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Research Article

A STUDY OF MEDICATION ERRORS IN GENERAL MEDICINE WARDS OF THE SOUTH INDIAN TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To identify and evaluate medication errors, opportunities like medication documentation errors and possible drug-drug interactions by a clinical pharmacist, in general, medicine wards of the South-Indian tertiary care hospital.

Methods: A study was conducted for a period of 6-month. The data were collected by chart review method from the inpatient records from the day of admission to the day of discharge. If medication error or any opportunity to cause error was observed, it was documented and clinical pharmacist interventions were done. The parameters, such as medication error rate, types of errors, opportunities of errors, and outcome of errors, were evaluated.

Results: A total of 32 medication errors were reported in 497 patients and the medication error rate was 6.4%. Administration errors (28; 87.5%) were found to be higher than prescription errors (4; 12.5%). Omission error was the most common (12; 42.9%) administration error. Factors which increase the risk of medication errors such as medication documentation errors were found in 316 (63.6%) medication orders and 203 (40.8%) had 574 possible drug-drug interactions of which the majority (65.2%) of the interactions were of moderate severity. The outcome of error was found to be error, no harm category for the majority (90.6%) of errors. 32 pharmacist interventions were done and 29 (90.6%) were accepted by health-care professionals.

Conclusion: A medication error reporting is a new and evolving concept in Indian hospitals. This study highlights the role of a clinical pharmacist in detection, evaluation, and prevention of medication errors in an Indian hospital.

Keywords: Medication error, Hospital, Medication error outcome, Clinical pharmacists' intervention, Documentation errors.

INTRODUCTION

As per National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP), 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 drug delivery is a complex process and errors can take place at any step from prescribing to the administration of the drug [2]. In India, 5.2 million injuries have been reported each year due to medication errors and adverse events [3] while in US 7000 deaths have been reported in hospitals per year [4]. The medication error increases morbidity, mortality, cost burden, and ultimately decreases the patient's confidence in the health-care system [5]. Some common factors, which lead to medication errors, are lack of drug information, drug-drug related reactions, lack of patient education, miscommunication of drug order due to poor handwriting, missing information, external factors such as interruption, workload, job-related stress, improper training or education, and sound alike look-alike packaging of medications [6].

Any health-care organization should aim to identify the errors and build a safer system, for which it is necessary to collect information. Analyzing such data will help us to learn about current health-care system practices and by adopting protocols or organizational changes the patient safety can be improved [7].

Clinical pharmacist can play an integral role as a health-care professional in the health-care team. Identification and prevention of medication errors can reduce adverse events in a hospital. Unfortunately, the practice of medication error identification, it's reporting, and development of medication error reporting system does not exist, and the role of a clinical pharmacist for this purpose is obscure in many Indian hospitals.

The primary objectives of the study were to identify, evaluate medication errors; to study the opportunities which can increase the risk of occurrence of medication errors like medication documentation errors and drug-drug interactions. The secondary objectives were to categorize the types of medication errors and to determine its outcome.

METHODS

A prospective interventional study was conducted in general medicine wards of a 2000 bedded South-Indian tertiary care hospital for a period of 6-month from November 2013 to April 2014. 497 randomly selected patients who were willing to participate in the study were included. Patients who were shifted to special wards from general medicine wards were excluded. Ethical clearance was obtained from Institutional Ethics Committee.

Patient demographics, medications prescribed at the time of admission and follow-up, and laboratory data were collected by chart review method using patient profile form from various inpatient medical records from the day of admission until the day of discharge. These collected data were evaluated daily by Clinical pharmacist for different types of medication errors based on American Society of Health-System Pharmacists definitions [8]. The identified medication errors were documented in medication error reporting and documentation form. The medication errors were then informed to concerned health-care professionals, and appropriate interventions were done to prevent it.

Along with medication errors, medication documentation errors and drug-drug interactions which could increase the risk of occurrence of medication errors were also evaluated. Drug-drug interactions and their severity level were checked using Micromedex 2.0.

The outcome of error was assessed using NCC MERP Index for Categorizing Medication Errors [1]. For data analysis, SPSS version 20.0 was used.

RESULTS

Demographic status

Of the 497 patients, 245 (49.3%) were males and 252 (50.7%) were females. A median age was 47 years with a range of 15-86 years. The patient's length of stay in the hospital was between 2 and 31 days with a mean of 6.18±2.99 days. The average number of drugs prescribed per day was between 1 and 14 drugs with a mean of 5.2±2.17 drugs per medication order.

During our study 32, medication errors were identified and medication error rate was found to be 6.4%. 30 medication orders had medication errors in which 28 medication orders had 1 and 2 medication orders had 2 medication errors in each, respectively.

Out of 32 medication errors, physicians and nurses were involved in 4 (12.5%) and 28 (87.5 %) cases, respectively. The median age of 30 patients, who were identified having medication errors, was 52 years with a range of 20-77 years. The length of stay in the hospital of patients having identified with medication error was between 3 and 14 days with a mean of 7.83±2.82 days. The average number of drugs prescribed to patients with medication errors was between 4 and 11 drugs with a mean of 6.33±1.88.

Types of medication errors

Out of 32 medication errors, 4 (12.5%) prescription errors and 28 (87.5%) administration errors were identified. Details of the types of medication error identified are described in Table 1.

Factors which increase the risk of medication error

On the evaluation of 497 patient data, it was found that 316 (63.6%) medication orders had 453 medication documentation errors, and 203 (40.8%) medication orders had 574 possible drug-drug interactions.

In medication documentation errors 437 (96.5%) were prescribing errors, 15 (3.3%) were administration documentation errors and 1 (0.2%) was transcription errors. Details of identified medication documentation errors are described in Table 2.

About 574 possible drug-drug interactions were identified and the mean drug-drug interaction per prescription was found to be 2.81±2.63. Maximum drug-drug interactions were of moderate severity. Fig. 1 represents severity rate of drug-drug interactions identified.

Table 1: Types of medication error

Medication errors (N=32)	
Types of prescription	**Number of errors (n=4) (%)**
Incorrect drug selection	1 (25)
Illegible handwriting	1 (25)
Wrong frequency prescribed	2 (50)
Incorrect dose	-
Incorrect dosage form	-
Incorrect quantity	-
Incorrect route	-
Incorrect concentration	-
Incorrect instructions for use of a drug product ordered	-
Types of administration error	**Number of errors (n=28) (%)**
Omission error	12 (42.9)
Unauthorized drug	4 (14.3)
Improper dose	3 (10.7)
Wrong time	8 (28.6)
Wrong dosage form	1 (3.6)
Wrong route	-

It was observed that antimicrobials and drugs affecting blood and blood formation were the main class of drugs causing major drug-drug interactions. Identified 186 drugs having major drug-drug interactions are listed in Table 3.

Common drugs involved in medication errors

Common drugs involved in 32 medication errors were found to be gastrointestinal drugs (12; 37.5%), antimicrobials (4; 12.5%) and vitamins (3; 9.3%).

Outcome of medication error

Among 32 errors, outcome of 3 (9.4%) errors were categorized as no error and subcategory A. Error outcome category of 29 (90.6%) errors were error, no harm and subcategory C(4) and D(25). None of the errors belonged to error, harm and error, death category.

Table 2: Types of medication documentation error

Medication documentation errors (n=453)	
Types of prescribing errors	**Number of errors (n=437) (%)**
Wrong/unclear drug name	9 (2.1)
Wrong dose	11 (2.5)
Wrong route	1 (0.2)
Wrong dosage form	205 (46.9)
Wrong date	2 (0.5)
Missing dose	32 (7.3)
Missing dosage form	18 (4.1)
Missing route	45 (10.3)
Missing quantity	78 (17.8)
Missing frequency	3 (0.7)
Missing patient name	1 (0.2)
Missing doctors signature	21 (4.8)
Missing date	11 (2.5)
Wrong frequency	-
Wrong quantity	-
Wrong patient details	-
Types of administration documentation errors	**Number of errors (n=15) (%)**
Missing date	1 (6.7)
Wrong drug name	3 (20)
Wrong dose	3 (20)
Wrong frequency	3 (20)
Wrong time	2 (13.3)
Wrong date	1 (6.7)
Missing administration documentation errors	2 (13.3)
Wrong patient details	-
Wrong quantity	-
Wrong route	-
Wrong dosage form	-
Missing dosage form	-
Missing dose	-
Missing quantity	-
Missing route	-
Missing frequency	-
Missing time	-
Missing patient details	-
Missing nurse signature	-
Types of transcription errors	**Number of errors (n=1) (%)**
Wrong frequency	1 (100)
Wrongly transcribed drug name	-
Wrongly transcribed dose	-
Wrongly transcribed dosage form	-
Wrongly transcribed quantity	-
Wrongly transcribed route	-
Missing new orders	-
Not transcribed stop order	-

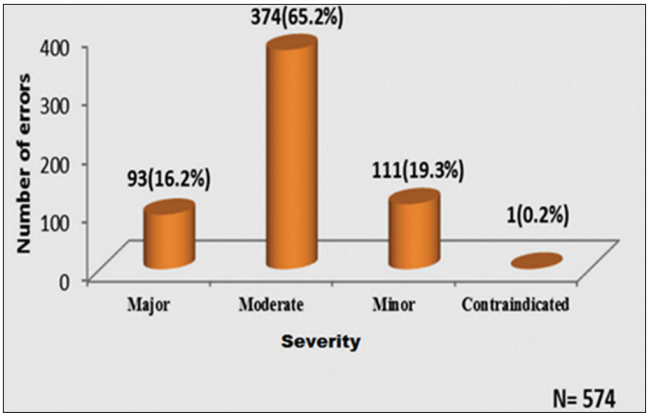

Fig.1: Severity rate of drug-drug interactions

Table 3: Class of drugs involved in major drug-drug interactions

Classification of drugs	Number of drugs (N=186)
Antimicrobials (n=49)	
Antibiotics	29
Antituberculars	9
Antifungal	7
Antiviral	3
Antimalarial	1
Drugs affecting blood and blood formation (n=45)	
Antiplatelets	28
Anticoagulants	9
Hypolipidaemic agents	8
Gastrointestinal (n=31)	
Proton pump inhibitors	15
Antiemetics	16
Drugs acting on CNS (n=29)	
Antidepressants	13
Opioid analgesics	9
Anticonvulsants	5
Antipsychotics	2
Autacoids (n=18)	
Antirheumatoid	14
NSAIDS	4
Cardiovascular (n=8)	
Antihypertensives	8
Hormones and related drugs (n=4)	
Oral hypoglycemic agents	1
Corticosteroids	2
Antithyroid	1
Drugs acting on ANS (n=2)	
Antiadrenergic and Vasodilator	2

CNS: Central nervous system, ANS: Autonomic nervous system, NSAIDS: Nonsteroidal Anti-inflammatory Drugs

Clinical pharmacist interventions

The clinical pharmacist medication error interventions were done for all 32 medication errors among them 29 (90.6%) interventions were accepted by health-care professionals and corrections were made.

DISCUSSION

The medication error is any preventable mistake which occurs during the medication use process. It may cause harm or sometimes remains neglected. Since human life is at stake, this topic is always an important issue in the health-care sector. To build safer system the first step is to detect the errors and perform the root cause analysis.

In this study, the errors which reached the patients were considered as medication errors. Out of 497 patients followed 245 (49.3%) were males and 252 (50.7%) were females which show an equal gender-wise distribution of patients. The majority of patients (227; 45.7%) were between 40 and 59 years which depicts that in general medicine wards mostly patients with chronic diseases are admitted. The length of stay in the hospital was 3-6 days for most (293; 59%) of the patients. The average number of drugs prescribed for maximum patients (276; 55.5%) was 4-6.

The medication error rate was reported to be 6.4% (32 out of 497). In our study, the number of nurses (28; 87.5%) involved in errors was more than physicians (4; 12.5%). The findings of Karna *et al*. [6] and Acharya *et al*. [9] also reported similar results showing the higher involvement of nurses than physicians in the most of the medication errors (61.6% vs. 16.1% and 67% vs. 33%, respectively). It may be due to their busy schedule/workload. The age wise distribution of patients with medication errors was mostly (19; 63.3%) within 40-59 years. This may be due the reason that the maximum number of patients enrolled in the study were within this age range. The study conducted by Solanki and Shah [10] (60; 51%) and Acharya *et al*. [9] (31; 46%) reported a higher incidence of medication errors in the age group of 40-60. The in the hospital of maximum (15; 50%) number of patients with medication errors were 7-10 days which is higher than the length of stay (3-6 days) of the maximum number of patients (293;59%) enrolled in the study. The average number of drugs prescribed per day to the maximum number (16; 53.3%) of patients with medication error was 4-6. This may be because the average number of drugs prescribed for maximum patients enrolled (276; 55.5%) was also 4-6.

The medication errors were classified as prescription and administration errors and more administration errors (28; 87.5%) than prescription errors (4; 12.5%) were reported. Studies conducted by Karna *et al*. [6] and Karthikeyan and Lalitha [11] also reported a higher rate of administration errors, i.e., 46.1% and 28.35%, respectively.

Out of 32 medication errors, 4 were prescription errors which are given below:

Incorrect drug selection

Escitalopram and metoclopramide are contraindicated when prescribed together because of the risk of extrapyramidal reaction.

Illegible handwriting

Methotrexate and Folic acid were administered together because of illegible handwriting.

Wrong frequency prescribed

Injection ceftriaxone 2 g was prescribed 8th hourly instead of once daily in a patient diagnosed with cirrhosis and portal hypertension.

Omeprazole was prescribed 1 tablet in the morning which was wrongly transcribed in doctor's sheet as 1 tablet at night, resulting in an overdose.

Out of 32 medication errors, 28 administration errors were reported. Omission error was found to be common (12; 42.9%). The study conducted by Acharya *et al*. [9] (33%) and Arun Kumar *et al*. [12] (33.02%) also observed omission error having a higher rate than other administration errors. The examples of administration errors identified are explained below.

Omission error

1. Injection Pantoprazole 40 mg 4 am dose missed
2. Tablet clopidogrel 75 mg and atorvastatin 10 mg stat (morning) dose missed
3. Tablet clonidine noon dose was not given
4. Nebulizer budecort dose was missed (3 am)
5. Tablet amlodipine 10 mg, moxonidine 0.3 mg, olmesartan 40 mg, metoprolol 50 mg morning dose missed
6. Capsule loperamide 2 stat dose missed
7. Multivitamin night dose missed
8. Injection ceftriaxone dose missed (5:45 pm)

9. Tablet pantoprazole 40 mg night dose missed
10. Tablet calcium + Vitamin D3 night dose missed
11. Injection piperacillin + tazobactam 4.5 g 3 am dose missed
12. Tablet adrenochrome mono-semicarbazone noon dose was missed.

Improper dose

1. Injection piperacillin + tazobactam instead of 2.25 g 8th hourly, 4.5 g 8th hourly was given
2. Injection furosemide 20 mg was given instead of 40 mg prescribed (7:30 am)
3. Tablet amoxicillin + clavulanic acid 625 mg was administered instead of 1 g.

Wrong time

1. Tablet furosemide 20 mg was given within a gap of 2 hrs instead of 8 hrs
2. Tablet pantoprazole 40 mg was administered 12th hourly instead of 24th hourly
3. Nebulizer ipratropium + levosalbutamol was given within 2 hrs instead of 8th hourly
4. Tablet folic acid 5 mg was administered on the same day with Methotrexate 15 mg
5. Tablet rabeprazole 20 mg was administered within 2 hrs instead of 24th hourly
6. Table rabeprazole + levosulpiride was administered within 8 hrs instead of 24 hrs
7. Table pantoprazole administered at 2 am
8. Tablet folic acid 5 mg was administered on the same day with methotrexate 7.5 mg.

Unauthorized drug

1. Injection nalbuphine 10 mg stat was administered without any instruction documented in doctor's order or reason mentioned in nursing administration chart
2. Tablet pantoprazole 40 mg was administered without being prescribed
3. Tablet pantoprazole + domperidone order was stopped previous day but it was administered again and within 2 hrs injection pantoprazole 40 mg was administered
4. Table paracetamol 650 mg was given without doctor's order.

Wrong dosage form

Instead of injection pantoprazole 40 mg, tablet pantoprazole was administered. Various studies have reported that medication documentation error and drug-drug interaction can cause medication errors. A cross-sectional study conducted by Lisby *et al*. [13] concluded that 50% of the errors in doses and prescriptions in the medication process were caused by missing actions. In our study, we have documented these opportunities which can increase the risk of medication errors.

About 316 (63.6%) patients' medication orders had medication documentation errors. A total of 453 medication documentation errors were identified in which 437 (96.5%) prescribing errors, 15 (3.3%) administration documentation errors and 1 (0.2%) transcription error were found. A retrospective study by Hartel *et al*. [14] reported that documentation errors occurred in 65 of 1934 prescribed agents (3.5%) and 37% prescribing errors, 53% transcription errors and 10% administration documentation errors. Lisby *et al*. [13] observed transcription errors to be 56% (310/558). In our study, wrong dosage form documented (205; 46.9%) was the error with the highest rate. The most of the prescribers made mistakes in writing capsules and tablets.

Among the wrong/unclear drug name documentation error, an example is, instead of palitex (a brand of tramadol+paracetamol), the physician documented palitax (brand of paclitaxel) in a patient diagnosed with anemia. In this study, errors regarding patient's details were none. Missing dosage form, quantity, dose, frequency, route and prescriber's signature were 205 (46.9%), 78 (17.8%), 32 (7.3%), 3 (0.7%), 45 (10.3%) and 21 (4.8%), respectively. A cross-sectional retrospective study conducted by Ansari and Neupane [15] with a sample of 268 prescriptions also reported that no error was found regarding the name, age, sex, and address of the patients. The errors in prescriptions regarding the prescriber's signature were 15.7%. Dosage form, quantity, dose, frequency and route of administration were not mentioned in 12%, 60%, 19%, 10% and 63% of the prescriptions, respectively. Likewise, the strength of the prescribed medicines was not stated in 40% of the cases.

We observed that the errors like wrong documentation of drug name, dose, route and dosage form in medication order sheet were also repeated in administration documentation sheet; it may be due to negligence or lack of knowledge of nursing staff. Apart from prescribing errors repetition, 15 (3.3%) administration documentation errors were found. Errors like wrong drug name, dose and frequency were common. In administration documentation errors, there were 2 (13.3%) missing administration documentation errors. On identifying these errors, confirmation was done that these were not omission errors. Corrections were done by the concerned nursing staff. The two missing administration documentation error are described below.

1. Injection cefoperazone+sulbactam 2 g night dose (7:45 pm) was not documented as given
2. Capsule amoxicillin+clavulanic acid afternoon dose was not documented as given.

In literature transcription errors were common but in our study, we identified only one transcription error which resulted in prescribing and administration of wrong frequency of medication. It was also observed that in all the medication orders some of the abbreviations which have been considered as error-prone abbreviations as per Institute for Safe Medication Practices [16] were used and hence the need for setting a protocol for standard abbreviations to be used in the study hospital setting.

Unmonitored drug-drug interactions can lead to serious adverse drug events. We observed that in 497 prescriptions, 574 possible drug-drug interactions were present of which 374 (65.2%) were of moderate severity. Karthikeyan and Lalitha [11] reported 40.29% of drug interactions out of 67 medication errors and most of the interactions were of the moderate type. In our study, 93 (16.2%) drug-drug interactions were of major category. Antimicrobials were reported to be the class of drugs with the highest number (49/186) of drug-drug interactions of major category.

We observed that gastrointestinal drugs (Proton pump inhibitors) were more involved in medication errors. Proton pump inhibitors do not come under high alert medications [17] and the errors occurred were classified under error, no harm category. This may be the reason why these drugs are often neglected. A study conducted by Abbasinazari *et al*. [5] observed that cardiovascular medications were the class with highest detected errors (31.6%) followed by gastrointestinal agents (15.6%). Studies by Karna *et al*. [6] and Pote *et al.* [18] reported that majority of medication errors were belonging to CNS drug class (19.7%) and antimicrobials (29.4%). A review done by Mansouri *et al*. [19] concluded that anti-infectives were the most frequent drugs involved in the medication errors.

The maximum number of errors (29; 90.6%) belonged to error, no harm category. Studies by Karna *et al*. [6] and Acharya *et al*. [9] also observed that majority of the errors (89.8% and 96%) belonged to error, no harm category.

About 29 (90.6%) clinical pharmacist interventions were accepted by the concerned health-care professionals among 32 medication errors.

The study had its limitations. First, since this study was conducted in general medicine wards of a single hospital, results are not to be extrapolated to other wards of the same hospital or to any other hospital settings. Second, some types of errors might have been neglected since the chart review method was employed as it poorly captures latent

failures. Third, only medication errors which reached the patient when the medication was in control of the health-care professionals were studied.

The overall rate of medication errors was found to be 6.4% in our study. The rate of administration error was higher than prescription errors. The types of prescription errors involved in the study were incorrect drug selection, illegible handwriting, and wrong frequency prescribed. Omission errors were mainly among administration errors. The administration errors identified in this study were the wrong time, unauthorized drug, improper dose, and wrong dosage form administered. In our study, gastrointestinal drugs (proton-pump inhibitors) were mostly involved in errors.

Among medication documentation errors, prescribing errors were found to be higher than administration documentation errors and transcription errors. The maximum drug-drug interactions identified were of moderate severity. Drug-drug interactions in the major severity were caused mainly by antimicrobials. The outcome of medication errors belonged mainly to error no harms subcategory D.

The clinical pharmacist and medication error reporting are a new and evolving concept in Indian hospitals. This study highlights the role of a clinical pharmacist in detection, evaluation and prevention of medication errors in an Indian hospital. There is a need to modify the doctor's order sheet. A protocol should be developed for our hospital for writing medication orders which should include standard error free abbreviations and the use of block letters while writing the drug names and instructions. Few continuing education programs regarding medication errors and its prevention strategies based on practical aspects should be conducted. In our hospital, the majority of the health-care professionals are willing to report medication errors. Therefore, a medication error reporting system could be developed for our hospital with the help of clinical pharmacists which will greatly improve the quality of our health-care service.

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