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Clinical Pharmacist Influence in Minimizing Drug-Related Problems at a Tertiary Care Teaching Hospital, Narketpalli

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ABSTRACT

To assess the clinical pharmacist's role in identifying and resolving drug-related problems (DRP) and to assess the DRP-related economic burden. This study was a prospective and interventional study and was approved by the Institutional Human Ethics Committee. The study was carried out in the Medicine, Emergency Medicine, Surgery, Orthopedics, and Gynecology departments of a tertiary care teaching hospital in North Telangana. A suitably designed data collection form was used to capture the demographic, clinical and therapeutic details of the patients. Hepler & Strand classification was used to assess the types of Drug Related Problems (DRP). CockCroft–Gault formula was used to calculate the renal function to make drug dose adjustments. WHO Probability and Naranjo's scales were applied to assess the causality and the Hartwig scale was used to assess the severity levels. Direct and Indirect costs were calculated to assess the economic burden of the DRP. Among 600 patients reviewed, 348 were male with a mean average age of 44.95 years. A total of 246 DRPs were identified with an incidence rate of 44%. The predisposing factors identified were co-morbidities, polypharmacy, allergy, high BMI, hepatic impairment, and renal impairment. Most of the drug-related problems identified were drug interactions (39%) and adverse drug reactions (18%), Drug use without indication (14%), untreated indications (14%) followed by failure to receive the drugs (12%). Among the DRPs identified, 10.1% were major and 36.4% were moderate in nature. The net cost associated with the DRPs was Rs.2,58,300/-. Clinical Pharmacist presence in the ward rounds helped in minimizing drug-related problems and associated costs.

Keywords: DRP, DRUG INTERACTION ASSESSMENT, *CockCroft–Gault formula*

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INTRODUCTION

Drugs play an important role in healthcare management. However, drugs do cause negative therapeutic outcomes due to drug-related problems. Drug-related problem (DRP) is defined as any undesirable event experienced by a patient that involves drug therapy and hinders achieving the desired therapeutic goals [1]. According to the Hepler & Strand classification system, eight categories of DRPs are Untreated indications, Improper drug selection, Subtherapeutic dosage, Failure to receive drugs, Overdosage, Adverse reactions, Drug interactions and Drug use without indication [2].

DRPs have become a serious concern in today's world due to an upsurge in the number of people suffering from chronic illnesses whose immediate consequences are comorbidities and polypharmacy. The potential risk factors identified as causing the DRPs are age, gender, comorbidities, and polypharmacy. Currently, chronic diseases are the leading cause of morbidity and mortality across the globe. Any individual suffering from clinical ailments needs medication management to alleviate symptoms and improve therapeutic outcomes. In the process of treating the patient, clinicians prescribe medication aiming the positive clinical outcomes [3].

Currently, DRPs remain a huge public health concern worldwide. DRPs can result in harmful clinical outcomes ranging from temporary minor symptom exacerbations to permanent disability or death. About 10% - 28% of in-patients experience at least one ADR during their hospital stay. Studies have also estimated that 5%-10% of DRPs lead to hospital admissions and become a clinical and economic burden to the individual and to society [4]. In US alone, every year 200,000 people due to DRP s and the economic burden is estimated at US$ 200 billion each year alarming the significance of the problem [5].

South Indian tertiary care teaching hospital-ba sed study estimated the average cost of DRP as USD 17,788.65; with direct cost accounting for USD 12,327.02 and indirect cost for USD 5,461.63 [6]. Many studies have corroborated that the majority of DRPs are (50-80%) preventable if detected early [7].
DRPs including medication errors have posed a major challenge to the safety of hospitalised patients such as prolonged hospitalization, limiting the quality of life of the patients, affecting health budgets and sometimes death [8-10].
A higher frequency of DRPs is majorly observed in hospitalised patients causing prolonged hospital stays, admissions to emergency services, repeated doctor visits and repeat prescriptions [11-12]. This evidence corroborates the economic burden, morbidity, and mortality on society. Several strategies have been studied and implemented to assist in monitoring medication therapy. As per various literature sources, medication chart review, associated or assisted with electronic alerting systems, and integrations of pharmacists to daily ward rounds along with clinicians were the strategies found highly useful in minimizing DRPs [13-14].
According to pharmacoepidemiology for improving medication safety processes medication chart review is considered as the gold standard [15]. Identification, resolution, and prevention of DRPs are considered fundamental activities of pharmaceutical care. Clinical pharmacists are adequately trained to do the treatment chart review and detect the DRPs. In identifying and preventing DRPs, many studies have shown the useful role of clinical pharmacists [16-20].
The present study was conducted to assess the clinical pharmacist's role in identifying and resolving drug-related problems and assess the DRP-related economic burden.

MATERIAL AND METHODS

Study design and setting

This study was a Prospective, observational, and interventional study carried out at Kamineni Hospital, Narketpally, a 1000-bed teaching hospital. The study was approved by the institutional ethics committee (02/ Ph.D/1/2022/). This study was initiated in departments such as General Medicine, Nephrology, Emergency medicine, Gynecology, and Pulmonology.
The study was conducted over a period of 6 months. The present study was conducted to assess the clinical pharmacist's role in identifying and resolving drug-related problems and assess the DRP-related economic burden.

DRP CLASSIFICATION

Hepler and Strand's classification is used to assess the type of DRPs.

INTERVENTION PROCEDURE

All DRP interventions were brought to the notice of a panel of consultants from General Medicine, Emergency Medicine, and Professor of Clinical Pharmacy. The committee reviewed them and advised the researcher to inform the prescriber to make necessary changes in the prescription.

DRUG INTERACTION ASSESSMENT

A drug interactions checker in CliniRex® was used to identify drug interactions with types and severity levels.

ASSESSMENT OF ADR CAUSALITY and SEVERITY

WHO Probability and Naranjo's scales were used to assess the causality and the Hartwig scale was applied to assess the severity level. assessment scale was applied to check the severity of the event.

Calculation of Economic Burden

Both direct and indirect costs associated with the DRP and its negative consequences were calculated and made up to the total cost of each DRP. The average cost of the total DRPs was calculated.

RESULTS

During the study period, about 600 case records of the patients were reviewed in the General medicine, Nephrology, Emergency medicine, Gynaecology and Pulmonology departments.
The demographic details of the recruited patients are presented in Table. 1.

Table 1. Demographic details of the patients enrolled in the study

PARAMETERS	N (%)
Gender:	>
Male	348(58.6%)
Female	252(41.4%)
Age:	
20-29 years	132 (21%)
30-39 years	150(25%)
40-49 years	144(24%)
50-59 years	90(15%)
>60 years	84 (14%)
Education:	
Illiterate	180(30%)
School	264(44%)
College	156(26%)
Profession:	
Farmer	228(38%)
Daily labourer	118(19.7%)
Private job	96(16%)
Government job	44(7.3%)
Businessman	30(5.0%)
Homemaker	72(12%)
None	12(2%)
Body Mass Index (Kg/m^2)	
<18	269
18-25	286
>25	45

DRPs Incidence rate:

A total of 264 DRPs were found in 600 case records. The incidence rate of Drug-Related Problems (DRP) was calculated using the following formula.

Incidence = Number of DRPs/Total number of case records ×100

=264/600×100

Incidence ratio = 44%.

Predisposing factors for DRPs

The predisposing factors for DRPs were identified as gender, age, allergy, body mass index, polypharmacy, hepatic impairment, and renal impairment. The predisposing factors were analysed and their significance was assessed using the student's t-test between the enrolled patients with DRP and the enrolled patients without DRPs. At 95% CI, the p-value of the variables was calculated as 0.16. The data is presented in Table 2.

Table 2. Predisposing factors for DRPs

Variable	Categories	Patients without DRP	Patients with DRP	Total Sample	P value*
Gender	Male	170	178	348	0.16
	Female	166	86	252	
Mean Age (years)		39.5 y	44.95 y		
Allergy	Yes	213	147	360	0.16
	No	42	198	240	
BMI (Kg/m^2)	<18	180	89	269	0.16
	18-25	138	148	286	
	>25	16	29	45	
Polypharmacy	≤ 3 drugs	86	48	134	0.16
	4-6 drugs	159	132	291	
	≥7 drugs	112	84	196	
Hepatic impairment	Yes	0	14	14	0.16
	No	564	22	586	
Renal impairment	<30	0	4	4	0.16
	30-60	98	6	104	
	>60	472	20	492	

*Student t test

All the identified drug-related problems were categorized as per the Hepler & Strand classification system. The identified DRPs are presented in the following figure.1.

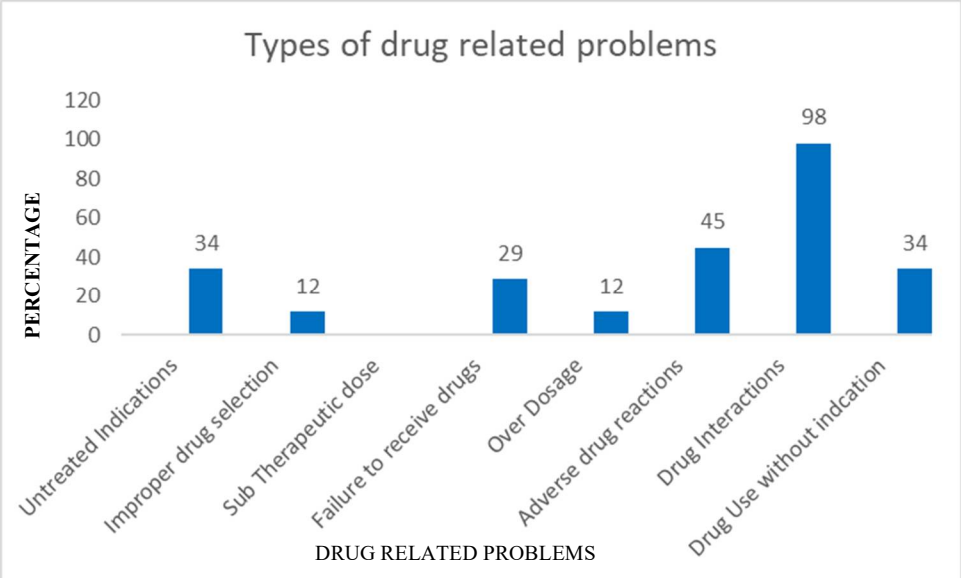

Figure 1. Types of Various Drug-Related Problems

The severity of the identified drug-related problems was assessed. Most of the drug-related problems identified were drug interactions (98) adverse drug reactions (34), and untreated indications (34) followed by failure to receive the drugs (29). The majority of DRPs were moderate in nature. The findings are presented in Figure 2.

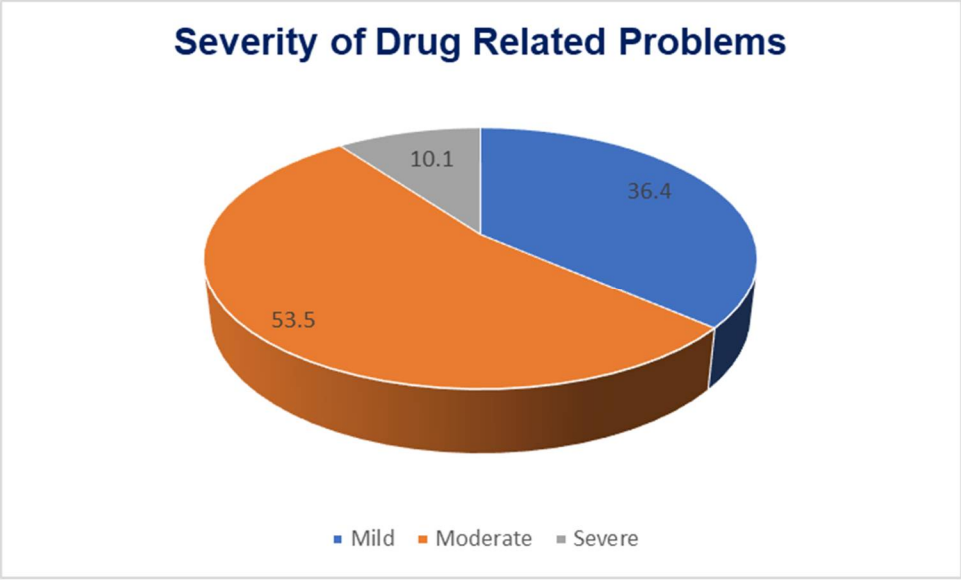

Fig.2. Severity of the Drug-Related Problems

Among the drug interactions identified as DRPs, a further analysis of frequency and severity was made focusing on the clinical manifestations and risk of interactions. The data is presented in Table 3.

Table. 3. Drug-drug interactions as DRP with frequency and Severity

Drugs	Frequency	Severity	Clinical Manifestations	Risk of Interaction
Atorvastatin + Pantoprazole	14	Major	Increased fatigue Mild chest pain Shortness of breath	Rhabdomyolysis
Atorvastatin + Clarithromycin	4	Major	Shortness of breath	AV block
Bisoprolol + Amlodipine	9	Major	Severe hypotension Chest Pain	Severe hypotension Congestive heart failure
Empagliflozin + Telmisartan	8	Major	Severe hypotension Postural dizziness Syncope	Syncope Dehydration Orthostatic hypotension
Digoxin + Atorvastatin	12	Major	Confusion Loss of appetite	Increased digoxin exposure
Aspirin + Clopidogrel	20	Major	Stomach pain Red or black stools Bloody emesis	Increased risk of bleeding
Ciprofloxacin + Prednisolone	9	Major	Tendon rupture Pain, swelling of a tendon	Tendinitis Tendon rupture
Aspirin + Prednisolone	6	Major	GI toxicity Bleeding Ulceration Perforation	Increased salicylates clearance
Aspirin + Atenolol	6	Moderate	Headache	Decreased antihypertensive effect
Warfarin + Metronidazole	10	Major	Stomach pain Black stools	Increased Risk of Bleeding

The Economic Impact of Detected Drug-Related Problems

The economic consequences of DRPs were analysed. Direct and indirect costs were applied. The Direct costs include consultation charges, lab charges, and radiographic charges which are fixed by the hospital where the study was conducted. The pharmacy bills were checked for medication costs. The indirect costs include the attendants' travel, stay and food cost.

Overall, 123 DRPs were found moderate and severe in severity level and attracted direct and indirect expenses due to increased length of stay, additional tests, and medications. The average direct cost was calculated as Rs.1250 per patient and the indirect cost was calculated as Rs.850 per patient. So, the overall cost was calculated as 2100 per patient. This amount was calculated based on the rural hospital location and the discounted prices. If the same DRPs are identified in a corporate hospital, then the cost of DRP will vary and may be Rs.6500 to Rs.9000 per DRP. This additional cost would have been saved if the clinical pharmacist is employed and made as a member in the healthcare team.

DISCUSSION

According to WHO, an event or circumstance involving drug therapy that actually or potentially interferes with the desired health outcomes is called a Drug-related issue. This study was conducted at a tertiary care teaching hospital and the DRPs were observed and detected by the clinical pharmacist during regular ward round participation and reviewing case records of the patients who were admitted to the hospital in different departments. DRPs were very common in patients who were admitted to hospitals due to co-morbidities, polypharmacy, age, and gender. These problems may lead to patient morbidity and mortality and result in an increase in hospitalization and health-related expenditure. Thus, this study mainly focuses on calculating the incidence, types of DRP and severity levels, and economic impact on patients who are admitted to the Hospital.

Current study, the incidence of DRP was found as 44%. The DRP incidence reported in various other studies ranged from 8.54 to 99.16%, with a median (IQR 90) of 70.04% (59%) [22].

The high incidence of DRPs was attributed to polypharmacy, comorbidities, elderly age, and over-the-counter medications (OTC).[23] Studies have observed that certain categories of medicines such as cardiovascular drugs, proton pump inhibitors, and antimicrobial agents were responsible for causing high incidences of DRPs. Similar findings were also observed in our study. Atorvastatin, Pantoprazole, Amlodipine, Digoxin, Aspirin, Clopidogrel and Ciprofloxacin were found responsible for causing drug-drug interactions with high severity levels [24].

Current study, Hepler and Strand classification was applied to assess DRPs. According to it, DRPs were categorized into Drug without indication, Indication without drug, Adverse drug reaction, Overdose, Underdose, Drug duplication, Non-adherence, and Drug interactions. However, in some studies, the DRPs were classified based on PCNE classification which is Drug selection, Drug form, Dose selection, Treatment duration, Dispensing, Drug use process, and patient-related factors. Hepler and Strand's classification gives an advantage in assessing and classifying the DRPs in a very simple way whereas PCNE classification[14] assesses the DRPs more in-depth such as drug dispensing and medication errors. In India a study conducted by Shireesha A, the DRPs were assessed by using the Hepler and Strand classification of drug-related problems[25]. In this study, a total of 230 case sheets of the patients during the ward rounds were reviewed. Among the DRPs identified, the majority of DRPs were moderate in nature and most of them were Drug interactions and drugs without indication. In our study, the predominant DRPs observed were drug-drug interactions, adverse drug reactions, untreated indication, drug use without indication, and overdoses. Many drug interactions were severe in nature.

The predisposing factors were the main cause of the occurrence of DRPs. In our study, the predisposing factors responsible for DRPs is polypharmacy, which is about 87%. Polypharmacy means an individual taking more than 5 drugs a day. Polypharmacy can lead to experiencing drug interactions and adverse drug reactions. A study conducted at a public hospital in Brazil describes that the increase in the number of medications leads to an increased risk of potential drug interaction occurrence [26]. In our study, the most implicated drugs in polypharmacy were Metronidazole, Ondansetron, Calcium Carbonate, Tramadol, and Cefpodoxime Proxetil.

The traditional role of the pharmacist includes the procurement and dispensing of the medications to the patients. However, many studies have corroborated that, clinical pharmacists with their pharmacotherapeutic expertise minimise drug-related problems and save both direct and indirect expenditures.

Current study, the direct and indirect costs were calculated per DRP as Rs. 2,100/-. This cost is calculated based on the pricing of the rural tertiary care teaching hospital. The same may go up to Rs.10,000/- in the case of corporate hospitals.

An Indian-based study by Madhan R and Vinnetha M identified 923 DRPs among 556 patients. Common DRPs were non-compliance (58%), ADRs (19%), drug-drug interactions (12%) and inappropriate prescribing (7%). DRPs were commonly identified in the young elderly age group, male gender, patients with middle socioeconomic class, widows, joint family with polypharmacy and multiple diseases ($p<0.05$). Drug-related hospital visits were identified for 55 patients (28%). Critical care was needed for 140 (72%) patients among which 5 (4%) of them died. Adverse events were seen in 10% of patients due to DRPs. The total hospital cost of all drug-related admissions was USD 17,788.65; with direct cost accounting for USD 12,327.02 and indirect cost for USD 5,461.63 [7].

Another study conducted by Madhan R. and his team identified 469 DRPs. Due to their interventions, the mean length of Stay was reduced by 19.6% with a net saving of Rs.207,134/- on direct medical expenses [27].

Another study conducted in Ireland to assess the economic outcomes of clinical pharmacist interventions and net cost savings revealed that, during a year period of study, a total of € 710,000 was saved through 3,417 interventions. The most prevalent interventions were the identification of omissions of patients' regular pre-admission medications, and dose changes. The common categories of medications requiring interventions were Proton Pump Inhibitors (PPI), Statins, Beta Blockers, corticosteroids, and antimicrobial agents. The average time spent on intervention was 25 minutes [8].

CONCLUSION

In the present study**,** out of the total patients enrolled in the study, 230 patients were observed with a total of 100 DRPs. The most frequently occurring DRPs were drug interactions and indications without the drugs. These DRPs can significantly increase the length of stay in the hospital. Proper identification of DRPs will help in reducing the length of stay. This study concludes that clinical pharmacists participate the health care management by identifying DRPs and resolving them with better physician suggestions to get the required outcomes and minimize the economic burden to the patients.

LIMITATIONS

Post Corona, the patient admission rate has come down thus it affected the sample size in this teaching hospital.

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Conflict of Interest
None

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