CHALLENGES OF HEALTHCARE WASTE MANAGEMENT IN TIMES OF HEALTH CRISIS: AN ANALYSIS IN PUBLIC HOSPITALS

DESAFIOS DA GESTÃO DE RESÍDUOS DE SERVIÇOS DE SAÚDE EM TEMPOS DE CRISE SANITÁRIA: UMA ANÁLISE EM HOSPITAIS PÚBLICOS

RETOS DE LA GESTIÓN DE RESIDUOS SANITARIOS EN TIEMPOS DE CRISIS SANITARIA: UN ANÁLISIS EN HOSPITALES PÚBLICOS

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ABSTRACT

This study analyzes the implementation of the Healthcare Waste Management Plan (PGRSS) in two public hospitals in Teresina (PI), Brazil, during the COVID-19 pandemic, focusing on general service professionals. The research uses interviews, questionnaires, and technical visits to evaluate the organizational structure, the procedures adopted, and the workers' knowledge of the subject. The results indicate that, although both hospitals have formalized PGRSS plans, there are significant differences in practical implementation, especially regarding the training of professionals and the monitoring of waste generation. The state hospital presents greater organization and control, while the municipal hospital faces structural and operational limitations. The pandemic intensifies the challenges, increasing the volume of waste and requiring rapid adaptations. It is concluded that effective waste management depends on the articulation between planning, continuous training, and the appreciation of the professionals involved.

Keywords: Healthcare Waste Management. COVID-19 Pandemic. Sanitary Safety. Environmental Impacts.

RESUMO

O estudo analisa a execução do Plano de Gerenciamento de Resíduos de Serviços de Saúde (PGRSS) em dois hospitais públicos de Teresina (PI) durante a pandemia de COVID-19, com foco nos profissionais de serviços gerais. A pesquisa utiliza entrevistas, questionários e visitas técnicas para avaliar a estrutura organizacional, os procedimentos adotados e o conhecimento dos trabalhadores sobre o tema. Os resultados indicam que, embora ambos os hospitais possuam PGRSS formalizados, há diferenças significativas na implementação prática, especialmente quanto à capacitação dos profissionais e ao monitoramento da geração de resíduos. O hospital estadual apresenta maior organização e controle, enquanto o municipal enfrenta limitações estruturais e operacionais. A pandemia intensifica os

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desafios, aumentando o volume de resíduos e exigindo adaptações rápidas. Conclui-se que a gestão eficaz dos resíduos depende da articulação entre planejamento, capacitação contínua e valorização dos profissionais envolvidos.

Palavras-chave: Gestão de Resíduos de Serviços de Saúde. Pandemia de COVID-19. Segurança Sanitária. Impactos Ambientais.

RESUMEN
Este estudio analiza la implementación del Plan de Gestión de Residuos Sanitarios (PGRSS) en dos hospitales públicos de Teresina (PI), Brasil, durante la pandemia de COVID-19, centrándose en el personal de servicios generales. La investigación utiliza entrevistas, cuestionarios y visitas técnicas para evaluar la estructura organizativa, los procedimientos adoptados y el conocimiento del personal sobre el tema. Los resultados indican que, si bien ambos hospitales cuentan con planes PGRSS formalizados, existen diferencias significativas en la implementación práctica, especialmente en lo que respecta a la capacitación del personal y el monitoreo de la generación de residuos. El hospital estatal presenta mayor organización y control, mientras que el hospital municipal enfrenta limitaciones estructurales y operativas. La pandemia intensifica los desafíos, incrementando el volumen de residuos y requiriendo adaptaciones rápidas. Se concluye que una gestión eficaz de residuos depende de la articulación entre la planificación, la capacitación continua y la valoración del personal involucrado.

Palabras clave: Gestión de Residuos Sanitarios. Pandemia de COVID-19. Seguridad Sanitaria. Impactos Ambientales.

1 INTRODUCTION

Proper management of solid waste from health services (HSW) is not only essential for environmental preservation, but also plays a crucial role in promoting health, preventing disease, and promoting the safety of health workers and the community at large. With the COVID-19 pandemic, there has been a significant change in the patterns of generation and disposal of this waste, requiring an adaptive and efficient approach.

Despite a large discrepancy in the increase in the volume of solid waste from health services produced in countries that suffered from COVID-19 (ranging from 18% to 425% increase), it can be seen that in all countries this increase was significant (LIANG *et al.*, 2021), thus showing the urgency of understanding its impacts on the environment and, consequently, on society.

Thus, the increase in waste production, the disposal of personal protective equipment (PPE), and the management of contaminated waste are challenges that, if not addressed effectively, can result in serious consequences for the environment and public health. Thus, in this context, the role of professionals who work directly in cleaning (general services) becomes even more important, requiring specific training, adequate resources and a continuous commitment to safe handling and disposal practices.

In Brazil, the Panorama of Solid Waste in Brazil 2018/2019 shows that only 63.8% of the MW collected had an adequate destination (ABRELPE, 2019), that is, there was already a lag in the treatment of this waste in the country before the pandemic, in addition to being one of the countries with the highest number of COVID-19 cases since the beginning of the pandemic, so the concern with the management of HCW should be even greater.

Thus, this article aims to analyze the execution of the Health Services Waste Management Plan (PGRSS) in hospitals belonging to the municipal and state public network in a regional health center (Teresina-Piauí) considering the general service professionals in these hospitals.

2 METHODOLOGY

2.1 DELIMITATION AND CHARACTERIZATION OF THE OBJECTS OF STUDY

The objects of study of this research were two hospitals, in Teresina, capital of Piauí, with 871,126 inhabitants (IBGE, 2021), located in the Middle North of the Brazilian Northeast, and being a reference center in health in the Northeast. The choice of these hospitals was defined seeking to cover reference hospitals in COVID-19 care, both municipal and state public networks.

The selected municipal public hospital has been operating since March 23, 2020

exclusively for COVID-19 patients, in September 2021 it returned to providing a cardiology and nephrology bed, but from January 2022 to May 2022, with the increase in respiratory disease syndromes, it became exclusive again for COVID-19 and flu-like syndromes, being, since the beginning of the pandemic, a reference in the municipal network for the treatment of this disease.

Like the previous one, the chosen state public hospital has also become a reference in the fight against COVID-19, mainly because it already has specialized care in infectious diseases, with its main structure for patient isolation. In addition, since the beginning of the pandemic, it has quickly adapted to new needs, making necessary changes and adaptations, with reinforcement in the acquisition of PPE, respirators, non-invasive ventilation equipment.

2.2 METHODOLOGICAL PROCEDURES

Changes and adaptations to protocols for the management of solid waste from health services during the pandemic period were raised, for this semi-structured interviews were conducted, after approval by the Ethics and Research Committee, with the professionals of the units regarding the daily processes performed by them, as well as with their supervisors, making a comparison with the current protocols already surveyed previously.

In addition to the application of questionnaires with the professionals of the units, in order to know the profile of these professionals, their tasks, their demands regarding the work, as well as what they observed in terms of adaptations during the pandemic period and what they understand about solid waste management. For the purpose of calculating the sample size of the number of professionals who should participate in the questionnaires, in each hospital, the population size (N) was considered, which represents the number of employees in sectors with functions that are directly related to the HCW management stages in 2023, which in the state public hospital is 38 and in the municipal hospital is 16. A confidence level of 90% (with z = 1.64), a margin of error (e) of 10%, a standard deviation (p) of 0.5, and an estimated rate of 10% of non-respondents were also defined.

By inserting the values mentioned in the formula proposed by Luiz and Magnanini (2000), the sample size (n) of 21 employees in the HRPE and 11 in the HRPM was reached, which correspond to the initial numbers of employees who should be part of this research. However, a refusal rate of 10% of potential participants was added, resulting in a sample size of 19 employees in HRPE and 10 employees in HRPM.

In addition, based on the waste management of each unit, the volumes and main types of waste generated with the pandemic, in the years 2019 to 2022, as well as their form

of storage, transportation, treatment and final destination, were surveyed through access to electronic spreadsheets for monitoring and control of this waste and analysis of documentary records of the weighing of this waste in the two hospitals.

Data on the Health Service Solid Waste Management Plan were obtained through weekly technical visits in both hospitals, starting on January 11, 2023 at the state public hospital and on January 17, 2023 at the municipal public hospital, and ending on April 27, 2023, totaling 14 technical visits to hospitals.

In these there were 3 main moments, a first moment of presentation of the research to the directors and supervisors of the general services, a second moment of analysis of internal documents, such as the PGRSS, and, finally, the interviews with the supervisors of the sector.

These results were obtained through regular technical visits in both hospitals, which began on May 10, 2023 at the state public hospital, and are expected to be completed in this hospital on July 5, 2023. While in the municipal public network hospital, it began on June 13, 2023, ending on July 31, 2023.

3 RESULTS

3.1 PGRSS RESULTS

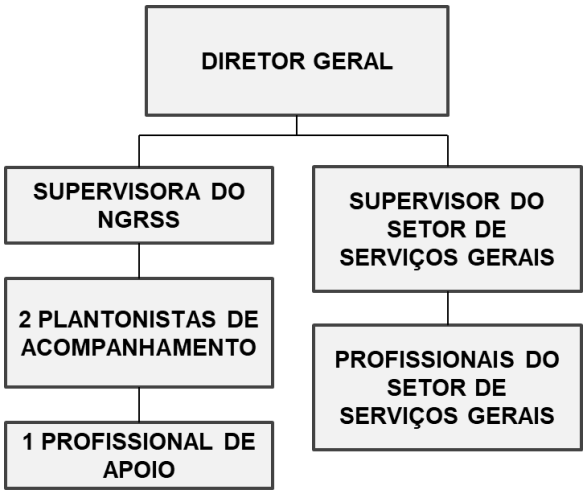
3.1.1 State Public Network Hospital (HRPE)

3.1.1.1 General information

The HRPE works with two sectors that involve waste management, in which the first is called general services or hospital hygiene, containing 38 general service professionals, who are divided and alternate between the hospital sectors and 1 supervisor and the second Sector is the Health Services Waste Management Center (NGRSS), which performs control and monitoring of the general services sector, containing 4 professionals, which are: 1 supervisor, 2 on-call monitoring staff and 1 support staff. All professionals are hired by the hospital itself. Figure 1 shows the organizational Table of the sectors that involve waste management.

Figure 1

Organizational Table of the HRPE sectors



Source: Authors, 2023.

The NGRSS on-duty staff and general service professionals work 44 hours a week, from 7 am to 7 pm, with a lunch break. It is worth noting that these professionals are divided into 2 buildings, one of the hospital itself and 1 annex building, which mainly functions the administrative part. It is also noteworthy the existence of a support room for this sector, where the products and equipment necessary to perform its functions are located. In Figure 2 is the entrance to this room.

Figure 2

Entrance to the support room of the hospital hygiene sector at HRPE

Source: Authors (2023).

As Figure 2, it is possible to observe already at the entrance some products used in the function, as well as one of the open trash cans and problems of infiltrations and the

presence of fungi, especially in the lower part of the wall. The interior of the room is shown in Figure 3.

Figure 3

Inside the support room of the hospital hygiene sector at HRPE

Source: Authors (2023).

Figure 3 shows the internal part of the room, being air-conditioned by a split air conditioner and has a small window for air circulation. It is also noteworthy the existence of many parts of the floor with cracks and breaks, in addition to the access door being stabilized by means of a stone circled in Figure 3, which can cause incidents and/or accidents.

The main attributions of each of these 2 sectors are as follows: 1. NGRSS – promote the recycling of recyclable waste through collection, shredding of paper, packaging and external collection in order to comply with the institutional PGRSS and current legislation; perform daily terminal cleaning of collection cars and containers; carry out visits within the institution observing non-conformities within the sectors; perform, whenever necessary, replacement and repair of defective trash cans or adjust the size of the trash cans according to the waste generation of each sector; monitor the daily weighing of waste carried out by the contracted company; observe, on a daily basis, the conformity of the colors of the bags in the trash cans according to the classification of waste; identify, whenever necessary, trash cans without stickers or with erased stickers; perform daily terminal cleaning after external collection in the shelters and keep shelter gates closed; among others.

The sectors have rules on the use of personal protective equipment, such as the use of gloves, boots, masks and the correct clothing, with the pandemic these PPE had an increase with the use of goggles and masks (N95). Another point of change, according to the

supervisor, was regarding the arrangement of plastic cups from the nutrition sector, which were previously recycled, however since the pandemic they are no longer recycled.

3.1.1.2 Solid waste management plan and training

The HRPE only started to have its own solid waste management plan in January 2019, and this plan was updated in November 2022, valid for 1 year, with the expected results being the minimization of the volume of waste generated in the institution, correct and safe management of the HSW generated from segregation to final disposal, implementation of selective collection of waste that can be recycled, reduction of occupational accidents related to the management of waste with biological potential, adherence to good practices in health services in the management of HSW.

It should be noted that this hospital also produces waste from groups A, B, D, E, following the classification of RDC ANVISA No. 222/2018, and is distributed in the sectors according to Figure 4.

Figure 4

Distribution of waste by sector in the HRPE

GRUPOS DE RESÍDUOS	GRUPO A					GRUPO B	GRUPO D	GRUPO E
SETORES/ÁREAS	A1	A2	A3	A4	A5			
Áreas administrativas				■			■	
Postos de enfermagem	■			■		■	■	■
Enfermarias	■						■	
Isolamentos	■			■				
UTIS	■			■			■	
Consultórios	■						■	
Salas de procedimentos	■			■		■	■	■
Salas de exames	■			■		■	■	■
Setor de RX/TC	■			■		■	■	■
Corredores							■	
Banheiros							■	
Laboratórios	■			■		■	■	■
Setor de nutrição							■	
Farmácias						■	■	
Unidade de processamento de roupas	■						■	
Necrotério	■							
Prédio Anexo adm.				■			■	
Prédio Anexo Laboratórios	■			■		■	■	■

Source: Authors.

Regarding the final disposal of this waste generated, there is only one outsourced company responsible, which is for both common waste and hazardous waste. According to the hospital's PGRSS, the frequency of collection of this waste in the generating sectors is as shown in Table 5.

Table 1

Frequency of collection in the generating sectors in the HRPE

Types of Waste	Standardized Schedules	04 times a day	Other Frequency
Group A	**6:00, 9:00, 13:00, 18:00**	**X**	
Group B	**7:00 a.m. to 6:00 p.m.**		Through collection request
Group D	**6:00, 9:00, 13:00, 18:00**	**X**	
Group E	**6:00 a.m. to 6:00 p.m.**		Through collection request

Source: Authors.

Table 1 describes the frequency and times of waste collection in the sectors according to the group to which they belong. As for the frequency of collection by the outsourced company, it occurs from Monday to Saturday morning, since the company is responsible for both common waste and hazardous waste.

According to the supervision of the monitoring sector, all on-duty workers received training on their standard operating procedures (SOP), however there is no specific training focused on the solid waste management plan. Table 2 shows all the training carried out with the employees of the hospital hygiene service from 2019 to 2022, these are controlled only through printed minutes that prove the completion of the training.

Table 2

Training with employees of the hospital hygiene service from 2019 to 2022 at HRPE

THEME	DATE
Guidelines on waste segregation. Target audience: nursing and hospital hygiene professionals.	02/05/2019
Segregation of waste from health services. Target audience: all IDTNP employees (there are hygiene employees who have taken this training).	24/09/2019
Educational blitz on waste segregation	28/01/2020
Safe Use of PPE for Management of Patients with Suspected COVID-19	18/03/2020 to 27/03/2020
Hospital sanitizers used in the hospital hygiene sector	16/03/2020 to 18/03/2020
Safe Confrontation with COVID-19	05/05/2020
Welcoming the COVID-19 area and coping	18/05/2020
Safe practice in the use of sanitizers	07/07/2020
World Patient Safety Day	16/09/2020 to 18/09/2020
Principles of Hygiene: sanitization and COVID-19, terminal, concurrent and immediate cleaning	21/10/2020
Safe use of PPE	07/01/2021 and 08/01/2021
Weighing of healthcare waste	02/26/2021 and 02/27/2021
Assertive communication	04/03/2021
Hospital cleaning and disinfection	09/04/2021

Improved concurrent and terminal cleaning and disinfection	10/14/2021 and 10/15/2021
Placement, use, storage, disposal and conservation	18/08/2022
Job description training (responsibility and technical skills)	10/10/2022

Source: Authors.

Some of the main training sessions were on the correct disposal of sharps waste, suspension of the collection of lamps and batteries by the outsourced company and standardization of the black bag for the nutrition sector, SOP for weighing waste, safe management of HSW.

3.1.1.3 Waste generation

As for the amount of waste generated, in 2019, in the hospital's PGRSS there were only annual indicators related to the generation of 2018 HCW. As of 2019, these data were quantified monthly, according to Tables 3 to 6.

Table 3

Generation of HSW on average from 2019 to 2022 in the HRPE

MÊS/ANO	2019		2020		2021		2022		
	GRUPO B	GRUPO A/E	GRUPO B	GRUPO A/E	GRUPO B	GRUPO A/E	GRUPO B	GRUPO A/E	GRUPO D
JANEIRO	NÃO GEROU	3.124kg	NÃO GEROU	2.346kg	NÃO GEROU	7.396,6kg	94,85kg	3.751,06kg	8.381,22kg
FEVEREIRO	52kg	6.406,7kg	NÃO GEROU	1.985kg	NÃO GEROU	8.986,56kg	NÃO GEROU	4.537,63kg	3.727,98kg
MARÇO	NÃO GEROU	5.523kg	NÃO GEROU	2.258kg	NÃO GEROU	11.441,66kg	NÃO GEROU	5.942,43kg	2.724,49kg
ABRIL	NÃO GEROU	7.751kg	NÃO GEROU	2.638kg	NÃO GEROU	9.850,26kg	53,68kg	4.234,65kg	3.257,67kg
MAIO	NÃO GEROU	4.985kg	NÃO GEROU	3.155kg	NÃO GEROU	10.667,7kg	60,70kg	4.590,6kg	5.027,30kg
JUNHO	NÃO GEROU	2.967kg	NÃO GEROU	9.722kg	NÃO GEROU	10.424,5kg	21,7kg	4.692,8kg	5.396,36kg
JULHO	NÃO GEROU	2.812kg	NÃO GEROU	13.232kg	NÃO GEROU	9.708,46kg	76,8kg	5.013,48kg	4.603,7kg
AGOSTO	43kg	3.388kg	NÃO GEROU	9.404,5kg	NÃO GEROU	9.746,46kg	NÃO GEROU	5.181,4kg	4.382,2kg
SETEMBRO	160kg	8.588kg	NÃO GEROU	8.486kg	NÃO GEROU	8.802,04kg	150,6kg	4.276,4kg	4.444,1kg
OUTUBRO	11kg	3.739kg	NÃO GEROU	8.560kg	NÃO GEROU	8.484,88kg	NÃO GEROU	4.236,6kg	4.678,30kg
NOVEMBRO	195kg	2.037kg	NÃO GEROU	7.925kg	NÃO GEROU	8.931,57kg	105,8kg	4.572,6kg	5.037,77kg
DEZEMBRO	10kg	1.967kg	NÃO GEROU	7.237,1kg	NÃO GEROU	8.264,28kg	67,2kg	4.392,75kg	4.955,05kg
	TOTAL ANUAL: 53.758,7kg		TOTAL ANUAL: 76.948,6kg		TOTAL ANUAL: 112.704,97 kg		TOTAL ANUAL: 112.669,87kg		

Source: Authors.

According to Table 1 to 4, it can be seen that from 2019 (the year before the COVID-19 pandemic) to 2020, 2021, 2022, respectively, there was an increase of 43.1%, 109.6%, 109.5% in waste generation, showing a significant increase in the amount of waste

generated in the pandemic years, which is in accordance with what was identified in the literature published in the area.

3.1.2 Municipal Public Hospital (HRPM)

3.1.2.1 General information

Regarding the municipal hospital, the general services sector is outsourced by another company, as well as the firefighters, concierge agent, cupbearers and stretcher bearers, all of whom share only one internal supervisor, who is responsible for supervising all these 5 sectors. In the general services sector, the focus of the research, there are 18 cleaning workers, who work 44 hours a week, from 7 am to 7 pm. Figure 5 shows the organizational Table of the sectors that involve waste management in this hospital.

Figure 5

Organizational Table of the HRPM sectors

Source: Authors, 2023.

According to the supervision sector, this sector has rules on the use of personal protective equipment, such as the use of gloves, boots, masks and the correct clothing, with the pandemic these PPE had the addition of a mask (N95) and a waterproof overalls.

3.1.2.2 Solid waste management plan and training

HRPM only started to have its own solid waste management plan in 2019, and this plan was updated in January 2023, valid for 1 year, with the following general objectives: to increase the level of safety of employees, users, and patients; obtain proper waste management, minimize health risks associated with service activities; and to train and

instruct all employees on the proper management of HCW, emphasizing the need to comply with the standards.

It should be noted that according to its PGRSS, the hospital generates waste from groups A, B, D, and E, following the classification of ANVISA RDC No. 222/2018, that is, infectious, chemical, common, and sharps waste, respectively. In addition, the sectors present in the hospital are described, as well as the waste generated in each of them, as shown in Figure 6.

Figure 6

Distribution of waste by sector in the HRPM

SETORES	GRUPOS DE RESÍDUOS				
	A	B	C	D	E
Central de esterilização	■			■	■
Farmácia central		■		■	■
Almoxarifado		■		■	
Rouparia				■	
Serviço de nutrição				■	
Serviço social				■	
Sala de diluição de material		■		■	
Diretoria geral, técnica, administrativa e RH				■	
Central de EPI'S				■	
Sala de paramentação				■	
Comissão de Infecção Hospitalar				■	
Gerência de enfermagem				■	
Técnico de informação				■	
Copas				■	
Serviço de radiologia	■	■			■
Sala de desparamentação	■				
Farmácia satélites	■	■			■
Recepção paciente COVID-19	■				
Sala dos fluxistas	■				
Sala gasômetro	■	■			■
Laboratórios	■	■			■
Postos	■	■			■
UTI'S	■	■			■
Enfermarias	■	■			■
Psicologia				■	
Necrotério	■				
Vestiário enfermagem/ Serviço gerais				■	

Source: Authors, 2023.

Figure 6 shows the distribution of waste of each type by sector. It is worth noting that in the hospital there are two different outsourced companies responsible for the final disposal of the waste generated, one for common waste and the other for infectious waste, that is,

the waste of groups A, B and E, are weighed and collected by one company, and those of group D are only collected by another company.

As for the frequency of collection of this waste, the employees of the third-party company responsible for group D, perform this activity 3 times a week (Tuesday, Thursday and Saturday), being sent directly to the landfill, while the company responsible for groups A, B and E, collect it 2 times a week, this collection is also carried out by employees of the contracted company, However, to weigh this waste, there is the accompaniment of 1 supervising employee of the hospital's cleaning sector.

In the PGRSS it is also possible to find the final disposal carried out for each group of waste, in which groups A and E, after undergoing specific treatment, are sent to the licensed landfill; group B goes through the incineration process and the ashes generated go to the landfill, and, finally, group D, the recyclables can be segregated at the source of generation and reused through recycling, and the non-recyclables are sent to the landfill.

According to the sector's internal supervisor, when cleaning workers are hired and receive training on their position and functions and regular training that occurs as needed, however there has never been training focused on the solid waste management plan, nor is there an internal control over these trainings.

According to the hospital's PGRSS, it is described as a basic requirement for management that all professionals have received training on the PGRSS, as well as all professionals directly involved in hygiene and cleaning are aware of their responsibilities, and correctly know all the procedures recommended in the handling, collection and transport of HSW and in the proper cleaning of equipment and waste shelters, being evaluated and monitored by the hospital's Hospital Infection Control Committee.

3.1.2.3 Waste generation

As for the amount of waste generated, this hospital does not monitor the generation, having only the amount of infectious waste from March 2021, every period prior to this there is no data monitored, in addition the common waste is not weighed, since with this company they have a closed contract, in which the amount charged is not based on the amount of waste generated. Table 5 shows the generation, in kg, of infectious waste monthly from March 2021 onwards.

Table 4

Generation of infectious waste in 2021 and 2022 in HRPM

MONTHS	YEAR	
	2021	2022
January	-	1834,7
February	-	2081,8
March	2797,9	1767
April	2567,6	1684,4
May	2771,1	1783,4
June	2333,7	2005,2
July	2138,2	1583,4
August	1704,4	1161,6
September	1416,3	1149,8
October	1965,4	1154,6
November	1968,2	1371,8
December	1606,8	1549,8
ANNUAL TOTAL in Kg	21269,6	19127,5

Source: Authors.

Given the lack of control in previous years in this hospital, it is unfeasible to verify the increase in the volume of waste during the pandemic, but it is possible to see that there was a drop from 2021 to 2022, even if there is no data for January and February 2021, which would make this drop even greater. This decrease can be related to the fact that in 2021 it was still in a more intense period of the pandemic, which can be inferred that in the pandemic period the amount of waste was higher.

3.2 RESULTS OF THE QUESTIONNAIRE WITH GENERAL SERVICE PROFESSIONALS

3.2.1 State Public Network Hospital (HRPE)

As provided for in the methodology, to ensure the level of confidence of this research, a number of at least 19 employees responding to the questionnaire would be required in this hospital. Thus, the number of 22 respondents was obtained, exceeding the methodological forecasts.

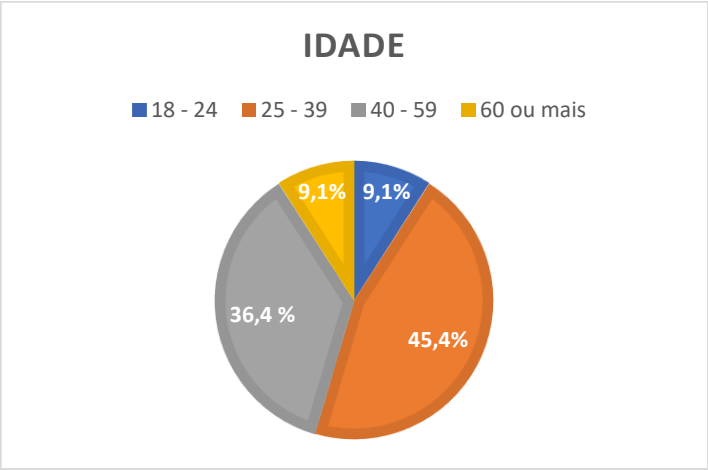
3.2.1.1 Sociodemographic information

In this subtopic, it will be seen how the sociodemographic information of the employees, such as gender, age and level of education, behaved within the sample of 22 respondents.

Regarding age, there were two respondents aged 18 to 24 years, ten respondents aged 25 to 39 years, 8 respondents aged 40 to 59 years, and 2 respondents aged 60 or over, the representative percentages of each age group can be seen in Figure 7.

Figure 7

Age of the HRPE participants



Source: Authors (2023)

Figure 7 shows that together the categories 25 to 39 and 40 to 59 are the most representative, with 45.4% and 36.4%, respectively, while the categories 18 to 24 years and 60 years and over accounted for 9.1%.

Regarding gender, there was a predominance of females with 64% of the sample, and only 36% of males. In addition, regarding the salary level, all received between 1 and 2 minimum wages, even those respondents who worked during the night shift.

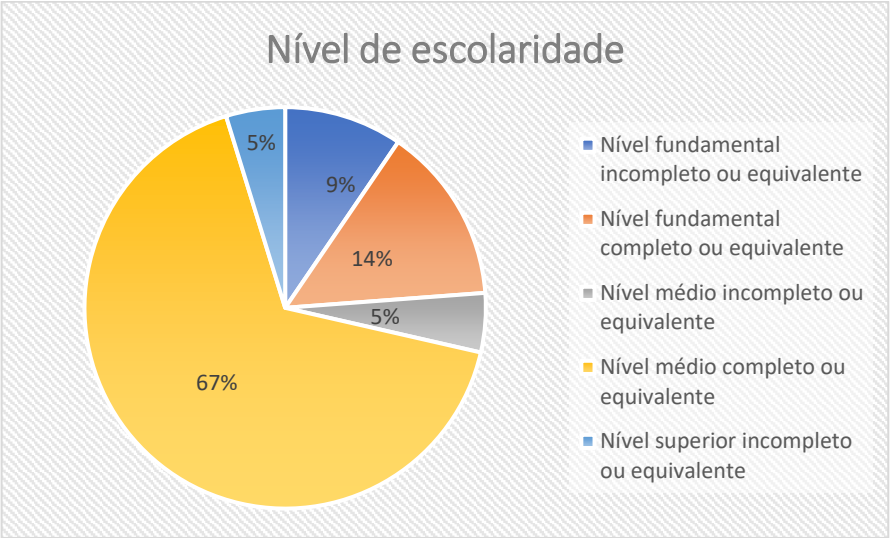
And, as for receiving vacation and thirteenth salary, only 5 enjoyed both, 7 answered that they were entitled only to vacation, and 10 answered that they did not receive either vacation or thirteenth. In terms of the working day, all worked 12 hours and 36 hours off, with breaks of an average of 1 hour, for rest and meals.

When asked about performing some other function during their time off, 15 answered that they worked exclusively at the hospital, and 7 answered that they worked during their time off, they performed activities such as app drivers, motorcycle taxis, cook in a hamburger restaurant, self-employed and artisan.

Regarding the participants' level of education, none answered that they were in the categories without education and less than one year of schooling and not determined, 2 respondents with incomplete elementary school, 3 respondents with complete elementary school, 1 with incomplete high school, 14 with complete high school, 1 respondent with incomplete higher education and 1 with complete higher education or equivalent.

Figure 8

Education level of the HRPE participants



Source: Authors (2023).

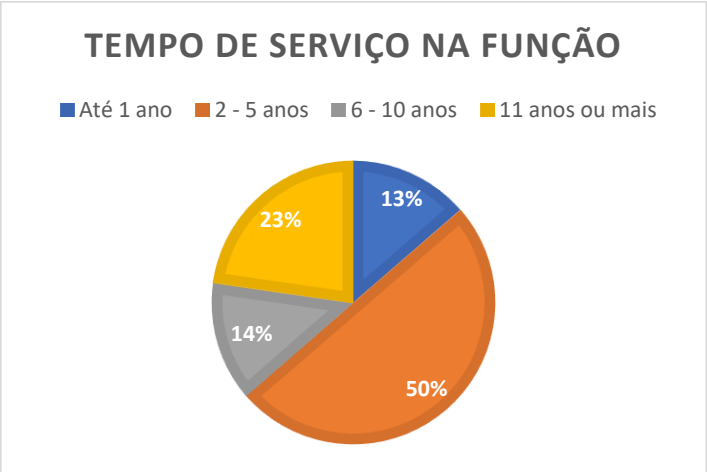
Figure 8 shows that most participants (67%) had completed high school, followed by complete elementary school with 14% and incomplete elementary school with 9% of the respondents. The other levels completed obtained the percentage of 5% in each, representing together 10% of the total.

3.2.1.2 Function data

Regarding the length of time in the position, 3 respondents have up to one year, 11 answered from 2 to 10 years, 3 fit into the category between 6 and 10 years and 5 answered more than 11 years of service, the representative percentages of each time range can be seen in Figure 9.

Figure 9

Length of service in the HRPE function



Source: Authors (2023).

Figure 9 shows that 13% have been up to 1 year old, half (50%) have been working for 2 to 5 years, 14% between 6 and 10 years, while the category of 11 years or more represents 23% of the participants. These percentages tended to be repeated when asked about the length of service in the hospital, that is, the vast majority started their activities in the function hired by the hospital studied.

3.2.1.3 Data related to solid waste

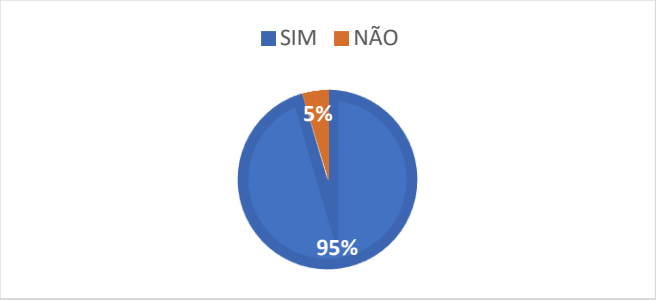
In the first question, the respondents were asked about their understanding of the management of solid waste from health services. Thus, 9 respondents, that is, 40.9%, mentioned in their response one or more stages of the management of solid waste from health services, among them segregation was the most mentioned, and the collection and transportation of hospital waste was also mentioned. 10 respondents (45.5%) stopped to mention that they involve hygiene, care with waste handling and the use of PPE.

It should also be noted that 3 respondents (13.6%) said they had no knowledge about the management of solid waste from health services. According to Law 12.305/2010, solid waste management is defined as the set of actions carried out, directly or indirectly, in the stages of collection, transportation, transshipment, treatment and environmentally appropriate final disposal of solid waste and environmentally appropriate final disposal of waste, which shows that most respondents did not have the correct and/or complete understanding of the subject.

In the second question, his knowledge about the risks of this waste for the social, environmental and economic spheres was questioned. Figure 10 below shows the percentage of answers to this question.

Figure 10

Knowledge of the risks of this waste for the social, environmental and economic spheres



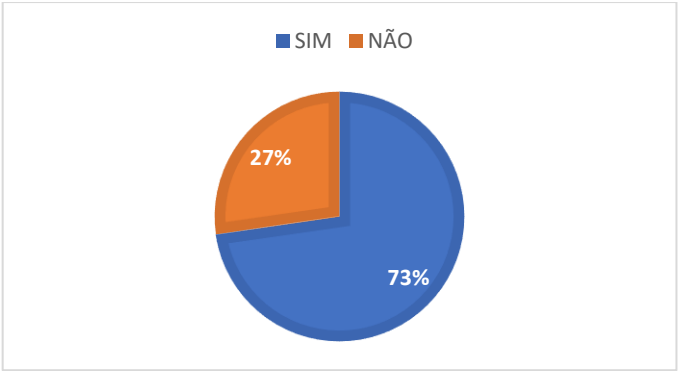
Source: Authors.

Thus, it was found that only one person answered that they did not know, therefore, 95% of the people said they knew about these risks, in which 11 (52.4%) mentioned in their answers only social risks, such as the risk of cutting and contamination by bacteria or the risk of diseases for the population and for themselves, and 10 (47.6%) included the environmental risk, such as polluting the environment, clogging of sewers, soil contamination, among others. Meanwhile, none cited any economic risk in their response.

When asked if they knew what steps these health waste should go through in their management, 16 (73%) answered yes, and 6 (27%) answered no (see Figure 11).

Figure 11

Knowledge about the stages of health service waste management



Source: Authors.

Of the 16 who answered that they knew the stages, 2 commented that they did not know how to give an opinion or no longer remembered, none commented on all the stages of HCW management, 14 mentioned at least 1 of the stages of HCN management, with segregation and final disposal being the most cited. Among these answers are: "There is the disposal and separation of the waste by people, then we separate the infectant from the common and then the company discards it.", "Cleaning, separation of common and infectious

waste and disposal", "The material is used and discarded, then properly collected, separating chemical, infectious and common waste, and then discarded.".

When asked if they were aware of the existence of the solid waste management plan, the majority (54.5%) said they were not aware of it, and of the 10 (45.5%) who answered yes, 2 did not know how to comment on it, and the others mentioned that they were the lectures on the use of PPE and careful handling of waste.

When asked if there were changes in these processes during the pandemic, 3 did not give an opinion, because they were not working during the pandemic, 5 (22.7%) answered no and 14 (63.6%) that there were changes, of these most cited the use of more PPE, such as the use of the N95 mask, use of gowns, gloves and caps, more terminal cleanings were also mentioned, use of specific products for COVID-19 and employees who worked in the COVID-19 ward could not use the common areas, such as meals.

Regarding the classification of these changes, of the 16 respondents who answered that they had changes, 5 believe that they are permanent, and that they continue even with the end of the pandemic, 3 believe that they are temporary, and that there are already employees who no longer use PPE correctly, and 6 respondents believe that some are temporary and some permanent, with the permanent ones only in the intensive care units (ICU).

When asked what risks they would link to health waste in this pandemic period, all of them marked at least one risk, of which 6 (27.3%) marked the 3 risks: social risk/Contagion of those who handle them in management, environmental risk/Greater environmental contamination and economic risk/Higher management costs. And, 7 (31.8%) answered only social and environmental risk and 9 (40.9%) believe they only have social risk.

About having already undergone some type of specific training to perform their function, all answered that they have already received at least 1 training. 22.7% had 4 or more trainings, 31.8% had only 1 training, and 45.5% had gone through 2 or 3 trainings. 95.5% of the respondents said that the training lasted an average of 1 to 3 hours, and only 1 answered that it lasted 3 days, addressing topics on the use of PPE and products, hospital hygiene and separation of common and infectious waste. Although there is some relationship between some of these trainings and the PGRSS, none of them had this specific focus. Regarding the time since the last training was performed, the majority (81.8%) received the last training in 6 months or less.

As positive points in relation to their function, 77.3% of the employees reported a good relationship with the team, 40.9% mentioned having good equipment, 22.7% the fact that it is an essential function and contributes to the health of society.

As for the negative points, 27.3% did not mention any negative points, while 72.7% mentioned at least one, in which of these 25% cited the bad relationship with people from other sectors, such as nurses and doctors, 56.3% cited problems with the cleaning cart, lack of PPE or low quality materials, and 18.7% cited the low salary and lack of attendance of colleagues.

Below, some of the reports made by them can be observed:

- "This way we have to improve the issue of hierarchy, because we are often despised by doctors or nurses." (E.S.S)

- "There are some cleaning carts with problems with the wheel, which is bad to transport, and there are also some products that are not very good" (F.C.)

- "We had to improve our equipment, for example here, I'm wearing a punctured boot" (C.N.E.P.)

3.2.2 Municipal Public Hospital (HRPM)

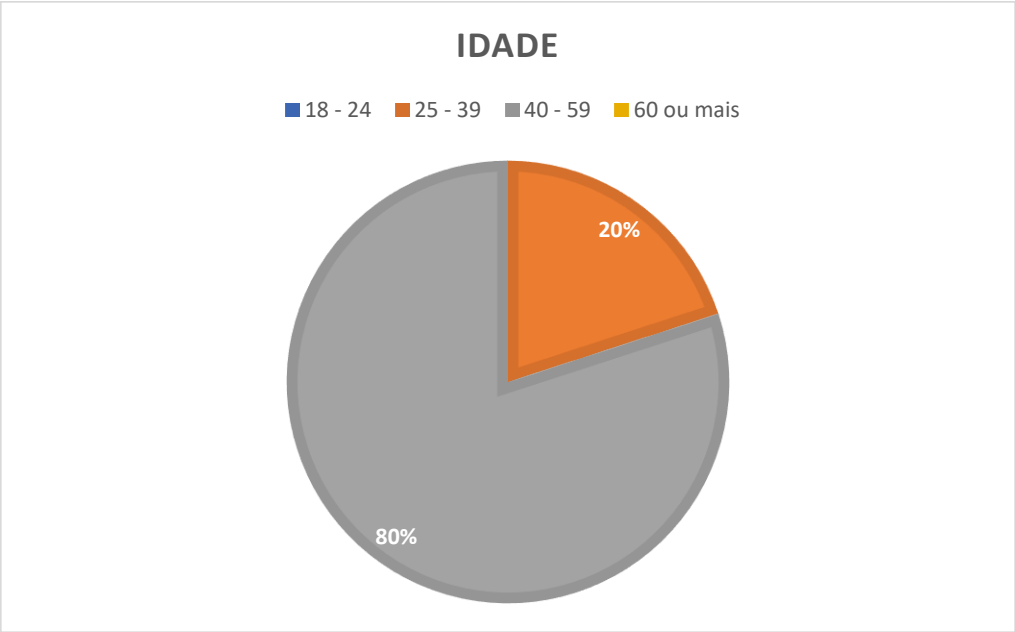
As provided for in the methodology, to ensure the level of confidence in this research, a number of at least 10 employees responding to the questionnaire would be required in this hospital. Thus, the minimum number of respondents was obtained, meeting the methodological forecasts.

3.2.2.1 Sociodemographic information

Regarding age, there were two respondents aged 25 to 39 years and 8 respondents aged 40 to 59 years, the other categories had no respondents, the representative percentages of each age group can be seen in Figure 12.

Figure 12

Age of HRPM participants



Source: Authors (2023)

Figure 12 shows that the 40 to 59 category is significantly more representative, with 80% of the respondents in this age group.

Regarding gender, there was a predominance of females with 60% of the sample, and only 40% of males. In addition, regarding the salary level, all received between 1 and 2 minimum wages, even those respondents who worked during the night shift.

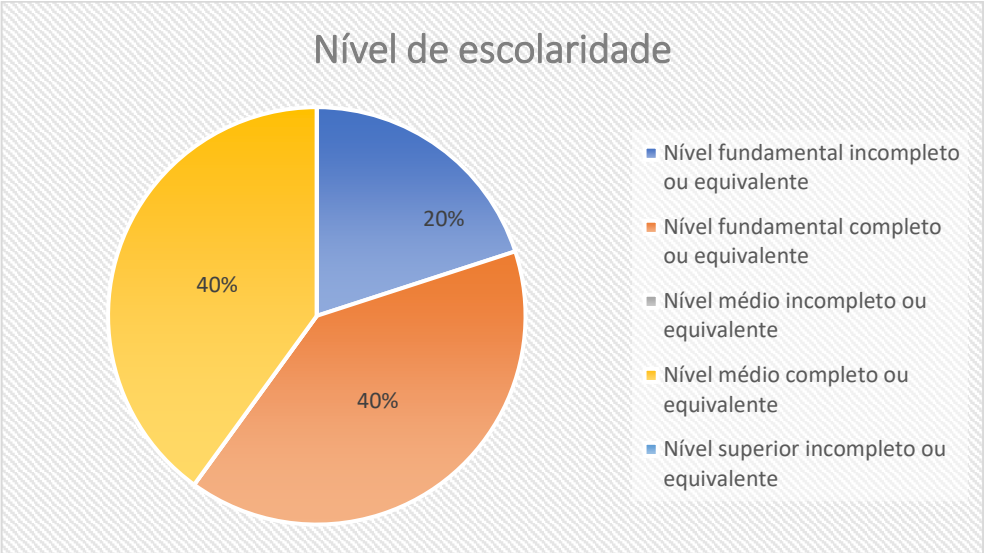
And, as for receiving vacation and thirteenth salary, all answered that they enjoyed both, just as they all worked 12 hours and 36 hours off, with breaks of an average of 1 hour, for rest and meals.

When asked about performing some other function during their time off, 7 answered that they worked exclusively at the hospital, and 3 answered that they worked during their time off, of which all were self-employed.

Regarding the level of education of the participants, only 3 categories had respondents, namely the category incomplete elementary school, with 20% of the employees, and the categories complete elementary school level and complete high school level, which obtained the same percentage of respondents, with 40% in each (see Figure 13).

Figure 13

Education level of HRPM participants



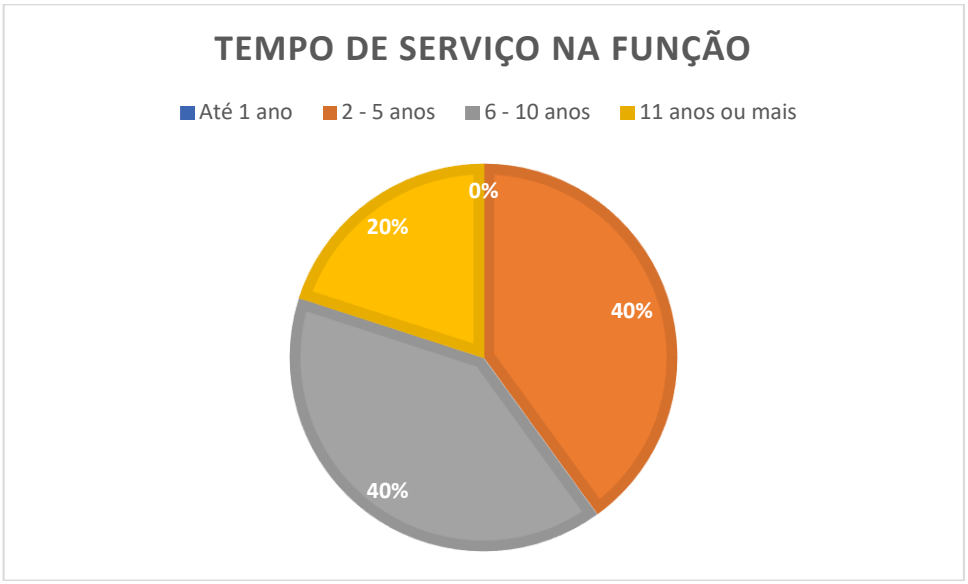
Source: Authors (2023).

3.2.2.2 Function Data

Regarding the length of time in the position, 4 respondents had between 2 and 5 years of service in the function, another 4 employees had between 6 and 10 years, and the others had more than 11 years in the function.

Figure 14

Length of service in the HRPM role



Source: Authors (2023).

Figure 14 shows that no employee has been working for less than 1 year in the position, and together the categories of 2 – 5 years and 6 – 10 years, represent the vast majority with 80% of the respondents. These percentages again tended to be repeated when

asked about the length of service in the hospital, that is, the vast majority started their activities in the function hired by the hospital studied.

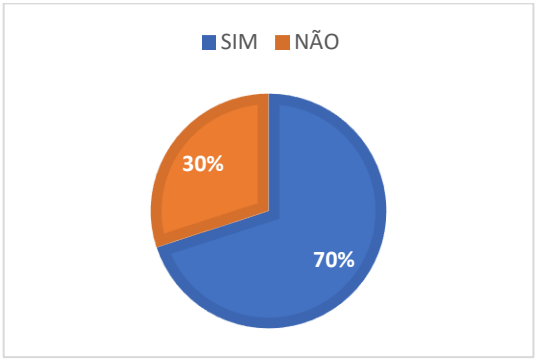
3.2.2.3 Data related to solid waste

As mentioned above, in the first question, the respondents were asked about their understanding of the management of solid waste from health services. Thus, 6 respondents, that is, 60%, mentioned in their answer one or more stages of the management of solid waste from health services, among them segregation was the most mentioned, and the collection and transportation of hospital waste was also mentioned. 3 respondents (30%) stopped to mention that they involve hygiene, care with waste handling and use of PPE, and 1 only mentioned that the recycling and reuse of materials was blocked, which shows, as in the HRPE, that most respondents did not have the correct and/or complete understanding of the subject.

In the second question, his knowledge about the risks of this waste for the social, environmental and economic spheres was questioned. Figure 15 below shows the percentage of answers to this question.

Figure 15

Knowledge of the risks of these wastes for the social, environmental and economic spheres



Source: Authors.

Thus, it was found that 3 employees did not know the risks of this waste, being a high percentage for those who work directly handling this waste, and of the 7 who said they knew these risks, all mentioned social and environmental risks in their answers, being only the risk of cutting and contamination by bacteria and pollution of the environment and none mentioned any economic risk in their answer.

When asked if they knew what stages these health waste should go through in their management, 7 (70%) answered no, and 3 (30%) answered yes. Of the 3 who answered that they knew the steps, none commented on all the stages of HCW management, but all

mentioned at least 1 of the stages of HCW management, with collection, segregation and final disposal being the ones mentioned.

When asked if they were aware of the existence of the solid waste management plan, the majority (70%) said they were not aware of it, and of the 3 (30%) who answered yes, 1 did not know how to comment on it, and the others mentioned that they were the step-by-step of the waste, citing the separation of common and infectious waste as an example.

When asked if there were changes in these processes during the pandemic, 2 (20%) answered that there were no changes, however this occurred because they already worked in the isolation ward, and 8 (80%) that there were changes, of which most cited the use of more PPE, such as the use of the N95 mask, use of gowns, gloves and caps, also the addition of more trash cans in the sectors.

Regarding the classification of these changes, of the 8 respondents who answered that they had had changes, 5 believe that some are temporary and others permanent, 2 believe that they are temporary, and only 1 believes that they are permanent.

When asked what risks they would link to health waste in this pandemic period, only one mentioned not having any additional risk, while 4 mentioned only social risk, and 1 added environmental risk, and the other 3 (30%) marked the 3 risks: social risk/Contagion of those who handle them in management, environmental risk/Greater environmental contamination and economic risk/Higher management costs.

About having already undergone some type of specific training to perform their function, all answered that they have already received at least 1 training. 50% had 4 or more trainings, 10% had only 1 training, and 40% had gone through 2 or 3 trainings, and all mentioned that the trainings lasted, on average, from 1 to 3 hours, covering topics on the use of PPE and products, hospital hygiene, separation of common and infectious waste, and types of cleaning. Although there is some relationship between some of these trainings and the PGRSS, none of them had this specific focus. Regarding the time since the last training was performed, the majority (60%) received the last training in 6 months or less, while the others more than 1 year ago.

As positive points in relation to their function, 60% of the employees reported a good relationship with the team, 30% cited the importance of the function and its contribution to the health of society, and one answered that he learned about humanization in the function.

As for the negative points, 70% did not mention any negative points, the other 30% cited the low salary and the lack of a rest room.

Below, some of the reports made by them can be observed:

- "I miss a place to rest, which I used to have and now no longer has." (M.R.)

- "Here the work is easy, but if I have to say something, I say the salary that could be better" (M.A.)

- "In addition to the salary, I think that the involvement with the patients' problem, sometimes we get attached and suffer together." (H. E.)

4 DISCUSSIONS

4.1 DISCUSSIONS ON WASTE MANAGEMENT IN PUBLIC HOSPITALS: A COMPARATIVE ANALYSIS BETWEEN STATE AND MUNICIPAL INSTITUTIONS

Healthcare waste management (HCW) has gained significant prominence during the COVID-19 pandemic, owing to the exponential increase in the production of infectious waste and the risk associated with improper handling of these materials. Recent studies indicate that the amount of medical waste has increased dramatically worldwide during the pandemic, putting pressure on health systems to adapt and improve their waste management plans (Mani & Sankaranarayanan, 2021; Ilyas et al., 2021).

Teresina, capital of the state of Piauí, stands out as an important regional health center in the Brazilian Northeast. With a population of 871,126 inhabitants (IBGE, 2021), the city serves as a reference center for medical care, not only for the local population, but also for neighboring municipalities, especially in times of health crises such as the COVID-19 pandemic. Teresina's responsiveness to health demands during the pandemic reinforced its position as a regional hub, demonstrating the importance of well-equipped and managed health structures (Sousa et al., 2020).

The results obtained in this research provide valuable insights into solid waste management in public hospitals in Teresina, presenting a comparative approach between the State Public Network Hospital (HRPE) and the Municipal Public Network Hospital (HRPM). The analysis of these institutions, considering several parameters, reveals essential nuances that directly impact labor practices and compliance with environmental regulations, in addition to significant differences in terms of structure, working conditions, use of PPE, training, and waste production.

The HRPE faced critical structural problems, such as infiltrations and cracks in the floor of the general services support room, compromising safety and efficiency in the management of HSW, since the inadequacy of the facilities can negatively influence the morale and productivity of workers (Araujo and Silva, 2020). In contrast, HRPM presented better structural conditions, with no significant reports of infrastructure problems, providing a safer and more efficient work environment. In addition, the outsourcing of the general

services sector, with shared internal supervision, facilitated the management of HSW in the HRPM, improving operational efficiency.

Both hospitals substantially increased the use of PPE during the pandemic. At HRPE, there was an intensification in the use of N95 masks and waterproof coveralls, in addition to periodic training to ensure that professionals were prepared for the safe management of HCW, which according to Oliveira et al. (2021) minimizes risks of infection and contamination and contributes to the safety of professionals and patients (Barbosa et al., 2021). Similarly, the HRPM also adopted additional PPE and reported the existence of continuous training, however there is no control over the occurrence of these trainings by the hospital itself, being only the responsibility of the outsourced company, a fact that may compromise the guarantee that workers were up to date on the best practices for HSW management.

As for waste production, it was also seen that there was an increase in both hospitals due to the pandemic. At HRPE, waste production grew dramatically from 2019 to 2022, reflecting the increased use of disposable materials and PPE due to COVID-19. In the HRPM, there was also a growth in waste production, although the specific data are not as detailed as in the HRPE, as there was no record of these quantities in the years 2019 and 2020, which made it difficult to verify.

The updated Solid Health Waste Management Plan (PGRSS) in both hospitals was essential to face the challenges imposed by the pandemic. In the HRPE, the PGRSS was implemented in January 2019 and updated in November 2022, including the segregation and disposal of waste according to ANVISA RDC No. 222/2018. Waste collections were carried out by a third-party company from Monday to Saturday, ensuring the regular and safe removal of waste. At HRPM, the PGRSS was implemented in 2019 and updated in January 2023, with clear objectives to increase employee safety, properly manage waste, and minimize health risks. The frequency of collections was also standardized and carried out efficiently to avoid the accumulation of waste.

However, with the analysis of the Health Services Waste Management Plans (PGRSS), it was found that the objectives outlined in these plans were predominantly perceived as formal obligations, devoid of concrete strategies for their implementation. In addition, a disparity was found between the information regarding the training declared in the PGRSS and that obtained through questionnaires and minutes of training documented in the hospitals.

For example, in the PGRSS of the Municipal Hospital, there is a sector responsible for controlling the training carried out by the outsourced company, however, the data collected indicated the absence of this practice, since there was no record of training in this

hospital. On the other hand, at the State Hospital, despite having control of these trainings through minutes, the PGRSS stated that specific training was carried out on the same, however, when confronting these allegations with the training control minutes, it was found that this specific training was not effectively carried out.

Thus, these divergences found in the PGRSS and the absence of specific training on this plan in both hospitals is a worrying finding, as this knowledge gap can compromise the effectiveness of waste management practices and be directly linked to the gap found regarding the lack of knowledge about the stages involved in the management of HCW by most of the professionals of general services studied.

Another significant observation resulting from this research is the disparity in the understanding of solid waste management by the employees of both hospitals. The finding that many do not fully understand the critical steps of this process highlights a gap in knowledge that must be addressed through specific educational strategies, the implementation of robust and ongoing training programs can be an effective response to mitigate these gaps and promote a conscious organizational culture.

With regard to the sociodemographic profile, the HRPE exhibited a more pronounced diversity, while the HRPM presented a more uniform distribution, with a notable concentration of experienced professionals. These differences point to the need for differentiated approaches to improve working conditions, taking into account the specific characteristics of each hospital environment.

The hospitals' response to the pandemic emerged as a focal point and operational changes were implemented in both institutions, indicating a proactive response to crisis situations. However, differences arose in how employees viewed the permanence of these changes, this dynamic illustrates the importance of adaptive strategies to deal with unpredictable and constantly evolving events.

The results also showed divergent perceptions about positive and negative working conditions, the lack of a break room in the HRPM and the problems with equipment in the HRPE are tangible issues that require immediate attention, as these aspects can directly influence the well-being and productivity of health professionals.

5 CONCLUSIONS

The analysis of the management of Health Services Waste (HSW) in two public hospitals in Teresina (PI) during the COVID-19 pandemic shows advances and weaknesses in compliance with the guidelines of the Health Services Waste Management Plan (PGRSS). It is observed that, although both hospitals have implemented formal management plans,

significant gaps persist in the continuous training of general service professionals, especially with regard to technical knowledge about the stages of waste management and its environmental, social and economic impacts.

The state hospital has greater structure, with its own team and a specific sector for the management of HCW, in addition to more consistent records on waste generation. The municipal hospital, on the other hand, with an outsourced team and less document control, demonstrates fragility in the monitoring and systematic training of workers. The pandemic intensified waste generation and required rapid adaptations, revealing the importance of continuous investments in infrastructure, training, and inspection.

Therefore, the effectiveness of the PGRSS depends not only on the existence of a formal plan, but on its practical operationalization, the appreciation of the professionals involved and the integration between hospital sectors. The efficient management of HCW is an essential condition for health and environmental security, especially in crisis contexts.

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