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MEDICATION ERRORS AND DRUG-DRUG INTERACTIONS THROUGH PRESCRIPTION ANALYSIS AT DIFFERENT HEALTH CARE CENTRES

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ABSTRACT

The objective of the study was to appraise the incidence and patterns of medication errors occurring in a random population, at multiple sites in the regional health care centers. The patients and drug charts were identified through routine ward rounds and prescription monitoring of all departments. In the present study, a total of 250 prescriptions gathered over the study period and were assessed for medication errors, which was the primary outcome of the study. Out of 94 medication errors reported, most frequent errors were compliance errors 36, omission errors 28, followed by prescription errors 16, wrong time administration errors 14. The further differentiation was NCCMERP error categorization, namely category A (15), category B (20), category C(18), category D(6), category F(2), category G(1), while category E, category H, category I were not reported. The secondary outcome of the study is drug-drug interactions. Of the 154 drug-drug interactions, interactions with major severity accounted for 73(47%), while those with moderate and minor severity accounted for 63(40%) and 18(13%) respectively. Even though our study is of small scale we figured out much medication errors which evidences that the current health care system should adopt some standard monitoring procedures to minimize the errors and drug-drug interactions in order to improve a better care. Measures as obtaining detailed patient history, medication reconciliation and continuing follow up could propagate a better understanding.

Key words: Medication errors, Drug-drug interactions.

INTRODUCTION

Health care is nearly 10 years behind other industries in its efforts to reduce the errors. Medically inappropriate, ineffective and economically inefficient use of pharmaceuticals is commonly observed in the health care system throughout the world especially in the developing countries. Some of the errors though are serious and require attention. Understanding these potential reactions and their mechanisms help us to navigate the hazardous waters of combining drugs with other medicines, food, herbs and vitamins with confidence.

MEDICATION ERRORS

According to the National coordinating council for medication error reporting and prevention (NCCMERP), a medication error is an episode associated with the use of medicine that should be preventable through effective control system. A medication error is a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient [1].

The Institute of medicine report in 1999 estimated that 44000 to 98000 people die each year at least in part because of medical error the report dramatically increased awareness of the problem of medical errors [2]. Physicians are aware of medical errors but believe that the report of the Institute of Medicine seriously overstates the magnitude of the problem [3]. System analysis of ADRs showed that drug-drug

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interactions represented 3%-5% of all in-hospital medication errors [4]. Bates et al found that medication errors were common, occurring at a rate of 5per 100 medication errors orders however, only 7 in 100 medication errors had significant potential for harm, and 1 in 100 actually resulted in injury and have demonstrated that some of the interventions can be effective in particular, physician computer order entry reduced medication error significantly in an academic medical centers [5].

Contributing factors to prescribing error occurrence include:

- Incomplete patient information
- Unavailable drug information or drug updates
- Illegible handwriting of a prescriber
- Inaccurate medical history taking
- Drug name confusion: Similar looking medications or packing could be the cause for dispensing errors.
- Inappropriate use of decimal points
- Use of abbreviations
- Use of verbal orders
- Minimal or no time for patient counselling
- Lack of appropriate label instructions on the packs

Many factors were claimed to cause medication errors at various states of health care system. Among which, the communication barriers mostly result in medication errors during each stage in medication administration process. Errors often occur when clinicians are inexperienced and novel procedures of medications introduced [6].

Medication error rate

"Medication error rate" is determined by calculating the percentage of errors. The numerator in the ratio is the total number of errors. The numerator in the ratio is the total number of errors that they observe, the denominator is called "opportunities for errors" and includes all the doses observed being administered plus the doses ordered but not administered.

The equation for calculating a medication error rate is as follows:

$$\text{Medication Error Rate} = \frac{\text{Number of Errors Observed}}{\text{Opportunities for Errors}} \times 100$$

.**DRUG-DRUG INTERACTIONS**

Every time a drug is administered with any other prescription medicine, OTC products, herbs or even food we expose ourselves to the risk of a potentially dangerous interaction. A drug interaction occurs when a patient's response to a drug is modified by food, nutritional supplements, formulation excipients, environmental factors, other drugs or disease. Interactions between drugs (drug drug interactions) may be beneficial or harmful.

The early literature on incidence rates of drug interactions is scant. However, drug-drug interactions in general are rarely reported and information about the ADRs due to drug-drug interactions is usually lacking.

Drug interactions represent one of eight categories of drug-related problems that have been identified as events or circumstances of drug therapy that may interfere with optimal clinical outcome. Identification, resolution, and prevention of drug-related problems are important determinants for patient management and are the responsibility of those providing pharmaceutical care. The continued development of new, high-potency drugs increases the potential for drug interactions.

Micromedex is an evidence-based, multi-database drug search engine that provides summary and in-depth information for drugs The Micromedex 2.0 delivers smart search functionality and a streamlined design to help you find the evidence-based drug information and clinical answers you expect from Micromedex. The interactions tool provides instant access to drug-drug, drug-food, drug-ethanol, and drug-lab test reactions (available with a subscription to DRUG-REAX®).

Clinician's role in Drug interaction management

Drug interactions are right increasingly central phenomena in the globe of clinical therapeutics. The mission is to make the most of the reimbursement and minimize the risk, but before that, ought to assess it accurately. To achieve such reduction in Drug interactions incidence, a clinician first needs to understand the frequency and cause of those events.

Pharmacist plays a valuable role in screening for interactions and advising on management when an interaction occurs. This may be at the patient's bedside, as part of the dispensing process or during the sale of a non-prescription medicine. Pharmacists, especially those practicing in India, are well placed to contribute significantly to the development of this knowledge.

A young prescriber should be able to tackle new prescribing conditions; however, they should also be trained to deal with those they are expected to meet routinely. Another strategy include documentation of the reason for Drug interactions on the chart, and adhering to existing prescribing policies [7]

Computerized drug interaction profiles should be used by pharmacists to ensure recognition of all potential drug interactions [8].

METHODOLOGY

The present study was conducted at three different health care concerns.

Study Criteria

Inclusion Criteria:

✓ Inpatients & out patients of both gender, any age group, irrespective of the diseases were included in the study

Exclusion Criteria:

✓ Pregnant and pediatric patients were excluded from the study.

Operational Modality

Patients were enrolled as per the inclusion criteria of the study. The patients were closely monitored from the admission to the discharge, whereas the outpatients were randomly reviewed on their visits to OPD. In the present study, a total of 250 prescriptions gathered over the study period. The patients and drug charts were identified through routine ward rounds and prescription monitoring of all departments. All the relevant information was collected by one-to-one interaction with the patients. Patient data collection form was developed with considerations required for the study. The data collected includes patient demographic characters (name, Age, Gender etc.), and Anthropometric measurements, Patient histories, Diagnosis and the prescribed medications in detail. Data were collected from patient's case sheet and transferred to data entry format for evaluation. The results have been evaluated by steps in the process ordering, administration and monitoring of the prescribed medications. The so collected prescriptions were intensively monitored. The medications taken by the patients at hospital visit were analyzed for possible drug interaction through the electronic database - Micromedex × 2.0. The potential drug interactions of major and moderate severity were documented. These interactions were also classified in terms of their documentation status and mechanism.

RESULTS & DISCUSSION

Fig 1. Gender wise distribution

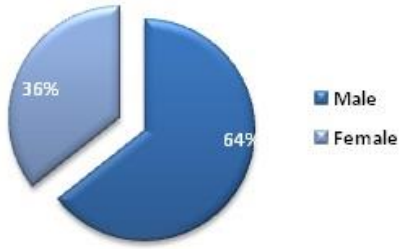


Fig 2. Age wise distribution in study population

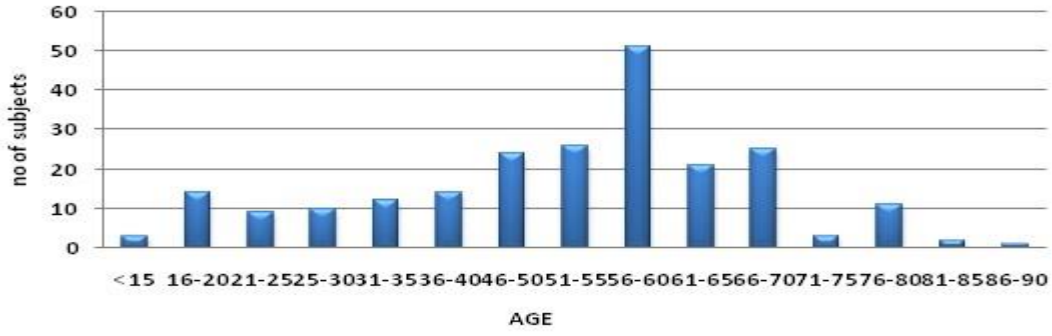


Fig 3. Number of drugs per prescription

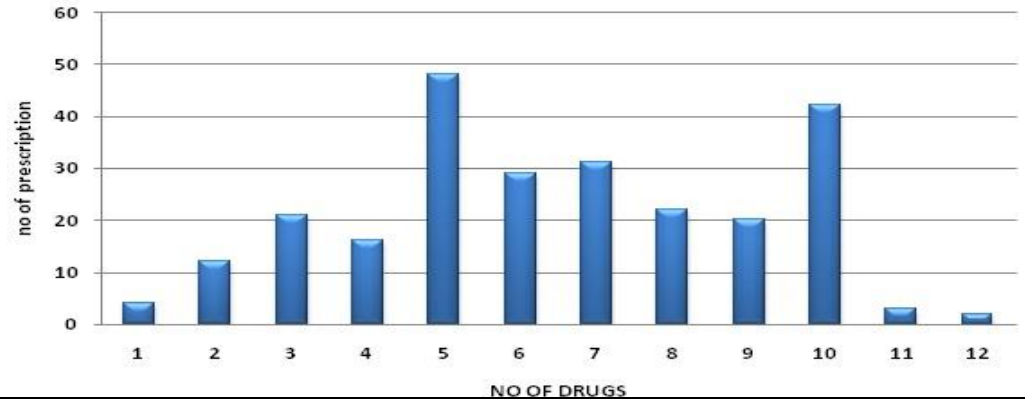


Fig 4. Mode of Pharmacotherapies in study population

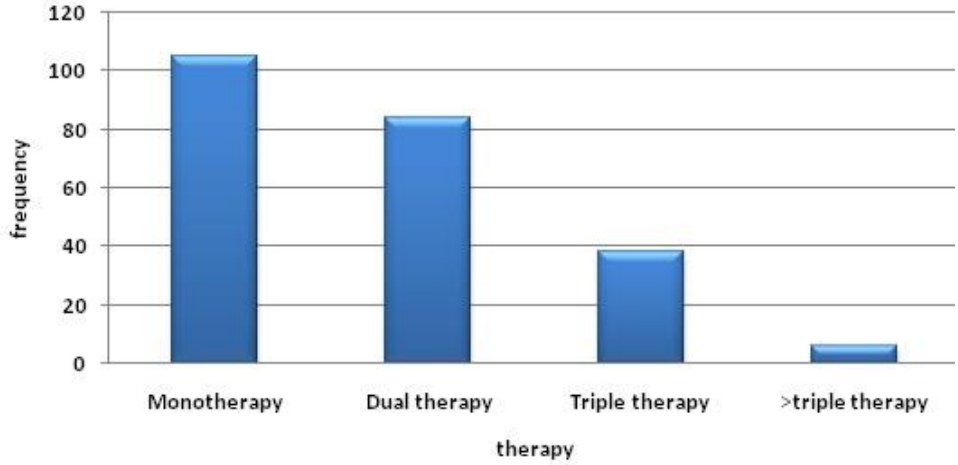


Fig 5. Co Morbidities distribution wise study

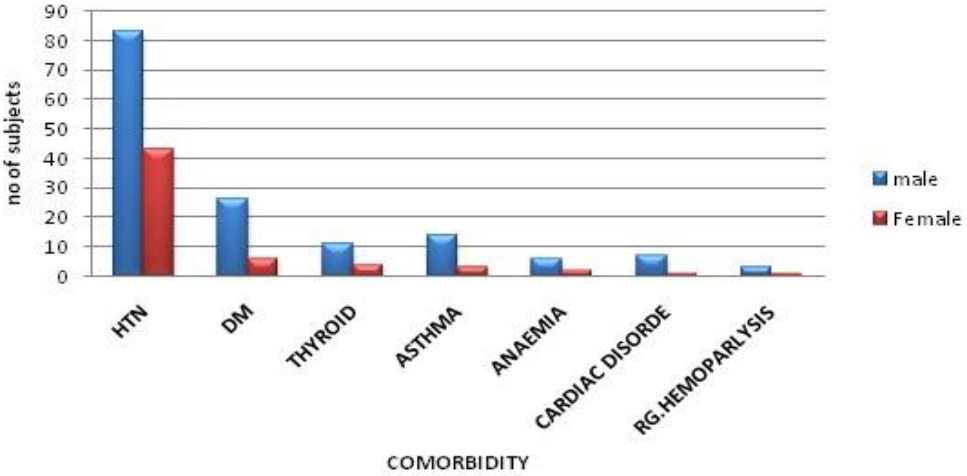


Fig 6. distribution of pharmacological drug classes

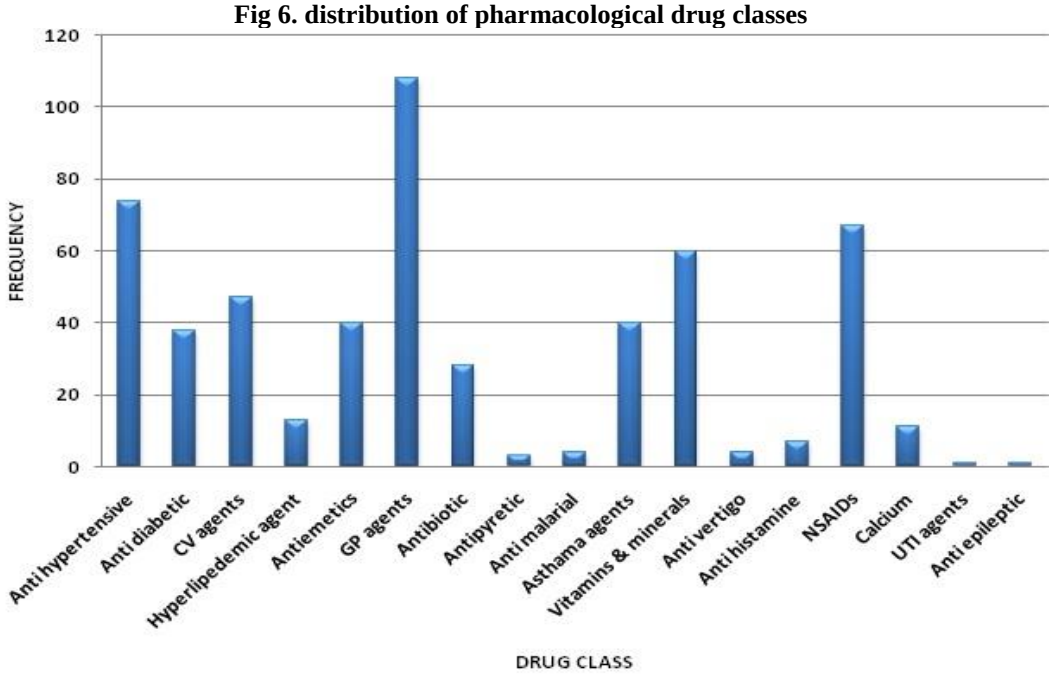


Fig 7. Medication errors types

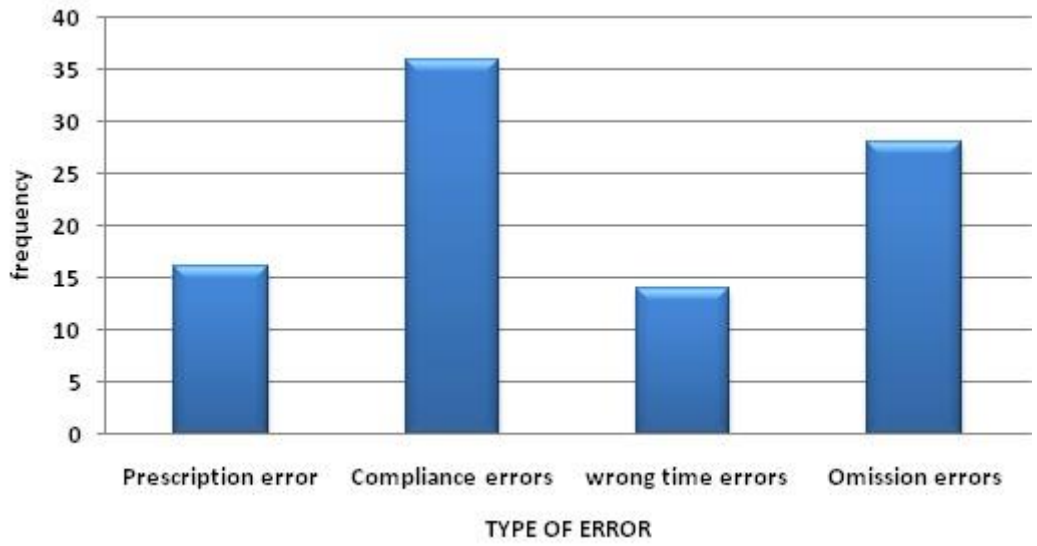


Fig 8. Medication error categorization

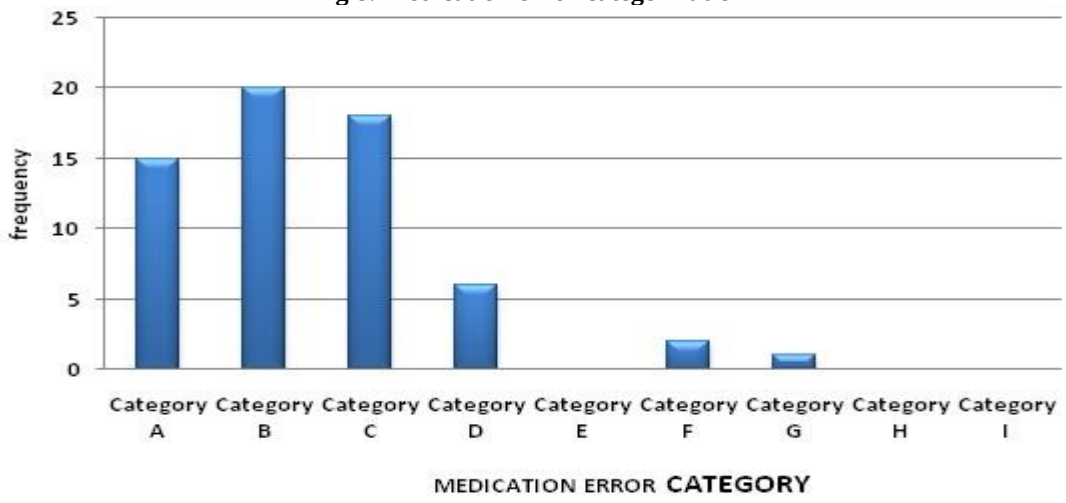


Fig 9. Severity assessment Drug-drug interactions

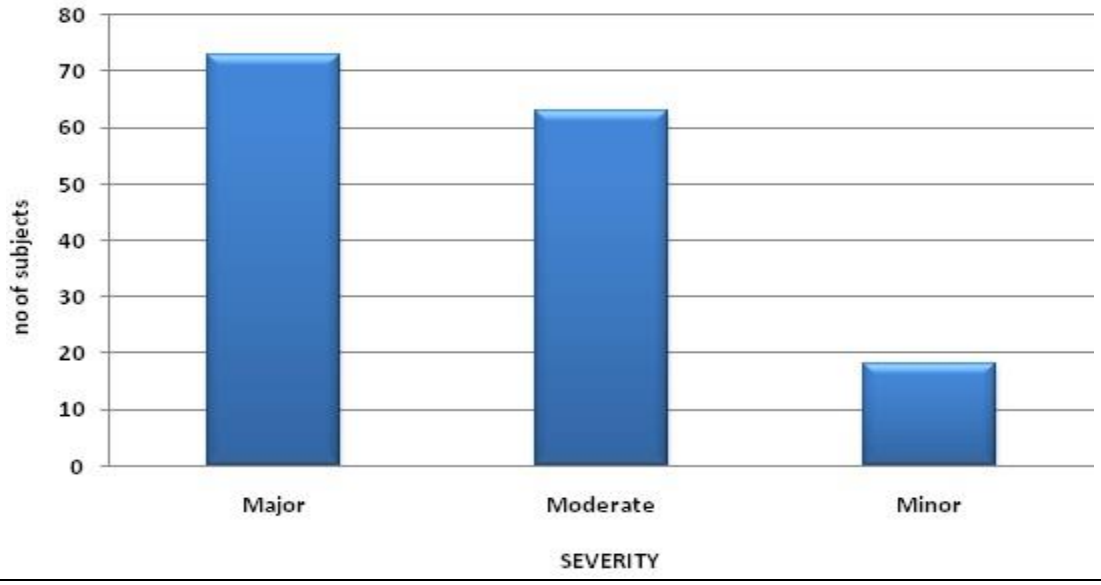


Fig 10. Drug-drug combinations (active substance) most frequently involved in Drug-Drug Interactions

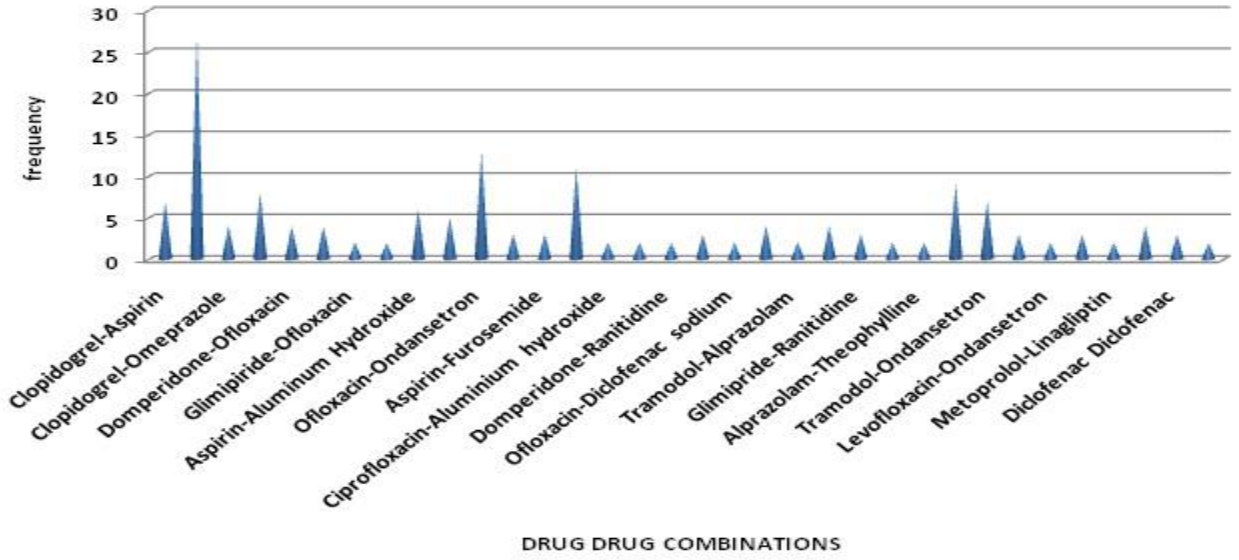


Fig 11. Active substance most frequently involved in Drug-Drug Interactions

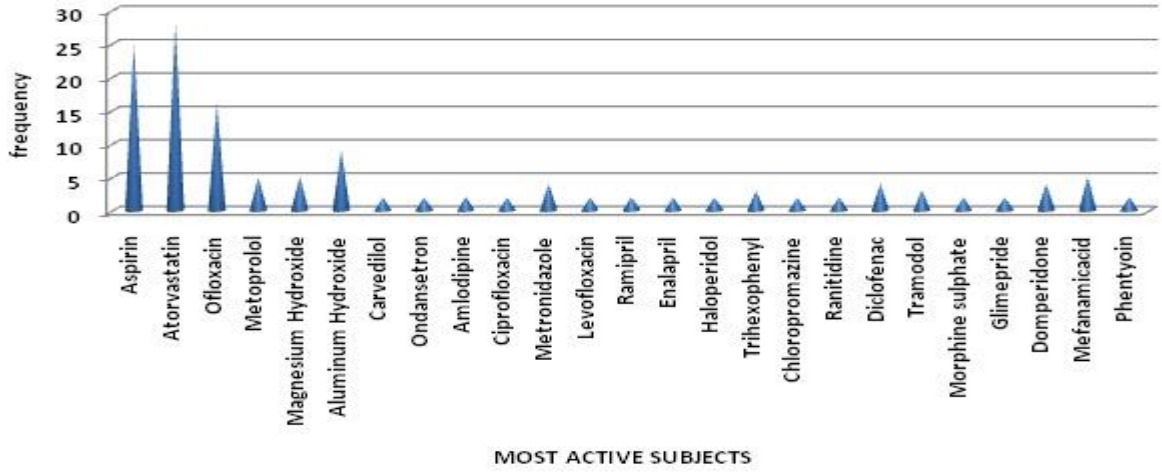
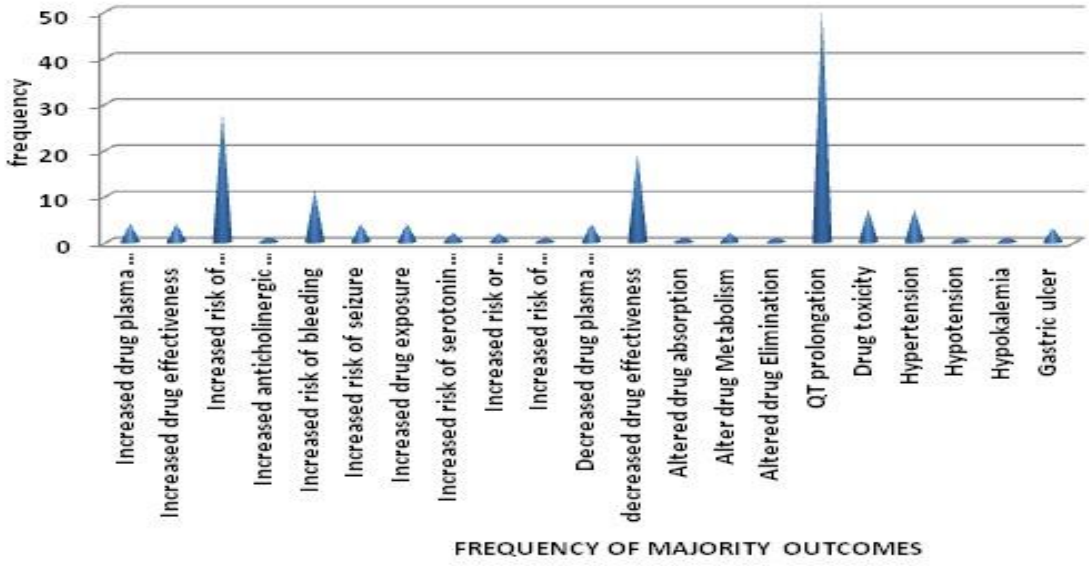


Fig 12. Frequency of majority of different outcomes of Drug-Drug Interactions



DISCUSSION

In the present study, the males are of 64.4% and females of 35.6%. Many studies reported that adverse drug effects were more common among females [9]. Female gender is considered of higher risk due to multiple factors including gender related differences in pharmacological profile, pharmacogenetics, immunology, hormonal factors and use of medicines as contraceptives in comparision to males. Similar results were observed in other studies showing higher incidence of ADRs in females [10]. But opposite to Arulmani R et.al., 2014, however Jose and Rao observed similar incidence of 0.15% for both genders.

The mean age of the patients was 50-55 years. The youngest was of 11 years old girl child, and the eldest was 89 year old male patient. The age group distribution for <15, 16-20, 21-25, 25-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, 66-70, 71-75, 76-80, 81-85, 86-90 were 3, 14, 9, 10, 12, 14, 24, 26, 51, 21, 25, 3, 11, 2, 1 respectively. Of this, the 56-60 age groups were of high enrollments stating 20.4% of total subjects.

Although the age could not be the precipitant of medication errors, the age groups as pediatrics, geriatrics are more prone to complications of these errors. None of the studies specifies that a particular age group was affected by the errors.

Of total 250 prescriptions, 1620 drugs have been prescribed. In which the prescriptions possessing 5 drugs were of high incidence accounting 19.2% of total. Followed by 10 drugs per prescription 42 in number (16.8%), 7 drugs per prescription 31 in number (12.4%), 6 drugs per prescription 29 in number (11.6%), 8 drugs per prescription 22 in number (8.8%), 3 drugs per prescription 21 in number (8.4%), 9 drugs per prescription 20 in number (8%), 2 drugs per prescription 12 in number (4.8%), 1 drug per prescription 4 in number (1.6%), 11 drugs per prescription 3 in number (1.2%) and least 12 drugs per prescription 2 in number (0.8%).

The most prescriptions covered minor problems that can be treated by monotherapy either of one or two drugs. In the prospective study, monotherapies account 45% of total. The dual therapy accounting 36% and triple therapy 16.3%, other multiple therapies 2.57%. The polypharmacy is the major risk factor for errors.

The co morbid conditions could precipitate the ADRs that probably cause the severe ill effects and even death to the patients. Hypertension (50.4%) is of high prevalence, followed by diabetes mellitus (13.6%), asthma (6.8%), thyroid disorders (6%), gastric problems (4.8%), anemia & cardiac disorders (3.2%) and hemoparalysis(1.6%) respectively.

A total of 1620 drugs prescribed, in which Gastroprotective agents accounting 19.7%, are of highest prescribed class of drugs. Second leading were antihypertensive agents 13.5% followed by NSAIDs accounting 12.2%. Next comes vitamins & mineral supplements (10.9%), cardiovascular agents (8.6%), anti emetics 7.3%, anti asthmatics 7.3%, anti diabetic agents 6.9%, antibiotics 5.1%, hyperlipidemic agents 2.3%

MEDICATION ERRORS

In this prospective study, we obtained two outcomes namely, medication errors and drug-drug interactions. The primary outcome of the study is medication errors. We perhaps botched to discover approximately errors, intensely dosing errors, administration errors. Additionally, we may be futile to spot more or less errors, inappropriate drug choice, which is detected mainly using candid criteria based on evidence, than abrupt criteria based on clinical judgment. There were a total of 94 medication errors were identified from the total prescriptions.

Out of 94 medication errors reported, further differentiated as prescription errors 16, compliance errors 36, wrong time errors 14, omission errors 28. Among these the prescription errors are of mostly illegible handwriting that probably leads to misunderstanding of the dispenser which thus may lead to serious injury to the patients. The compliance errors were the highest in number among the types of medication errors reported.

The results of many studies do not distinguish between the different types of medication error such as prescribing, dispensing and administration errors [11-12**]**. Studies of the prescribing error frequency generally fall into two groups, those based on the pharmacist review of medication orders and those based on the identification of patient harm. While little is known about the incidence of errors in primary care, there is no reason to suppose that prescribing errors are any less frequent [13].

Medication errors are categorized according to NCCMERP as category A (15), category B (20), category C(18), category D(6), category F(2), category G(1), while category E, category H, category I were of zero numbers.

Similar studies in southeastern countries are limited due to lack of reporting on medication errors.

DRUG-DRUG INTERACTIONS

In these 250 prescriptions, total 154 drug-drug interactions were detected with the help of Micromedex 2.0. Out of these, 17 drug pairs were potentially showed one drug-drug interaction, 14 drug pairs were potentially showed two Drug-drug interactions and 3 drug pairs were potentially showed three drug-drug interactions.

The severity of drug-drug interactions was classified as major, moderate, and minor. Of the 154 drug-drug interactions, the most of them were major severity. Interactions with major severity accounted for 73(47%) of the total drug-drug interactions, while those with moderate and minor severity accounted for 63(40%) and 18(13%) respectively.

The 25 active substances most frequently involved in drug-drug interactions. As excepted

cardiovascular drugs were the most frequently involved. Majority were atorvastatin 28(16.23%), followed by aspirin, ofloxacin, aluminum hydroxide, metoprolol, magnesium hydroxide, mefenamic acid, metronidazole, diclofenac, domperidone, trihexyphenyl, tramdol, carvedilol, ondanserton, amlodipine, ciprofloxacin, levofloxacin, ramipril, enalapril, haloperidol, chlorpromazine, ranitidine, morphine sulphate, glimipride, phenytoin was in 25(16.2), 16 (10.38%), 9(5.84%) , 5(3.24%),5(3.24%),5(3.24%), 4(2.59%), 4(2.59%), 4(2.59%), 3(1.94%), 3(1.94%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%), 2 (1.29%) and 2 (1.29%) respectively.

The 154 drug-drug interactions corresponded 34 drug combinations, however, the first 11 were responsible for 45.9% of all drug-drug interactions, the combination most frequently involved were Clopidogrel-Atorvastatin-27(17.53), Ofloxacin-Ondansetron-13(8.44%) , Ciprofloxacin-Theophylline-11(7.14%),Metronidazole-Ondansetron-9(5.84%), Clopidogrel-Amlodipine-8(5.19%), Clopidogrel- Aspirin-7(4.54%), Tramodol-Ondansetron- 7(4.54%), Aspirin-Aluminium hydroxide-6(3.89%), Aspirin-Magnesium hydroxide- 5(3.24%), Clopidogrel-Omeprozole-4(2.59%), Domperidone-Ofloxacin-4(2.59%), Magnesium oxide-Ofloxacin 4(2.59%), Ofloxacin–Metronidazole 4(2.59%), Glimipride-Metaprolol- 4(2.59%), Metaprolol-Metformin4(2.59%), Ofloxacin-Aliuminium hydroxide-3(1.94%), Aspirin-Furosemide-3(1.94%), Ofloxacin-Metformin- 3(1.94%) , Glimipride –Ranitidine- 3 (1.94%) , Metronidazole-Ofloxacin3(1.94%), Metoprolol-Aspirin 3(1.94%), Diclofenac–Diclofenac 3(1.94) , Glimipride-Ofloxacin 2(1.29%) , Glimipride- Metaprolol 2(1.29%), Ciprofloxacin- Aluminium hydroxide-2(1.29%) , Ciprofloxacin-Magnesium hydroxide2(1.29%), Domperidone –Rantidine-2(1.29%), Ofloxacin-Diclofenac sodium- 2(1.29%), Tramodol-Alprazolam-2(1.29%), Glimipride-Ramipril-2(1.29%), Alprazolam-Theophylline-2(1.29%), Levofloxacin-Ondansetron 2(1.29%), Metoprolol-Linagliptin-(1.29%), Clopidogrel-Phenytoin-2(1.29%).

Among the 154 drug interactions, when classified to the according to the resulting effect, the frequencies of the majority outcomes of the drug-drug interactions was found that 31.84% lead to be QT interval prolongation, followed by increased risk of hypoglycemia or hyperglycemia 17.83%; decreased drug effectiveness 12.10%; increased risk of bleeding 7%; drug toxicity, hypertension, increased plasma drug concentration, increased drug effectiveness, increased risk of seizures, increased drug exposure, decreased drug plasma concentrations accounting 4.45%; gastric ulcers 1.91%; increased risk of serotonin syndrome, increased risk of rhabdomyolosis, altered drug metabolism accounting 1.27%; increased anticholinergic effects, increased risk of CNS/Respiratory depression, altered drug absorption, altered drug elimination, hypotension, hypokalemia accounting 0.63%.

In general elderly patients are at higher risk for drug-drug interactions (David N.Juurlink et al.., 2003). It is because they are likely to have multiple diseases that usually occur with an increased duration of medication use. As the presence of co-morbidities leads to polypharmacy is common in the patients. In this study the average number of drugs per prescription was 6.48±2.58, in most prescriptions the number was higher .Thus, it was evident that polypharmacy is a predisposing factor for drug-drug interaction.

In our study most potentially drug-drug interactions were ‘major’. These potential drug-drug interactions suggest that there is a need for dosage adjustment. Cite related article. In order to prevent these drug drug interactions, healthcare providers should have adequate information about drug drug interactions [14].

CONCLUSION

Medication errors are an important clinical issue and claimed to be the cause of mortality and morbidity. In this study we aimed to estimate the incidence of medication errors, and had observed the drug-drug interactions as a secondary outcome.

Even though our study is of small scale we figured out much medication errors which evidences that the current health care system should adopt some standard monitoring procedures to reduce the errors and drug-drug interactions in order to improve patient’s health status. Measures as obtaining detailed patient history, medication reconciliation and continuing follow up.

Through this prospective study we conclude that it is the responsibility of every personnel in the health care system to avoid medication errors. Especially the pharmacist, practicing clinical pharmacy, possessing knowledge of calculations, pharmacology, toxicology and particularly pharmacokinetics of the medicine prescribed, should have more allegiance towards this field.

The awareness on reporting of an adverse drug reaction without any bias is to be brought out. The reporting of these can lead to eradication of those events.

ACKNOWLEDGEMENT

Nil

CONFLICT OF INTEREST

Nil.

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