Clinical pharmacist endeavour at medication error mitigation through comprehensive surveillance

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ABSTRACT

Medication errors are frequent incidents in health care settings. Medication errors are the most common issue among medical professionals in different ways including Prescribing, intending, dispensing and administration errors. .The study was carried out in a tertiary care hospital in Malappuram district of Kerala and involved collection of prescriptions from various departments. In this study the medication errors were stratified on the basis of several criteria such as medical staff involved, departmental distributions etc. The main reason for medication errors was found to be poly-pharmacy and multiple co-morbidities such as hypertension, diabetes mellitus, dyslipidemia, cardiovascular, renal and hepatic diseases in geriatric patients. Anonymous self-reporting, incident reporting, critical incident method, chart review method, direct observation method etc can be adopted in to the system to monitor the medication errors. Numerous methods are available to prevent medication errors in different countries with few of them being patient education, prior authorization, electronic technology such as bar coding, electronic prescription records, E-prescribing, electronic Drug Utilisation Review, automated medication dispensing and internal quality control procedure. Patient counseling is an effective method for preventing and correcting of prescribing, intending, dispensing and administration medication errors.

INTRODUCTION

"To err is human and a doctor is human". Patients will be safer when we accept this reality and design clinical tasks accordingly. Medication errors pervade all phases of acute care. Medication errors are prevalent in the hospital settings; it is a well-known problem and an unfortunate reality in hospitals. To ensure the patient safety and provide better health services, medication errors should be curbed. India is still lacking adequate regulatory systems for the control of medication errors. Therefore, a stringent regulatory set up should be established to reduce medication errors. Awareness among the health-care professionals regarding medication errors may be the major factor in the establishment of a successful regulatory system. Errors may occur at any stage of prescribing, documenting, dispensing, preparation or administration. Medication use in a hospital is a complex and tedious process which depends on successful liaison among health care professionals functioning in different departments. [1]

The National Coordinating Council for Medication Error Reporting and prevention (NCCMERP) defines 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." Such events may be related to professional practice, health care products, procedures and systems including: prescribing,medication-order communication, product labeling, packaging and nomenclature, compounding, dispensing, distribution, administration, education monitoring and use. [2]

Errors can be classified as potential errors and actual errors. They can also grouped into error of commission and error of omission. The NCCMERP, USA, categorizes the medication errors into four groups based on the harm and injury to the patients. These categories are (A) no error occurred even though the circumstances had the capacity to cause errors (B) errors occurred but no harm was caused, (C) error occurred and caused harm, and (D) error occurred and caused harm.Medication errors can be classified as three main types, prescribing errors, dispensing error and medication administration errors.

The drug prescription and administration process in most hospitals worldwide is still based on handwritten medical chart

entries. Several steps in this complex and unchecked process can lead to high frequency of relevant errors. These undetected medication errors in patients' drug documentation may be a significant source of ADEs. Medication errors are common and can cause serious adverse effects and even death. Registered Nurses (RNs) are particularly exposed to the risk of committing medication errors since they are involved in the entire medication process and are usually the ultimate link within-patient.Medication error expands the healthcare cost, significantly prolongs hospital stay and increase the risk of death almost two-fold.Several easily identifiable factors associated with large populations of medication errors includes inadequate knowledge regarding drug therapy, age, impaired renal function, drug allergy , need for calculation of drug dose, specialized drug formulation characteristics and medication prescribing nomenclature. Other most common factors contributing to medication error include lack of drug information, incorrect diagnosis, drug-drug interactions, dose miscalculations, incorrect drug administration, 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 look-alike packaging of medications. [3]

Elderly population consumes more medicines than the general population and they are at potential risk for developing errors while receiving various medications. The higher incidence of chronic diseases and degenerative pathologies increases the demand for prescription medicines to treat these conditions, and to provide quality of life and well□being, which renders the elderly susceptible to the risk of polypharmacy and drug related illnesses. Aging related pathophysiologic changes also make them more prone to medication error. The resulting altered pharmacokinetics and pharmacodynamics due to these changes, makes them more susceptible to the adverse effects of drugs. [4]

Anonymous self-reporting, incident reporting, critical incident method, chart review method, direct observation method etc can be adopted into the system to monitor the medication errors. Numerous methods are available to prevent medication errors in different countries with few of them being patient education, prior authorization, electronic technology such as bar

coding, electronic prescription records, E-prescribing, electronic DUR, automated medication dispensing and internal quality control procedure. It is essential to carry out a study on medication errors to alleviate the errors associated with prescribing, dispensing and administration. The current study was aimed at determining the errors associated with the health care so as to optimize patient care.

MATERIALS AND METHODS

The medication errors were analyzed through a prospective observational study conducted over a period of 12 months (2014 January-2015 January) in a 350 bedded tertiary care referral hospital, in North Kerala. The study was conducted in ten departments of the hospital: general medicine, pulmonology, nephrology, general surgery, cardiology, gastroenterology, neuromedicine, orthopedics, psychiatry and pediatrics. The errors were oftenencountered in the above departments and attempt was made by the pharmacy practice department to rectify the errors through timely interventions. The ethical approval from corresponding ethical committee was perceived and study was conducted based on inclusion and exclusion criteria. The in-patients from the above mentioned departments were included in the study; out-patients as well as patients under the authority of other department, even if cross-referred to the departments under study were excluded. The data was collected by chart review method and ward round participation. During the study, inpatient case records, hospital records, medical records, nurse's drug administration chart and pharmacy bills were randomly selected, reviewed, and the details were followed till discharge of the enrolled patients. The details includes patient case histories, diagnosis, physician medication order sheets, nurse medication administration records, progress chart, laboratory investigations, cost of the drug, quantity to be dispensed by the pharmacist, time of dispensing and report of other diagnostic tests were collected. The enrolled patients were followed throughout the hospital stay for identifying the errors. The collected information was recorded in the specially designed patient profile form. The patient data collection form contains patient demographics, social history, family history, lab parameters, drugs used, provisional diagnosis and final diagnosis. The medication errors identified during chart review or ward round participation were documented in medication error reporting and documentation form. Drug

Table 1 : Department wise distribution of errors

Department	Frequency	Percentage (%)
Cardiology	2	2.0
Gastroenterology	2	2.0
General medicine	39	39.0
General surgery	13	13.0
Nephrology	34	34.0
Neuro Medicine	1	1.0
Orthopedics	2	2.0
Pediatrics	2	2.0
Psychiatry	1	1.0
Pulmonology	4	4.0

chart review method was adopted for identifying the prescribing errors. The caregiver or the patient was interviewed for assessing the administration error. All medication errors documented were analyzed for following parameters such as type of errors, professionals involved in the errors, causes of medication errors, incidence of medication errors, drug involved, and type of intervention and complications of error. The severity level of error was assessed by using NCCMERP proposed medication error index. Each prescription was analyzed multiple times and patient interviews were performed for confirming the medication errors. All the prescriptions were scrutinized for medication errors by utilizing Micromedex, CIMS, and drugs.com. SPSS 18 for Windows version was the software used for statistical analysis of the data and binomial tests and one sample chi square test were employed for the same. Confidence interval for evaluating the significance was set at 95%.

RESULTS

Among the aggregate of 100 medication errors analyzed, 61% of which manifested in females in contrast to 39% in males. The difference was found to be significant with $p=0.036$. The mean age of the sample was determined as 60.27 ± 20.319 years with majority (58%) of the subjects falling within the age group of 60-80 years.

Department wise distribution (Table 1) revealed General Medicine and Nephrology departments to be the sources contributing to almost three-fourth (73%) of the overall medication errors. The difference between the contributions of individual departments to the total medication errors was estimated to be extremely significant with $p<0.0001$.

On analyzing the type of errors, 53% were administration errors (n=53), 42% were prescription errors (n=42), 2% were wrong time error (n=2) and 1% comprised compliance, dispensing and dose omission errors each. The difference was found to be extremely significant ($p<0.0001$) using one-sample chi-square test. The NCC-MERP classification of the medication errors in the study sample yielded result depicted in Fig 1.

Medication error categorization showed that category C as the most prominent and serious one. The distribution of medication errors across different categories were found to be extremely significant with $p<0.0001$. Table 2 represents the cross tabulation data between departments and the error category. 29% errors were of C category obtained from General medicine department and 25% from the Nephrology department which were much greater than any error categories in individual departments. The proportion of different categories of medication errors among each department was found to be non-significant with $p= 0.987$. Furosemide and Metronidazole were involved in most number of errors with 5% each of the total cases. On analysis of staff involved in the causation of error, 49% were attributed to physicians, 50% were due to nurses and 1% was due to patients.

All the medication errors were reported by PharmD.; of which, 99% were obtained through chart reviews in comparison to 1% which was observed during the ward round participation. Of the total errors observed, interventions were done by the students in 62% cases as compared to 38%, where no intervention was done. There was found to be significant difference between the number of errors in which intervention was done and number of errors in which it was not ($p=0.021$). Of these 62 errors, where intervention was done by the pharmacy practice students; the intervention reached the patients in only 41 cases (66.13%). There was found to be significant positive correlation between the number of interventions done and number of interventions received with Spearman's correlation coefficient yielding a value of 0.653.

Category of error and type of staff involved were detected on testing of correlation between categorical data, significance was observed in the between type of staff involved and category of error yielding Spearman's correlation coefficient of 0.503 and is represented in table 4. Categorization of medication errors with route of administration revealed that 67% errors propagated when the medication was given orally in contrast to 10% and 23% errors that occurred with inhalation and parenteral dosage forms. This observed difference between the prevalence of medication errors

Table 2 : Cross-tabulation between departments and error categories

Department	Category					Total
	A	B	C	D	E	
Cardiology	0	1	1	0	0	2
Gastroenterology	0	0	2	0	0	2
General medicine	0	7	29	3	0	39
General surgery	0	2	11	0	0	13
Nephrology	3	6	25	0	0	34
Neuro Medicine	0	1	0	0	0	1
Orthopedics	0	2	0	0	0	2
Pediatrics	0	1	1	0	0	2
Psychiatry	0	0	0	0	1	1
Pulmonology	0	0	4	0	0	4
Total	3	20	73	3	1	100

Table 3 : Cross tabulation between sub-type of error and staff involved

Sub-type of Error	Type of Staff			Total
	PHYSICIAN	NURSE	PATIENT	
Compliance Error	0	0	1	1
Dose Omission Error	0	19	0	19
Drug Name Confusion	4	0	0	4
Illegible Handwriting	32	0	0	32
Improper Recording	0	2	0	2
Inappropriate Substitution	0	1	0	1
Wrong Administration	4	4	0	8
Wrong Dose	0	2	0	2
Wrong Drug	0	1	0	1
Wrong Dose Selection	4	0	0	4
Wrong Time	0	26	0	26
Total	49	50	1	100

Table 4 : Cross-tabulation between category of error and type of staff involved

		Type of staff			Total
		PHYSICIAN	NURSE	PATIENT	
Category	A	3	0	0	3
	B	19	1	0	20
	C	26	46	1	73
	D	1	2	0	3
	E	0	1	0	1
Total		49	50	1	100

between different routes of administration was found to be extremely significant with p<0.0001.On classifying the medication errors on the basis of class of drugs involved, Antibiotics and Antihypertensive agents were found to be involved in 23% cases each, thus accounting for a total of 46% medication error when combined. On statistical analysis the difference was found to be extremely significant (p<0.0001) between the different drug classes.

DISCUSSION

A medication error can occur at any stage of the drug therapy, from the time of writing a prescription till its administration. In the current study, more errors were observed in male (61%) than in female geriatric patients. Majority of the errors (39%) occurred in patients admitted under general medicine department. The main reason detected was polypharmacy and multiple co-morbidities such as hypertension, diabetes mellitus and dyslipidemia in geriatric patients. Out of 100 errors reported, 50 % of the errors were medication administration errors caused by the nurses, 49% were made by physicians as prescribing error and only 1% was attributable to patients in the form of compliance error. Administration error happened as wrong time (n=26), wrong dose (n=2), wrong drug (n=1),improper recording after drug administration (n=2),dose omission (n=19),wrong administration technique (n=4) and inappropriate substitution (n=1). The main reason behind this was the change in the duty roster, shifting of staff and work overload. Majority of the administration errors occurred due to the workload of nurses, distraction during medication preparation and administration, pressure from patient, patient's family or staff members, lack of adequate guidelines or information, negligence, forgetfulness or lack of attentiveness, negligence of protocol, communication errors including documentation, inexperienced and inadequately trained staff, improper drug storage, poorly functioning supervising committees, verbal order and the lack of awareness and knowledge about the drug use.

Table 5 : Medication errors classified under drug classes

Drug class	Frequency	Percentage (%)
Antihistamine	11	11.0
Antibiotics	23	23.0
PPI	6	6.0
Anti-migraine Drugs	1	1.0
H2 Receptor Antagonists	2	2.0
Hepatic Protectants	2	2.0
Cholesterol Lowering Agents	2	2.0
NSAIDs	2	2.0
Antacids	4	4.0
Local Anesthetics	1	1.0
Hemostatic Agents	1	1.0
Antihypertensives	23	23.0
NMDA receptor antagonist	1	1.0
Antidiabetics drugs	2	2.0
Steroids	2	2.0
Nootropics	1	1.0
Anticonvulsants	1	1.0
Ant parkinsonism agents	3	3.0
Anticoagulants	2	2.0
Antiasthmatics	5	5.0
Laxative	1	1.0
Antipsychotics	1	1.0
Vitamin Supplements	1	1.0
Antiplatelets	1	1.0
Electrolyte Supplement	1	1.0
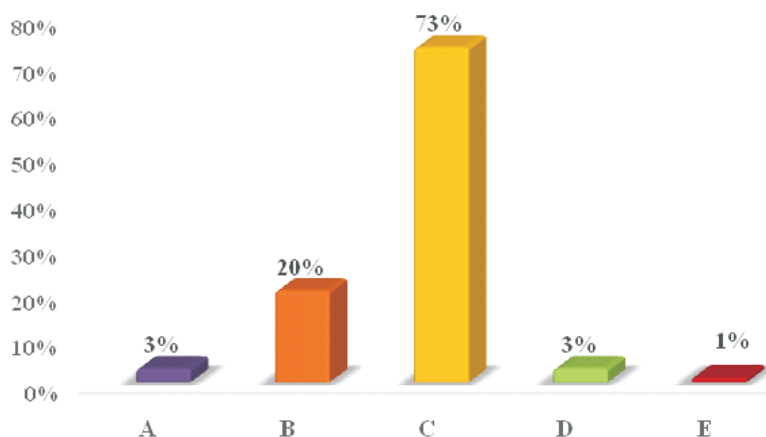
Fig. 1 : Categorization of medication errors

Continuing education to the nursing staff can be helpful in reducing medication errors. Medications that are new to the facility should receive high teaching priority. Staffs should receive updates on both internal and external medication errors, since an error that has occurred at one facility is likely to occur at another. As medication-related policies, procedures, and protocols are updated, this information should be made readily available to staff members. Nursing staff should be encouraged to report the medication error to the quality control department so as to reduce the incidence of medication errors. Prescribing errors (49%) occurred due to reasons such as, messy and illegible handwriting (n=32), drug name confusion (n=4), wrong administration technique (n=4) and wrong drug selection (n=4). Most of the prescribing errors occurred due to the busy schedule of the physician. Junior and resident doctors did not have thorough knowledge about the prescription writing. Prescribing errors could be minimized by training, adherence to existing systems of work, and through the introduction of new working practices. Several prescribing errors happened because of the negligence of current good clinical practice. The doctor should write prescriptions clearly, scientifically and systematically in order to minimize medication errors during transcription, and that all medication orders should be crosschecked by pharmacists before dispensing. Other examples of good clinical practice that might reduce prescribing errors include documenting the reason for prescribing a drug in a patient's note, detailing allergies on the chart, and adhering to existing prescribing policies. Patient related errors can be reduced by drafting guidelines for patient counseling approach. The healthcare provider, especially clinical pharmacist should teach patients about the name of each medication they're taking, route and time of drug administration, potential adverse effects and possible interactions, what it looks like, and what it's being used to treat.

In this study all the errors were reported by pharmacy students; of which, 99% were obtained through chart reviews in comparison to 1% which was observed during the ward round participation. Of the total errors observed, interventions were done by the students in 62% cases whereas in 38%, no interventions were carried out. It was mainly due to fear, lack of communication between pharmacy students and other health care professionals, and change or shifting of duty roaster etc. But it was observed that only 66.13% interventions had reached the patients. The main reason behind this was the lack of awareness about medication error, patient safety and the lack of time of health care professionals. The clinical pharmacist is expected to play a pivotal role in preventing medication abuse. Ideally, the pharmacist should collaborate with the prescriber in developing, implementing, and monitoring a therapeutic plan to producedefinite therapeutic outcomes for the patient. It is also vital that the pharmacist should devote careful attention to dispensing processes to ensure that errors are not produced during their handling.*Chloe Copping*[5] states that good communication, clarity and vigilance are vital whenever drugs are being administered. Medication administration is a skilled but potentially dangerous procedure and it is essential to be alert to possible pitfalls and to follow guidelines in order to alleviate the risks. When undertaking the administration of medicines, nurses must be willing to take responsibility for their actions and rectify any shortfalls in their knowledge. The above study suggests that proper care, observation and communication can alleviate the errors during prescribing, dispensing and administration.

In a study conducted by *Grace M Kuo*,[6] 779 errors were reported from a total of 924 medication errors observed. 145 cases were excluded due to unavailability of complete information. Drug errors occurred in both the inpatient (61%) and outpatient (39%) settings; the outpatient setting consisted of outpatient facilities (29%), home (7%), and other (3%) settings such as emergency departments. Participants discovered drug errors from review of patient medical records (70%) and from other health care professionals (11%), patients (8%), laboratory reports (4%), pharmacy computerized electronic alert systems (3%), caregivers or family members (1%), and other unspecified sources (3%). A total of 2030 hours of clinical pharmacist hours was committed towards detecting the errors reported in this study.

CONCLUSION

This study was aimed at finding out the occurrence of medication errors and the occurrence of risk factors for medication errors in the inpatient setting of the private hospital in south Kerala. Most of the physicians and nurses were unaware about the proper use of medications at right time, right dose and right route of administration to the right patient. Clinical pharmacists and pharmacy practice students can play a pivotal role in the detection and prevention of medication errors and make strong interventions thus improvingthe quality of care provided to the patients. This helps to ensure that the 'right' patient is receiving the 'right' drug in the 'right' dose at the right time by the authorized clinician.

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