The Study of Types and Categories of Inpatient Dispensing Errors in a Government Hospital

Chaivanee Kaosayapandhu, B.Sc.
Department of Pharmacy, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 17000, Thailand.

ABSTRACT

Objective: The purpose of this study was to determine the types and categories of dispensing errors reported by five inpatient pharmacies in a 2200-bed tertiary care teaching hospital from January 2010 to December 2012.
Methods: Dispensing error reports from five inpatient pharmacies in a 2200-bed tertiary care teaching hospital over a three-year period were analyzed. The reported incidents were categorized according to type of errors and categories of errors. The statistical analyzes were performed in frequency and percentage.
Results: A total dispensing error rate was 1.68 reports per 10,000 processed prescriptions from five different inpatient pharmacies for the period examined. Among the total of 535 prescriptions with dispensing errors, the three main types of errors included 315 (55.65%) being the wrong drugs, 110 (19.43%) being the wrong strengths, and 57 (10.07%) being the wrong dosage forms. The remaining types of errors were 31 (5.48%) wrong quantities, 30 (5.30%) missing items, 12 (2.12%) wrong instructions, and 11 (1.94%) wrong patients. The categories of errors, according to severity category A-I, were: 534 (94.3%) for categories A and B; 22 (3.9%) for category C; and 10 (1.8%) for category D.
Conclusion: Accurately reported and analyzed information on dispensing errors within the organization is needed to change the drug dispensing practice. A redesigned pharmacy distribution system is essential for preventing and reducing dispensing errors.

Keywords: Medication errors, dispensing errors, prescriptions, pharmacies, adverse events

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INTRODUCTION

Medication errors are one of the most frequent causes of adverse events in healthcare. According to two large studies conducted in Colorado, Utah and New York, medication errors account for 2.9 and 3.7 percent of hospitalizations, respectively.[1] The UK National Health Service (NHS) reported that 83% of medication errors caused no harm to patient, 12.6% caused low harm to patient, 4% caused moderate harm to patients, and 0.1% caused severe harm to patients or contributed to patient's death.[2] The drug-use process commonly involves errors in prescribing, dispensing, and administration.[3] The NHS also reported that dispensing errors accounted for 18% of the reported incidents.[2] The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) defined a medication error as "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."[4] Also, there is a growing concern about the recurrence and effect of medication errors.[5] Hence, there are an increasing number of studies published on this subject. However, the majority of the research focused on prescribing and administration errors. Little published evidence relating to dispensing errors is available.[6]

Although, dispensing error rates are relatively low; over 100 undiscovered dispensing errors may occur in a functioning hospital pharmacy daily due to the high volume of medications dispensed.[7] Given the high volume of drugs dispensed, albeit a low rate of dispensing errors renders a large number of errors with potential to harm patients.[7] According to NCC MERP, a standardized categorization for medication errors was developed to help institutions track medication errors in a consistent and systematic manner. The classification is as follows:[8]

- Category A: Circumstances or events that have the capacity to cause error;
- Category B: An error occurred but the error did not reach the patient;

Correspondence to: Chaivanee Kaosayapandhu
E-mail:chaivanee@gmail.com
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- Category C: An error occurred that reached the patient, but did not cause patient harm;
- Category D: An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm;
- Category E: An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention;
- Category F: An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization;
- Category G: An error occurred that may have contributed to or resulted in permanent patient harm;
- Category H: An error occurred that required intervention necessary to sustain life; and
- Category I: An error occurred that may have contributed to or resulted in the patient's death.

Like most areas of clinical practice, a variety of errors occur during the process of dispensing prescriptions in hospital pharmacies. A recent review of the literature available indicated that the majority of reported dispensing errors were in the form of selection of the wrong medicine, wrong drug strength, wrong dosage form, wrong quantity, or the provision of incorrect labeling.[6,9,10,11] The main factors causing dispensing errors are high volumes of prescriptions per pharmacist, fatigue, a large number of look-alike sound-alike medications[9,12] and interruptions during dispensing.[9]

Research on medication errors has been conducted internationally, although the majority of the studies are based solely in The United States of America and The United Kingdom.[10] On the other hand, Thailand, a developing country, lacks certain resources that exist in those countries such as The United States of America and The United Kingdom where safe medication systems have been created and evaluated. Therefore, an appropriate dispensing system is an important factor for the prevention or reduction of dispensing error opportunities in a Thai hospital pharmacy. Pharmacy dispensing systems require further process redesigning to achieve the highest possible level of safety and reliability.

In addition, a number of research studies in this area have discussed the frequency and type of dispensing errors. They also make recommendations for reducing dispensing error rates and preventing dispensing errors. Nonetheless, only a small numbers of beds were taken into account. Beso A, et al, (2005) conducted their research in a 450-bed London teaching hospital. Another study by Oswald and Caldwell (2007) took place in a 613-bed acute and tertiary care university hospital. The occurrence for dispensing errors in each hospital pharmacy varies depending on the number of beds, medications distribution system, and organizational culture. Hence, this study will be conducted in a 2200-bed tertiary care teaching hospital where dispensing errors have never been researched before.

This research plan was reviewed and approved by the hospital's board of committee for the human subjects in research in this tertiary care teaching hospital with reference to research ethics code 175/2013 (ECI).

MATERIALS AND METHODS

Setting

The study was performed in an accredited 2200-bed tertiary care teaching hospital, in which over four million drugs are dispensed annually. Two inpatient pharmacies are open 24-hours every day and the other three inpatients pharmacies are open from 08:30 to 16:30 Monday to Friday. Thirty two pharmacists and 52 pharmacist assistants are assigned to inpatient pharmacies on most weekdays. Sample

The sample was a convenience sample. The sample consisted of 535 prescriptions with errors over a three-year period. The sample size was calculated based on a confidence level of 95%, rate/proportion of category A and category B to total dispensing errors of 50%, allowance errors of 4.5%, and relative error of 9% from the data calculated, an acceptable sample size of 475 prescriptions with dispensing errors was obtained, to affirm the data reliability in this research, the sample size included a discrepancy of 10%. Therefore, the reliable sample of 523 or more prescriptions with identified dispensing errors were appropriated for this study.

Study Design

The study was an observational descriptive study. When dispensing errors occurred, pharmacists marked the prescriptions and identified the types of errors by comparing the contents of the prescription with the label on the container. Samples were obtained from five inpatients pharmacies in proportion to the volume of prescriptions each dispensed. The samples of all 535 marked prescriptions of the total prescriptions of 3,192,462 during January 2010 to December 2012 were retrieved. The data from the marked prescriptions were then analyzed and categorized into type and category of errors in the pre-constructed form. Dispensing errors were classified into seven different types including wrong patient, wrong drug, wrong dose, missing items, wrong instructions, wrong quantity, and wrong dosage form. The errors were also classified into categories A-I according to their severity.

Statistical Analysis

Data were tabulated in Microsoft Excel (Excel 2007; Microsoft Corp., Redmond, WA) according to type of errors and category of errors separated by year (2010, 2011, and 2012). The collected data were used to find the percentage average for each type and category of dispensing errors over the three-year period. The average data of prescriptions with errors were used to calculate the reduced rate compared to the base year 2010.

RESULTS

This section is divided into three parts. The first section reports the overall data of the dispensing errors

in the study hospital. The second section deals with data on the type of dispensing errors. The third discusses data directly related to the severity category A-I of the dispensing errors.

Overall Dispensing Errors

During the study period, 535 prescriptions with errors of a total of 3,192,462 prescriptions were analyzed. Each prescription contained an average of four items. A total of 566 wrong medication items were observed, representing the error rate of 1.77 per 40,000 items. According to the number of prescriptions with errors, the dispensing error rate reduced by 22.66% in 2011 when compared to 2010 and reduced by 29.96% in 2012 when compared to 2010. According to the wrong item dispensed, the dispensing error rate reduced by 22.11% in 2011 when compared to 2010 and reduced by 31.49% in 2012 when compared to 2010. The overview of dispensing errors at this study hospital during the three-year period has been summarized in Table 1.

Types of Dispensing Errors

Overall, 535 prescriptions with errors were analyzed in the study; a total of 566 wrong items were detected. Wrong drug was the most common type of errors at 315 (55.65%). Wrong strength and wrong dosage form were the second and third common types of errors with 110 (19.43%) and 57 (10.07%) respectively. The remaining types of dispensing errors were wrong quantity 31 (5.48%), missing item 30 (5.30%), wrong instructions 12 (2.12%), and wrong patient 11 (1.94%). The types of dispensing errors were summarized in Table 2.

Examination of instances of wrong drug dispensed, and examples of wrong drug selection included the followings: aminophylline inj for amikacin inj, cefazolin inj for ceftriaxone inj, cefotaxime inj for ceftazidime inj, hydralazine tab for hydroxyzine tab, sulfadiazine tab for sulfasalazine tab.

The second most common type of dispensing error was wrong strength. Examples of wrong strength included: acetylcysteine granules 200 mg., filled as acetylcysteine granules 100 mg.; alprozolam tab 1 mg., filled as alprozolam tab 0.5 mg.; amlodipine tab 10 mg., filled as amlodipine tab 5 mg.; calcium carbonate cap 350 mg., filled as calcium carbonate tab 1000 mg.; and lorazepam tab 0.5 mg., filled as lorazepam tab 1 mg.

The third most common type of dispensing error was use of the wrong dosage form. Examples of the wrong dosage form were as follows: bisacodyl tab filled as bisacodyl supp; haloperidol tab filled as haloperidol inj; ferrous sulfate drops filled as ferrous sulfate elixir; omeprazole inj filled as omeprazole cap; and sodium valproate syrup filled as sodium valproate inj ,

Other types of errors accounted for 84 (14.84%) of the 535 reported dispensing errors. These errors consisted of wrong quantity, missing item, wrong instruction, and wrong patient.

Categories of Dispensing Errors

From the overall 566 error items dispensed, 534 (94.3%) were in category A and category B, 22 (3.9%) were in category C, and 10 (1.8%) were in category D. The categories of dispensing errors have been illustrated in Table 3.

TABLE 1. Overview of dispensing errors from January 2010 to December 2012.

	Year			Total	Average
	2010	2011	2012		
Prescriptions	1,024,480	1,090,159	1,077,823	3,192,462	1,064,154
Items	4,097,920	4,360,628	4,311,292	12,769,840	4,256,613
Prescriptions with dispensing errors	209	172	154	535	178
Wrong items dispensed	222	184	160	566	189
Dispensing error rate (per 10,000 prescriptions)	2.04	1.58	1.43	-	1.68
Reduction in dispensing error rate of prescriptions % (compare with year 2010)	-	22.66	29.96	-	-
Dispensing error rate (per 40,000 items)	2.16	1.69	1.48	-	1.77
Reduction in dispensing error rate of items % (compare with year 2010)	-	22.11	31.49	-	-

TABLE 2. Types of dispensing errors from January 2010 to December 2012.

Year	Type of dispensing error (%)							
	Wrong drug	Wrong strength	Wrong dosage form	Wrong quantity	Missing item	Wrong administration method	Wrong patient	Total
2010	116 (52.25)	49 (22.07)	24 (10.81)	8 (3.60)	11 (4.95)	11 (4.95)	3 (1.35)	222 (100)
2011	113 (61.41)	37 (20.11)	12 (6.52)	16 (8.70)	5 (2.72)	0 (0.00)	1 (0.54)	184 (100)
2012	86 (53.75)	24 (15.00)	21 (13.13)	7 (4.38)	14 (8.75)	1 (0.63)	7 (4.38)	160 (100)
Total	315 (55.65)	110 (19.43)	57 (10.07)	31 (5.48)	30 (5.30)	12 (2.12)	11 (1.94)	566 (100)

TABLE 3. Categories of dispensing errors from January 2010 to December 2012.

Year	Category of dispensing error (%)			
	Category A and Category B	Category C	Category D	Total
2010	211 (95.0)	6 (2.7)	5 (2.3)	222 (100)
2011	174 (94.6)	8 (4.3)	2 (1.1)	184 (100)
2012	149 (93.1)	8 (5.0)	3 (1.9)	160 (100)
Total	534 (94.3)	22 (3.9)	10 (1.8)	566 (100)

Examples of wrong drug dispensing errors in category A and category B included the followings: enalapril tab 10 mg., for quinapril tab 10 mg.; glibenclamide tab 5 mg., for glipizide tab 5 mg.; hydralazine tab 25 mg., for hydroxyzine tab 25 mg.; potassium chloride inj for 50% magnesium sulfate inj; and tramadol inj for tramadol cap. Examples of wrong drug dispensing errors in category C included the following: cefalexin cap (Keflex®) 500 mg., for levetiracetam tab (Keppra®) 500 mg.; pyridostigmine tab (Mestinon®) 60 mg., for betahistine mesylate tab (Merislon®) 6 mg.; and levofloxacin tab (Lefloxin®) 500 mg., for ciprofloxacin tab (Cifloxin®)500 mg.

Examples of wrong drug dispensing errors in category D included the following: letrozole tab (Femara®) 2.5 mg., for methotrexate tab (Remedica®) 2.5 mg.; epoetin alfa inj (Espogen®) 4,000 IU – prefilled syringe for fligrastim inj (Neupogen®) syringe inj 480 mcg.; and methylprednisolone inj (Solu-Medrol®)1 g., for hydrocortisone inj (Solu-Cortef®) 100 mg.

DISCUSSION

At the study hospital, where over a million prescriptions were dispensed, these error rates translate to about 189 dispensing errors which went undetected. These numbers might seem relatively low, although, they are hardly acceptable considering the hospital as a place to cure patients, not to cause potential harm. Hence, classifying the errors types, categories and learning from the errors would likely yield positive results in reducing dispensing errors.

The main findings were that dispensing errors within the sample of this hospital, usually take the form of wrong drug, wrong strength, and wrong dosage form. These findings are in agreement with the data reported in previous research in that the three most common causes of dispensing errors were incorrect selection of medications, strength, and dosage form.[7,9,10]

Several factors may explain the presence of errors in dispensing processes. Previous studies have shown the common factors to be busy, short-staffed, subject to time-constraints, the physical condition of the individual, work interruption, and the look-alike sound-alike drugs.[6,9,10,12]

A large number of look-alike sound-alike medications were one of the main factors causing wrong drug to be dispensed.[9,10,12] Most of the look-alike sound-alike errors were thought to have originated from using a short code in the drug selection field. For instance, an entry METT might pull up Metformin instead of Methycobal, HYDT might pull up Hydrea instead of Hydergine, NORT might pull up Norvir instead of Norvasc, BROT might pull up Bromocriptine instead of Bromhexine, DILT might pull up Dilantin instead of Dilitazem. The system has so many choices that are very similar; therefore, it is relatively easy for wrong drug selection to occur.

To this researcher's knowledge, among prior research on dispensing errors at this study hospital, this study is the first which reported analysis of dispensing errors classified by their severity using standardized categorization (category A-I) for medication errors developed by NCC MERP. It is very important to investigate and identify the root causes of dispensing errors especially the errors that were in category A and category B as this would prevent the errors before exacerbating their severity into category C when they reach the patients.

Learning from errors would likely result in reducing dispensing errors. Dean (2002) suggested that active learning and reflective practice should be used in the health care profession. Several strategies which have informally been implemented during the study period may prove in future to reduce dispensing error rate. For instance, setting a pharmacist screening for completed prescriptions, using a symbol on labeling for high alert drugs, using hyphen and capital letters to distinguish the common error of drug dispensed from its similar drug name (HY-DRA-LA-ZINE vs Hydroxyzine). Moreover, Beso et al., recommended that the procedure to handle interruption and distraction should also be considered. Automatic drug dispensing machines could reduce the errors.[6,9,12] Technology such as dispensing robots and bar-code scanning might serve as tools to reduce human errors.[7]

There were several limitations to this study. Firstly, the undetected error was the primary concern since it could lead to underreporting of the dispensing errors. This limitation would tend to underestimate the true rate of dispensing errors. Secondly, the study used a convenient sample of five high-volume inpatient pharmacies in a single hospital study. The findings could not be generalized to other hospital pharmacies as some variation in the nature and number of dispensing errors is likely to occur across regions. Thirdly, the study also had a potential limitation if the pharmacists chose not to disclose information which reflected badly on them.

CONCLUSION

The result of the study showed the three most common types of dispensing errors as being wrong drug, wrong strength, and wrong dosage form. Almost all the dispensing errors fell into category A and category B. These errors need to be taken into serious consideration as they can lead to the prevention of the errors before exacerbating their severity into category C. Reflective practice and active learning could be one way to help minimize the errors. Another method is the implementation of automated dispensing machine and application of technology such as bar-code scanning, computerized prescriber order entry, and dispensing robots. Technology

would greatly reduce human errors. By learning from the experience in the organization where accurately reported and analyzed information is needed, this can lead to the change in the drug dispensing practice with lesser dispensing errors.

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