Jornal de Assistência Farmacêutica e Farmacoeconomia
v.10, n.2, 2025.
Original Article

Pharmacist interventions in an public emergency hospital service of Porto Alegre classify according Pharmaceutical Care Network Europe (PCNE) Association Classification For Drug-Related Problems

Intervenções Farmacêuticas em um hospital público de pronto atendimento de Porto Alegre classificadas de acordo com a Pharmaceutical Care Network Europe (PCNE) Association Classification For Drug-Related Problems

Patrick Tauchert Rossato[1], Karin Hepp Schwambach[2], Matheus William Becker[2], Carine Raquel Blatt[3]

[1]Universidade Federal de Ciências da Saúde de Porto Alegre, Porto Alegre, RS, Brazil.
[2]Hospital de Pronto Socorro de Porto Alegre, Secretaria Municipal de Saúde. Porto Alegre, RS, Brazil.
[3]Universidade Federal de Ciências da Saúde de Porto Alegre. Porto Alegre, RS, Brazil.

Corresponding author
Patrick Tauchert Rossato – https://orcid.org/0009-0009-1456-5591 - Rua Caetano Gonçalves 1061, Bagé, RS, Brazil 96400-040. E-mail: patricktrossato@gmail.com

How to cite: Rossato PT, Schwambach KH, Becker MW, Blatt CR. Pharmacist Interventions In An Public Emergency Hospital Service Of Porto Alegre Classify According Pharmaceutical Care Network Europe (PCNE) Association Classification For Drug-Related Problems. JAFF [Internet]. June 26, 2025. https://doi.org/10.22563/2525-7323.2025.v10.e00174e

Received on: 08/27/2024

Accepted for publication on: 05/24/2025

ABSTRACT

Objective: To analyze the records of pharmaceutical interventions of a public hospital and classify them using the Pharmaceutical Care Network Europe (PCNE) Association Classification for Drug-Related Problems. **Methods:** Descriptive and retrospective study, based on a database of records of pharmaceutical interventions performed in 2022 by the Clinical Pharmacy service of a public emergency care hospital. The interventions were quantified and classified according to the service standards and then reclassified according to the standards of the classification for drug-related problems of the PCNE version 9.1. **Results:** During 2022, 414 pharmaceutical interventions related to 337 patients were recorded. Regarding the location, the interventions were performed on patients admitted to the clinical inpatient unit (35%), intensive care unit (33%), emergency room (27%), and surgical recovery room (5%). According to the service's own classification, reconciliation of health information (36%) and dose or frequency adjustment (33%) were the most frequent pharmaceutical interventions. Using the PCNE system to classify pharmaceutical interventions, the main problems identified were: effectiveness (86%) and safety of treatment (7%); the main causes were: dose selection (36%) and patient transfer (37%); and the main type of intervention: related to the prescriber (91%). **Conclusions:** The PCNE classification can be used in a hospital environment to generate quality indicators that allow the evaluation of processes and results related to pharmaceutical interventions. Research is needed that uses standardized methods to evaluate outcomes and events, allowing comparison between results.

Key-words: Pharmacy, Hospital Pharmacy Service, Evidence-Based Pharmacy Practice, Health Care Quality Indicators.

RESUMO

Objetivo: Analisar os registros de intervenções farmacêuticas de um hospital público e classificá-los utilizando a *Pharmaceutical Care Network Europe (PCNE) Association Classification for Drug-Related Problems*. **Métodos:** Estudo descritivo e retrospectivo, com base em um banco de dados de registros de intervenções farmacêuticas realizadas em 2022 pelo serviço de Farmácia Clínica de um hospital público de pronto atendimento. As intervenções foram quantificadas e classificadas de acordo com os padrões do serviço e após, reclassificadas de acordo com os padrões da classificação para problemas relacionados a medicamentos da PCNE versão 9.1. **Resultados:** Durante o ano de 2022 foram registradas 414 intervenções farmacêuticas relacionadas a 337 pacientes. Em relação ao local, as intervenções foram realizadas em pacientes internados em unidade de internação clínica (35%), unidade de terapia intensiva (33%), emergência (27%) e sala de recuperação cirúrgica (5%). Conforme a classificação própria do serviço, conciliação de informações em saúde (36%) e ajuste de dose ou frequência (33%) foram as intervenções farmacêuticas mais frequentes. Utilizando o sistema da PCNE para a classificação das intervenções farmacêuticas, foram identificados como principais problemas: efetividade (86%) e segurança do tratamento (7%); as principais causas foram: seleção de dose (36%) e transferência de paciente (37%); e principal tipo de intervenção: relacionada ao prescritor (91%). **Conclusões:** A classificação PCNE pode ser utilizada em ambiente hospitalar para gerar indicadores que possibilitem a avaliação de processos e resultados referentes às intervenções farmacêuticas. Categorização das intervenções farmacêuticas de forma padronizada permite a comparação entre resultados.

Palavras-chave: Farmácia; Serviço de Farmácia Hospitalar; Prática Farmacêutica Baseada em Evidências; Indicadores de Qualidade em Assistência à Saúde.

Introduction

The clinical practice of pharmacists in Brazil was regulated by Resolution No. 585 of August 29, 2013, of the Federal Council of Pharmacy (CFF).[1] Clinical pharmacists play a fundamental role in improving the safety and quality of medication use, optimizing pharmacological therapy, and achieving clinical outcomes.[1–6] Pharmaceutical intervention can be defined as a set of planned, documented, and pharmacist-led actions aimed at preventing, mitigating, and solving health-related problems.[1]

Recording the pharmacist's clinical assessment in the patient's medical record is one of the responsibilities of this professional.[1,7–8] These records must be accessible to all professionals involved in patient care, ensuring proper communication among teams and continuity of care.[9] Thus, documenting clinical practice activities is an essential skill for pharmacists. Progress notes must contain clearly and systematically organized descriptions of relevant information for care and continuity.[1,7–10]

Pharmaceutical interventions may be performed to resolve, mitigate, or prevent health problems.[1] Drug-related problems (DRPs) are events or potential circumstances involving drug therapy that may interfere with the desired health outcome.[11] DRPs may arise from several causes, including prescription errors, failure to provide patients with adequate information, dispensing or administration issues, among others.[1,11] Depending on the context, pharmacists can play a critical role by conducting interventions such as medication review, patient counseling on appropriate drug use, identification and prevention of potential drug interactions, and proposing solutions to DRPs.[1,11]

Although clinical pharmacy services existed prior to federal regulation in Brazil, this is still considered a relatively recent practice.[1,5,6,12] Clinical pharmacy has been expanding and gaining recognition in different countries, acknowledging pharmacists as healthcare providers and consolidating the integration of clinical pharmacy within multidisciplinary teams.[4–6,12–19] Pharmacist interventions have a significant effect on patients' clinical outcomes, although there is no consensus regarding positive economic effects.[12–22] The scarcity and lack of standardization of data remain major challenges in descriptive studies on clinical services and their economic impact.[9,10]

Different tools exist for classifying pharmaceutical interventions in healthcare services. However, there is no standardization among hospital pharmacy services.[23–25] No studies have been identified that widely justify the preference for any particular classification method for pharmaceutical interventions.[26] The classification of DRPs proposed by the Pharmaceutical Care Network Europe (PCNE) uses variables defined across five domains: type of DRP, cause of the problem, type of intervention performed, acceptability of the intervention, and outcome.[11] The PCNE systematization is robust, encompasses several pharmaceutical activities, and has proven to be applicable in various contexts, including pharmacy teams working in different types of healthcare facilities.[11]

In the Brazilian academic context, there is a growing number of studies and research using classifications of pharmaceutical interventions as tools to assess the effectiveness of clinical activities, measure outcomes, and establish indicators and practice standards.[27–31] Standardizing data related to pharmaceutical interventions is important for adequate comparison between descriptive and comparative studies.[9,10,24,26] By exploring and understanding pharmaceutical interventions carried out in a public emergency hospital in Porto Alegre, it will be possible to classify them according to the PCNE and analyze their results. These data are relevant to highlight and improve clinical practices, contributing to the enhancement of pharmaceutical care quality.

The objective of this study is to analyze the records of pharmaceutical interventions in a public emergency hospital and classify them using the Pharmaceutical Care Network Europe (PCNE) Association Classification for Drug-Related Problems v9.1.[11]

Methods

This is a descriptive study with retrospective data collection, conducted using a database of records of pharmaceutical interventions from the Clinical Pharmacy Service during the year 2022, at a public

emergency hospital located in Porto Alegre, capital of the Brazilian state of Rio Grande do Sul. The hospital is a referral center for urgent and emergency care of polytrauma patients.

The hospital provides care for severe polytrauma, traumatic brain injury, major burns, and traumatic injuries in the specialties of maxillofacial surgery, otorhinolaryngology, ophthalmology, and pediatrics. In addition to trauma cases, it also manages clinical emergencies such as myocardial infarction, stroke, and decompensations of chronic diseases (e.g., asthma, diabetes, and coronary heart disease). The hospital is also a referral center for the prescription and dispensing of post-exposure prophylaxis for HIV (PEP) and for the management of accidents caused by venomous animals. The institution hosts residents from multiprofessional residency programs and interns from technical and higher education programs. The estimated number of inpatient beds in 2022 was 98, distributed across adult clinical wards (40 beds), pediatric clinical wards (10 beds), adult intensive care unit (20 beds), pediatric intensive care unit (8 beds), and the emergency department (20 beds).

The Clinical Pharmacy Service team is responsible for performing and recording pharmaceutical interventions. In the year of the study, the team included seven pharmacists and between one and four undergraduate pharmacy interns. Clinical activities are carried out simultaneously with other hospital pharmacy services. Routine pharmacy activities include dispensing (electronic processing of prescriptions, medication preparation, guidance to the healthcare team, and delivery of medications to the wards or at the counter), inventory management, medication reconciliation, participation in multidisciplinary rounds, and health education for hospital teams.

The instrument for data collection and handling was developed in spreadsheets, in a digital document created using Google Sheets®. The data analyzed originated from manual records and reports of interventions performed by the Clinical Pharmacy Service team. Data entry into the spreadsheets and monitoring were carried out by pharmacists and interns of the Clinical Pharmacy Service. The recorded information included: patient's name, sex, medical record number, description of the intervention, textual content of clinical notes, type of intervention, and whether it was accepted.

The Clinical Pharmacy Service team classified pharmaceutical interventions as follows:

- dose and/or frequency adjustment: according to institutional protocols or patient conditions, for example, adjustment based on renal function;
- dosage form and/or administration route adjustment: substitution of parenteral for oral route, when possible, or substitution of solid for liquid dosage forms for administration via feeding tube;
- prescription adjustment due to duplication: same medication in different dosage forms within the same prescription, or more than one drug from the same therapeutic class in the same prescription;
- absence of prescription: lack of daily prescription or absence of a medication in the prescription during an already established treatment period, for example, antimicrobials;
- reconciliation of health information: information on previous health problems and prior medication use obtained through consultation of e-SUS records and/or patient and/or family interviews;
- referrals to Primary Health Care: recording of hospitalization-related information;
- pharmacovigilance reporting: observation of adverse drug reactions and reporting through the Vigimed system;
- patient counseling;
- professional counseling;
- medication validation: verification of patient's prior-use medications not dispensed by the hospital pharmacy, and verification of correct identification and physical integrity for use during hospitalization.

The interventions performed were classified according to their acceptance or non-acceptance by the healthcare team or the patient, with the following possible categories: "accepted", when there was partial or complete implementation of the proposed intervention; "not accepted", when the intervention was not implemented; "not verified", when accep-

tance and implementation were not verified; and "not applicable", when implementation was strictly carried out by the pharmacy team or when it was not possible to assess external implementation, as in the case of medication validation and hospital discharge counseling.

The reclassification of pharmaceutical intervention records according to the Pharmaceutical Care Network Europe (PCNE) Association Classification for Drug-Related Problems V9.1[11] was performed by one of the researchers, who also participated in recording the interventions during the study period, using the descriptions and pharmaceutical progress notes available in the records. Classification doubts were resolved by two or more researchers.

According to the PCNE classification of Drug-Related Problems (DRP), problems were grouped according to treatment effectiveness, treatment safety, and others. The categories of causes included: drug selection, dosage form, dose selection, treatment duration and medication dispensing, drug use process, patient-related, patient transfer-related, and others. The intervention plan was classified as: prescriber level, drug level, no intervention, or other. Regarding the acceptability of the interventions performed, these were categorized as accepted or not accepted, while the DRP status was categorized as: unknown problem status, problem resolved, problem partially resolved, and problem not resolved. Furthermore, problems could be classified as potential or manifested[11].

For data analysis, descriptive statistics were applied using absolute and relative frequencies.

This study is part of a project of the Clinical Pharmacy Service. The project was submitted to and approved by the Research Ethics Committee (CEP) of the Porto Alegre Municipal Health Department (CAAE 62935722.1.0000.5338, opinion no. 5801905). All ethical and legal guidelines were followed during the development of the project, ensuring the protection of participants' confidentiality. All information collected was treated confidentially, in an aggregated and anonymized manner, being used solely for academic purposes and strictly within the scope of the project. Furthermore, privacy and non-identification of patients or professionals involved in the pharmaceutical interventions analyzed were guaranteed.

Results

During 2022, 414 interventions were recorded, related to 337 patients, most of whom were male and had one recorded intervention. Table 1 describes the information regarding the number of pharmaceutical interventions and patients.

Table 1. Characteristics of patients (n=337) and number of pharmaceutical interventions (n=414) in an emergency hospital in Porto Alegre (RS), Brazil, in 2022.

Variable	N	Percentage
Sex		
Male	204	60.53%
Number of interventions per patient		
1	282	83.68%
2	39	11.57%
3	11	3.26%
4	4	1.19%
5	1	0.30%
Total	337	100%

Source: Prepared by the authors

Pharmaceutical interventions were more frequent in the clinical inpatient unit (35.02%) and in the intensive care unit (32.61%). They were carried out mainly in the first quarter of the year (35.51%). The most common types of interventions were health information reconciliation (36.23%) and dose and/or frequency adjustment (32.61%). In most interventions, acceptance could not be verified (39.86%). Table 2 describes the pharmaceutical interventions by hospital unit, quarter of the year, type of intervention, and acceptance, according to the service classification.

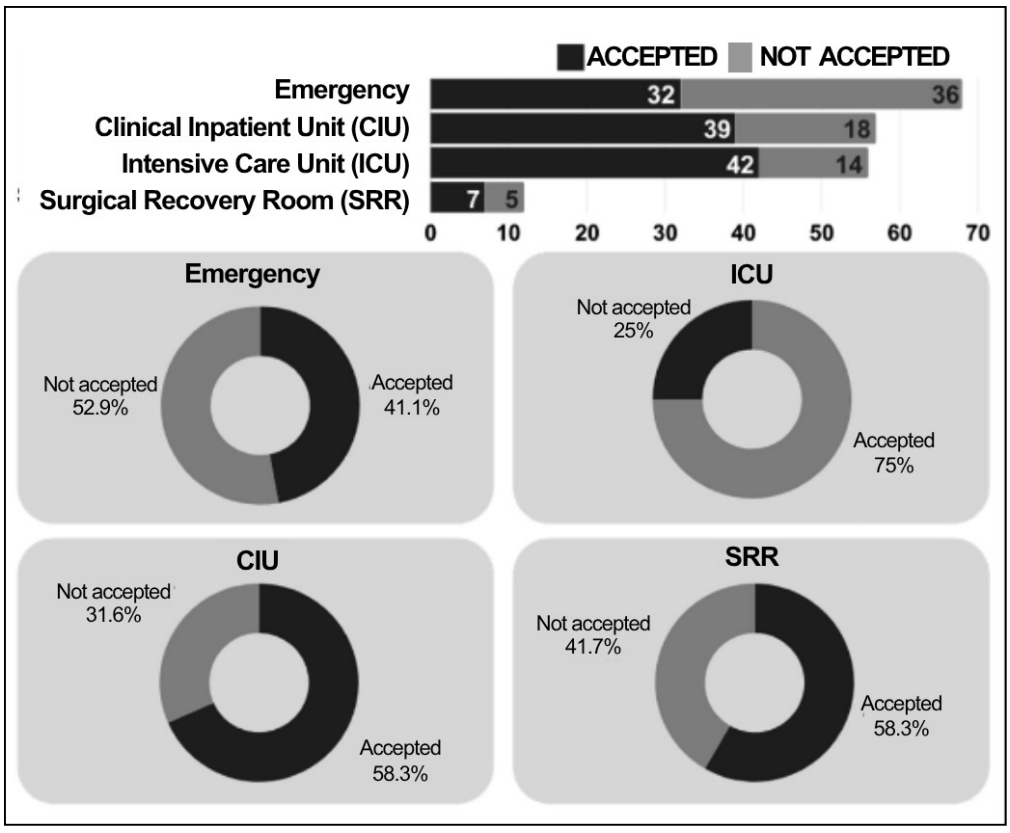
The clinical inpatient and intensive care units were the hospital units with the highest percentage of acceptance of the proposed pharmaceutical interventions. Figure 1 shows the distribution of accepted and not accepted pharmaceutical interventions by hospital units.

Table 2. Characterization of pharmaceutical interventions according to the Clinical Pharmacy Service (n=414) in an emergency hospital in Porto Alegre (RS), Brazil, in 2022.

Variable	N	Percentage
Units of Care		
Clinical Inpatient Unit	145	35.02%
Intensive Care Unit	135	32.61%
Emergency	113	27.29%
Surgical Recovery Room	21	5.07%
Quarter		
First	147	35.51%
Second	91	21.98%
Third	112	27.05%
Fourth	64	15.46%
Type of Intervention (according to the Pharmacy Service classification)		
Health information reconciliation	150	36.23%
Dose and/or frequency adjustment	135	32.61%
Adjustment of dosage form and/or route of administration	35	8.45%
Prescription without indication	25	6.04%
Medication validation	18	4.35%
Medication counseling for professionals	16	3.86%
Medication counseling for patients	13	3.14%
Adjustment of duplicate prescription	12	2.90%
Absence of prescription	5	1.21%
Referral to primary health care	4	0.97%
Pharmacovigilance notification	1	0.24%
Acceptability (according to the Pharmacy Service classification)		
Could not be verified	165	39.86%
Accepted	120	28.99%
Not Accepted	73	17.63%
Not applicable	53	13.53%
Total	414	100%

Source: Prepared by the authors

Figure 1. Distribution of pharmaceutical interventions accepted and not accepted by hospital units (n=193) according to the classification adopted by the Pharmacy Service in an emergency care hospital in Porto Alegre (RS), 2022.



Source: Prepared by the authors

The reclassification of the pharmaceutical interventions according to the PCNE classification can be seen in Table 3.

Tabela 3. Caracterização das intervenções farmacêuticas conforme *Pharmaceutical Care Network Europe* (n=414) em hospital de pronto atendimento de Porto Alegre (RS) no ano de 2022.

Variable	N	Percentage
PROBLEM MANIFESTATION		
Potential problem	351	84.78%
Manifested problem	63	15.22%
PROBLEM		
P1 Treatment effectiveness	**355**	**85.75%**
P1.1 No effect of drug treatment despite correct use	1	0.24%
P1.2 Effect of drug treatment not optimal	204	49.28%
P1.3 Indication or symptom not treated	150	36.23%
P2 Treatment safety	**29**	**7.00%**
P2.1 Adverse drug event occurring	29	7.00%
P3 Other	**30**	**7.25%**
P3.1 Unnecessary drug treatment	8	1.93%
P3.2 Other type of problem	22	5.31%

Variable	N	Percentage
CAUSE OF THE PROBLEM		
C1 Drug selection	**31**	**7.49%**
C1.1 Drug inappropriate according to guidelines or formulary	10	2.42%
C1.2 No drug indication	8	1.93%
C1.3 Inadequate combination of drugs, or drugs and herbal products, or drugs and dietary supplements	2	0.48%
C1.4 Inappropriate duplication of therapeutic group or active ingredient	9	2.17%
C1.5 No or incomplete drug treatment despite existing indication	2	0.48%
C2 Dosage form	**12**	**2.90%**
C2.1 Dosage form or formulation inappropriate for the patient	12	2.90%
C3 Dose selection	**149**	**35.99%**
C3.1 Drug dose too low	1	0.24%
C3.2 Dose of a single active ingredient too high	11	2.66%
C3.3 Dosage regimen not frequent enough	1	0.24%
C3.4 Dosage regimen too frequent	6	1.45%
C3.5 Dosage timing instructions incorrect, unclear or missing	130	31.40%
C4 Treatment duration	**0**	**0.00%**
C5 Dispensing	**4**	**0.97%**
C5.1 Prescribed drug not available	4	0.97%
C6 Drug use process	**9**	**2.17%**
C6.1 Inappropriate administration time or dosing intervals by a healthcare professional	5	1.21%
C6.2 Drug underadministered by a healthcare professional	1	0.24%
C6.4 Drug not administered at all by a healthcare professional	1	0.24%
C6.6 Drug administered via wrong route by a healthcare professional	2	0.48%
C7 Patient behavior	**14**	**3.38%**
C7.1 Patient unable to understand instructions correctly	1	0.24%
C7.6 Patient stores the drug inappropriately	2	0.48%
C7.7 Inappropriate dosing times or intervals	10	2.42%
C7.9 Patient physically unable to use the drug/form as indicated	1	0.24%
C8 Patient transfer	**152**	**36.71%**
C8.1 Medication reconciliation problem	152	36.71%
C9 Other	**43**	**10.39%**
C9.1 No or inappropriate outcome monitoring (including pharmacotherapy monitoring)	24	5.80%
C9.2 Other cause	19	4.59%
TYPE OF INTERVENTION		
I1 At prescriber level	**376**	**90.82%**
I1.1 Only informed prescriber	1	0.24%
I1.3 Intervention proposed to prescriber	362	87.44%
I1.4 Intervention discussed with prescriber	13	3.14%
I2 At patient level	**15**	**3.62%**
I2.1 (Drug-related) counseling to patient	11	2.66%
I2.4 Spoke with family member or caregiver	4	0.97%
I3 At drug level	**7**	**1.69%**
I3.4 Instructions for use altered	6	1.45%
I3.5 Drug paused or discontinued	1	0.24%

Variable	N	Percentage
I4 Other intervention or activity	**16**	**3.86%**
I4.1 Other intervention (specify)	15	3.62%
I4.2 Side effect reported to authorities	1	0.24%
ACCEPTABILITY		
A1 Accepted	**35**	**8.45%**
A1.1 Intervention accepted and fully implemented	14	3.38%
A1.2 Intervention accepted, partially implemented	1	0.24%
A1.4 Intervention accepted, implementation unknown	20	4.83%
A2 Not accepted	**0**	**0.00%**
A3 Other	**379**	**91.55%**
A3.1 Intervention proposed, acceptance unknown	364	87.92%
A3.2 Intervention not proposed	15	3.62%
OUTCOME		
O0 Unknown	**396**	**95.65%**
O0.1 Problem status unknown	396	95.65%
O1 Solved	**17**	**4.11%**
O1.1 Problem fully solved	17	4.11%
O2 Partially solved	**1**	**0.24%**
O2.1 Problem partially solved	1	0.24%
O3 Not solved	**0**	**0.00%**
Total	**414**	**100%**

Source: Prepared by the authors

Nos registros das intervenções farmacêuticas foram identificados 178 medicamentos. Os medicamentos encontrados com maior frequência (10 ou mais registros nas intervenções farmacêuticas) foram: fluoxetina (n=38), sinvastatina (n=36), omeprazol (n=29), Terapia Antirretroviral (TARV) (n=28), enalapril (n=25), dipirona (n=24), vancomicina (n=23), metformina (n=22), hidroclorotiazida (n=19), amitriptilina (n=18), diazepam (n=18), clorpromazina (n=17), ácido acetilsalicílico (n=16), anlodipino (n=16), ácido valproico (n=15), carbamazepina (n=15), insulina (regular ou NPH) (n=13), losartana (n=13), paracetamol (n=13), salbutamol (n=13), furosemida (n=11) e haloperidol (n=10). Em 12 intervenções não havia medicamento especificado.

Discussion

A total of 414 pharmaceutical interventions involving 337 patients were analyzed, with a predominance of male patients and most having only one intervention. Health information reconciliation (36%) and dose or frequency adjustment (33%) were the most frequent pharmaceutical interventions when applying the classification system of the hospital's Clinical Pharmacy Service.

With reclassification according to the PCNE system, it was possible to determine that most pharmaceutical interventions were related to the prescriber level (90.82%), with interventions proposed or discussed with the prescriber, i.e., before dispensing and medication use. This highlights the preventive nature of clinical pharmacy actions. Regarding treatment effectiveness, the most frequent subtypes were "Drug treatment effect not optimal" (49.28%) and "Untreated indication or symptom" (36.23%). In the authors' view, classifying the types of identified problems allows a more detailed understanding of the issue and the intervention required, which may assist in planning preventive actions. This aspect could not be observed with the classification system used by the hospital's Clinical Pharmacy Service.

In the hospital's own classification system, more interventions were recorded as "acceptance not verified" than those effectively verified, which hinders

overall evaluation of the data. It is possible that verification could have been performed through retrospective review of the electronic medical records, but this was discarded due to the high risk of bias during retrospective data collection. Therefore, the authors suggest that acceptance verification should ideally be performed within 48 hours by the service itself. Moreover, in the hospital system, intervention outcomes were not evaluated, making it impossible to classify problems as fully resolved, partially resolved, or unresolved.

The hospital service's classification of intervention types showed little similarity with PCNE intervention categories but resembled the PCNE domains of problem causes. The two most frequent causes were "Medication reconciliation problem" (36.71%) and "Incorrect, unclear or missing dosage instructions" (31.40%). The PCNE "intervention type" domain categorizes how the intervention was communicated and implemented. In this study, the vast majority were "Intervention proposed to the prescriber" (90.82%). It should be noted that in this hospital, as in other health facilities, some interventions are directed toward nursing staff (e.g., infusion times or incompatibility). These were categorized as "drug-level interventions" under the "instructions for use" subdomain, although in the authors' opinion they were more properly nursing-level instructions.

Few Brazilian studies have used the PCNE classification to assess pharmaceutical interventions in hospitals. One study in a public hospital in Santa Catarina used a modified PCNE system to analyze 818 interventions in general and cardiology ICUs. The main problems were "Adverse event (possibly) occurring" (34.8%) and "Unavailability or inadequacy of dosage form" (28.9%). The most frequent causes were "Inappropriate dosage form" (19.3%), "Prescribed drug not available" (19.3%), and "Inappropriate duplication of therapeutic group or active ingredient" (16.6%). The most frequent intervention plans were "Dosage form changed" (22.1%) and "Intervention discussed with prescriber" (16.6%). Most interventions were accepted and fully implemented (93.4%). Outcomes were not assessed using PCNE, but rather patient status. Another hospital pharmacy service in southern Brazil analyzed 857 DRPs and interventions, finding "Possible adverse drug reaction" (39.1%) as the most common DRP. The most prevalent cause was "Incorrect, unclear or missing dosage instructions" (22.8%). The most frequent interventions were "Drug withdrawal" (25.8%) and "Change in administration instruction" (25.7%). Most interventions were accepted, implemented, and fully resolved the problem (85.9%), and 41.8% generated institutional cost savings. The findings differ from those of the present study, likely due to differences in hospital type and patient population.

Other studies classified pharmaceutical interventions according to their own systems. In two Brazilian studies from different regions (Midwest and Northeast), in emergency and ICU units, very high intervention acceptance rates (>96%) were reported. Another 2017 study in a public ICU in Santa Catarina analyzed 664 interventions and DRPs, with the main types being drug interactions (40%), potential adverse effects (28%), and dose adjustment needs (13%). Acceptance rate was 64%. The diversity of classification methods makes comparison across studies difficult, underscoring the importance of standardization.

Our findings corroborate that acceptance of pharmaceutical interventions is generally high in ICUs, highlighting their importance in critical care and showing better integration of pharmacy services. The Emergency Department had lower acceptance rates, likely due to high patient turnover.

The wide variety of medications involved reflects the complexity and diversity of conditions treated at the hospital. Most drugs cited were included in the hospital formulary and the Municipal List of Essential Medicines (REMUME) of Porto Alegre. The predominance of drugs such as fluoxetine, simvastatin, and omeprazole suggests a significant focus on treating depression, dyslipidemia, and gastrointestinal disorders. The high frequency of antiretroviral-related interventions underscores the importance of pharmaceutical management in HIV care, ensuring adherence and treatment effectiveness.

The absence of specific medications in some interventions shows that not all pharmaceutical interventions need to be linked to drugs. Recording untreated comorbidities during reconciliations may lead to pharmacotherapy prescriptions, but also to

exam requests or referrals to psychology, nutrition, physiotherapy, speech therapy, and social work. These do not appear in PCNE, which focuses narrowly on prescriptions, not broader healthcare. Therefore, adaptations were made: PRM was redefined as "treatment-related problem," and "Medication reconciliation problem" was expanded to "Health information reconciliation problem."

Overall, the PCNE system allowed satisfactory description of problem nature, causes, and interventions. Retrospectively, it was not feasible to determine acceptance and outcomes, but this limitation can be overcome by implementing the classification system into routine pharmacy practice. The PCNE's structure—problem, cause, intervention type, acceptance, and outcome—strengthens pharmacists' clinical reasoning and enables outcome evaluation. Another advantage is comparability across different services and health systems.

A drawback of PCNE is its strong drug-centered focus, while pharmacists often take a broader view of treatment, including ensuring access to medicines and health information. Furthermore, training is required for proper use of any classification system.

Study limitations include incomplete recording of all interventions due to feasibility or pharmacist workload, limited IT resources, and insufficient dedicated clinical pharmacy staff. Greater pharmacist integration into healthcare teams and stronger digital record systems may improve acceptance, effectiveness, and monitoring.

Finally, this study proposes the adoption of PCNE as a classification tool. Nationwide adoption would enable regional metrics to monitor clinical services. If PCNE is chosen, validation of its Portuguese translation will be essential.

Conclusions

The PCNE classification system can be applied in hospital settings to generate indicators that allow assessment of processes and outcomes of pharmaceutical interventions.

The study showed that pharmaceutical interventions were predominantly preventive, addressing potential problems. High acceptance rates in ICUs highlight the relevance of clinical pharmacists in critical care. However, lack of acceptance verification and incomplete records remain major barriers to fully evaluating the impact of interventions. Overcoming these challenges requires better pharmacist integration into care teams, stronger technological infrastructure, and more human resources dedicated to clinical pharmacy services. Continuous research using standardized methods is needed to evaluate outcomes and enable comparisons across studies.

For the development and consolidation of Clinical Pharmacy in Brazil, broad discussion of pharmaceutical intervention classification systems is necessary.

Declaração de autoria e contribuição dos autores
PTR, KHS, MWB, and CRB: Study design, methodology validation, results interpretation, manuscript review, and approval of the final version of the manuscript.

Conflicts of interest
The authors declare no conflicts of interest.

Funding
No funding to declare.

Responsible editor
Lindemberg Assunção Costa.

Acknowledgments
We thank the pharmacists of the hospital pharmacy team who enabled the research, the faculty members of the academic institution who coordinated and reviewed the work, and our families for their constant support during our professional journeys.

References

1. Brazil. Federal Pharmacy Council (CFF). Resolution 585, of August 29, 2013. Regulates the clinical duties of the pharmacist and other provisions. Official Gazette of the Union. Aug 30, 2013.
2. Barbiero AC, Souza AA, Almeida ACG. Prescription errors in the Brazilian hospital environment: a systematic review. Research, Society and Development. 2023 Jun;12(6):e3112641989. doi:10.33448/rsd-v12i6.41989.
3. Hepler CD. Clinical pharmacy, pharmaceutical care, and the quality of drug therapy. Pharmaco-

therapy. 2004 Nov;24(11):1491-8. doi:10.1592/phco.24.16.1491.50950.

4. Lin G, Huang R, Zhang J, et al. Clinical and economic outcomes of hospital pharmaceutical care: A systematic review and meta-analysis. BMC Health Serv Res. 2020;20(1):487. doi:10.1186/s12913-020-05346-8.
5. Storpirtis S, Melo AC, Noblat LACB, Palhano TJ. The origin of Clinical Pharmacy in Brazil, the Brazilian Society of Clinical Pharmacy, and the harmonization of concepts and nomenclature. Rev Infarma. 2023;35(3):351-363. doi:10.14450/2318-9312.v35.e3.a2023.pp351-363.
6. Brazilian Society of Clinical Pharmacy. The origin of Clinical Pharmacy in Brazil, its development, related concepts and perspectives. Brasília: SBFC; 2019.
7. Brazil. Federal Pharmacy Council (CFF). Resolution 555, of November 30, 2011. Regulates the registration, storage, and handling of information resulting from pharmaceutical care practices in health services. Official Gazette of the Union. Dec 14, 2011; Section 1:188.
8. Brazil. Federal Pharmacy Council (CFF). Resolution 476, of May 28, 2008. Regulates the registration, storage, and handling of information resulting from pharmaceutical care practices in health services. Official Gazette of the Union. 2008.
9. Lima ED, Blatt CR, Caregnato RC. Recording of hospital pharmacist clinical activities: an integrative review. Rev Contexto & Saúde. 2020;20(38):101-112. doi:10.21527/2176-7114.2020.38.101-112.
10. Hoque DME, Kumari V, Hoque M, Ruseckaite R, Romero L, Evans SM. Impact of clinical registries on quality of patient care and clinical outcomes: A systematic review. PLoS ONE. 2017;12(9):e0183667. doi:10.1371/journal.pone.0183667.
11. Pharmaceutical Care Network Europe (PCNE). Classification for Drug Related Problems V9.1. 2020. Available from: https://www.pcne.org/upload/files/417_PCNE_classification_V9-1_final.pdf
12. Tavares AL, Brasil LX, Javarini HV, Santos-Júnior GA, Araújo DC, Rocha KS. Implementation of clinical services provided by pharmacists in Brazilian hospitals: a scoping review. Rev Bras Farm Hosp Serv Saude. 2024 Mar;15(1):1072. doi:10.30968/rbfhss.2024.151.1072.
13. Atey TM, Peterson GM, Salahudeen MS, et al. Impact of pharmacist interventions provided in the emergency department on quality use of medicines: a systematic review and meta-analysis. Emerg Med J. 2022 Aug 1:emermed-2021-211660. doi:10.1136/emermed-2021-211660. Epub ahead of print. PMID:35914923.
14. Barboza-Zanetti MO, Barboza-Zanetti AC, Rodrigues-Abjaude SA, Pinto-Simões B, Leira-Pereira LR. Clinical pharmacists' contributions to hematopoietic stem cell transplantation: A systematic review. J Oncol Pharm Pract. 2019;25(2):423-433. doi:10.1177/1078155218782372.
15. Carter BL. Evolution of Clinical Pharmacy in the USA and future directions for patient care. Drugs Aging. 2016;33:169-177. doi:10.1007/s40266-016-0349-2.
16. Drovandi A, Robertson K, Tucker M, et al. A systematic review of clinical pharmacist interventions in paediatric hospital patients. Eur J Pediatr. 2018;177:1139-1148. doi:10.1007/s00431-018-3187-x.
17. Lin HW, Yang LC, Mafruhah OR, Nguyen HTH, Cao TTB, Yam FK. Evolution of Clinical Pharmacy Practice and Pharmacy Education in Taiwan, Vietnam, and Indonesia: A Narrative Review. J Am Coll Clin Pharm. 2020;3(5):947-958. doi:10.1002/jac5.1258.
18. Maleki S, Alexander M, Fua T, Liu C, Rischin D, Lingaratnam S. A systematic review of the impact of outpatient clinical pharmacy services on medication-related outcomes in patients receiving anticancer therapies. J Oncol Pharm Pract. 2019;25(1):130-139. doi:10.1177/1078155218783814.
19. Gallagher J, McCarthy S, Byrne S. Economic evaluations of clinical pharmacist interventions on hospital inpatients: a systematic review of recent literature. Int J Clin Pharm. 2014;36:1101-1114. doi:10.1007/s11096-014-0008-9.
20. Mi X, Su X, Jin Z, et al. Economic evaluations of clinical pharmacy services in China: a sys-

tematic review. BMJ Open. 2020;10:e034862. doi:10.1136/bmjopen-2019-034862.
21. Tiguman GB, Junior RM. Economic impact of pharmaceutical interventions on healthcare services from Brazil: a systematic review. Rev Bras Farm Hosp Serv Saude. 2020;11(4):0512. doi:10.30968/rbfhss.2020.114.0512.
22. Adusumilli PK, Adepu R. Drug related problems: an overview of various classification systems. Asian J Pharm Clin Res. 2014 Sep;7(4):7-10. Available from: https://journals.innovareacademics.in/index.php/ajpcr/article/view/2728
23. Navarro M. Classification systems of pharmaceutical interventions in hospital settings: integrative review and model proposal [Internet]. 2020. Available from: https://bdta.abcd.usp.br/directbitstream/4f30c3d4-510b-4bec-8235-2f244ae2528c/3062178.pdf
24. van Mil JW, Westerlund LO, Hersberger KE, Schaefer MA. Drug-related problem classification systems. Ann Pharmacother. 2004;38(5):859-867. doi:10.1345/aph.1D182.
25. Basger BJ, Moles RJ, Chen TF. Application of drug-related problem (DRP) classification systems: a review of the literature. Eur J Clin Pharmacol. 2014;70(7):799-815. doi:10.1007/s00228-014-1686-x.
26. Colin SL, Nutti C. Pharmaceutical intervention: Description of the role of the clinical pharmacist in intensive care units. Rev Bras Farm Hosp Serv Saude. 2022;13(2):0766. doi:10.30968/rbfhss.2022.132.0766.
27. Spezia IA, Cimarosti HI. Identification of drug-related problems and pharmaceutical interventions performed in a hospital in southern Brazil. Rev Bras Farm Hosp Serv Saude. 2022;13(2):794. doi:10.30968/rbfhss.2022.132.0794.
28. Botelho JDA, Roese FM. Interventions performed by pharmacists in an urgent care unit. Rev Bras Farm Hosp Serv Saude. 2019 Mar;8(1). Available from: https://rbfhss.org.br/sbrafh/article/view/280.
29. Barros ME, Araújo IG. Evaluation of pharmaceutical interventions in an intensive care unit of a teaching hospital. Rev Bras Farm Hosp Serv Saude. 2021;12(3):0561. doi:10.30968/rbfhss.2021.123.0561.
30. Dias D, Wiese LPL, Pereira EM, Fernandes FM. Evaluation of clinical pharmaceutical interventions in an ICU of a public hospital in Santa Catarina. Rev Bras Farm Hosp Serv Saude. 2018 Sep; e093.005. doi:10.30968/rbfhss.2018.093.005.
31. Porto Alegre City Hall. Relação Municipal dos Medicamentos Essenciais – REMUME 2025 [Municipal List of Essential Medicines – REMUME 2025]. Porto Alegre, 2025. Available from: https://prefeitura.poa.br/sites/default/files/usu_doc/cartadeservicos/REMUME%2520-%2520Rela%C3%A7%C3%A3o%2520Municipal%2520dos%2520Medicamentos%2520Essenciais%2520-%25202025%5B1%5D.pdf. Accessed Feb 28, 2025.