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Evaluation of Medication Errors and Prevention Strategies in a Selected Tertiary Care Hospital

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ABSTRACT

A medication error is defined as a deviation from the physician's medication order as written on the patient's chart. Evaluation of medication errors and the implementation of prevention strategies are necessary to ensure patient safety and improve healthcare outcomes. Prospective and observational study was conducted on 218 patients, 50 (22.9%) reported medication error with 56% females and 44% males. Most of the patients included in the study were in the age group between 18 to 65 years (72%). The most common co-morbidity in patients was hypertension (27.94%). In the study, the most common category of harm is Category D (35.29%), followed by Category A (19.6%), Category F (17.64%), Category E (9.8%), Category B (7.84%), Category C (5.88%), and the least common category of harm was Category I (3.92%) based on NCC MERP guidelines. The most specific reported error was wrong dose either strength or frequency (25.84%). Prescription error 34(68%) was the most common type of error reported based on CHCF guidelines. Comparing the wards in which errors were made, (42%) occurred in the female ward. Categorizing the severity of the effect of error found, 38% patient needs monitoring, 20% patient were not harmed, 18% patients required more hospitalization time, 10% patient required treatment, 10% of the patients were not affected, and 4% of the patient died. After implementing the prevention strategies, prescription errors were prevented but other errors (Dose omission, Multi-dose) were reduced from 20% to 10%.

Keywords: Medication error, NCC MERP, CHCF, prevention strategies.

INTRODUCTION

A medication error is defined as a deviation from the physician's medication order as written on the patient's chart. According to the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), a medication error can be 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 or consumers. According to the California HealthCare Foundation (CHCF), Medication errors are classified as administration, prescribing, dispensing, compliance, monitoring, potential, and other medication errors. Based on the extent of harm to patients, the NCCMERP classified medication errors as follows: no error; error, no harm; error, harm; error, death.

This event may be related to professional practice, healthcare products, procedures, and systems, including prescribing, order communication, product labelling, packaging and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use. Numerous medication errors go

unrecognized and are not detected or reported. However, some medication errors result in serious patient morbidity or mortality.

The error happens due to a lack of knowledge, poor performance, and physiological lapses. The pharmacist system in order to ensure patient safety. Studies were carried out to identify medication errors and adherence to WHO prescription writing guidelines in a tertiary care hospital to create awareness regarding the irrational use of medications by providing feedback to healthcare professionals.

Drug information service (DIS) is a service that encompasses the activities of specially trained individuals to provide accurate, unbiased, factual information, primarily in response to patient-oriented problems occurring from the healthcare teams. Other factors contributing to MEs could also include inadequate continuity of care, multiple healthcare providers, keeping unnecessary medications, Generic names / Trade names, and understanding the label. The involvement of nurses in the happening of MEs was higher than treating physicians. It seems, more beneficial for pharmacists to attend at the time of the prescription and provide specialized knowledge as it is needed. Pharmacy automation contributes to decreasing dispensing errors, improving workflow and inventory control, and easing pharmacists' distributive responsibilities.

Electronic prescribing is supported by Computerized Physician Order Entry (CPOE) systems which refers to a variety of computer-based systems for ordering medications, which share the common features of automating the medication ordering process. The CPOE systems can range from systems that only provide a list of possible medications that the physician can then choose from, to systems providing varying levels of decision support, including checks of drug-drug interactions, drug-allergy contraindications, or checks of prescriptions concerning the patient's recent laboratory results.

The goal of medication use is to achieve defined therapeutic outcomes with the improvement of quality of life and minimize patient risk. It increases morbidity and mortality of the population along with an increase in the cost of the treatment. Further, it also affects patients' confidence in medical care. Probably, computerizing the medication process system in hospital settings and pharmacological education of prescribers and nurses could help to reduce Medication Errors.

MATERIALS AND METHODS

Study site:

This study was conducted on inpatients of different wards (Special Medicine Ward, General Male Medicine Ward, General Female Medicine Ward, Pediatric Department, and Surgery Ward) of a 320-bedded multispecialty tertiary care CSI Holdsworth Memorial (Mission) Hospital located in Mysuru, Karnataka. This study has been approved by the Institutional Ethical Committee of Farooqia College of Pharmacy, Mysore.

Period of study:

The study period was 6 months from April 2023 to October 2023, which was divided into two phases. The results of the first 5 months were compared with the next 1 month by implementing a prevention strategy (double checking) to analyze the influence of interventions of the clinical pharmacist and the effect of the clinical meeting on the reduction of medication errors.

Research design:

A prospective observational study was conducted by simple random sampling of inpatient case records of the different wards to observe the incidence of medication errors. Thus, the study aimed to promote safety in medication use and ensure quality in the healthcare service by effective utilization of the clinical pharmacist.

Study subjects:

All outpatients, patients in the medical intensive care unit, in-patients without medication therapy, emergency department and inpatients on drug therapy with an admission of <3 days were excluded from the study.

Study procedure:

Case sheets of inpatients in the different departments were randomly selected and other healthcare professionals dealing with the department were included in the study. Ethical committee clearance and formal permission from the institute were obtained before the initiation of the study. A data collection form was designed to conduct the study, which included admission details, previous medication history, drug details, personal history, allergy history, and coexisting conditions. The prognosis and diagnosis of the patient were recorded, along with their treatment plan, progress reports, and additional lab investigations that were pursued in a patient data collection form. clinical pharmacy department created a medication error documentation form after consulting with medical professionals and reference publications. The form's purpose is to record and classify medication errors and do statistical analysis. the information gathered was then assessed to identify problems in medicine administration, prescription, and dispensing. Drug interactions were then noted, and appropriate preventative measures were recommended

Materials used:

Data Sources include Patient Case Sheets which contain Information about the patient's condition and its management, as well as medical case records, nursing notes, and treatment charts, which were gathered from the patient care notes. assessed using books (Tertiary sources) and online sites such as Medscape, and PubMed.

Analysis of the study:

All necessary data was gathered and recorded in a form that was appropriately constructed for data collection and medication errors. The gathered information was put into a Microsoft Excel sheet for convenient data analysis, retrieval, and storage. Preventing prescription errors and developing efficient prevention techniques were the goals of this investigation.

RESULTS

Details of Age and Gender Distribution in Different Types of Medication Error:

A total of 218 cases screened, 50 errors were found, in which 2 (4%) of the participants were Infants, 2 (4%) participants were Children, 2 (4%) participants were Adolescents, 36 (72%) participants were Adults and 8 (16%) participants were Older Adults. Among them 22 (44%) were males, in which 12 Prescription Error, 2 Administration Error and 8 Others (Self Error, Dose Omitted or Delayed), whereas 28 (56%) were females, in which 22 Prescription Error, 4 Administration Error and 2 Others (Self Error, Dose Omitted or Delayed) **(Table 1)**

Age Groups	No of patients	%	Gender					
			Male			Female		
			P	A	O	P	A	O
Infants (1 Month to 1 Years)	2	4	1	0	0	1	0	0

Children (2 Years to 12 Years)	2	4	1	0	1	0	0	0
Adolescents (13 Years to 17 Years)	2	4	1	0	0	1	0	0
Adults (18 Years to 64 Years)	36	72	7	1	6	18	3	1
Older Adults (Above 65 Years)	8	16	2	1	1	2	1	1
Total	50		12	2	8	22	4	2
%			24	4	16	44	8	4
Overall			22(44%)			28(56%)		

Table 1: Details of Age and Gender Distribution in Different Types of Medication Error (n=50)

***Note** – P: prescription errors; A: administration errors; O: Other errors

Comorbidities in Study Patients:

In 50 cases, 19 (27.94%) had Hypertension, 16 (23.52%) participants had No comorbidities, 11 (16.17%) were having Type 2 Diabetes, 4 (5.88%) were having Chronic bronchitis, 3 (4.41%) were having Asthma, 3 (4.41%) were having Hypothyroidism, 3 (4.41%) were having Epilepsy, 3 (4.41%) were having Ischemic Heart Disease, 2 (2.94%) had Acute Kidney Injury,1 (1.47%) had Chronic Obstructive Pulmonary Disease, 1 (1.47%) had Cerebrovascular Disease, 1 (1.40%) had Osteoporosis, 1 (1.47%) had Spondylosis, 1 (1.47%) had Parkinson's disease, 1 (1.47%) had Poly Cystic Ovary Disease. **(Table 2)**

Table 2: Comorbidities in Study Patients (n=70)

Comorbidities	No. of Patients
Hypertensive	19
No Comorbidities	16
Diabetic (type 2)	11
Chronic bronchitis	4
Ischemic Heart Disease	3
Asthma	3
Hypothyroidism	3
Epilepsy	3
Acute Kidney Injury	2
Chronic Obstructive Pulmonary Disease	1
Cerebrovascular Disease	1
Osteoporosis	1
Parkinson's diseases	1

Poly Cystic Ovary Disease	1
Spondylosis	1

Details of Medication Errors by Health Care Professionals and Patients:

In 50 cases, 17 (34%) errors were found in the Male ward, in which 7 by doctors, 1 by the nurse, and 9 by patients, 21 (42%) errors were found in the Female ward, in which 16 by doctors, 3 by nursing staff, 2 by patients, 10 (20%) errors were found in Special ward, 9 by doctors, 1 by the nurse, 2 (4%) errors were found in Pediatric ward, 2 by doctor. There was a notable difference in errors by nurses when compared to patients and doctors in the male ward. The was a notable difference in errors by doctors when compared to nurses and patients in the female ward. **(Table 3)**

Table 3: Details of Medication Errors by Health Care Professionals and Patients (n=50)

Whom					
Wards	**Doctor**	**Nurse**	**Patient**	**Total**	**%**
Male ward	7	2	9	18	36
Female ward	16	3	1	20	40
Special ward	9	1	0	10	20
Pediatric ward	2	0	0	2	4

Details of Medication Error Outcomes (Harm):

The 50 cases were categorized into different degrees of harm, 10 fall into the category "**Patient was not harmed",** 10 fall into the category **Patient required more hospitalization time**, 5 fall into the category **Patient requires treatment**, 2 fall into the category **Patient died**, 5 fall into the category **Patient was not affected**, 19 fall into the category **Patient needs monitoring**. **(Table 4)**

Table 4: Details of Medication Error Outcomes (n=50)

	Patient was not harmed	**Patient required more hospitalization time**	**Patient requires treatment**	**Patient died**	**Patient was not affected**	**Patient needs monitoring**	**Total**
Doctor	9	1	3	1	4	16	34
Nurse	1	1	0	0	1	3	6
Patient	0	7	2	1	0	0	10
Total	10	9	5	2	5	19	50

Detailed Classification by Degree of Error:

According to NCC MERP guidelines, most of the incidents were of Category D (34%), followed by Category A (20%), Category F (18%), Category E (10%), Category B (8%), Category C (6%), and Category I (4%). **(Table 5)**

Table 5: Medication error classification by degree of patient harm according to the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP)

NCC MERP Category	Definition	Classification	n	%
A	Circumstances or events have the capacity to cause error	No error	10	20
B	An error occurred, but error did not reach the patient (near miss)	Error, no harm	4	8
C	An error occurred that reached the patient but did not cause patient harm		3	6
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		17	34
E	An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention	Error, harm	5	10
F	An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization		9	18
G	An error occurred that may have contributed to or resulted in permanent patient harm		0	0
H	An error occurred that required intervention necessary to sustain life		0	0
I	An error occurred that may have contributed to or resulted in the patient's death	Error, death	2	4
	Total		50	100

Distribution based on types of specific events:

Most of the events were Wrong dose strength or frequency 23 (25.84%), followed by Others 16 (17.97%), Wrong medicine 13 (14.6%), Contraindication including known allergies 10 (11.23%), Dose omitted or delayed 6 (6.74%), Monitoring, clinical or laboratory error 6 (6.74%), Wrong dosage form 4 (4.49), Wrong quantity 3 (3.37%), Wrong time of dose administration 3 (3.37%), Wrong rate (too fast/too slow) 1 (1.12%). (**Table 6)**

Table 6: Details of event type in identified medication errors

Event Type	n	%
Wrong patient	0	0
Wrong dose, strength or frequency	23	25.84
Wrong rate (too fast/too slow)	1	1.12
Wrong route of administration	0	0

Wrong method of administration	0	0
Poor quality or counterfeit medicine	0	0
Wrong medicine	13	14.6
Wrong quantity	3	3.37
Wrong dosage form	4	4.49
Monitoring error clinical or laboratory	6	6.74
Wrong preparation method	0	0
Wrong time of dose administration	3	3.37
Contraindication including known allergy	10	11.23
Wrong duration	4	4.49
Wrong formulation	0	0
Expired medicine	0	0
Dose omitted or delayed	6	6.74
Other (please specify)	16	17.97
Total	89	100

Implementing Double-Check Process:

After implementing the double-check method, 20 cases were screened in which we found that the Prescription errors were fully reduced from 68% to 0%, Administration errors were reduced from 12% to 0% and the other errors (Dose omission, multi-dose) were reduced from 20% to 10%. **(Table 7)**

Table 7: Details of Errors Before and After Implementing the Double-check Method

	Prescribing		Administration		Others	
	Before	**After**	**Before**	**After**	**Before**	**After**
Total	34	0	6	0	10	2
%	68%	0%	12%	0%	20%	10%

PREVENTION STRATEGIES FOR MEDICATION ERRORS BASED ON STUDY RESULTS:

To mitigate the risk of medication errors and promote patient safety, the following prevention strategies were carried out. This can also be considered by other organizations or healthcare professionals.

Medication Reconciliation:

Medication reconciliation process was done during each transition of care, such as admission, transfer, and discharge to ensure that patients receive the correct medications and their doses to prevent medication errors.

Standardized Medication Orders:

Monitored if standard medication orders and protocols within healthcare facilities were used to reduce variability in prescription practices, which helped minimize the number of errors related to incorrect doses, frequencies, and routes of administration.

Double-Check Procedure:

Double-check/check-recheck procedure was used which involves two healthcare professionals to independently verify and document medication orders and administration methods before administrating them to the patient. This was done to ensure accuracy, and quality, and reduce risk which increases

efficacy.

Continuous Improvement:

Continuously assessed medication safety practices through audits, peer reviews, and feedback.

Patient Engagement:

Encouraged patients and their caretakers to ask questions about medications, keep a medication checklist, and inform healthcare providers in case of any allergies, social history, or previous adverse reactions.

Regular Medication Reviews:

Medication charts of patients were reviewed regularly, especially those with comorbidities or with multiple medications, to reduce the risk of drug interactions.

Peer Review:

A peer review system was followed to assess medication errors and adverse events to promote shared learning and process improvement.

Feedback:

Feedback was obtained after counselling the patient to implement strategies that can reduce the risk of medication error.

Auditing:

Auditing was done to see whether the right treatment was given to reduce/treat the disease.

These prevention strategies were followed to create a safer environment for medication management, reduce the occurrence of errors, and ultimately enhance patient safety outcomes.

DISCUSSION

A prospective observational study was conducted for the evaluation of medication errors and prevention strategies in a selected tertiary care hospital with the results providing valuable insights into the gender distribution, age distribution, comorbidities, medication errors, correlations, and their associated factors among a group of 218 participants within the population over a period of six months, out of which 50 patients showed medication errors. These findings have significant implications for healthcare professionals and policymakers in improving patient care and safety.

The overall percentage of medication error observed in our study is 22.93%, female (56%) preponderance was noted and male was 44 % which is in contrast to the study done by Satish Kumar BP et al.

Errors were more prominent among adults (72 %), followed by older adults (16 %) and children (12 %) which differs from the study conducted by Marimuthu Karthikeyan et.al where the error pattern was increased in older adults followed by adults and then children. Also, patients who were admitted had one or multiple co-morbidities. The average percentage of hypertension in cases having mediation error was 27.94% and diabetes was 16.19%. These findings emphasize the need for healthcare providers to consider comorbid conditions while prescribing medications, as they can impact treatment outcomes.

The most common type of error reported for both genders was Prescription Error 36 (72%), which is significantly more than that in the study done by Marimuthu Karthikeyan et al. Understanding the gender distribution of medication errors can guide in improving medication safety, and training for healthcare professionals.

Errors occurred due to health care professionals and patients, in which the majority of the Errors were by doctors 34 (68%), followed by patients 11 (22%) and nurses 5 (10%).

This study found out that 16 (32%) Patient need monitoring, 9 (18%) Patient was not harmed, 4 (8%)

Patient was not affected, 3 (6%) Patient required treatment, 1 (2%) Patient required more hospitalization time, and 1 (2%) Patient died were the outcomes of errors by doctor.
Patient required more hospitalization time 7 (14%), Patient required treatment 2 (4%) and Patient died 1 (2%) were the outcomes of errors by the patient.
Patient need monitoring 3 (6%), Patient was not affected 1 (2%), and Patient was not harmed 1 (2%) were the outcomes of errors by nurse.
The most and the least reported events were wrong dose, strength or frequency (25.84%), and wrong route (1.12%) respectively. Based on NCC MERP index out of 50, the most common category of harm is Category D (35.29%), followed by Category A (19.6%), Category F (17.64%), Category E (9.8%), Category B (7.84%), Category C (5.88%), and the least common category of harm is Category I (3.92%), contrasting the study done by Mohammed Aseeri et al. where the most common category was Category B.
According to WHO, 100% of the medications should be prescribed in generics, in our study around 12% of prescriptions were written in generic names.
Trending in medication error were rechecked after the implementation of prevention strategies for one month, and then prescription errors were fully prevented that is from 72% to 0%, when we compare our study to the study conducted by Marimuthu Karthikeyan et al. in their study they found out that after implementation of strategies the prescribing errors were reduced to 19.51% from 26.92% before implementing the strategies, that administration errors were fully prevented that is from 10% to 0%, when we compare our study to the study conducted by Marimuthu Karthikeyan et al. in their study they found out that after implementation of strategies the administration errors was reduced to 19.28% from 42.30% before implementing the strategies. but Other errors (Dose omission, Multi-dose) were not fully prevented that is from 18% to 10% as they occurred by the patients.
The limitations of the study included insufficient patient information which hampered the efforts to gather comprehensive data. Tracking cases across multiple time intervals has proven challenging and faced feasibility issues. Implementing prevention strategies became difficult as cooperation was limited. The distribution of the sample population was skewed and not uniformly distributed.
Development of patient-centric mobile applications that serve as medication management tools and engaging with local communities can be done to educate them about medication safety. Developing smart alerts and decision support systems within electronic health records to provide real-time guidance and prevent errors. Exploring the potential of emerging technologies like artificial intelligence, machine learning, or predictive analytics to detect patterns leading to errors. Implementing feedback for patients to report their experiences and concerns related to medications. Developing a safety reporting system, and encouraging HCPs to identify and report errors. Clinical pharmacists should actively participate in double-checking to reduce errors.

CONCLUSION

Based on NCC MERP and CHCF guidelines medication errors were identified and categorized. The most common category of harm was Category D (35.29%) and the most reported events were wrong dose, strength or frequency (25.84%).
Prescription errors were the most common type of error. A substantial proportion of prescriptions were not adhering to the WHO recommendation for generic names suggested an avenue for improving prescription practices.

Healthcare professionals, especially doctors, were identified as the primary source of errors, indicating the need for continuous training and implementing interventions. Implementing auditing, regulation medication review, medication reconciliation, feedback, and double-checking procedures can be done to enhance patient safety.

The result suggested the necessity of establishing a medication error reporting program in the hospital to provide quality healthcare services.

Trending in medication errors were rechecked after the implementation of prevention strategies, it was found that prescription errors were fully prevented but other errors (Dose omission, multi-dose) were not prevented as they occurred by the patients.

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REFERENCES:

1. Marimuthu Karthikeyan, Devi Lalitha. A prospective observational study of medication errors in the general medicine department in a tertiary care hospital. Drug Metabolism and Drug Interactions 2013; 28(1): 13-21.
2. Molly Billstein-Leber, Jorge. D. Carrillo, Angela T. Cassano et al. ASHP Guidelines on Preventing Medication Errors in Hospitals. ASHP REPORT 2018; 75: 1493-1517.
3. Dilnasheen Sheikh, Uday Venkat Mateti, Shamaprakash Kabekkodu et al. Assessment of medication errors and adherence to WHO Prescription writing guidelines in a tertiary care hospital. Future Journal of Pharmaceutical Sciences 2017; 3: 60-64.
4. Kandavalli Sridevi, Venkata Subbaiah, Surekha et al. Clinical pharmacist role in Drug Information Services and Medication Errors Management at Tertiary Care Hospital. IOSR Journal of Dental and Medical Sciences 2017; 16: 16-23.
5. Susan Koch, Rhonda Nay, Kim Nichols. Strategies to reduce medication errors with reference to older adults. International Journal of Evidence-Based Healthcare 2006; 4(1): 2-41.
6. Kamal Boostani, Hamid Noshad, Farahnoosh Farnood at el. Detection and Management of Common Medication Errors in Internal Medicine Wards: Impact on Medication Costs and Patient Care. Advanced Pharmaceutical Bulletin 2019; 9(1): 174-179.
7. Mohammed Aseeri, Ghadeer Banasser, Omar Baduhduh et al. Evaluation of Medication Error Incident Reports at a Tertiary Care Hospital. Pharmacy 2020; 8: 69.
8. Franklin Acheampong, Berko Panyin Anto, George Asumeng Koffuor, et al. Medication safety strategies in hospitals- A systemic review. International Journal of Risk and Safety in Medicine 2014; 26: 117-131.
9. Mary VanOyen Force, Linda Deering, John Hubbe et al. Effective Strategies to Increase Reporting of Medication Errors in Hospitals. The Journal of Nursing Administration 2006; 36(1): 34-41.
10. Nrupal Patel, Mira Desai, Samdih Shah et al. A study of medication errors in a tertiary care hospital. Perspectives in Clinical Research 2016; 7(4): 168.
11. Elske Ammenwerth, Petra Schnell, Christof Machan et al. The Effect of Electronic Prescribing on Medication Errors and Adverse Drug Events: A Systematic Review. Journal of the American Medical Informatics Association 2008; 15: 585.
12. Cherri Hobgood, Clifford R. Peck, Benjamin Gilbert, et al. Medical Errors—What and When: What Do Patients Want to Know? Academic Emergency Medicine 2002; 9(11): 1063-1367.

13. Jitendra Zaveri, Rajesh Shah, Rushika S Modi et al. An evaluation of awareness about medication error among paramedical staff working at tertiary care hospital: National Journal of Physiology, Pharmacy, and Pharmacology 2022; 12(08):1252-1255.
14. David W. Bates, Lucian L. Leape, David J. Cullen et al. Effect of Computerized Physician Order Entry and a Team Intervention on Prevention of Serious Medication Errors: American Medical Association 1998; 280(15): 1311-1316.
15. Carlos M. Romero, Nicole Salazar, Lorena Rojas et al. Effects of the Implementation of a Preventive Interventions Program on the Reduction of Medication Errors in Critically Ill Adult Patients. Journal of Critical Care 2013; 28: 451–460.