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Healthcare waste (RSS): management and cost analysis of destination[1]

Waste From Health Services: management and analysis of disposal costs

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Summary
The disposal of hospital waste generates costs for health services, as it is subject to strict regulations due to the potential for contaminants and risks to health and the environment. In this sense, the present research aims to identify the costs of managing healthcare waste (RSS) generated in a public hospital. Methodologically, the study is characterized as bibliographic and documentary, with a qualitative approach, intentional non-probabilistic sample and defined by convenience. The data collected refers to the year 2019. The results point to the relevance of caring for the correct management of RSS not only from environmental aspects due to its high contaminating factor, but also under the aegis of costs that need to be covered by the organization .
Key words: Waste from Health Services. Waste Management. Management

Abstract
The disposal of hospital waste generates costs for health services, as it is subject to strict rules due to the potential contaminant and risks to health and the environment. In this sense, this research aims to identify the costs of waste management of health services generated in a public hospital. Methodologically, the study is characterized as bibliographic and documentary, with a qualitative approach, an intentional non-probabilistic sample and defined by convenience. The data collected refers to the year 2019. The results point to the relevance of care with the correct handling of waste from health services not only under the environmental aspects due to its high contaminating factor, but also under the aegis of the costs that need to be borne by the organization.
Keywords: Waste from Health Services. Waste Management. Environmental Management.

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1. Introduction

According to data from the 2018/2019 Solid Waste Panorama, produced by the Brazilian Association of Public Cleaning Companies (Abrelpe), in 2018, 79 million tons of waste were generated in Brazil. Of these, 252,948 tons of Solid Health Waste were collected, treated and disposed of in an environmentally appropriate manner as required by law. In total, 4,540 municipalities provided services related to the collection and disposal of RSS, which is equivalent to 1.2 kilos per inhabitant per year. (ABRELPE, 2019).

Health Service Waste (RSS) is understood to be that generated in any service providing medical, health care or similar establishments, coming from hospitals, outpatient health units, clinics and medical and dental offices, pharmacies, clinical analysis laboratories and pathologies, blood and milk banks and veterinary clinics, among others, as established by the National Health Surveillance Agency (Anvisa), through RDC nº 306/2004. (BRAZIL, 2004).

Another RSS regulatory body is the National Environmental Council (CONAMA), which through Resolution No. 358/2005, in line with RDC No. 306/2004, defined services related to human or animal health care as generators, including those for home care and field work, as well as health product laboratories, morgues, funeral homes and services where embalming activities (thanatopraxy and somatoconservation) are carried out, among other similar activities (BRASIL, 2005).

RSS can be organic (kitchen), resulting from administrative or high-risk activities, as they contain infectious biological agents (laboratory slides, blood transfusion bags, medicines), potentially flammable, corrosive or toxic components (reagents, residues with metals heavy), radioactive materials (such as those used in radiotherapy) and sharp materials (needles, scalpel blades, glass ampoules). (ABRELPE, 2019).

For the purposes of this research, RSS is considered to be waste arising from hospital activities, produced in a public hospital located in the Center-South Region of the State of Paraná. The RSS management process generates costs for hospital institutions, whether due to the handling that requires personal protective equipment for contaminating items, or for the correct packaging and storage and subsequent disposal of

environmentally appropriate manner or, in the event of non-compliance with extensive legislation, monetary fines.

Given the context, the problem question presents itself as follows: what is the RSS management process like in a public hospital of medium complexity and what are the costs arising from the correct allocation?

2 Literature Review

2.1 Health service waste (RSS)

The Brazilian Technical Standard - NBR n. 10.004, from the Brazilian Association of Technical Standards, defines solid waste as being waste resulting from activities of industrial, domestic, hospital, commercial, agricultural, service and sweeping origin. This definition includes sludge from water treatment systems, those generated in pollution control equipment and installations, as well as certain liquids whose particularities make their release into the public sewage system or water bodies unfeasible, or require it to be released. solutions that are technically and economically unfeasible in the face of the best available technology. ABNT (2004, p. 1).

According to Guedes (2006), hospital waste represents only 2% of the total waste produced in Brazil, but special attention must be paid, as it constitutes a source of pathogenic organisms, as it contains toxic substances in its components and the presence of sharp objects. If inadequately managed, they can pose risks to human health and the environment.

In some municipalities, city halls collect solid waste from health services, taking responsibility for the environmentally appropriate disposal of waste, establishing collection routes and routines in public and private health services.

RSS are popularly known as medical waste, but it is not just hospitals that produce this type of waste. Pharmacies, dental and veterinary clinics, home care, morgues, care institutions for the elderly, blood centers, clinical and research laboratories, educational institutions in the health sector also produce waste, as well as patients with diabetes who use insulin and use sharp materials are examples of generators and need to be guided to

store and dispose of them in an organized and safe manner. (GARCIA; RAMOS, 2004; BERTO; CZYKIEL; BARCELLOS, 2012; ALVES et al, 2016; ALAM*et al,*2019; BARROS et al, 2020; CARVALHO et al, 2021).

According to Confortin (2001), classification plays an essential role in the development of the subsequent phases of this management process. Through this control, it is possible to promote a distinction between contaminated and uncontaminated waste, effectively helping with efficient, economical and safe management. The objective is to promote the safety of workers and users so that they are not exposed to contamination through handling.

The RSS have numerous standards and classifications, the best known and used in Brazil being those coming from the Brazilian Association of Technical Standards (ABNT), the National Environmental Council (CONAMA), the National Health Surveillance Agency (ANVISA), the World Health Organization Health (WHO) and Environmental Protection Agency (EPA).

The Resolution of the Collegiate Board (RDC) No. 222/2018 of the National Health Surveillance Agency (ANVISA), which provides for the requirements of Good Practices for Management of Waste from Health Services, the RDC and Resolution No. 358/2005 of the Council National Environment Agency (CONAMA), which define RSS as all waste generated in any service providing human or animal medical assistance, and classifies them into five groups: group A – biological; groups B – chemicals; group C – radioactive; group D – common and group E – sharps (ANVISA, 2018)

In this work, CONAMA Resolution, nº 358/05 and RDC ANVISA, nº 306/04 are used to classify RSS:

Table 1-Classification of Solid Health Waste

A group Infectants	All residues that are susceptible to the presence of biological agents that present a risk of infection due to their greater virulence characteristics or concentration.
Group B Chemicals	Waste that contains chemical substances that pose a risk to public health or the environment, depending on their flammable, corrosive, reactivity and toxicity characteristics. Hormonal products and all other products that are controlled by Ordinance MS 344/98 and its updates. Waste from sanitizers, disinfectants, laboratory reagents image processors; effluents from automated equipment used in clinical analyses; other products classified as dangerous, in accordance with the classification of NBR-10.004 by ABNT.
	Any materials resulting from human activities that contain radionuclides in quantities exceeding the elimination limits

Group C Radioactive	specified in the standards of the National Nuclear Energy Commission - CNEN, such as, for example, nuclear medicine and radiotherapy services, etc.
Group D Common	Waste that does not pose biological, chemical or radiological risks to the health or the environment, which can be equated to household waste. Sanitary paper and diapers, sanitary napkins, disposable items, among others; Leftover food and food preparations; Leftovers cafeteria food; Waste from administrative areas; Waste from sweeping, flowers, pruning and gardens; Gypsum waste from healthcare
Group E Sharps	This group includes all piercing or spitting materials, such as: Razor blades; Needles; Glass ampoules; Drills; Scalpel blades.

Source: CONAMA Resolution, nº 358/05 and RDC ANVISA, nº 306/04

The waste generated by the hospital institution, the subject of this research, will be classified according to Tables 1 and 2. Highlight is given to Group A, infectious, which has subdivisions, as established in the legislation:

Table 2: Subgroups of Waste Classified in "Group A – Infectious"

A GROUP	
Subgroup 1	Cultures and stocks of microorganisms; Waste from genetic manipulation laboratories; Waste resulting from health care for individuals or animals; Leftover laboratory samples containing blood or body fluids.
Subgroup 2	Carcasses, anatomical parts and other waste from animals subjected to experimentation processes with inoculation of microorganisms; Animal corpses suspected of being contaminated with microorganisms from epidemiological relevance and risk of dissemination.
Subgroup 3	Anatomical parts of the human being; Fertilization product without vital signs, which has no scientific or legal value and that there has been no request from the patient and family.
Subgroup 4	Kits of artisanal lines, intravenous and dialyzers, when discarded; Air filters and gases aspirated from contaminated areas; Leftover laboratory samples and containers containing feces, urine and secretions, originating from patients who do not possess or are suspected of containing Class of Risk 4.
Subgroup 5	Organs, tissues, organic fluids, sharp or scarifying materials and other materials resulting from health care for individuals or animals, with suspected or contaminated by prions.

Source: RDC Resolution No. 306, (2004)

According to Table 2, group A, shows the groups of subdivisions for the RSS, considered infectious and which require specific care for collection, packaging and disposal.

2.2 RSS Management

ANVISA, through RDC 306/04, defined that RSS management is a set of management procedures, planned and implemented based on scientific and technical, normative and legal bases, aiming to reduce waste production and make waste generated viable, a safe destination, in an efficient manner, seeking to protect workers and preserve public health, natural resources and the environment.

Incorrect management of RSS can cause accidents and contamination of workers responsible for collection. Sharps waste can also contribute to an increase in the incidence of hospital infections (BRASIL-MS, 2001).

It is necessary that in the management of all stages of planning physical and material resources and training of human resources be covered in the involvement of conducting RSS (BRASIL-ANVISA, 2004). In this way, it is possible to establish systemic and integrated forms in each of them, goals, programs, organizational systems and technologies, according to the local reality (BRASIL - ANVISA, 2006).

According to Seraphim (2016), in practice, the economic reality, interest of local authorities and level of knowledge and awareness about waste residues are what define waste management and inspection models in Brazil.

According to Guassú (2007), Brazilian legislation imposes the responsibility of the RSS generator to manage it from creation to destination, where the services necessary to put this into practice must be fully in accordance with current legislation.

Therefore, it appears that the correct management of this waste is essential, not only requiring the organization and systematization of these generating sources, but also ensuring that the human and collective consciousness of professionals who have connections in these environments is awakened. Furthermore, studies also relate the relevance of innovative and control processes to business well-being. (SERAPHIM, 2016; CARVALHO et al, 2021; PRZYBYCZEWSKI.; STROPARO, 2021; STROPARO; DOMBROSKI, 2018; DELPONTE et al, 2020)

3 Methodological Procedures

This research is classified as applied, descriptive research, with a qualitative, bibliographic, documentary approach, with non-probabilistic, intentional and convenience sampling, using observation techniques and structured interviews.

The research instrument consists of a structured script with open and closed questions, applied to the occupational safety and financial sectors, aiming to identify the aspects necessary to answer the problem question, as well as observations *on site*.

Issues related to the process of collection, storage and environmentally appropriate disposal of waste generated by the hospital were identified. The instrument was formatted into four blocks: Block 1 - Hospital Waste Management Plan; Block 2 - Types and quantities generated; Block 3 - Packaging, identification and temporary storage; Block 4 - final destination.

In Block 1, the questions deal with Hospital Waste Management and aimed to fulfill the specific objective of identifying waste generated by a hospital unit. The questions dealt with the collection process and underlying procedures. Block 2 - Types and quantities generated deals with issues related to the quantities generated, classifications of dangerousness, biological risks, etc. The questions present in Block 3 - Packaging, identification and temporary storage, refer to the management and packaging of waste identified in the hospital unit. In Block 4, which deals with the final destination itself, the questions were relevant to costs and method of disposal, for example, regularly constituted companies that provide the service, location, etc.

As it is applied research, interviews were carried out with those responsible for the sectors that deal with the collection, storage and disposal of waste, aiming to qualify the waste management process. Afterwards, data were collected*ex post facto*, the amount of waste generated, as well as the costs related to environmentally appropriate disposal. The collection described here was based on documents generated and made available by the hospital itself, as well as an interview with the person responsible for the sector.

4 Discussion and Data Analysis

The Hospital studied is philanthropic, provides services basically through the SUS, characterized as medium complexity, with a built area of approximately 7,583 square meters, serving patients from 9 municipalities in the region, with an average of more than 160 thousand inhabitants and patients referred through of the Regulation Center. It currently has 150 beds, divided into Neonatal ICU, Adult ICU, Surgical Clinic, Medical Clinic, Rooming-In (maternity), Psychiatry and Pediatrics.

The person responsible for waste management is a nurse and there is also a hospital hygiene supervisor who periodically carries out audits to ensure that the waste is being disposed of correctly.

4.1 Hospital Waste Management Plan

When asked whether there are specific protocols for the collection, classification, storage and disposal of hospital waste, the response was that the hospital has a management plan in accordance with law 12.305/2010, which describes waste production, segregation, packaging , internal transport and external transport.

It should be noted that there are specific standards that regulate the treatment, management and disposal of waste. Control is strict due to the contamination that exists in part of the waste, notably biological and contaminant waste. The hospital periodically receives reports proving environmentally correct disposal.

The hospital has a collection schedule that must be followed by the professionals responsible for internal collection. Annual training is carried out with all professionals, from generators, such as doctors and nurses, so that they dispose of waste in their appropriate places, so as not to mix contaminants with common waste, and with those responsible for collection, who must know how to use personal protective equipment (IPE) receive training so that they know how to remove this waste, how to store it, to avoid becoming contaminated with this waste. The costs of training the entire team are borne by the hospital itself.

Inside the hospital, at each workstation, there are duly identified bins, with washable signs that describe the waste that must be discarded in that packaging. The bins have automatic opening, so that no hands are used to open them, with the exception of the surgical center where there are no lids to facilitate disposal, and after each surgery this waste is collected. In the ICU there are bins next to the beds to facilitate disposal, thus reducing the risk of contamination.

All hospital bins are washed and disinfected weekly. Common and organic waste is stored in black bags, paper in blue bags. Those that can be recycled are donated to the Recyclable Collectors Cooperative – on average 2 truck loads per week – with the cooperative itself being responsible for collection and transportation.

4.2 Types and Quantitatives Generated

The waste generated by the hospital is classified as follows:

Group A – all infectious agents, including those coming from isolation areas, where all material is considered potentially dangerous due to the high level of environmental contamination. During periods when there are patients in isolation, the volume of infectious waste increases considerably, as in the case of COVID-19 cases, for example. Although data collection predates the pandemic, there is no doubt about the resulting impacts. The hospital also generates biological waste, such as placentas that are discarded in specific containers.

For items in Group A, automatic opening bins with identification on the lid are used. Group B – chemical waste such as leftover medication, expired medication, including antibiotics and other chemicals. Group C – radioactive: although there is an X-ray sector in the hospital, waste is no longer generated due to the adoption of a digital system. Group D – common waste: non-recyclable, delivered to the city hall's public collection system, which disposes of it in accordance with current regulations. Paper and other recyclable items have their own packaging and are sent to the recycling cooperative. Group E - sharps: needles, ampoules, blades and other similar items are sent for incineration by a specialized company.

The glasses are placed in green packaging with an easy-to-use opening, facilitating disposal, inside the packaging they are lined with a white bag to prevent accidents during collection.

4.3 Packaging, Identification and Temporary Storage

The hospital does not have internal temporary storage and all waste generated is collected and transferred to the external area. There are specific times for the removal of waste from within the hospital according to the schedule drawn up by the infection control sector, with the exception of common waste which can be removed at any time.

The hospital hygiene team, properly dressed with appropriate protective equipment, collects the material in internal areas. Waste collection times cannot coincide with feeding times so that there is no possibility of contamination and consequent hospital infection. There is rigidity in collection times, as well as specific protocols for the activity. Items considered infectious are collected three times a day or according to demand.

Once collected, the items are transferred to the storage room where the waste is stored until collection for final disposal. The site is isolated and has restricted access and contaminating waste is deposited, that is, sharps, with potential contamination and biological waste.

Non-contaminants are stored in open rooms, outside the main building, with open access to the recycling cooperative and city hall. Items from the kitchen (organic) and recyclable items such as administrative papers.

4.4 Final Destination

Group D waste, which is common waste, for example, organic waste and waste that does not pose health risks, is collected daily by the city hall, generating no cost to the hospital.

Infectious, sharp and chemical waste (A, E and B) is collected by an outsourced company, with a charge of R$2.70 per kilogram generated: A and E and BR$5.00.

Waste A and E are neutralized through autoclaving and are destined for landfill. The chemicals are incinerated and the ashes deposited in industrial landfills.

4.5 Cost of Hospital Waste

Waste A – B and E are collected by a third-party company, which charges different amounts for each type of waste generated. The price per kilo charged by group B is lower than that of groups A and E, which have the same value.

Group B waste, chemicals, are produced on a low scale by the hospital compared to infectious and sharps, but they pose risks to the population. This category includes, for example, chemical, flammable, or pharmaceutical waste such as medicines that may be expired or contaminated. The cost of disposing of this type of waste is 5.00 per kilo.

Waste from groups A and E has a much higher production volume, as all waste generated in isolation is classified as infectious, as they are hosts of suspected pathological agents, in the months when these types of patients exist, the volume of infectious tends to increase, needles, syringes, blood, gauze, tissues, sharps, among others are also produced on a large scale daily.

This research presents disposal costs over a period of one year, 2019, with data provided by the hospital, based on invoices generated by the outsourced company responsible for collection.

Table 1-Values and Quantities of Waste Generated - 2019

Month / Year	Classification A - E			Classification B			Monthly Total
	value unit.	quantity.kg	Amount	Value Unitary	quantity kg	Value Total	
Jan/19	R$ 2.70	1,391.90	R$ 3,758.13	R$ 5.00	108,605	BRL 543.03	R$ 4,301.16
Feb/19	R$ 2.70	1,456.23	R$ 3,931.82	R$ 5.00	108.23	BRL 541.15	BRL 4,472.97
Mar/19	R$ 2.70	2,126.84	BRL 5,742.47	R$ 5.00	117,058	BRL 585.29	BRL 6,327.76
Apr/19	R$ 2.70	2,043.27	BRL 5,516.83	R$ 5.00	111,173	BRL 555.87	BRL 6,072.69
May/19	R$ 2.70	1,760.93	BRL 4,754.51	R$ 5.00	98,333	BRL 491.67	R$ 5,246.18
Jun/19	R$ 2.70	1,159.92	BRL 3,131.78	R$ 5.00	107,321	BRL 536.61	BRL 3,668.39
Jul/19	R$ 2.70	1,641.17	BRL 4,431.16	R$ 5.00	128,614	BRL 643.07	BRL 5,074.23

Aug/19	R$ 2.70	1,359.58	BRL 3,670.87	R$ 5.00	39,483	R$ 197.42	R$ 3,868.28
Sep/19	R$ 2.70	1,543.75	BRL 4,168.13	R$ 5.00	142,203	BRL 711.02	BRL 4,879.14
Oct/19	R$ 2.70	1,546.67	BRL 4,176.01	R$ 5.00	84,851	BRL 424.26	R$ 4,600.26
Nov/19	R$ 2.70	1,916.46	BRL 5,174.44	R$ 5.00	174,945	BRL 874.73	R$ 6,049.17
Dec/19	R$ 2.70	1,594.30	R$ 4,304.61	R$ 5.00	136,639	R$ 683.20	R$ 4,987.81
Total		19,541.2	R$52,760.75		1357.45	R$6,787.8	R$59,548.03

Source: Research Data, (2019)

During the period analyzed, there was no increase in the amount charged per kg of waste discarded. There is a contract with the collecting company responsible for environmentally appropriate disposal for a period of twelve months, with R$ 2.70 per kilo for types “A” and “E” and R$ 5.00 per kilo for type “B”. However, it appears that the amounts are significant, totaling R$112,308.78 in 2019, as shown in table 1.

Research carried out with Carvalho et al (2021) in a hospital located in the state of Rio Grande do Sul presents similar results and corroborates the present research in the sense that it discusses the relevance of the correct classification, packaging and disposal of waste.

Final considerations

Solid waste management presents itself as one of the concerns of hospital managers due to legal requirements, the costs related to the environmentally appropriate disposal of waste, as well as because it involves elements such as potential contaminants that require special care.

With the aim of identifying the costs of managing RSS generated in a public hospital, this research identified the waste generated by a hospital unit, classifying them according to their danger and degree of contamination, in accordance with current environmental standards and carried out measuring environmentally appropriate disposal costs.

It was found that the process of collecting, packaging and disposing of waste requires institutionalized protocols that allow standardization of practices and avoid contamination and accidents that could pose a risk to the health of employees responsible for handling. It should also be noted that there are strict standards for the process of

waste management in hospital units, regulated by Law 12,305/2010 and other specific regulations.

Once the different types of waste generated have been identified, classified according to their danger, toxicity and degree of contamination, there is a need for disposal, which is carried out with the help of a company specially hired for this purpose. The waste is then safely sent for disposal, without environmental risk of contamination. Therefore, this research fulfilled its objectives by monitoring the management process and measuring disposal costs. In this way, it reiterates the relevance of cost control and the analysis of the financial impacts of correctly managing the waste generated.

It is suggested that further research be carried out in other hospital units in the region to analyze waste management processes and verify the impact of costs, as well as the costs of implemented protocols such as the use of protective equipment for employees, construction of dedicated spaces for storing waste , use of appropriate and appropriate materials (drums and special plastic bags).

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