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Pharmaceutical Interventions in Drug-Related Problems in a Hospital Setting

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ABSTRACT **Original research paper**

The role of clinical pharmacists is directed toward the promotion, protection, and restoration of health, as well as the prevention of harm resulting from the inappropriate use of medications. Pharmaceutical intervention is a clinical activity carried out by the clinical pharmacist, a healthcare professional and member of the multidisciplinary team, with the aim of resolving or preventing problems related to pharmacotherapy. During the evaluation of medication prescriptions—an essential step in the dispensing process—the pharmacist must consider both legal and technical aspects, which may enable the identification and prevention of drug-related problems (DRPs) through appropriate pharmaceutical interventions. The type of pharmaceutical intervention performed is directly related to the identified DRP, defined as events or circumstances associated with pharmacotherapy that may lead to negative clinical outcomes. This study aimed to analyze pharmaceutical interventions carried out in patients admitted to the Medical Clinic and Adult Intensive Care Units of the University Hospital of Brasília, Federal District, Brazil. This was an observational, cross-sectional study with retrospective data collection. Data were obtained from electronic and/or physical patient records, medical prescriptions, and internal records from the Clinical Pharmacy Unit between August and October 2023. A total of 184 hospitalized patients received at least one pharmaceutical intervention. The majority were male (55.6%), with a mean age of 58.6 years. The most frequent DRPs were related to dose selection, dosage prescribed, and drug selection, accounting for 47.4% of all DRPs. The acceptance rate of pharmaceutical interventions was 59.4%. The most commonly involved medication classes were anti-infectives (14.3% of all interventions) and cardiovascular drugs (12.2%).

Keywords: Pharmaceutical interventions, Drug-related problems, Clinical pharmacy, Hospital, Patient safety.

Introduction

The clinical pharmacist plays a crucial role in the promotion, protection, and recovery of health, as well as in the prevention of harm resulting from the inappropriate use of medications (Brasil, 2013). Among the professional responsibilities attributed to this role is the pharmaceutical intervention, a clinical activity carried out by the pharmacist as a healthcare professional and active member of the multidisciplinary team, with the purpose of resolving or preventing problems related to pharmacotherapy (Organização Pan-Americana da Saúde [OPAS], 2002).

When evaluating medication prescriptions—an essential step in the dispensing process—the pharmacist must

consider both legal and technical aspects. This evaluation enables the identification and prevention of drug-related problems (DRPs) through appropriate pharmaceutical interventions when necessary (Brasil, 2013; Rocha et al., 2020). DRPs are defined as events or circumstances related to pharmacotherapy that may lead to negative clinical outcomes (Pharmaceutical Care Network Europe [PCNE], 2019; Cruz et al., 2020). The type of pharmaceutical intervention is directly associated with the nature of the DRP identified.

A study conducted in a university hospital reported that, out of 18,795 prescriptions evaluated, 2,834 DRPs were identified, with the most frequent issues related to dilution or infusion rate (28.7%) and presentation or pharmaceutical form (19.0%). The authors concluded that pharmaceutical interventions can offer significant benefits to patient care and safety, highlighting the importance of integrating clinical pharmacists into healthcare teams (Cruz et al., 2020).

In addition to improving patient safety, pharmaceutical interventions can contribute to reducing healthcare costs. In a study conducted in a university hospital, 943 pharmaceutical interventions resulted in substantial cost savings for the institution (Arantes et al., 2021). These findings reinforce the role of the clinical pharmacist in promoting the safety, efficiency, and effectiveness of pharmacotherapeutic outcomes (Cardoso et al., 2020).

Given this context, the present study aimed to analyze pharmaceutical interventions performed in patients admitted to the Medical Clinic and Adult Intensive Care Units of the University Hospital of Brasília (HUB), located in the Federal District, Brazil.

Method

This study employed an observational, cross-sectional design with retrospective data collection. It was conducted at the University Hospital of Brasília (Hospital Universitário de Brasília – HUB), a public institution integrated into the Unified Health System (Sistema Único de Saúde – SUS), which provides healthcare services free of charge to the population. The HUB is managed by the Brazilian Hospital Services Company (Empresa Brasileira de Serviços Hospitalares – Ebserh), a public company linked to the Ministry of Education. Since 2005, the hospital has been accredited as a Teaching Hospital, actively engaged in the development and promotion of teaching, research, and extension activities.

Population and Eligibility Criteria. The study population comprised patients aged 18 years or older who were hospitalized in the Medical Clinic Unit—which includes the specialties of Cardiology, Pulmonology, and Infectology—and in the Adult Intensive Care Unit (ICU) of HUB. Patients were eligible for inclusion if they had received at least one pharmaceutical intervention during the period from August to October 2023.

Data Collection. Data were collected retrospectively through the review of electronic and/or physical medical records, medication prescriptions, and internal documents of the hospital's Clinical Pharmacy Unit. The following data were collected: Sociodemographic variables: sex, age, ethnicity, and marital status; Hospitalization details: primary reason for hospitalization and length of stay; Pharmacological treatment: drug name, dose, administration frequency and interval, route of administration, pharmaceutical form, and duration of therapy; Drug-Related Problems (DRPs): type of DRP identified; Pharmaceutical interventions: type of intervention performed, level of intervention (prescriber, patient, medication, or other), acceptance of the intervention, and resolution status of the DRP.

The classification of DRPs, pharmaceutical interventions, intervention acceptance, and resolution status was based on the Pharmaceutical Care Network Europe (PCNE) Classification for Drug-Related Problems, version 9.0. Health conditions were categorized using the International Classification of Diseases (ICD), and medications were classified according to the Anatomical Therapeutic Chemical (ATC) classification system.

Descriptive statistical analysis of the collected data was conducted using JAMOVI software, version 1.0. This study is part of the research project titled *"Evaluation of clinical services provided by pharmacists in the Clinical Pharmacy Unit of the University Hospital of Brasília"*. The project was approved by the Research Ethics Committee of the Faculty of Health Sciences and Technologies at the University of Brasília (UnB), under Certificate of Presentation for Ethical Consideration (CAAE) No. 26855719.0.0000.8093.

Results

A total of 184 hospitalized patients received at least one pharmaceutical intervention during the study period. The majority were male, with a mean age of 58.6 years, and most self-declared as of brown ethnicity. The average length of hospital stay was 21 days, with hospitalizations due to cardiovascular diseases being the most prevalent (Table 1).

Table 1. Sociodemographic and clinical characteristics of patients by inpatient unit

Description	CM[1] (n)	UTI[2] (n)	Total (n;%)
Hospitalized patients	105	84	184
Sex			
Men	59	46	105 (55.6)
Women	46	38	84 (44.4)
Age (years)			
Mean	59,4	57,9	58.6
Minimum	20	28	
Maximum	90	88	
1 month	0	2	
Ethnicity			
Brown	83	75	158 (83.6)
White	11	6	17 (9.0)
Black	9	2	11 (5.8)
Indigenous	2	0	2 (1.1)
Yellow	0	1	1 (0.5)
Marital Status			
Single	40	21	61 (32.3)
Married	32	27	59 (31.2)
Divorced/Separated	6	3	9 (4.8)
Widowed	6	4	10 (5.3)
Stable Union	2	1	3 (1.6)
Separated	1	2	3 (1.6)
Other	18	26	44 (23.3)
Length of hospitalization (days)			
Mean	21,9	21,7	21.8
Minimum	1	1	1
Maximum	115	110	112.5
Most frequent ICDs			
Certain infectious and parasitic diseases (Chapter 1)	10	5	15 (7.9)
Neoplasm (Chapter 2)	0	10	10 (5.3)
Diseases of the nervous system (Chapter 6)	0	1	1 (0.5)
Diseases of the circulatory system (Chapter 9)	36	44	80 (42.3)
Diseases of the respiratory system (Chapter 10)	15	7	22 (11.6)
Diseases of the digestive system (Chapter 11)	0	4	4 (2.1)
Diseases of the skin and subcutaneous tissue (Chapter 12)	1	0	1 (0.5)
Diseases of the musculoskeletal system and connective tissue (Chapter 13)	2	0	2 (1.1)
Diseases of the genitourinary system (Chapter 14)	4	4	8 (4.2)
Congenital malformations, deformations, and chromosomal abnormalities (Chapter 17)	0	1	1 (0.5)
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (Chapter 18)	3	3	6 (3.2)

Foreign body in respiratory tract, unspecified part (Chapter 19)	1	0	1 (0.5)
Factors influencing health status and contact with health services (Chapter 21)	25	5	30 (15.9)

[1]Medical Clinic; [2]Intensive Care Unit

Table 2 presents an overview of the Drug-Related Problems (DRPs) identified according to inpatient unit. Among 189 patients, a total of 798 DRPs were addressed through pharmaceutical interventions performed by clinical pharmacists, resulting in an average of 4.2 interventions per patient. The Medical Clinic Unit attended a higher number of patients compared to the Intensive Care Unit (ICU), which consequently led to a greater number of DRPs being recorded in the Medical Clinic Unit.

With regard to the types of DRPs, problems related to dose or dosage selection were the most frequently identified in both units, with a notably higher incidence in the Medical Clinic. Issues related to drug selection and dispensing were also identified in both settings, again more frequently in the Medical Clinic. Conversely, DRPs associated with the drug use process were more prevalent in the ICU. No DRPs related to treatment duration were observed in either unit. Additionally, a small number of DRPs related to patient behavior were identified exclusively in the Medical Clinic Unit (Table 2).

Table 2. Number of DRPs and PIs per inpatient unit

Description	**CM[1]**	**UTI[2]**	**Total**
Number of patients	105	84	189
Number of DRPs found	474	324	798
Type of DRP (cause)*			
C1. Drug selection problem	123	31	154
C2. Drug form	24	19	43
C3. Dose/prescription dosage selection and drug selection	215	163	378
C4. Treatment duration	0	0	0
C5. Dispensing. Prescription and dispensing logistics	92	78	170
C6. Drug use process	13	33	46
C7. Patient-related (behavior)	7	0	7
Number of Pharmaceutical Interventions performed	474	324	798
Type of intervention *			
0. No intervention	0	0	0
1. At prescriber level	102	18	120 (15.0)
2. At patient level	0	0	0
3. At drug level	354	292	646 (81.0)
4. Other intervention	18	14	32 (4)
Intervention accepted			
Yes	290	184	474 (59.4)
No	175	140	315 (39.5)
No information	9	0	9 (1.1)
Intervention implementation *			
A1. Accepted and implemented interventions	290	184	474 (59.4)
A2. Non-accepted and non-implemented interventions	175	140	315 (39.5)
A2.1 Reason: not feasible	30	34	64 (8.0)
A2.2 Reason: no agreement	63	66	129 (16.2)

A2.3 Other reason	20	31	51 (6.4)
A2.4 Unknown reason	62	9	71 (8.9)
A3. Other (no information)	0	0	0

*Classification according to PNCE (2019). [1]Medical Clinic; [2]Intensive Care Unit.

Table 2 also details the profile of pharmaceutical interventions (PIs) conducted in the inpatient units. The Medical Clinic Unit accounted for a significantly greater volume of interventions compared to the ICU. In both units, most interventions were classified at the medication level, with a higher prevalence in the Medical Clinic. Interventions directed at prescribers were also substantially more frequent in the Medical Clinic than in the ICU. No interventions were recorded at the patient level in either unit, and no interventions were categorized under "no intervention".

Regarding the acceptance of pharmaceutical interventions, a substantial proportion was accepted in both units, with a higher acceptance rate observed in the Medical Clinic. Nonetheless, a significant number of interventions were not accepted in both settings. Among the non-accepted interventions, the most commonly reported reasons were infeasibility and disagreement. In the Medical Clinic Unit, a considerable number of non-accepted interventions were classified as having an unknown reason, whereas this category was less frequent in the ICU.

Table 3. Main groups and medications involved in pharmaceutical interventions

Class	Inpatient Unit	Number of interventions	Involved medications
Analgesics	Medical Clinic	44	Dipyrone (44); paracetamol (5);
	ICU	10	Tramadol (3); morphine (10)
	Subtotal	**54**	
Anti-infective	Medical Clinic	67	Piperacillin+tazobactam (28); meropenem (11); vancomycin (11); ampicillin+sulbactam (9); ceftriaxone (8)
	ICU	47	Meropenem (34); amikacin (5); linezolid (4); darunavir (3)
	Subtotal	**114**	
Cardiovascular	Medical Clinic	58	Furosemide (13); isosorbide (12); propatylnitrate (15); metoprolol (10); enoxaparin (8)
	ICU	39	Clonidine (18); metoprolol (6); hydralazine (5); norepinephrine (3); nitroglycerin (3); nimodipine (2); dobutamine (2)
	Subtotal	**97**	
Gastrointestinal	Medical Clinic	66	Ondansetron (42); omeprazole (12); metoclopramide (7); pantoprazole (5)
	ICU	23	Ondansetron (14); bromopride (6)
	Subtotal	**89**	
Metabolism	Medical Clinic	10	Insulin (10)
	ICU	3	Insulin (3)
	Subtotal	**13**	

Table 3 presents the classes of medications most frequently associated with pharmaceutical interventions in each inpatient unit. In the Medical Clinic Unit, anti-infective agents were the most involved, with *piperacillin/tazobactam* and *meropenem* being the most prominent medications. Gastrointestinal drugs also

accounted for a large number of interventions, particularly *ondansetron*, an antiemetic. Analgesics and cardiovascular agents were also commonly targeted, with frequent interventions involving *dipyrone*, *propatylnitrate*, *furosemide* (a loop diuretic), and *isosorbide* (a nitrovasodilator).

Similarly, in the ICU, anti-infective medications were the most frequently involved in interventions, with *meropenem* again being the leading drug. Cardiovascular and gastrointestinal medications were also common targets, with *clonidine* and *ondansetron* standing out in these respective classes. Analgesics and metabolic agents were less frequently involved in ICU interventions, with *morphine* (an opioid analgesic) and *insulin* being the most representative medications in these categories.

Overall, the Medical Clinic Unit registered a higher volume of pharmaceutical interventions across all drug classes when compared to the ICU. Notably, anti-infective and gastrointestinal drug classes were consistently the most frequently involved in pharmaceutical interventions in both units.

Discussion

The main findings of the study indicate that, among the sociodemographic and clinical characteristics of the patients, the majority were male (55.6%), and diseases of the circulatory system were the leading cause of hospitalization (42.3%). Regarding Drug-Related Problems (DRPs) and Pharmaceutical Interventions (PIs), the most frequently identified DRPs were associated with dose selection, prescription dosage, and drug selection, accounting for 47.4% of the total. The overall acceptance rate of pharmaceutical interventions was 59.4%, indicating that more than half of the proposed interventions were implemented. Finally, the pharmacological classes most frequently involved in pharmaceutical interventions were anti-infective agents (14.3% of total interventions) and cardiovascular drugs (12.2%).

When analyzing multiple studies addressing Drug-Related Problems (DRPs) and Pharmaceutical Interventions (PIs), considerable variability is observed in both the age groups and the clinical contexts investigated, which poses challenges in establishing standardized patterns for these variables. In the present study, the population comprised 184 patients with a broad age range—from 1 month to 90 years—and a mean age of 58.6 years. This demographic heterogeneity contrasts with findings from studies that targeted specific age groups. For instance, Ahmed et al. (2024) conducted a study exclusively with neonates, reporting a mean gestational age of 34 ± 4 weeks and a mean birth weight of 2.03 ± 0.85 kg. Conversely, Ma et al. (2025) focused on elderly patients experiencing acute exacerbation of chronic obstructive pulmonary disease (COPD), with a mean age of 75.18 years. Similarly, Alkanj et al. (2025), in a study conducted in a French university hospital, found that pharmaceutical interventions were predominantly carried out in patients aged 65 years or older (49.1%). Tasaka (2018), in a nationwide study in Japan, also reported a predominance of elderly individuals, with 68.2% of patients over 65 years and a mean age of 72 years. Likewise, Krumm et al. (2023), in a study conducted in a palliative care unit, observed mean patient ages of 72.5 years during the control phase and 70.3 years during the intervention phase, reinforcing the trend of research focusing on older populations. Among the reviewed studies, the one conducted by Saldanha (2020) presented a population most similar to the adult profile observed in our research, with a mean age of 52.6 ± 17.7 years.

Regarding gender distribution, 55.6% of the patients in our study were male, and 44.4% were female. This profile is consistent with other studies, such as Saldanha et al. (2020), who reported 50.9% female participants, and Tasaka et al. (2018), who observed a distribution of 51.1% male and 48.6% female patients. In contrast, Ma et al. (2025) found a markedly higher proportion of male patients (87.13%) in a study involving individuals with chronic obstructive pulmonary disease (COPD), which predominantly affects men—a fact that may explain the gender imbalance in that population.

Hospitalization characteristics also varied. In our study, the mean length of hospital stay was 21.8 days, which is considerably longer than that reported by Saldanha et al. (2020), who observed an average of 12 days. This difference may reflect the diversity of clinical conditions and care complexity, as well as differences in hospital profiles and resources among the studies evaluated.

With regard to the types of Drug-Related Problems (DRPs), issues related to dose or dosage selection and drug selection were the most frequently identified, accounting for 47.4% of all DRPs in our study. This finding aligns with evidence from other studies. Ahmed et al. (2024), in a systematic review focused on neonatal pharmaceutical interventions, found that problems related to drug dosage were the most prevalent (75.4%),

followed by inappropriate drug selection (16.9%). Ma et al. (2025), investigating elderly patients with COPD, also reported high frequencies of inappropriate drug selection (40.2%) and incorrect dosage (13.7%). Likewise, Robert et al. (2020) identified dosage issues as the most frequent type of DRP (40%). The recurrence of these findings across different clinical settings underscores the critical importance of precise dose calculation and appropriate drug selection to ensure safe and effective pharmacotherapy.

In terms of the acceptance of pharmaceutical interventions, our study recorded a rate of 59.4%, which falls within the range reported in the literature, typically varying from 51.7% to 88.5% (George et al., 2015; Robert et al., 2020; Saldanha et al., 2020). Higher acceptance rates have been observed in studies conducted in general and tertiary care hospitals, such as 88.5% (Saldanha et al., 2020) and 83.1% (George et al., 2015), respectively. Conversely, Robert et al. (2020) reported a lower acceptance rate of 51.7% in a university hospital. These variations may be influenced by multiple factors, including the strength of collaboration between pharmacists and prescribers, the perceived relevance and clarity of the intervention, and institutional culture regarding interprofessional communication. The findings highlight the need for ongoing efforts to strengthen the integration of clinical pharmacy services and promote multidisciplinary collaboration to enhance the effectiveness of pharmaceutical interventions in patient care.

The primary classes of medications involved in pharmaceutical interventions in our study were anti-infective agents (14.3% of total interventions) and cardiovascular drugs (12.2%). These findings are in agreement with those of other studies that also identify these therapeutic groups as commonly associated with Drug-Related Problems (DRPs) and, consequently, with pharmaceutical interventions. For instance, a systematic review by Robert et al. (2020) found that the drug classes most frequently involved in DRPs were anti-infective agents (23.9%), cardiovascular drugs (16.7%), and nervous system medications (13.3%). Similarly, in a Brazilian study conducted by Saldanha et al. (2020), anti-infective agents were the most frequent class involved (19.4%), followed by cardiovascular (16.7%) and nervous system drugs (12.6%).

The frequent involvement of these classes may be attributed to several factors, including their complex pharmacokinetic profiles, narrow therapeutic indices, and the need for individualized dose adjustments, particularly in hospitalized patients with multiple comorbidities. These characteristics increase the likelihood of inappropriate prescribing and dosing errors, thus necessitating vigilant pharmaceutical monitoring. These findings underscore the essential role of clinical pharmacists in monitoring and managing therapies involving high-risk medications to prevent DRPs and ensure patient safety.

Despite the relevance of the findings, this study presents some limitations that should be acknowledged. First, the retrospective design may have led to the omission of relevant data due to incomplete or inconsistent medical records, potentially affecting the comprehensiveness and accuracy of the results. Second, the research was conducted in a single university hospital, which limits the generalizability of the findings to other healthcare institutions or regions with different clinical practices and patient profiles. Third, the study period was limited to three months, which may not reflect seasonal variations or long-term trends in DRPs and pharmaceutical interventions. Finally, reliance on electronic health records and internal documentation from the pharmacy service may not fully capture all pharmaceutical interventions or DRPs, especially those not formally recorded.

Nevertheless, the present study contributes significantly to the understanding of the prevalence, types, and implications of DRPs and pharmaceutical interventions within a tertiary care context in Brazil. It highlights the critical role of clinical pharmacists in improving the quality and safety of pharmacotherapy and reinforces the need for their inclusion in multidisciplinary healthcare teams.

Conclusion

This study offers relevant insights into the types of Drug-Related Problems (DRPs) and the characteristics of Pharmaceutical Interventions (PIs) performed by clinical pharmacists in a university hospital setting. The high prevalence of DRPs related to dose or dosage selection and drug selection emphasizes the importance of thorough and systematic prescription evaluation as a fundamental strategy to ensure safe and effective pharmacotherapy.

Although the rate of acceptance of pharmaceutical interventions was satisfactory, the findings suggest the need for strengthened communication and collaboration among healthcare professionals to enhance the integration of pharmaceutical care into clinical decision-

making processes. Additionally, the frequent involvement of anti-infective and cardiovascular drug classes in pharmaceutical interventions highlights the need for continuous and targeted pharmacological monitoring of these medications, given their complexity and potential for adverse outcomes.

Despite inherent limitations—such as its retrospective design, the single-institution scope, and the short period of data collection—this study reinforces the essential role of clinical pharmacists in improving the safety, quality, and effectiveness of patient care within hospital settings. The results support the expansion and institutionalization of clinical pharmacy services as a strategy for optimizing therapeutic outcomes and minimizing risks associated with pharmacotherapy.

This research was approved by the Research Ethics Committee of the Faculty of Health Sciences and Technologies at the University of Brasília (UnB), under the Certificate of Presentation for Ethical Appreciation (CAAE) no. 26855719.0.0000.8093.

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