Research Article

Assessment of Medication Errors in Tertiary Care Hospital

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ABSTRACT

Medication errors are the most common and preventable causes of iatrogenic injuries. The main aim of the study is to identify the type, incidence, outcome of the medication errors and resolving them for better patient care. This was a prospective and observational study. Patients satisfying inclusion and exclusion criteria were enrolled in the study. The required data was collected by treatment chart review method. Inpatients are followed from day of admission to discharge. Type of Medication errors, causes, contributing factors of medication errors, outcome of events, and percentage of errors reaching the patient are evaluated and intervention is done. In a total of 250 cases 73 Medication errors were observed. Most of the errors are seen in patients of age group 21-30 (21.9%). In type of Medication errors 16 prescribing errors were detected (21.9%). Adverse drug reactions and drug interactions were found in 55 cases (75.34%). In department group most of the errors are seen in General medicine. The errors that reached the patients are 42(57.53%). Illegible prescriptions were 12(16.43%). Errors that occurred due to failure to adhere to work are 2. Intervention is done by informing to the staff in 61 cases (83.56%). In 11(15.06) cases the treatment was changed to correct drug. Early detection and intervention of Medication errors will improve the therapeutic outcomes. Implementation of the medication error reporting system in the hospital, educating nurses regarding effects of medication errors will reduce the cost of treatment, improves patient care and safety.

Keywords: Drug-Drug interactions, Iatrogenic injuries, Medication errors.

INTRODUCTION

The National Coordinating Council for Medication Error Reporting and prevention has defined medication error (ME) 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.

Self-medication, poor communications between the prescriber and the patient, and even demand of the patient for medicine for each symptom, unethical drug promotion and inducement increases irrational prescribing. This increases in number of drugs per prescription which may lead to ME and DDIs. Hence monitoring of DDIs, rationality plus ME would be essential element of high quality of medical care. Prescribing of medications outside the accepted medical standards is known as inappropriate prescribing.

Types of Medication Errors

1. Prescription errors
2. Administration errors
3. Dispensing errors

Prescription Error

The first individual who can play an active role in preventing medication error is the prescriber himself. It is difficult to quantify the extent of errors related to prescribing because many errors go undetected or unreported. Even if the prescription is accurate and complete, it may be miss interpreted if it cannot be read. Poorly written orders may delay the administration of medication. They can increase the potential for the serious medication error stemming from an incorrect understanding of the intended drug, dosage, route of administration or frequency of dosing.

Factors Contributing to Prescription Errors

Wrong time of administration in prescription, improper dose error, wrong dosage, monitoring errors, illegible hand writing errors, direction errors, and drug interaction errors contribute to the prescription errors.

Role of Pharmacists in Reducing Prescription Errors

Pharmacist can play a very critical and effective role in solving all types of the prescription errors. The doctors are always busy and they work in an environment which can contribute positively for such errors. The mistakes and errors have to be identified and brought to the notice of the doctors in a complementary and supportive role. Wherever required or needed, the evidence to the clinicians supporting the need for corrections are to be provided[1].

Administration Error

Nurses are often the last "gatekeeper" in the administration process to prevent medication errors. It is important to take the time needed to ensure patient safety, and to minimize distractions throughout the

process. Here are strategies on how to prevent medication errors in nursing:

The rights of medication administration

Initially, there were five rights for administration including the right patient, drug, time, dose and route. A sixth right is the right reason. Some literature describes up to 12 rights, including education, documentation, right to refusal and expiration date.

Independent double checks

The Institute for Safe Medication Practices (ISMP) (2014) recommends the use of redundancies, such as independent double checks of high alert medications due to the increased risk for patient harm.

Medication review

Practices include comparing the medication administration record and patient record at the beginning of a nurse's shift; determining the rationale for each ordered medication, and requesting that physicians rewrite orders when improper abbreviations are used, are important strategies.

Knowledge

A nurse should never administer a medication which he/she is unfamiliar.

Patient education

Ensuring that patients and families are knowledgeable regarding the medication regimen so that they can question unexplained variances are also associated with lower rates of medication errors[3].

Dispensing Medication Errors

Pharmacists are professionally and legally responsible for accurate dispensing of prescriptions. They have to develop and follow policies and procedures to prevent the occurrence of dispensing errors. The dispensing errors include a) errors of commission b) errors of omission.

a) Errors of Commission

Dispensing the wrong medicine, wrong dose, wrong dosage form or wrong quantity are examples of dispensing errors of commission.

b) Errors of Omission

Failure to give proper directions to the patients or failure to alert the patient, regarding an aspect of the dispensed item constitutes an error of omission. In countries like USA, where counseling at the time of dispensing is the professional responsibility of the pharmacist, failure to counsel the patient or screen the prescription for interaction also constitute dispensing errors of omission type. Failure to identify possible drug interactions or to give contraindications also causes dispensing errors of omission type. Sometimes dispensing errors are categorized as mechanical errors and judgment errors.

Role of Pharmacist and Patient Counseling In Reducing Dispensing Errors

The pharmacist has an added responsibility and professional obligation to reduce and avoid dispensing errors. The Good Dispensing practice (GDP) has to be followed to avoid the errors and to identify the possible commission and omission errors that has happened at the prescription stage or can happen at the administration stage. Patient counseling has a very important role in identifying and preventing dispensing errors. Dispensing errors were identified and corrected during patient counseling. The verified medication may be shown to the patients. Sometimes the patients have been prescribed the same medication earlier, but he may not recognize the medication name now. This 'show and tell' may help to catch an error. An educated or informed patient is one of the best safe guards in prevention of medication errors[1].

Administration Errors

Medication use is a multi-disciplinary process. There is a wrong concept that responsibility for accurate administration medicine lies solely with the nurses or the person administering it. Persons who prescribe, dispense and administer medicines have to rely on one another to identify and avoid medication error. While reviewing a patient's previous day medication regimen, a physician may detect the administration of a non-prescribed medicine or detect the inadvertent discontinuity of a drug[1].

Types of Adverse Drug Reactions

1 Type A (Augmented)

2 Type B (Bizarre)

Type A

These reactions are usually the exacerbation of the pharmacological effects of a drug and are thus dose dependent. These reactions are usually predictable due to the know pharmacology of a drug and thus preventable. Although the incidences of this type of reactions are high, they are generally associated with less morbidity and mortality. Example: Insulin induced hypoglycemia.

Type B

These are hypersensitivity reactions and are not dose dependent. These are often not predictable and preventable in individual case (unless the patient has known history of these type of reactions). This is associated with high morbidity and mortality. Occurrence in clinical setting is low. Example: - Penicillin induced hypersensitivity reactions.

Predisposing Factors

Polypharmacy

Patients on multiple drug therapy are more prone to develop an ADR either due to alteration of drug effect through an interaction mechanism or by synergist effect.

Multiple and Intercurrent Diseases

Patients with multiple diseases are at increased risk of developing an ADR due to multiple drug use for their diseases. Patients with impaired hepatic or renal status are at high risk of developing ADR. Example: Patient with decreased renal function who is treated with amino glycosides is at increased risk of developing Nephrotoxicity unless appropriate dose adjustments are made.

Age

Elderly and pediatric patients are more vulnerable to ADRs. Elderly patients are more susceptible to ADRs due to the physiological changes (pharmacokinetic and pharmacodynamics) which accompany ageing, and also because they often take many drugs for chronic and multiple diseases. EX: Nitrate or an ACE inhibitor induced postural hypotension in an elderly patient. Where the reaction may be exacerbated by age related impaired bar receptor response to a change in posture.

Drug Characteristics

Some drugs are highly toxic in nature and patients who are treated with these agents are at an increased risk of ADRs. EX: Nausea and vomiting is a common ADR seen in patients treated with cytotoxic anti-cancer drugs. Patients treated with drugs which have a narrow therapeutic range such as Dioxins and Gentamycin are more susceptible, as a slight increase in the serum concentration of these drugs may result in toxicity.

Gender

Women are reported to be more susceptible to ADRs than men due to physiological, pharmacokinetic, pharmacodynamics, and hormonal changes. EX: Chloramphenicol induced a plasticanemia and Phenylbutazone induced Agranulocytosis are twice and thrice are common in women as in men respectively.

Race and Genetic Factors

Genetically predisposed individuals are more prone to ADRs. EX: Patients who are deficient in glucose-6-phosphate dehydrogenises are at high risk of developing hemolytic due to primaquine than those who are not. Race and genetic polymorphism may account for alterations in handling of drugs and their end organ effects[2].

Prevention of Adverse Drug Event

The pathway connecting a clinician's decision to prescribe a medication and the patient actually receiving the medication consists of several steps:

- Ordering: The clinician must select the appropriate medication and the dose, frequency, and duration.
- Transcribing: In a paper-based system, an intermediary (a clerk in the hospital setting or a pharmacist or pharmacy technician in the outpatient setting) must read and interpret the prescription correctly.
- Dispensing: The pharmacist must check for drug–drug interactions and allergies, then release the appropriate quantity of the medication in the correct form.
- Administration: The correct medication must be supplied to the correct patient at the correct time[4].

Table 1: Strategies to Preventing Adverse Drug Events

STAGE	SAFETY STRATEGY
Prescribing	Avoid unnecessary medications by adhering to conservative prescribing principles Computerized provider order entry, especially when paired with clinical decision support systems Medication reconciliation at times of transitions in care
Transcribing	Computerized provider order entry to eliminate handwriting errors
Dispensing	Clinical pharmacist to oversee medication dispensing process Use of "tall man" lettering and other strategies to minimize confusion between look-alike, sound-alike medications Automated dispensing cabinets for high-risk medications.
Administration	• Adherence to the “five rights" of medication safety (administering the Right Medication, in the Right Dose, at the Right Time, by the Right Route, to the Right Patient) Barcode medicine administration to ensure medications is given to the correct patient. • Minimize interruptions to allow nurses to administer medications safely. • Smart infusion pumps for intravenous infusions. • Multi compartment medication pumps for patients taking multiple medications in ambulatory or long-term care settings. • Patient education and revised medication labels to improve patient comprehension of administration instructions.

Although each of the strategies enumerated in the Table can prevent ADEs when used individually, improving medication safety cannot be divorced from the overall goal of reducing preventable harm from all causes.

The Institute for Safe Medication Practices maintains a list of high-alert medications that can cause significant patient harm if used in error. These include medications that have dangerous adverse effects, but also include look alike and sound alike medications: those that have similar names and physical appearance but completely different pharmaceutical properties. The Beers criteria which define certain classes of medications as potentially inappropriate for geriatric patients have traditionally been used to assess medication safety. However, the newer STOP criteria (Screening Tool of Older Person's inappropriate Prescriptions) have been shown to more accurately predict ADEs than the Beers criteria and are therefore likely a better measure of prescribing safety in elderly patients.

Though there are specific types of medications for which the harm generally outweighs the benefits, such as benzodiazepine sedatives in elderly patients, it is now clear that most ADEs are caused by commonly used medications that have risks, but offer significant benefits if used properly. These medications include antidiabetic agents (e.g., insulin), oral anticoagulants (example, warfarin), antiplatelet agents (such as aspirin and clopidogrel), and opioid pain medications. Together, these four medications account for more than 50% emergency department visits for ADEs in Medicare patients.

Drug-Drug interaction (DDI) is defined as combining two or more drugs in such a way that the potency or efficiency of one drug is significantly modified by the presence of another.

Chart Review

Chart review can be used to detect errors and adverse events related to medication. Ordering, transcribing, dispensing, administering, or monitoring. It is often used in research focusing on patient harm resulting from medication errors. The review is usually done by specially trained nurses who examine the medication orders, laboratory test results, physician's progress notes, nursing notes, and medication administration record for clues that an error has occurred. They look for signs and symptoms typical of over dosage, under dosage, omission, and administration of unordered drugs. For example, an elevated blood glucose concentration might indicate an omitted insulin dose. The administration of naloxone or flumazenil might suggest that a medication error has occurred.

MATERIALS AND METHODS

Study Setting

The study was carried out at both inpatient and outpatient in all departments at a tertiary care teaching hospital which is 300 bedded.

Study Design

It was a prospective and observational type of study in which both inpatients and out patients record where studied.

Study Period

Study Period was 6 months

Study Criteria

Inclusion criteria

Both inpatients and outpatients were included in the study. Population of age group between new born to 80 years was included.

Exclusion criteria

Cases that are absconded and discharged against medical advice are excluded from the study.

Source of data

Data was obtained about the patient through clinical reports, treatment chart review method, interviewing the patient and care giver, ward round participation.

Study Material

*Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) Medication Error Reporting Form was used. It consists of

1. Type (Inpatient or Outpatient)
2. Demographic details
3. Diagnosis
4. Type of the error
5. Whether the error reached the patient or not
6. Outcome of the event
7. Causes and contributing factors involved in the event
8. Intervention details.

Study Procedure

A suitable data collection JIPMER medication error reporting form was taken and data is collected from the posted departments for a period of 6 months. The inpatient case was reviewed daily from the day of admission to discharge which includes patient case history, diagnosis, physician medication order sheets, nurse's administration records, laboratory reports. Nurse's records were checked for details like route, frequency, dosage form administration of medication as

per physician's orders was also checked. All the errors were noted and informed to the concerned staff.

The collected data was subjected for the statistical method using statistical software SPSS. The results were calculated by using Descriptive one sample method.

RESULTS AND DISCUSSION

Distribution of Patients Based on Gender

A total of 250 patients were enrolled in the study and a count of 73 medication errors was found. Among 250 patients 101 are males and 149 are females. In males 28(38.35%) errors were found and in females 45(61.64%) errors are found. More errors are seen in females due to the difference in physiological, pharmacokinetic, pharmacodynamics, and hormonal changes.

Table 2: Percentage Distribution of Errors Based on Gender

Gender	Total no of cases	Total no of errors	Percentage
Males	101	28	38.35%
Females	149	45	61.64%

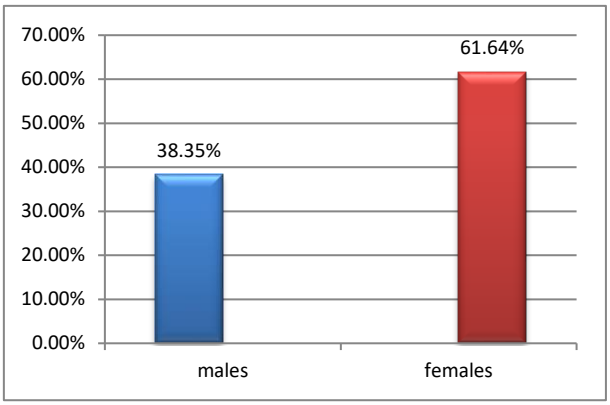

Figure 1: Percentage Distribution of Errors Based On Gender

Distribution of patients based on Age group

The distribution of age of the study population ranged from new born to 80 years.

Table 3: Percentage Distribution of Errors Based on Age Group

Age Group	No of Cases	No of Errors	Percentage
1 -10	38	07	9.58%
11-20	12	01	1.36%
21-30	51	16	21.91%
31-40	38	11	15.06%
41-50	42	13	17.80%
51-60	31	12	16.43%
61-70	25	09	12.32%
71-80	10	04	5.47%
81-90	03	00	0.00%

Distribution of Errors Based on Department

Patients visiting all the departments were included in the study. Among 113 cases from General Medicine 42 (57.53%) errors were found. Patients are included by random selection method. As the flow of patients is more in General medicine and pediatrics in that hospital number were included from that department.

Table 4: Percentage Distribution of Errors Based On Department

Department	No of Cases	No of Errors	Percentage
General medicine	113	42	57.53%
General surgeon	16	02	2.73%
Pediatrics	35	06	8.12%
Orthopedic	18	05	6.84%
Gynecology	16	01	1.36%
Neurosurgeon	11	04	5.47%
Pulmonology	10	03	4.10%
Cardiology	10	04	5.47%
Nephrology	11	05	6.84%
Gastrology	05	00	00
Urology	05	00	00

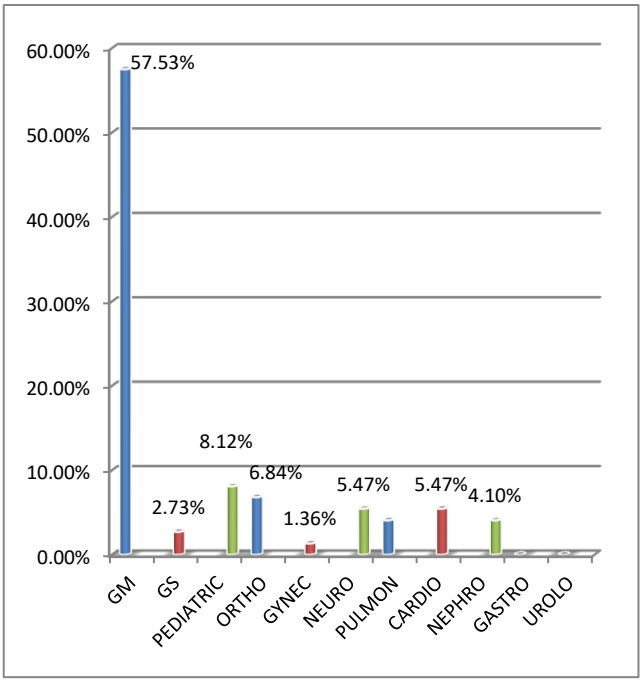

Figure 2: Percentage distribution of Errors based on Department

Percentage Distribution of Type of Errors

The data collection form used in our study divides types of errors into 4 types. Prescribing errors were 16(21.91%), Administration errors were 02(2.73%), others include drug-drug interactions and adverse drug reactions and they are 55(73.34%). No dispensing errors were noted.

Table 5: Percentage Distribution of Type of Errors

Type	No of Errors	Percentage
Prescribing errors	16	21.91%
Administration errors	02	2.73%
Dispensing errors	00	00
Other errors	55	73.34%

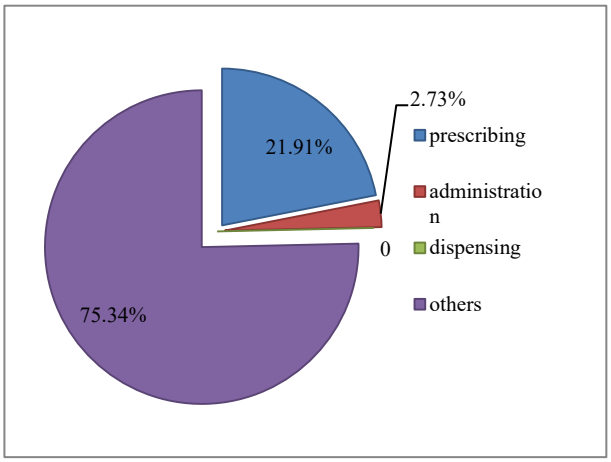

Figure 3: Percentage Distribution of Type of Errors

Percentage of Errors Reaching the Patient

Among the 73 errors 42(57.53%) errors were seen in the patients and 31(42.46%) errors were not seen in the patient. Errors that are not seen in patients include serious possible drug-drug interactions.

Table 6: Percentage Distribution of Errors Reaching Patients

Error seen in patients	Error not seen in patients
42(57.53%)	31(42.46%)

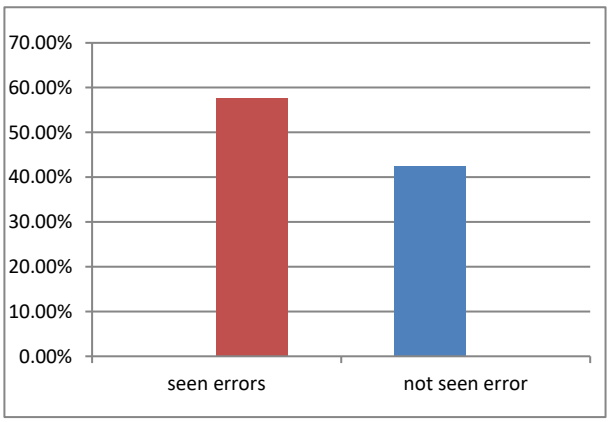

Figure 4: Percentage Distribution of Errors Reaches Patient

Outcomes of Errors

The events that occur after medication error was analyzed temporary harm was seen in 28(38.35%). Death occurred in 1(1. 36%). No permanent harm and near death were observed.

Table 7: Percentage Distribution of Outcomes of the Error.

Events	Errors	Percentage
Have potential to cause errors	13	17.80%
Error didn't reach patients	06	8.21%
No Harm	04	5.47%
No Harm requires monitoring	11	15.06%
Temporary Harm	28	38.35%
Harm Requiring Hospitalization	10	13.69%
Permanent Harm	00	00
Near to Death	00	00
Death	01	1.36%

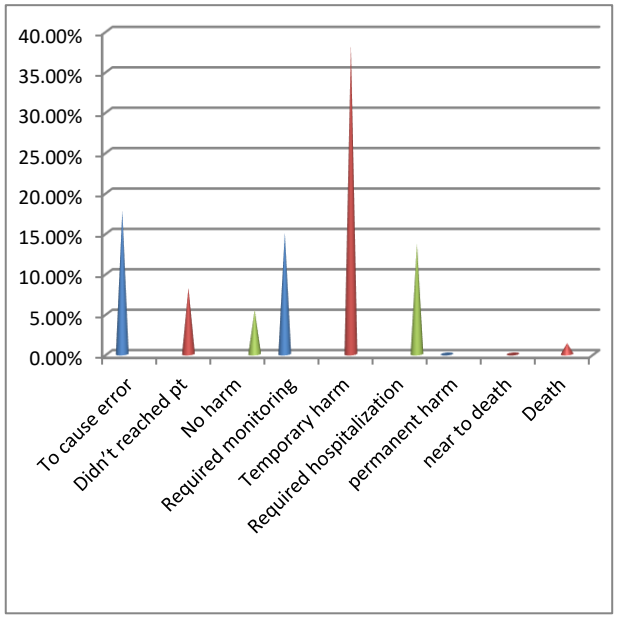

Figure 5: Percentage Distribution of Outcomes of The Errors

Causes and Contributing Factors

The causes and contributing factors that lead to medication errors were analyzed and found that others that included serious possible drug-drug interactions, adverse drug reactions and unindicted drugs were 59%(80.82%). Illegible prescriptions were 12(16.43%), failure to adhere to work are 02(2.73%)

Table 8: Percentage Distribution of Causes and Contributing Factors

Illegible prescription	Failure to adhere to work	Others
12(16.43%)	02(2.73%)	59(80.82%)

Intervention

Intervention is done by informing to the staff. All 73 medication errors were informed to the staff and 11(15.92%) were changed to correct drug and dose.

Table 9: Percentage Distribution of Intervention

Changed to correct drug/dose	11	15.92%
Informed to staff	62	84.92%

Category of Drugs That Lead to Medication Errors

All the drugs that are involved in medication errors are divided based on the pharmacological category of drug and it is found that Antibiotics 37(21.76%) was the major category that leads to error. Anti-Hyperlipidemias, muscle relaxants 01(0.58%) are less in number.

Table 10: Percentage Distribution of Category of Drugs that Lead to Errors

S.No	Drug Category	Percentage
1	Antibiotics	37(21.76%)
2	Anti- emetics	23(13.52%)
3	Analgesics	21(12.35%)
4	Anti-Hypertensive	19(11.17%)
5	Anti-spasmodic	05(2.94%)
6	Anti-platelets	08(4.70%)
7	Anti-malarial	02(1.17%)
8	Anti- TB	08(4.70%)
9	Anti –Depressant	02(1.17%)
10	Anti-cancer	01(0.58%)
11	Bronchodilators	02(1.17%)
12	Corticosteroids	05(2.94%)
13	G.I	03(1.76%)
14	PPI	14(8.23%)
15	Sedatives	02(1.17%)
16	Hepato-protective	02(1.17%)
17	Anti- histamine	02(1.17%)
18	Anti-hyperlipidemias	01(0.58%)
19	Muscle Relaxant	01(0.58%)
20	Vitamins	02(1.17%)

Table 11: Serious Possible Drug-Drug Interactions Found in our Study

S.No	Drugs	Effect
1	Flucanazole + Ondansetron	Both increases QTC interval. ECG monitoring is required
2	Piroxicam + Sulfasalazine	Both increases Anti-coagulation and serum K+
3	Azithromycin + Piperacillin	Azithromycin decreases the effect of piperacillin by pharmacodynamics antagonism
4	Dicyclomine + Hyoscyamine	Both decreases cholinergic effects
5	Olmesartan + Carvedilol	Both increases serum K+
6	Ofloxacin + Ondansetron	Both increases QTC interval. ECG monitoring is required
7	Lorazepam + Tramadol	Both increases sedation
8	Ofloxacin + Sumatriptan	Either increases toxicity of other by increasing serotonin levels
9	Doxycycline + Ceftriaxone	Doxycycline decreases the effect of Ceftriaxone
10	Metronidazole + Montelukast	Metronidazole increases the effect of Montelukast
11	Amlodipine + Atenolol	Both increases Anti-Hypertensive blocking
12	Cinnerazine + Prochlorperazine	Both increases sedation

Limitations of the study

- Cases discharged against medical advices not included
- Unable to record the Medication errors occurred during public holidays
- This not an interventional study
- The serious possible drug-drug interactions were not noticed during the hospital stay as they require time.

*The p value for all the results was found to be less than 0.005 and is significant

CONCLUSION

In a population of 250 we observed 73 errors (29.2%). The major factors involved in medication errors are Adverse drug reactions, possible drug-drug interactions, unindicted drugs and sub therapeutic treatment hence there is a need to critically address the legibility of the prescription. Early detection and intervention of Medication errors will improve the therapeutic outcomes. Implementation of the medication error reporting system in the hospital, educating nurses regarding the effects of medication errors will reduce the cost of treatment, improves patient care and safety.

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