International Journal of Research in Hospital and Clinical Pharmacy

Assessment of drug related problems in patients prescribed with antibiotics in a tertiary care hospital

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ABSTRACT

India has one of the greatest burdens of bacterial infections in the world and the crude mortality rate is 417 per 100,000 persons. The present research was conducted with the purpose to evaluate drug-related issues (DRPs) among patients receiving antibiotics in a tertiary care hospital. A potential observational study was carried out in 170 inpatients at the General Medicine Department of Government General Hospital (RIMS) that was conducted in Kadapa between October 2024 and April 2025. The selection of patients was done according to the willingness and inclusion criteria, and the ethical approval was received within the Institutional Human Ethics Committee. Descriptive and inferential statistical analysis that used p-value estimation were carried out with Jamovi v2.6.44.0. DRPs were the most prevalent among the participants aged 31-60 years (30 cases; 51.72). The proportion of males (70.68) was higher than that of females (29.32). The cephalosporins were the class of antibiotics with the greatest number of DRPs (31 cases; 53.45%). Patients with chronic obstructive pulmonary disease (COPD) had the highest number of DRPs and this was 15 cases. Twelve patients (20.69%), and 46 patients (79.31%) were found to be exposed to polypharmacy and not exposed to polypharmacy respectively. The p-value of 0.210 shown was at 0.05 level, meaning that there were no statistically significant differences between DRPs and length of hospital stay. The research concludes that the issue of DRPs is significant among patients taking antibiotics at tertiary care facilities. DRPs were selected and classified according to the PCNE classification system (version 9.1) using the type, cause, and outcomes.

Keywords: Antibiotics; DRP'S; Cephalosporins; ADR's.

ISSN: 2582-0672
Research Article

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Article Info

Received on: 02-03-2026
Revised on: 12-03-2026
Accepted on: 15-03-2026

DOI: https://doi.org/10.33974/ijrhcp.v8i1.244

INTRODUCTION

The drugs are said to be a two-sided therapeutic means as they have both the possibility of healing and the possibility of causing damage. They have the potential to cure or prevent or even diagnose a disease, relieve signs and symptoms and even improve quality of life but when utilized incorrectly and abused may become a source of patient morbidity and even mortality. These issues of medicines are not simple, but rather have pharmacological, pathological, epidemiological and legal aspects with their own peculiar consequences. It is especially evident in antibiotics. Determined as agents that inhibit or kill microorganisms in the lowest possible concentration through the selection of the microorganisms by microorganisms, antibiotics do not include natural agents such as antibodies secreted by higher organisms. [1,2] Their discovery changed the field of medicine because many once deadly infections could now be treated, however their indiscriminate use has resulted in one of the biggest contemporary health problems in the population: antimicrobial resistance. Antibiotics are applied as treatment and prophylaxis of infections. In the hospitals, approximately half of all of the

prescriptions are prophylactic and they are meant to prevent infection in patients who are surgical or immunocompromised. Although prophylaxis is necessary in certain cases, there should be strict justification, as its blind use leads to resistance with no relative value. The misuse and overuse is commonplace as patients frequently prescribe antibiotics to viral diseases like cold and influenza where the treatment is not effective. Even bacterial diseases such as sinusitis or ear infections can be treated without medication, but they are commonly prescribed. Misuse also happens in the cases when patients use a wrong antibiotic, inappropriate doses, and/or inappropriate periods of treatment. Stockpiling of antibiotics that are no longer required or even pressurizing doctors to prescribe them makes the situation even worse. The drug-related problems (DRPs) include inappropriate selection of a drug, wrong dosing, drug-drug interactions, drug adverse reactions, and lack of adherence.[2,4] DRPs are especially harmful in the setting of antibiotics, as they hasten resistance and worsen patient safety, as well as raise the costs of healthcare. The Pharmaceutical Care Network Europe (PCNE) classification system, version 9.1, is a structured system that allows to categorise DRPs to allow systematic identification and intervention. The purpose of a study devoted to the evaluation of DRPs in antibiotics-prescribed patients in a tertiary care hospital has very specific goals: assessments of prescriptions and classification of DRPs, identification of high-risk groups and risk factors, the minimization of DRPs on the levels of physicians, pharmacists, or patients, and the effect of the latter on patient outcomes. Populations at risk are the elderly patients who require more complex regimens and are more likely to have an interaction; patients with renal or hepatic dysfunction whose drug clearance is disturbed; and pediatric patients whose weight-based dosing causes issues with therapy; and patients with renal or hepatic dysfunction where drug clearance changes.[5,6] Polypharmacy, insufficient patient education, insufficient monitoring, and poor communication amongst the healthcare professionals are some of the risk factors of DRPs. The pressures of time and work pressure in hospitals and self-medication and easy access to antibiotics by communities are factors that contribute to prescribing errors and self-medication respectively. Rational use is also complicated by the cultural beliefs that antibiotics will act as a remedy to all. Reduction of DRPs needs responses at various levels. Doctors should be guided by rational prescribing patterns, guidelines, and knowledgeable of resistance patterns. Pharmacists are significant in the review of the prescription, counselling and interaction monitoring. Patients should be taught compliance, self-medication risks, and how to avoid abusing themselves.[7-10] Joint care models where physicians and pharmacists are closely involved have demonstrated potential in the elimination of DRPs. The effect of DRPs on patient outcomes is immense: they lengthen the hospital stay, raise the expense of healthcare and worsen outcomes. Drug-resistant infections demand less effective or more toxic medications and the rate of mortality increases when first-line antibiotic medications have been ineffective. In addition to the individual patients, DRPs lead to the public health crisis, including the antimicrobial resistance which has been pointed at by the World Health Organization as one of the biggest threats to the global health.

The originality of the given project is its all-encompassing character of recognizing and classifying the issues concerning drugs within the framework of antibiotic prescriptions with the help of the PCNE classification system. Although the amount of research on antibiotic misuse has been large, few have mapped DRPs in the levels of physician, pharmacist, and patient in a tertiary care facility in an organized manner. Both this systematic approach to the problem and the recognition of the most vulnerable populations suggest that the issue of DRPs is widespread and is equally important as offering a specific chance to develop interventions. The project will contribute to the sphere of pharmaceutical care by incorporating the clinical practice and the population health by applying the pharmacological analysis and epidemiological and patient-centered approaches, which is why the project closes the gaps between the two areas. [11-15] The potential of the project is enormous. The study might have been extended to cover more hospitals and regions to give a wider epidemiological understanding of the antibiotic-related DRPs. The use of modern technologies, including electronic prescribing systems, artificial intelligence, and machine learning, might help to improve the real-time identification of possible DRPs and reduce damage before it arises. The findings could be used to develop educational programs that would be patient-, physician-, pharmacist-specific and evidence-based to guarantee that interventions are evidence-based and specific. The implications to the policy are also important: the findings may guide the country-wide policies regarding antibiotics stewardship, reinforce policies against the sale of antibiotics over the counter, and promote international actions to address antimicrobial resistance. Moreover, interdisciplinary partnerships involving clinical pharmacology, epidemiology, and health informatics might be supported by the project to develop sustainable solutions. Finally, medications, especially antibiotics, are the best examples of the dualistic character of a therapeutic means: they are not only curative but also dangerous.[16-20] Abuse and overuse cause drug related issues, which not only impact on individual patients, but also on the society. Healthcare systems can reduce harm and maximize benefit by systematically identifying DRPs, focusing on the high-risk groups, and intervening at the various levels. Its innovative approach to antibiotic-related DRPs is

structured and multi-level, and its future emergence is bound to advance in the technology, education, and policy. The war on antibiotic misuse is not the clinical issue only, but it is also the business of the society and collaboration between physicians, pharmacists, patients, policymakers and educators are needed. Such concerted action is only what will help maintain the effectiveness of antibiotics and protect the health of the population of generations to come.

MATERIAL AND METHODS

It was a prospective and observational study, which was carried out over a period of six months on inpatients of the General Medical Department of Government General Hospital (RIMS), Kadapa. The inclusion criteria were as follows: the patients should be of both genders and be aged over 18 years, and they should be hospitalized in the department, taking an antibiotic, and they should be willing to volunteer. The exclusion criteria were patients who were allergic to antibiotics, as well as people who had a history of antibiotic resistance. The case sheets of inpatients were sampled in their regular ward rounds, and thus were accurate and relevant to prescribing practices. The area under study was limited to Government General Hospital, Kadapa where a representative sample was obtained in a tertiary care environment. The Microsoft Excel 2021 was used to record and organize the data of the patients through the use of statistical analysis. Descriptive statistics like averages and standard deviations were used to assess the demographic parameters whereas inferential statistics like p-values were assessed using Jamovi v2.6.44.0 to ascertain the relevance of the findings. This methodological design was used to assure systematic identification of the drug related issues in antibiotic prescription and offered a solid foundation on the effect of the drug-related problem on patient outcomes.

RESULTS & DISCUSSION

Out of 170 samples of patients recruited to participate in the research, 58 drug-related problems (DRP) were identified and sorted into the Pharmaceutical Care Network Europe (PCNE) version 9.1 classification system. All the DRPs were recorded to include the nature of the DRP, its cause, and the possible effects on the treatment. The risk factors that led to the occurrence of DRPs were examined specifically, taking into consideration demographic and clinical data like the age of the patient, gender, and class.

Distribution and Causes of Drug-related Problems

Out of the 170 samples of patients under analysis, 58 drug-related problems (DRPs) were detected and categorized using the Pharmaceutical Care Network Europe (PCNE) version 9.1 system. The classification showed that most of the problems occurred in terms of treatment effectiveness, which comprised 24 cases (41.37%), and the treatment safety, which also comprised 24 cases (41.37%). The rest of the 10 problems (17.26%) went under the other category representing those problems that were beyond the main spheres of effectiveness and safety. The 34 different causes of these DRPs as per the PCNE framework were further analyzed to determine the reasons behind the same among 170 patients. The causes domain in PCNE has 7 major domains and 35 subdomains, which offer an elaborate field of

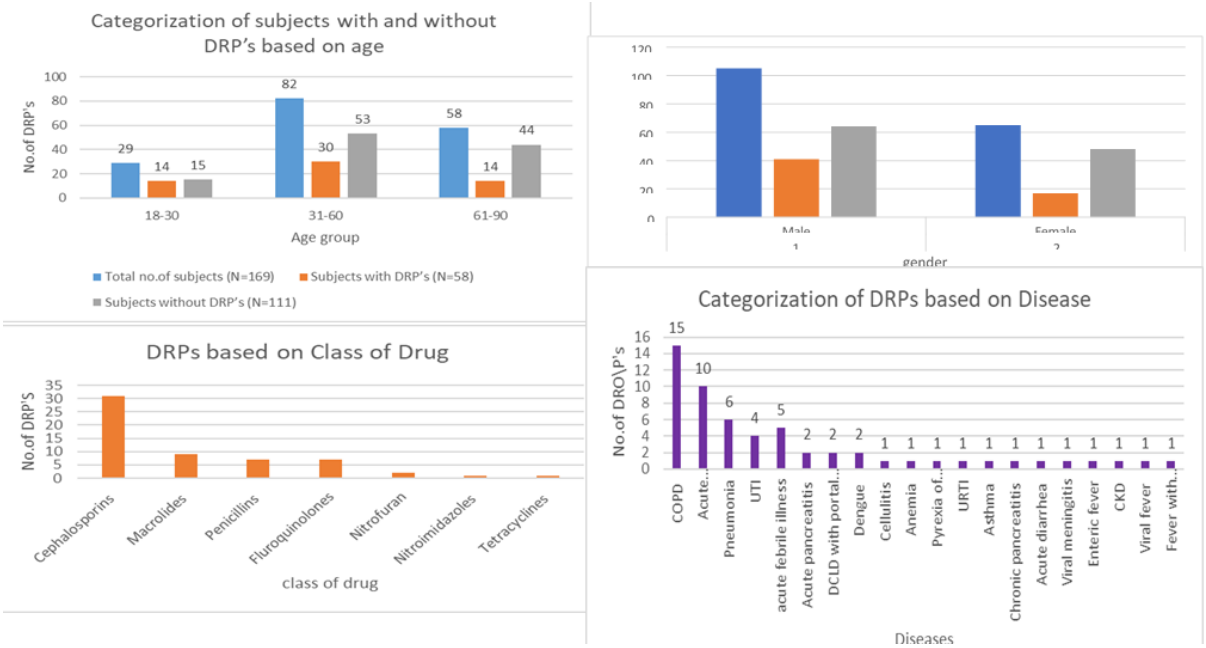

Figure 1: Distribution of DRPs by age, gender, antibiotic class, and disease profile among hospitalized patients, illustrating key demographic and clinical risk factors in a tertiary care setting

Table 1: Summary of drug-related problems (DRPs) based on PCNE v9.1, including types, causes, interventions, outcomes, and patient demographics (N=170)

Section	Domain / Category	Code	Detailed Classification	Number (n)	Percentage
Problems (N=58)	Treatment effectiveness	P1	Treatment effectiveness issues	24	41.37%
	Treatment safety	P2	Treatment safety issues	24	41.37%
	Others	P3	Other problems	10	17.26%
Causes (N=34)	Drug selection	C1.1	Inappropriate drug as per guidelines/formulary	21	61.76%
		C1.2	No indication for drug	9	26.48%
		C1.3	Inappropriate drug combination	1	2.94%
		C1.6	Too many drugs for indication	1	2.94%
	Dose selection	C3.1	Drug dose too low	1	2.94%
		C3.3	Dosage regimen not frequent enough	1	2.94%
Interventions (N=58)	No intervention	I0.1	No intervention	0	0%
	At prescriber level	I1.1	Prescriber informed only	18	31.03%
		I1.3	Intervention proposed to prescriber	10	17.24%
	At patient level	I2.1	Patient counseling	4	6.89%
		I2.3	Patient referred to prescriber	2	3.44%
		I2.4	Spoken to family/caregiver	3	5.17%
	Drug level	I3.1	Drug changed	14	24.17%
		I3.2	Dosage changed	1	1.72%
		I3.5	Drug stopped/paused	6	10.34%
Outcomes (N=58)	Not known	O0.1	Problem status unknown	14	24.13%
	Solved	O1.1	Problem solved	27	46.55%
	Partially solved	O2.1	Problem partially solved	14	24.13%
	Not solved	O3.2	Lack of prescriber cooperation	1	1.73%
		O3.3	Intervention not effective	2	3.46%
Age Distribution (N=170)	18–30 yrs	—	With DRPs: 14	14/29	—
		—	Without DRPs: 15	15/29	—
	31–60 yrs	—	With DRPs: 30	30/83	—
		—	Without DRPs: 53	53/83	—
	61–90 yrs	—	With DRPs: 14	14/58	—
		—	Without DRPs: 44	44/58	—
Gender Distribution (N=170)	Male	—	With DRPs: 41	41/105	—
		—	Without DRPs: 64	64/105	—
	Female	—	With DRPs: 17	17/65	—
		—	Without DRPs: 48	48/65	—

breakdown. In the current investigation, the highest rate was the prescription of wrong drugs based on guidelines or formulary which comprised 21 cases (61.76%). Other prominent causes were drugs that were prescribed without reason, and noted in 9 cases (26.48%), and wrong combination of drugs with herbal medications or dietary supplements, which were also noted in 1 case (2.94). Other reasons were prescription of excessive different drugs and active ingredients with one indication (1 case, 2.94%), low dosage (1 case, 2.94%), and non-frequency of dosage regimens (1 case, 2.94%). This distribution demonstrates that most DRPs were caused by the violation of the current prescribing standards and the use of unnecessary drugs, which is why it becomes crucial to follow the requirements of the formulary and the best practice of prescribing medications in order to reduce the risks and enhance patient outcomes.

Interventions and outcomes

The designed interventions were designed based on the Pharmaceutical Care Network Europe (PCNE) framework that consists of five major domains and fifteen subdomains. Fifty-eight interventions were recommended to solve the identified drug-related issues.[15-21] These interventions were spread at various levels with most of them being administered at the prescriber level (48.27%), then at the drug-level (36.22%) and finally at the patient-level (15.51%). Among the 58 scheduled interventions,

acceptance was most impressive as 56 interventions (96.5) were accepted at either prescriber or patient level, and only 2 interventions (3.5) were not assimilated. The PCNE classification system with four major domains and six sub domains was also used to determine the outcomes of these interventions. [26-30] Out of the 58 interventions assessed, 27 problems (46.55) were entirely resolved, 14 problems (24.13) were partially resolved, 3 problems (5.19) were not resolved, and in 14 assessments (24.13) no outcome was known because of an incomplete follow-up or no documentation was done. The effectiveness of structured interventions in solving drug-related problems is identified in this analysis, and it proves the fact that the majority of the issues can be effectively coped with in the cases when cooperation between prescribers and patients is reached. The results show that systematic planning of intervention, high acceptance rates, and continuous monitoring are essential in enhancing patient safety and maximizing therapeutic outcomes in hospitals. [25-31]

Distribution of drug-related problems

In this study, drug-related problems (DRPs) were analyzed across multiple dimensions including age, gender, class of antibiotic, and underlying disease conditions to provide a comprehensive understanding of their distribution. Age-wise categorization revealed that patients between 31–60 years were most affected, accounting for 30 DRPs (51.72%), which may be attributed to higher antibiotic exposure in this age group due to chronic illnesses and hospital admissions. The younger group aged 18–30 years contributed 14 DRPs (24.13%), while the elderly group aged 61–90 years also accounted for 14 DRPs (24.13%), highlighting that DRPs are not confined to a single age bracket but occur across all adult populations. Gender-based analysis showed that males were disproportionately affected, representing 70.68% of DRPs compared to 29.32% in females, which could reflect differences in disease prevalence, prescribing patterns, or healthcare-seeking behavior. When examined by class of antibiotic, cephalosporins were most frequently associated with DRPs, contributing 31 cases (53.45%), followed by macrolides with 9 cases (15.55%). Penicillins and fluoroquinolones each accounted for 7 DRPs (12.06%), while nitrofurans contributed 2 cases (3.44%), and nitroimidazoles and tetracyclines each accounted for 1 case (1.72%). This distribution suggests that broad-spectrum antibiotics, particularly cephalosporins, are more prone to inappropriate use or prescribing errors. Disease-based categorization revealed that chronic obstructive pulmonary disease (COPD) patients experienced the highest number of DRPs (15 cases), reflecting the frequent and complex antibiotic regimens used in respiratory infections. Acute gastroenteritis accounted for 10 DRPs, pneumonia for 6, urinary tract infections (UTIs) for 4, acute febrile illness for 5, and acute pancreatitis for 2. Other conditions such as decompensated chronic liver disease (DCLD) with portal hypertension, dengue, and cellulitis each contributed 2 DRPs, while anemia, pyrexia of unknown origin, upper respiratory tract infections (URTI), asthma, and chronic kidney disease (CKD), among others, were each associated with 1 DRP. This detailed distribution highlights that DRPs are influenced by demographic factors, antibiotic class, and underlying disease conditions (Figure 1). The findings emphasize the need for targeted interventions, particularly in middle-aged patients, male populations, and those receiving cephalosporins or treatment for chronic respiratory diseases. Such insights are crucial for guiding rational prescribing practices, strengthening antibiotic stewardship programs, and ultimately improving patient safety and therapeutic outcomes in hospital settings.

CONCLUSION

Our research paper has shown that drug-related issues (DRP) is a major issue among patients receiving antibiotics in a tertiary care hospital environment. We identified and classified DRPs systematically using the Pharmaceutical Care Network Europe (PCNE) version 9.1 classification, based on the type, cause, and outcome. The most common issues were also identified as concerns pertaining to treatment effectiveness and treatment safety, with 41.37 and 41.37 percent correspondingly, with the rest of the issues (17.26) considered as other. Inappropriate drug choice based on guidelines, antibiotics based on unclear indication, wrong dosing regimen, and wrong combination of drugs were the major causes. These results demonstrate the necessity to pay close attention to the compliance with the standard treatment guidelines in order to reduce DRPs and enhance patient safety. The antibiotic group most commonly involved was cephalosporins then macrolides, fluoroquinolones and penicillins. The proposed interventions by clinical pharmacists were very effective and an acceptance rate of 96.5 was obtained to the prescriber or patient level. Results indicated that almost half of the DRPs (46.55%) were fully resolved, 24.13% resolved, 5.19% not resolved, and 24.13% (Table 1) not known because of the incomplete follow ups. These findings have a strong argument in favor of introducing clinical pharmacists into regular patient care since their efforts with prescribers maximize drug use and improve therapeutic outcomes. The paper also highlights the changing role of the pharmacy students and future pharmacists whose duties are not limited to dispensing, but also to clinical decision making, intervention planning and patient education. This experience solidified the importance of teamwork to healthcare where collaboration of pharmacists, physicians, nurses, and patients results in more advantageous therapeutic choices. In the future,

increased involvement of clinical pharmacists in patient care, regular medication assessments, and the creation of awareness about rational use of antibiotics are the ways of decreasing the number of DRPs. The present study does not only serve a purpose in the academic context, but it also highlights the significance of patient-centered strategies in enhancing healthcare outcomes.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Institutional Human Ethics Committee, Government General Hospital, Kadapa, on 27 October 2023 (Reference No.: ACAD./E3B/2023–2024).

AUTHOR FUNDING

There is no funding for this project.

AUTHORS CONTRIBUTIONS

All the authors are involved in the research of literature, collection of data and preparation of the manuscript and also they were involved in reviewing and editing of the manuscript.

CONFLICT OF INTERESTS

There is no conflict of interest for this research

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