrong time, wrong drug, extra drug, lack of drug). Independent variables were gender (male, female), age group (<60 years old and ≥ 60 years old), number of diseases (<2, ≥2), department (Internal Medicine Department, other), and total drugs in prescription (<5 drugs, ≥5 drugs). A p-value <0.05 was statistically significant.

RESULTS

Characteristics of the study population

We collected 442 pre-intervention medical records and 442 post-intervention medical records. Patients' age, gender and departments did not significantly differ between pre- and post-intervention ($p > 0.05$). However, there were significant

differences in the total diseases, total number of drugs (p < 0.001). Patient characteristics in pre- and post-intervention prescriptions are presented in Table 1.

Table 1. Patient characteristics in pre- and post-intervention prescriptions

Characteristics		n (%)		p-value
		Pre-Intervention	Post-Intervention	
Gender	Male	(137) 31.00	(145) 32.81	0.817
	Female	(305) 69.00	(297) 67.19	
Age	< 60	(228) 51.58	(240) 54.30	0.593
	≥ 60	(214) 48.42	(202) 45.70	
Total diseases	< 2	(245) 55.43	(260) 58.82	**0.007**
	≥ 2	(197) 44.57	(182) 41.18	
Department	Internal Medicine	(181) 40.95	(146) 33.03	0.803
	Cardiology - Endocrinology	(152) 34.39	(127) 28.73	
	Obstetrics	(74) 16.74	(80) 18.10	
	Surgery	(29) 6.56	(77) 17.43	
	Pediatrics	(6) 1.36	(12) 2.71	
Total drugs	< 5	(266) 60.18	(277) 62.67	**<0.001**
	≥ 5	(176) 39.82	(165) 37.33	

Factors associated with medication errors

According to the multivariate logistic regression model, the group of patients with the total number of diseases ≥ 2 was 3.918 times more likely to have MEs than the group of patients with the total number of diseases < 2. (OR=3.918; 95% CI=0.979-15.677), statistically significant (p < 0.05) is presented in Table 2.

Evaluate the results of interventional medication errors

The results of interventional MEs in inpatient treatment at Hoan My Minh Hai General Hospital showed that the rate of MEs decreased from 7.70% (Pre-Intervention) to 5.70% (post- intervention), the difference was considered statistically significant (p<0.001). The rate of wrong route used decreased from 1.13% (pre-intervention) to 0.90% (Post-intervention), the difference was statistically significant with p<0.05. The rate of wrong medication decreased from 1.58% (Pre-Intervention) to 1.13% (post-intervention), the difference was statistically significant with p<0.05 (Table 3).

DISCUSSION

The difference in patient gender, age and department characteristics in the prescriptions before and after the intervention was not statistically significant (p > 0.05). Females accounted for a higher rate than males, in the majority with 69.00% (pre-intervention) and 67.19% (post-intervention). Patients < 60 years of age accounted for most cases, at 51.58% in pre-intervention and 54.30% at post-intervention. There is an increasing number of young patients who are getting sick and hospitalized for treatment, possibly because of economic development, urbanization, people are more and more active and exposed to dust, chemicals, waste, pollution, environmental pollution, etc. Besides, work and life pressure also affect mental health.[17] Young people with better health awareness and concerns should visit the hospital more often. Another study found that before the age of 60, women were more likely to be hospitalized than men for obstetric-related conditions.[18] In our study, the proportion of patients with <2 diseases in both pre- and post-intervention stages was high. This may be because the characteristics of our study subjects were mostly young patients (<60 years old) so there are not many comorbidities. The number of drugs used <5 drugs accounts for a high rate in both stages. This was explained by patients admitted to the hospital are all at the young age and they do not have any underlying illnesses. For those reasons, they are not prescribed many drugs by physicians.

In our study, the MEs proportion in pre-intervention was 7.70%, this rate in some other studies was quite high,[15,19,20] due to the different objects of study, research design, and location. MEs prevalently occur during the process of drug use.[2,20] Thus, our

Table 2. Results of factors related to MEs before intervention

Characteristics		**MEs n (%)**		**Univariate**			**Multivariate**		
		Yes	**No**	**OR**	**95%CI**	**p**	**OR**	**95%CI**	**p**
Gender	Female	14.96%	85.03%	1	-	0.573	1	-	0.654
	Male	12 (8.76)	91.24%	1.235	0.593-2.573		1.189	0.558-2.532	
Age	<60	17 (7.45)	211 (92.55)	1	-	0.846	1	-	0.847
	≥60	17 (7.94)	197 (92.06)	1.071	0.532-2.155		1.073	0.526-2.187	
Total number of diseases	<2	10 (4.08)	235 (95.92)	1	-	**0.001**	1	-	**0.049**
	≥2	24 (12.18)	173 (87.82)	3.257	1.520-6.993		3.918	0.979-15.677	
Department	Other	17 (6.51)	244 (93.49)	1	-	0.264	1	-	0.244
	Internal medicine	17 (9.39)	164 (90.61)	1.488	0.738-2.994		1.534	0.746-3.154	
Total drugs	<5	13 (4.89)	253 (95.11)	1	-	**0.007**	1	-	0.793
	≥5	21 (11.93)	155 (88.07)	2.638	1.284-5.405		1.193	0.319-4.464	

Table 3. Evaluation of MEs intervention

Characteristics		Pre-Intervention (%)	Post-Intervention (%)	p-value*
MEs	Yes	(34) 7.70	(25) 5.70	**<0.001**
	No	(408) 92.30	(417) 94.30	
Stage	Precribing	(6) 1.36	(2) 0.45	0.973
	Transcribing	(9) 2.04	(8) 1.81	0.153
	Dispensing	(6) 1.36	(5) 1.13	0.944
	Preparation and Administration	(9) 2.04	(8) 1.81	0.169
	Monitoring	(4) 0.90	(2) 0.45	0.982
Description of MEs	Wrong route	(5) 1.13	(4) 0.90	**0.045**
	Wrong dose	(7) 1.58	(6) 1.36	0.891
	Wrong time	(6) 1.36	(5) 1.13	0.934
	Wrong drug	(7) 1.58	(5) 1.13	**0.043**
	Lack of drug	(6) 1.36	(3) 0.68	0.96
	Excess of drug	(3) 0.67	(2) 0.45	0.986

study examined all processes from prescribing to monitoring. This study recorded that MEs appeared in all 5 stages: prescribing, transcribing, dispensing, preparing, administering, and monitoring drugs. Especially, the preparation and administration, which ranked the highest at 2.04%. At this stage, some errors include wrong patient, medication, infusion, dosage, drug form, and errors in drug preparation.

Before the intervention, the MEs stage at the transcription was high (2.04%), this is also the stage in which MEs occur most often.[20-23] At this stage, errors appeared when medical staff do not check carefully the information on prescriptions, leading to missing information, confusing handwritten prescriptions or abbreviations, the same drug names, or the work pressure, the large number of patients makes it easy for medical staff to confuse.

The MEs in our study included wrong route of administration, wrong dose, wrong time of taking the drug, wrong drug, lack of drug and excess of drug. In which, wrong dose is the most common MEs (1.58%). This can be explained that the inexperience of the physician or lack of training in a specific area can lead to serious harm being suffered by patients, especially pediatric patients, the elderly, patients with liver or renal failure, lack of patient information such as weight, renal function in order to adjust the dose. Most pharmacists could detect errors in dosage because they can check the prescriptions from the physicians, beside that, the pharmacists also have an acquaintance of the drug dosage, to ensure the medicines and doses are correct.[24] Some of the reasons for the low reporting rate of MEs were recognized to be many reasons, including fear of responsibility, a culture of secrecy, fear of affecting their work and relationships with colleagues; errors are missed over time, medical staff self-assess errors as harmless, as a result, they do not report them.[21,25] Research by Massah L. in 2021 showed that solutions such as rewarding, training knowledge, encouraging and motivating medical staff help increase the reporting rate of MEs at hospitals.[4,26,27] The detection and reporting of MEs play an important role in drug administration, and MEs are reported by any healthcare professional and should be reported as soon as they are detected.[21]

Wrong-time medication administration errors in our study were 1.36%. Errors in medication timing are a high risk to patients' health, according to statistics of the National Patient Safety Authority (NPSA), wrong time of medication is one of the most common MEs in the world and causes damage to the health and lives of patients.[10] Wrong administration time is taking the medicine at the wrong time of the drug, usually in the groups of drugs that need to be taken before breakfast, the cause may be due to the delay in drug distribution, the medical staff do not lead patients to some clear instructions on the time of taking the drug, especially drugs that must be used at specific times of the day to maximize their effects, medical staff lack information about the time to take drugs, they have too much work to remember to instruct the patient, the patient uses too many drugs at the same time, so it is easy to confuse the time of taking the medicine, the patient's daily habits (taking the medicine after meals), the patient is not at the bed at the time of taking the medicine, the patient is sleeping.[10]

Factors associated with medication errors

According to univariate analysis, factors such as the total number of diseases and the number of drugs are related to the occurrence of MEs pre-intervention (p<0.05). The results of multivariate analysis of factors related to the occurrence of MEs showed that: the total number of diseases ≥2 were 3.918 times more likely (OR=3.918; 95% CI=0.979-15.677), statistically significant (p < 0.05). Studies in the world showed that the total number of diseases is a factor related to the occurrence of MEs.[7,28] This could explain our results: in patients with a higher number of diseases whereby more drugs were prescribed or longer hospital duration, leading to an increased risk of medication errors.

Evaluate the results of interventional medication errors

Detecting and reporting medication errors is very important, helping to improve drug safety, find the cause, and provide interventions to prevent errors.[21] Pharmacists played an important role in clinical operations at the hospital and prevent MEs, clinical pharmacists monitored all medication use processes to detect errors.[29,30] We compared the rate of MEs in pre- and post-intervention, and the results showed that the difference in the rate of MEs between two phases was statistically significant (p<0.001). Our research results were similar to other studies in the world.[27,31,32] This can prove the effectiveness of the pharmacist's interventions that have contributed to improving the quality of the stages in the drug use process, helping to reduce the rate of MEs, positively impacting the patient's health and reduce treatment costs.[33,34]

The proportion of MEs between the two phases was compared, the rate of wrong route used decreased from 1.13% to 0.90% and the difference was statistically significant (p<0,05). This result was similar to the study.[1,35] This shows that the pharmacists'

intervention helped medical staff be more cautious in selection, comparison and dispensing by providing updated information; physicians also restricted the use of abbreviations and clearly interpreted orders in medical records.

For the stages in the drug use process, we recorded that the rate of MEs decreased after the intervention. The stages of drug use are carried out continuously and according to the procedure at the hospital, at each stage will be handled by different physicians, pharmacists, and nurses, this helped the prescriptions to be controlled. more objective investigation and comparison. In addition, each suitable solution for each period also contributes to reducing the rate of MEs. For example, the medical staff in charge of the prescribing phase will be sent to attend intensive training courses, participate in continuing training courses, seminars, and be provided with relevant documents on treatment for prescribing. accuracy and minimize errors. At the drug distribution stage, solutions are given to ensure that the drug name, drug label, and packaging form are clear and correct; provide a list of drugs that look alike or have similar trade names; dispensing to the clinical department drugs with clear names, contents, and labels for all drugs; highlight drug names and strengths, arrange similar-looking drugs in separate places to avoid confusion; use warning labels for healthcare professionals about drugs with special instructions for storage or safety and in the clinical setting, oral medications are stored in a box until dispensed to the patient, etc.[11,36]

The rate of wrong dose decreased from 1.58% to 1.36% after intervention and the difference was not statistically significant. From determining the cause of the wrong dose, we have proposed appropriate interventions, thereby helping to reduce the rate of wrong dose. Solutions to limit wrong dose include organizing seminars and seminars to update knowledge about treatment, drug use for medical staff, regularly providing drug documentation, and how to adjust the above dose. patients, pointing out errors in drug use, etc.

Identifying factors related to MEs helped medical staff find effective strategies to prevent and manage MEs, thereby reducing economic burden and increasing patient confidence in the hospital.[2] Grasping the above situation, the Ministry of Health issued a document for continuous patient safety training, which listed the causes of MEs and guided solutions to reduce MEs. Systematic solutions such as providing fully accurate patient information, and drug information for medical staff; ensuring complete and accurate exchange of information between physicians-pharmacists-nurses; ensuring that the drug name, drug label, and package form are clear and correct; preserving and storing drugs meeting GSP standards: easy to see, easy to get, easy to find, avoid confusion and damage; ensure the selection of drug support devices appropriate to the hospital and professional level; ensure the working environment affects medical staff; regular training and evaluation of medical staff's ability, appropriate work arrangement; advising patients on drug information and treatment adherence; develop quality and risk management processes at the unit. Specific solutions with relevant subjects such as doctors, pharmacists, and nurses. Medication error monitoring and management including closely monitoring potential factors for errors and managing MEs by ensuring support and providing patients with corrective therapies when errors occur, full reporting of errors; hospital leaders, quality management council, dean (department), and relevant individuals at the hospital to review errors and take timely remedial measures; wide information about the causes and solutions of errors that have occurred. Errors are often systemic and should not be handled with disciplinary action, but reporting is encouraged as a precaution.[11]

CONCLUSIONS

At most stages in the drug use process occur medication errors. The total number of diseases ≥2 was significantly related to the occurrence of MEs ($p<0.05$). Pharmacist interventions can reduce medication error rates. From there, implement solutions to improve the detection and reporting of MEs, and at the same time reduce the MEs.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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ETHICS APPROVAL

The study was approved by the Medical Ethics Council of Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam. Participants were informed that taking part in the study was voluntary.

AVAILABILITY OF DATA AND MATERIAL

The data that support the findings of this study are available from the corresponding author, **Vo Quang Loc Duyen** (i.e., upon reasonable request).

AUTHORS' CONTRIBUTIONS

Conceptualization: N.T.L.T., T.T.T.V.; methodology: N.T.L.T., T.T.T.V.; validation: N.T.L.T., T.T.T.V., V.Q.L.D.; investigation: N.T.L.T., T.T.T.V., V.Q.L.D.; resource: N.T.L.T., T.T.T.V., T.V.D., V.Q.L.D., L.T.M.T.; writing-original draft: N.T.L.T., T.T.T.V., V.Q.L.D., T.V.D.; writing-review and editing: N.T.L.T., T.T.T.V., T.V.D., L.T.M.T.; supervision: N.T.L.T., T.V.D., L.T.M.T.

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