Revista ARACÊ
ISSN: 2358-2472

ANALYSIS OF THE DISPOSAL OF DISUSED AND/OR EXPIRED PHARMACEUTICAL WASTE: HIGH DISPOSAL OF DIURETICS

https://doi.org/10.56238/arev7n4-172

Submitted on: 15/03/2025 **Publication date:** 15/04/2025

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ISSN: 2358-2472

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ABSTRACT

Introduction: The consumption of medicines has increased significantly in recent decades. Pharmaceuticals and their unaltered metabolites can affect humans and animals when inserted into the environment. Nowadays pharmaceutical products are often used in health, agriculture and aquaculture. The disposal of expired or unused medicines presents a risk to human health, considering that the main forms of disposal are still common garbage and sewage networks. Given the challenges that these issues pose to human and environmental health, this study was carried out. **Objectives:** To analyze the qualitative and quantitative analysis of the home disposal of unused and/or expired pharmaceutical waste of users of the family health program in the municipality of Goiatuba, GO. **Methodology:** The collection of medicines stored in the homes of program users took place in seven ESF's in the city of Goiatuba, located in the southern mesoregion of the state of Goiás, from September 2021 to April 2022. The medications were collected through a container made with a cardboard box covered with kraft paper. The data obtained were coded, stored and tabulated in an Excel database. In addition, a narrative review was carried out to compose and contrast the data obtained from the collection of unused and/or expired pharmaceutical waste in the municipality of Goiatuba-GO. **Results:** 76 different pharmaceutical classes were counted, with the pharmaceutical class most discarded by the population being diuretics, with 416 pills. The 10 main classes discarded were: diuretics, antilipemics, ARA II, ACEA, antidepressant, antidiabetic, anesthetic, hypoglycemic, beta-blocker. **Conclusion:** The data found on the main pharmaceutical classes discarded in health centers through collection for research were shown to be in line with the data quantified in the municipality of Goiatuba-GO, highlighting the ACE inhibitors and ARBs, along with the diuretics.

Keywords: Environmentalist theory. Florence Nightingale. Nursing.

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ISSN: 2358-2472

INTRODUCTION

The consumption of medicines has increased significantly in recent decades, and can be justified not only by the longer life expectancy of human beings, by self-medication, but also by the involvement of the population by Chronic Non-Communicable Diseases (NCDs) such as Systemic Arterial Hypertension and Diabetes Mellitus, resulting in the use of drugs in the long term and in large quantities (TONET, 2017; ALMEIDA, 2022). In view of this, thousands of medicines are made available for human consumption and even for veterinary use; and these substances are undoubtedly released into water effluents in their natural form or as pollutants not metabolized by the human body after their ingestion, through urine and feces (YOSHINO, 2022).

Medications must be prescribed safely, always with the indication of a health professional in order to avoid unwanted side effects, therapeutic failure and risk of death. In this sense, medications can cause short, medium and long-term effects, whether they are desirable or not. In addition, for the patient to adhere to the proposed therapy, aspects such as economic and cultural class, cost of the drug, adverse reactions to the drug, interactions, and degree of understanding of the patient must be taken into account (ALMEIDA, 2022).

Medicines are pharmaceutical products intended for the control of diseases, in such a way that their management must ensure that the population has guaranteed access to these products in a timely manner for their administration (OLIVEIRA *et al.*, 2019). They are indispensable, having unquestionable benefits for both the health and lifestyle of human beings. However, improper storage and disposal of these unused products can cause adverse consequences (KAR, ROY, LESZCZYNSKI, 2018; INSANI *et al.*, 2020). According to Fernandes et al. (2020), the elimination and storage of expired products are not the only problems in domestic pharmacies, as storage conditions stand out as a significant factor in the preservation and effectiveness of medicines, as well as in the prevention of domestic accidents.

Pharmaceuticals and their unaltered metabolites can affect humans and animals when inserted into the environment. Nowadays pharmaceutical products are often used in health, agriculture and aquaculture. (KAR, ROY, LESZCZYNSKI, 2018).

The disposal of expired or unused medicines presents a risk to human health, considering that the main forms of disposal of medicines are still common garbage and sewage networks. Thus, it is necessary to take the initiative to develop public policies aimed at the proper disposal of household medicines. It is essential to expand health education

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programs as an instrument to raise community awareness about the correct practices of storage and disposal of medicines (CONSTANTINO *et al.*, 2020).

A regulation was published, Decree No. 10,388/2020, which regulates the reverse logistics of medicines, expired or unused, from Brazilian households, but only includes municipalities with more than one hundred thousand inhabitants (BRASIL, 2020).

> XV – Reverse logistics of expired or unused household medicines and their packaging discarded by consumers – an instrument of economic and social development characterized by a set of actions, procedures and means aimed at enabling the return of these medicines and their packaging to the business sector for environmentally appropriate final disposal;
> XVI – household medicines – medicines for human use, expired or in disuse, industrialized and manipulated, subject to the provisions of articles 5 and 6;
> XVII – logistics operator – company holding an operating authorization and special authorization, when applicable, qualified to provide transportation or storage services;
> XVIII – primary storage point – place intended for the temporary storage of bags, boxes or containers with expired or unused household medicines discarded by consumers until collection and transport to secondary storage points;
> XIX – secondary storage point – place intended for the storage of bags, boxes or containers with discarded medicines in a place indicated by the medicine distributors until the collection and transport stages are carried out to the environmentally appropriate final disposal sites;
> XX – fixed point of receipt – point located in drugstores, pharmacies or other places where container dispensers are installed for the disposal by consumers of expired or unused household medicines; and
> XXI - temporary point of receipt - point located in drugstores, pharmacies or other places where container dispensers for collection campaigns are installed.

Given the challenges that these issues pose to human and environmental health, it is essential to expand health education programs as a tool to raise awareness about appropriate practices in the storage and disposal of medicines at home (CONSTANTINO *et al*., 2020). The objective of this study is to analyze the qualitative and quantitative household disposal of disused and/or expired pharmaceutical waste from users of the family health program in the municipality of Goiatuba, GO.

METHODOLOGY

PLACE OF STUDY

The study was carried out in the city of Goiatuba, located in the southern mesoregion of the state of Goiás, with a population, in the last census in 2022, of 35,664 people (IBGE, 2022). The municipality has ten programs of the Family Health Strategy (ESF) and 36 neighborhoods.

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The collection of medicines stored in the homes of the users of the program took place in seven ESF that are located in the Sectors: ESF 301 Jardim Maranata, ESF 302 Buriti Park Sector, ESF 303 Central Sector, ESF 304 Central Sector, ESF 305 West Sector, ESF 306 Central Sector, ESF 307 Recreio dos Bandeirantes Sector. FHS 401, 402 and 403 were not covered in the study because they are located in the rural area of the municipality and travel is difficult.

CONTAINERS FOR COLLECTING MEDICINES

Seven (7) containers were made available (Figure 1), distributed in seven (7) FHS in the city of Goiatuba, GO. The container used was made with a cardboard box covered with *kraft* paper and identified with the phrase "Deposit your expired or unused medicine here". It had an upper opening for users to deposit medicines without the person's identification and without the violation of discarded medicines.

Figure 1 - Container for collecting medicines

Source: The authors.

The boxes were placed from September 2021 to April 2022, in places that are easily accessible to users. The containers were available for "collection" for 30 days in each season of the year. Due to the social isolation measures, caused by the Covid-19 pandemic, all material collected was sanitized with 70% alcohol.

RESULTS AND DISCUSSION

From the collection of pharmaceutical waste in the municipality of Goiatuba-GO, it was possible to identify the pharmaceutical classes discarded in the seven ESF's (Graph 1). 76 different types of drugs were counted and the pharmaceutical class most discarded by the population were diuretics, totaling 416 pills (18%).

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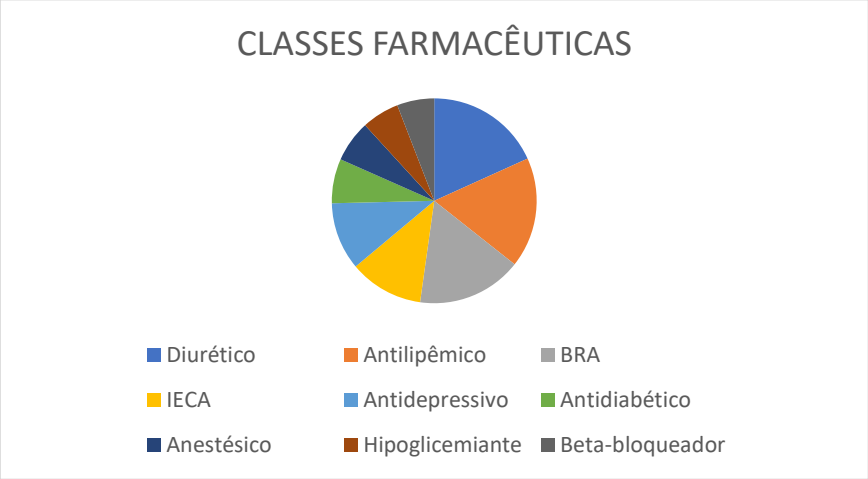
Graph 1 - The 10 main classes of drugs collected in the ESF's.



Source: The authors. Legend: BRA= Angiotensin II Receptor Blocker; ACE inhibitor= Angiotensin-converting Enzyme inhibitor.

Regarding diuretics, the FHS that obtained the highest disposal of this class was in the FHS 303 Center Sector. Considering the indications of diuretics for the treatment of diseases such as Systemic Arterial Hypertension, Renal Failure and Congestive Heart Failure, these drugs are released daily into the environment, being products of metabolization in the human body. Diuretics are divided into four types, taking into account the site of action, namely: carbonic anhydrase inhibitors, loop inhibitors, potassium-sparing inhibitors and thiazides (ALMEIDA *et al.*, 2017).

The use of carbonic anhydrase inhibitors may lead to mild or moderate metabolic acidosis; in the long term, thiazide diuretics may cause hypokalemia, hyponatremia, and cardiovascular changes, as well as hypoxia and sudden death. Loop diuretics can cause ototoxicity in patients who use them for the treatment of renal failure, as well as other adverse events such as hypokalemia, hypomagnesemia, and hypokalemia. Unlike loop diuretics that have hypokalemia as an adverse event, potassium-sparing diuretics can cause hyperkalemia. In addition, potassium sparing can cause gynecomastia and impotence in men (ALMEIDA *et al.*, 2017).

The second most discarded class was antilipemic drugs, with 397 pills in this class (17%), with 262 pills collected in FHS 304, and the others in the other six FHS. Antilipemic drugs, which can be represented by statins and aim to control the plasma concentration of cholesterol, mainly the low-density lipoprotein (LDL) fraction, in order to reduce the risk of death from cardiovascular diseases. They can cause serious undesirable effects such as rhabdomyolysis, being considered a severe myopathy that can lead to the patient's death by triggering apoptosis of muscle fibers (RIBEIRO, FLORÊNCIO, 2000).

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With similar results, a study carried out in the city of Governador Valadares-MG on the profile of drugs discarded by the population, showed that the main pharmaceutical classes discarded were diuretics, ACE inhibitors, ARBs, beta-blockers, hypoglycemic agents, hormonal contraceptives and antilipemic drugs. In addition, among ACE inhibitors, the one that was most discarded in this study was captopril, which can be justified by the side effect of dry cough, which occurs in 5 to 20% of patients who use it (ALMEIDA, 2022).

Another study carried out in the Metropolitan Region of the state of São Paulo, detected the most commercialized drugs, led by non-steroidal anti-inflammatory drugs (NSAIDs), being represented by more than 44% of sales, with dipyrone being the drug with the highest number of sales, followed by the antidiabetic metformin, with 20% of sales. The rest of the best-selling drugs were electrolytes with about 7% and antihypertensives with 4% of sales. In view of these data, the author Aragão (2020) fosters the need for environmental monitoring and control, since tons of these drugs are commercialized and end up being incorporated into ecosystems and drinking water in the form of metabolites, causing impacts on biota, the environment, and humans.

In a survey carried out in a Treatment Unit for Waste discarded in the common garbage in the municipality of Terenos-MS, between 2015 and 2016, it was observed that the most identified medications consisted of anti-inflammatories, muscle relaxants, antihypertensives and antibiotics, with antihypertensives accounting for about 18% of the total discarded medications (TONET, 2017). In the city of Divinópolis-MG, in 2014, the main pharmacological classes discarded were antihypertensive drugs (representing more than 22% of the discards) followed by hypoglycemic drugs and antiplatelet agents (BALDONI, 2015). This study is similar to what was found in the municipality of Goiatuba-GO, in 2022, with antihypertensive drugs having a high disposal rate.

Antihypertensive drugs of the ACE inhibitor and ARB classes block the renin-angiotensin-aldosterone system, having different mechanisms of action and undesirable effects. Like the drugs of these classes, ACE inhibitors are represented by enalapril, captopril, lisinopril, among others. ARBs, on the other hand, are represented by losartan, olmesartan, valsartan, among others. ACE inhibitors have the mechanism of action that prevents the degradation of bradykinin, so that the increased bradykinin in the body promotes the release of nitric oxide in a way that contributes to the vasodilation effect (RIBEIRO, FLORÊNCIO, 2000). On the other hand, bradykinin is involved in the

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pathogenesis of cough, and an important side effect of ACE inhibitors is dry cough (CAMPANA, 2020).

In patients with renal failure, it is of paramount importance to evaluate renal function and potassium concentration in the body, because when prescribing an ACE inhibitor or ARB, these can cause an acute deterioration of the patient's renal function (VARGAS FILHO, 2007).

Drug collection points were implemented in Family Health Programs in the municipality of Paraguaçu-MG in 2015, so that the largest amount of pills discarded at the collection points was of the antihypertensive class, with more than 30% of the total discarded in pharmaceutical forms (pills, pills and pills) (OLIVEIRA, 2015). This demonstrates that antihypertensive drugs in many studies lead among the most discarded classes of drugs. In addition, among the class of antihypertensive drugs, according to Almeida (2022), ACE inhibitors, with captopril as their representative, were the most discarded in his work.

In Brazil, in regions where there is no basic sanitation, the disposal of medicines is even more harmful. This fact is that, without sanitation, the drug does not undergo any type of prior treatment, being released in the way it is acquired in the environment. Thus, according to research carried out in Brazilian waters and soils, they found the presence of drugs such as diuretics (furosemide, hydrochlorothiazide), antilipemic, anti-inflammatory, and antihypertensive drugs (TAVARES, 2019).

According to Dias (2019), some pharmacological classes are detected in the environment more frequently, being represented by six classes, namely: NSAIDs, antibiotics, antilipemics, hormones, antiepileptics, and beta-blockers. These data allow us to assess that the classes most detected in the environment were the most discarded by the population, as in the work carried out in Goiatuba-GO.

Medicines are essential for human health. However, when discarded or used improperly, they generate negative impacts on humans and other living organisms (TAVARES, 2019). The similarity of metabolic pathways, receptors and biomolecules that many living organisms have to humans puts them at risk, as the drugs that are released into the environment when they come into contact with living beings in the place cause irreversible physiological changes, justified by the similarity with humans (LOURENÇO, 2014). According to Nogueira and Moraes (2013), pharmaceutical products can be detected

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in the environment on a scale ranging from ng/L to µg/L in order to cause toxic effects to humans and living organisms.

According to Nurse Florence Nightingale's environmentalist theory, the environment plays a crucial role in restoring the health of patients, always prioritizing a favorable and healthy environment for the healing process. Thus, the objective of nursing is to help patients in the process of restoring health, enabling environmental hygiene (HADDAD, 2011; MEDEIROS, 2015; BORSON, 2018).

In this sense, the work of nursing professionals has great relevance in environmental health in the process of training communities and members of their health teams on how to release the environmental rights that constitute the right to health. Nurses, as educational agents, must provide health-promoting practices, expressing shared socio-environmental responsibility to rescue the ideal of ecological well-being. This can solidify positive human attitudes to change and improve the environment and the quality of human life (MONIZ *et al.*, 2020)

CONCLUSION

In view of the information, the ways and reasons that drugs are discarded in the environment are diverse, and may be products of metabolization by the human body. Considering the increase in NCDs and the need for pharmacological treatment for them, the high consumption of drugs gives rise to metabolites that are excreted largely through urine and feces, contaminating water, soils and animals.

The impacts caused by medications, especially antilipemic drugs, diuretics and antihypertensives on the environment range from the ability to bioaccumulate, synergism with other drugs in the environment, obesity and increased liver volume in fish, alteration of the chloroplast in algae, to damage to fauna and flora.

The data found on the main pharmaceutical classes discarded in health centers through collection for research were shown to be in line with the data quantified in the city of Goiatuba-GO, highlighting the ACE inhibitors and ARBs, along with the diuretics.

Another issue addressed in the review was in relation to the concentrations of the drugs found in waters of several countries. Thus, relatively small concentrations can cause impacts on the environment and human health in the long term, requiring more research on the subject, as the damage of some pharmaceutical classes is not yet well elucidated.

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Finally, health professionals, especially nursing professionals, and patients should be advised about the need to indicate the therapy that best suits the patient, in order to optimize adherence, avoid adverse effects and therapeutic abandonment. Thus, the amount of expired and discarded medicines can be minimally reduced.

ACKNOWLEDGMENT

FAPEG - Foundation for Research Support of the State of Goiás

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ISSN: 2358-2472

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