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Research Article

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Effectiveness Of Medication Reviews In Identification And Management Of Medication Related Problems By Clinical Pharmacist

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Abstract: Medication related problems (MRPs) are any preventable events that lead to inappropriate medication use or patient harm. Clinical pharmacist plays a key role in various clinical activities of hospital and contributes to improve the quality of medication use and patient safety with an aim to provide better patient outcome. Hence our aim in this study is to identify, classify and develop management strategy of various MRPs in a tertiary care teaching hospital and report them to concerned doctors to modify the drug therapy accordingly. Out of total collected cases; prescribing errors (21%) and adverse drug reaction (ADR) (35%) were most common, followed by drug duplication (11%), improper drug selection (8%), untreated indication (7%), double dosing (6%), wrong dose (5%) were frequently repeated drug related issues. Other MRPs were inappropriate dose, omission error, drug without indication and drug insufficiency with very minimal appearance which also satisfy the PCNE categorization of drug related problems. We found that Anticonvulsants and Antibiotics were frequently identified prescription medicine to develop MRPs.. Cerebrovascular accidents and Epilepsy were mostly involved in disease where MRPs were seen frequently. Standard management guidelines were also described to the doctors for individual MRP cases. Certain MRPs were frequently appearing and clinical pharmacists should be alert enough to address them with proper management strategy. Our study highlights the significant role of clinical pharmacist's intervention in identification of MRPs, which generally remain unidentified unless harm occurs. This study also shows a new avenue of drug therapy optimization by providing proper medication information to overcome identified MRP issues to enhance patient safety and care. Our role was highly accepted and appreciated by various doctors.

Keywords: Medication related problems, Clinical pharmacist intervention, management strategy, optimization therapy

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1. INTRODUCTION

Medication related problems (MRPs) are considered as any preventable event which if unattended may lead to improper medication use or patient harm. Such events may be related to professional practice, health care products, procedures & systems, including prescribing, order communication. The medication related problems are classified in different approaches.

1. One approach is based on sequence of medication use process such as prescribing, transcribing, dispensing, administration or monitoring.
2. Another approach is to consider the types of errors occurring, such as wrong medication, dose, frequency, administration route or patient.
3. A further approach classifies errors according to whether they occur from mistakes made when planning actions (knowledge-based or rule-based mistakes) or errors in the execution of appropriately planned actions (action-based errors, known as "slips", or memory-based errors, known as "lapses").[1]

Clinical pharmacist plays a key role in various clinical activities of hospital and contributes to improve the quality of medication use and patient safety with an aim to provide better patient outcome.[2] Clinical pharmacist also plays a key role in promoting better medication use by ensuring that patient receive appropriate pharmacotherapy thus minimizing the risk of unfavorable outcomes of pharmacotherapy.[3]Clinical pharmacist intervention have a significant effect in various patient care setup in the hospital through drug therapy optimization , avoidance of adverse drug events and patient education. Their roles are also essential in ensuring medication safety either through specific medication interventions or in designing macro processes to reduce the medication-related risk of error.[4] The Pharmacist has become an integral member of the multidisciplinary team providing clinical patient care in various healthcare settings. Pharmacist's interventions in outpatient, inpatient and emergency department settings have been shown to improve treatment related problem outcome and reduce hospitalizations and mortality.[5]The role of pharmacist have evolved from simple dispensing of medications to more patient focused services such as; provision of pharmaceutical care, which includes the identification, prevention and resolution of MRPs.[6] Pharmaceutical intervention enables prescription optimization and can prevent adverse drug reactions (ADRs) and efficacy attenuations, which are extremely important to provide safe and effective pharmacotherapy. The analysis of routine pharmaceutical interventions can be used to detect potential MRPs, leading to improvement in prescription which requires optimizations that were detected and identified by clinical pharmacists.[7] According to Pharmaceutical care network of Europe (PCNE) MRPs were classified into 15 types which include:

1. Allergy
2. Administration error
3. Drug Interaction
4. Drug without indication
5. Drug Duplication
6. Failure to receive medication
7. Improper drug selection
8. Inappropriate duration
9. Omission error
10. Prescribing error
11. Toxicity
12. Untreated indication
13. Wrong dose
14. Drug insufficiency
15. ADR.[8]

Hence we aimed to assess the effectiveness of medication reviews in identification and management of Medication Related Problems (MRPs) by clinical Pharmacists in a tertiary care teaching hospital.

2. METHODOLOGY

This prospective patient case analysis study was conducted for a period of 8 months between August 2018 and March 2019. Study was conducted in the departments of General medicine, Dermatology Venerology & Leprosy and Pediatrics, Gandhi Medical College and Hospital, Secunderabad. Study Protocol was approved by Institutional Ethical Committee, CMR College of Pharmacy, Hyderabad. Ethical approval number – CMRCP/IEC/2018-19/02 dated 07/01/2019. Selected cases were collected and documented in a structured data collection form from the in-patient units of above mentioned departments on a daily basis according to study inclusion criteria which includes; cases of all ages and genders in which MRP were identified and the same was authenticated by the visiting doctor. Confirmed MRP cases were included only with complete information till discharge. Study exclusion criteria includes; Cases with pre existing medication which was not related to present admission condition and cases with incomplete information were excluded from the study.

2.1 Study method

After selection of the study; a structured documentation form was prepared to document relevant data. Study was initiated by visiting the selected in-patient departments on daily basis to review individual case sheet of the patient to identify MRP. Once a MRP was identified it was brought to the notice of the concerned doctor for the particular unit for further discussion and confirmation. Discussion about identified MRP was performed with standard reference support only to establish a concrete authentication. Up on discussion with the doctor proper management approach was suggested accordingly for the particular MRP. Selected cases were followed and updated on a daily basis to find the suggested management outcome and for any other issues. These cases were followed up until discharge and a discharge summary used to note down in the documentation form for further processing. Analysis and interpretation of data was performed according to various categories and parameters to get the final result. Further discussion of result was executed to accomplish the outcome.

2.2 Data collection

Identified MRPs were recorded and discussed with the concerned doctor. Collected MRPs were categorized by utilizing PCNE criteria.[8] Upon thorough discussion with visiting doctors and careful scrutiny, we documented a total of 103 cases in which MRP were authenticated by the doctor.

3. RESULTS

The General Medicine department contributes maximum in-patient admissions in this hospital (approximately one third

of all admissions) thus the numbers of collected cases were high in number in this department compared to DVL and Pediatrics. A total of 250 cases were collected primarily with possible MRPs but thorough screening and discussion lands with 103 cases which were justifiable to include for the study following all criteria's.

Table 1 shows that male and females are at equal risk of developing MRPs with n= 61(n is total study cases) and 42 respectively. Age distribution among collected cases shows a superior rate of incidence in 50-60 years (n=21), followed by age group of 30-40 years, 60-70 years (both, n=18) other age groups have mixed distribution. Department wise distribution shows a high rate of cases in General Medicine (n=84). This is mainly because it has more beds when compared to others.

Table 2 highlights the incidence of various MRPs and shows that ADR (35%) and Prescribing error (21%) are with higher frequency followed by Drug Duplication (11%), Improper drug selection (8%), Untreated Indication (7%), Double dose (6%), Wrong dose (5%), Failure to receive medication (3%) were repeating problems and the least were Inappropriate dose, Drug without indication, Omission error and Drug insufficiency were contributing 1% each.

Table 3 shows the pharmacological class of drugs involved in MRP occurrence. This finding shows that; Anticonvulsants andAntibiotics are with higher frequency to develop MRPs and drugs with moderate frequency includes; anti-hypertensive, analgesics, proton pump inhibitors, anticoagulants and anti platelets. Less frequency drugs include anti diabetics, corticosteroids, anti histamines, H_2 receptor antagonists, Vaccines, anxiolytics, anti hyperlipidemic, Vitamins.

A total of 51 different diagnosis were involved in the development of 103 MRPs amongst them CVA (cerebrovascular accident, n=17) and epilepsy, n=10 were with high incidence as the diagnosis has no direct relation with development of MRP hence we are not highlighting the table.

Table 4describes the total intervention approach by clinical Pharmacist and their acceptance and non acceptance on various types of MRP.

3.1 Adverse drug reactions (ADRs)

ADRs were the most frequent MRPs (n=36) reported in our study. E.g.:

- For Aspirin induced gastritis; one Proton pump inhibitors (PPI) and Sucralfate was suggested to include in the prescription.
- For Hydrocortisone induced rash; intervention was done by providing information to stop the offending drug and also a management suggestion was provided to include alternate drug Dexamethasone and Chlorpheneramine.

3.2 Prescribing error

Prescribing error is the pen habit mistakes of doctors and is also frequently observed MRPs. In this study a total of 22 such errors were reported. E.g.:

- Inj(Injection) Ondansetron was prescribed as 4gm but it's available in 4mg. The same was discussed with the physician and it was later rectified by physician as 4mg (Figure-1)
- Tab (Tablet) Atorvastatin was prescribed as intravenous route and similarly it was rectified to oral route of administration only (Figure-2)

3.3 Drug duplication

Drug duplication was the third most regularly reported MRP in our study with a total number of 11 reported errors. E.g.:

- Two acid suppressor agents'; Pantoprazole and Ranitidine were prescribed simultaneously for a single day administration. It was discussed with the doctor and upon discussion Ranitidine was removed from the prescription keeping only Pantoprazole (Figure-3).
- FIVE (05) Central nervous system agents; Sodium Valproate, Midazolam, Leviceteram, Lamotrignine and Clobazam were prescribed concurrently for a single day. This is not recommended. It was thoroughly discussed with the doctor and the same was modified by removing Lamotrigine and Clobazam from the existing prescription.

3.4 Improper drug selection

Improper drug selection as MRP was present in 8 cases in this study. E.g.:

- Multivitamin was prescribed along with Dextrose-Normal Saline (DNS) in a Type-2 Diabetes Mellitus patient with GRBS (Generalized random blood sugar) – 354mg/dL. Dextrose significantly increases plasma glucose level, and upon discussion with the doctors it was switched to Normal Saline (Figure-4).
- Gentamycin 80 mg TID was prescribed in the case of acute kidney injury, this drug should be avoided in the acute kidney injury and upon discussion Ciprofloxacin was prescribed in place of Gentamicin.

3.5 Untreated indication

Untreated indication was found with 7 cases in our study. E.g.:

- Serum levels of Potassium (<2mEq/L) was significantly less for a patient but Potassium supplement was not prescribed. Hence a rational suggestion was provided with a request to add Syrup. Potassium Chloride.
- For a patient with high blood pressure of 170/100mmHg, anti-hypertensive was not prescribed, with prior discussion Tab. Nifidipine 20 mg was added to the existing prescription and the condition was improved.

3.6 Double dose

A total of 6 double doses MRP were reported in the study. E.g.:

- Inj. Ranitidine 50mg b-i-d and Tab. Ranitidine 150mg b-i-d were given 2 times in a single day prescription, this prescription was modified by removing the oral Ranitidine and intravenous Ranitidine was advised to continue.

3.7 Wrong dose

Wrong dose was the next common MRP found and 5 cases of wrong dose were reported in our study. E.g.:

- Inj. Pantaprazole was prescribed with the dose of 120 mg/day but the maximum dose of Pantoprazole is

80mg/day upon discussion the dose of Pantoprazole was modified to 40 mg/day.

3.8 Failure to receive medication

Failure to receive medication is next commonly found MRP and 4 were reported in our study. E.g.:

- Non-adherence to Insulin (5u) and later developed diabetic ketoacidosis and management was done by counseling patients about the regular medication use and insulin was continued.

3.9 Inappropriate dose

Inappropriate dose was least reported MRP with only single reported in the study. E.g.:

- Insulin dosing was not instructed based on GRBS of 756mg/dl (25u -10u SC) upon discussion management was done with Human Insulin 12u TID and NPH (isophane) insulin 8u-6u SC which is according to GRBS range.

3.10 Drug without indication

Drug without very minimal reported MRP with only single reported in the study. E.g.:

- Inj. Furosemide 20 mg was prescribed in a patient where there was no pleural effusion/oedema/hypertension and upon discussion with doctor furosemide was discontinued for this patient.

3.11 Omission error

Omission error was only one reported MRP in study. E.g.:

- Chlorpheneramine was abruptly withdrawn from prescription even though cough and cold were persistent and management was done by reintroducing Chlorpheneramine

3.12 Drug Insufficiency

Drug Insufficiency also accounts for only single reported MRP in study. E.g.:

- For a 6 yr old child with seizures; 30 mg (5mg/kg) of Phenytoin is insufficient where child over 6yrs of age requires minimum dose of 300 mg/day for seizures then management was done by advising prescriber to modify the dose to Phenytoin 300 mg/IV.

Table 1: Demographic distribution of collected cases (n=103)

Gender wise distribution		
1.	Male	61
2.	Female	42
Age (in years) wise distribution		
1.	0-10	12
2.	10-20	06
3.	20-30	13
4.	30-40	18
5.	40-50	08
6.	50-60	21
7.	60-70	18
8.	70-80	06
9.	80-90	01
Department wise distribution		
1.	General medicine	84
2.	Pediatrics	13
3.	DVL (Dermatology, Venerology, and Leprosy)	06

Table 2. Categorization of MRPs in collected cases (n=103.)

S. No	Different types of MRPs	Total cases	Percentage (%)
1	Adverse drug reactions	36	35 %
2	Prescribing Error	22	21 %
3	Drug Duplication	11	11 %
4	Improper drug selection	08	8 %
5	Untreated indication	07	7 %
6	Double dose	06	6 %
7	Wrong dose	05	5 %
8	Failure to receive medication	04	3 %
9	Inappropriate dose	01	1 %
10	Drug without indication	01	1 %
11	Omission Error	01	1 %
12	Drug insufficiency	01	1 %

Table 3. Medication categorization as per Pharmacological Class (n=114)

S. No	Pharmacological class	Frequency
1	Anticonvulsants	19
2	Antibiotics	15
3	Antihypertensive	12
4	Analgesics	12
5	Proton pump inhibitors	8
6	Anti coagulant	7
7	Antiplatelet	6
8	Anti-diabetic	5
9	Corticosteroids	4
10	Antihistamines	4
11	H2 receptor antagonists	4
12	Vaccines	4
13	Anxiolytic	2
14	Anti-hyperlipidemic	2
15	Vitamins	1
16	Anti-arrhythmic	1
17	Antispasmodic	1
18	Anti-thyroid	1
19	Immunosuppressant	1
20	Antiemetic	1
21	Proteolytic enzyme	1
22	Bronchodilators	1
23	Cognitive enhancing agent	1
24	Immunoglobulin agent	1

Table 4. Management approach towards identified MRPs and outcome of clinical pharmacist's intervention

S. NO	Different types of MRPs	Total (n=103)	Clinical Pharmacists Intervention	
			Accepted	Not Accepted
1	Adverse drug reaction	36	36	0
2	Prescribing Error	22	22	0
3	Drug Duplication	11	07	4
4	Improper drug selection	08	07	1
5	Untreated indication	07	06	1
6	Double dose	06	05	1
7	Wrong dose	05	04	1
8	Failure to receive medication	04	03	1
9	Inappropriate dose	01	01	0
10	Drug without indication	01	01	0
11	Omission Error	01	01	0
12	Drug insufficiency	01	01	0

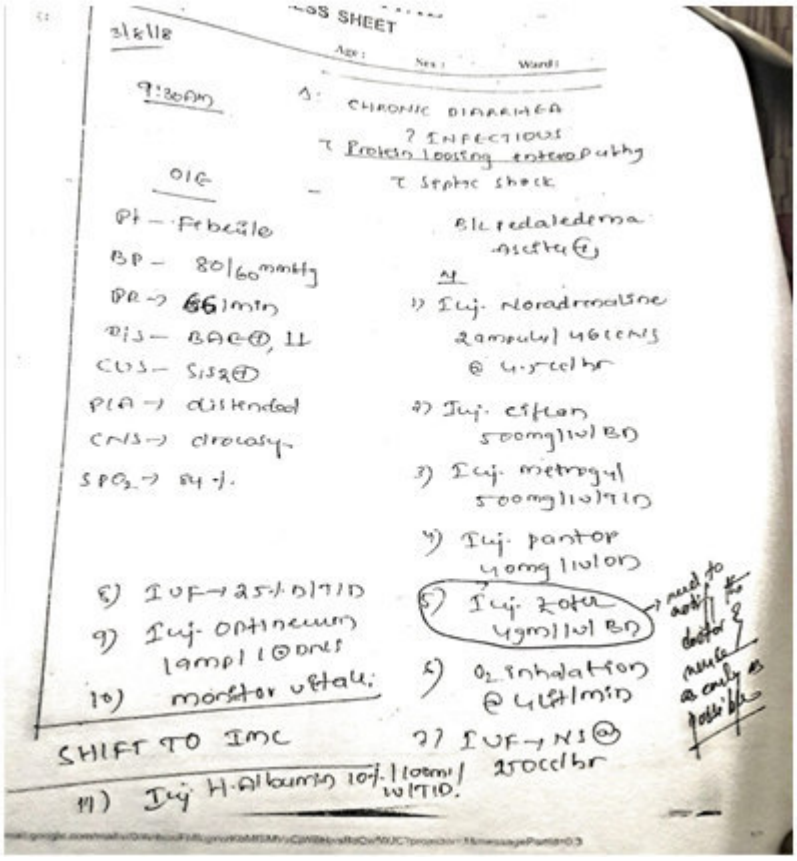

Fig 1. Prescribing Error-1

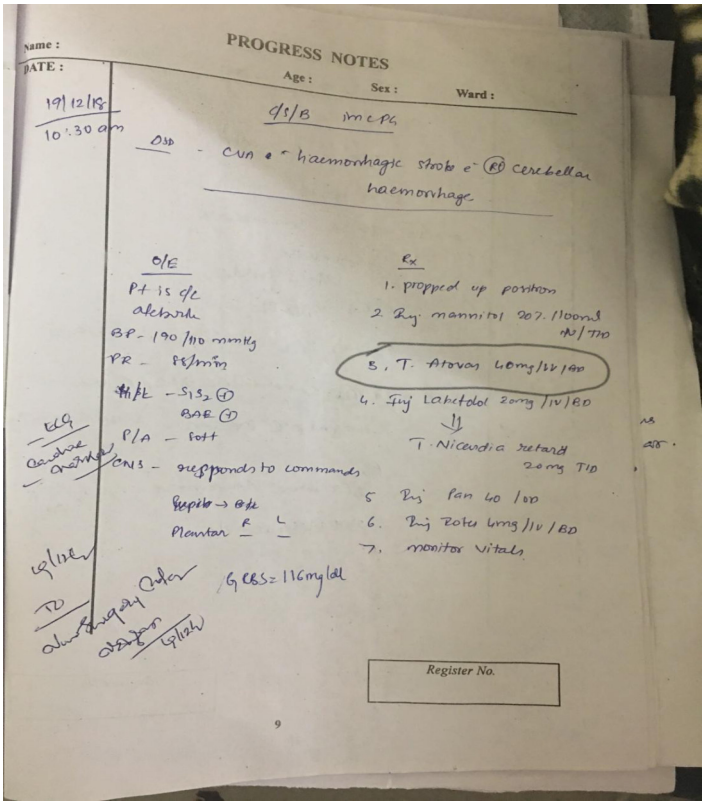

Fig 2. Prescribing Error-2

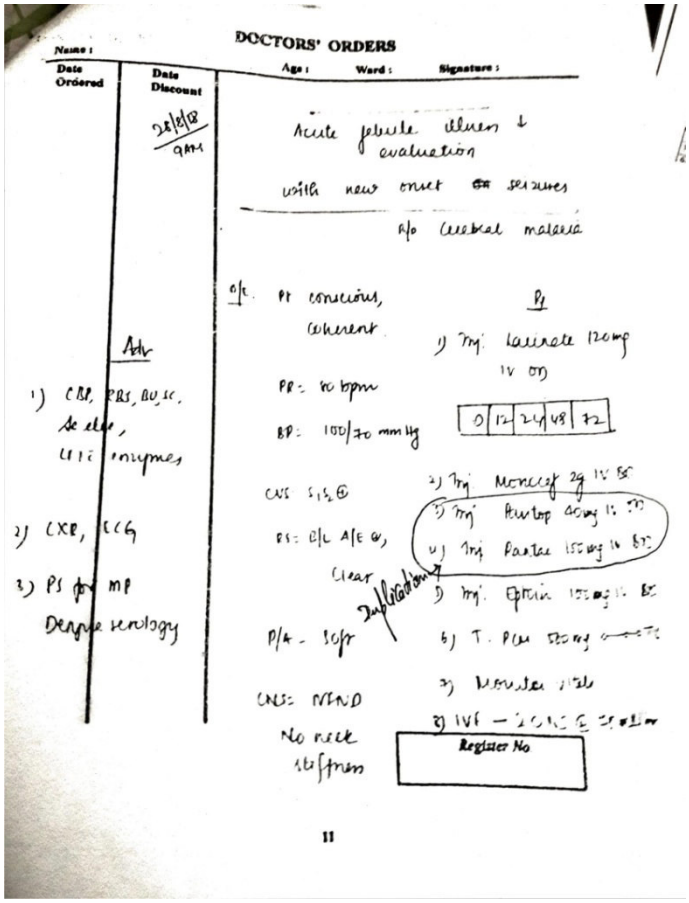

Fig 3. Drug Duplication-1

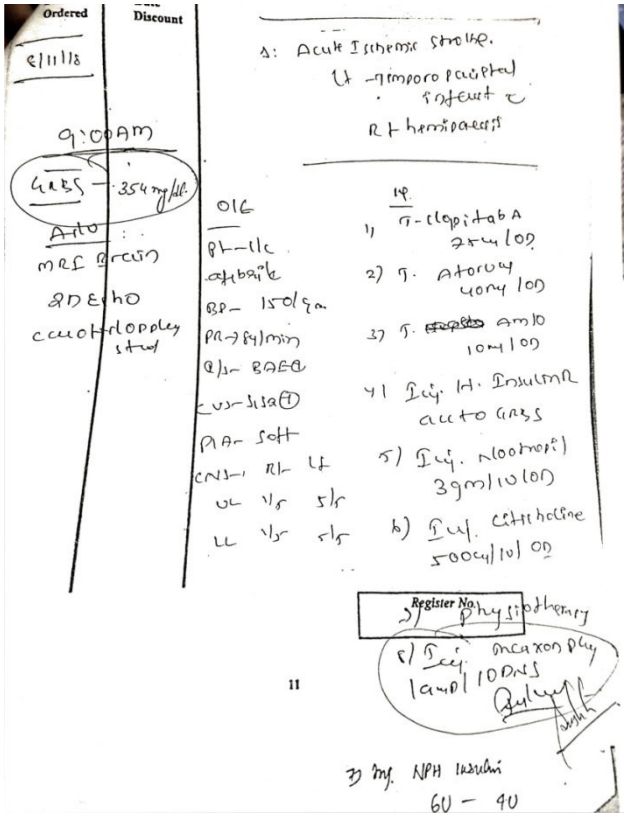

Fig 4. Improper Drug selection-1

4. DISCUSSION

In this prospective study, cases were collected from various In-patient units of General Medicine, Pediatrics and Dermatology Venereology & Leprosy departments. Out of 103 cases, male were slightly higher than female admission. A similar prospective observational and interventional study conducted by Ganachari MS (2010)[9] from Belgaum India also reported male predominance over female. We would like to highlight four specific cases with MRP which collected during

our study and the same shown in 4 various figure. In a case Injection Zofer (Ondensetron was mentioned as 4gm instead of 4mg (Figure 1) and was considered as prescription error. In another case Atorvastatin 40 mg was prescribed as injection (Figure 2) where as it is available only as tablet formulation and was considered as prescribing error. In third case both Pantoprazole and Ranitidine was prescribed in a single day prescription (Figure3), as both are indicated for similar indication thus it was considered as drug duplication. In the fourth case Dextrose Normal Saline was prescribed in Diabetic patient to administer multivitamin (figure 4) which is not suggested in diabetic patient and was considered as improper drug selection. In all of the above mentioned cases we have intervened and informed the visiting doctor about the issue and all these cases were modified accordingly to rationalize the therapy. From our study we identified that the incidence of MRPs was high among the patients aged between 50-60 years. Similar observation was also published previously by Movva R (2015).[10] This is mainly due to multiple disease, polypharmacy and deteriorating health condition which leads to multiple medicine prescription leading to development of medication errors. In our study Prescribing errors and adverse drug reactions were predominant as MRPs among all different types. It was followed by Drug duplication, untreated indication, double dosing, wrong dose which were frequently repeating issues. Other identified MRPs were inappropriate dose, omission error, drug without indication and drug insufficiency with a very minimal appearance which satisfy the PCNE categorization of drug related problems.[8] Our study shows inappropriate dose as a less reported MRP while ADRs was highly identified MRP which contradict the previously published reports of Kumar SBP (2013)[11], they have reported in their study that inappropriate dose was high and ADRs were moderate. Another report by Nirayo YL (2018)[12] stated that untreated indications were on the higher side than drug duplication and ADR where as in our study drug duplication, Untreated indication and ADRs were frequently reported MRP issues. Our results coincide with few previously published reports. One of them is by Aguiar KS (2017)[13] where they reported prescribing errors were most common and drug duplication was moderate and inappropriate dose were least. According to the report given by Sagita VA (2018)[14] ADRs were higher in number and untreated indications were less which coincided with our study. Our results coincide with the report given by Kuo GM (2013)[15,] that prescribing errors were higher in number. An important aspect of our study is frequent involvement of anticonvulsants and antibiotics in development of various MRPs. The findings also direct us to create awareness while prescribing these drugs so as to minimize MRPs and to improve patient outcomes. Similar findings were also reported previously by Jose B (2012)[16]and pointed to the same issues in his report. Our study highlights that the diseases involved in the majority of MRPs were Cerebrovascular accident and Epilepsy. Furthermore, our study findings indicates that, prescribing error as a frequently identified MRP and the same can be managed and rectified by constant reviewing of the patient case sheet before administering the medicine. This type of error occurred mainly due to pen writing habits of the physician. Our study regarding prescribing error identification coincides with Acheampong F (2016)[17] where they reported that, majority of drug errors were due to Prescription habit. Our study identified Drug duplication as another major MRP. Which even may lead to patient mortality. Similar findings about drug duplication was also reported previously by Alves GMR (2014)[18] and Goedken AM (2018)[19] in their outcome they have highlighted that drug duplication is second most common MRP. In our study we found that improper drug selection was also present in minimal number, this is mainly because of restricted drug choice, inability of patients to purchase alternate medicine from outside hospital or even physician's perception about medicine, which contradicts the study reported by Movva R (2015)10, in which they mentioned that improper drug selection was found to be the highest. Untreated indication accounting for a very small number but as this point is mainly determined on complaint by patient and same may not be established in clinical evaluation, therefore an exact correlation cannot be established. This finding contradicts with previous study conducted by Smith M (2011)[20] who reported that the majority of drug therapy problems were untreated indication. From our study we found that Double dose as medication error, and the same can be easily overcome by reviewing the prescription, this finding also contradicts with previous study conducted by Tasaka Y (2018)[7] where over dosage was most frequently occurring DRP. Wrong dose selection by clinician occur due to error in dose calculation and can be avoided by a clinical pharmacist . Clinical pharmacists should be watchful for calculating the doses and doctor should take the help from them to avoid such errors to achieve a better and optimal therapeutic effect.. In the management approach, we have discussed with the doctors for every single identified MRP and also provided sufficient and justified support obtained either from drug information textbook or from standard medical websites like www.drugs.com. Based on our discussion and information support most of the medication related problems were accepted and our service was appreciated. But to our surprise we found that not all prescription modification was done on the patient case sheet as per discussed. We believe various factors were involved for this particular situation. These can be summarized as drugs were prescribed by the unit chief/Senior professor, Post Graduate Trainees are unable to change those without prior permission and thus it may take a few days to alter. Few drugs are not available at the unit while prescribing them; it may take a few days to make the drug available in the unit. Along with that, doctors are not confident about clinical pharmacist's intervention and suggestion to alter a drug therapy. Furthermore doctors are unable to come out of their learning concept which they learn during their study period, even though sufficient information support was provided along with justification. And finally doctors may have different or better judgments about a reported MRP.

5. CONCLUSION

Our study concludes that certain medication related errors were frequently come into sight by constant medication reviews by clinical pharmacist. Even some of those identified MRPs were potential enough to cause patient harm if not rectified in proper time. Furthermore inclusion of clinical pharmacist as a member of patient care team will not only improve the therapeutic efficacy but also enhance better patient care. Hence our study highlights the need of clinical pharmacist intervention in optimizing drug therapy by providing proper medication information. Our service was accepted and appreciated by various doctors and creates an avenue for future direction in this particular area.

6. ACKNOWLEDGEMENT

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7. AUTHORS CONTRIBUTION STATEMENT

Mr. Sushanta Kumar Das is the Principal Investigator for this study; he has developed the idea and outlined the protocol preparation. Further Mr. Das has made sure that the work accomplished in due time and evaluated the study data to establish the outcome and reviewed the manuscript. Ms. G. Priyanka, Ms. G. Jayanthi, Mr. M. Shiva Krishna and Ms. K. Pheoba Lydia Rani carried out the study as Co-Investigator. They have participated in the ward round and has communicated with the doctors about MRP cases and finally they have drafted the manuscript.

8. CONFLICTS OF INTEREST

Conflict of interest declared none.

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