Reverse logistics of medicines; Case study in the municipality of Belém-Pará

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ABSTRACT
The inadequate disposal of medications has serious ramifications, such as ecosystem aggression, water and soil pollution, and posing a risk to the health of humans and animals. The implementation of Medication Reverse Logistics (LR) constitutes a remarkable technological progress for the pharmaceutical industry, as it not only fulfills their responsibilities but also plays a crucial role in reducing hazards to public health and the environment. This study aims to investigate how LR is being implemented in the disposal of expired or unused medications in pharmacies, as well as the perception of the residents of Belém, PA. The methodology employed was a descriptive field study using questionnaires, with data collected through structured interviews conducted in person with pharmacists and a remote survey with consumers on the subject. The results of the applied research showed that, according to pharmacy networks, LR practices are adopted as a result of environmental and sanitary requirements. Furthermore, the research indicated that 100% of the networks inform their customers about the importance of LR-related practices. Regarding the final destination, they reported that 80% of pharmaceutical waste is incinerated. Among the surveyed population, it was found that 70.16% of expired or unused medications are disposed of in regular trash, while 3.49% are flushed down the toilet. It was also observed that 62.02% of consumers have never found any collection points in the pharmacies they frequent, and 96.12% responded that they have never received any information regarding the proper disposal of medications.

Keywords: Medication disposal, Reverse logistics, Environmental impact, Public health awarenes.

1 INTRODUCTION

The Brazilian population has been increasing more and more over the years. According to the Brazilian Institute of Geography and Statistics (IBGE) through the 2022 Demographic Census, the country's population has reached the mark of 207.750.291 Inhabitants, consequently, occurs the growth of solid waste production in the country, only in the year 2022 the country produced more than 81 million tons of municipal solid waste, generating more than 380 kilos per inhabitant per year. (ABRELPE, 2022).

Thus, due to the large number of solid waste production and the possible environmental impacts that they can cause, in August 2010 the National Solid Waste Policy (PNRS) was created, providing for its principles, objectives and instruments, as well as the guidelines related to integrated management and solid waste management, including the dangerous ones, the responsibilities of the generators and the public power and the applicable economic instruments. Individuals or legal entities, of public or private law, responsible, directly or indirectly, for the generation of solid waste and those who develop actions related to the integrated management or management of solid waste are subject to compliance with this Law. It does not apply to radioactive waste, which is regulated by specific legislation. (BRASIL, 2010.)

Thus, Neto and Moreira (2010) highlight that the PNRS helps in adding value to these wastes, increasing the competitiveness of the productive sector, promoting social inclusion and mainly delimiting the role of States and Municipalities in Solid Waste Management.

The Solid Waste Policy defines Solid Waste as:

> "Material, substance, object or discarded good resulting from human activities in society, the final destination of which is proceeded, proposed to proceed or is obliged to proceed, in solid or semi-solid states, as well as gases contained in containers and liquids whose particularities make it impracticable to release them into the public sewerage system or into bodies of water, or demand for this technically or economically unfeasible solutions in the face of the best available technology" (BRASIL, 2010).

In view of this, drug waste stands out because of its great capacity for contamination to the environment and risk to public health, because it has in its composition chemical substances. These drugs are classified as Group B Health Services Waste (Chemicals) which covers any chemical substance that presents some type of risk to public health or the environment, depending on its characteristics of toxicity, corrosivity, flammability and reactivity (BRASIL, 2010).

2 JUSTIFICATION

The reflection on the damages caused by the incorrect disposal of medicines by the population, whether in disuse or expired, as well as the methods that health institutions have used to manage this waste is extremely relevant.

Population growth and accelerated growth of pharmaceutical industries have contributed to the increase in the production of solid waste, including drug waste. Unfortunately, these wastes are often disposed of improperly in the environment, which results in significant socio-environmental impacts. With the increase in the consumption of medicines by the population, it becomes even more necessary to address in a cohesive and effective way the management of this waste, in order to mitigate the negative impacts and ensure an adequate destination, preserving public health and the environment, in addition to allowing the recovery of materials and substances that can be reused or properly eliminated.

The National Solid Waste Policy (PNRS) establishes Reverse Logistics (LR) as an appropriate way of disposing of drug waste, which through this aims at the return of products after consumption, with shared responsibility between manufacturers, distributors, consumers and public agencies. In the case of drug waste, LR implies the safe and correct return of unused or expired medicines to the production chain, where they will be disposed of in an environmentally appropriate manner. For LR to occur efficiently, it is necessary to implement educational actions, the availability of specific collection points and the proper monitoring of the entire process, thus ensuring the proper and safe disposal of drug waste.

However, it is attached to LR, in a research conducted by Azevedo *et al.* (2020) it was observed that of the total number of people surveyed, 91.18% discarded medications inappropriately, further demonstrating that the lack of information is one of the main factors for this improper disposal of drug waste.

In this context, the present study is based on the explanation of the impacts caused to public health and the environment, caused by the disposal and improper disposal of pharmacological waste. In addition to being able to be used to subsidize programs and projects that assist in the implementation and/or improvement of LR in the sector, focusing on the municipality of Belém.

3 RESEARCH PROBLEM

From the understanding of the impacts on the environment and public health, it is important to emphasize the role of the management of the establishments in the search for initiatives to minimize the effects caused by the incorrect disposal of medicines. LR is precisely the strategy that fulfills the role of operationalizing the return of after-sales and post-consumer waste in a responsible way until the final destination of the products in the most appropriate way possible, avoiding irregular disposal. (Rabbit, *et al.,* 2018).

Currently one of the challenges to achieve the effectiveness of LR is the population's lack of knowledge of how to perform the correct disposal, a survey conducted in the extreme south of Santa Catarina, also found that people in general do not know how to proceed with drug residues and also

do not consider that these can cause environmental problems due to incorrect disposal. (RODRIGUES *et al*., 2018).

Given the above, some ways for the process of LR become effective is the continuing education that aims to guide the importance of the correct disposal of medicines in establishments, in addition to some important measures are the availability of a place for the population to deliver post-consumption medicines near the residence or workplace of this public; creation of packaging that correctly preserves waste in accordance with current legislation and development of logistic models in the performance of collections at different points. (DA SILVA and MARTINS, 2017).

In a study conducted on the disposal of medicines, it points out that there are flaws in the implementation of the practices of awareness of the population and conclude that the need to implement public education policies so that the population knows the correct way to dispose of these drugs, as well as collection and dissemination of these posts so that society has access. (SOUSA, *et al.,* 2021).

4 OBJECTIVES

4.1 GENERAL OBJECTIVE

To know the management of drug waste in pharmacies of the private network, with a view to the implementation of LR (Reverse Logistics), in the city of Belém/PA.

4.2 SPECIFIC OBJECTIVES

- To investigate the policy of disposal and reverse channels of expired drugs adopted in the pharmacies studied and to compare the management applied to drug residues in the light of the legislation aimed at LR.
- Understand the degree of knowledge of consumers regarding the subject, as well as what practices are applied in the disposal of these products.
- Suggest optimization and implementation instruments aimed at the management of drug waste, according to the weaknesses presented by the managers of pharmaceutical networks and consumers of medicines.

5 THEORETICAL FRAMEWORK

5.1 MEDICINES

Currently medicines are used in large quantities worldwide, with the intention of reducing suffering, improving the quality and life expectancy of the population. (OLIVE TREE, *et al*, 2017), however, also contribute to the origin of public health and environmental problems. In addition, the National Health Surveillance Agency defines medicine as a pharmaceutical product, technically

obtained or prepared for prophylactic, curative, palliative or diagnostic purposes. A finished pharmaceutical form that contains the drug, usually in association with pharmacotechnical adjuvants (ANVISA, 2002).

According to the Federal Council of Pharmacy (2021), 89,879 pharmacies and drugstores were registered throughout Brazil. In addition, according to the Association of the Pharmaceutical Industry Research, Interfarma, (2022) Brazil is currently oscillating between the eighth and tenth position in the world drug market.

A study conducted by the Brazilian Academy of Neurology (ABN) found that 81% of the Brazilian population practices self-medication in cases of headache. This data shows that people seek to solve their problems without seeking help from professionals, and are often influenced by drug advertisements. (KOWACS, 2017). It is known that in addition to practicing self-medication, which leads to the accumulation of medications at home, it is common for people to dispose of medications in the residential garbage (SOUZA, et al., 2018).

5.2 THE IMPACTS CAUSED BY IMPROPER DISPOSAL OF MEDICINES

The vast majority of the Brazilian population has medicines in their homes and tend to accumulate them, thus forming a domestic reserve, these, being the result of leftovers of interrupted treatments, excessive purchases or due to self-medication, without medical prescription, which are stored for future use. (DE OLIVEIRA and BANASZESKI 2021; DE OLIVEIRA, 2010).

However, for a drug to be effective, it needs to be used correctly and within its shelf life. These conditions are important to ensure the safety and effectiveness of treatment. After the end of the useful life, establishments such as pharmacies and drugstores should be available to the population to receive expired or unexpired drugs or that have exceeded the treatment, thus returning to the laboratories that produced it so that disposal can be promoted. (DE OLIVEIRA and BANASZESKI 2021; HOUSE OF REPRESENTATIVES, 2011).

However, Almeida *et al.* (2014), in a case study revealed that most people discard unconsumed medicines in the common garbage or in the toilet. Although they are aware of the environmental damage that this attitude can cause, they do not have enough information about the specific damages that they can cause to nature and do not know where to find collection points in the city, the interviewees also highlighted that there is a lack of legal provisions that can discipline and encourage the elaboration and implementation of an integrated management system of waste from unconsumed medicines.

ANVISA considers medicines as chemical waste and when they are disposed of outdoors, they become part of the garbage and can spread diseases through vectors that reproduce in these places or that use these residues as a food source, therefore, This fact should also be addressed in public

campaigns for clarification, because society in general is unaware of the consequences that this act can cause to the environment and also to living beings. (PINTO *et al.*, 2014).

In addition, improper disposal of medicines can cause serious damage to the environment. When thrown into the common garbage or sewer system, these drugs can contaminate soil, surface and groundwater, including rivers, lakes, oceans and groundwater. In adverse conditions of humidity, temperature and light, these chemicals can turn into toxic substances and alter the balance of the environment, damaging biogeochemical cycles and interfering with food webs and chains. (PINTO *et al.*, 2014).

According to the National Health Surveillance Agency (2018), the presence of medicines in the environment can contribute to the development of antibiotic-resistant bacteria, which poses a threat to public health. Since human and animal contamination by drug residues can occur through the ingestion of contaminated water or food, as well as by direct contact with the drug or the contaminated environment. It is important to highlight that the improper disposal of medicines can contribute significantly to environmental contamination by these products.

Therefore, to transform this scenario, it is necessary to change the attitude towards environmental practices, from the individual level to the global scale, preserving the use of natural resources, rethinking the production of waste and ensuring what is known as Sustainable Development. (CAMPANHER, 2016).

5.3 NATIONAL SOLID WASTE POLICY

Sanctioned in 2010, Law 12,305, also known as the "solid waste law", is responsible for regulating the management of solid waste in Brazil, including the prerogatives of non-generation, reduction, reuse, recycling, treatment of solid waste and proper final disposal. In short, the law highlights that to achieve these objectives it is important the joint action of the Federal, State and Municipal governments (BRASIL, 2010).

Solid waste management is one of the main environmental challenges faced by Brazilian cities. The National Solid Waste Policy emerged to deal with this issue, seeking to improve people's quality of life and protect the environment. A literature review by Kuhn; Banks; Alves, (2018) highlights the importance of the participation of society in the implementation of the PNRS, especially through educational campaigns and the encouragement of selective collection.

The National Solid Waste Policy has also brought important advances regarding the treatment and final disposal of solid waste. A work by Silva Tagliaferro; De Oliveira, (2021) points out that the PNRS encouraged the implementation of selective collection systems and the proper disposal of waste, including composting and recycling. In addition, the PNRS also established goals for the elimination of dumps and the implementation of sanitary landfills.

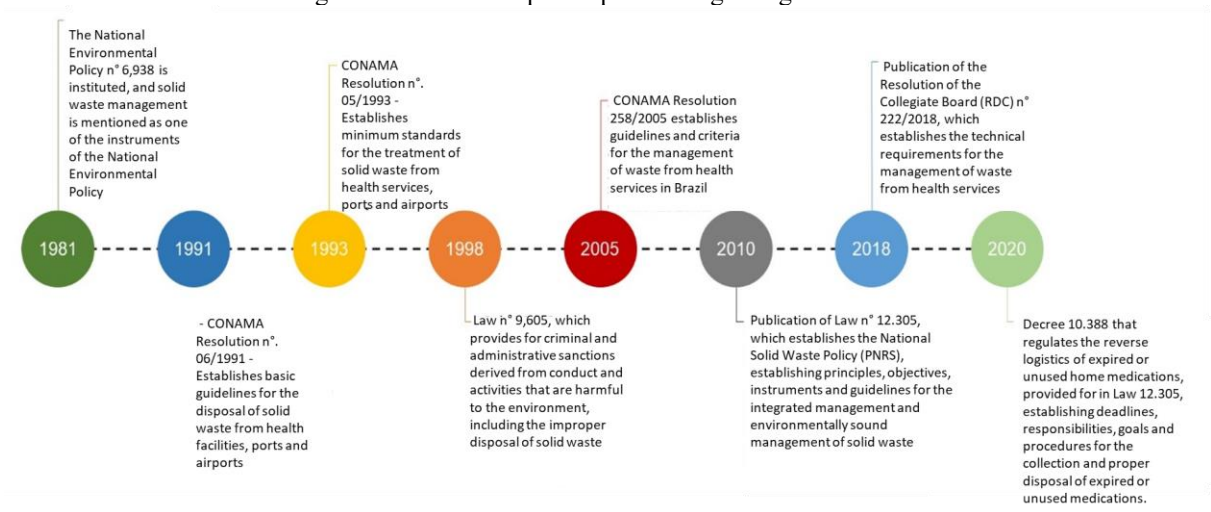
It is worth mentioning that the National Solid Waste Policy also has important economic and social implications. A survey conducted by Trombeta (2012) highlights that the PNRS encourages the creation of new businesses and the generation of jobs in the solid waste management sector, especially in selective collection and recycling. In addition, the PNRS also encourages social inclusion, since selective collection and recycling can generate income for waste pickers and their families.

In addition, another objective of the PNRS is to encourage the return of expired or disused medicines to appropriate collection points, such as pharmacies and drugstores, as pointed out by Vital *et al.* (2022). The PNRS also provides for shared responsibility among government, industry, commerce and the population in the management of solid waste, including medicines (ALVES *et al.,* 2021).

However, there are still challenges, it is not enough just to have the legislation that specifies how to proceed with drug residues, it is necessary to put into practice, supervise and guide the population so that the objectives contained in the laws are achieved. (SOUZA *et al.,* 2021), however, the high cost for the adequate treatment of expired or disused drugs is still a challenge for the implementation of the PNRS, as highlighted by Luna and Viana (2019).

The Brazilian legislative framework regarding the National Solid Waste Policy has a timeline, as shown in Figure 1, which helps to understand the evolution of public policies aimed at solid waste management in the country and the importance of implementing effective measures in this regard.

Figure 1: Timeline of public policies regarding solid waste.



Source: Prepared by the authors (2023)

Due to the high relevance of this subject throughout history, it was established through Decree No. 11,043, of April 13, 2022 the National Solid Waste Plan (Planares) is an essential instrument of the National Solid Waste Policy. It is important because it provides guidance to achieve the objectives of the policy and implement it in a concrete way, through guidelines, strategies, actions and goals that

aim to improve the management of solid waste in Brazil. In other words, Planares offers a way forward to ensure proper management of solid waste in the country. (BRASIL, 2022)

When dealing at the state level the Legislative Assembly of the state of Pará, recently established the law No. 9,898, of April 28, 2023, which provides obligation to pharmacies and drugstores of the State of Pará to receive from the consumer any expired or disused medicines to a suitable environmental destination through LR, as well as in the availability and maintenance of container dispensers used for drug collections. In addition, it provides in its Art. 7 on "The responsibility of elaborating communication and information actions, with educational purpose, regarding the proper disposal of medicines and the rational use of medicines. (PARÁ, 2023). However, the active participation of all those involved in the chain of production and consumption of medicines is still necessary, including citizens, pharmaceutical industries, commercial establishments and public authorities.

5.4 REVERSE LOGISTICS AND THE MANAGEMENT OF DRUG WASTE

According to Liva; Point; Oliveira, (2003) LR is the area of business logistics that is concerned with the logistical aspects of the return to the business or productive cycle of packaging, after-sales and post-consumer goods, adding to them values of various natures: economic, ecological, legal, logistics, corporate image, among others. According to national legislation, there are specific legislations involving Health Service Waste (RSS), and the National Health Surveillance Agency (ANVISA) and the National Environment Council (CONAMA) are the main federal agencies involved in the regulation and supervision in this area. (CHAGAS, 2021).

With the population growth, the production of waste has also intensified, specifically among them are the Health Services Waste (RSS). With this, the National Council of the Environment (CONAMA), published resolution No. 358/2005, which establishes the procedures and criteria for the disposal of waste from health services, including medicines. It mandates that health facilities, such as hospitals, clinics and pharmacies, must implement health service waste management systems, which include selective collection and environmentally appropriate final disposal of medicines. (CONAMA, 2005).

By virtue of obtaining a better management of the RSS, the Ministry of Health, together with the National Health Surveillance Agency (ANVISA), through RDC No. 222/2018, implemented the health services waste management plan (PGRSS), which aims to describe all the actions used in health institutions, among them are the qualification and training of the employees involved in all the units that generate the RSS. (ANVISA, 2018).

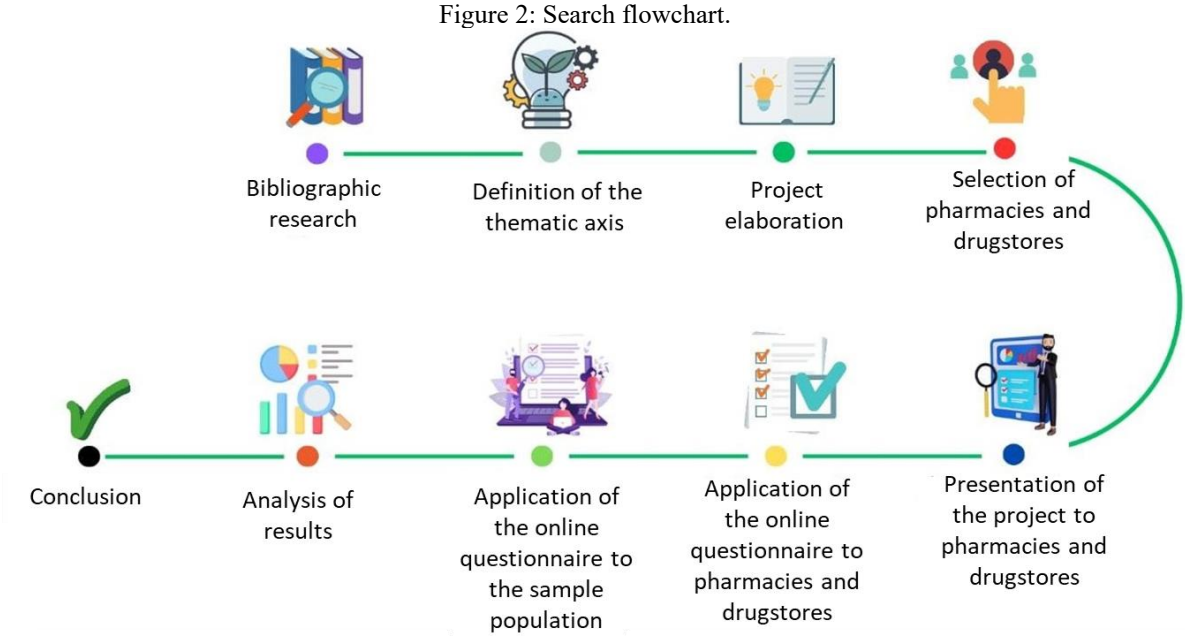
Finally, Decree 10,388/2020 that regulates the LR of expired or disused home medicines, provided for in Law 12,305/2010. The decree defines the responsibilities of manufacturers, importers,

distributors and traders of medicines, who must organize themselves in a collective system for the collection and proper disposal of this waste. The decree also provides for the creation of a national registry of LR medicines and establishes annual targets for the collection and proper disposal of expired or disused medicines. In addition, the decree provides for the supervision of the implementation of the LR of medicines by the competent environmental agencies, which may apply penalties in case of non-compliance with the obligations provided for in the law and the decree. (BRAZIL, 2020).

6 MATERIALS AND METHODS

The study was developed according to the flowchart presented in Figure 2, constant of 9 stages, capable of leading to the achievement of the proposed objectives.

Figure 2: Search flowchart.



Source: Elaborates by the authors (2023)

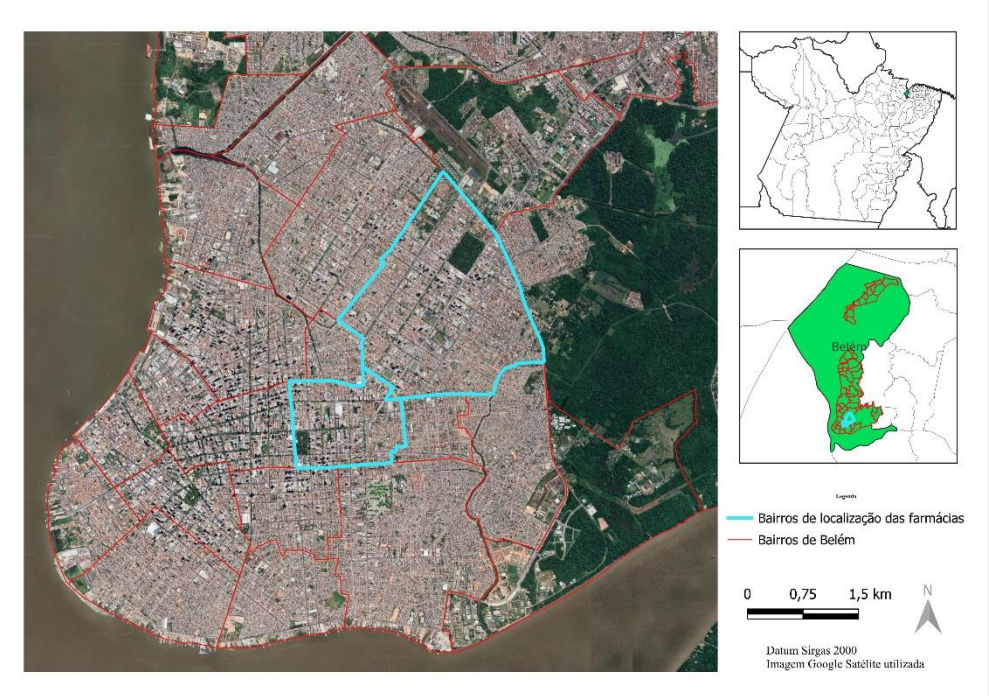
In principle and permeating the whole study, a bibliographic research was developed, which, according to Cervo, Bervian and Silva (2007, p.61) "constitutes the basic procedure for monographic studies, by which the mastery of the state of the art on a given theme is sought". In this way, the study is developed from materials published in books, articles, dissertations and theses, and aims to find solutions to proposed problems, through the use of scientific methods.

The study area was the municipality of Belém do Pará, located in the northern region of the country. It belongs to the Metropolitan Mesoregion of Belém and the Microregion of Belém. The city is situated on the banks of the Guamá River, near its mouth, in the Atlantic Ocean. According to the most recent data released by the IBGE in 2021, the population of Belém do Pará is 1,506,420

inhabitants, which results in a demographic density of approximately 1,421.87 inhabitants per km² (IBGE, 2021).

For the first stage of the field research it was initially necessary to identify, through the *google maps application, the* largest networks of pharmacies and drugstores that operate in the municipality, of a national nature, performing a first filter in the selection of those in more populous neighborhoods and in more central regions of the city, opting for the neighborhoods of Marco and São Braz, for presenting at least a branch of the largest networks of pharmacies and drugstores of a national nature, operating in the municipality. Subsequently, the first visit was made in 6 different units of the largest pharmacy and drugstore chains to present the project to the representatives of the pharmacies and drugstores of the selected neighborhoods, Marco and São Brás, in the municipality of Belém. After the presentation of the project, five of the six pharmacies visited representing the largest networks operating in the city consented to participate in the study. Figure 3 shows the map of the place of study, highlighting the neighborhoods where the research was done.

Figure 3: Location map of pharmacy neighborhoods.



Source: Elaborates by the authors (2023)

The third and fourth stages of the study occurred simultaneously, with the application of questionnaires to pharmacy managers and customers, respectively.

As for the questionnaire applied to the managers of the participating pharmacies, it was prepared considering the one established by Law 12,305/10 and Decree 10,388/20, which establishes the Reverse Logistics of expired or disused home medicines, for human use, industrialized and manipulated, and their packaging after disposal by consumers.

As for the questionnaire applied to consumers, it was modified by Souza (2019), with sociodemographic questions aimed at knowing the management applied to drug waste in their own homes, with a view to realizing whether, in fact, these consumers tend to return such drugs and their packaging to pharmacies, as well as questions about reverse logistics.

The statistical sampling (sampling of finite populations) had a degree of reliability of 90%, as well as the sampling error of 10%, for the population of 1,499,641 inhabitants, so the sample size was 258 individuals.

The application of the questionnaire to consumers was applied electronically, through the free platform *Google Forms, in* which the inclusion criterion took into account the age group from 18 years old, and must reside in the municipality. The questionnaire was published on the official website of the Federal Institute of Pará (IFPA), through social networks, pamphlets and posters scattered in strategic points of the city, where they contained a QR code, which directed to the research.

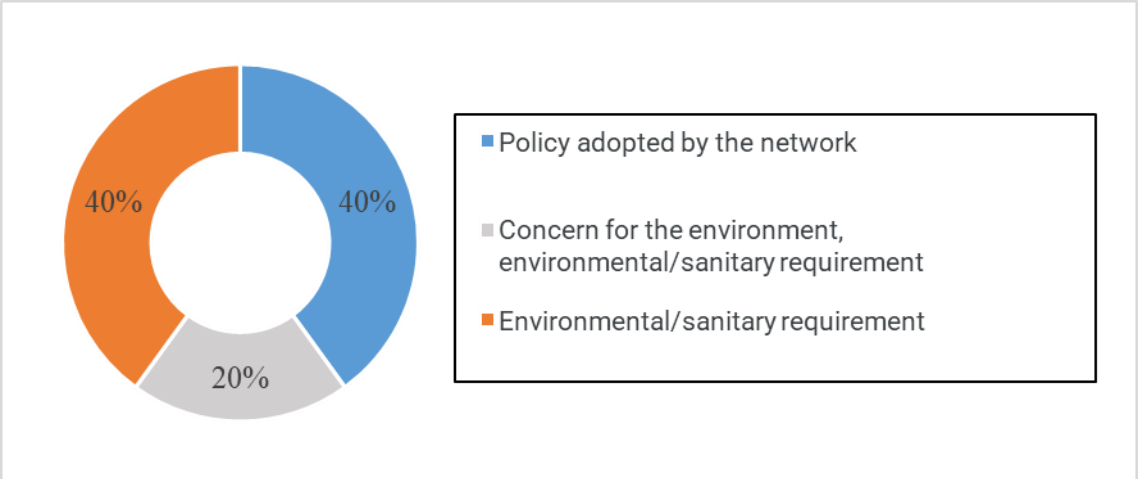
7 RESULTS AND DISCUSSIONS

The results presented initially seek to analyze the policy of disposal and reverse channels of expired drugs adopted in the pharmacies studied. In the second stage, it presents the knowledge and practices adopted by the consumers of medicines, regarding those expired in their homes, or who remain from a treatment. And finally, the study presents suggestions capable of guiding managers in the optimization and expansion of LR in services that produce drug residues, which encompasses a wide activity of health services, such as public and private pharmacies, hospitals and veterinary clinics.

7.1 POLICY OF DISPOSAL AND REVERSE CHANNELS OF EXPIRED DRUGS ADOPTED IN THE PHARMACIES STUDIED

After data collection, its consolidation and analysis was verified, that from the perspective of pharmaceutical networks, 100% inform about the importance of the correct disposal of medicines to their customers.

Figure 4: Reasons that led pharmaceutical networks to adopt the practice of LR of medicines.

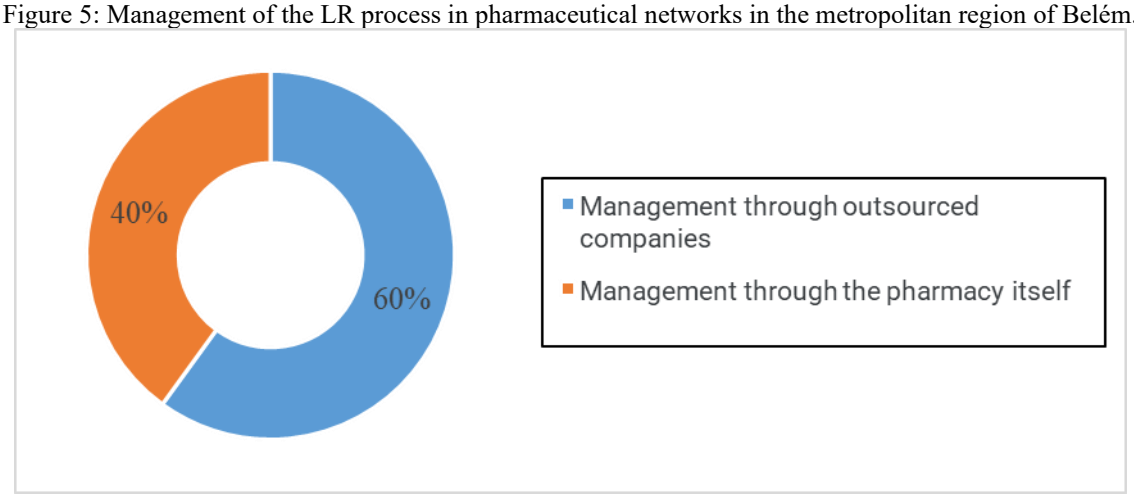


Source: Elaborates by the authors (2023)

The participating pharmaceutical networks declare to adopt the practice of LR in their establishments where it is highlighted in Figure 4 that the stimulus of the legal requirement corresponds to 80% of the reasons that lead managers to adopt LR, when the factor of being an internal policy of the network and environmental and sanitary requirement (Sanitary Surveillance) are added. In addition, when asked if the regional pharmaceutical council carried out any campaign to encourage the establishment to adopt LR, 40% of the managers of the pharmacy networks studied answered no, and 60% said that they were encouraged through the council to adopt the practice.

When asked about the conducts adopted for the segregation of these residues before the collection for LR, the pharmacy networks answered that the segregation is done according to the classification of the groups (class B) and pharmaceutical form (liquid or tablet) only one network does not identify and separate the drugs. Still about the disposal process, it was asked about the responsibility for the management process carried out, with the result represented in Figure 5.

Figure 5: Management of the LR process in pharmaceutical networks in the metropolitan region of Belém.



Source: Elaborates by the authors (2023)

According to Figure 5, 60% of pharmacies outsource this service while 40% do their own disposal management process. It is noteworthy that the two forms of management are in accordance with Decree 10.388/20.

Regarding the frequency in which the residues of existing medicines in the pharmacy are collected, 80% of the networks reported that it occurs once a month, while 20% did not inform the amount of times, justifying that there is no routine of this frequency, being variable according to the amount of residues accumulated in the pharmacy. The approximate amount of drugs discarded, according to the participating managers, is between 1 Kg to 5 Kg/month in 3 pharmacies studied, and less than 1 Kg/month in the 2 other pharmacies. A really worrying fact is that 80% of drug waste is destined for incineration and another 20% of the networks reported not knowing the final destination of these. Although incineration is a solution that minimally impacts the environment and public health, it is noteworthy that the goal of LR is that this waste return to the manufacturer, or another industry that can give a sustainable destination to them, as presented in the study by Oliveira (2022) that proposes the recycling of drug blisters.

7.2 KNOWLEDGE AND PRACTICES ADOPTED BY CONSUMERS OF MEDICINAL PRODUCTS

Continuing the study, we researched the management of waste by drug consumers, and their practice of LR. It was observed the predominance of female respondents, in which it represents 73.64%. Regarding the age group, 38.76% is in the range of 21 to 30 years, followed by the range of 31 to 45 years, with 29.07%.

Table 1: Sociodemographic data of the interviewees.

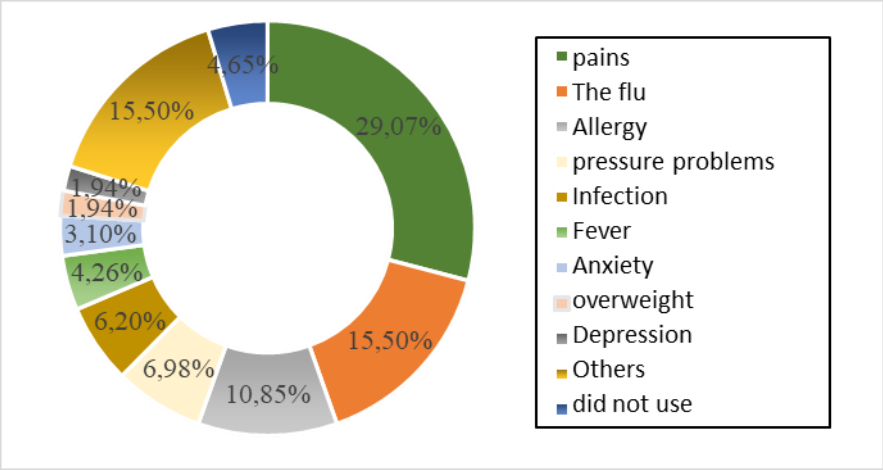
Gender		Total
Female	190	258
Male	68	
Age group		Total
18-20	32	258
21-30	100	
31-45	75	
46-60	43	
Over 60	8	

Source: Elaborates by the authors (2023)

Participants were asked if they used medications in the last 5 months 95.35% of people answered yes, highlighting the use of pain medications in general with 29.07%, The second largest use was of medications to treat influenza with 15.50%, as evidenced in Figure 6, Ferreira and De Carvalho, (2021) and Wolff and De Peder, (2021) state that analgesics and anti-flu drugs, have their consumption

quite common mainly for the ease of access to these drugs, as well as having the habit of buying without first consulting a doctor, added to the fact of the influence of marketing related to these drugs.

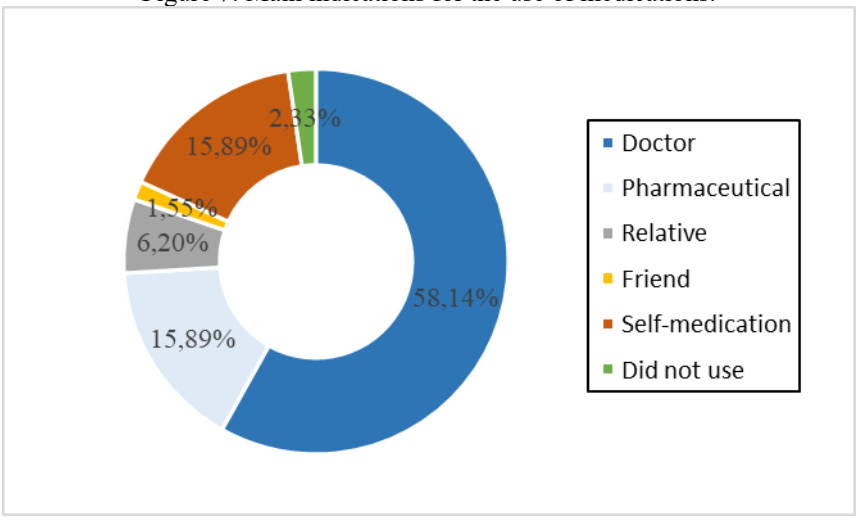
Figure 6: Main reasons for medication use.



Source: Elaborates by the authors (2023)

Among those who had medications, 58.14% purchased them with a medical prescription, while 15.89% of the interviewees stated that they had received guidance from pharmacists, 6.20% from family members and 1.55% from friends. Notably, a significant index of 15.89% declared that they used medications without any guidance, based on their experience, previous knowledge about medications and previous prescriptions, as shown in Figure 7. When asked if they used all the contents of the packages, 32.30% answered no, and that they saved it for future use. Batista, (2020) and Klein *et al*., (2020), in their research concluded that family or friends influence, presence of household stock, are the main reasons that lead the practice of self-medication in the search for a quick and practical treatment.

Figure 7: Main indications for the use of medications.

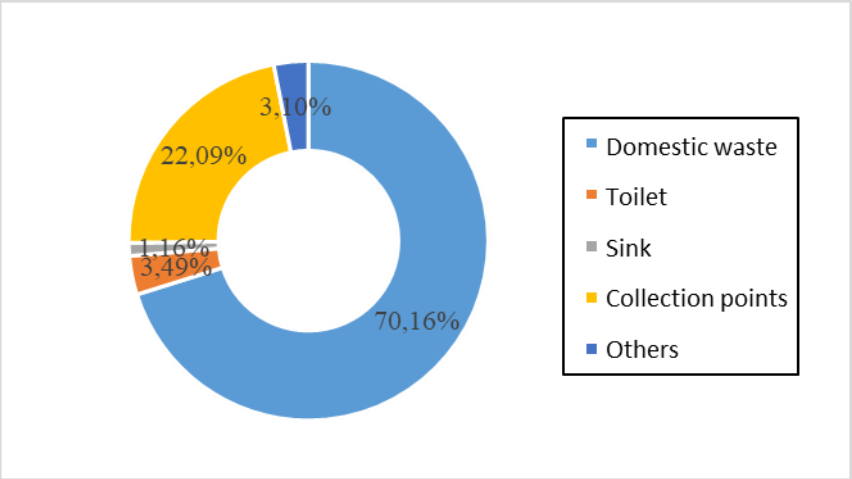


Source: Elaborates by the authors (2023)

Due to the accumulation of medicines in homes, a form of incorrect disposal ends up occurring, as shown by the results obtained from the questioning about the way in which expired or disused medicines are discarded. It was noted that 74.81% of people dispose of it in household waste, in the toilet or in the sink. That is, the vast majority discard incorrectly. Only 22.09% of the interviewees properly dispose of the drugs in health centers or pharmacies, as shown in Figure 8.

The results obtained in this study corroborate with other studies described in the literature. Despite being a work done with the academics of the Unisociesc College, in the municipality of Jaraguá do Sul – SC, it was observed that 60% of the interviewees dispose of them in the common garbage. (LOPES *et al.*, 2021). Also in accordance with our results Dos Santos and Frizon (2019), demonstrated that approximately 76% of respondents dispose of medicines inappropriately in the municipality of Sananduva – RS. Another study conducted in the city of Jacareí – SP, showed that only 13% of the participants discarded correctly. (BROOK *et al.*, 2019). As well as, Barros *et al.,* (2021), evidenced that 78.9% of the respondents in the municipality of Palmeirândia -MA dispose of it in the common garbage.

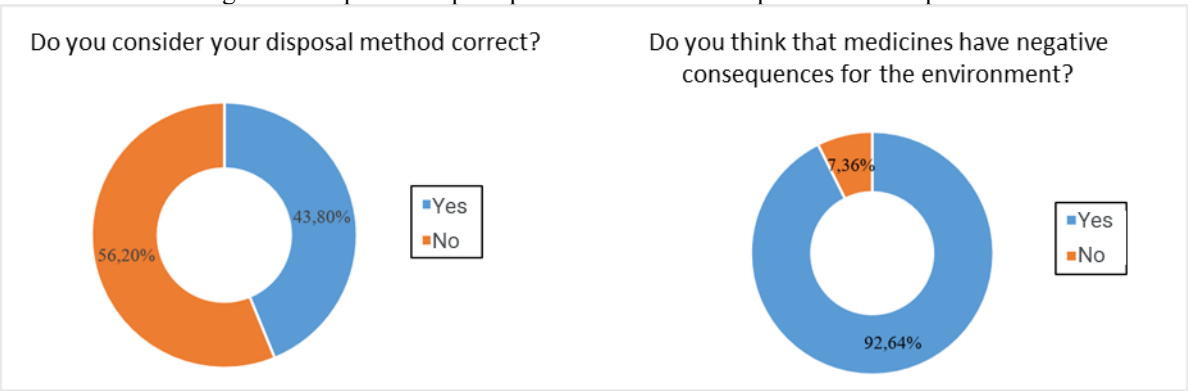
Figure 8: Main forms of drug disposal.



Source: Elaborates by the authors (2023)

It is worth mentioning that although only 22.09% of the interviewees discard properly, at the collection points, 43.80% of the people interviewed believe that their form of disposal is correct. In addition, 7.36% of the interviewees answered that the disposal of medicines does not bring negative consequences to the environment, as shown in Figure 9. Therefore, these results reinforce the word of Gonzales and De Ferreira, (2020) when they affirm that the practice of incorrect disposal, as well as ignorance about the consequences to the environment, portrays the lack of information of the population on how to proceed with this waste.

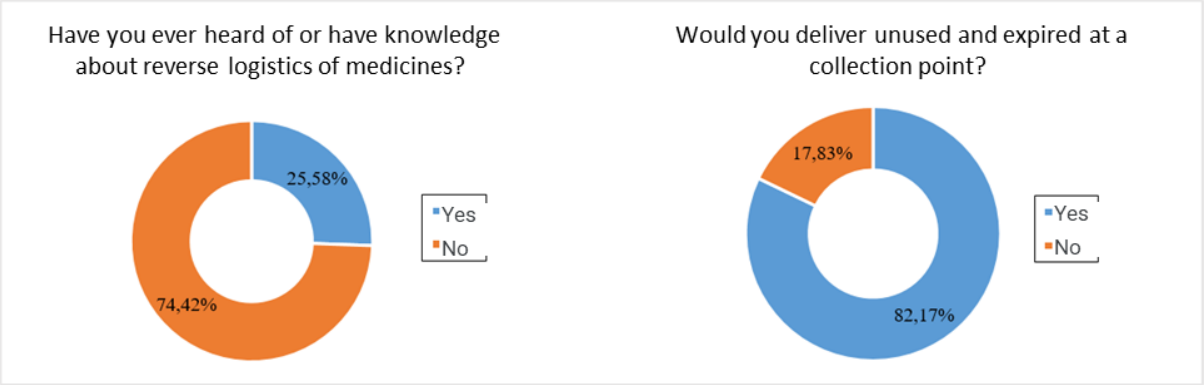
Figure 9: Respondents' perception of the form of disposal and its impacts.



Source: Elaborates by the authors (2023)

The questionnaire also contained questions about people's knowledge about the LR of Medicines, the vast majority, about 74.42%, answered that they had no knowledge on the subject, however, many interviewees, 82.16%, would be willing to deliver their expired or disused medications to collection points, as shown in Figure 10. These results emphasize the importance of studies such as Morretto's *et al.,* (2020) and Sousa *et al.,* (2021), where they make it clear that it is necessary to put into practice, supervise and guide the population so that the objectives contained in the laws are achieved.

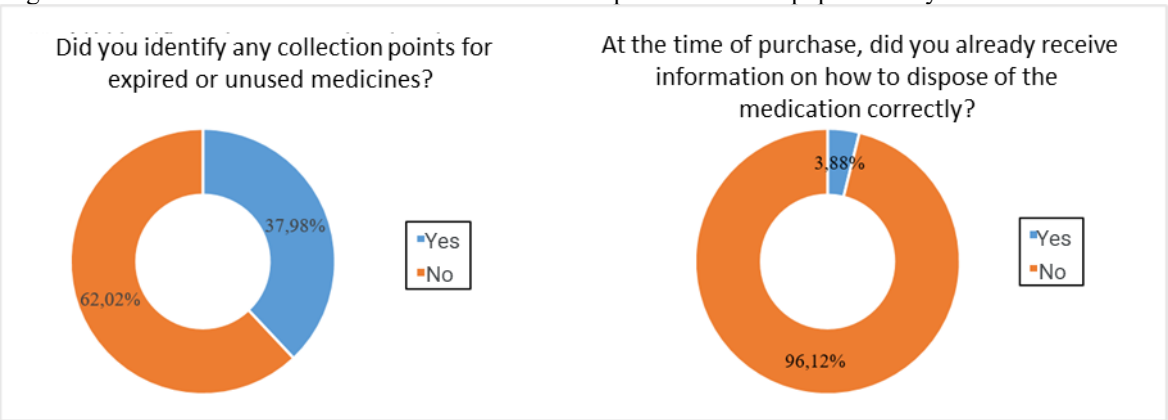
Figure 10: Degree of knowledge about LR and respondents' willingness to practice it.



Source: Elaborates by the authors (2023)

Regarding the awareness of the population, the respondents showed an almost unanimity, 96.12%, when answering that at the time of purchase they did not receive any information on how to dispose of the medications correctly, as well as, 62.02% of the participants never identified any point of collection of medicines in the pharmacies and drugstores that they usually frequent, illustrated in Figure 11.

Figure 11: Verification of the level of information on LR passed on to the population by the establishments.



Source: Elaborates by the authors (2023)

These results (figure 11) endorse the results obtained by the Da Silva researchers; Júnior and Bastos (2020) in the municipality of São Jose dos Campos – SP, where they state that 72% of the participants did not receive information about the disposal of medicines, as well as 52% of the interviewees never found collection points in the municipality.

7.3 SUGGESTIONS AND REFERRALS FOR OPTIMIZATION AND IMPLEMENTATION OF LR IN THE PLACES STUDIED

Considering the results obtained from managers and consumers, and also Decree No. 10,388 of June 2020, there were points of improvement to be prioritized by managers, in which the following stand out:

> 1) The decree establishes that consumers must dispose of expired or disused household medicines, including packaging, at collection points in drugstores, pharmacies or other places defined by merchants. However, the data showed that a significant majority of consumers interviewed (70%) still dispose of their drug residues in household waste containers.

In this case, it is suggested that managers and other related entities have an education program aimed at raising consumer awareness. The points of sale of medicines (pharmacies and drugstores) are an important link so that consumers can return their drug residues to LR;

> 2) Drugstores and pharmacies will have to make available and maintain at least one fixed point of receipt per 10,000 inhabitants. Participating pharmacies have a container for waste collection, which may be insufficient for current and future demand.

Thus, it is suggested that pharmacies observe the characteristic determined by the decree, of one point for every 10 thousand inhabitants.

3) The collection of discarded drugs will be the responsibility of the pharmaceutical companies and distributors. In all pharmacies surveyed, they are responsible for the management of the waste collected.

It is suggested a negotiation with the distributors and pharmaceutical industries to share the responsibility in this management. It is important to mention that the decree also notes the need to have points with greater capacity for the receipt of waste discarded by consumers in pharmacies.

It should also be suggested, at the level of regional and local policy, that the process of enabling service providers who may work in the LR system be fulfilled. This process is essential to have other alternatives of destination besides incineration.

As an example, the study by Oliveira (2021) highlights the recycling of drug packaging blisters as an option for LR.

At the national and regional level, it is also suggested the possibility of pharmaceutical companies to reproduce information about LR in the medicine box, with instructions for correct disposal. As for the regional level, it is suggested the creation of donation programs for medicines that are disused, but in their validity. These can be prepared by the municipalities in partnership with the Basic Health Units (UBS) and with the support of the State, so that it minimizes the impacts that the incorrect disposal will cause in the environment and in public health, and also contribute to the distribution of medicines to the economically disadvantaged population.

8 CONCLUSION

Through this research, it was possible to identify the conduct of drug disposal in the pharmacies and drugstores studied, where all adopt disposal policies, being legally required or for environmental concern. Regarding the applied management, it is evident that much of the process is outsourced, where monthly collections are performed and incinerated.

The study showed that a percentage of residents of the city of Belém located in the State of Pará, know little about the policies of LR of medicines, as well as practice the incorrect disposal of medicines, although they know that it is potentially harmful to the environment and public health. Although all participating pharmacies reported that they have these guidelines, the population studied still has difficulty finding collection points for expired medications.

Law 9.898/2023 came to change this scenario, making it mandatory for pharmacies and drugstores in the State of Pará to receive from the consumer any expired or disused medicines and gives an appropriate destination, as well as to elaborate communication and information actions, with educational purposes, regarding the proper disposal and rational use of medicines.

However, the existence of legislation alone will not be enough to promote the necessary changes. Thus, it is essential that society as a whole acquires awareness and assumes the responsibility

of reducing the generation of this waste. In addition, it is worth mentioning that the lack of appropriate places for the disposal of these drugs hinders the access of the population, which is often not even aware of their existence.

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APPENDIX A

TECHNOLOGY COURSE IN HOSPITAL MANAGEMENT

QUESTIONNAIRE – PHARMACIES AND DRUGSTORES

1. Nature of the establishment:

( ) Public ( ) Private

2. Neighborhood of the establishment:

_____

3. Position/Function:

_____

4. How long have you been working at the establishment?

_____

5. Does the establishment inform its customers about the importance of the correct disposal of medicines?

( ) Yes ( ) No

6. Does the establishment have a drug collection point?

( ) Yes ( ) No

7. If not, what are the reasons for the absence of the collection point?

_____

8. Does the establishment adopt the practice of reverse logistics?

( ) Yes ( ) No

9. If so, what prompted the establishment to adopt the practice?

( ) concern for the environment

( ) environmental/sanitary requirement

( ) policy adopted by the network

10. Has the Regional Council of Pharmacy carried out any campaign in order to encourage the establishment to adopt the practice of reverse logistics?

( ) Yes ( ) No

11. Pre-disposal information Check all that apply.

( ) No identification/separation

( ) Separation by pharmaceutical classes

( ) Separation according to group classification

( ) Separation by active ingredient

( ) Separation by pharmaceutical form

12. How many times a month is the collected medicines discarded?

( ) 1 time per month

( ) 2 - 3 times a month

( ) > 3 times a month

13. Approximate amount of pharmaceutical products discarded

( ) Less than 1 Kg/month

( ) Between 1 and 5 Kg/month

( ) Between 5 and 10 Kg/month

( ) More than 10 Kg/month or campaign

( ) The waste is not weighed

If the weighing is done in volume, inform below:

_____

14. How is disposal management carried out?

( )Through outsourced companies

( )The pharmacy itself does this management

15. Final destination of medicines.

( )Incineration

( )Controlled Landfill

( )Recycling

( )Reverse Logistics

( )I don't know the fate

APPENDIX B - Research instrument for data collection

TECHNOLOGY COURSE IN HOSPITAL MANAGEMENT

QUESTIONNAIRE – CONSUMERS

Socio-demographic data

1. Sex

( ) female ( ) Male

2. Age group

( ) 18 to 20 years

( ) 21 to 30 years

( ) 31 to 45 years

( ) 46 to 60 years

( ) 60+

3. Neighborhood of housing

_____

Data on the disposal of drug residues

1. Have you used any type of medication in the last 5 months?

( ) Yes ( ) No

2. If Yes what is the reason for the use of the drug?

( ) pain ( ) fever ( ) allergy ( ) flu ( ) infection ( ) pressure problems ( ) overweight ( ) anxiety () depression ( )

Other:_____

3. Did you use the entire contents of the medicine?

( ) Yes ( ) No

4. If **Yes** who indicated the drug?

( ) friend

( ) relative

( ) pharmacist

( ) physician

Other:_____

5. How do you usually dispose of leftovers and expired medications?

( ) in the common garbage

( ) in the toilet

( ) played in the sink

( ) discarded in a pharmacy

Other:_____

6. Do you consider your form of disposal correct?

( ) Yes ( ) No

7. Have you heard of or are you aware of drug reverse logistics?

( ) Yes ( ) No

8. If **so**, how did you get knowledge?

_____

9. Would you deliver disused and expired medicines to a collection point?

( ) Yes ( ) No

10. At the time of purchase have you received information on how to dispose of the drug correctly?

( ) Yes ( ) No

11. Do you think you should get this information?

( ) Yes ( ) No

12. If **so**, why?

_____

13. Have you identified any collection points for expired or disused medicines?

( ) Yes ( ) No

14. Do you think that medicines have negative consequences for the environment?

( ) Yes ( ) No