



Study and Evaluation of Medication Errors in Medicine and Orthopedic Wards of a Tertiary Care Hospital

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Authors' contributions

This work was carried out in between the both authors. Both the authors were involved completely in designing of the study and execution of the study completely.

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ABSTRACT

Aims: The main aim of the present study was to detect and evaluate the incidence, types, factors and severity of medication errors in the medicine and orthopedic wards of a tertiary care hospital.

Study Design: This was a prospective and observational study.

Place and Duration of Study: Department of Medicine and Orthopedic wards of Sri Adichunchanagiri Hospital and Research Centre, B.G.Nagara-571448, Karnataka, India, between June 2014 to February 2015.

Methodology: The patients who satisfied inclusion and exclusion criteria were enrolled after obtaining their consent. The required data was collected in the Case Record Form and reviewed daily from the day of admission to discharge in the posted department. Different types of medication errors was identified, documented and the severity of medication error was identified by using NCC MERP guidelines.

Results: A total of 200 inpatient cases from orthopedic ward and medicine ward were collected, 100 cases from each ward. In orthopedic ward, 40% patients were of 20-39 years age and in medicine ward, 48% patients were of 60-79 years age. A total of 136 and 103 medication errors

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were observed in orthopedic and medicine ward, among them 65% and 62% were prescription errors, 25% and 18% were administration errors, 6% and 12% were transcription errors and 4% and 8% were dispensing errors. The cause of medication errors were 64.7% and 62.1% were due to physicians, 31.6% and 30.1% were due to nurses and 3.7% and 7.8% were due to pharmacists in orthopedic and medicine ward. Majority of medication errors 68.4% and 62.1% were belonged to category-B severity in orthopedic and medicine ward respectively.

Conclusion: Clinical pharmacist can play a major role in preventing medication errors by early detection. Since our system lacks a well-organize detection and reporting mechanism, Hence, as the first step we must implement a system where errors are routinely detected and reported.

Keywords: Medication error; clinical pharmacist; orthopedic and medicine ward; severity of error.

1. INTRODUCTION

A medication is defined as a product that contains a compound with proven biological effects containing excipients along with the active compound is usually a drug or prodrug/cellular element. Medication process in a healthcare service is an interdisciplinary complex process which involves every aspect of medication related process includes doctor's written prescription, transcribing case sheets followed by pharmacist review for appropriateness and nursing administration of the medication order to the patient [1].

Medication errors are sometimes described as human errors which lead them for prolonged hospitalizations, extra medical interventions, morbidity and even death, sometimes burden to both patients and hospitals. These errors are preventable [2,3].

A medication error can be defined as 'A failure in the treatment process that leads to, potential to harm to the patient' [4] or the medication error is defined as: " the failure of the planned action to be completed as intended or use of as wrong plan to achieve an aim" [5].

According to NCCMERP (National coordinating council for medication error reporting and prevention) a medication error is defined as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer" [6].

Medication error is a universal problem which affects globally at any stage of healthcare delivery process leads to patient injury or death in hospitals. Commonly occurring errors in healthcare system are prescription errors, administration errors, transcription errors and dispensing errors [7-10].

1.1 Prescription Errors

It is defined as the errors which arise due to fault in the prescription charts directions made by physicians. These errors include incomplete prescription, incorrect information, inappropriate doses etc. prescription errors results from the fault and the mistakes committed by the physicians.

1.2 Administration Errors

These occur when there is a discrepancy between instructions of the physician leads to wrong medication administered to the patient. Administration errors caused by any deviation from physician's instructions as written on patient chart, it includes incorrect or wrongful administration of a medication.

1.3 Transcription Errors

Transcription sheet is an identical copy of physician's order which is copied by nurses as they are recorded in nursing written transcribing index. Transcription errors are changes in name, route, dose, frequency etc.

1.4 Dispensing Errors

Pharmacy is an important part of any healthcare organization and is mainly responsible for the different types of errors like commission and omission. Dispensing error may be error of commission (dispensing of wrong route or dose) and error of omission (dispensing of incorrect medication, dosage strength or dosage forms) [1].

The US agency for healthcare research and quality has reported that 20-30% of medical errors lead to death or injury. In the USA, MEs have been found to be responsible for 7000 patient injuries per year, with a similar incidence

and consequences in the UK. Approximately one third of adverse drug events are associated with medication errors and which are preventable. MEs occur on 6.5 of 100 adult hospital admissions and 5 of 100 adult medication orders [11].

In US, 225000 deaths occur per year due to unintentional medical errors. It is reported that nearly 98000 people die annually, because of mistakes committed by medical professionals in hospitals. In India, among 720000 ADRs, deaths are approximately 400000, hence ME are one of the leading cause of death and disability among the seventh most common cause [12-14].

Based on the severity of outcome NCCMERF classifies ME categories into A to I.

Category A- Circumstances/event that have the capacity to cause error.

Category B- An error occurred but the error did not reach the patient.

Category C- An error occurred that reached the patient but did not cause patient harm.

Category 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.

Category E- An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention.

Category F- An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization.

Category G- An error occurred that may have contributed to or resulted in permanent patient harm.

Category H- An error occurred that required intervention necessary to sustain life.

Category I- An error occurred that may have contributed to or resulted in the patient's death [10].

The incidences of medication error are challenging and increasing day by day so many medication errors are probably undetected so its occurrence is common in both developed as well as developing countries [15].

Some of the studies have shown that approximately 5% to 10% of medical errors are due to inadequate communication, 40% to 45% due to medical diagnosis, and 20% to 25% due to management. The some of the reasons for errors are often made by physicians with less

experience, extreme busy, complicated case, high confidence level, overestimate their skills and abilities, stress, burnout and depression of healthcare personnel [16-18].

Most common factors contributed to medication errors are lack of communication between physician and patient or between health-care professionals, inaccurate diagnosis, and/or the inappropriate management of a patient, lack of drug information, incorrect diagnosis, drug-drug interactions, dose miscalculations, incorrect drug administration and lack of patient education, miscommunication of drug order resulting from poor hand writing, missing information when the drug is packed into smaller units, external factors such as interruption, work load, job stress, improper training or education and sound alike lookalike packaging of medications by the experienced or inexperienced staff. Many medication errors are probably undetected, due to this which affects the patient's morbidity or mortality so medication errors should not be taken lightly and an effective system should be established at the stage of ordering, dispensing and administering medications. Medication errors should be identified and documented in order to recognize recurring causes and therefore develop systems to minimize them [3,8,9,19].

Leape et al. [20] study showed 66% adverse events can be preventable if the pharmacist presence in the ward rounds [19]. The detected or identified medication errors documentation will facilitate the error avoidance for understanding of the lapses in medication process and interferences for increasing awareness, policies and confidence in the health care system [20,21].

The nature and types of the errors should be identified and reduce the incidence of medication error for improving the health care. Medication error can be obtained by extraction from practice data, incident report from health professionals and patient surveys. Practice data includes charts, laboratory and prescription data. Investigating the incidence, type and nature of medication errors are very crucial need to prevent and to improve the quality of health delivery.

According to the American society of health system pharmacists' guidelines, medication error should be identified and documented and their causes should be studied in hospitals to develop systems for minimizing the recurrence and for improving of quality health care delivery in the hospital.

Adichunchanagiri institute of medical sciences (AIMS) is a 1050-bedded tertiary care teaching hospital situated in a rural area of B.G Nagara of Nagamangala Taluk. There were no studies conducted previously in this rural hospital regarding study and evaluation of medication errors in medicine and orthopedic wards of tertiary care teaching hospital. Hence the present study was carried out in our hospital of the orthopedic and medicine departments.

2. MATERIALS AND METHODS

2.1 Study Setting

The study was carried out at in-patient Department of orthopedic and medicine at Adichunchanagiri hospital and research centre, B.G Nagara which is 1050 bed tertiary care teaching hospital.

2.2 Study Design

It was a prospective observational type of study in which patients receiving medication during the time of treatment were studied.

2.3 Study Period

It was a prospective type of study initiated from June 2014 to February 2015(Nine Months)

2.4 Study Criteria

Patients of Orthopedic and Medicine department were enrolled into the study by considering following criteria.

2.4.1 Inclusion criteria

Patients who were shown interest to participate in the study.

2.4.2 Exclusion criteria

Surgery, pediatric, OBG patients and Outpatients.

2.5 Source of Data

Data was obtained from the Inpatients case sheets, patient care giver interview, patient demographic details, treatment charts, and investigation reports of the patients who were admitted in orthopedic and medicine departments.

2.6 Study Material

The following material was used for the study:

- Patient profile form (Includes patient prescription and administration details)
- Case record data collection form. (Annexure-III)
- Patient informed consent

2.7 Study Procedure

A suitable questionnaire/patient data collection form was prepared and the required data was collected in the CRF form in the orthopedic ward (5 months) and medicine ward (4 months). The inpatient case record was reviewed daily from the day of admission to discharge in the posted department which includes patient case history, diagnosis, physician medication order sheets, nurses' administration records, progress charts, laboratory investigations and report of other diagnostic tests. Different types of medication errors was identified and was documented, nursing records was checked for the details like dose, frequency, route, dosage form, administration of the medication as per the orders was checked. Any omission of the doses was also noted. Different contributing factors causing Medication errors was analyzed and documented.

The severity of medication error was identified by using National coordination council for medication error reporting and prevention proposed medication error index. The collected data was subjected for suitable statistical method using statistical software SPSS 20.0.

3. RESULTS AND DISCUSSION

3.1 Distribution of Patients Based on Gender

A total of 200 Inpatient cases were observed, among them, 100 cases were from orthopedic and 100 cases were from medicine ward. Out of 100 orthopedic cases and 100 medicine cases medication errors were identified in 73(73%) cases and 67(67%) cases respectively. Out of 100 orthopedic cases, the number of males are more i.e. (73%) when compare to female (27%), (Table 1), this is because males are highly exposed to works and the chances of accidental incidents were more common which might be the reason for high number of males when compare

to female. Even the similar results were observed in the study carried out by Karna et al. [19] on study and evaluation of medication errors in medicine wards which showed predominant of males over females [i.e. males (77.4%) and females (22.6%)].

Out of 100 medicine cases, the numbers of females are more i.e. (60%) when compared to male (40%), which is quite reverse when compare to orthopedic cases (Table 1). This may be because of physiological and other working related issues like household activities and gets exposed to dust; self care is low, lack of awareness. The similar type of results was observed in the study conducted by Laguluri Redenna et al. [8] in medicine, pediatric and OBG ward [i.e. males (28.77%) and females (71.28%)].

3.2 Distribution of Patients Based on Age-category

The distribution of age of the study population was ranged from one year to 99 years. In orthopedics ward, 20-39 years (40%) were constituted more in number (Table 2). This is because the 20-39 years age group patient visited the hospital are in high number and this age group patient may be highly exposed to works and the chances of accidental incidents may be more common so this group constitutes more in number. The similar type of results was observed in Laguluri Redenna et al. [8] study conducted in outpatient ward of medicine, pediatrics and OBG [i.e.13-30 years (27.5%) and 31-50 years (26%)].

In medicine ward, the age group of 60-79 years (48%) constituted more in number (Table 2). This may be because the old age patient suffers more from disease due to low care, lack of awareness, household activities and as 60-79 years group visited hospital in large number hence it constitute more in number.

3.3 Distribution of Medication Errors Based on Age Wise

In orthopedic ward, the incidence of medication errors was high between 20-59 years (40%) (Table 3), this may be because of lot of stresses at this age group may leads to health related issues even system related factors were observed. Even the almost similar type of results was observed in the study conducted by Karna et al. [19] in medicine wards which showed high

incidence of medication errors in 20-60 years of age [i.e. 20-40 years (31.4%) and 40-60 years (38.5%)].

In medicine ward, the incidence of medication error was observed more at the age group of 60-79 years (Table 3). Even this may be cause because of physiological changes and financial stress and showing need of pharmaceutical care in these patients.

3.4 Distribution of Medication Error Related to Professionals and Its Contributing Factors

Out of 73 orthopedic cases and 63 medicine cases had 136 medication errors and 103 medication errors respectively In orthopedic and medicine ward 43 (31.6%) and 31 (30.1%) were due to nurses in which 10 (23.3%) and 12 (38.7%) were due to untrained nurses, 17 (39.5%) and 3 (9.7%) were due to increased workload on nurses, and 16 (37.2%) and 16 (51.6%) were due to high activity like stress environment, rushing and distraction in work. However 5 (3.7%) and 8 (7.8%) were due to pharmacist in which 2 (40%) and 2 (25%) were due to high workload, 3 (60%) and 6 (75%) were due to generic drugs and 88 (64.7%) and 64 (62.1%) were due to physician, in which 2 (2.3%) and 1 (1.6%) were due to unclear order, 6 (6.8%) and 1 (1.6%) were due to wrong order, 80 (90.9%) and 62 (96.9%) were due to work without support from seniors/prescribing by post-graduates (Tables 4 and 5). The reasons for nursing errors may be due to commitment of the errors by the nursing students at the time of administration of drugs, increased workload, and forgetfulness for the administration of drugs to the patient and high activity attributed to medication administration errors. The factors for the errors made by pharmacist may be due to high workload, number of patient in queue for taking the medicines and errors in dispensing the generic drugs The reasons for errors made by physicians may be due to writing the unclear order in the prescription and writing the wrong order due to lack of knowledge and heavy patient load. The common factor may be lack of adequate knowledge in PGs regarding drug therapy, lack of drug information, incorrect diagnosis, lack of patient education and poor handwriting and job related stress and work load which are the reasons for errors committed by physicians. Even similar result was observed in the study carried out by karna et al. [19] conducted in medicine wards, [i.e. untrained

nurses (20.3%), increased workload (37.8%), stress environment (41.7%), handwriting (43.2%), high workload (18.9%), generic drugs (13.5%), unclear order (55.5%), and wrong order (44.4%).

3.5 Distribution of Types of Medication Errors

In orthopedic ward and medicine ward, a total of 136 and 103 medication errors were observed, among them majority of errors i.e. 88 (65%) and 64 (62%) were due to prescription, 34 (25%) and 19 (18%) were errors due to medication administration, 9 (6%) and 12 (12%) were due to medication transcribing, 5 (4%) and 8 (8%) were due to medication dispensing (Table 6 and Figs. 1 and 2). The factors for high prescription errors may be due to prescribing by the post graduate students who do not write the doses, route, and frequency of drugs due to lack of patient education, lack of drug information, rushing and hurry environment. This was similar to the study conducted by Redenna et al. [8] in outpatient ward of medicine, pediatric, OBG which had shown majority of prescribing errors i.e. (88.89%) and another study conducted by Asad et al. [22] in emergency department which showed even similar type of errors i.e. Prescription errors (53.9%), Administration errors (34.8%), Transcription errors (10.7%), Dispensing errors (0.6%).

3.6 Distribution of Type of Prescription Error

In orthopedic ward and medicine ward, prescription error was found to be 88 and 64. Among them, 56 (63.6%) and 47 (73.4%) were dosage related error, 16 (18.2%) and 11 (17.2%) were related to absence of frequency, 8 (9.1%) and 4 (6.3%) were due to absence of route, 6 (6.8%) and 1 (1.6%) were due to wrong dose, and 2 (2.3%) and 1 (1.6%) were due to wrong route written and wrong frequency (Table 7). This may be because of the writing of prescription by post graduate students due to not writing the doses, route, and frequency of drugs may be due to lack of patient education, lack of drug information,

rushing, busy schedule, personal stress and hurry environment. Sometimes the physicians do not write the doses of commonly used drugs, and whenever in hurry they commits mistakes, so prescription errors occurs. The similar results was found in the study conducted by Majed et al [11] in pediatric inpatient department [i.e. dose error (22.1%), route errors (12%), frequency errors (5.4%)] respectively.

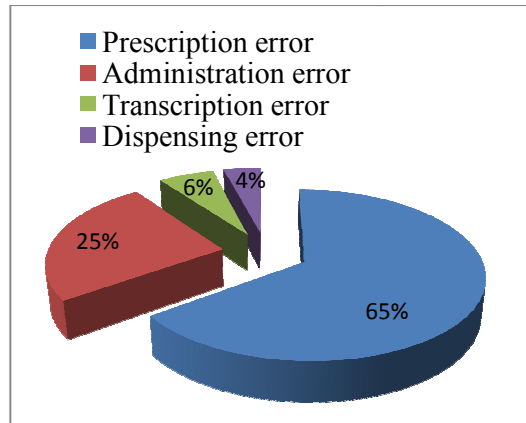


Fig. 1. Types of medication errors (Orthopedic ward)

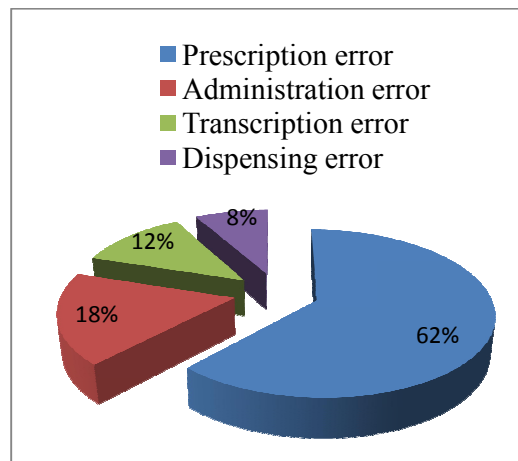


Fig. 2. Types of medication errors (Medicine ward)

Table 1. Distribution of patients based on gender

Sex	Orthopedic ward	Medicine ward
	Number and percentage	Number and percentage
Male	73	40
Female	27	60
Total	100	100

Table 2. Distribution of patients based on Age-category

Age group (years)	Orthopedic ward		Medicine ward	
	Number and percentage		Number and percentage	
1-19	8		0	
20-39	40		17	
40-59	37		30	
60-79	14		48	
80-99	1		5	
Mean±SD	40.27±15.698		56.58±16.183	

Table 3. Distribution of medication errors based on age wise

Age group (years)	Orthopedic ward		Medicine ward	
	No. of errors	Percentage	No. of errors	Percentage
1-19	9	6	0	0
20-39	54	40	18	17
40-59	54	40	32	31
60-79	16	12	50	49
80-99	3	2	3	3
Total	136	100	103	100
Mean±SD	27.2±24.8		20.6±20.8	

Table 4. Distribution of medication error related to professionals

Professionals involved	Orthopedic ward		Medicine ward	
	No. of errors	Percentages	No. of errors	Percentages
Medication errors by physician	88	64.7	64	62.1
Medication errors by nurses	43	31.6	31	30.1
Medication errors by pharmacist	5	3.7	8	7.8
Mean±SD	45.3±41.5		34.3±28.1	

Table 5. Distribution of factors contributing to medication error

Factors	Number and percentages	
	Orthopedics ward	Medicine ward
Medication errors by nurses		
Untrained nurses	10(23.3%)	12(38.7%)
Increased workload on nurses	17(39.5%)	3(9.7%)
High activity and stress environment, rushing and distraction in work	16(37.2%)	16(51.6%)
Total	43(31.6%)	31(30.1%)
Mean ± SD	14±3.78	10.33±6.65
Medication error by pharmacist	Orthopedics ward	Medicine ward
High workload	2(40%)	2(25%)
Generic drugs	3(60%)	6(75%)
Total	5(3.7%)	8(7.8%)
Mean ± SD	2.5±0.70	4±2.82
Medication errors by physicians	Orthopedics ward	Medicine ward
Unclear order	2(2.3%)	1(1.6%)
Wrong order	6(6.8%)	1(1.6%)
Work without support from seniors/prescribing by post-graduates	80(90.9%)	62(96.9%)
Total	88(64.7%)	64(62.1%)
Mean ± SD	29.33±43.92	21.33±35.21

Table 6. Distribution of types of medication errors

Types of medication errors	Orthopedic ward		Medicine ward	
	No. of errors	percentage	No. of errors	Percentage
Prescription error	88	65	64	62
Administration error	34	25	19	18
Transcription error	9	6	12	12
Dispensing error	5	4	8	8
Total	136	100	103	100
Mean±SD	34±38.2		25.7±25.9	

Table 7. Distribution of type of prescription error

Types of prescription error	Orthopedic ward		Medicine ward	
	No. of errors	Percentage	No. of errors	Percentage
Dose not written	56	63.6	47	73.4
Frequency not written	16	18.2	11	17.2
Route not written	8	9.1	4	6.3
Dosage form not written	0	0	0	0
Wrong drug	0	0	0	0
Wrong dose	6	6.8	1	1.6
Wrong dosage form	0	0	0	0
Wrong route in prescription	2	2.3	0	0
Wrong dose in interval	0	0	1	1.6
Mean±SD	9.77±18.15		7.11±15.38	

3.7 Distribution of Types of Administration Errors

In orthopedic ward and medicine ward, administration error was found to be 34 and 19. Among them, 15 (44.1%) and 8 (42.1%) were errors in omission of drug, 2 (5.9%) were errors in wrong time, 6 (17.16) and 5 (26.3%) were errors in wrong dose, 7 (20.6%) and 5 (26.3%) were errors in wrong route, and 4 (11.8%), 1 (5.3%) were errors in administer after discontinue order (Table 8). The reasons for this may be forgetfulness of nurses to administer the drugs because of the high workload, stress environment, more number of patients admitted at the same time, nursing students who do not properly administer the drugs, untrained nurses, increased workload on nurses, high activity, stress environment, rushing and distraction in work. This was similar to the study conducted by Ramesh A et al. [7] conducted in medicine ward [i.e. omission errors (33.02%), wrong route (1.83%), wrong time (12.84%) and wrong dosage form (1.83%)].

3.8 Distribution of Types of Transcription Errors

In orthopedic and medicine ward, transcription error was found to be 9 and 12. Among them, 8

(88.9%) and 8 (66.7%) were errors in omission of drug in transcribing index, 1 (11.1%) and 2 (16.7%) were errors in wrong frequency and 2 (16.7%) were errors in wrong dose transcription in medicine ward (Table 9). This may be because of high workload, high activity, rushing, stress condition and forgetting nature of nurses which result in transcription errors. This was similar to study conducted by Afsaneh Vazin et al. [23] on study of medication errors in ICU [i.e. transcription error (3.3%)].

3.9 Distribution of Types of Dispensing Errors

In orthopedic and medicine ward, dispensing error was found to be 5 and 8. Among them, 3 (60%) and 5 (62.5%) were errors in wrong drug dispensing, 2 (40%) and 3 (37.5%) were errors in wrong dosage form and wrong dose dispensing (Table 10). This may be due to the generic drugs dispensing, high workload, patients in queue, lack of well arrangement of drugs in racks which leads to dispensing errors. This was similar with the study conducted by Clyde d et al. [24] on study of medication errors in oncology ward [i.e. wrong drugs (1), incompatible drug (1), and wrong dose (3)].

Table 8. Distribution of types of administration errors

Types of administration error	Orthopedic ward		Medicine wards	
	No. of errors	Percentage	No. of errors	Percentage
Omission	15	44.1	8	42.1
Wrong patient	0	0	0	0
Wrong time	2	5.9	0	0
Wrong dose	6	17.6	5	26.3
Wrong route	7	20.6	5	26.3
Administer after discontinue order	4	11.8	1	5.3
Mean±SD	5.66±5.24		3.16±3.31	

Table 9. Distribution of types of transcription errors

Types of transcription error	Orthopedic ward		Medicine wards	
	No. of errors	percentage	No. of errors	Percentage
Omission	8	88.9	8	66.7
Wrong frequency	1	11.1	2	16.7
Wrong dose	0	0	2	16.7
Mean±SD	3±4.35		4±3.46	

Table 10. Distribution of types of dispensing errors

Types of dispensing error	Orthopedic ward		Medicine wards	
	No. of errors	percentage	No. of errors	Percentage
Wrong drug	3	60	5	62.5
Wrong dose	0	0	3	37.5
Wrong dosage form	2	40	0	0
Mean±SD	1.66±1.52		2.66±2.51	

3.10 Distribution of Medication Errors Based on Therapeutic/System-wise Classification

In orthopedic ward, the study revealed that drugs of analgesics, antipyretics, NSAIDs (31.6%) was the most commonly encountered medication class of errors followed by gastrointestinal (31.6%), antibiotics and anti-infective (30.9%), vitamins and minerals (3.7%), cardiovascular (1.5%) and endocrine (0.7%) respectively (Fig. 3). This may be because as in orthopedic ward, patients are often treated with analgesics, antibiotics and gastrointestinal group of medications in which patient come across with the complaint of infection and pain hence physician prescribe antibiotics and analgesics drugs and for the fast healing and treatment of stomach upset they prescribe gastrointestinal and vitamins drugs hence the error incidence are high in these classes of medication groups. This was similar results with the study conducted by Redenna et al. [8] conducted in medicine, surgery, pediatrics and OBG outpatient wards where more number of errors occurred in class of

NSAIDs (21.11%), gastrointestinal (16.67%) and anti-microbial (23.33%) respectively.

In medicine ward, majority of medication errors were due to drugs of gastrointestinal (22.1%) followed by endocrine(8.1%), cardiovascular (11.8%), diuretics (1.5%), vitamins and minerals (0.7%), respiratory drugs (2.9%), antipyretics, analgesics, NSAIDs (8.8%), medicines affecting blood (0.7%) and anti-epileptics, CNS, muscle relaxant (5.1%) respectively (Fig. 3). As in medicine ward maximum patient come across with complaints of high blood pressure, high blood sugar, high cholesterol level and stomach upset hence patient are mostly treated with CVS, gastrointestinal and endocrine drugs so the errors are occurred more in these groups of drugs. Even the similar results were observed in the study carried out by Karna et al. [19] on study and evaluation of medication errors in medicine ward, where the largest number of medication errors occurred with the drugs of cardiovascular (16.7%), gastrointestinal (7.1%) and endocrine system (4.1%) respectively.

3.11 Distribution of Medication Errors Based on Severity (NCCMERP)

In orthopedic ward, the severity level assessment of medication errors revealed that majority of the errors 93 (68.4%) belong to category B, 40 (29.4%) belong to category C and 3 (2.2%) belongs to category E. Majority of errors i.e. 68.4% did not reach to the patient and 29.4% reached the patient but did not cause harm to the patient. In medicine ward, it was found that the medication error 64(62.1%) belong to category B, 38(36.9%) belong to category C and 1(1%) belongs to category E (Fig. 4). This was similar to the study conducted by Karna et al. [19] on study of medication errors in medicine wards [i.e. Cat-B (28.1%) did not reach to the patient and Cat-C (61.6%) reached to patient but did not cause harm to the patient].

3.12 Distribution of Drug-Drug Interaction Based on Severity

In orthopedic ward, the total no of drug-drug interaction was found to be 11. Interestingly all of them belong to moderate class. In medicine ward, the total no of drug-drug interaction was found to be 11. Among them 1 (9.1%)

interactions belong to minor class followed by 9 (81.8%) belong to moderate class, and 1 (9.1%) belong to major class respectively (Table 11). This may be because physician prescribes the drugs which are not compatible to each other and due to lack of proper drug knowledge drug-drug interactions occurs.

In orthopedic ward, more number of drug-drug interactions were found in the class of analgesics and NSAIDs group of drugs which were moderate interactions, maximum interactions were found in prescribing of Aceclofenac and Diclofenac at the same time, Methocarbamol and Tramadol, Aceclofenac and Amikacin, Ibuprofen and Diclofenac etc similarly in medicine ward, maximum number of drug-drug interactions were found in antibiotics, gastrointestinal and antihypertensive class of drugs. Major drug-drug interaction was found in prescribing of Ciprofloxacin and Ondansetron followed by moderate interactions in prescribing of Ramipril and Aspirin, Ramipril and Furesamide, Levofloxacin and Metformin followed by minor interaction between Metronidazole and Phenytoin which are pharmacodynamic and synergistic in nature.

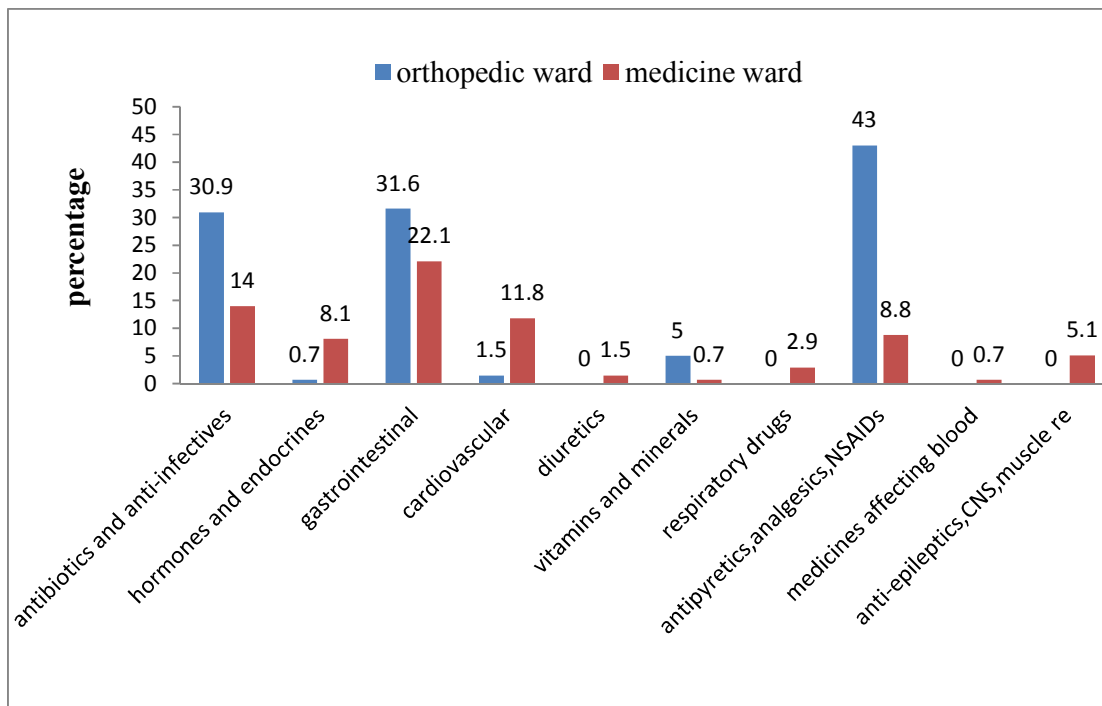


Fig. 3. Class-wise categorization of drugs involved in medication errors

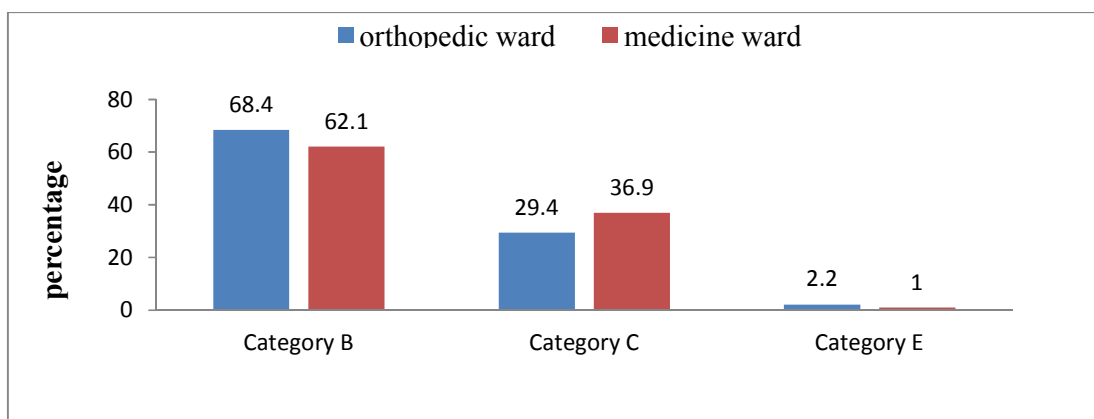


Fig. 4. Distribution of medication error based on severity

Table 11. Distribution of drug-drug interaction based on severity

Level of severity	Orthopedic ward		Medicine ward	
	No. of interactions	percentage	No. of interactions	percentage
Minor	0	0	1	9.1
Moderate	11	100	9	81.8
Major	0	0	1	9.1
Mean±SD	3.66±6.35		3.66±4.61	

4. LIMITATIONS

The study was done for a short term period i.e. 9 months. Even this study can be done for longer duration. The sample size of the patients included in the study was less. The study was not an interventional study.

5. CONCLUSION

A clinical pharmacist can play a major role in this situation for strong intervention, by early detecting and preventing of medication errors for improving the quality of care to the patients. Educating the patient about the drugs and their importance of right use, literacy can be helpful in minimizing errors. "This helps to ensure that the right patient is receiving the right drug in the right dose by the authorized clinician".

This study clearly showed the need for a clinical pharmacist to work full-time at the medicine and orthopedic ward and to develop hospital formulary, drug protocols and prescription policies in hospital. Future prospective studies should be planned to detect how the rate of medication errors would change within the medicine and orthopedic ward when all the patients are interviewed by the pharmacist at the

time of hospital admission, and when guidelines and protocols are implemented. The results may be a better proof to the fact that a ward-based clinical pharmacist can prevent negative consequences related to medications.

Since our system lacks a well-organize detection and reporting mechanism, there is no means for preventing errors in the first place. Hence, as the first step we must implement a system where errors are routinely detected and reported.

ETHICAL APPROVAL

Ethical clearance was obtained from the ethical committee of Adichunchanagiri Hospital and Research Centre, B. G. Nagara. (AIMS/IEC104/2014-2015) (16/7/2014).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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