

# MEDICAL WASTE IN THE SURGICAL CENTER: ADJUSTMENTS WITH COST MEASUREMENT

*Resíduos de serviços de saúde em centro cirúrgico: adequações com mensuração do custo*

*Residuos de servicios de salud en centros quirúrgicos: adaptaciones con medición de costos*

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**ABSTRACT: Objective:** To identify the cost of the necessary adjustments to a surgical center so that it meets the current Brazilian legislation, which provides for medical waste. **Method:** Exploratory, descriptive research with a quantitative approach in the modality of case study of the surgical center of a public university hospital. In the protocol, a documental research was applied, through a check-list comparing the current Brazilian legislation with the reality found, mapping the process with the technique of the flowchart map. The average direct cost was used as a costing method. **Results:** There was an average direct cost of R\$ 7,891.25 for the hospital to fully comply with the Brazilian legislation on healthcare waste, with infrastructure adjustments and long-term acquisitions and an additional monthly cost of R\$ 542.38. **Conclusion:** For all groups of waste from health services in the surgical center under study, adjustments are needed in order to comply with the legislation, as well as the articulation of the various managers involved in the management and measurement of costs related to waste to optimize economic results in health.

**Keywords:** Costs and cost analysis. Surgicenters. Legislation. Medical waste.

**RESUMO: Objetivo:** Identificar o custo das adequações necessárias a um centro cirúrgico para que este atenda à legislação brasileira vigente, que dispõe sobre resíduos de serviços de saúde. **Método:** Pesquisa exploratória, descritiva, de abordagem quantitativa na modalidade de estudo de caso do centro cirúrgico de um hospital universitário público. No protocolo, foi aplicada uma pesquisa documental, por meio de um *check-list* comparando a legislação brasileira vigente com a realidade encontrada, mapeou-se o processo com a técnica do mapa-fluxograma. Utilizou-se como método de custeio o custo direto médio. **Resultados:** Verificou-se o custo direto médio de R\$ 7.891,25 para o hospital atender integralmente à legislação brasileira de resíduos de serviços de saúde, com adequações de infraestrutura e aquisições de longa permanência e um adicional no custo mensal de R\$ 542,38. **Conclusão:** Para todos os grupos de resíduos de serviços de saúde do centro cirúrgico em estudo, são necessárias adequações a fim de atender à legislação, bem como articulação dos diversos gestores envolvidos no manejo e na mensuração dos custos relacionados aos resíduos para otimização de resultados econômicos em saúde. **Palavras-chave:** Custos e análise de custo. Centros cirúrgicos. Legislação. Resíduos de serviços de saúde.

**RESUMEN: Objetivo:** Identificar el costo de los ajustes necesarios a un Centro Quirúrgico (CQ), para que cumpla con la legislación brasileña vigente que prevé Residuos de Servicios de Salud (RSS). **Método:** Investigación exploratoria descriptiva con abordaje cuantitativo en la modalidad de estudio de caso de un CQ en un Hospital Universitario Público. En el protocolo se aplicó investigación documental, a través de un *checklist* de la legislación brasileña vigente con la realidad encontrada, se mapeó el proceso mediante la técnica de diagrama de flujo-mapa. Se utilizó el costo directo promedio como método de cálculo de costos. **Resultados:** Hubo un costo directo promedio de R\$ 7.891,25 para que el hospital cumpliera plenamente con la legislación brasileña sobre RSS, con ajustes de infraestructura y adquisiciones de largo plazo y un costo mensual adicional de R\$ 542,38. **Conclusión:** Para todos los grupos RSS del CQ en estudio, se necesitan ajustes para cumplir con la legislación. Existe la necesidad de articulación entre los distintos gestores involucrados en la gestión, medición de costos relacionados con los residuos para optimizar los resultados económicos en salud.

**Palabras clave:** Costos y análisis de costo. Centros quirúrgicos. Legislación. Residuos sanitarios.

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## INTRODUCTION

Medical waste (MW) has generated wide discussion in recent decades among health service managers, especially with regard to hospitals, their largest generators. There are legal responsibilities related to environmental, social, and health aspects, which implies the need for safe management at all stages of the handling of MW, starting with the classification of these residues in hospitals. The conscientious use of materials should be encouraged, avoiding waste and excessive expenses, thus contributing to sustainable and economic development.

Due to the need to regulate and improve the disposal of these materials, Resolution of the Collegiate Board of Directors (*Resolução da Diretoria Colegiada – RDC*) No. 222/2018 was approved, replacing RDC No. 306/2004, which was in force for 14 years. RDC No. 222/2018 has new guidelines to be implemented, with new procedures and criteria. Thus, health services need to readjust their Waste Management Plan (WMP)<sup>1,2</sup>, also taking into account the Brazilian Standard (*Norma Brasileira – NBR*) 7500 and Ordinance No. 344/98<sup>3,4</sup>.

RDC No. 222, of March 28<sup>th</sup>, 2018, provides for good practices for managing MW and the importance of occupational safety. It contains the classification of MW into: Group A (infective, which is divided into five subgroups: A1, A2, A3, A4, and A5), Group B (chemical), Group C (radioactive waste), Group D (common recyclable and non-recyclable), and Group E (sharps)<sup>1</sup>.

MW management comprises planned and implemented actions based on current Brazilian legislation. This management includes the following steps: segregation, identification, packaging, collection, internal and external transport, temporary and external storage, treatment, and final disposal<sup>5</sup>.

In the hospital context, the surgical center (SC) is classified as a sector with restricted access, which has its specificities both in material and human resources. Due to the diversity of surgeries performed, this sector has a multidisciplinary team<sup>6</sup>, is a great consumer of material resources<sup>7</sup> and, consequently, a great generator of hospital waste.

In view of the classification of MW generated in the SC, a study showed that, of the total waste, 50.62% belonged to the infective and sharp waste group (Group A + Group E), 28.50% to non-recyclable waste (Group D), 19.26% to recyclables (Group D), and 1.64% to Group B<sup>8</sup>.

WMP should estimate the amount of waste that will be generated and, if possible, consider local reverse logistics

methods to dispose of it, thus encouraging local social initiatives<sup>1,9</sup>.

Therefore, an adequate approach to MW is necessary, in order to minimize environmental impact. Even with current legislation, there is still no compliance with these in its entirety by some health services. With this, the promotion of continuing education measures regarding waste is paramount<sup>10</sup>.

This study was justified by the change in legislation on waste that took place in 2018. Therefore, it is necessary to identify the changes in legislation so that health services can adapt to the one concerning hospital waste in Brazil.

## OBJECTIVE

To identify the cost of the necessary adjustments to a surgical center so that it meets the current Brazilian legislation on medical waste.

## METHOD

This is an exploratory, descriptive research with a quantitative approach, in the form of a case study. The study was carried out at the SC of the University Hospital of Universidade Estadual de Londrina (HU/UEL), a supplementary body of the institution<sup>11</sup>.

The SC observed has seven operating rooms, a post-anesthesia care unit (PACU), support areas such as a locker room, satellite pharmacy, pantry, equipment storage room, administrative area, and medical rest area.

The case study becomes relevant when research questions require a broad and deep description of some phenomenon, problem or real situation, that is, it seeks to explain some present circumstance, the how or why of this phenomenon. It is a contemporary investigation within a real context, which is not clearly defined, and adopts multiple sources of evidence without the use of manipulation or control<sup>12</sup>.

In turn, the case study aims to answer practical questions, bringing solutions to problems. The collection and analysis of data aims to study aspects in a varied and in-depth way, and to examine the event within its context<sup>13</sup>.

Chart 1 is presented next, with the protocol model<sup>12</sup> used in the steps of the case study.

After the documentary research, based on RDC No. 222/2018, NBR 7500<sup>3</sup> and Ordinance No. 344/1984, the

current legislation in Brazil was compared, through a checklist, with the reality found in the sector. This comparison was carried out in February 2020. The flow of MW management in the SC was represented using the map-flowchart technique, which consists of a flowchart placed on the physical plant of the site for process mapping<sup>14</sup>. The generation points by location and the classification of MW by groups of RDC No. 222/2018 were considered<sup>1</sup>.

The average direct cost was used as the costing method for cost information from the HU/UEL management information system.

The study is part of the research project entitled Sustainability and Hospital Cost Management (*Sustentabilidade e Gestão de Custos Hospitalares*), which is approved by the Research Ethics Committee (CEP), with Opinion No. 3.814.132

and Certificate of Presentation of Ethical Appreciation (CAAE) No. 21617119.9.0000.5231.

## RESULTS

The distribution of MW collectors by group and the flow of MW management, observed in the SC under study during the period of data collection, were presented in Figure 1.

It was observed that all operating rooms had a collector with a milky white bag for infectious waste (Group A), and a rigid puncture-resistant collector for sharp waste (Group E); the other groups had no specific segregation. In the sector's routine, after the surgery, the nursing technician tied and identified the bags with the room number

**Chart 1.** Research protocol of the case study on MW in SC.

Steps	Objectives	Activities
To analyze the national legislation on MW and know the sector being studied.	To know the management processes of the WMP.	<ul style="list-style-type: none"> <li>– Documentary research on legislation (RDC No. 222/2018 of the National Health Surveillance Agency (<i>Agência Nacional de Vigilância Sanitária – Anvisa</i>)).</li> <li>– Visit to HU/UEL for observation.</li> <li>– To identify the initial links in the chain of reference that guided the key informants responsible for managing MW.</li> <li>– Participant observation of the management steps in the SC.</li> </ul>
To identify MW management criteria.	To map the current management process.	<ul style="list-style-type: none"> <li>– To represent the flowchart map of the SC studied.</li> </ul>
To compare RDC No. 222/2018 with the reality found in the SC.	To comparison of reality with RDC No. 222/2018.	<ul style="list-style-type: none"> <li>– Documentary research to compare current legislation with the reality found.</li> <li>– To compare the reality found with the checklist based on RDC No. 222/2018.</li> </ul>
To propose an adequacy plan.	To contribute to the adequacy of HU/UEL to national legislation.	<ul style="list-style-type: none"> <li>– To articulate with the CC team and the technical manager possible proposals to be carried out in the reality of the hospital.</li> </ul>
To measure the cost of adjustments to comply with the current legislation.	To contribute to more efficient MW management choices.	<ul style="list-style-type: none"> <li>– To identify inputs, materials, and equipment involved in MW management.</li> <li>– To check physical structure adjustments.</li> <li>– To measure the cost of each item based on the micro-costing of the hospital's financial information.</li> <li>– Items not included in the hospital's financial information system were: three prices were consulted for the products and their average price was calculated.</li> </ul>
Data analysis.	Analysis related to sustainability actions and costs.	<ul style="list-style-type: none"> <li>– Triangulation of sources, aiming to contrast the data collected through documentary research, participant observation, checklist, and cost calculation based on the Real currency (R\$).</li> </ul>
Conclusion.	To present a conclusion to managers in the form of management reports, with proposals for adequacy and publication in scientific journals.	<ul style="list-style-type: none"> <li>– To synthesize data, considerations, and contributions in management decision making.</li> </ul>

and work shift, and left them in the external corridor for the hospital hygiene employee to transport them to the temporary shelter.

The PACU had a collector for MW from groups A, D (recyclable), and E. The satellite pharmacy had collectors for waste from groups A, B, D (recyclable), and E. In the pantry, there were waste collectors from Group D (recyclable and non-recyclable), while in the administrative areas there were collectors for Group D waste (non-recyclable). In these areas, the waste was sent directly by the hygiene worker to the temporary MW shelter.

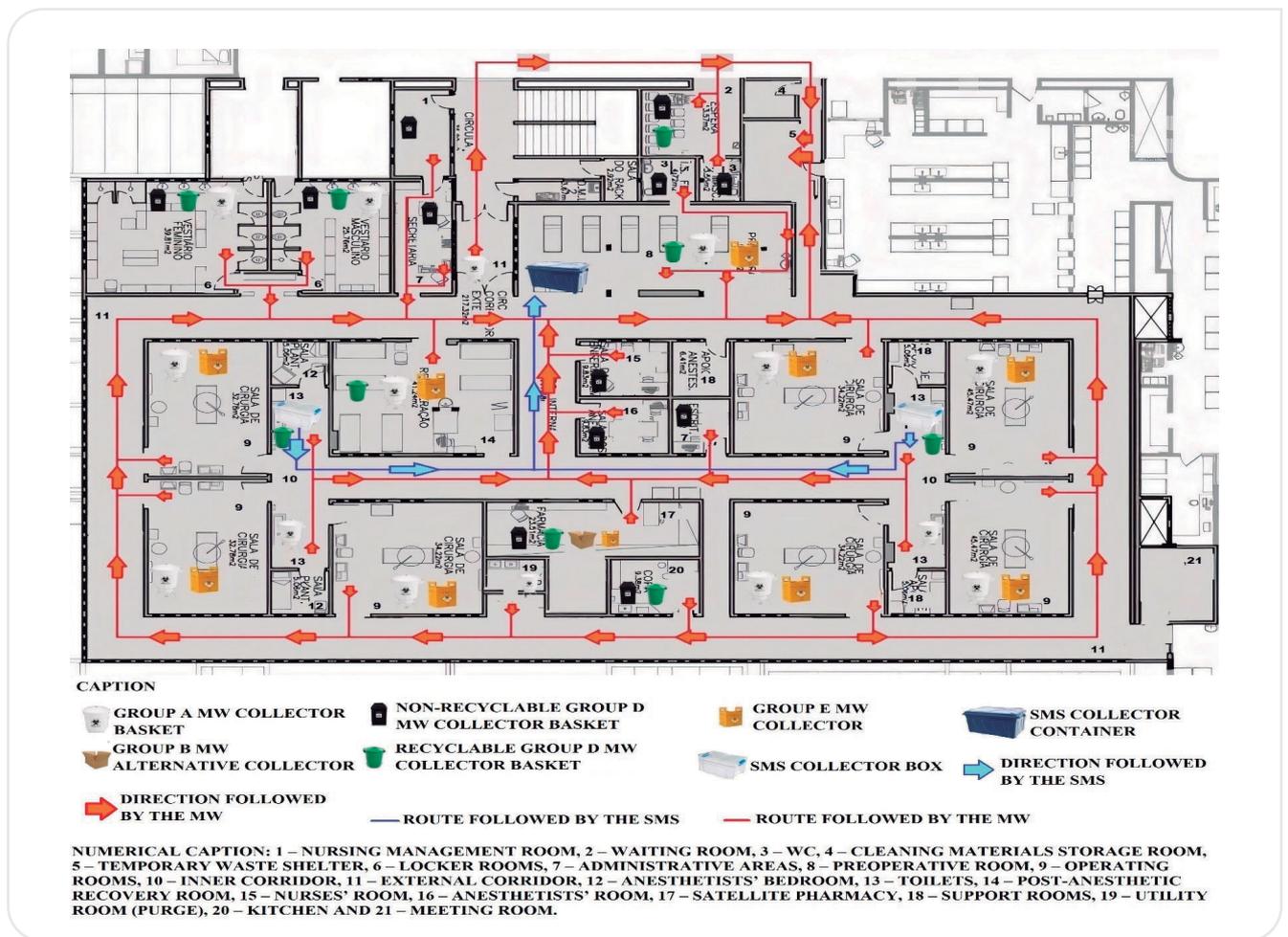
For recyclable Group D waste, a green bag was used and for non-recyclable ones, a black bag. Professionals from the general services division were responsible for transporting the MW from the SC's internal to the external shelter, located near the hospital parking lot, where they were accommodated in separate cells, according to the groups established by the legislation.

Subsequently, recyclable waste was collected by a recycling cooperative three times a week. The Group D MW (non-recyclable) was collected by a university truck, which sent them to a landfill.

Infectious, chemical, and sharp waste, classified as Class I hazardous waste, were weighed before being collected by the outsourced company. Infectious and sharps were sent for autoclaving and chemicals for incineration; later, the final disposition of these MW was carried out.

The hospital pays for the disposal of these wastes according to their weight and after presentation of the destination certification, which guarantees that the MW were disposed of in a safe and legal manner.

It can be seen in Figure 1 that the current Brazilian legislation was not fully complied with in the hospital under study. The need for new criteria for MW classification, acquisition of equipment and inputs in groups A, B, D, and E was evaluated, as shown below:



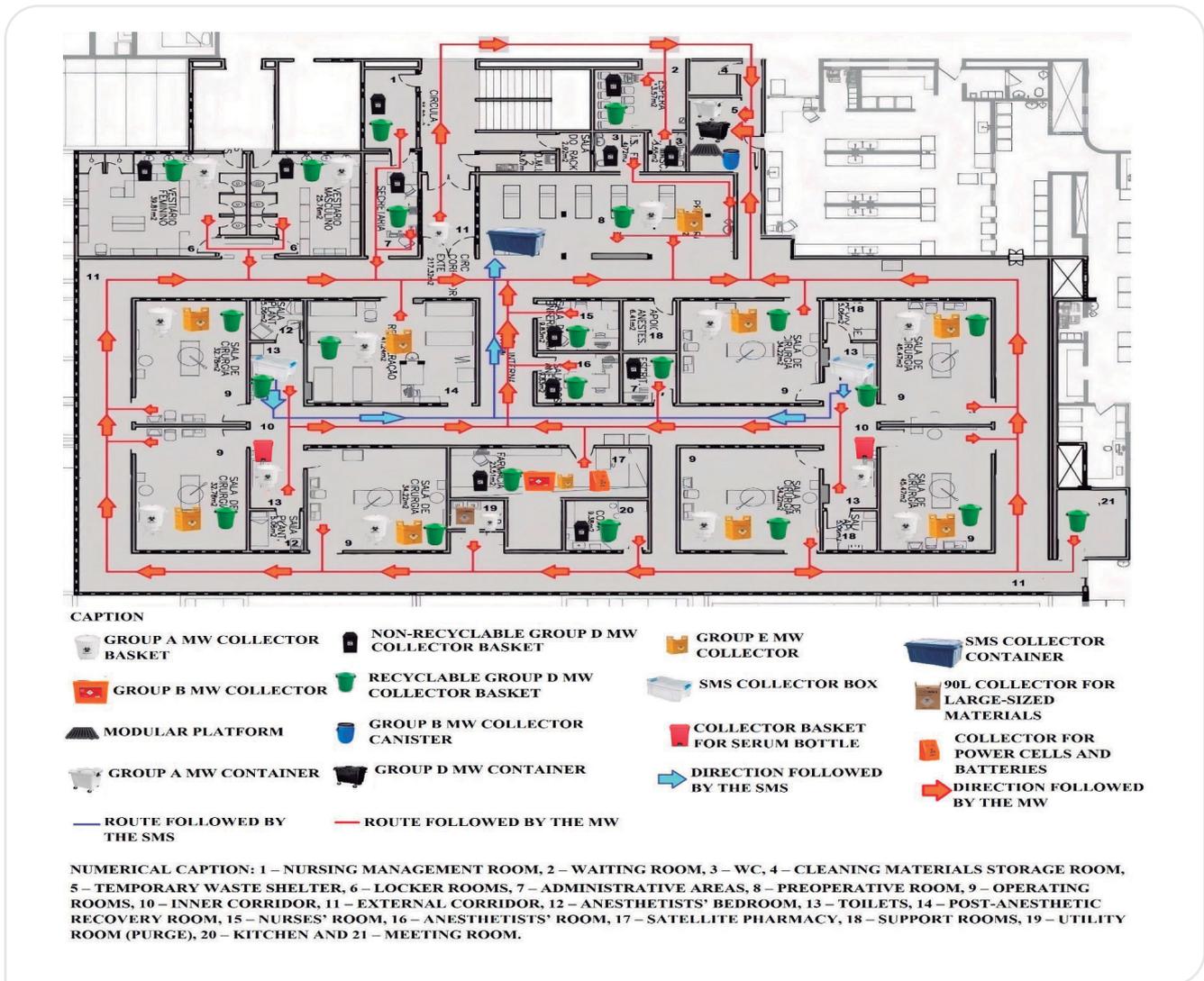
**Figure 1.** Distribution of collectors by MW group in the SC observed during data collection.

- Group A: implementation of 30 L and 50 L red collection bags (subgroup A1);
- Group B: implementation of a chemical waste collector centralized in the satellite pharmacy for disposal of leftover medication, a 50 L collection canister, which is suggested to be allocated in the internal waste shelter to collect chemical waste, such as formaldehyde, bottles of fixatives of anatomical parts, reagents, and liquid and sanitizing products;
- Group D: implementation of collectors for recyclable waste for serum near surgical center washrooms, operating rooms, and administrative areas;
- Group E: replacement of nine 20 L sharp waste collectors, at a unit cost of R\$ 5.45, found in the SC under study, by 3 L collectors, at a unit cost of R\$ 2.15 (values

extracted from the management information system of HU/UEL) and implementation of a 90 L collector for large-format materials, such as disposable materials used in videosurgeries.

As for the adequacy of the intermediate shelter on the SC premises, it is necessary to purchase a platform, so that the sharps boxes are not placed directly on the floor, in addition to rigid containers with lids (to transport MW) and nameplates.

From the triangulation of the data, Figure 2 shows the flowchart map with proposals for adjustments to RDC No. 222/2018, so that the SC under study would fully comply with current legislation and include sustainable practices in MW management.



**Figure 2.** Proposal for adaptation to legislation RDC No. 222/2018 and improvements for the surgical center.

To enhance a possible implementation of the adjustments, the costs of the material resources involved were measured, from the perspective of the hospital manager.

The average direct cost of materials needed to purchase long-term items is shown in Table 1, and the items that must be purchased monthly in Table 2.

Together with the acquisition of new collectors, plates, identification stickers, among other proposed materials, it is essential that the service offers some type of continuing education activity, in order to raise awareness and guide professionals on the proper handling of MW.

As for the average direct cost of the necessary adjustments to the SC in this study, the initial total investment of R\$ 7,891.25 was reached, with that, the SC would fully comply with the current Brazilian legislation. The main argument, from the manager’s point of view, was the fact that no other

reference studies were found that relate the cost of adapting the MW management processes.

## DISCUSSION

The great challenge in managing MW is to articulate all the planned stages in a safe and sustainable manner, as this requires knowledge, investment, and multidisciplinary strategies on the part of the professionals involved in this process.

Nursing professionals are prominent actors in this scenario, as they are the ones who consume most of the materials that will give rise to the MW and who manage the processes related to this theme<sup>15</sup>.

A study carried out with the objective of quantifying the types of MW generated in a hospital located in the southern

**Table 1.** Measurement of the cost of adequacy proposals for long-term items.

Items	Quantity	Unit Cost (R\$)	Total Cost (R\$)
60 L green collector basket	07	70.00	490.00
60 L red collector basket	01	70.00	70.00
10L trash can with pedal, with steel support	06	73.33	439.98
3 mm PVC plate, size 80x15 cm, in digital sticker, for identification*	01	16.80	16.80
3 mm PVC plate, size 40x10 cm, in digital sticker, for identification*	03	05.60	16.80
10x10 cm vinyl sticker for identification	42	03.83	160.86
15x25 cm vinyl sticker for identification	05	16.95	84.75
20x20 cm vinyl sticker for identification	05	17.00	85.00
Modular polypropylene platform*	01	64.68	64.68
Container (cart for manual transport – 500 L plastic model)*	04	1,480.00	5,920.00
<b>Total cost</b>			<b>7,348.87</b>

\*Values extracted from the HU/UEL management information system, Londrina, 2020.

**Table 2.** Measurement of the cost of adequacy proposals with monthly purchase items.

Items	Quantity	Unit Cost (R\$)	Total Cost (R\$)
Group B MW Collector*	01	26.15	26.15
50 L collection canister for Group B MW	01	102.50	102.50
20 L collector for power cells and batteries	01	142.33	142.33
50 L green bag for common MW*	600	00.20	120.00
30 L red bag for infectious MW*	150	00.20	60.00
50 L red bag for infectious MW*	150	00.23	34.50
90 L collector for large-sized materials	01	56.90	56.90
<b>Total cost</b>			<b>542.38</b>

\*Values extracted from the HU/UEL management information system, Londrina, 2020.

region of Brazil found that the operating room was the sector that occupied second place in terms of waste generation. The most generated were those in Group A (infective), due to the large number of invasive procedures performed in this sector<sup>16</sup>.

Considering that the first step for proper MW management is the correct segregation of these wastes when they are generated, it is up to health professionals to dispose of them in the proper place to ensure the safety of the following steps of their management<sup>5</sup>.

Therefore, it is extremely important that workers know the criteria for MW classification and, in the event of a change in the legislation on its management, that continuing education is promoted.

It is also essential that health services provide adequate collectors, transport, and storage structure for the management of these wastes.

It is worth noting a change in the legislation on the use of a red collection bag, which, in RDC No. 306/2004, was only for some subdivisions of Group A and, in current Brazilian legislation, the use of a red bag is mandatory for all Group A waste, which needs treatment<sup>1,2</sup>.

The cost of disposing of hazardous waste was eight times higher than common waste, which is all the more reason for the proper handling of MW<sup>8</sup>.

In this study, the placement of collectors for Group B-Chemical MW was suggested, two of them allocated in the satellite pharmacy, one for the collection of bottles with leftover medications and the other exclusive for batteries.

The collector of power cells and batteries was suggested to avoid negligence in their disposal, as presented in another study<sup>17</sup>.

For the disposal of bottles of chemical products, such as formalin and sanitizing products (belonging to Group B), it was suggested to place a 50 L collection canister in the internal MW shelter of the SC under study.

The adaptations of collectors have the main objective of complying with legislation RDC No. 222/2018 and, consequently, reduce risks to the professional's occupational health and the environment.

It was observed that items such as disposable tweezers from videosurgery were being discarded in the sharps collector in an irregular manner. It was suggested to reduce the size of the piercing-cutting MW collection box in the operating room and to implement the 90 L collector for large-sized materials, which is a specific container for this type of material.

The operating room is a sector that poses a risk to the health of workers, so that professionals, at various times of care, are exposed to the generated MW. Nursing professionals are not the only generators of MW, but it is up to them to provide continuity of care. With this, they are often the professional designated to manage the MW<sup>18</sup>.

Taking sustainability into account, it is essential to have articulated planning with the purchasing, material resource management, pharmacy and laboratories sectors, in order to implement measures for non-generation and/or reduction of MW, reuse policies, and recycling<sup>19</sup>.

In this study, it was proposed to install collectors for recyclable waste in operating rooms. Another study showed the use of a specific collector for serum bottles, as this material can be recycled, transformed, and reused<sup>20</sup>.

A reuse strategy already implemented in the SC under study is the separation of a non-woven fabric, the spunbonded metblown spunbonded (SMS), a product made 100% of polypropylene and used as surgical packaging, with no commercial market and technology for processing in the region. In the work routine, the room circulator personnel separate the clean SMS, fold it, and place it in boxes, which are sent to make bags for the patients of the hospital under study<sup>21</sup>.

The correct identification of the type of MW is a requirement of current legislation in Brazil and an important facilitator of the health professional's work in the correct segregation of MW<sup>17</sup>. With that, there is a wide benefit for health services, workers, the community, and the environment.

Therefore, the acquisition of identification items is justified, as recommended by RDC No. 222/2018<sup>1</sup> and NBR 7500<sup>3</sup>.

Taking into account Regulatory Standard (NR) No. 32, which discusses occupational safety and health in health services, it regulates that the service must promote measures that reduce and prevent occupational accidents<sup>22</sup>.

It is noteworthy that, with the implementation of all proposals for adaptation and improvement for the sector, it is extremely necessary to carry out a broad and constant work of continuing education with the team members and health education with patients and caregivers<sup>23</sup>.

The limitation of this study is related to the unavailability of indirect cost variables in the management of MW, as they involve several contracts with the university, so it is possible to include only the average direct cost in the scope of this research.

The advancement of knowledge lies in making known the necessary adjustments to the new legislation and to the

cost values (R\$), which can be used as a model of comparison in studies involving other hospitals.

Carrying out a diagnosis of the profile of local waste generation, identifying the groups generated, sectors that generate them the most, estimating the generation and volume of collectors, mapping the existing transport, storage and final disposal flows and processes can enhance management practices sustainable in the operating room and increase the safety of workers and the environment<sup>8</sup>.

## CONCLUSION

It was evident that adjustments are needed in the surgical center under study regarding the current legislation in Brazil

in all groups of MW so that their management is correct and safe. For the changes to be implemented, it is necessary to coordinate the various managers involved in the management and measurement of costs related to waste.

Measures focusing on occupational safety and continuing education related to MW are necessary for the implementation of sustainable practices and the maintenance of the adequacy plan proposed in this study.

This study is expected to help other health services to identify the necessary adjustments to Brazilian legislation and define cost methodologies so that it can be used as a reference in future investigations and arguments with managers, and that the cost values serve as a reference for other services that may need to be adapted to current Brazilian legislation.

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