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Environmental disclosure of healthcare waste in public university hospitals in Brazil: diagnosis and proposal of a disclosure model aimed at transparency and sustainability

Divulgación ambiental de residuos de servicios de salud en hospitales universitarios públicos en Brasil: diagnóstico y propuesta de un modelo de divulgación orientado a la transparencia y la sostenibilidad

Evidenciação ambiental de resíduos de serviços de saúde nos hospitais universitários públicos no Brasil: diagnóstico e proposição de modelo de divulgação voltado à transparência e sustentabilidade

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Abstract

Purpose: Propose an environmental disclosure model for healthcare waste aimed at public university hospitals in Brazil.

Methodology: The research, of a descriptive nature, employed content analysis of reports published by university hospitals and Brazil's top hospitals. Data collection was conducted by accessing the hospitals' websites to download the latest report published by each institution. After identifying the reports, all were analyzed according to the categories and items of the

research instrument, with scores ranging from 0 (when the item was not disclosed) to 3 (when the item was disclosed with detailed information).

Results: Based on the results, an HCW environmental disclosure model was developed for public university hospitals, structured into three categories: (1) Senior Management Approach (4 items), which address waste management strategies and practices; (2) Waste Management Activities (8 items), which details actions for managing and reducing HCW production; and (3) Waste Management Performance (14 items), which assesses monitoring, related incidents, and implemented changes in HCW management.

Contributions of the Study: This research contributes to the literature by expanding knowledge on healthcare waste in public university hospitals in Brazil. Additionally, it has significant practical implications. Public university hospitals can use the proposed model to enhance their waste management disclosure, aligning with sustainability and transparency principles. The model can also be adopted by regulatory bodies to standardize HCW disclosure in Brazilian hospitals, providing a framework for these public institutions to implement in their reporting practices.

Keywords: Healthcare waste (HCW). Disclosure. Healthcare sector. Sustainability.

Resumen

Objetivo: Proponer un modelo de divulgación ambiental de residuos de servicios de salud destinado a hospitales universitarios públicos en Brasil.

Metodología: La investigación, de carácter descriptivo, utilizó el análisis de contenido de los informes divulgados por los HUs y por los mejores hospitales de Brasil. La recopilación de datos se realizó mediante el acceso al sitio web de los hospitales para descargar el último informe divulgado de cada institución. Después de identificar los informes, todos fueron analizados según las categorías e ítems del instrumento de investigación, asignándose una nota de 0 (cuando el ítem no fue evidenciado) a 3 (cuando el ítem fue divulgado con información detallada).

Resultados: Con base en los resultados obtenidos, se elaboró un modelo de evidencia ambiental de RSS para los HUs públicos, compuesto por tres categorías: 1) Enfoque de la alta gerencia (4 ítems), que trata de la estrategia y prácticas de gestión de residuos; 2) Actividades de gestión de residuos (8 ítems), que detalla las acciones para gestionar y reducir la producción de RSS; y 3) Desempeño de gestión de residuos (14 ítems), que evalúa el monitoreo, los accidentes relacionados y los cambios implementados en la gestión de RSS.

Contribuciones del Estudio: Esta investigación contribuye a la literatura al ampliar el conocimiento sobre residuos de servicios de salud en hospitales universitarios públicos en Brasil. Además, posee implicaciones prácticas importantes. Los hospitales universitarios públicos pueden utilizar el modelo propuesto para mejorar su divulgación de gestión de residuos, en consonancia con los principios de sostenibilidad y transparencia. El modelo también puede ser adoptado por órganos reguladores para estandarizar la evidencia de RSS en Brasil para hospitales, ofreciendo un marco para que estas instituciones implementen en sus prácticas de divulgación.

Palabras clave: Residuos de servicios de salud (RSS). Divulgación. Sector de la salud. Sostenibilidad.

Resumo

Objetivo: Propor um modelo de evidência ambiental de resíduos de serviços de saúde destinado a hospitais universitários públicos no Brasil.

Metodologia: A pesquisa, de caráter descritivo, utilizou análise de conteúdo dos relatórios divulgados pelos HUs e pelos melhores hospitais do Brasil. A coleta de dados se deu por meio de acesso ao site dos hospitais para realizar o download do último relatório divulgado de cada instituição. Após identificar os relatórios, todos foram analisados conforme as categorias e itens do instrumento de pesquisa, sendo atribuída uma nota de 0 (quando o item não foi evidenciado) a 3 (quando o item foi divulgado com informações detalhadas).

Resultados: Com base nos resultados obtidos, foi elaborado um modelo de evidência ambiental de RSS para os HUs públicos, composto por três categorias: 1) Abordagem da alta gerência (4 itens), que trata da estratégia e práticas de gerenciamento de resíduos; 2) Atividades de gestão de resíduos (8 itens), que detalha as ações para gerenciar e reduzir a produção de RSS; e 3) Desempenho de gestão de resíduos (14 itens), que avalia o monitoramento, os acidentes relacionados e as mudanças implementadas na gestão de RSS.

Contribuições do Estudo: Esta pesquisa contribui para a literatura ao ampliar o conhecimento sobre resíduos de serviços de saúde em hospitais universitários públicos no Brasil. Além disso, possui implicações práticas importantes. Os hospitais universitários públicos podem utilizar o modelo proposto para aprimorar sua divulgação de gerenciamento de resíduos, em consonância com os princípios de sustentabilidade e transparência. O modelo também pode ser adotado por órgãos reguladores para padronizar a evidência de RSS no Brasil para hospitais, oferecendo um framework para estas instituições implementarem em suas práticas de divulgação.

Palavras-chave: Resíduos de serviços de saúde (RSS). Evidência. Setor de saúde. Sustentabilidade.

1 Introduction

The healthcare industry is one of the fastest-growing sectors worldwide, offering a vast range of specialised services that, in turn, generate an increasing volume of healthcare waste (HCW) (Kenny & Priyadarshini, 2021; Ranjbari et al., 2022; Sepetis et al., 2022). The World Health Organization (WHO) defines HCW as all waste produced in hospitals, medical and healthcare centres, research and diagnostic units, treatment and immunisation facilities, and related investigative institutions (Ananth et al., 2010).

Proper management of healthcare waste remains a major challenge for hospital administration (Thakur et al., 2021), as its inappropriate handling poses severe risks to the environment, human health, and sustainability, due to its hazardous and infectious nature (Ranjbari et al., 2022). The rising demand for hospital services and the need to integrate sustainable practices into management have led hospitals to redesign their business models and adopt new operational approaches (Garzoni et al., 2024). In this context, corporate sustainability is essential to ensure that hospital organisations become more competitive and environmentally responsible (Oliveira & Oliveira, 2022).

In this regard, sustainability reports have become a vital tool for organisations to demonstrate their positive contributions to society while providing a comprehensive account of

areas that present challenges or shortcomings (Jones & Mucha, 2014). According to Oliveira et al. (2024), disclosure involves presenting economic, financial, social, and environmental data and information to stakeholders through specific reporting techniques.

There are multiple ways of disclosing social and environmental information, as there is no universally standardised format for such reporting. Although the Global Reporting Initiative (GRI) recommends the inclusion of sustainability-related content in corporate reports, the specific information disclosed varies according to each organisation's context (Prates & Avelino, 2024). According to Peña et al. (2020) and Andrades et al. (2021), sustainability disclosure practices in the public sector are less widespread than in the private sphere, and the healthcare sector lags behind other industries in adopting sustainability reporting practices.

Brazil has in place public policies aimed at protecting occupational and public health, as well as the environment. Despite having a legal framework guiding healthcare waste management, the issue remains a challenge for hospital administrations, given the need for investments in infrastructure and training to reduce waste generation and to ensure that only hazardous waste is treated, along with the necessity for managerial knowledge and accountability (Figueiredo et al., 2020).

In Brazil, healthcare operates under two systems: the Unified Health System (Sistema Único de Saúde – SUS), which is the main source of hospital funding, and the private sector. The hospital sector is further divided into three sub-sectors: public hospitals administered by federal, state, or municipal authorities; private philanthropic hospitals contracted by the SUS; and private for-profit hospitals (Loreti et al., 2018).

Brazilian university hospitals (UHs) are public institutions funded by the government and integrated into the SUS network (Rosa et al., 2022). The Brazilian Hospital Services Company (Empresa Brasileira de Serviços Hospitalares – EBSEH) [Brazilian Company of Hospital Services] defines UHs as key centres for training healthcare professionals and supporting education, research, and community outreach at federal universities to which they are affiliated (EBSEH, 2024).

According to Abbade (2022), the management of Brazilian university hospitals faces highly complex challenges that demand assertive measures to modernise both strategic and operational management in healthcare. Accordingly, this research addresses the following question: **What is the level of environmental disclosure regarding healthcare waste management in the management reports of public university hospitals in Brazil?** Based on this question, the study aims to propose an environmental disclosure model specifically designed for public university hospitals in Brazil.

Rodrigues et al. (2020) observe that within the healthcare industry, there is not only a lack of transparency concerning sustainability practices but also a shortage of studies addressing sustainability aspects, despite their critical importance to the sector. Garzoni et al. (2024) further emphasise that, although the topic has gained relevance, it remains underexplored in academia. To date, few studies have examined environmental disclosure practices concerning healthcare waste in Brazilian public university hospitals.

This research is justified by the relevance of proposing a healthcare waste disclosure model for public university hospitals in Brazil. These institutions, due to their social mission, are called upon to integrate environmental and social concerns into their operations. The proposed model emerges from a structured investigative process that includes document analysis, mapping of current disclosure practices, and identification of gaps in the environmental reporting of Brazilian public university hospitals.

Thus, this study contributes to a deeper understanding of environmental disclosure practices within the public healthcare sector, offering a practical framework that may support managers, policymakers, and regulatory bodies in promoting greater transparency and socio-environmental accountability in healthcare waste management.

2 Literature Review

2.1 Healthcare Waste

Worldwide, there is a shortage of effective services for the management of healthcare waste (HCW), particularly in nations with lower levels of economic development. Statistics from 2019 reveal that one-third of hospital units globally are poorly managed and that HCW lacks proper and safe management systems (Aghapour et al., 2013; WHO, 2022).

This situation can be attributed to the challenges faced in implementing healthcare waste management policies, such as insufficient financial resources, lack of training among workers handling infectious waste, and the use of outdated technologies and methods for waste disposal (Thakur et al., 2021). However, for healthcare waste management policies to be successfully implemented, access to accurate and comprehensive information on waste generation rates, proper identification, quantities, and composition of waste is essential to achieve safe and effective management (Ranjbari et al., 2022; Taghipour & Mosaferi, 2009).

The World Health Organization (WHO) and the International Atomic Energy Agency (IAEA) have developed policies and guidelines to assist countries in implementing improved healthcare waste management systems. Additionally, 184 countries have signed the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989), 180 have signed the Stockholm Convention on Persistent Organic Pollutants (2004), and 128 have signed the Minamata Convention on Mercury (2013) (WHO, 2017; Ranjbari et al., 2022).

The Basel Convention aims to protect human health and the environment from the adverse effects of the generation, management, transboundary movements, and disposal of hazardous and other wastes. The Stockholm Convention on Persistent Organic Pollutants seeks to safeguard human health and the environment from highly hazardous and long-lasting chemical compounds by eliminating their production, use, trade, release, and storage. The Minamata Convention, in turn, stipulates under Article 4 the gradual elimination of the import, export, and manufacture of mercury thermometers and sphygmomanometers, as well as dental amalgam used in healthcare services (WHO, 2017).

In addition to adherence to these international conventions, Brazil has several key legal frameworks governing healthcare waste management, including Law No. 12.305 of 2 August 2010, National Environmental Council (CONAMA) Resolution No. 358 of 29 April 2005, and Collegiate Board Resolution (RDC) No. 222 of 28 March 2018.

Law No. 12.305/2010 establishes the National Solid Waste Policy, outlining its principles, objectives, and strategies, and setting guidelines for integrated management and control of solid waste, including hazardous waste. It defines the responsibilities of waste producers and governmental authorities (Law No. 12.305, 2010). CONAMA Resolution No. 358/2005 provides guidelines for the final disposal of healthcare waste, with special attention to potential environmental impacts (*CONAMA Resolution No. 358, 2005*).

RDC Resolution No. 222/2018, issued by the National Health Surveillance Agency (Anvisa), regulates best practices for healthcare waste management and related procedures. According to Article 2, this resolution applies to all healthcare waste generators, whether public or private, and includes institutions engaged in teaching and research activities that involve any stage of waste management (*RDC Resolution No. 222, 2018*).

Healthcare waste management must encompass all stages of planning and resource allocation, including the training of human resources, and must address all phases of waste generation within healthcare facilities - segregation, transportation, storage, treatment, and final disposal (Aghapour et al., 2013; *RDC Resolution No. 222, 2018*). Thakur et al. (2021) further

emphasise the importance of appropriate monitoring plans and the reduction of pollution during waste treatment.

Hospital waste can be classified into two main types: general waste, also known as common waste, and hazardous waste (Lee et al., 2004). Approximately 85% of all healthcare waste produced by medical providers is classified as non-hazardous or general waste (WHO, 2017; Taghipour & Mosaferi, 2009). Since general waste shares the same composition as municipal solid waste, it must be properly segregated, sealed, and processed through the municipal waste disposal system alongside other urban waste (Chaerul et al., 2008; Massei & Specchia, 2023; Taghipour & Mosaferi, 2009). The remaining 15% is considered infectious or hazardous and may pose significant risks to human health and the environment, as it is a by-product of diagnostic, experimental, and therapeutic procedures (WHO, 2017; Taghipour & Mosaferi, 2009). Proper segregation plays a vital role in controlling healthcare waste management costs and ensuring the correct methods of storage, transport, and final disposal (Aghapour et al., 2013; Lee et al., 2004).

Hazardous healthcare waste requires specific treatment and disposal methods. Segregation at the source is a crucial step, as it determines the final destination of the waste—whether it will be recycled, reused, or subjected to additional treatment (Massei & Specchia, 2023). Treatment methods for healthcare waste can be divided into three main categories: 1. Thermal processes, 2. Chemical processes, and 3. Irradiation processes, although incineration, a thermal method, remains the most commonly used (Diaz et al., 2005; Kenny & Priyadarshini, 2021). Other treatment methods include recycling, reuse and processing, landfilling, burial in special pits, and encapsulation.

To ensure efficient resource management and promote sustainable procurement, healthcare institutions should adopt and monitor specific indicators to identify opportunities and establish goals aimed at reducing waste generation, lowering costs, and implementing effective waste management programmes (Sepetis et al., 2022; Taghipour & Mosaferi, 2009). For a healthcare system to achieve sustainability, appropriate organisational reforms, policy adjustments, operational changes, and management model innovations are essential, as these actions are critical to preserving health and social well-being (Sepetis et al., 2022).

2.2 Sustainability Reports

Companies around the world are increasingly adopting sustainability reports, a growth driven by stakeholders' demand for greater transparency on environmental and social issues (Purvis et al., 2019; Siew, 2015). Although organisations differ in how they interpret and implement sustainability in their daily operations, most agree on the importance of disclosing sustainability information (Landrum & Ohsowski, 2018).

The evolution of sustainability reporting can be divided into four distinct phases: 1) First phase (1960s–1970s) – Neglecting Sustainability; 2) Second phase (1980s–1990s) – Experimenting with Sustainability Niches; 3) Third phase (2000s–2010s) – Reinforcing Sustainability; and 4) Fourth phase (2020 onwards) – Integrating Sustainability (Lai & Stacchezzini, 2021).

The development of sustainability reports dates back to 1962. The first phase was characterised by limited interest in sustainability-related issues, with the debate largely centred on accounting standards and how to produce more transparent and comparable financial reports across industries and countries (Lai & Stacchezzini, 2021). The publication of *Silent Spring* by Rachel Carson in 1962 sparked the first wave of socio-environmental awareness, exposing the harmful effects of industrial activities and influencing global environmental consciousness (Gokten et al., 2020).

The term sustainability remains an open and multifaceted concept with various interpretations (Purvis et al., 2019). The most widely accepted definition is found in the Brundtland Report (1987), titled *Our Common Future*, which describes sustainable development as that which meets the needs of the present without compromising the ability of future generations to meet their own needs. Although the term had existed earlier, the Brundtland Commission popularised it globally (Purvis et al., 2019).

During the second phase, accounting practices evolved to include non-financial information, contributing to the creation of early sustainability reporting models (Lai & Stacchezzini, 2021). One of the first methodological frameworks to emerge was environmental accounting (Elkington, 1993), defined as a method for measuring, analysing, and categorising the environmental costs of organisational activities, preparing reports that serve both internal and external stakeholders in decision-making and performance evaluation (Alassuli, 2023). Following the Exxon Valdez oil spill in 1989, environmental reporting gained greater global relevance (Gokten et al., 2020). In the early 1990s, sustainability reporting began to appear in discussions surrounding environmental accounting, focusing on the ecological impacts of corporate operations (Gokten et al., 2020).

The third phase, spanning the first two decades of the 21st century, saw a marked increase in non-financial reporting, as noted by the International Integrated Reporting Council (IIRC). This trend reflected a shift in how companies communicate performance and management practices (Lai & Stacchezzini, 2021). During the late second and early third phases, the Global Reporting Initiative (GRI) emerged as the main international reference framework for sustainability disclosure (Gokten et al., 2020), alongside the development of Integrated Reporting (Lai & Stacchezzini, 2021).

A sustainability report is an integrated form of disclosure that presents an organisation's economic, environmental, and social performance. It must be publicly accessible and provide stakeholders with information on how the company addresses corporate sustainability challenges (Daub, 2007). The World Business Council for Sustainable Development (WBCSD) (2002, p. 7) defines sustainability reports as “public disclosures to internal and external stakeholders of the corporate position and activities regarding the economic, environmental, and social dimensions,” whose purpose is to demonstrate the company's contribution to sustainable development.

The fourth phase of sustainability reporting, from 2020 onwards, demands significant changes in corporate disclosure, driven by policymakers, regulators, and standard-setting institutions (Lai & Stacchezzini, 2021). Stakeholder interest in environmental issues has grown considerably in recent years, motivating companies to provide more voluntary environmental information (Benjamin et al., 2020).

Signalling and disclosure theories suggest that companies engaging in environmentally responsible activities seek to highlight such efforts to stakeholders and the public through voluntary environmental reporting (Benjamin et al., 2022). In the context of hospitals, sustainability disclosure is regarded as a non-mandatory norm that ensures institutional legitimacy (Garzoni et al., 2024).

Since the 1990s, various initiatives have been launched to promote sustainability reporting, including the Global Reporting Initiative (GRI) and the United Nations Global Compact (Andrades et al., 2024). Until 2020, most sustainability reporting standards and guidelines were developed by both public and private institutions such as the GRI, IIRC, Climate Disclosure Standards Board (CDSB), Task Force on Climate-related Financial Disclosures (TCFD), and Sustainability Accounting Standards Board (SASB), among others (Afolabi et al., 2022; Ginner & Luque-Vílchez, 2022).

Founded in 1997 by the Coalition for Environmentally Responsible Economies (CERES) and the Tellus Institute, with the support of the United Nations Environment

Programme (UNEP), the GRI became one of the main institutions defining environmental reporting standards (Afolabi et al., 2022; Gokten et al., 2020). Its stakeholder-focused guidelines aim to ensure that companies disclose information enabling a better understanding of how their operations affect social and environmental issues. The GRI's primary mission is to provide a reliable framework for sustainability reporting (Ogata et al., 2018; Villiers et al., 2022).

The IIRC, founded in 2010, sought to provide a framework for the emerging concept of Integrated Reporting, aiming to improve information quality for financial capital providers and promote more efficient and productive capital allocation (Ogata et al., 2018). The SASB, established in 2011 as an independent standard-setter, developed 77 sustainability accounting standards covering 77 industries organised across nine sectors, including healthcare (SASB, 2024b).

In 2020, two additional institutions entered the sustainability reporting arena: the European Commission (EC), in partnership with the European Financial Reporting Advisory Group (EFRAG), and the International Financial Reporting Standards (IFRS) Foundation (Ginner & Luque-Vílchez, 2022). In November 2021, the IFRS announced the creation of the International Sustainability Standards Board (ISSB), designed to develop a comprehensive global baseline of sustainability disclosure standards to improve comparability across companies and time periods, addressing concerns such as greenwashing and bluewashing (Prates & Avelino, 2024).

Considering the complexity of the corporate sustainability disclosure landscape, in June 2021 the International Integrated Reporting Council (IIRC) merged with the Sustainability Accounting Standards Board (SASB), thus creating the Value Reporting Foundation (VRF). This merger represented significant progress towards simplifying sustainability reporting (Afolabi et al., 2022; SASB, 2024a).

The International Financial Reporting Standards (IFRS) Foundation consolidated the Climate Disclosure Standards Board (CDSB) and the VRF in 2022 (CDSB, 2022; SASB, 2024a). As a result of these consolidations carried out by the IFRS, the International Sustainability Standards Board (ISSB) materialises the work on sustainability reporting designed to meet investors' information needs, providing companies with standards, frameworks, and recommendations to disclose useful information that supports efficient decision-making in global capital markets (SASB, 2024a).

The EFRAG, a private association established in 2001 with encouragement from the European Commission, expanded its mission in 2022 under the Corporate Sustainability Reporting Directive (CSRD) to offer technical advice for developing and revising sustainability standards for the European Union (EFRAG, 2024). Compared with the IFRS Foundation, the EFRAG adopts a broader vision, aiming to contribute directly to sustainable development goals, whereas the IFRS initially focused on investor-oriented reporting (Ginner & Luque-Vílchez, 2022).

In summary, numerous global organisations are engaged in defining sustainability reporting standards and guidelines. However, newer institutions such as the IFRS and EFRAG aim to establish mandatory global standards—unlike earlier initiatives, which merely provided voluntary disclosure frameworks (Ginner & Luque-Vílchez, 2022).

3 Methodological Procedures

To answer the research question, a descriptive and qualitative study was conducted to examine the disclosure practices of healthcare waste (HCW) through content analysis of the most recent annual reports (or similar reports) published on the websites of university hospitals administered by the Brazilian Hospital Services Company (EBSERH) and of the best hospitals

in Brazil. The ranking of the best hospitals is provided by Newsweek and Statista, which includes the best hospitals in the world (Newsweek, 2024).

Figure 1 and Table 1 present, respectively, the university hospitals administered by EBSEH and the top-ranked hospitals that were the objects of this study. All reports were collected between August and September 2024.

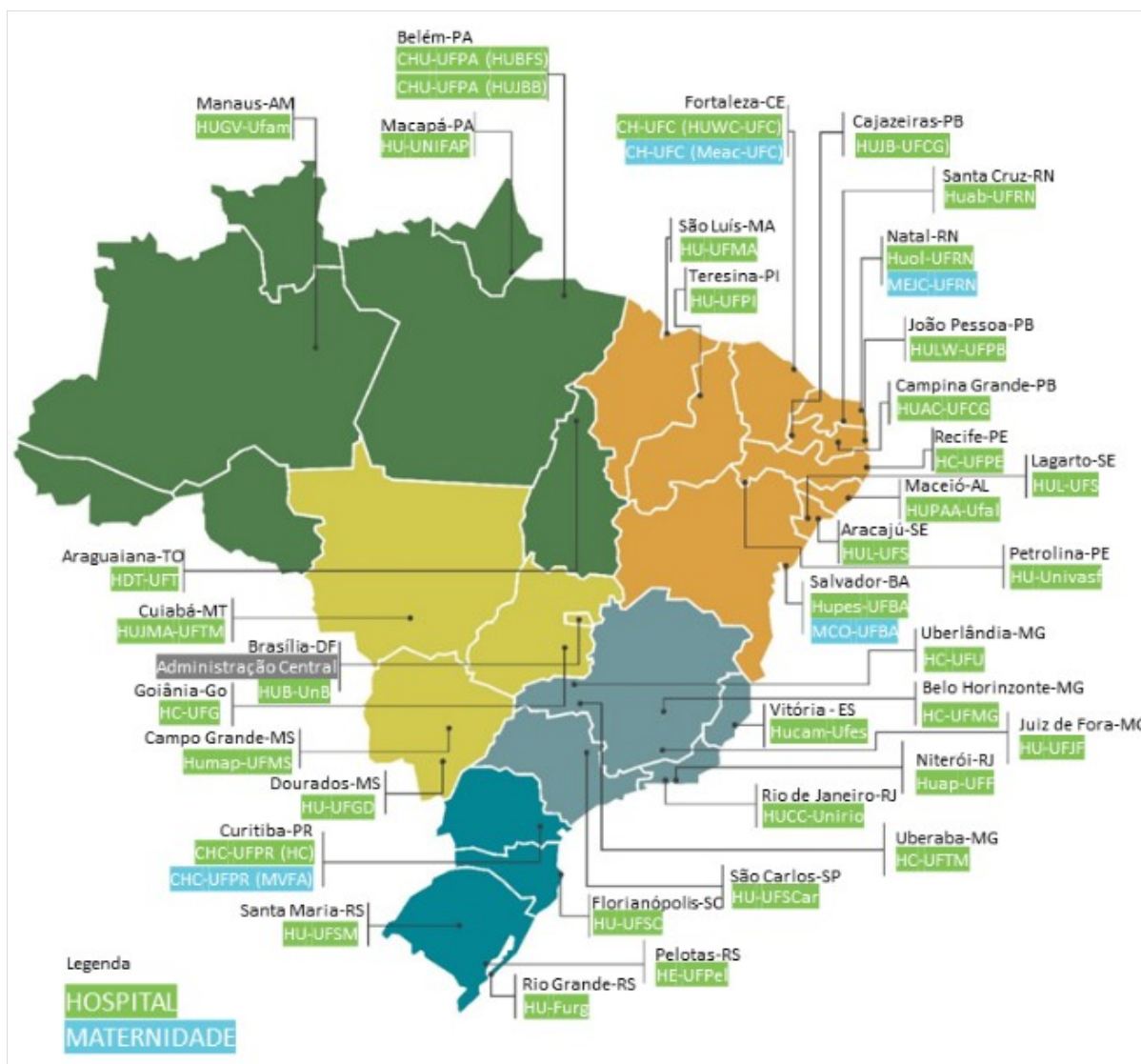


Figure 1 University Hospitals administered by EBSEH

Source: EBSEH, 2024.

In 2023, EBSEH was responsible for managing 37 university hospitals and 4 teaching maternity hospitals. However, only 33 reports were analysed, as documents from five university hospitals were not found on their respective websites. In addition, three federal universities with hospital complexes disclosed a single consolidated report.

Table 1*World's Best Hospitals 2024 – Top 250 – Brazilian Hospitals*

Position	Hospital	City
28	Hospital Israelita Albert Einstein	São Paulo
82	Hospital Sírio-Libanês	São Paulo
119	Hospital Alemão Oswaldo Cruz	São Paulo
132	Hospital Moinhos de Vento	Porto Alegre
171	Hospital Santa Catarina Paulista	São Paulo
200	Hospital das Clínicas da Universidade de São Paulo	São Paulo

Source: adapted from *Newsweek* (2024).

The best hospitals in Brazil, according to the annual ranking World's Best Hospitals 2024 – Top 250, include six leading institutions. Considering the relevance of these hospitals in the Brazilian healthcare context, it becomes essential to investigate how they communicate their environmental practices, particularly regarding waste management.

In this regard, content analysis is widely adopted by accounting researchers to collect and report evidence on environmental and social reports (Ha & Mansi, 2023).

The proposed model was developed based on the study by Ha and Mansi (2023) and grounded in the GRI 306: Waste 2020 Technical Standard (GRI, 2020), which provides guidelines for organisations to report environmental impacts related to waste and their management strategies. Additionally, relevant Brazilian regulations were considered, such as CONAMA Resolution No. 358/2005, which defines guidelines for the treatment and final disposal of healthcare waste (HCW), and the National Solid Waste Policy (Law No. 12.305/2010), which guides waste management at the national level. The RDC Resolution No. 222/2018, which establishes best practices for healthcare waste management, was also incorporated into the model's structure.

Based on these references, the research instrument comprised 26 key items for waste disclosure, distributed into three categories: 1) Top management approach (4 items), which deals with strategy and waste management practices; 2) Waste management activities (8 items), which detail the actions taken to manage and reduce the generation of healthcare waste (HCW); and 3) Waste management performance (14 items), which assesses monitoring, related incidents, and the changes implemented in HCW management. The categories were adopted from the study by Ha and Mansi (2023). The exclusion of the category related to waste management costs is justified as it does not fall within the scope of this research.

The analysis of the items was performed using the four-point scale proposed by Adler et al. (2018), shown in Table 2, to assess the extent of disclosure. This approach overcomes the limitations of a binary scale, which fails to distinguish between hospitals with detailed disclosure and those with limited disclosure of a given item.

Table 2*Quality Scale: Disclosure of Waste Management Items*

Score	Description
0	The index item was not disclosed.
1	Disclosures were minimal, vague, and/or entirely general.
2	Disclosures contained objective, verifiable, and current data.
3	Disclosures included all elements classified as “2” and provided specific details such as data explanation, facility identification, etc.

Source: adapted from Adler et al. (2018).

The data analysis and storage procedures were carried out using Microsoft Excel spreadsheets, which assisted in organising the collected data.

4 Results and Analysis

The findings reveal an unsatisfactory performance of the university hospitals (UHs) assessed regarding the disclosure of information on waste. Most UHs, corresponding to 60.61% (20 UHs), scored 0, reflecting a significant absence of information on waste in the reports analysed. A smaller group, representing 24.24% (8 UHs), scored 1, while only one UH (3.03%) achieved a score of 2. In addition, 9.09% (3 UHs) reached a score of 3, and only one UH (3.03%) obtained a score of 5. Given that the maximum possible score was 78 points (26 waste disclosure items multiplied by the maximum score of 3 for each item), the overall results of the university hospitals were well below expectations, demonstrating a deficiency in transparency and disclosure of waste-related information.

The university hospital that achieved the highest score was the Federal University of Goiás (UFG) Hospital, which disclosed 5 of the 26 items analysed. Table 3 presents the average score of the UHs by region.

Table 3
Average Score of UHs by Region

Region	Average Score
Central-West	1,200
Northeast	0,625
North	0,333
Southeast	0,833
South	0,667

Source: *Research data.*

The region with the highest average was the Central-West, with an average score of 1.200. The UFG Hospital was responsible for this result, considering that only the University of Brasília Hospital disclosed a single item, while the remaining hospitals in the Central-West region presented no disclosure for the items analysed. The second-highest average was observed in the Southeast region (0.833), followed by the South (0.667). The regions with the lowest waste disclosure were the North and Northeast, with averages of 0.333 and 0.625, respectively.

None of the top hospitals achieved the maximum score. Despite the overall low results, waste disclosure among Brazil's top hospitals was slightly higher than that observed in the UHs. Information disclosure was more consistent across the evaluated categories, with only 8 items (30.77%) not being disclosed by any hospital. Two hospitals (Hospital Santa Catarina Paulista and Hospital das Clínicas da Universidade de São Paulo), representing 33.33% of the top hospitals analysed, scored zero, indicating an absence of waste information in their reports. Hospital Moinhos de Vento achieved a score of 2, while Hospital Sírio-Libanês had the highest waste disclosure, reaching 32 points, disclosing 16 of the 26 items analysed. It was followed by Hospital Alemão Oswaldo Cruz with 28 points, and Hospital Israelita Albert Einstein with 20 points.

For a more detailed analysis of the reports, the 26 items were grouped into three categories: Top Management Approach to Waste (Category 1), Waste Management Activities (Category 2), and Waste Management Performance (Category 3), as shown in Table 4.

Table 4
Average Waste Disclosure by Category

Category	HUs	Brazil's Top Hospitals
1. Top Management Approach to Waste	0,000	0,667
2. Waste Management Activities	0,072	0,583
3. Waste Management Performance	0,011	0,476

Source: *Research data.*

Table 4 shows the average score of items according to the categories. As a result of the analysis, it was identified that waste disclosure levels were very low for both types of hospitals analysed. Among university hospitals, the averages ranged from 0.000 to 0.072, while among Brazil's top hospitals, the averages ranged from 0.476 to 0.583. The UHs did not make any disclosures in the items that make up Category 1 and achieved very low scores in the remaining categories. Although Brazil's top hospitals disclosed all three categories, their overall scores remained insufficient, given the relevance of the waste management topic. A possible explanation for this low level of disclosure may be related to the lack of clear standards, recommendations, and guidelines on how information concerning sustainability aspects should be disclosed within the healthcare industry (Garzoni et al., 2024).

The absence of waste disclosure found in the reports of the hospitals analysed also corroborates the findings of Andrades et al. (2021) and Peña et al. (2020), which indicate that the healthcare sector lags behind other sectors in adopting sustainability disclosure practices. This situation worsens when the hospital belongs to the public sector, as sustainability practices in the public sphere are not as widespread as in the private sector.

Hospitals Sírio-Libanês and Albert Einstein disclosed waste management information in accordance with the GRI standards, corroborating the findings of Peña et al. (2020), who found that Spanish public hospitals adopting the GRI framework in their annual or sustainability reports achieved higher levels of disclosure compared to those that did not. The university hospitals, however, did not follow any framework in their disclosures.

Garzoni et al. (2024) found that hospitals affiliated with universities tend to have a greater propensity to disclose sustainability information through their websites. This finding, however, was not confirmed in the present study, since the university hospitals showed lower levels of disclosure in their reports when compared with the top hospitals.

Previous studies on sustainability reports have focused on broad concepts of sustainability, neglecting specific aspects. Ha and Mansi (2023), when studying waste disclosure in the reports of Australian mining companies, reached a similar conclusion to the present research — that, in general, waste disclosure in corporate reports tends to be vague and incomplete, with limited reporting.

A possible explanation for the low extent of healthcare waste information disclosed by hospitals may be related to the reduced impact of coercive forces arising from mandatory legal requirements. In Brazil, the publication of reports that extensively cover information on hospital waste is not mandatory. This issue was also noted by Peña et al. (2020), who observed limited sustainability disclosure among Spanish public hospitals. Although certain laws and regulations have been approved in Spain, the extent of disclosed information remains limited, due to the lack of coercive mechanisms, such as the enforcement of penalties for non-compliance, which undermines efforts to promote sustainability disclosure.

In general, Brazilian university hospitals need to strengthen their commitment to waste management policies, so that such commitment is reflected in the disclosure of healthcare waste information. The following section presents a proposed environmental disclosure model for healthcare waste in public university hospitals in Brazil, based on the reports analysed.

5 Proposed Model for Environmental Disclosure of Healthcare Waste (HCW) for Public University Hospitals in Brazil

This section presents the proposed model for HCW disclosure for public university hospitals in Brazil.

Table 5

Proposed Disclosure Model

1. TOP MANAGEMENT APPROACH TO WASTE
This category comprises the top management strategy and focuses on waste management practices, including the vision, focus, and overall agenda of senior management.
1 Waste Management Policy
Disclose the policy adopted by hospital senior management for waste management, containing: - Objective - Scope - Principles - Guidelines; and - Responsibilities.
2 Waste Management Goals/Objectives or Action Plans for the Coming Years
Clearly disclose the goals/objectives established by senior management for waste management during their period of responsibility. Example: Reduce the total waste generated per patient by X% by 202X Recycle XX% of total common waste generated by 202X. Disclose the structured action plan designed to achieve the stated objectives.
3. Zero-Waste Index/Programmes
Disclose programmes developed by the hospital aimed at preventing the generation of waste. Provide detailed information about the programme, including its name, period, objectives, target audience, and applicable regulations. Example: Programme Name: Paperless Period: 2023 Applicable Regulation: Normative Resolution 534/2022, issued by the National Regulatory Agency for Private Health Insurance and Plans (ANS) Objective: To make the exchange of information between the hospital and health insurance operators 100% digital. Target Audience: Hospital Administrative Sector Note: Action implemented in 2023 by Hospital Albert Einstein.
4. Life-Cycle Approach
Disclose projects related to the life-cycle responsibility of products used in hospital activities, including partnerships with cooperatives or other associations of recyclable material collectors.
2. WASTE MANAGEMENT ACTIVITIES
This category comprises hospital waste management activities, stages, and initiatives undertaken to manage and reduce HCW generation.
5. Measures Taken to Prevent Waste Generation Throughout the Supply Chain
Disclose the actions taken to prevent waste generation throughout the supply chain. Examples: Sustainable procurement: Choosing suppliers who use biodegradable, recyclable, or returnable packaging. Reusable materials: Replacing disposable materials with reusable alternatives whenever possible, such as stainless-steel trays and fabric towels.
6. Recycled Materials Used in Operations
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Disclose actions undertaken during the reporting year to reuse recycled materials in hospital operations.

Provide detailed information about each initiative, including name, period, objectives, and results achieved.

Example:

Initiative: Green Bag

Brief Description: Reverse logistics partnership where plastics generated by the hospital are transformed into garbage bags for internal use.

Period: 2023

Objective: To eliminate new plastic generation in hospital activities.

Result Achieved: In 2023, 10 tonnes of alcohol gel and soap containers, as well as de-characterised saline syringes, were converted into raw materials for manufacturing garbage bags and recycling bins used within the hospital.

Note: Action implemented in 2023 by Hospital Sírío-Libanês.

7. Waste Management Partners

Disclose active partnerships in the reporting year, including partner name, objective, and partnership period.

Example:

Partner: Green Cycle

Period: 01/01/202X – 31/12/202X

Objective: Zero textile waste disposal.

Result Achieved: During 2023, nearly 13 tonnes were reused. Since the start of the programme, approximately 20 tonnes of sanitised fabrics have been transformed by the NGO partner into products such as bags and toiletry kits.

Note: Action implemented in 2023 by Hospital Albert Einstein.

8. Processes Used to Collect and Monitor Waste Data

Disclose the processes used to collect and monitor waste management data.

Example: Waste weighing at source, tagging and tracking, manual or digital reports, internal and external audits.

9. Waste Management Projects

Disclose waste management projects developed within the hospital.

Provide detailed information about each project, including name, period, objectives, target audience, and applicable regulations.

Example:

Project Name: Zero Waste

Period: 2023

Objective: To reduce the volume of waste sent to landfills.

Actions: Implementation of selective waste collection in all hospital sectors, promotion of recyclable material reuse, and composting of organic waste.

Result: Reduction of XX% in waste volume sent to landfills.

10. HCW Awareness Events for Staff and/or the Community

Disclose projects, actions, or training sessions related to HCW awareness.

When the event consists of staff training, disclose the number of participants, duration, and a brief description of the topics covered.

When the initiative targets the entire hospital, disclose its objectives, actions taken, and results achieved.

Example:

Initiative Name: Recycling Matters

Actions: Lectures and workshops, distribution of informational materials, and awards for departments achieving the best waste reduction rates.

Result: Increased staff engagement and recycling rates.

11. Participation in Waste Management Associations

Disclose any participation in associations specialising in hospital waste management.

12. For significant – actual and potential – waste-related impacts, provide a description of:
i. inputs, activities, and outputs that cause or may cause such impacts
ii. whether these impacts relate to waste generated by the organisation's own activities or by upstream/downstream activities in its value chain.

When disclosing this item, hospitals may specify input and output types, which may include raw materials, production materials, spills and losses, waste, by-products, products, or packaging (GRI 306).

3. WASTE MANAGEMENT PERFORMANCE

This category includes waste management performance measures, such as waste monitoring, waste-related accidents, and tracking changes over time.

13. Total Waste Generated (in metric tonnes), Broken Down by Waste Composition

Disclose the total volume of hazardous and non-hazardous waste over the last three years, as well as the percentage variation for the two most recent years, as shown below:

Example Disclosure (GRI 306-3)	2021	2022	2023	Δ 202x/202x
Hazardous waste generated by composition (in metric tonnes)				
infectious				
chemical				
radioactive waste				
Total Hazardous Waste				
Non-hazardous waste by composition (in metric tonnes)				
non-Recyclable				
recyclable				
organic				
Total Non-Hazardous Waste				
Hazardous and Non-Hazardous Waste (in metric tonnes)				
infectious, chemical and radioactive (hazardous)				
non-recyclable (non-hazardous)				
recyclable and organic (non-hazardous)				
Total waste (hazardous and non-hazardous)				

14. Contextual Information Required to Understand the Data and Compilation Methods

Disclose how the data were compiled and any additional contextual information necessary to interpret the data reported under Item 13.

15. Total Non-Disposed Waste (in metric tonnes), Broken Down by Waste Composition

Disclose the total volume of non-disposed waste (in metric tonnes) over the last three years, as well as the percentage variation for the two most recent years, as shown below:

Example (GRI 306-4 a.)	2021	2022	2023	Δ 202x/202x
Waste Composition				
organic waste – composting				
paper, plastic, metal, glass, etc. – recycling				
recycled hazardous waste				
Total				

16. Total Hazardous Waste Not Disposed (in metric tonnes), by Recovery Operations:

- i. preparation for reuse;**
- ii. recycling;**
- iii. other recovery operations.**

Disclose the total volume of **hazardous waste not destined** for disposal (in metric tonnes) over the last three years, and the percentage variation for the two most recent years, as shown below:

Example (GRI 306-4 b.)	2021	2022	2023	Δ 202x/202x
Hazardous Waste				
reprocessing				
co-processing				
recycling and batteries, accumulators, and LED lamps				

Total				
17. Total volume of non-hazardous waste not destined for disposal (in metric tonnes) and a breakdown of this total by the following recovery operations: i. preparation for reuse; ii. recycling; iii. other recovery operations (e.g. composting)				
Disclose the total volume of non-hazardous waste not destined for disposal (in metric tonnes) over the last three years, and the percentage variation for the two most recent years, as shown below:				
Example Disclosure (GRI 306-4 c.)	2021	2022	2023	Δ 202x/202x
non-Hazardous Waste				
recycling				
other recovery operations (composting)				
Total				
18. For Each Recovery Operation (Items 16 and 17), Report the Total Weight (in metric tonnes) of Hazardous and Non-Hazardous Waste Not Disposed: i. within the organisation ii. outside the organisation.				
Disclose whether the disposal took place within or outside the hospital.				
Model for disclosure when disposal occurs outside the organisation:				
All disposals took place outside the organisation (offsite).				
19. Contextual Information Required to Understand the Data and Compilation Methods				
Disclose how the data were compiled and any other relevant contextual information necessary for understanding the data reported in Items 16, 17 and 18.				
20. Total volume of waste destined for disposal (in metric tonnes) and a breakdown of this total by waste composition				
Disclose the total waste disposed of (in metric tonnes) over the last three years, as well as the percentage variation for the two most recent years, as shown below:				
Example Disclosure (GRI 306-5 a.)	2021	2022	2023	Δ 202x/202x
Composition				
Infectious Waste				
Chemical Waste				
Common Waste				
Sharps				
Carcasses and anatomical parts				
Total				
21. Total volume of waste destined for disposal (in metric tonnes) and a breakdown of this total by waste composition: i. Incineration (with energy recovery) ii. Incineration (without energy recovery) iii. Landfilling iv. Other disposal operations.				
Disclose the total volume of hazardous waste destined for disposal (in metric tonnes) over the last three years, and the percentage variation for the two most recent years, as shown below:				
Example Disclosure (GRI 306-5 b.)	2021	2022	2023	Δ 202x/202x
Hazardous Waste				
Incineration (with energy recovery)				
Incineration (without energy recovery)				
Co-processing				
Reprocessing				
Autoclaving				
Total				

22. Total volume of non-hazardous waste destined for disposal (in metric tonnes) and a breakdown of this total by the following disposal operations:

- i. Incineration (with energy recovery)**
- ii. Incineration (without energy recovery)**
- iii. Landfilling**
- iv. Other disposal operations**

Disclose the total volume of non-hazardous waste destined for disposal (in metric tonnes) over the last three years, and the percentage variation for the two most recent years, as shown below:

Example Disclosure (GRI 306-5 b.)	2021	2022	2023	Δ 202x/202x
Non-Hazardous Waste				
Landfilling				
Total				

23. For each disposal operation mentioned in Items 20 and 21, report the total weight (in metric tonnes) of hazardous and non-hazardous waste destined for disposal:

- i. Within the organisation**
- ii. Outside the organisation.**

Disclose whether the disposal took place within or outside the hospital.

Model for disclosure when disposal occurs outside the organisation: All disposal took place outside the organisation (offsite).

24 Contextual information required to understand the data and how the data were compiled

Disclose how the data were compiled and any additional contextual information necessary to interpret the data reported in items 20, 21, 22 and 23.

25. Volume of Hazardous Waste Transported, Imported, Exported, or Treated

Disclose the total volume of hazardous waste transported, imported, exported, or treated (in metric tonnes) over the last three years, as well as the percentage variation for the two most recent years, as shown below:

Example Disclosure:	2021	2022	2023	Δ 202x/202x
Total Volume (t) Transported				
Origin and Destination				
Treatment Methods (incineration, autoclaving)				
Transport Company				

26. Methodologies Used in the Transport of Hazardous Waste

Disclose the methodologies adopted for hazardous waste transport, considering all operational risks.

Source: Research data.

6 Final Considerations

This research was motivated by the scarcity of studies on healthcare waste reporting. The objective was to propose a model for environmental disclosure of healthcare waste (HCW) in public university hospitals in Brazil, based on an analysis of the level of environmental disclosure related to waste management in these hospitals' management reports. To achieve this objective, it was necessary to map the disclosure practices adopted in these hospitals' reports, identify the models used by Brazil's top hospitals, and analyse the content of healthcare waste disclosures made by public university hospitals.

The results reveal a low level of healthcare waste information disclosure among Brazilian public university hospitals. When such information was disclosed, it was vague and incomplete.

Based on the findings, a proposed model for environmental disclosure of HCW was developed for public university hospitals in Brazil, comprising three categories: 1) Top management approach (4 items), which addresses the strategy and waste management practices; 2) Waste management activities (8 items), which details the actions undertaken to manage and reduce the generation of healthcare waste; and 3) Waste management performance (14 items),

which evaluates monitoring processes, waste-related incidents, and the changes or improvements implemented in waste management.

The proposed model was developed based on the study by Ha and Mansi (2023), the GRI 306: Waste 2020 Technical Standard, CONAMA Resolution No. 358/2005, and the National Solid Waste Policy (Law No. 12.305/2010), which guides waste management in Brazil. In addition, RDC Resolution No. 222/2018, which establishes best practices for healthcare waste management, was incorporated into the structure of the model.

This research contributes to the literature by expanding studies on healthcare waste management in public university hospitals in Brazil. It also addresses a gap, as previous studies on sustainability have focused on general concepts while neglecting specific aspects such as waste management (Ha & Mansi, 2023). This research also has practical implications. Public university hospitals can use the proposed model to improve their waste management disclosure, aligning it with the principles of sustainability and transparency. The model may also be adopted by regulatory bodies to standardise HCW disclosure across hospitals in Brazil, providing a framework for public institutions to implement in their reporting practices.

This research presents some limitations. The results obtained are limited to the reports analysed, not considering other forms of disclosure adopted by the hospitals. Moreover, the data were collected exclusively from reports published by university hospitals managed by EBSEH, which may limit the applicability of the results to other university hospitals. The proposed model also applies only to the disclosure of solid healthcare waste, not including liquid or gaseous waste.

Future research may investigate the challenges and difficulties encountered by university hospitals in providing more extensive and detailed waste disclosures. Another suggestion is to expand the scope of analysis beyond traditional reports, including waste disclosures made through hospital websites and official social media channels.

Furthermore, future studies may explore the possible causes behind variations in environmental information disclosure among different hospitals, considering internal factors such as organisational structure, financial and human resources, as well as contextual aspects that may influence these practices. Such an approach may help identify the determinants that affect transparency and the effectiveness of environmental communication, thereby contributing to the development of more effective and context-sensitive strategies for the management and disclosure of solid healthcare waste.

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