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The pharmacoepidemiologic profile of a cardiology intensive care unit as a tool for standardization of a clinical pharmacy service

Thales de Oliveira PINHEIRO[1], Mariana Alves SILVEIRA[1], Fernando Henrique ZONZINI[2], Antônio Matoso MENDES[2],

[1]Programa de Residência Integrada Multiprofissional em Atenção Hospitalar – Complexo Hospital de Clínicas da Universidade Federal do Paraná, Paraná; [2]Unidade de Farmácia Clínica - Complexo Hospital de Clínicas da Universidade Federal do Paraná, Paraná

Corresponding author: Mendes AM, antonio.mendes@hc.ufpr.br

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Abstract

Objective: To describe the pharmacoepidemiologic profile of the cardiology intensive care unit (CICU) of a public university hospital as a way to contribute to planning, implementation and standardization of the clinical pharmacy service. **Methods**: A cross-sectional and retrospective study conducted at a public teaching hospital and developed in accordance with the recommendations of Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement. All medication orders made for patients admitted to the CICU (drug, dose, administration route, dosage) were included for analysis, in addition to data related to the patients' profile and to the hospitalizations (age, gender, hospitalization time). As a premise of analysis, indicators recommended by the literature on pharmacoepidemiology were used. The data were extracted from the hospital information system (*Sistema de Informação Hospitalar*, SIH) corresponding to the period from January 2015 to December 2019. They were subsequently compiled and analyzed using Microsoft Office Excel®, with analysis by means of descriptive statistics. **Results**: The study population consisted of 2,157 patients (51.3% male), with a mean age of 64 years old (SD ± 12.5) and mean hospitalization time of 4.5 days. 69.4% of the admissions were transferred to other hospitalization units, 24.6% were discharged from hospital and 6.0% evolved to death. The reasons for hospitalization were Acute Coronary Syndrome (44.6%), heart failure (9.7%), arrhythmias (4.9%), atrioventricular block (3.7%), valve stenosis (1.9%), cardiogenic shock (0.8%) and cardiac arrest with resuscitation (0.6%). The total number of medications prescribed was 175,573, with a daily rate of 96.2. A total of 468 medications were prescribed in different presentations, with Dipyrone 1g ampoule as the most prescribed item accounting for a total of 10,688 units (6.1%). **Conclusion**: The study contributed to characterizing the pharmacoepidemiologic profile of the cardiology intensive care unit with the purpose of presenting consistent data that will allow improving the clinical pharmacy service in its implementation and standardization.

Keywords: Pharmacoepidemiology; Cardiovascular diseases; Intensive Care Units; Clinical Pharmacy Service.

O perfil farmacoepidemiológico de uma unidade de terapia intensiva cardiológica como ferramenta para padronização de um serviço de farmácia clínica

Resumo

Objetivo: Descrever o perfil farmacoepidemiológico da Unidade de Terapia Intensiva Cardiológica de um Hospital Universitário Público como forma de contribuir no planejamento, implantação e padronização do Serviço de Farmácia Clínica. **Métodos**: Estudo transversal e retrospectivo realizado em um hospital público universitário e desenvolvido de acordo com as recomendações da declaração *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE). Foram incluídas para análise todas as prescrições realizadas para pacientes internados na UTI Cardiológica (medicamento, dose, via de administração, posologia), além de dados relacionados ao perfil de pacientes e de internamentos (idade, sexo, tempo de internamento). Como premissa de análise foram utilizados indicadores recomendados pela literatura em farmacoepidemiologia. Os dados foram extraídos do sistema de informação hospitalar (SIH) para o período de janeiro de 2015 a dezembro de 2019. Na sequência foram compilados e analisados em software Microsoft Office Excel® sendo analisados através de estatísticas descritivas. **Resultados**: A população do estudo foi composta por 2.157 pacientes (51,3% do sexo masculino), média de idade de 64 anos (DP ± 12,5), com tempo de internamento médio de 4,5 dias. Das admissões 69,4% foram transferidos para outras unidades de internamento, 24,6% receberam alta hospitalar e 6,0% vieram a óbito. Os motivos de internamento foram: síndrome coronariana aguda (44,6%), insuficiência cardíaca (9,7%), arritmias (4,9%), bloqueio atrioventricular (3,7%), estenose valvar (1,9%), choque cardiogênico (0,8%) e parada cardíaca com ressuscitação (0,6%). O total de medicamentos prescritos foi de 175.573, com uma taxa de medicamentos prescritos de 96,2 ao dia. Foram prescritos 468 medicamentos em diferentes apresentações, sendo a Dipirona 1g ampola o item mais prescrito no total de 10.688 unidades (6,1%). **Conclusão**: O estudo contribuiu para caracterizar o perfil farmacoepidemiológico da Unidade de Terapia Intensiva Cardiológica com o propósito de apresentar dados consistentes que permitirão aperfeiçoar o Serviço de Farmácia Clínica na sua implantação e padronização.

Palavras-chave: Farmacoepidemiologia; Doenças Cardiovasculares; Unidade de Terapia Intensiva; Serviço de Farmácia Clínica.

Introduction

Globalization and the accelerated urbanization process are usually accompanied by an increase in obesity rates, physical inactivity and, consequently, an increase in cardiovascular diseases (CVDs). In Brazil, its continental dimensions associated with socioeconomic inequalities lead to a high mortality rate related to non-communicable diseases, especially CVDs[1].

According to the World Health Organization (WHO), ischemic heart diseases led the ranking of the ten main causes of death in 2019, associated with nearly 8.9 million deaths in that year. During the same period, they represented approximately 16.0% of all deaths, followed by Stroke and Chronic Obstructive Pulmonary Disease (COPD), which were respectively responsible for 11.0% and 6.0 % of all deaths[2].

Faced with CVDs, the care provided by health professionals and the knowledge about courses of action ensure effectiveness and safety for patients. In this way, improving cardiovascular health care corroborates with greater subsidies for discussions between the multiprofessional team members, better management of the practices performed and, consequently, greater benefits for patients[3].

Clinical pharmacists play an important role within the multiprofessional team, as they perform activities that ensure safe and rational medication use. Among other activities, these professionals carry out activities that contribute to effective and safe care of patients, such as monitoring medications classified as potentially dangerous and reviewing pharmacotherapy to adjust dosage of the medications based on renal function[4].

The presence of clinical pharmacists has been associated with significant benefits, such as promoting rational medications use and reducing hospitalization times and hospital-related costs, as well as improving the patients' quality of life and mortality rates after hospital discharge[5]. According to Resolution No. 675 of October 31th, 2019, which regulates the clinical pharmacists' duties in intensive care units, these professionals have twenty-four care-related duties. Some of them include carrying out medication reconciliation, pharmacotherapy analysis to meet each patient's individual needs, and managing, evaluating and optimizing antimicrobial therapy, in addition to assessing needs and providing guidance to prescribers on adjusting medication doses due to kidney or liver dysfunction[6].

On the other hand, the scientific evidence has limitations regarding the description of interventions and clinical pharmacy services presented in different primary studies. The low reporting quality in pharmacy practice studies is the cause of the methodological heterogeneity among them and hinders the conduction of systematic reviews and meta-analyses that point to more robust results on the effectiveness of clinical pharmacists' activities[7]. Such weaknesses generate a gap on how clinical pharmacy services should be carried out in the different scenarios of a pharmacist's performance.

The pharmacoepidemiologic profile of a hospitalization unit can provide important information about the characteristics of the patients treated and the pharmacotherapy used in their treatments to elaborate and apply protocols in order to improve the quality of the services provided[8]. In Brazil, there are many electronic health databases that can be used for drug utilization research and pharmacoepidemiology. However, there is lack of data standardization, as well as of information about their quality and individualization by patients. The development of strategies to improve health data quality and promote transparency and accessibility for researchers and health professionals becomes a challenge in the face of such limitations[9].

Even though CVDs are related to a large proportion of hospital admissions and exert a significant impact on morbidity and mortality, drug utilization research in cardiology intensive care units (CICU) are scarce[10,11]. Thus, the objective of this study was to describe the pharmacoepidemiologic profile of a cardiology unit as a way to contribute to planning, implementation and standardization of the clinical pharmacy service.

Methods

This is an observational, cross-sectional and retrospective study with an exploratory approach, carried out by extracting data from the computerized prescription report generator of the Hospital Information System (*Sistema de Informações Hospitalares*, SIH) at the study hospital.

The research comprises the pharmacoepidemiologic profile of CICU from January 2015 to December 2019. The data were collected and analyzed using Microsoft Office Excel® between June 2022 and December 2022. All patients admitted to the study unit who had at least one medication order in the SIH were included in the research. Patients that did not present any medication order during the study period were excluded.

The CICU consists of 10 inpatient beds and mostly admits the following types of patients: those referred by the chest pain protocol of the city of Curitiba; those linked to the institution's cardiology service who need an elective surgical approach; and those admitted in other units of the hospital who have clinical conditions such as cardiac decompensation and need care from the CICU service.

Among the descriptive data of patients hospitalized in that unit are: gender; age; admission date; exit date; reason for hospitalization according to the International Classification of Diseases (ICD) code recorded in the system; and the type of exit (discharge, transfer and death). As for the data related to the daily medication orders made for these patients, the following were compiled: description of the medication (drug, concentration, pharmaceutical form and presentation); dose prescribed; and administration schedule and route.

The data obtained were treated as follows: age was presented in age groups (from 18 to 59 years old, from 60 to 79 years old and octogenarians ≥80 years old); admission ICD codes were presented as groups and subgroups; admissions as total, monthly and daily rate; length of hospital stay was obtained from the admission and exit dates; the medication prescriptions were presented in total, daily rate, median of prescriptions and range; and the medications prescribed were expressed as total, daily rate, and medication prescription per patient/day rate. And in a quantitative way, the medications were presented in an ABC curve (70%/20%/10%) based on the number of medication prescriptions in the unit.

Sampling was not carried out for statistical analysis, as the data for the period were included in full. The quantitative variables

were presented as central tendency and dispersion measures according to data normality (Kolmogorov-Smirnov). The qualitative variables were presented in absolute and relative frequencies. No statistical tests were performed to prove the hypothesis because this is an exploratory study to describe the pharmacoepidemiologic profile of the inpatient unit.

The study was approved by the Committee of Ethics in Research with Human Beings of the Clinical Hospital Complex, based on CAAE No. 49543321.6.0000.0096.

Results

In the given period (2015-2019), a total of 2,554 admissions were made to the CICU, with 2018 having the highest number of admissions (576). The mean age of the hospitalized patients was 64±12.5 years old. According to the sample, the gender profile corresponding to the admissions was 1,504 males (58.9%) (Table 1).

During the period evaluated, it was verified that the mean age was 64 years old, that 1,332 (61.8%) of the CICU admissions corresponded to patients belonging to the group aged between 60 and 79 years old, and that 198 admissions (9.2%) were patients classified as octogenarians (Table 1). The mean hospitalization time was 4.5 days. In 2017, the patients admitted to the CICU were hospitalized for a mean of 5.2 days, a number approximately 1.5 times greater than the one recorded in 2019 (Table 2).

Of the total group exiting the unit, most of the patients were transferred within the hospital environment (69.0%); in other words, leaving the intensive care unit for semi-critical units and wards, followed by discharge from the inpatient unit (25.0 %) and death (6.0%). The year 2019 was characterized by the lowest hospital discharge rate (20.5%) since, in that year, most of the patients (75.0%) were transferred to other inpatient units. Regarding the deaths, 2015 recorded the highest percentage in the 5-year period, totaling 27 deaths (6.8%), although not surpassing 2018 in absolute numbers, which totaled 38 deaths (Table 2).

Regarding the admission profile according to the ICD subgroup, unspecified Acute Myocardial Infarction (AMI) (I21.9) was the most prevalent (17.6%). Acute Coronary Syndrome (ACS) and the signs and symptoms that characterize it (e.g., acute transmural infarction of the anterior myocardium wall, I21.0) accounted for approximately 44.6% of the reasons for hospitalization in the unit, followed by other cardiovascular disorders such as: heart failure (I50) (9.7%), arrhythmias (I49) (4.9%), atrioventricular block (I44) (3.7%), aortic valve stenosis (I35.0) (1.9%), cardiogenic shock (R57.0) (0.8%) and cardiac arrest with resuscitation (I46.0) (0.6%).

During the 5-year period at the CICU, 175,573 medications were prescribed in nearly 12,050 medication prescriptions, comprising a rate of 14.6 medications per order. The number of medication orders had a median of 4 per patient, varying from a minimum of 1 to a maximum of 103. Such data are directly related to the mean length of hospital stay in the unit (4.5 days), as it is normal for each patient to have at least 1 medication order per hospitalization day (Tables 2 and 3).

The rate of medications administered daily in the CICU was 96.2. The year that represented the lowest daily rate of medications administered was 2015. On the other hand, 2017 leads with a total of 2,826 medication prescriptions and 110 medications administered daily in the unit (Table 3).

In relation to the administration route, the intravenous was the most used, in half of the medications prescribed (46.3%). The oral route ranks second (38.9%), followed by the subcutaneous (10.1%). Others, such as inhalation, topical, sublingual, intramuscular, ophthalmic, nasal and rectal together, accounted for 4.8%.

Table 1. Profile of patients in terms of number of admissions, age, age group and gender from 2015 to 2019.

Variable	Year					
	2015	2016	2017	2018	2019	Total
Admissions, n	382	396	441	468	470	2,157
Age, mean±SD	62.4±13.6	64.6±13.3	64.5±11.8	63.8±11.8	64.8±12.1	64.0±12.5
18-59 years old, n (%)	135 (35.3)	118 (29.8)	110 (24.9)	134 (28.6)	130 (27.7)	627 (29.1)
60-79 years old, n (%)	203 (53.1)	243 (61.4)	293 (66.4)	299 (63.9)	294 (62.6)	1,332 (61.8)
>79 years old, n (%)	44 (11.5)	35 (8.8)	38 (8.6)	35 (7.5)	46 (9.8)	198 (9.2)
Female n (%)	167 (43.7)	192 (48.5)	231 (52.4)	230 (49.1)	230 (48.9)	1,050 (48.7)

Note: SD – Standard Deviation.

Table 2. Length of hospital stay in days and outcome of exit from the cardiology intensive care unit (hospital discharge, internal transfers and deaths).

Variable	Ano					
	2015	2016	2017	2018	2019	Total
Length of hospital stay (in days), mean±SD	4.6±5.5	5.2±6.6	5.3±7.0	4.0±4.9	3.4±4.4	4.5±5.8
Hospital discharge, n (%)	100 (29.6)	92 (22.2)	117 (26.6)	124 (25.5)	99 (20.5)	531 (24.6)
Transfers, n (%)	214 (63.6)	296 (71.6)	296 (67.4)	330 (67.9)	361 (75.0)	1,497 (69.4)
Death n (%)	23 (6.8)	25 (6.1)	26 (6.0)	32 (6.6)	22 (4.6)	128 (6.0)

Note: SD – Standard Deviation.

Table 3. Number of medication orders, medication prescriptions, daily rate of medications administered and medications per patient/day rate.

Variable	Year					
	2015	2016	2017	2018	2019	Total
Medication orders	2,003	2,719	2,826	2,456	2,046	12,050
Total of medication prescription in the unit	27,416	39,370	40,133	37,262	31,392	175,573
Medications prescribed in the unit per day, median (IQR)	73 (60-90)	109 (95-121)	111 (98-121)	100 (85-121)	88 (76-98)	97 (80-114)
Medications prescribed per patient/day, median (IQR)	13 (11-16)	14 (11-17)	14 (11-17)	15 (12-18)	15 (12-18)	14 (11-17)

Note: IQR- Interquartile Range.

The scheduling influences the pharmacy and nursing routine in patient care. At the CICU, most of the medications were prescribed with a 24-hour interval between doses, with 78,439 of the drugs prescribed (44.7%). Therefore, the intervals were as follows: 12 hours (18.9%), 8 hours (16.5%), 6 hours (16.3%), 4 hours (3.5%) and 2 hours (0.1%). The other schedules, non-conventional, were only prescribed for 133 medication prescriptions (0.08%).

A total of 468 drugs were prescribed in different presentations between 2015 and 2019 at the CICU. Dipyrone (Metamizole) 1g ampoule was the most prescribed medication, totaling 10,688 units (6.2%), being prescribed at a fixed time when the medication is administered daily according to order or at the physician's appointment when the patient reports pain. Dipyrone (metamizole) makes up the base medication order for the CICU, along with other medications such as bromopride 10 mg ampoule (4.6%), enoxaparin 40 mg/0.4 mL syringe (4.1%), omeprazole 20 mg capsule (3.2%), human regular insulin 100 U/mL (2.9%) and glucose 50% ampoule (2.6%) (Table 4).

The most prescribed antibiotic at the CICU was vancomycin 500 mg (0.5%), followed by ceftriaxone 1 g (0.5%), meropenem 500 mg (0.4%), piperacillin/tazobactam 4.5 g (0.4%) and cefazolin 1 g (0.3%). The most prescribed vasoactive drugs (VADs) were the following: nitroglycerin 25 mg ampoule with 3,135 prescriptions (1.8%), followed by norepinephrine hemitartrate 8 mg ampoule (1.5%), dobutamine 250 mg ampoule (1.1%), vasopressin 20 UIs ampoule (0.2%), nitroprusside (0.1%), epinephrine 1 mg (0.1%) and dopamine 50 mg ampoule (0.1%). Among the ten most prescribed medications we also find acetylsalicylic acid (ASA) 100 mg tablet, with more than 8,000 prescriptions during the study period (4.6%), furosemide 20 mg ampoule (3.8%), atorvastatin 80 mg tablet (3.5%) and clopidogrel 75 mg tablet (3.2%) (Table 4).

In order to classify the items according to their impact and importance in the CICU, the Pareto analysis or ABC Curve was used. Curve A corresponds to 37 (7.6%) items, curve B to 54 (11.0%) and curve C to 377 (76.9%). The curves can be analyzed focusing on the medications that make up the pivots in Cardiology with high recommendation degrees and levels of evidence (Figure 1).

Table 4. The ten most prescribed medications in the cardiology unit in terms of times prescribed and percentages.

Order	Medication	Times prescribed (%)	ATC
1º	Metamizole (Dypirone) 1g ampoule	10,688 (6.1)	N02BB02
2º	ASA 100mg tablet	8,070 (4.6)	B01AC06
3º	Bromopride 10mg ampoule 2mL	7,925 (4.5)	A03FA04
4º	Enoxaparin 40mg/0,4mL syringe	7,056 (4.0)	B01AB05
5º	Furosemide 20mg ampoule	6,526 (3.7)	C03CA01
6º	Atorvastatine 80mg tablet	6,092 (3.5)	C10AA05
7º	Clopidogrel 75mg tablet	5,531 (3.2)	B01AC04
8º	Omeprazole 20mg capsule	5,515 (3.1)	A02BC01
9º	Insulina - regular (human) 100U/mL	5,018 (2.9)	A10AB01
10º	Glucose 50% 10mL ampoule	4,431 (2.5)	V06DC01

Note: ASA- Acetylsalicylic Acid; ATC- Anatomical Therapeutic Chemical Classification.

Figura 1. Curva ABC dos medicamentos, amostra de dez itens, prescritos na unidade cardiológica envolvidos no manejo clínico das doenças cardiovasculares.

Curve A (ATC)	Curve B (ATC)	Curve C (ATC)
ASA 100mg (B01AC06)	Isosorbide 5mg (C01DA08)	Nitroprusside 50mg (C02DD01)
Enoxaparin 40mg (B01AB05)	Simvastatin 20mg (C10AA01)	Digoxin 0,25mg (C01AA05)
Furosemide 20mg (C03CA01)	Amiodarone 150mg (C01BD01)	Epinephrine 1g (C01CA24)
Atorvastatine 80mg (C10AA05)	Hydralazine 25mg (C02DB02)	Metoprolol 5mg (C07AB02)
Clopidogrel 75mg (B01AC04)	Atorvastatine 40mg (C10AA05)	Tirofiban 0,25mg/mL (B01AC17)
Glyceryl Trinitrate 25mg (C01DA02)	Atorvastatine 20mg (C10AA05)	Esmolol 2500mg (C07AB09)
Norepinephrine 8mg (C01CA03)	Hydrochlorothiazide 25mg (C03AA03)	Dopamine 50mg (C01CA04)
Enalapril 10 mg (C09AA02)	Enalapril 20mg (C09AA02)	Propranolol 40mg (C07AA05)
Enalapril 5mg (C09AA02)	Clonidine 0,150mg (C02AC01)	Colchicine 0,5mg (M04AC01)
Amiodarone 200mg (C01BD01)	Warfarin 5mg (B01AA03)	Captopril 25mg (C09AA01)

Note: ASA- Acetylsalicylic Acid; ATC- Anatomical Therapeutic Chemical Classification.

Discussion

In this study, the description of the pharmacoepidemiologic profile of the CICU highlighted the importance of the relationship between the profile of the patients treated at the unit and the data related to the most prevalent diseases, as well as to the care actions that involve pharmacotherapy-related parameters. By itself, drug utilization research does not offer definitive answers aimed at changing practical courses of professional activities, but it plays an important role in promoting rational medication use[12].

Without knowledge about how medications are prescribed and used, it is difficult to initiate a discussion about their rational use or suggest measures to optimize the pharmacotherapy proposed. The data from drug utilization research can assist pharmacists in evaluating usual doses of prescribed drugs, identifying drug interactions, and preventing and managing drug-related problems[12]. The World Health Organization emphasizes that this type of study assists in interpreting drug therapies in terms of cost-effectiveness and definition of priorities for the rational allocation of health care budgets[13]. The current study reinforces the need for an individualized and personalized approach based on pharmacoepidemiology, considering each patient's clinical and pathophysiological characteristics, in order to ensure efficacy and safety of the pharmacological treatments.

According to DATASUS, in 2022 the profile of hospital admissions due to circulatory system diseases in Brazil according to gender was 58.5% male and 41.5% female[14]. Such epidemiologic data corroborate the CICU hospitalization profile, in which the hospitalized patients were mostly male.

In our results, age was a factor that deserved attention, given its correlation with the prevalence of cardiovascular diseases since, with aging, the vascular system suffers progressive stiffening and, consequently, an increase in blood pressure. The mean age of the patients admitted to the CICU is 64 years old, which is similar to the mean age of 59.9±9.6 found at the Alagoas Heart Hospital. In addition to that, in the hospitalization profile of the Brazilian Northeast region between 2018 and 2019, it was observed that the age groups from 60 to 69 years old and 80 years old or more respectively comprised 24.0% and 17.1% of all hospitalizations[15,16].

The mean CICU length of hospital stay is close to 96 hours, comparable to the study carried out with the Coronary Intensive Care Unit of a hospital in southern Mato Grosso and with a study carried out in Rio Grande do Sul, with means varying between 48 and 96 hours[17,18]. The mean length of hospital stay is related to the patient's clinical stabilization process and prognosis, hence the extension in the hospitalization time, which can be associated with a poor prognosis in the patient's recovery[17].

Among the cardiovascular morbidities, AMI is the most prevalent in the CICU, accounting for 17.6% of all admissions to the unit. In a hospital from southern Mato Grosso, of the 593 admissions to the coronary unit in 2017, 36.0% were due to AMI. These data highlight magnitude of the disease and the importance of early assistance in the management of infarction in the first hours with symptoms, in order to reduce the undesirable prognoses associated with this condition[17].

The complexity of CICU pharmacotherapy is not only linked to the medications and their indications. The high number of daily medication prescriptions and administrations renders the clinical pharmacy service essential for patient safety. During the study period, it was verified that a large number of medications were prescribed to be administered daily, with a median of 14 per patient. The load of medications to be prescribed, evaluated, prepared, checked, administered and monitored can be an important factor for the occurrence of medication errors and, consequently, of adverse events. Due to the presence of polypharmacy, potentially dangerous medications and constant changes in system prescriptions, the presence of a pharmacist becomes even more justified in ICUs[18,19].

The daily rate of medication ordersvaried around 6.6, with a drugs administered per patient/day rate of 14.6. The importance of clinical pharmacists and the clinical pharmacy service together with the multiprofessional team is related to identifying, reducing and correcting possible problems associated with pharmacotherapy; in other words, focusing on safe and rational medication use with pharmacists interventions of medication suspension, dosing suggestion, necessity assessment, incompatibility evaluation in devices and in preparation of the medication by the nursing team in reconstitution and dilution[19].

Although not directly related to the treatment protocols, the most prescribed medication in the cardiology unit is dipyrone 1 g, used to manage pain in hospitalized patients. When compared to paracetamol, it has greater analgesic effect and less anti-inflammatory action, which is preferable to the cardiovascular risk of non-steroidal anti-inflammatory drugs. The pharmacoepidemiologic profile worldwide is controversial since, in the United States, it is a proscribed substance due to the agranulocytosis risk, although it is authorized by ANVISA in Brazil[20]. Comparing with a study carried out in an intensive care unit for adults of a hospital in northwestern Paraná, dipyrone ranks second among the most prescribed medications (86.7%); in this environment, bromopride leads with 90.0% prevalence and omeprazole completes the list in third place (73.3%)[21]. Such medications have characteristics of being concomitantly prescribed in intensive care units for the treatment of presumed pain and prevention of ventilator-associated pneumonia[22,23].

Symptomatic drugs and those related to prophylaxis are essential in hospital medication orders, but are more involved with dispensing errors. According to a study carried out in a public hospital from Belo Horizonte, dipyrone, metoclopramide and heparin were the most prevalent in dispensing errors involving the following: less than the prescribed quantity was dispensed; no unit of the prescribed medication was dispensed; and when one or more units were dispensed in excess of the prescribed amount[24].

In relation to the antibiotics, vancomycin was the most prescribed antibiotic during the study period in the CICU. At a high-complexity cardiology hospital in the state of Amazonas, vancomycin was most frequently prescribed with 22.3% prevalence, followed by meropenem with 18.0% prevalence[25]. These data are an alert for the resistance profile of the inpatient unit, given the increase in bacterial resistance in recent years, mainly species from the Vancomycin-Resistant *Enterococcus* (VRE) genus that can transfer their resistance genes, for example, to *Staphylococcus aureus*, consequently generating selective pressures and reducing effective therapeutic options[26]. Pharmacists can optimize the use of antimicrobials in intensive care units through simple strategies such as antibiogram-guided therapies and dose adjustment based on renal function, or by means of more complex strategies such as therapeutic drug monitoring. In the case of the CICU, where vancomycin is the most prescribed antimicrobial, monitoring vancomycin serum concentration is a strategy with the potential to ensure patient safety, avoiding the development of renal toxicity, for example.

As far as the VADs are concerned, they are essential in intensive care units for the management of important hemodynamic changes in order to correct perfusion disorders and cardiovascular changes, restoring the global oxygen supply and demand in the organic systems. For example, in the intensive care unit at the municipal hospital in Fortaleza, noradrenaline was the most used VAD, followed by dopamine. The main reasons for hospitalization in the aforementioned study were stroke, pneumopathies and heart diseases[27]. On the other hand, nitroglycerin was the most prescribed VAD in the CICU, followed by noradrenaline. This profile matches the initial management of ACS, the most prevalent morbidity in the unit, given its benefit in peripheral and coronary circulation, used in the initial management at the emergency room, improving angina symptoms[28]. VDA monitoring by pharmacists can guarantee that they are prescribed in the correct dose according to the patient's weight, that the standard solution will be prepared in the compatible concentration and serum, and that the flow rate in the infusion pump will be calculated including the therapy time.

Quality tools are important for analyzing and intervening in situations aimed at improving service quality. The Pareto chart helps define goals and strategies compatible with the reality of institutions and inpatient units. The ABC curve, used to evaluate the medications in the cardiology unit, provides data to outline possible interventions with the drugs that cause the most impact on the service[29]. In the Pareto analysis, the drugs used in cardiology clinical protocols and trials exert the greatest impact. For example, ASA 100 mg tablet and clopidogrel 75 mg tablet are the dual antiplatelet therapy recommended for ACS. Furosemide 20 mg ampoule is the loop diuretic available in Brazil in intravenous presentation for the management of congestion, mainly in congestive heart failure. Atorvastatin 80 mg tablet has the function of reducing cardiovascular risk in patients with coronary atherosclerotic disease, influencing the LDL goal and the pleiotropic effect of stabilizing atheromatous plaques[28].

Intravenous and oral account for 85.2% of the drug administration routes, followed by subcutaneous, inhaled and intramuscular. The route is indispensable in relation to the effect of the drug and the desirable therapeutic response for the patient. The flow for the patient's medication starts with the physician medication order and ends with the nursing team administering the medication. In this process, as the link between both disciplines of the multiprofessional team, we have pharmacists evaluating the prescriptions in the medication orders[29]. Pharmacists actively participate by evaluating pharmacotherapy and proposing interventions, including replacing the administration route with a focus on reducing costs and promoting patient safety[30].

Scheduling at the CICU is carried out by the nursing team following the institution's standard. With this action, nurses ensure drug therapy continuity[31]. Scheduling is also associated with medication errors as well as with drug interactions. In a Pharmacy Service of a Municipal Hospital from in the the state of Bahia, out of 257 prescriptions made, 31 (12.1%) were inadequately scheduled[32]. Pharmacists can actively participate in scheduling, suggesting intervals that meet the best dosage convenience for each patient and the lowest risk of drug interactions, thus being able to ensure safe and effective pharmacotherapy.

From the previously discussed data, it is possible to observe that male individuals, aged over 60 years old and on polypharmacy, constitute a large part of the population of our study. Therefore, specialized attention is required in relation to altered pharmacokinetic parameters associated with aging, as well as to potential drug interactions in the care of patients in this unit. Although it is not possible to accurately assess the prescribers' intentions, the most prescribed medications are among those recommended by the national and international guidelines for the management of acute coronary syndromes, which suggests rationality in the use of these medications.

The study has some limitations, such as its retrospective nature and the fact that the patients' comorbidities and reasons for hospitalization and clinical status are not directly related to the medications prescribed. Thus, it was not possible to assess rationality or quality of the medication orders. Furthermore, the results only express prescription data, and it is not possible to confirm administration of all medications.

It is noted that, to the present day, no hospital accredited by the Brazilian Company of Hospital Services (*Empresa Brasileira de Serviços Hospitalares*, EBSerH) has published data regarding the pharmacoepidemiologic profile of its inpatient units. The current paper will be able to assist in creating a medication use database in teaching hospitals linked to federal universities, with the possibility of directing optimization in the care process related to pharmacotherapy.

Conclusion

The study contributed to characterizing the pharmacoepidemiologic profile of the CICU, with the purpose of presenting consistent data that will allow improving the clinical pharmacy service in its implementation. The clinical pharmacists' work in the cardiology intensive care unit is highlighted by the complexity of evaluating prescriptions due to the number of daily prescriptions, the number of medications prescribed by patients, the different administration routes and paying attention to scheduling and possible drug interactions. In addition to knowing the most prevalent cardiovascular diseases, such as ACS and heart failure, it is important for the professionals to delve into the use of the main medications and validated drug treatment protocols for these conditions, mastering pharmacodynamic and pharmacokinetic aspects.

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