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Responsible management of medications for their rational use: the profile of the Faculty of Pharmaceutical Sciences of Ribeirão Preto-SP

Manejo responsável de medicamentos promovendo seu uso racional: o perfil da Faculdade de Ciências Farmacêuticas de Ribeirão Preto-SP

Ana Beatriz Rabelo Timporim[1], Estael Luzia Coelho da Cruz-Cazarim[2]*, Luis Henrique Felício da Silva[3], Milena Costa Nocera[4], Maurilio Polizello Júnior[5], Marilisa Guimarães Lara[6], Maurilio de Souza Cazarim[7]

[1] Farmacêutica. Faculdade de Ciências Farmacêuticas de Ribeirão Preto.

[2] Farmacêutica. Mestre em Ciências. Universidade Federal de Juiz de Fora.

E-mail: estaelcruz@gmail.com

[3] Farmacêutico. Faculdade de Ciências Farmacêuticas de Ribeirão Preto.

[4]Farmacêutica. Serviço Farmacêutico. Faculdade de Ciências Farmacêuticas de Ribeirão Preto.

[5]Farmacêutico. Serviço Farmacêutico. Faculdade de Ciências Farmacêuticas de Ribeirão Preto.

[6]Farmacêutica. Doutora. Docente. Faculdade de Ciências Farmacêuticas de Ribeirão Preto.

[7]Farmacêutico. Doutor Docente. Universidade Federal de Juiz de Fora.

RESUMO

Introdução: O descarte adequado de medicamentos com o prazo de validade expirados e o uso racional dos mesmos contribuem na relação de sustentabilidade e saúde pública. **Objetivo:** Conhecer o perfil de descarte dos pacientes da Farmácia Ensino da Faculdade de Ciências Farmacêuticas de Ribeirão Preto. **Metodologia:** Os dados foram obtidos durante um ano de coleta por meio de um formulário que possibilitou conhecer o perfil de descarte da população, as características sociodemográficas e, paralelamente, promover estratégias de Educação em Saúde. **Resultados:** De caráter exploratório e transversal pode-se constatar uma alta taxa de descarte incorreto (71,3%), um público majoritariamente feminino (75%), que apesar da alta escolaridade (64,7%) ainda necessita de informações sobre o descarte correto de medicamentos. Os dados foram tratados com regressão logística, sendo possível associar as variáveis e concluir que o descarte adequado aumenta significativamente quando se tem informação (p-valor 0,02). **Considerações finais:** Medidas de Educação em Saúde pode ser considerada uma excelente estratégia no estímulo do descarte adequado dos medicamentos.

Palavras-chave: Descarte de medicamentos. Uso racional. Educação em saúde. Sustentabilidade. Automedicação. Farmácia caseira.

ABSTRACT

Introduction: The proper disposal of expired medications and their rational use contribute to the relationship between sustainability and public health. **Objective:** To understand the disposal profile of patients at the School Pharmacy of the Faculty of Pharmaceutical Sciences of Ribeirão Preto – USP. **Methodology:** Data were collected over the course of one year using a questionnaire form, wich allowed for an understanding of the population's disposal profile and sociodemographic characteristics, and in parallel, promote Health Education strategies. **Results:** Of an exploratory and cross-sectional design, it can be seen a high rate of incorrect disposal (71,3%), a mostly female audience (75%), who despite the high level of education (64,7%) still need information about the correct disposal of medications. The data were analyzed using logistic regression, making it possible to associate variables and conclude that proper disposal significantly increases when there is information available (p-value 0.02). **Final considerations:** Health Education measures can be considered an excellent strategy to encourage the proper disposal of medications.

Keywords: Medication disposal. Rational use. Health Education. Sustainability. Self-medication. Home pharmacy.

1. INTRODUCTION

The expansion of the development and commercialization of medicines, mainly from the 20th century, elevates the pharmaceutical market as one of the sectors that most moves the economy of Brazil. According to IPEA data, in 2017, the final consumption of medicines by families, added to those dispensed by the government through the SUS, reached US$ 24.8 million (VIEIRA e SANTOS, 2020). The country ranks sixth among the largest global pharmaceutical markets, a fact that underlies the origin of "home pharmacies" due to consumer demand (ICTQ, 2019). Referring to anxiolytic medications of the benzodiazepine class, Brazil is the third largest global consumer and the sixth largest producer of these drugs (BRASIL, 2019).

The term "home pharmacy" arises in reference to the accumulation of medications in households, a practice present in 91.6% of Brazilian homes (BUENO et al., 2009). The safety and effectiveness are not guaranteed in these cases, as reported by a study in which 42.6% of an over-the-counter medication found in households was within the expiration date but had a substandard content level (SERAFIM et al., 2007).

Inherent to this fact, the acquisition of medications for sporadic use often leads to leftovers and accumulation of the same. According to the National Committee for the Promotion of Rational Use of Medicines, drug therapy is generally seen as a faster approach to various health problems. However, most people do not have a real understanding of the inherent risks, and the culture of medicalization ends up prevailing (BRASIL, 2019). The COVID-19 pandemic has further accentuated the culture of "home pharmacy". According to the Federal Pharmacy Council, there has been a significant increase in the purchase of medications for palliative use and treatment of symptoms related to SARS-CoV-2 infection (CFF, 2021a).

The "home pharmacy" and recurring episodes of self-medication culminate in another public health issue: the improper disposal of medications and healthcare products. The final destination of the generated waste is often neglected in the chain of processes involving the rational use of these products. The sanitary reality in Brazil presents obstacles ranging from public health education to the treatment and disposal processes of biological and chemical waste (CASTRO et al., 2022). According to the National System of Toxic-Pharmacological Information (SINITOX, 2016), drugs have been in first place since 1996 as the agents causing the most health problems in Brazil. Furthermore, continuous exposure to these

agents has the potential to cause direct harm to the environment and indirect harm to health, such as the selection of resistant microorganisms, genotoxic effects, bioaccumulation, mutagenic activity, and metabolic effects due to endocrine disruptors (BILA, DEZOTI, 2007) (MAGALHÃES, MOL, 2013).

The Decree No. 10.388, issued on June 5 2020, which regulates and establishes the reverse logistics system for expired or unused household medications, can be considered a progress in terms of changing the scenery and paradigm of healthcare product disposal (BRASIL, 2020). Despite the existence of previous legislation that allowed pharmacies to participate in voluntary programs for the collection of chemical waste (ANVISA, 2009), Brazil still remains a country with high consumption and waste of medications (QUADRA et al., 2019). According to the report from the Office of the Comptroller General of Brazil, the loss of US$ 3.3 million due to the disposal of expired medications in Brazil highlights the potential savings that could be achieved if the medications were used appropriately or redirected when applicable, thereby reducing their improper disposal (BRASIL, 2017).

Based on the above, the proposal of the study was to implement a permanent collection and disposal system for healthcare products at the School Pharmacy, identify the profile of discarded medications and the population, promote health education, and evaluate the approximate cost of medications for both the population and the healthcare system.

2. MATERIALS AND METHODS

Study Design and Target Population

It is an exploratory, cross-sectional study based on the application of a patient intake form during the disposal of medications and healthcare products. The study was conducted at the School Pharmacy of the Faculty of Pharmaceutical Sciences of Ribeirão Preto at the University of São Paulo (USP), in the city of Ribeirão Preto, state of São Paulo, and consisted of collecting data over a one-year period, from October 2017 to September 2018. The target audience consisted of patients using the services of the School Pharmacy, including faculty, students, staff, contractors, and the local community of the USP Ribeirão Preto Campus. The patients were identified numerically, and the data was tabulated using Excel software.

Collection container for healthcare waste and final disposal

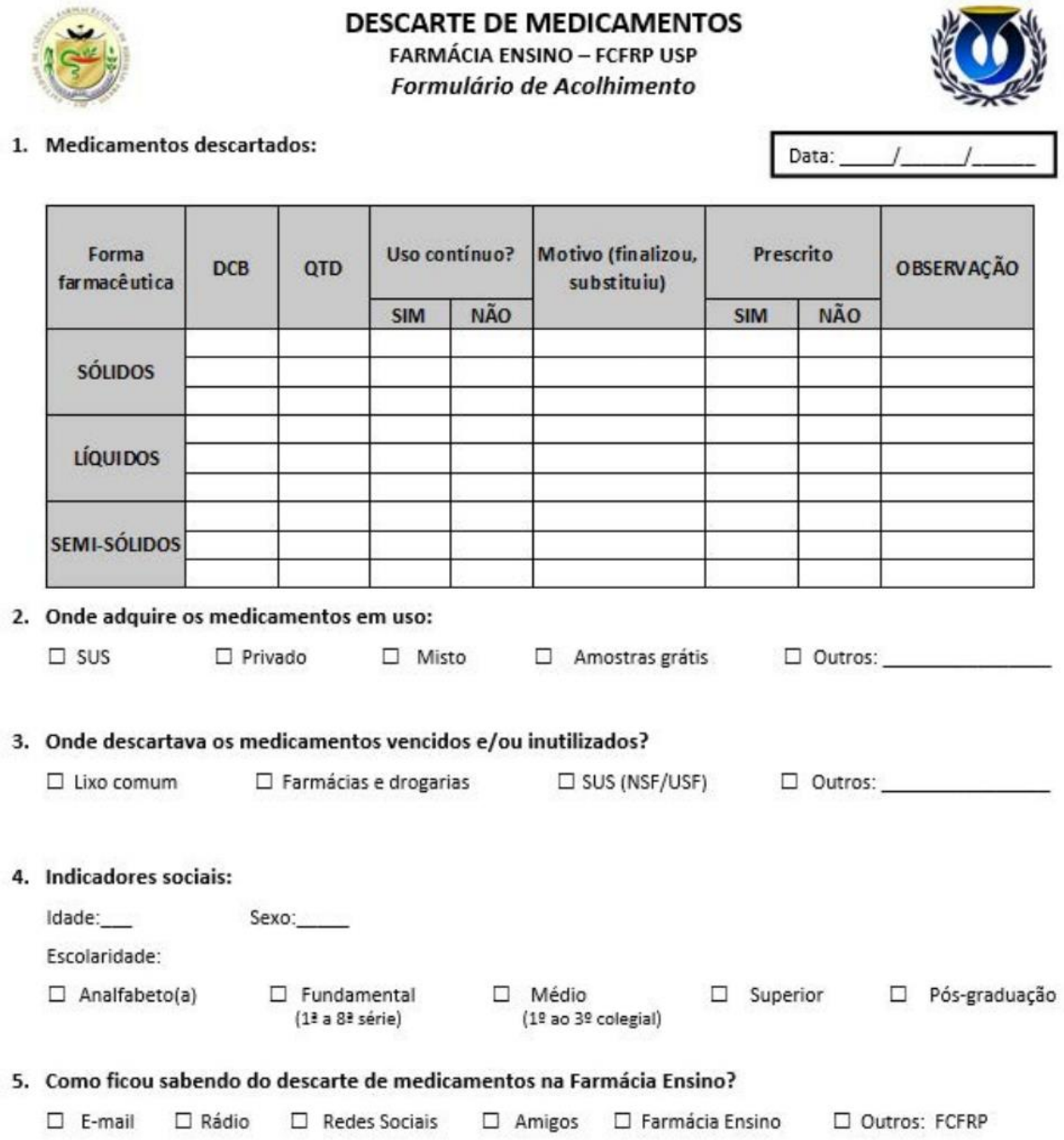
For the safe and proper storage of the discarded products, a specific structure was built to ensure storage no danger for the patients, pharmacists, and the environment, located in the service area of the School Pharmacy (Figure 1). The waste was segregated into: 1) solids (tablets, capsules, powders); 2) liquids and semi-solids (syrups, lotions, ointments, etc.); 3) leaflets and boxes. As recommended by ANVISA, each structure consists of a rigid container, PVC drums, into which bags are inserted to prevent leakage and withstand mechanical force. Solid, semi-solid, and liquid waste were placed in white waterproof bags, following the NBR 9191/200 standards from the Brazilian Association of Technical Standards, respecting the weight limits of each bag. Drug leaflets and boxes were placed in blue bags for final destination to recycling, in partnership with USP Recycles. Sprays were also placed in white bags and segregated from other health products, given their specificity during incineration. Sharps and syringes were not included in the tabulation, but they are collected and disposed of in a specific structure, available in the School Pharmacy. Blister packs were also segregated and placed in blue bags, which were sent to the Barretos Cancer Hospital aiming the correct recycling of aluminum.

Figure 1. Display made for the disposal of medicines.

The capacity of the storage containers was periodically checked, and once they reached the sufficient volume (70%) for incineration, the bags were removed from the structure, sealed, weighed, and identified with the corresponding UNO number. This number represents a four-digit code, used to identify hazardous materials and articles. In this regard, solid, semi-solid, liquid, and spray waste were identified with the respective UNO Numbers 3249, 1851, and 3248. Afterward, the bags were handed over to the Chemical Waste Management Committee of the Unit, responsible for the proper final disposal (incineration) of the Unit's waste, which supported the research.

Recruitment and approach of users

During the reception, a form (Figure 2) was applied in order to identify the patient's sociodemographic profile, the types of medications and healthcare products being discarded, as well as the patient's knowledge regarding pharmacotherapy. Therefore, questions were answered regarding categorical variables, including the usual location for discarding and acquiring the products, gender, education level, how they were informed about the disposal, among others. Throughout the application of the form, information on Health Education was provided, such as the importance of appropriate disposal and the safe and rational use of medications.



DESCARTE DE MEDICAMENTOS
FARMÁCIA ENSINO – FCFRP USP
Formulário de Acolhimento

1. Medicamentos descartados:

Data: _____/_____/_____

Forma farmacêutica	DCB	QTD	Uso contínuo?		Motivo (finalizou, substituiu)	Prescrito		OBSERVAÇÃO
			SIM	NÃO		SIM	NÃO	
SÓLIDOS								
LÍQUIDOS								
SEMI-SÓLIDOS								

2. Onde adquire os medicamentos em uso:

☐ SUS ☐ Privado ☐ Misto ☐ Amostras grátis ☐ Outros: _____

3. Onde descartava os medicamentos vencidos e/ou inutilizados?

☐ Lixo comum ☐ Farmácias e drogarias ☐ SUS (NSF/USF) ☐ Outros: _____

4. Indicadores sociais:

Idade:___ Sexo:_____

Escolaridade:

☐ Analfabeto(a) ☐ Fundamental (1ª a 8ª série) ☐ Médio (1º ao 3º colegial) ☐ Superior ☐ Pós-graduação

5. Como ficou sabendo do descarte de medicamentos na Farmácia Ensino?

☐ E-mail ☐ Rádio ☐ Redes Sociais ☐ Amigos ☐ Farmácia Ensino ☐ Outros: FCFRP

Figure 2. Form used to collect patient data.

As the monetary values for the cost evaluation, it was used Index for conversion of Central Bank of Brazil, where US$ 1 corresponded to R$ 4,85 on 13th June 2023 (available at the site: https://www.bcb.gov.br/en).

Ethic

The study received exemption from the Research Ethics Committee of the institution itself (Letter CEP/FCFRP No. 032/2017), as it was not possible to trace or identify the patients.

Statistical analysis of the data

The obtained data were tabulated in Microsoft Excel 2019 and analyzed using the statistical software MINITAB® v17, considering a significance level of 5% and a test power above 80%. The descriptive statistics performed for the continuous variables measured summary and dispersion measures, including mean, standard deviation, median, minimum, maximum, mode, and modal number. For the categorical variables, the absolute number and frequency were measured.

Simple binary logistic regression analysis was performed using the dependent variable "disposal location" with the options: correct and incorrect. The response "correct" was set as the reference in the regression analysis and it was understood as the disposal at the pharmacy, in compliance with the legislation for the reverse logistics of medications with proper disposal of pharmacological waste. The response "incorrect" was used to classify other disposal locations, such as toilet, regular garbage, environment, among others.

The independent variables were adjusted for the response with the highest association value with the variable. Pearson's analysis was also performed to evaluate the correlation between the variables. In addition, Odds Ratio (OR) analyses were conducted using logistic regression with a 95% confidence interval (95% CI), and the adjusted Odds Ratio was calculated without the independent variables that may be influencing the dependent variable (correct disposal).

3. RESULTS

A total of 136 patients were treated, with a predominance of females 102 (75%), and ages ranging from 18 to 85 years (mode: 32). Out of these, 88 patients (64.7%) had completed higher education, however, only 39 (28.7%) stated that they dispose of medications and healthcare products correctly. Among those who disposed of medications and healthcare products inadequately (71.32%), the predominant method was throwing them in the regular trash (57.35%). The majority of medications were obtained from the private system (80.8%), without a prescription from qualified healthcare professionals (75.7%), and for sporadic use (56.6%). The main reason for disposal was unused medication (56.6%), followed by expiration (43.3%). The majority of patients learned about the disposal system at the School Pharmacy itself (60.3%) (Table 1).

Table 1. Sociodemographic data and profile of medication and healthcare product disposal

CATEGORICAL VARIABLES						
Variable	**Category**	**Number (%)**	**Gross Odds Ratio (IC 95%)**	**Adjusted Odds Ratio (IC 95%)**	**Gross P-value**	**Adjusted P-value**
DEPENDENT CATEGORIC VARIABLE						
Disposal site						
	Correct disposal	39 (28,68)	-	-	-	-
	Incorrect disposal	97 (71,32)				
INDEPENDENT CATEGORIC VARIABLES						
Sex						
	Female	102 (75,0)				
	Male	34 (25,0)	0,3269 (0,1048; 1,0195)	0,3432 (0,1167; 0,9999)	0,400	0,038
Education						
	Higher education	88 (64,71)	0,0185 (0,0008; 0,4476)	0,0179 (0,0008; 0,3905)	0,009	0,006
	High School	46 (33,82)	0,2502 (0,0745; 0,8406)	0,2477 (0,0813; 0,7546)		
	Basic and Fundamental	2 (1,47)	13,5147 (0,7226; 252,7538)	13,8001 (0,8534; 223,1669)		
Acquisition source						
	Private	110 (80,88)	1,2293 (0,2020; 7,4797)	-	0,449	-
	SUS	9 (6,62)	2,3061 (0,6298; 8,4436)			
	Mixed	17 (12,50)	1,8759 (0,2299; 15,3081)			
Information source for disposal						
	School Pharmacy	82 (60,29)				
	Social media	15 (11,03)	1,1519 (0,3153; 4,2076)	-	0,028	0,023*
	Third parties	11 (8,09)	0,1818 (0,0173; 0,9082)			
	Others	28 (20,59)	1,4724 (0,15062*7; 0,9776)			

Form of use (Continuous use)						
	No	77 (56,62)	1,0750 (0,4191; 2,7571)	-	0,809	-
	Yes	8 (5,88)	1,9531 (0,2611; 14,6101)			
	Mixed	51 (37,50)	0,5504 (0,0656; 4,6146)	-		
Disposal reason						
	Disuse	77 (56,62)				
	Quality/ expiration date	59 (43,38)	0,8847 (0,3641; 2,2501)		0,7957	-
Prescription						
	Yes	33 (24,26)				
	No	103 (75,74)	0,6892 (0,2102; 2,2591)	-	0,533	-

Legend: Third parties include friends, radio, and email. Incorrect disposal refers to common waste, toilet, sink, among others. Correct disposal refers to pharmacies and Basic Health Units.
* Fixed categories for regression analysis. P<0.05 = statistical significance; P>0.05 = no statistical significance.

In absolute numbers, a total of 713 different products were discarded, with the maximum discarded by a single patient being 50 medications. A total of 9,660 units of various drug classes were discarded, averaging 91.2 per patient, with an average associated cost of US$ 56,84 (Table 2). Unclassified medications were also found, with 197 phytotherapeutic drugs (98.5%) and 3 homeopathic drugs (1.5%).

Table 2. Profile of discarded medications

CONTINUOUS VARIABLES								
Variable	**Mean (Sd)**	**Median (Q1-Q3)**	**Min-Max**	**Mode (N mode)**	**Gross Odds Ratio (IC 95%)**	**Gross P-Value**	**Gross P-value (IC 95%)**	**Adjusted P-Value**
Age	37,12 (14,27)	35,00 (24,00 - 46,00)	18-73	32 (11)	0,9546 (0,9112; 1,0001)	0,036	0,9563 (0,9167; 0,9977)	0,024
Number of medicines	7,036 (8,017)	4,00 (2,00 - 9,00)	1- 40	1 (27)	0,9210 (0,8338; 1,0172)	0,092	0,9370 (0,8678; 1,0118)	0,073
Quantity of medications	76,8 (140,9)	36,0 (9,0 - 80,5)	1-1066	1 (11)	0,9998 (0,9948; 1,0048)	0,932	-	-

Cost with medication (US$)	56,84 (85,17)	28,39 (8,37 – 71,65)	0,20-877,03	6,8; 32,45 (0,41)	1,0009 (0,9994; 1,0024)	0,195	1,0008 (0,9995; 1,0021)	0,179

Following the ATC (Anatomical Therapeutic Chemical) classification, there was a predominance of discarding medications belonging to the C (cardiovascular system), N (nervous system), and A (digestive system and metabolism) classes, accounting for 25.29%, 22.04%, and 20.54% respectively. The N class was associated with the highest total cost of discarding, amounting to US$ 1.595,38, representing an average cost per patient of US$ 16,97, corresponding to the discarding of 2,129 medication units. The cost information was obtained from the CMED Ministry of Health 2022 table (Table 3).

Table 3. ATC classification of discarded medications and calculated cost

ATC	No. of medication (%)*	Mean number of drugs per patient (SD)**	Total cost	Mean cost per patient (SD)	No. of drug with cost not found***
A	1984 (20,54)	21,11 (32,85)	US$ 1.529,39	US$ 16,26 (78,18)	451
B	213 (2,20)	2,27 (9,32)	US$ 38,34	US$ 0,40 (1,56)	2
C	2443 (25,29)	25,99 (113,94)	US$ 783,94	US$ 8,34 (27,41)	118
D	171 (1,77)	1,82 (5,60)	US$ 896,13	US$ 9,53 (21,69)	31
G	177 (1,83)	1,88 (8,35)	US$ 181,73	US$ 1,93 (7,18)	2
H	700 (7,25)	7,45 (53,27)	US$ 107,77	US$ 1,14 (4,20)	-
J	399 (4,13)	4,24 (13,91)	US$ 1.414,52	US$ 15,04 (91,78)	-
L	20 (0,21)	0,21 (1,16)	US$ 582,39	US$ 6,19 (55,35)	-
M	528 (5,47)	5,62 (12,80)	US$ 173,68	US$ 1,84 (4,03)	40
N	2129 (22,04)	22,65 (73,51)	US$ 1.595,38	US$ 16,97 (86,78)	37
P	82 (0,85)	0,87 (3,39)	US$ 85,44	US$ 0,90 (3,49)	-
Q	-	-	-	-	119
R	770 (7,97)	8,19 (21,36)	US$ 765,42	US$ 8,14 (18,54)	72
S	44 (0,46)	0,47 (0,98)	US$ 306,20	US$ 3,25 (7,09)	1
V	-	-	-	-	-

Legend: *All medications for which prices were not found in the CMED Table were discarded.
**SD (standard deviation).

***Includes medications not found in the CMED list and compounded medications.

During the collection period of medications and healthcare products, a total of 44.35 kg of waste was generated, with the prevalence of the semi-solid and liquid class accounting for 35.25 kg. The cost of incineration followed by landfilling of the ashes for this quantity was approximately US$ 81.83, subject to change depending on transportation costs.

4. DISCUSSION

The study data indicate a higher willingness of female individuals (75%) to dispose of the waste, similar to the findings in the study by Castro et al. (2022) (70.8%), male patients had about three times less likelihood of correctly disposing of these materials (95% CI 0.34). The age of the participants ranged from 18 to 73 years, with a mean age of approximately 37 years, and the most common age reported was 32 years.

Despite the high prevalence of patients with completed higher education (64.7%), the majority of the sample (71.3%) reported improper disposal of their waste, with regular household trash being the most frequent improper disposal location (57.35%). It would be expected that within a university environment, the scenario would be different, with a greater ecological and environmental concern. However, these numbers reflect the behavior of the Brazilian population as a whole, as indicated by Pinto et al. (2014) in a study conducted at a university center for undergraduate and technical course students, in that study, 91% of the participants reported discarding their medications in regular waste bins, recyclables, or down the drain, while only 4% disposed of them correctly. Similar to the findings of Castro et al. (2022) in their study conducted at the Federal University of Juiz de Fora, there was a predominance of incorrect disposal (74%), despite the high level of education among the participants, with 33.7% having completed higher education and 38.2% having completed high school.

Regarding self-medication behavior and incorrect use of medications, the data presented is alarming. 75.7% of patients stated that they acquire medications without a prescription or guidance from a healthcare professional, and 56.6% of them reported occasional use, these data corroborate the practice of "home pharmacy," as also identified by Bueno et al. (2009), where 91.6% of patients stated that they keep and possess medications at home, often without proper care. According to the Federal Council of

Pharmacy, 77% of Brazilians have the habit of self-medicating, with 47% of them engaging in this behavior at least once a month, and 25% once a week. Additionally, the Council highlights the occasional use of health products by the population, even when there is a prescription, as 57% of patients do not use them as indicated (CRF-SP, 2019).

Among the most discarded medications, according to the Anatomical Therapeutic Chemical classification, there was a predominance of class C (cardiovascular system), N (nervous system), and A (digestive system and metabolism), accounting for 25.2%, 22.0%, and 20.5% respectively, these three classes alone represented more than half of the medications discarded. Similar data was found by Bueno et al. (2009), where the predominant classes for medication disposal were N (27.3%), C (16.1%), and A (13.4%); and by Castro et al. (2022), with a predominance of A (19.5%), N (17.7%), and R (respiratory system) (13.9%). Indeed, Arrais et al. (1997), in a study profiling self-medication in Brazil, identified a high usage of medications for the digestive system and metabolism (class A) (24.0%) and the central nervous system (class N) (18.2%). In 24.3% of cases, patients reported using medications to alleviate pain symptoms, often without proper guidance, reinforcing once again the habit of self-medication and irrational use of medications by the Brazilian population.

In terms of costs, the N class (nervous system), mainly including analgesics and psychotropic drugs, which are medications with higher purchasing costs, were associated with the highest total disposal cost of US$1.595,38. Garcia et al. (2013) describes in their study that low-income families allocate nearly half of their monthly budget to purchasing analgesic medications, and overall, 42% of these families reported purchasing at least one product from this class in the last 30 days. Recently, the Federal Pharmacy Council conducted a survey indicating a 13% increase in sales of antidepressant medications, which is a significant rise considering the exponential growth in demand during the COVID-19 pandemic (CFF, 2021b).

Regarding the amount dispensed by the Unit for the final disposal of health products from School Pharmacy, we can say that it can be considered simple, if we take into account the risk factors associated with the improper disposal of this waste. According to Brazilian Statistics Institute, considering only municipalities with over 100,000 inhabitants, there has been a significant increase in improper disposal of healthcare products. In five years, from 2014 to 2018, the improper disposal of healthcare products increased from 2,474 to 3,123,

indicating a rise of 649 tons of improperly discarded medications, these numbers are consistent with the overall increase in medication consumption (HIRATUKA et al., 2013). In the state of Rio de Janeiro alone, approximately US$ 618.136,113 were spent on the incineration of 1,000 tons of expired medications and supplies, it is worth noting that a significant portion of these items could have been repurposed (BRASIL, 2016).

The environmental impacts of the presence of medications in the environment can be catastrophic, directly and indirectly affecting public health. Presence of contaminants such as paracetamol, naproxen, and methylparaben have been found in rivers in the southeastern region of Brazil (OLIVEIRA, 2017). However, the classes of greatest environmental concern are antibiotics, due to the possibility of bacterial resistance, hormones, which can cause reproductive system dysfunctions in animals, and antineoplastics, due to their mutagenic potential (JOÃO, 2011).

After the implementation of Decree N° 10.388, in June 2020, the reverse logistics of medications showed relevant progress in containing the potential hazard, regarding the improper disposal of these waste materials (BRASIL, 2020). In 2021, nearly 53% of packaging and pharmaceutical remnants, in terms of weight, were collected at the 3,634 collection points implemented in approximately 74 cities (SINIR, 2021), this represents an advancement in ensuring the safe and proper use of medications.

However, our study reinforces that only 60.3% of patients stated that they were aware of medication disposal only at the School Pharmacy. The value found in the variable "how did you know about disposal" (p-value 0.02) indicates that once patients receive proper education about disposal, the chances of correctly disposing of healthcare products increase significantly. Pinto et al. (2014) highlights that 92% of the participants stated that they were not aware of proper disposal collection sites for medications, and 98% of them had not been exposed even to any awareness campaigns on the subject. This trend reinforces the importance of health education and demonstrates the positive impact of raising awareness and adopting sustainable behaviors, such as proper disposal of healthcare waste.

5. FINAL CONSIDERATIONS

Proper disposal of expired and/or unused medications is essential to achieve safe and appropriate use of healthcare products and preserve the environment. However, there is a gap when it comes to information and proper locations for this purpose. Some measures

have been taken in an attempt to change this situation, such as the implementation of reverse logistics. Although, health education measures should be implemented in an attempt to raise awareness among the population about the risks associated with improper practices and the benefits of proper disposal.

The present study also demonstrates a high prevalence of medication use without a prescription, highlighting the need for behavior change within the community, which often lacks awareness of the risks associated with self-medication. In this regard, it is necessary to raise awareness among everyone, particularly healthcare professionals, in order to discourage the indiscriminate use of medications by the population.

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