

STUDY AND EVALUATION OF MEDICATION ERRORS IN A TERTIARY CARE TEACHING HOSPITAL – A BASELINE STUDY

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ABSTRACT

Medication error can increase the cost, prolong hospital stay and increase the risk of death almost two fold. Several studies have already demonstrated that pharmacist can play major role in detection and prevention of medication errors. Present study was aimed to detect and evaluate the incidence, types of medication errors and to assess the severity of medication errors in the medicine wards of Basaveshwar teaching and general hospital, Gulbarga. Prospective study was carried out from September 2010 to March 2011. Inpatients records of patients from six units of medicine department were reviewed during their stay in hospital. Detected medication errors were documented and evaluated. A total of 500 cases of the patients were selected, among them 77.4% were male and 22.6% were females. 38.5% of them were in the age group of 40 to 60 years. 167 medication errors were detected in 127 patients. Maximum medication errors (31) were detected in the month of December 2010. The overall incidence of medication error was found to be 33.4%. A total of 167 medication errors were observed, among them 30.5% were errors in medication ordering and transcription, 23.3% were errors in medication dispensing and 46.1% were nursing errors in medication administration. The causes of medication error were 61.6% were due to nurses, 22.1% were due to Pharmacists and 16.1% errors were due to physicians. Majority of medication errors were belonging to CNS drug class (19.7%). On evaluation of severity, majority of medication errors 89.8% were classified as category Error, No harm, followed by 7.7% were in category No Error and remaining 2.3% were in category Error, Harm. This study concluded that 33.4% medication errors were detected during study period and revealed that pharmacist can play a major role in preventing these errors by early detection.

Keywords: Medication error, Incidence of error, Severity of error, Inpatient medicine ward, Hospital.

INTRODUCTION

The Goal of drug therapy is the achievement of defined therapeutic outcomes that improve a patient's quality of life while minimizing patient risks known and unknown, associated with therapeutic use of drugs and other pharmaceutical agents. The Incidents and hazards that result from such risk have been defined as adverse drug misadventure and it includes adverse drug reaction and medication errors¹.

Although lots of study till now have been carried out to find out the impact of medication errors; but, the issue received maximum attention in the immediate years after the Institute of Medicine report 1999 was published². The published data demonstrates that approximately 5-10% of all hospital admissions are drug related³. A recent report of British Medical Association, says that at least a quarter of a million patients each year from UK are admitted to hospital with an adverse drug reaction (ADR) at a cost of around £466 million a year⁴. In US The Institute of Medicine and other experts reported that thousands of deaths and millions of hospitalizations were occurred due to medication errors. The expected annual benefit from preventing adverse events due to medication errors is equivalent to \$3.9 billion⁵. Medication errors are an unfortunate reality at hospitals approximately, 30% of problems occurring during hospitalization are related to medication errors⁶.

The medication error is defined as: "The failure of a planned action to be completed as intended or use of a wrong plan to achieve an aim"². Also a medication error is defined 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 and consumer"⁷. Such events may be related to the professional practice, healthcare products, procedures, and systems including prescribing, order communication, product labelling, packaging, compounding, dispensing, distribution, administration, education, monitoring and use⁸.

Medication errors increases cost, significantly prolongs hospital stay and increase the risk of death almost 2-fold. Several easily identifiable factors associated with large populations of medication

errors includes inadequate knowledge regarding drug therapy, such as age, impaired renal function and drug allergy, need for calculation of drug dose, specialized drug formulation characteristics and medication prescribing nomenclature⁹. Other most common factors contributed to medication error include lack of drug information, incorrect diagnosis, drug-drug related reactions, dose miscalculations, incorrect drug administration and lack of patient education, miscommunication of drug order resulting from poor handwriting, missing information when the drug is packed into smaller units, external factors such as interruption, work load, job-related stress, improper training or education and sound-alike lookalike packaging of medications¹⁰.

In order to reduce the medication errors, it is necessary to know more on the type of medication errors and the stages at which they take place. The medication ordering system has many components and breach in these processes leads to medication errors, which can cause harm to patients. The medication ordering sequence involves prescribing a medication, transcribing the order, sending the order to pharmacy, dispensing the medication from pharmacy to the floor, administering the medication to the patient, documenting the administered medication and assessing its effect on the patient⁷. Each step involved in this procedure has the potential to cause medication error.

Leape *et al* evaluated the impact of pharmacist participation in medical rounds in intensive care unit on occurrence of medication errors and adverse drug event (ADE) and their impact on patient outcome. They found a 66% reduction in adverse events related to preventable error when the pharmacist participated in daily rounds¹¹.

The detected or identified medication errors need to be documented and studied because doing so will facilitate about error avoidance, advance understanding of the short lapses and interferences that lead to error and help to maintain public confidence in the health care system¹².

A medication error is an episode which occurs due to the use of medication that should be prevented through effective control systems. Pharmacists have a long-standing interest in improving

medication safety and have studied the ways and means to reduce medication errors. All the incidents, which are related to medication error, are due to less awareness about the hospital policies. Because of the hospital pharmacists who are the best in assessing whether or not safe practices were being followed in handling, storage, administration or dispensing of drugs and related products. They must assume the mantle of responsibility for development of the required policies for adoption by the administration and hospital board of trustees¹³.

Now it is an appropriate time to quantify the problem of medication errors and take necessary steps to improve the quality of health care delivery. The nature and types of these errors should be identified, to reduce the incidence of medication errors and improve the health care. ADEs, potential ADEs and medication errors can be collected by extraction from practice data, incident reports from health professionals, and patient surveys. Practice data include charts, laboratory, and prescription data. Investigating the incidence, type, and nature of medication errors are very crucial to prevent them.

The purpose of present study was to identify and evaluate the incidence and types of errors and to assess the severity of medication errors in Medicine Department of tertiary care teaching hospital.

MATERIALS AND METHODS

Study setting: The study was carried out at in-patient Department of medicine at H.E.E.S Basaveshwar teaching and general hospital, Gulbarga which is 1200 bed tertiary care teaching hospital.

Study Design: It was a prospective type of study in which patients receiving medication during treatment were studied.

Study period: It was a prospective type of study initiated from September 2010 to March 2011 (Seven Months)

Study criteria: Patients of Medicine Department were enrolled into the study by considering following criteria:

Inclusion Criteria:

- Case sheets of Patients who admitted to Medicine Departments.
- Patients who were willing to participate in the study.

Exclusion Criteria:

- Patients who refused to take medication.
- Patients who were not willing to participate in the study

Source of data: Hospital and medical records ,Case sheet of the inpatient who were admitted in Medicine department.

Ethical clearance: The study was approved by Mahadevappa Rampure Medical College ethics committee on human subject research and issued ethical clearance certificate.

Informed consent: Informed consent was taken prior to enrollment of patients in for study.

Study Material: The following material was used for the study:

- Patient Profile Form (Includes patient prescription and administration details)
- Medication error reporting and documentation form.(Annexure -I)
- Patients informed consent

Study Procedure:

The medication errors were analyzed through a prospective observational study conducted over a period seven months at Medicine department of Basaveshwar teaching and general hospital in India. Prior approval from Institutional Ethics Committee on Human Subject Research was obtained and documented

The prescriptions were chosen randomly and/or the details were followed till discharge of the patients. The data for present study was collected by chart review method. During the study inpatients case records was reviewed, which includes patients case history, diagnosis, physician medication order sheets, nurse medication administration records, progress chart, laboratory investigations and report of other diagnostic tests. This information was documented in the patient profile form. Whenever Medication error is identified, during the review data from patient profile form is transferred to medication error reporting and documentation form. All medication errors documented were analyze for following parameters such as demographic status of patients, month wise distribution of the errors, professionals involved in the errors, Causes of medication errors, Incidence of medication errors, Types of medication errors and system wise distribution of errors.

Medication errors were also asses for its severity level by using the national coordination council for medication error reporting prevention proposed medication error index.

Each prescription was checked twice- once for medication errors. All the prescriptions were checked for errors using CIMS website (cimsasia.com), and these errors were confirmed by additional standard references (MICROMEDEX version 2, drug today handbook, and Drug digest website. All the data was represented as percentages.

RESULTS

A total of 2535 patients were admitted in the department of medicine during the study period seven months (September 2010-March 2011). Among them a total of 500 patients were selected and were followed for the present study. The cases were analysed based on the following parameters,

Demographic status of the patients

Among 500 cases of the patients followed during the study period 387(77.4%) were male and 113(22.6%) were females. Out of 500 cases medication errors were identified in 127(25.4%) cases was 81(63.7%) males and 46(36.2%) females.

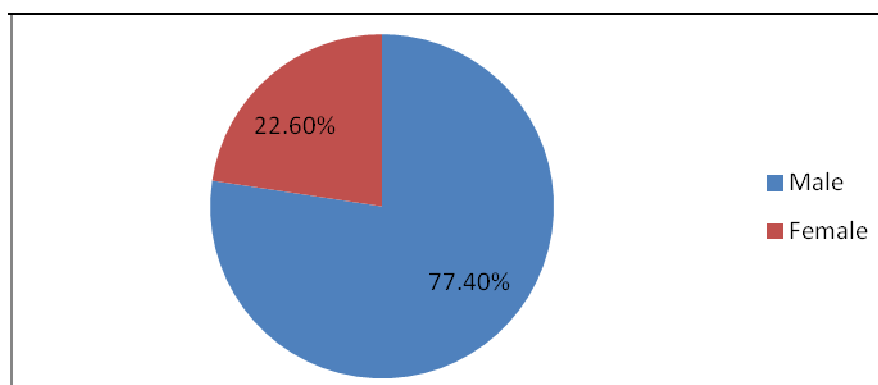


Fig. 1: Demographic status of the patients

Age – wise distribution

Out of 127 cases in which medication errors were identified, 9(7%) patients were below 20 years, 40 (31.4%) were age group between 20-40, 49(38.5%) were between 40-60 and 29(22.8%) patients were above 60 years.

Month – wise distribution of medication errors

Medication errors for the month of September was found to be 23(13.7%), followed by 21 (12.5%) in October , 27(16.1%) in November, 31(18.5%) in December, 19(11.3%) in January, 21(12.5%) in February, 25 (14.9%) in March, details shown in Table 2.

Table 1: Age – wise distribution of medication errors

No. of patients	< 20 yr.	20-40 yr	40-60 yr	> 60 yr
500(Total number of patients followed)	43	179	201	77
127(Patients with medication errors)	9(7%)	40(31.4%)	49(38.5%)	29(22.8%)

Table 2: Month – wise distribution of medication errors

Month – wise distribution	Medication errors
September	23(13.7%)
October	21 (12.5%)
November	27(16.1%)
December	31(18.5%)
January	19(11.3%)
February	21(12.5%)
March	25 (14.9%)

Professionals involved in Medication errors

Out of 167 Medication error, 103 errors (61.6%) were due to nurses, 37(22.1%) were due to pharmacists and 27(16.1%) were due to physicians.

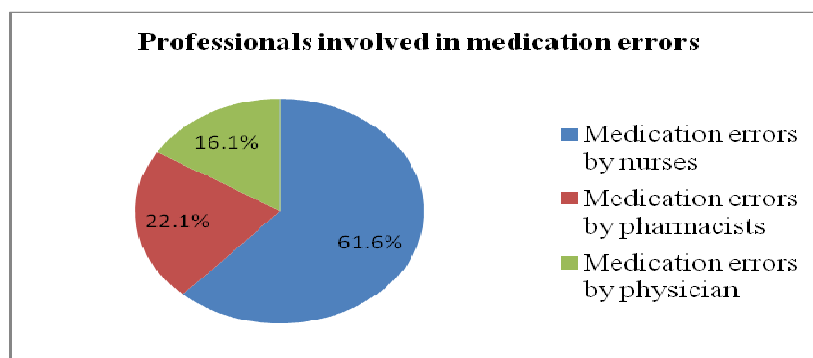
Root causes of medication errors

Root Cause Analysis (RCA) method is used for analysis of data, as it is a way to identify the cause that is most directly responsible for errors. The Joint Commission on Accreditation of Health Care Organizations (JCAHO) now requires all institutions to undertake

RCA (Root Cause Analysis) of all sentinel events. RCAs are multidisciplinary reviews of serious errors, which help to identify underlying causes or factors that may have contributed to the medication errors, details shown in Table 3.

Incidence of Medication errors

Among the 500 patients followed, 167 medication errors were found in 127 patients. Of the 127 patients 26 patients had more than one error during their hospital stay. Overall incidence of medication errors was found to be **33.4%**

**Fig. 2: Professionals involved in medication error****Table 3: Root causes of medication errors**

Medication errors by nurses 103(61.6%)	
Untrained nurses	21(20.3%)
Increased workload on nurse	39(37.8%)
High activity & stress environment, rushing & distraction in work	43(41.7%)
Medication errors by pharmacists 37(22.1%)	
Handwriting	16(43.2%)
High workload	7(18.9%)
Generics drugs	5(13.5%)
Lack of Privacy	9(24.3%)
Medication errors by physician 27(16.1%)	
Unclear order	15(55.5%)
Wrong order	12(44.4%)

Types of medication errors

A total of 167 medication errors were observed, among them 51(30.5%) were Errors in medication ordering and transcription, 39 (23.3%) were Errors in medication dispensing, and 77(46.1%) were Nursing errors in medication administration.

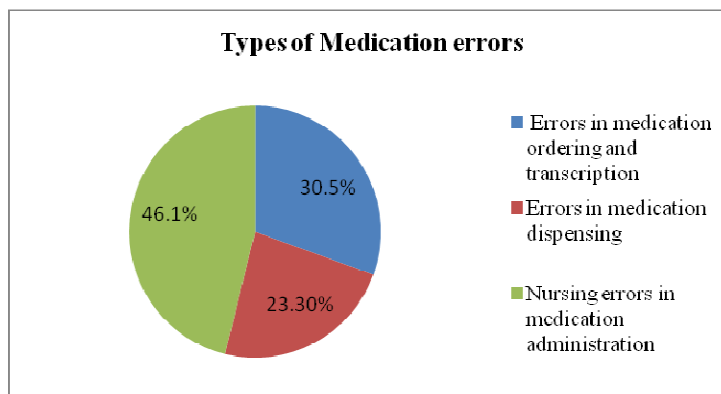


Fig. 3: Types of Medication errors

Table 4 (A): Errors in medication ordering and transcription 51(30.5%)

Type 1a. Physician order writing errors 14(27.4%)	
Order illegible	5(35.7%)
Order written on wrong chart	3(21.4%)
Wrong dose	3(21.4%)
Wrong Frequency	2(14.2%)
Fails to complete order	1(7.1%)
Type 1b. Ward clerk errors	
Fails to send copy of order to pharmacy	5(9.8%)
Type 1c. Nursing errors	
Enters wrong order into MAR	6(11.7%)
Type 1d. Pharmacy errors	
Miscopies written order into computer	24(47%)
Places order into computer without a written order	9(37.5%)
Fails to put order into computer	4(16.6%)
Fails to discontinue medication from computer when ordered	6(25%)
Fails to discontinue medication from computer when ordered	5(20.8%)
Type 1e. 1 errors not otherwise classifiable 2(3.9%)	

Table 4 (B): Errors in medication dispensing 39(23.3%)

Type 2a. Nursing dispensing errors 25 (64.1%)	
Dispenses wrong medication	15(60%)
Dispenses incorrect dose	10(40%)
Type 2b. Pharmacy dispensing errors 14(35.8%)	
Failure to send medication to the ward at appropriate time	6(42.8%)
Dispenses wrong medication	3(21.4%)
Dispenses an incompatible medication	2(14.2%)
Dispenses incorrect dose	3(21.4%)

Table 4 (C): Nursing errors in medication administration 77(46.1%)

Medication not given (Omission error)	34(44.1%)
Wrong medication given	7(9%)
Wrong time	7(9%)
Wrong dose	18(23.3%)
Wrong patient	1(1.2%)
Administered after discontinue order	4(5.1%)
Wrong route	3(3.8%)
Failure to chart medication	3(3.8%)

Medication class involved in medication errors

Majority of the medication errors were due to drugs of Central Nervous system 33 (19.7%) followed by cardiovascular 28(16.7%) ,infectious 25(14.9%), antibiotics 22(13.1%) , gastrointestinal

12(7.1%), respiratory 7(4.1%), endocrine 7(4.1%), NSAIDS 7(4.1%), steroids 6(3.5%), antidiabetic 6(3.5%), musculoskeletal and joint 4(2.3%), diuretics 6(3.5%), and anticoagulants 4(2.9%). Class wise categorization of drugs involved in medication errors is summarized below,

Table 5: Class wise categorization of drugs involved in medication errors

Medication class	Number of medication errors reported
Central Nervous system	33(19.7%)
Cardiovascular	28(16.7%)
Infectious	25(14.9%)
Antibiotics	22(13.1%)
Gastrointestinal	12(7.1%)
Respiratory	7(4.1%)
Endocrine	7(4.1%)
NSAIDS	7(4.1%)
Steroids	6(3.5%)
Antidiabetic	6(3.5%)
Musculoskeletal and joint	4(2.3%)
Diuretics	6(3.5%)
Anticoagulants	4(2.9%)

Severity level assessment of medication errors:

National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Proposed medication error index was used to assess the severity of medication error. It was found that the medication error 150(89.8%) belonged to the category Error, No harm which comes under sub-category B 47(28.1%) and sub-

category C 103(61.6%) followed by 13(7.7%) in the category No Error which comes under the sub- category A and 4(2.3%) belong to category Error, Harm which comes under sub- category E .

The other levels of severity such as Error, Death were not identified during the study period. The levels of severity of reported medication errors are shown in below,

Table 6: levels of severity of reported medication errors

Level of severity	Number of medication errors
No Error	Category A 13(7.7%)
Error, No harm	Category B 47(28.1%)
	Category C 103(61.6%)
	Category D 0
Error, harm	Category E 4(2.3%)
	Category F 0
	Category G 0
	Category H 0
Error, Death	Category I 0

DISCUSSION

Medication errors are the serious problems in health care and can be the source of significant morbidity and mortality in the health care setting¹⁴. In India, irrational use of drugs is common and this has led to antibiotic resistance, adverse drug reactions, medication errors and other drug related problems¹⁵. Drug therapies are important parts of medical care, contributing to medication errors and other drug-related problems. Keeping up with the growing number of prescription medications is a major challenge for the physicians. Numerous studies have found that pharmacists can improve patient safety and outcomes by preventing adverse events and recommending optimal therapies and dosages^{16,17}. Pharmacists need to make themselves more available to physicians, and physicians need to recognize and utilize the expert knowledge of pharmacists. Fortunately with the introduction of clinical pharmacy, pharmacy practice has changed significantly. Pharmacist's attention began to shift from the medication itself to the interaction between the patient and the medication. However, achieving true change has been a challenge, and many hurdles still remain to be overcome. In India many patients and physicians still have not fully understood the concept of the pharmacists as a key member of the healthcare team. Surprisingly this is also the case in developed countries, revealing the fact that this evolution is not happening fast enough. Sad to say, in a recent Medscape article¹⁸ four physicians were asked to discuss how doctors can stay current on drug information, and not one of them suggested turning to a pharmacist for assistance.

A medication error is an episode associated with use of medication that should be preventable through effective control system. The factors that that increases the chance of medication errors are the attributes of complex mechanisms involved in the prescribing, dispensing and administration of drugs. Many authors have reported mechanisms for reducing medication error include reduced reliance

on memory, improved access to drug information, simplification, standardization and training. Substantial evidence suggests that pharmacists in decentralized patient care setting can reduce the frequency of medication errors.

The demographic reports of our study showed high incidence of medication errors in male (77.4%) over Females (22.6%), which were similar results with epidemiological studies conducted by Jerry Philips et al¹⁹ in analysis of mortalities associated with medication errors and the study conducted by the Massachusetts Board of registration in pharmacy²⁰ cited a predominance of males over females.

The study conducted by Massachusetts Board of registration in pharmacy²⁰ showed higher incidence of medication errors in patients ranged between 31-40 years of age but in the study conducted by Leelavati D.Acharya et al¹⁴ in the Study and evaluation of medication errors in tertiary care south Indian teaching hospital showed higher incidence of medication errors in age group of 40-60 years and our study also showed similar results the higher incidence of medication errors in age group between 40-60 years. This can be attributed to the fact that more number of patients (38.5%) visited the hospital during study period was also ranged between 40-60 years of the age groups.

In the initial month the rate of reporting was (13.7%) but the reporting rate was found to be higher in the month of November (16.1%) and December (18.5%). This can be supported with the fact that maximum number of patients admitted in medicine ward during the study period was found to be in the month of November and December.

Of the total 167 medication errors identified in the study, 103 (61.6%) errors were due to nurses, in this (20.3%) were due to untrained nurses, (37.8%) were due to increased workload on nurse and (41.7%) were due to high activity & stress environment,

rushing & distraction in work, however 37(22.1%) errors were due to Pharmacists in this (43.2%) were due to illegible handwriting by physician, (18.9%) were due to high workload, (13.5%) were due to lots of generic drugs, (24.3%) were due to lack of privacy in the pharmacy store and 27 (16.1%) errors were due to physicians, in this (55.5%) were due to unclear order, (44.4%) were due to wrong order which may be due to the fact that most of time post-graduates were involved in writing medication order.

The overall incidence of medication errors was found to be 33.4%. The incidence was higher when compared to other studies, where it ranges from 3 to 17%. Studies carried out by Leelavathi D. Acharya et al¹⁴ on medication errors in tertiary care hospital showed a mean medication error rate was 17% and one other study carried out by Kenneth N. Barker et al²¹ on medication errors in nursing home and small hospitals showed a mean medication error rate of 12.2% and 11% respectively. This may be attributed to the fact of variation the method followed and variables such as hospital set-up, number of beds, duration of study and number of patients followed.

In our study total of 167 medication errors were observed, among them 51(30.5%) were Errors in medication ordering and transcription, 39 (23.3%) were Errors in medication dispensing, and 77(46.1%) were Nursing errors in medication administration, this was similar with the study conducted by Clyde D.Ford et al²² on study of medication errors in community hospital in oncology ward. Nurses were less likely to report medication errors that they felt were innocuous, especially late-arriving medications from the pharmacy.

The studies conducted by the Almut G.Winterstein et al²³. Alison Dale et al²⁴. and S.Nadeem H. Shahet et al²⁵. Showed that prescription errors are the most common among the types of errors. But in our study omission error (44.5%) was the most common among the all types of errors. similar results observed in study carried out by Leelavathi D. Acharya et al¹⁴, Bryony S.Dean et al²⁶ and Kenneth N. Barker et al²¹.

The study revealed that drugs of central Nervous system (19.7%) was the most commonly encountered medication class of errors followed by cardiovascular (16.7%) and infectious (14.9%), a finding consistent with the study carried out by Leelavathi D. Acharya et al¹⁴. and inconsistent with the study carried out by Jerry Philips et al¹⁹ which showed that the largest number of medication errors occurred with the drugs of Central Nervous System, Antineoplastics and Cardiovascular system.

The severity level assessment of medication errors revealed that majority of errors 150(89.8%) belonged to the category Error, No harm which comes under sub-category B 47(28.1%) and sub-category C 103(61.6%) followed by 13(7.7%) in the category No Error which comes under the sub- category A and 4(2.3%) belong to category Error, Harm which comes under sub- category E, this finding consistent with the studies carried out by Leelavathi D. Acharya et al¹⁴ showed that majority of error (96%) included in the sub-category B and Sub-Category C which comes under the category Error, No harm followed by 4% in the sub-category A which comes under category No, error and Rodney W. Diane et al²⁷ on analyzing the recorded medication errors for error category index, which showed that 35% of recorded errors did not reach the patients, 49% of the recorded errors reached the patients.

The present study has some limitations as duration of study and number of patients followed.

CONCLUSION

Study concludes that overall incidence of medication errors was found to be 33.4%, which is quite high even though there were no life threatening events. Clinical Pharmacist can play major role in the early detection and prevention of medication errors and thus can improve the quality of care to the patients. This study clearly shows the need for a clinical pharmacist to work full-time at the Medicine ward and to develop Hospital formulary, drug protocols and prescription policies in the hospital.

Future prospective studies should be planned to detect how the rate of medication errors would change within the medicine ward when all patients are interviewed by the pharmacist at the time of hospital admission, and when guidelines and protocols are implemented. The results may be a better proof to the fact that a ward-based clinical pharmacist can prevent negative consequences related to medications.

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