

Diagnosis of the health care waste management system of hospitals in the west of Santa Catarina State-Brazil¹

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Abstract

Introduction. The management of health solid waste is seen as an emerging and urgent need in Brazil. **Objective.** This paper aims at diagnosing the real situation in the management of health solid waste produced in different hospitals in cities located in the west of the state of Santa Catarina, Brazil. **Materials and Methods.** Brainstorming was one of the management tools used for identifying failures in the waste management system. After identifying the problem, the Leopold Matrix was used as a method of evaluating the magnitude and importance of the management steps and their different aspects. Also, the GUT Matrix was used to evaluate the seriousness, urgency and tendency of waste management problems aiming at setting priority indexes for subsequent adjustments. Finally, based on the situational diagnosis, the 5W2H tool was used as a forecast. **Results.** After the tools were applied, it was verified that the hospitals face relatively serious problems regarding their waste management. Besides, it was observed that the professionals involved in the process need qualification and training and the hospital units do not have internal waste storage shelters, which is considered a relevant problem in the transmission of vectors as well as an occupational safety hazard. Hospitals units also present sorting errors related to waste classes, packaging and

identification. On the prognosis, improvement actions were planned objectively, with a schedule draft, cost estimate and the people in charge. **Conclusion.** It is possible to conclude that a more effective environmental management in the hospital units is needed, prioritizing professional training for those involved in the Health Solid Waste Management Plan in accordance to the legislation.

Keywords. Hospitals. Management system. Health care waste.

Diagnóstico del sistema de gestión de residuos sólidos de salud de hospitales del oeste del estado de Santa Catarina-Brasil

Resumen

Introducción. El gerenciamiento de los residuos sólidos de salud se presenta como una necesidad emergente y urgente en Brasil. **Objetivo.** Diagnosticar la situación del gerenciamiento de los residuos sólidos de salud producidos en los distintos hospitales de ciudades en el oeste del estado de Santa Catarina, Brasil. **Materiales y Métodos.** Una de las herramientas de gerenciamiento utilizadas fue el Brainstorming, visando identificar fallas en el sistema de gerenciamiento de residuos. Tras la identificación

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del problema, se hizo uso de la Matriz de Leopold, como método de evaluación de la magnitud y de la importancia de las fases del gerenciamiento y sus diferentes aspectos. Se utilizó también la Matriz de GUT para evaluar la gravedad, urgencia y tendencia, visando construir índices de prioridad para posteriores adecuaciones y, finalmente, con base en el diagnóstico de la situación, se utilizó la herramienta 5W2H como pronóstico. **Resultados.** Tras la aplicación de las herramientas, se constató que los hospitales están con problemas relativamente graves en cuanto a su gerenciamiento de los residuos. Además, se observó que los profesionales involucrados en el proceso, necesitan de capacitación y entrenamiento. Se observó, aún, que las unidades hospitalarias no poseen alojamientos internos de almacenamiento de residuos, siendo este un problema relevante en la transmisión de vectores y seguridad ocupacional, y presentan errores en la segregación de las clases de los residuos, en el acondicionamiento e identificación de los mismos. En el pronóstico, fueron planeadas acciones de mejora, de forma objetiva, con elaboración de cronograma, estimativa de costos y responsables. **Conclusion.** Se puede concluir que hay necesidad de una gestión ambiental más adecuada en las unidades hospitalarias, priorizando la capacitación de los profesionales involucrados en el Plano de Gerenciamiento de Residuos Sólidos de Salud y obedeciendo a la legislación.

Palabras-clave. Hospitales. Sistema de gestión. Residuos sólidos de salud.

Diagnóstico do sistema de gestão de resíduos sólidos de saúde de hospitais do oeste do estado de Santa Catarina-Brasil

Resumo

Introdução. O gerenciamento dos resíduos sólidos de saúde apresenta-se como uma

necessidade emergente e urgente no Brasil. **Objetivo.** Diagnosticar a situação do gerenciamento dos resíduos sólidos de saúde produzidos nos diferentes hospitais de cidades no oeste do estado de Santa Catarina, Brasil. **Materiais e Métodos.** Uma das ferramentas de gerenciamento utilizadas foi o Brainstorming, visando identificar falhas no sistema de gerenciamento de resíduos. Após a identificação do problema, fez-se uso da Matriz de Leopold, como método de avaliação da magnitude e da importância das fases do gerenciamento e seus diferentes aspectos. Utilizou-se também a Matriz de GUT para avaliar a gravidade, urgência e tendência, visando construir índices de prioridade para posteriores adequações e, finalmente, com base no diagnóstico da situação, utilizou-se a ferramenta 5W2H como prognóstico. **Resultados.** Após a aplicação das ferramentas constatou-se que os hospitais estão com problemas relativamente graves quanto ao seu gerenciamento dos resíduos. Além disso, observou-se que os profissionais envolvidos no processo necessitam de capacitação e treinamento. Observou-se, ainda, que as unidades hospitalares não possuem abrigos internos de armazenamento de resíduos, sendo este um problema relevante na transmissão de vetores e segurança ocupacional, e apresentam erros na segregação das classes dos resíduos, no acondicionamento e identificação dos mesmos. No prognóstico, foram planejadas ações de melhoria, de forma objetiva, com elaboração de cronograma, estimativa de custos e responsáveis. **Conclusão:** Pode-se concluir que há necessidade de uma gestão ambiental mais adequada nas unidades hospitalares, priorizando a capacitação dos profissionais envolvidos no Plano de Gerenciamiento de Residuos Sólidos de Saúde e obedecendo à legislação.

Palavras chave: Hospitais. Sistema de gestão. Resíduos sólidos de saúde.

Introduction

Since the approval of the National Solid Waste Policy in Brazil in 2010 (ABRELPE, 2015), solid waste management has been debated quite frequently. The management of this type of waste presents itself as an emergent and urgent necessity. Considering the current situation in the country, where people are confronted with a

relatively different situation, new efforts, new research and more information are needed to discuss the subject, since investigation on the topic is only at its early stage.

The classification of waste from health services (health care waste - HCW) has importance for the application of the management system to be implemented. Such system should cover the nature and the potential risks of this waste, in

According to Omara, Nazlib, & Karuppananb (2012), hospital waste from the health services is a reservoir of pathogenic microorganisms that require adequate, safe and reliable treatment. There are risks associated with hospital waste, and contact with it can result in injury and illness.

According to Hamadama et al. (2012), approximately 15 to 25% (by weight) of healthcare waste is considered infectious. Despite the fact that waste management practices vary from hospital to hospital, problem areas are similar for all health facilities and at all stages of management, including segregation, collection, packaging, storage, transportation, treatment and provision.

Makajic-Nikolic et al. (2016) argue that health institutions are becoming more determined to apply risk management methods and techniques. This gives greater importance to the issue and high reliability of the functioning of the health system, as well as the health waste management system.

For Cafure & Patriarcha-Graciolli (2014), there is a risk to the people who handle HCW inside and outside the generating establishments, and there are risks that may affect the hospital community. Inadequate management of HCW can cause environmental risks which exceed the boundaries of the establishment. These risks can generate diseases and also a loss in the quality of life of the population that come into direct or indirect contact with the discarded material.

The literature presents numerous studies where monitoring and evaluation processes of solid health residues are reported, but few present tool applications for the proper monitoring and management of this type of waste (Schneider, Stedile, Bigolin, & Paiz, 2013; Zajac, Fernandes, David, & Aquino, 2016; Dorion, Severo, Olea, Nodari, & Guimarães, 2012).

In Brazil, the National Health Surveillance Agency (ANVISA) resolution, Collegial Board Resolution No. 306 (2004), states that health care waste is classified into five classes (Class A, B, C, D and E), with specific characteristics for packaging and final destination.

The management system encounters serious difficulties at all stages that can be attributed to several specific factors. According to Schneider, Emmerich, Duarte, & Orlandin (2004), Schneider et al. (2013), and Windfeld & Brooks (2015), lack of specific knowledge, negligence of staff, inadequate supervision and lack of pollution

prevention programs aimed at minimizing the generation of waste are preponderant factors that generate problems in health waste issues.

To contextualize the entire situation of HCW management, this research analyzes environmental management in six hospitals in the western region of the state of Santa Catarina and presents, from theoretical and field evaluations, the diagnosis of the waste situation of this region. Thus, qualitative, quantitative and management aspects were considered in order to gather data for elaboration of the diagnosis through management tools and to have a strategy that results in an improvement in the management of this waste. This improvement is outlined in accordance with the guidelines of the current legislation and is based on tools that have as principle to clarify and facilitate the processes involved in the execution of solid health waste management. In addition, from scientific and technical bases, the work aims to protect the employees of these hospitals and preserve public health, natural resources and the environment.

Materials and methods

This research evaluates quantitative and qualitative data on the management of solid health care waste in hospitals in six municipalities. The hospitals subject to study were classified with numbers from 1 (one) to 6 (six), for greater discretion and integrity of the institutions.

The hospitals studied are located in cities with populations between 10 and 40 thousand inhabitants. They perform only primary health care procedures and serve, besides the inhabitants of the Municipality, people from the neighboring municipalities. Most of the hospitals perform only basic procedures. Only one unit (5) has an intensive care unit (ICU). In general, all units provide medical, obstetric, pediatric and surgical (small procedures) urgency and emergency services (except 2 and 6). Table 1 presents some characteristics of each hospital studied.

Table 1: Number of beds, coverage area and population served by the hospitals in the study
Fuente: Contreras & Barbosa (2013)

Hospital	Number of beds	Cities served	Population served
Hospital 01	60	3	29,050
Hospital 02	20	1	5,097
Hospital 03	34	2	16,788
Hospital 04	43	1	10,374
Hospital 05	90	21	174,732
Hospital 06	37	1	8,505

Data were collected through questionnaires applied in each of the six hospitals. The questionnaire was used to evaluate the updated hospital waste management system in terms of segregation, quantification, collection, transport, treatment and disposal based on ANVISA recommendations (ANVISA, 2004).

In addition to the data provided by the questionnaire, standardized techniques were used to collect data through systematic observation and mass quantification of HCW generation. The data were processed, analyzed, and grouped in the form of tables and graphs. Brainstorming, the Leopold Matrix, the GUT Matrix, and 5W2H were used as tools for the evaluation and improvement of the process.

The Brainstorming tool is used to generate ideas / suggestions from the employees of the hospital units. With this tool it is possible to collect ideas from several managers of the institutions, besides helping in the development of a theme. (Roldan et al., 2009; Diaz, Savage, & Eggerth, 2005).

For the Leopold Matrix, the various activities in the matrix were listed, with the purpose of evaluating the magnitude and importance of each. Adaptations were made from the Leopold Matrix allowing the application of the HCW process (Leopold, Clarke, Hanshaw, & Balsley, 1971). In the matrix, the impact attributes, with their numerical scales representing values that refer to each attribute, allow for better quantitative analysis. To calculate the magnitude of the impacts, the attributes: extension (size of the environmental action or influenced area); periodicity (duration of the effect of the action as permanent, variable or temporary) and intensity (high, medium or low, defined by the size of the impacting action) were taken into account. To calculate the importance of the impacts, action, ignition and criticality attributes were taken into account. Action is given by the number of effects that the action causes. Ignition indicates the time that the action takes to be perceived, that is, time between the action and the effect. Criticality is the level of interactivity between the factors of the action and effect. Then, the arithmetic average of the magnitudes and amounts of each impact was performed, and for the final index, the magnitude average is multiplied by the importance average of each impact.

In the GUT Matrix the data were described to measure gravity (G), urgency (U) and tendency (T), classifying the problems encountered and pointing out the most common and comprehensive

deviation in the region, as well as the tendency of aggravation. The priority index was constituted by multiplying the planned values of gravity, tendency and urgency, according to Ferreira, Oliveira, & Garcia, (2014). In this matrix, an integer between 1 and 5 is assigned in each of the dimensions (G, U and T); 5 correspond to the highest intensity and 1 is the smallest. The values obtained are multiplied in order to obtain a value for each problem or risk factor analyzed.

Finally, the 5W2H tool was used because it is important to perform the prognosis, finalizing the work and mapping improvements (Tague, 2005). It is a checklist of the activities that need to be developed. The application of the 5W2H methodology as a tool for the elaboration of action plans is simple and objective. The action consists of answering seven questions: what will be done (what?), why it will be done (why?), where it will be done (where?), when it will be done (when?), who will do it (who?), how it will be done (how?) and how much it will cost (how much?).

Results

Quantification of HCW

For quantification of waste in the hospital units, data were collected individually from the company that collects class A, B, D and E waste, according to ANVISA (2004) classification.

Group A - Residues with possible presence of biological agents that present a risk of infection. These are the so-called infectious residues;

Group B – Residues containing chemicals that may pose a risk to public health and the environment. They are the chemical residues;

Group C –Residues contaminated with radionuclides from clinical analysis laboratories, nuclear medicine and radiotherapy services. They are the so-called radioactive residues;

Group D - Residues that do not present biological, chemical or radiological risks to health or the environment, but which were generated within health services and could be assimilated to household waste. They are common waste;

Group E - The waste generated from puncturing or scarifying materials, such as contaminated or uncontaminated needles and glass sheets. These are the so-called puncturing residues.

The collections are basically biweekly, with the exception of hospital unit 05 where weekly collections are carried out. These values in liters (infectious) and kilograms (common and pungent chemicals) generated in the first quarter of 2016 are presented in Table 2. It is important to note that none of the establishments produce class C (radioactive) waste.

weighing of the organic waste was carried out at the end of each day, except for hospital unit 05, which performs the composting practice and has this quantification already defined.

For the quantification of recyclable common waste, weekly weighing was performed, except for hospital unit 05, which already has a person responsible for this task who provided the data.

In order to determine its quantification, individual

Table 2: Quantification of waste in the different hospitals.

Source: from the author.

Hospital Units	Class A Waste (L)	Class B Waste (kg)	Class D Waste (kg)	Class E Waste (kg)
Hospital 01	3,285	163	2,550	700
Hospital 02	1,930	50	1,100	72
Hospital 03	4,140	15.7	5,100	217
Hospital 04	1,720	29	1,320	101
Hospital 05	27,910	465	12,390	1,030
Hospital 06	350	2.5	750	60
TOTAL	39,335	700	23,210	2,180

Based on the values presented in Table 2, it was possible to measure the generation of waste per bed daily in the different hospital units in the first quarter of 2016. With this calculation it was possible to identify which units produce the most waste, and which produce the least, according to the number of beds.

between 1.0 and 4.5 kg / bed/ day for Latin America, in agreement with OPAS/OMS (1997). Table 3 presents the result of the quantification of waste generated per day in beds in the first quarter of 2016.

OPAS/OMS (1997) states that in Latin America, the average generation of waste varies from 1.0 to 4.5 kg / bed / day; however, between 10 to 40% of that waste is considered hazardous. Dutra & Monteiro (2011) also indicate a waste generation rate

Hospital units in a general context produce a daily average of 2.56 kg of waste per bed. Through individual quantification it is noticed that hospital 05 exceeds the 1.0-4.5 kg value, totaling 5.15 kg. Hospital units 01, 02 and 03 are within the average, and units 04 and 06 generate waste amounts below average.

Table 2: Quantification of waste in the different hospitals.

Source: from the author.

Hospital Units	Total quantification of waste (kg)	Quantification of waste (kg/day)	Number of beds	Quantification (kg/bed/day)
Hospital 01	6,698	74.42	60	1.24
Hospital 02	3,152	35.02	20	1.75
Hospital 03	9,472	105.24	34	3.09
Hospital 04	3,170	35.22	43	0.81
Hospital 05	41,796	464.39	90	5.15
Hospital 06	1,162	12.91	37	0.34
Total	65,450	727.22	284	2.56

It can be considered that the number of beds available is directly related to the amount of waste generated by them. The determination of the amount of waste generated by a hospital is an extremely important data to establish a waste management program according to the legislation. It should be noted that the term kg / patient / day is convenient but slightly imprecise, since all waste generated in a hospital, including outpatient, visitor and employee waste, was divided by the number of patients hospitalized.

Even though in the general context, a daily average of 2.56 kg of waste per bed is produced, the most correct methods would be those that avoid the production of waste as much as possible, with a view to minimize it. When possible, the recovery of waste items for secondary use, and even waste that cannot be recovered, must be treated with options that produce the least environmental impact: recycling, in this context. The use of recycling is suggested in the literature by Chartier et al. (2014).

Segregation and packaging of waste in hospital units

Segregation of waste was observed in all generating units. In general, mistakes were made regarding class segregation, mixtures of chemical and infectious waste, and infectious and common waste, mainly common paper towels and food packaging.

Infectious waste is collected every day in the early morning, late afternoon and at the end of surgical procedures from the outpatient clinics, clinics, laboratories, hospital purges and surgery rooms. A diagnosis was made regarding the packing of waste by classes in the six hospital units. A serious error in the process of class A packaging of infectious waste was observed, since hospitals 01, 04 and 06 do not use the red bag with the infection symbol, and are also not aware of such requirement, thus putting the packaging for all the infectious waste generated in a white bag.

The generation of waste of chemical origin in the different hospitals is limited to solid waste. The hospitals did not produce chemical waste in a liquid state. It was noticed that this type of waste is found in greater quantity in clinics and pharmacies. Unit 04 has created an alternative method for storing this waste by using cardboard boxes in which the smaller boxes containing medicines arrive at the hospital unit. Hospital units 01, 02 and 04 purchase their own cardboard boxes for this purpose. This waste, which contains drug waste

and packaging in general, must be packed in containers of rigid material as required by ANVISA (2004) legislation, so units 03 and 06 need to comply by changing their current form of packaging which is the use of plastic bags.

Common waste (Class D) in the six generating units is comprised mostly of organic waste, packaging and administrative waste. Only unit 05 has a recycling program in place. Other units also segregate the recyclables that are sent to collectors of this type of material. With the exception of hospital 05, there are no internal policies to encourage recyclability of materials and these are often collected mixed with other municipal solid waste.

It is important to note that Class D waste collected by recyclable waste collectors is not disposed of in public places. The City Hall, through a contract with an outsourced company, collects this waste and discards it in landfills.

ANVISA (2004) requires that class E waste be packed in rigid containers, resistant to puncture, rupture and leakage, with a lid, and clearly identified. It can be stated that the packaging of class E waste is the correct one. Hospital 03 has created an alternative packaging in bottles, but follows the legislation.

Shelters for storage and final destination of waste

In three hospital units, 01, 05 and 06, the internal shelters were constructed appropriately. Hospital 05 has four internal shelters. In units 02, 03 and 04 the internal shelters are in the laundry area; there is no internal storage room which is against legislation.

The hospital units have external shelters, but not all are adequate and reconstruction of the external shelters in some cases is recommended. Hospitals 02 and 05 use metal and wood structures to support waste in their respective packaging; hospital units 01, 03, 04 and 06 store their bagged waste directly on the floor.

With regard to external collection, an outsourced service is contracted. Two employees are responsible for this type of outsourced service, a driver and an assistant, who perform the weighing and loading. The collection is done with refrigerated transport. Hospital collections at units 01, 02, 03, 04, and 06 are held biweekly, and in hospital 05 the collections take place three times a week.

Through this outsourced service, the infectious waste is transported to the municipality of Anchieta in Santa Catarina. After the company carries out physical treatment by autoclave, the waste is disposed of in the company's own landfill. Human body parts are sent to another company by means of a hospital contract with the company. All companies are duly accredited and licensed to perform such procedures. Chemical waste in hospitals 01, 02, 03, 04 and 06 is not frequent; therefore, in certain months it is not collected. These materials are collected by an accredited company that takes them to the municipality of Chapecó, making the final disposal in a sanitary landfill for hazardous waste.

Sharp waste is collected, autoclaved and disposed of in a landfill. After the process, this hospital waste is disposed along with the common waste.

Applications of management tools

Brainstorming was applied as a method to stimulate creativity. Participation of all staff was allowed through a meeting, where people had either the same points of view or different opinions. The application of brainstorming in all the hospital units had an average participation of five people. The activity included the following issues:

- Training and qualification of the personnel involved;
- Difficulties in changing the habits of the institution's professionals;
- Demanding compliance from and warning professionals who do not follow the HCWMP application;
- Need for a permanent professional in the HCWMP;
- Need to standardize an internal room to serve as temporary shelter for waste;
- Reconstruction of the external storage shelter;
- Adequacy of cleaning equipment;
- More frequent meetings within the unit;
- Search for information, procedures and legislation from ANVISA and other bodies;
- Participation in external training;

- Improvement of the composting activity and segregation system and commercialization of recyclable waste with material saving programs;
- Improvement of internal environmental education activities and inclusion of external activities that further improve the image of the hospital.
- The Leopold Matrix was organized in rows and columns; the columns list aspects of HCW management and the management phases of HCW are set out in the rows (Table 4).

Table 4: Design of the Leopold Matrix.
Source: Adapted from Leopold et al., 1971

Management Phases	Aspects													
	Awareness		Training		Occupational safety		Vectors		Environmental Contamination		Environmental Damage		Averages	Final Index
	M	I	M	I	M	I	M	I	M	I	M	I	M	I
Segregation														
Packaging														
Identification														
Internal Transport														
Internal Storage														
External Storage														

For the processing of the Leopold Matrix, the magnitude and importance of each aspect were classified and the values were listed according to the score of Table 5, with a maximum weight of 10 points of magnitude and 10 points of importance, obtaining the averages of magnitudes and importance, and, at the end, the magnitude is multiplied by the importance, for each management phase in each hospital unit.

Table 5: Leopold Matrix Processing
Source: Adapted from Leopold et al., 1971.

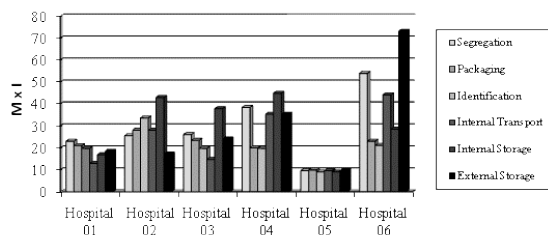
Magnitude	M – Magnitude	I – Importance	Importance
Extension (1 to 4 points)			Action (1 to 4 points)
Periodicity (1 to 3 points)			Ignition (1 to 3 points)
Intensity (1 to 3 points)			Criticality (1 to 3 points)
Sum of Magnitude			Sum of Importance

The Leopold Matrix method allows for an easy understanding of the results from different perspectives, covers qualitative and quantitative data, and induces a good orientation for the evaluative character of the system as a whole. This contributes to an improvement plan that can be implemented, following an order of priority.

Figure 1 puts together the Leopold Matrix of the six hospital units, providing a clearer and easier interpretation of the results, from the perspective of different aspects.

There were some similarities among hospital units 01, 02, 03 and 04. Hospital unit 05 presented low rates of magnitude and importance, and hospital unit 06 had the highest rates.

Figure 1: Comparison between the six applications of the Leopold Matrix in the different hospital units.
Source: from the author.



The GUT matrix measures the gravity, urgency, and tendency of management failures. In order to evaluate the gravity of these problems, they were classified as 5 (Extreme gravity), 4 (High gravity), 3 (Gravity), 2 (Low gravity) and 1 (No gravity). Urgency refers to the immediacy to resolve a particular failure (immediate or long-term action): 5 (requires immediate action), 4 (urgent), 3 (action is required as soon as possible), 2 (not urgent) and 1 (can wait). Tendency refers to the ability of a given problem to worsen in the medium to long term, with determination of index 5 (will worsen rapidly), 4 (will worsen in a short time), 3 (will worsen), 2 (will worsen in the long term) and 1 (will not change).

To obtain the priority value, which is called the priority index, gravity, urgency and tendency are simply multiplied (Ferreira et al., 2014). The resulting value of this equation should be adopted as a priority.

Based on all the results tabulated by the processing of the GUT Matrix, it became apparent that the hospital unit with the most seriousness and urgency and with a greater tendency to worsen is

unit 06. It was also noticed, with the exception of unit 05, that all the institutions need education, training and information regarding the management of solid waste from health services. It should be emphasized that hospital unit 05 presents very low priority indexes when compared to the other institutions.

Hospital units 02, 03 and 04 present the absence of internal shelters for temporary storage of waste as a higher priority. This highlights the dangers of improper storage for vector proliferation and occupational safety.

Hospital units 01 and 06 present priority indices for the segregation and external storage of waste.

Hospital unit 05 presents the least problems. It only needs to maintain the standard of management, new programs, new methods of professional awareness and environmental marketing. The other units are very similar. However, units 02 and 06 obtained priority indexes equal to and above 100, a situation of criticality and urgency.

Tables 6 and 7 present the results from the hospital units that obtained the best index and the one that presented the worst index.

For hospital 05, the results are shown in Table 6. It was considered as a priority that the rules that are imposed by the HCWMP committee are not being fulfilled. Despite constant training, there are still some errors of segregation, which is serious and needs to be corrected urgently, as it tends to worsen in the long term if this is not better managed within the hospital unit.

Table 7: Processing of the GUT Matrix to hospital 06.
Source: from the author.

List of Problems	Gravity	Urgency	Tendency	Total
Segregation	5	5	5	125
Packaging	4	5	5	100
Identification	4	4	5	80
Internal Transport	4	5	5	100
Internal Storage	3	4	5	60
External Storage	5	5	5	125

Discussion

The use of questionnaires for data collection followed by Brainstorming to diagnose problems related to HCW is very frequent in the literature. Schneider et al. (2013) use the MIS (Management Information System) to evaluate the HCW management process.

Zajac et al. (2016) carried out a follow-up study of the waste management routine. They used statistical methods (analysis of variance) to establish feasible practical targets in the gradual implementation of HCW segregation.

Dorion et al. (2012) studied twelve hospitals in the South of Brazil to identify if the HCW management process was in accordance with the legislation.

None of the cited studies used management tools to detect system failures with magnitude and importance assessment methods, such as the Leopold Matrix, or even to evaluate gravity, urgency and tendency using the GUT matrix. The use of prognostic tools such as 5W2H was not applied either.

The application of the 5W2H tool was performed for all hospital units as shown in Table 8. This tool helped to complete the work, based on the diagnosis of the situation of the hospital units, and at this stage, the improvement actions were planned. The tool considers the tasks in an objective way with the development of a schedule, and the definition of the people responsible for each task and the corresponding costs.

The use of the 5W2H methodology (Table 8) made it possible to divide the HCW management flaws in different stages, providing proof for what was being done in each situation, which people were operating each phase, in which sector the step was being carried out, as well as the financial

Table 8: Application of 5W2H tool for hospital units.

Source: from the author.

What?	Why?	When?	Where?	Who?	How?	Howmuch?
Defining a committee responsible for the HCWMP per hospital.	Value the different points of view by means of a meeting with the participation of all sectors	Once a month, around the beginning of the first semester of 2017.	At the hospital unit.	Committee at the head of HCWMP	Internal meetings, exchange of knowledge and information among sectors	No cost, since meetings will be held during working hours, an activity important for everyone.
Provision of professional services qualified for this function, and the person in charge of the HCWMP of each institution in the hospital unit	Redo the existing HCWMP, making them clearer, more accessible and adaptable to the hospital unit.	Once a year, upon expiration or validation of the HCWMP; and reformulation of a new one.	At the hospital unit.	The head of the committee.	Some HCWMP are overdue, and poorly designed.	US \$ 700.00 / month (hiring a qualified professional).
Appointing at the head of the HCWMP committee, a professional with a minimum of one year in the hospital units.	Value the professionals.	In the first semester of 2017.	At each hospital unit.	Nurse	Professionals with less than one month of work in the institution with the function of leading the HCWMP.	US \$ 700.00 / month (hiring a professional with a specific degree).
Allowing the HCWMP committee or just the leader to know other realities in other hospital units.	Exchange information among hospitals to improve knowledge.	Twice a year (semester visits)	Visits to other hospital units.	HCWMP Committee or a leader with a nursing degree.	Exchange of information among hospitals to enable mutual help.	US\$ 40.00. (Trips to other hospital units).
Obtaining technical training.	Obtain information, knowledge, compliance with legislation and enrichment of ideas.	Once a year or whenever there are changes in relevant legislation.	Events in universities or professional courses in the area.	HCWMP committee or leader	Allowing HCWMP committee or leader to seek training in large and / or other urban centers, informational events or courses.	US \$ 100,00 (travel); US\$ 200,00 (registration fees); US \$ 100,00 (daily lodging)
What?	Why?	When?	Where?	Who?	How?	How much?
Passing on the knowledge acquired to all the employees of the different institutions.	Align operational practices.	Once each month (per shift), or whenever a new employee joins the institution.	Inside the hospital unit.	HCWMP Committee.	Internal meetings with training.	US \$ 900.00 (within the activities of the qualified professional) US \$ 90.00 (8 hours of work for such function).

The use of the management tools allows for the identification of errors, identifying weaknesses in the whole system, for later proposition of improvements. Since the main point identified in this research is the lack of training of the professionals who work in the hospital units, little knowledge in the area of hospital waste management was observed. It should be encouraged that all health-care workers are trained to adequately segregate waste and recognize the identification system.

The hospital units must train their employees, allowing the professional at the head of the HCWMP to be well instructed, in order to lead a process of improvement. As a suggestion, the formation of a committee in each hospital unit, meetings among the six hospital units with information exchange, visits to hospitals with well-implemented HCWMP and visits to other regions in order to evaluate the developments of other institutions are proposed.

Conclusions

This research considered qualitative, quantitative and management aspects in order to gather data for drawing up a strategy that resulted in an improvement in the management of health care waste. This improvement has to be aligned with the guidelines of current legislation and based on tools that have, in principle, the objective of making the processes involved in the implementation of solid waste management of health-care facilities clearer and more efficient.

The western region of Santa Catarina is in full growth. Therefore, it is necessary to have health waste management practices that keep hospital units up to date, adequate, and in compliance with legislation, as well as provide adaptations and training for professionals. These are some of the paths that will lead to the progress of the region. This article intends to demonstrate, through practical applications of management tools, how health units can approximate the gap between practice and health solid waste management; monitoring actions, with adequate deadlines and dates, with the resources available, and thus systematically comply with current legislation.

As recommendations for future work, it is worth considering the possibility of comparative studies with other regions of the state, or even interstate, as well as the possibility of working with hospital effluents, an all-encompassing and extremely

important issue.

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