



Recebido: 10/05/2017- Aprovado: 19/12/2017

DOI: <https://doi.org/10.5585/geas.v7i3.894>

E-ISSN: 2316-9834

DIAGNOSIS OF HOSPITAL WASTE MANAGEMENT IN VALE DO RIO PARDO-RIO GRANDE DO SUL, BRAZIL

¹Lourdes Teresinha Kist²Fernanda Raquel da Rosa³Jorge André Ribas Moraes⁴Ênio Leandro Machado

ABSTRACT

Health Service waste is the environmental liability, coming from the various health services whose characteristics may endanger human health or ecosystems. The methodology applied was a questionnaire for all those responsible for the sectors and nursing team, which aimed to identify the level of knowledge regarding the issues of waste management, evaluation and management analysis. As a quality tool for assessing the impacts of management, the PDCA (Plan-Do-Check-Action), GUT (Gravity, Urgency, Trend) and 5W2H (What, When, Why, Where, Who, How, How Much). It was observed in the studied area that there is a lack of information regarding the generation of waste and this contributes to an inadequate management of RSS, which can cause risks to the worker, public health and the environment. Considering the use of quality tools, qualitative, quantitative and management aspects, it was possible to gather data to elaborate a strategy that results in an improvement in the management of this waste. This improvement is outlined in line with the guidelines of the current legislation and as a basis the principle to make the processes involved in executing RSS management more clear and agile. The results obtained were able to generate contributions to the definition of programs and projects, focusing on actions monitored, mitigated and avoided, and based on scientific and technical bases, aim at the protection of the employees of this hospital, the preservation of public health, preservation of natural resources and environmental preservation.

Keywords: Solid Health-Care Waste; Waste Management; PDCA.

¹ Doutora em Química pela Universidade Federal de Santa Catarina – UFSC. Florianópolis, SC (Brasil). E-mail: lourdes@unisc.br

² Mestre em Tecnologia Ambiental pela Universidade de Santa Cruz do Sul – UNISC. Santa Cruz do Sul, RS (Brasil). E-mail: fernanda.rosa@unicred.com.br

³ Doutor em Engenharia de Produção pela Universidade Federal de Santa Catarina – UFSC. Florianópolis, SC (Brasil). E-mail: jorge@unisc.br

⁴ Doutor em Engenharia de Minas, Metalúrgica e de Materiais pela Universidade Federal do rio Grande do Sul – UFRGS. Porto Alegre, RS (Brasil). E-mail: enio@unisc.br





DIAGNÓSTICO DO GERENCIAMENTO DE RESÍDUO DE UM HOSPITAL LOCALIZADO NO VALE DO RIO PARDO-RIO GRANDE DO SUL

RESUMO

Resíduos de Serviço de Saúde são os passivos ambientais, provenientes dos vários serviços de saúde cujas características podem determinar perigo à saúde humana ou aos ecossistemas. A metodologia aplicada foi de questionário para todos os responsáveis dos setores e equipe de enfermagem o que objetivou identificar o nível de conhecimento em relação às questões do manejo de resíduos, avaliação e análise do gerenciamento. Como ferramenta de qualidade para a avaliação dos impactos do gerenciamento foi utilizada o PDCA (*Plan-Do-Check-Action*), GUT (Gravidade, Urgência, Tendência) e 5W2H (*What, When, Why, Where, Who, How, How Much*). Constatou-se na área estudada que há carência de informações quanto à geração de resíduos e isso contribui para um gerenciamento inadequado de RSS, o qual pode causar riscos ao trabalhador, à saúde pública e ao meio ambiente. Considerando-se o uso das ferramentas de qualidade, os aspectos qualitativos, quantitativos e de gerenciamento, foi possível reunir dados para elaboração de uma estratégia que resulte em uma melhora na gestão destes resíduos. Esta melhora está delineada em consonância com as diretrizes da legislação vigente e como base o princípio tornar mais claros e ágeis os processos envolvidos na execução da gestão dos RSS. Os resultados obtidos foram capazes de gerar contribuições para a definição de programas e projetos, focando as ações monitoradas, mitigadas e ou evitadas, e a partir de bases científicas e técnicas, visar a proteção dos funcionários deste hospital, a preservação da saúde pública, a preservação de recursos naturais e a preservação ambiental.

Palavras-chave: Resíduos Sólidos da Saúde; Gerenciamento de Resíduos; PDCA.

DIAGNÓSTICO DEL GERENCIAMIENTO DE RESIDUOS DE UN HOSPITAL LOCALIZADO EN EL VALLE DEL RIO PARDO-RIO GRANDE DO SUL

RESUMEN

Residuos de Servicio de Salud son los pasivos ambientales provenientes de los varios servicios de salud, cuyas características pueden determinar peligro a la salud humana o a los ecosistemas. La metodología aplicada fue la de cuestionario para todos los responsables de los sectores y equipo de enfermería, lo que objetivó identificar el nivel de conocimiento en relación a las cuestiones del manejo de residuos, evaluación y análisis del gerenciamento. Como herramienta de cualidad para la evaluación de los impactos del gerenciamento, fue utilizada el PDCA (*Plan-Do-Check-Action*), GUT (Gravedad, Urgencia, Tendencia) y 5W2H (*What, When, Why, Where, Who, How, HowMuch*). Se constató en el área estudiada que hay carencia de informaciones cuanto a la generación de residuos y, eso, contribuye para un gerenciamento inadequado de RSS, el cual puede causar riesgos al trabajador, a la salud pública y al medio ambiente. Considerándose el uso de las herramientas de cualidad, los aspectos cualitativos, cuantitativos y de gerenciamento, fue posible reunir datos para la elaboración de una estrategia que resulte en una mejora en la gestión de estos residuos. Esta mejora está delineada en consonancia con las directrices de la legislación vigente y, como base, el principio de tornar más claros y ágiles los procesos envueltos en la ejecución de la gestión de los RSS. Los resultados obtenidos fueron capaces de generar contribuciones para la definición de programas y proyectos, enfocando las acciones monitoreadas, mitigadas y o evitadas, y a partir de bases científicas y técnicas, visar la protección de los funcionarios de este hospital, la preservación de la salud pública, la preservación de recursos naturales y la preservación ambiental.

Palabras-clave: Residuos Sólidos de la Salud; Gerenciamiento de Residuos; PDCA





1 Introduction

Discussions about environmental concerns are increasingly present in today's society, involving propositions, policies and daily actions of social organizations, including business, government and institutions, as well as social control mechanisms with rules, laws, habits, among other issues (Deus *et al.*, 2015; Velloso, 2008; Afonso *et al.*, 2016).

In Brazil, the panorama of solid waste is presented by *Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais* (ABRELPE) (2014), which has been monitoring the situation of the waste sector since 2003. Since then, several factors have influenced the management of waste in the country and have brought changes, which were presented year by year. None of these previous factors had more of an impact on waste management than the National Solid Waste Policy, established by Federal Law n. 12.305/2010. This policy provides guidelines for a new systematic form of waste management based on modern concepts and contains clear rules and an established deadline for the intended improvements to be implemented.

ABRELPE (2014) conducted research in the state of Rio Grande do Sul with a sample of 63 municipalities. The research shows that these municipalities generate a total of 5,460 tons of health-care waste (HCW), with an index of 0.487 kg/inhabitant/year. The study also found that the final destinations of the HCW collected are 54.1% autoclave, 42.8% incineration 1.6% microwave and 1.5% other methods.

In this scenario, it must be pointed out that waste management is the result of health-care activities and such waste can present great diversity and hazardousness (Diaz *et al.*, 2008; Dutra *et al.*, 2011, Makajic-Nikolic *et al.*, 2016).

Hospitals and health institutions should stop treating the problem as external, adopt a management system for their waste and

develop procedures that minimize environmental problems (Silva *et al.*, 2005a; Silva, 2005b; Schneider *et al.*, 2013).

To this end, it is necessary to understand that the gap between the practice of health-care waste management, as called for by legislation, and the day to day reality found in health institutions is a major issue that requires further studies and research that lead to an effective advancement in the subject.

There are several factors that have contributed to the increase in the generation of solid health-care waste, such as the continued increase in the complexity of medical care, the increasing use of disposables, the increase in the elderly population that usually requires more health services, as well as being frequent users of various types and levels of expertise (Schneider *et al.*, 2001; Windfeld *et al.*, 2015). In addition, there are a variety of health institutions, such as: Emergency Care Units (ECU), the Family Health Strategy (FHS), Clinics, Hospitals, Municipal Health Centers (MHC) among others.

Understanding the problem makes it possible to formulate goals and strategies to achieve the effective management of solid waste from health-care facilities.

Every day, this research aims to reach the following objective: health-care professionals are active and involved in the health-care process and with diseases of the population. Also, it is known that waste, when not properly managed, is a major source of disease transmission. Therefore, it is important that health-care professionals, who have the task of promoting health and preventing diseases, be aware of the process of health-care waste management (HCWM) and participate in the proper handling of the generated waste.

Thus, this research seeks to analyze the environmental management in the hospital and present, from theoretical evaluations and from the field, the diagnosis of the current





situation of health-care waste management. Therefore, the study considered the qualitative, quantitative and management aspects in order to gather data for creating a strategy that results in an improvement in the management of this waste. This improvement must be aligned with the guidelines of current legislation and based on tools that aim to make the processes involved in the implementation of health-care waste management clearer and more efficient.

Finally, the intention of this work was to propose improvements for the handling of HCW, and from a scientific and technical basis, it sought to protect the staff of this hospital, and preserve public health, natural resources and the environment.

2 Theoretical Basis

Currently the classification of solid waste involves the identification of the process or activity where it originated; the participation of its constituents and the characteristics of the waste, and finally the comparison of these constituents with lists of types of waste and substances that are known to have an impact on health and the environment.

Due to the growing concern of society regarding environmental issues and sustainable development, a committee was established by ABNT to evaluate and study the solid waste, classify it and review the NBR 10004: 1987. The purpose of this review was to correct, complement and update the standard that was in place and to disassociate from the classification process in relation to the final disposal of waste. It also sought to broaden understanding to the scientific community and the population in general (ABNT NBR 10,004: 2004).

Thus, solid wastes are classified into two groups, hazardous and non-hazardous, yet the latter group is divided into non-inert and inert.

According to Omara *et al.* (2012) hospital waste from health services is a reservoir of pathogenic microorganisms that require adequate, safe and reliable treatment.

There are risks associated with hospital waste where contact can result in injury and illness.

Hamadama *et al.* (2012) report that approximately 15 to 25% (by weight) of health-care 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 disposal.

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

Health-care waste (HCW) is classified under NBR 10.004: 2004 as hazardous waste. However, in addition to this classification, a more comprehensive classification must be followed, in this case, being guided by ANVISA to follow the classification of the Executive Board Resolution - RDC 306/2004. In this Resolution, health-care waste is presented in the following classifications:

- Group A – Waste with the possible presence of biological agents that present a risk of infection. This is classified as infectious waste;
- Group B - Waste containing chemicals that may pose a risk to public health and the environment. This is classified as chemical waste;
- Group C – Waste contaminated with radionuclides from clinical analysis laboratories, nuclear medicine and radiotherapy services. This is classified as radioactive waste;
- Group D – This is waste that does not present biological, chemical or radiological risks to health or the environment, but which was generated within health services and could be assimilated to household waste. This is common waste;



- Group E - The waste generated from materials that can puncture or cut, such as contaminated or uncontaminated needles and glass sheets. This is classified as sharps waste.

Salman *et al.* (2014) recommend the following actions to minimize sources of hospital waste

1- People regulating research should use their influence to reduce other causes of waste and inefficiency in research.

2- Regulators and policy makers should work with researchers, patients, and health professionals to streamline and harmonize the laws, regulations, guidelines, and processes that govern whether and how research can be done, and ensure that they are proportionate to the plausible risks associated with the research.

3- Researchers and research managers should increase the efficiency of recruitment, retention, data monitoring, and data sharing in research through the use of research designs known to reduce inefficiencies, and do additional research to learn how efficiency can be increased.

4- Everyone, particularly individuals responsible for health-care systems, can help to improve the efficiency of clinical research by promoting integration of research in everyday clinical practice.

3 Methodology

Due to the fact that this research has been developed through the conceptual approaches of authors, using books, articles, norms and resolutions; it presents a model of bibliographic research. According to Santos (2000) this type of research uses materials already elaborated and published by other authors.

On the information reported in this study, demonstrating its importance, by the fact that the public in general still knows little about the subject chosen, this research can also be classified as exploratory. As described by Gil (2008), exploratory research is characterized by developing and clarifying concepts and propositions.

This research also sought to evaluate the activities performed by the employees of the ten health units. In view of this, the study also fits in as descriptive research.

Because it is research that reveals real facts, it is also classified as a case study. For Yin (2005), the case study is a strategy in which contemporary facts are presented for the understanding of the real characteristics of the situation, being developed through rigorous investigations of empirical data.

Because one of the objectives of this research is to present propositions of improvements for the management of HCW, it can be classified as a study of qualitative and quantitative analysis.

For Gil (2008) research that generates data is classified as quantitative, since the procedures to be analyzed can be defined in advance.

For the research that is characterized as a case study, there is no way to predetermine situations to help the researcher to use real facts; the research is subject to knowledge, the capacity of interpretation and innovative propositions of the researcher.

For the bibliographic research, information was obtained on literature related to current HCW (health-care waste) and HCWMP (health-care waste management plan) legislation. Also, in addition to studying tools such as CP (Cleaner Production) and quality control, the authors of the study searched for books and articles that addressed the issue, by making an investigation of the major contributions that are the basis for the context of this research.

The field research used an interview and questionnaire method. This questionnaire was applied in ten health care units belonging to a hospital which is located in the middle region of the eastern center of the state of Rio Grande do Sul - Brazil. The Ministry of Health classified the 131 bed hospital as medium-sized (Brasil, 1977).

A questionnaire, consisting of 64 questions (Appendix 1) related to the general conditions of management and existing management of HCW and HCWMP in the





hospital, was applied to the heads of each unit.

The hospital in this study provides services for basic clinics: medical, pediatrics, obstetrics, surgery and Adult Intensive Care Unit (ICU), as well as emergency and X-Ray

services. The clinical laboratory, the blood bank and hemodialysis are outsourced but work within the area of the institution.

The steps that make up the methodology used for the investigation and proposition of this research are represented by Figure 1.

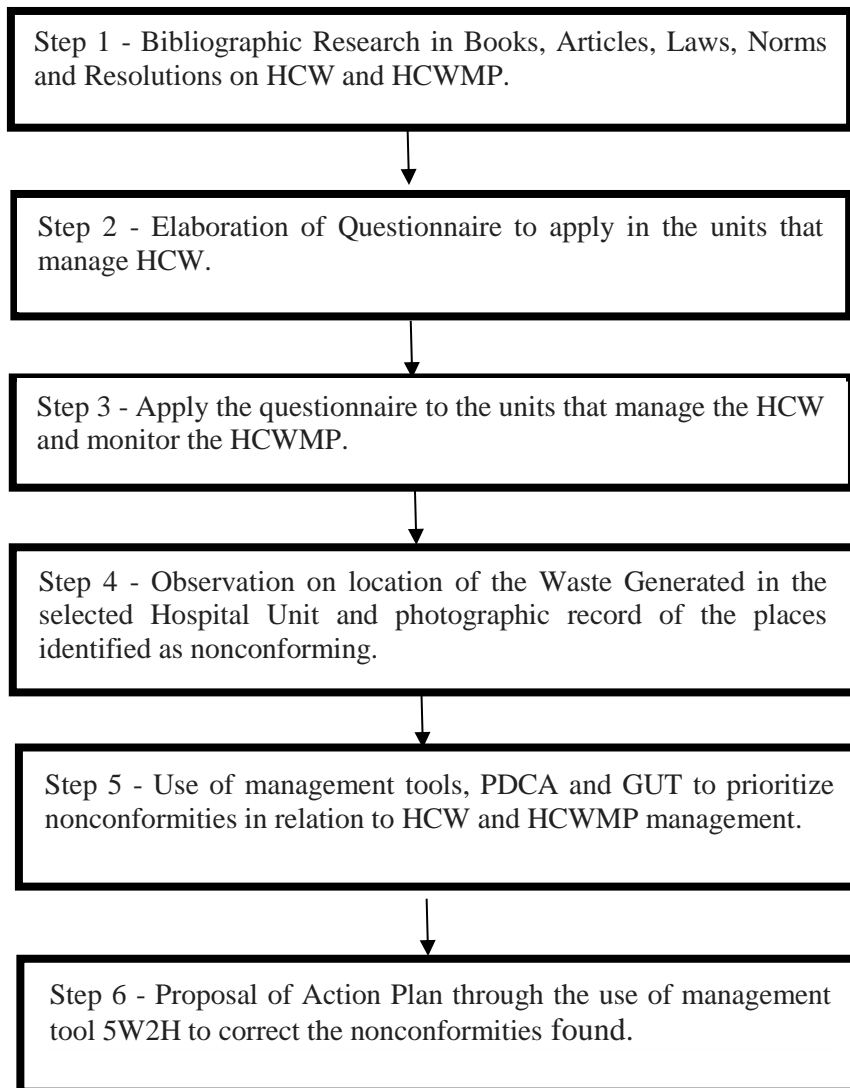


Figure 1. Stages that compose the methodology used for the elaboration of the research. Source: from the author.

3.1 Diagnosis of HCW generation scenario

To develop a diagnosis, it was essential to apply research tools to evaluate the forms of HCW management within the hospital and with the third-party providers that are directly related to the handling of the waste produced in the hospital. Information was obtained on the waste generated, the sources of the waste and the

procedures for collection, packaging, storage, transport and, in some cases, treatment.

The diagnosis was developed through notes and photographic records, interviews, and questionnaires on a sectorial basis (units), considering the different modes of consumption and disposal for each unit.

The study used the PDCA - Plan-Do-Check-Action method, which consists of a set of actions





in a sequence that is represented by the letters that make up the acronym: P (Plan), D (Do, Execute), C (Check, Verify) and A (Act, Take corrective action) (Jin *et al.*, 2012). The concept of the PDCA cycle is also linked to the idea that for an organization to achieve a certain goal, the organization needs to plan and control the activities related to accomplishing it.

In an attempt to prioritize and comparatively evaluate the waste generation and waste management of this hospital, the study used the methodology proposed in the GUT matrix. GUT considers the gravity, urgency and tendency of a certain phenomenon in order to prioritize the sequence of actions. Gravity (G) considers intensity, the depth of damage that the problems may cause. Urgency (U) considers the time for the outbreak of damage or undesirable outcome to occur. Tendency (T) considers how the problem will develop in the absence of action (Ferreira *et al.* 2014).

3.2 Prognostic development

The study tried to encompass actions and solutions for all problematic situations encountered in the diagnosis and assign responsibility to each function to be performed. Two frames were built, 5W and 2H, in order to establish an action plan in accordance with the priorities of each activity. This action plan must serve as a mapping of these listed activities, which establishes: what will be done, who will do what, at what time, in what area of the hospital and all the reasons why this activity should be done. The second step must show a plan on how this activity will be done and how much it will cost the organization.

4 Results and Discussion

It is important to note that the HCWMP advocates, with the utmost importance, the management practices that are aimed at minimizing the generation of HCW. The investigation of the research in the hospital showed that the HCWMP was partially implemented. Some anticipated modifications were made, since the implementation started in the first half of 2015.

The hospital has investigated the practice of segregating solid waste, showing a commitment to environmental management, and therefore, aligning with the principles described in the

literature by Schneider *et al.* (2004), Saurabh *et al.* (2009) and Zajac *et al.* (2016). This literature emphasizes that health-care waste, that is not correctly segregated, poses risks of contamination to professionals in these services.

The steps of segregation, packaging and identification are essential for the effective continuation of the entire HCW management process, since, in these steps, the waste is segregated according to its particular characteristics. The factors that make up correct segregation are the presence of securing devices, in quantity and quality consistent with the HCW generated in each hospital environment, and that completely conform to the RDC (Executive Board Resolutions) n. 306/2004 of ANVISA (National Health Surveillance Agency) and Resolution n. 358/2005 of CONAMA (National Council of Environment) (CONAMA, 2005).

One of the problems encountered was the employees' lack of awareness and commitment in relation to HCW segregation. The importance of effective ongoing training is critical, because if the trainings were efficient, this problem would tend to be minimized to the extent that knowledge is available. Trainings are periodic reminders that contribute to maintaining practices that have been developed.

The responses of the questionnaire indicated that the situation of the HCW in this health facility is monitored, but informal acts and some neglected actions by some employees connote to a resumption of more forceful management actions and a stronger structure to permit the construction of a new dynamic in the management of HCW in this hospital.

HCW of classes A (infectious), E (sharps) and B (chemical) were weighed for the quarter of August, September and October of 2015.

From the percentage distribution class of A and E waste (Figure 2), it can be confirmed that there were no major variations in the monthly quarter when the study was conducted. The sector with the highest percentage (35-36%) of class A and E waste was the adult ICU. This was followed by the sectors in the emergency room, operating room, surgical clinic and medical clinic, with values between 9% and 14%. It is worth mentioning that the medical clinic reduced waste from 12% to 7% this quarter. While ward A showed an increased variation of waste from 7% to 10% in the quarter studied. The other sectors showed less significant values in the quantification of class A and E waste.



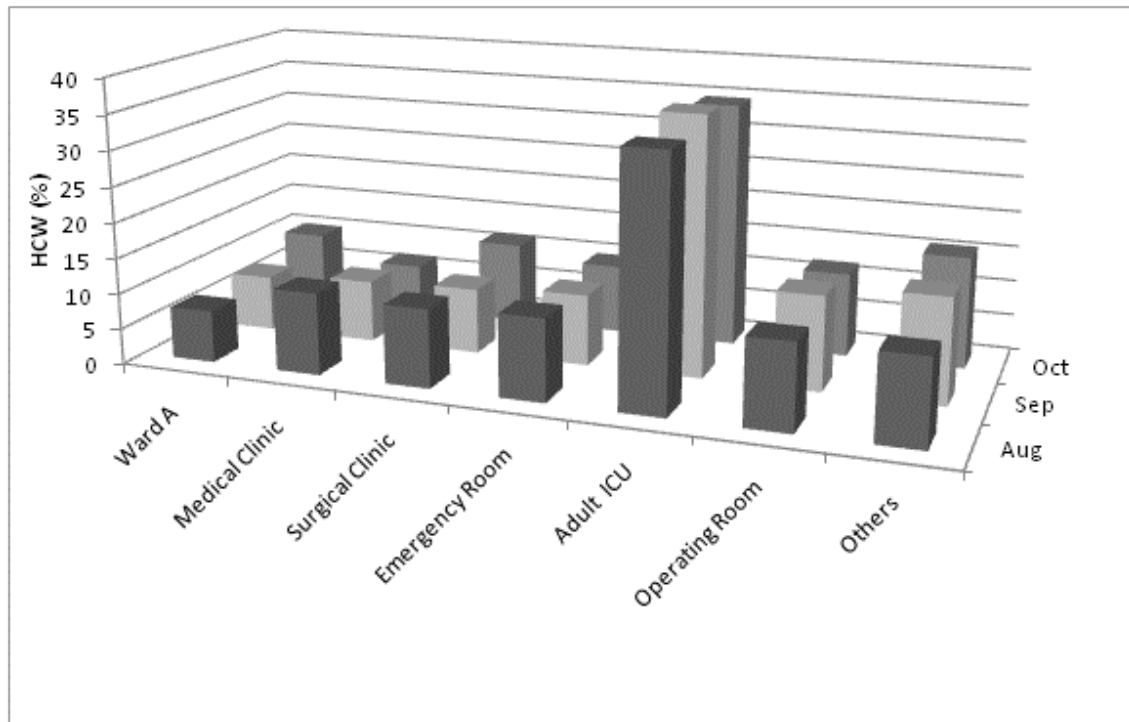


Figure 2. Percentage distribution of class A and E waste for the quarter of August, September and October of 2015. Source: from the author.

Observing the percentage distribution of the class B waste in the quarter studied (Figure 3), it could be noted that the largest percentage amounts are not in the adult ICU, as in the case of class A and E waste. In this case, it was the medical clinic that showed values of 26% in September, 9% in October and 7% in August. The surgical clinic already had values of 20% in

August, 9% in September and 17% in October. The surgical block ranged between 10% and 14% in the quarter. In August, ward A presented 13%, a reduction in this amount of waste to 8% in September and October. The other sectors showed less significant values in the quantification of Class B waste.



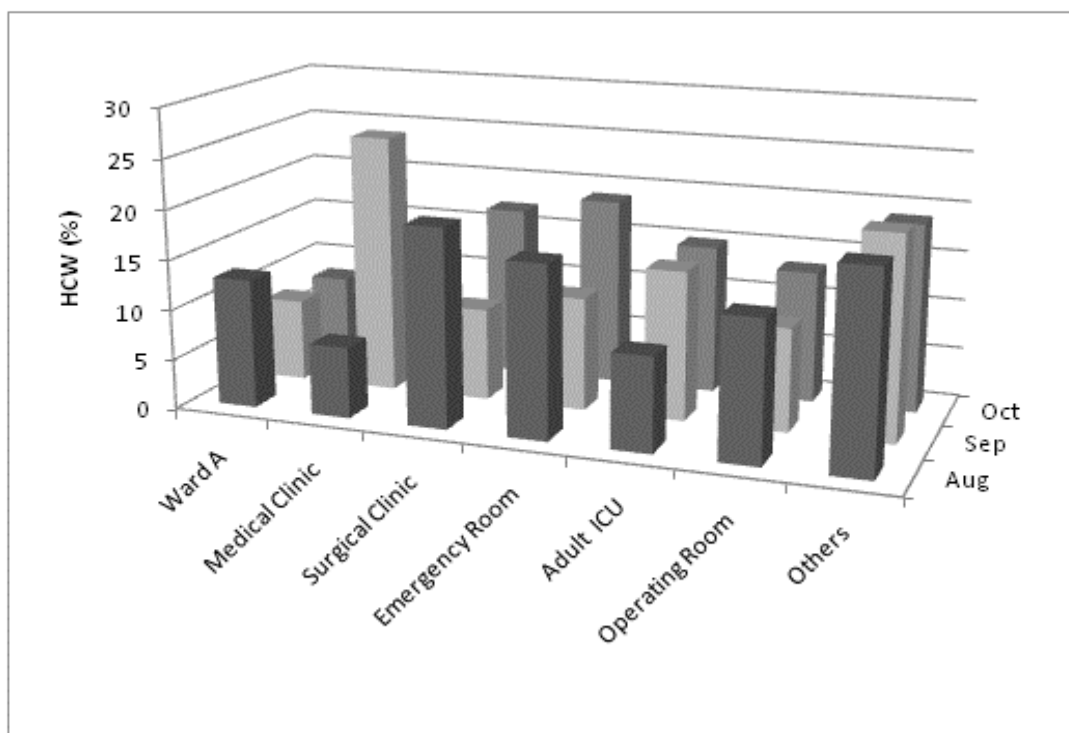


Figure 3. Percentage distribution of class B waste for the quarter of August, September and October of 2015. Source: from the author.

The rate of waste in the hospital for the classes studied showed values of 0.470 kg/HCW per day, per bed. The hospital in the study has no control over the waste categorized as common, because this fraction is not quantified. Making a comparative evaluation with the mean occurring in Brazil for the generation of HCW can be considered 0.470 kg/day, close to the values estimated by Dutra and Monteiro (2011), 1.0 to 4.5 kg/bed/day. However, it should be noted that this difference is including the garbage categorized as common.

Although the time period of the data collection is a limitation of the research, it can be observed that during the year 2016, the variations of the waste generated in each unit of the hospital investigated were always close to the percentages found during the data collection of the three months of the year 2015.

4.1 Quality management tools

Quality management is a process of the continuous improvement of services, involving organizational and cultural changes. To cause change, it is necessary to know and apply the tools that will help managers diagnose and find solutions to problems that plague daily activities.

In this context, the evaluation of the impacts of HCW management was carried out from the proposed tools: PDCA, GUT and 5W2H.

Hospital management is currently characterized as one of the most important and rapidly growing areas in Brazil, mainly due to the concern that organizations that manage the health services show the current Brazilian context. As a result, it appears that services that provide health and well-being are gaining ground in dealing with a precious asset, the life of customers/users.

A long with this concept is the observation of legislation, which Law N°12,305 of August 2010 establishes the National Policy on Solid Waste (NPSW), with the principles of: prevention and precaution; the polluter - payer and protector - receiver; systemic vision, solid waste management, which considers environmental, social, cultural, economic, technological variables and public health; sustainable development; eco-efficiency, through the reconciliation of supply, competitive prices, qualified goods and services that satisfy human needs and bring quality of life and the reduction of environmental impacts and the consumption of natural resources to a level that is at least equivalent to the estimated carrying capacity of the planet; cooperation between the different





spheres of government, the business sector and other segments of society; the shared responsibility for the life cycle of products; recognition of reusable and recyclable solid waste as economic and social benefit, working and generating income and promoting citizenship; respect for local and regional diversity; society's right to information and social control and reasonableness and proportionality (Brasil, 2010).

4.2 PDCA

The study began with the use of the PDCA management tool. This procedure was selected because it is one of the few instruments that aim to search for continuous improvement. It achieves better results with the purpose of ensuring the survival and growth of organizations through systematic actions (Fornari Junior, 2010; Rodrigues, 2016).

In the "P" phase, the plan phase, the problem was identified in order to clearly define the importance and relevance of this study.

Brainstorming was used to identify the problem. This involved unstructured interviews with hospital employees with the purpose of collecting the ideas, the problems, and the key issues that most concerned the staff. The responses of the applied questionnaires were used to identify the problem.

The defined problem was the result of the mismanagement of the HCW. The study investigated the specific features of the problem, which was HCW originating from the hospital.

For phase "D", the execution phase, onsite training was conducted to qualify the employees responsible for the management of HCW.

For phase "C", the check phase, observations were conducted on the progress of the relevant steps: separation, packaging and identification. These steps are fundamental for the effective and continual management of the HCW process.

For the phase "A", the action phase, it is necessary to include the standardization of the services implemented and the application of preventive measures to eliminate problems. It is also necessary to take suggestions in order to make the management of hospital waste more systematic. At this point, the development and implementation of measures, such as the HCWMP, are crucial.

4.3 GUT

In order to prioritize and comparatively evaluate the situation of the generation and management of HCW, a GUT matrix was used to consider the gravity, urgency and tendency of a certain phenomenon to define an order of actions.

Gravity (G) must consider the intensity, the depth of the damage that the problem can cause. Urgency (U) must consider the time for the onset of damage or undesirable outcome. Tendency (T) considers how the problem will develop in the absence of action. The evaluation of damage caused by a given activity through these three points was performed using a scale ranging from 1 to 5 (Ferreira *et al.*, 2014).

Table 1 presents the criteria used for the application of GUT (Gravity, Urgency and Tendency) considering the hospital as one single unit.

Table 1 - **Diagnosis used for the application of GUT**

	Criteria	Scoring
Gravity (G)	No toxic waste generated	1
	Low quantity and low hazardousness	2
	High quantity and low hazardousness	3
	Low quantity and high hazardousness	4
	High quantity and high hazardousness	5





Urgency (U)	Segregate, package, quantify, label, store, treat or recover the final destination	1
	Segregate, package and quantify	2
	Package and store	3
	Only store	4
	Segregate as common waste	5
Tendency (T)	Does not generate waste	1
	Generates in the long term (1 month)	2
	Generates in the medium term (2 weeks)	3
	Generates in a short term (1 week)	4
	Generates in the short term (daily)	5

Source: adapted from Ferreira *et al.*, 2014.

After the specification of Table 1, which shows the criteria that were used for classification, the Priority Index equation was used, which is presented in Equation 1. Note that in the literature by Ferreira *et al.* (2014) the weights for G, U and T are always identical. Because the study is in a hospital setting, where the gravity and urgency of issues are dealt with certain distinction, the GUT tool was adapted, taking into account the following prioritization criteria: consider the weight of gravity three times greater than the tendency and the weight of urgency double the weight of the tendency. Equation 1 is defined as follows:

$$PI = 3 G \times 2 U \times T \quad (\text{equation 1})$$

From the adaptation of the prioritization matrix formula, three intervals were defined in relation to the criteria adopted:

- HCW management was considered great: when the score reached values between 6 and 50;

- HCW management was considered regular: when the score reached values between 51 and 350;

- HCW management was considered bad: when the score reached values between 351 and 750.

The weight of gravity was considered as triple the tendency due to the impact caused by the HCW that was not being managed well and

that could tarnish the hospital's image, as well as cause problems in public health and harm the employees and the environment. It is important to emphasize the need to provide greater safety for the professionals, patients and hospital visitors, promote the reduction of occupational accidents and contribute to reducing hospital infection rates that HCW can cause.

The weight of urgency was considered as double the tendency due to time pressures to solve certain issues involving the lives of many patients. This time used was considered due to deadlines for compliance with legislation and as a response to the environment, as well as to adapt all waste management stages.

The tendency, T, considers the evolution of this situation because there is an evolution to manage this problem in the hospital under study. It is believed that there is no potential problem of growth over time.

For the application of equation 1, the scores for each problem were considered, as identified in Table 1. The problems listed in Table 2 were taken from the questionnaire applied in the 30 hospital sectors.

Table 3, elaborated with the use of equation 1, shows that it was possible to verify the main problems related to HCW in each of the activities carried out by hospital employees. Table 2 shows the distribution of the weights assigned to each of the scored problems, taking into account the gravity, urgency and tendency at the time of the



evaluation. After prioritizing the problems, it is necessary to draw up a plan of action to solve them. The suggested tool in this case was 5W2H.

Table 2 - Problems table with the application of GUT adapted by equation 1.

Problem	G	U	T	Scoring
Management (M)	2	2	3	72
Segregation (S)	2	2	2	48
Packing (P)	2	2	3	72
Identification (I)	2	2	3	72
Internal Transportation (IT)	3	3	2	108
Temporary Storage (TS)	3	3	3	162
External Storage (ES)	3	3	3	162
Collection and Transportation (CT)	2	2	2	48
Final provisions (FP)	2	2	2	48

Source: elaborated by the authors.

Table 3 - Ranking and scoring of problems table.

Ranking	Scoring	Solution
1°.	162 (TS)	Correct collection and segregation
2°.	162 (ES)	More frequent collection
3°.	108 (IT)	Organize better scheduling of transit through units
4°.	72 (M)	Management of keeping staff updated
5°.	72 (P)	More control
6°.	72 (I)	Always check labels and bags
7°.	48 (CT)	Be more agile
8°.	48 (S)	Failure to wear PPE, due to forgetfulness and lax attitude of management
9°.	48 (FP)	Monitoring of third-parties

Source: elaborated by the authors.

4.4 5W2H





The 5W2H is a check list of activities that must be developed with as much clarity as possible by the parties involved.

From the data obtained in the previous analysis and from the established prioritization in

Table 3, some lines of action can be proposed that aim to remedy or minimize the problems encountered. These lines of action, as well as the development of the tool used, are shown in Figures 4 and 5.

What?	Why?	When?	Who?	Where?	How?	How Much?
Revise mapping of the process	To streamline the process	The first semester of each year	Nurse responsible for environmental issues	The entire hospital	Through flow mapping	No additional costs
Motivation of the professional team	Responsibility to manage HCW	Constant	Team of facilitators	By unit or sector	Motivational lectures	No additional costs

Figure 4: Internal transport, temporary storage and external storage as applied to the lines of action for 5W2H. Source: elaborated by the authors

What?	Why?	When?	Who?	Where?	How?	How much?
Training courses	Implement a new managing method	Second semester of each year	Technical and administrative managers	The entire hospital	Preparing lectures	No budget
Hospital infections	Reduce incidents of hospital infections	Constantly	Patients and employees	The entire hospital	HCW management	No additional costs
Generating waste	Reduce quantity and recovery of wastes	Constantly	All hospital staff	The entire hospital	Provide separation for recycling	Reduce additional costs
Create environmental folders and booklets	Provide clarification for those working with circulation	Second semester of each year	Specialists responsible for environmental issues	Distributed throughout the hospital	Graphs of the area	No budget

Figure 5: Manage, segregate, pack and identify the lines of action applied through 5W2H. Source: elaborated by the authors





5 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 these wastes. 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.

As for the objectives of this research proposal, it was to analyze the HCW management in the hospital, as well as to compare its environmental management practices with the current legislation. The study was successful in building some considerations and investigations which enabled answers to these proposed objectives. However, it should be noted, that the hospital has its particular features and operating characteristics, but is seeking to adjust according to the current legislation.

The research found that the hospital has updated its HCWMP and is in accordance with ANVISA RDC N° 306/2004 for all steps: segregation, packaging, collection, storage, transportation, treatment and final disposal.

However, the study points out the lack of a training policy that focuses on the issue of waste management. Waste management trainings would provide staff with better knowledge of the existing legislation. Also, it is essential to include a program for continuing education and lifelong learning for the effective implementation of legislative provisions on the appropriate management of HCW in order to transform practices that constitute the current institutional culture. A transformative process of this size can only be made possible with the action of managers, who have the task of disseminating knowledge and awareness among hospital staff about the individual and collective risks of inadequate waste management.

Because of the importance of the issue, future studies are needed to contribute to the preservation of the environment by implementing a HCWMP in all hospitals.

It is up to the managers of these institutions to focus on the health of their employees and to manage the waste generated by health services within these units by applying and monitoring management tools that can identify the priorities and the most frequent problems that are often

covered by routine. The PDCA cycle and the corrections of nonconformities through the GUT prioritization matrix and the Action Plan, intend to generate a standardization of this improvement implemented through the SDCA (Standard; Do; Check; e Action); this is to standardize the new practices and monitor them so that the improvements are permanent. A new cycle will tend to repeat itself as new actions for improvement are identified, thus fulfilling the process of continuous improvement that is advocated by the PDCA tool.

This article intends to demonstrate, through practical applications of management tools, how health units can close the gap between the practice and management of solid health-care waste. This is accomplished through monitoring actions with the available resources and providing adequate deadlines and dates. The result is systemic compliance with current legislation.

Due to the importance of the theme, it is necessary to suggest future work that will contribute to the preservation of the environment. Also, a greater collection of data in several hospitals of the same region and investigation through good administrative practices of the HCWMP is needed. After this investigation in the different hospitals, it would be possible to disseminate information through benchmarking those actions that are contributing to the care of life.

6 Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

7 Acknowledgments

We express our thanks to the Research Incentive Fund and acknowledge the financial support from the Graduate Program in Environmental Technology of the Universidade de Santa Cruz do Sul (UNISC).



References

- ABRELPE - Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. Panorama dos Resíduos sólidos no Brasil em 2014. São Paulo, 2014. Disponível em: <<http://www.abrelpe.org.br/Panorama2014.pdf>> Acesso em: set. 2016.
- Afonso, T., Zanon, M. A. G., Locatelli, R. L. & Afonso, B. P. D. (2016). Consciência ambiental, comportamento pró-ambiental e qualidade de gerenciamento de resíduos em serviço de saúde. *Revista de Gestão Ambiental e Sustentabilidade: GeAs*, 3(1), 106-119.
- ANVISA, Agência Nacional de Vigilância Sanitária. Resolução da Diretoria Colegiada nº 306 de dezembro de 2004. Dispõe sobre o Regulamento técnico para o gerenciamento de resíduos de serviços de saúde. Diário Oficial da República, Brasília, 7 dez, 2004.
- BRASIL. Ministério da Saúde. Portaria nº 30 de 11 de fevereiro de 1977.
- BRASIL. Presidência da República. Lei nº 12.305, de 2 de agosto de 2010. Institui a Política Nacional de Resíduos Sólidos; altera a Lei no 9.605, de 12 de fevereiro de 1998; e dá outras providências. Diário Oficial da República Federativa do Brasil, Brasília, DF, 189º da Independência e 122º da República. 2 ago. 2010.
- CONAMA. Conselho Nacional de Meio Ambiente. Resolução n.º 358 de 29 de Abril de 2005. Tratamento e a disposição final dos resíduos dos serviços de saúde e dá outras providências. Diário Oficial da União, Brasília, maio. 2005.
- Deus, R. M., Battistelle, R. A. G., & Silva G. H. R. (2015). Resíduos sólidos no Brasil: contexto, lacunas e tendências. *Revista de Engenharia Sanitária e Ambiental*, 20(4), 685-698. <http://dx.doi.org/10.1590/S1413-41522015020040129347>
- Diaz, L. F, Eggerth, L. L., Enkhtsetseg, S. H., & Savage, G. M. (2008). Characteristics of health care wastes. *Waste Management*, 28(7), 1219-1226. <http://dx.doi.org/10.1016/j.wasman.2007.04.010>
- Dutra, L. M. A., & Monteiro, O. S. (2011). Gerenciamento de resíduos sólidos em um hospital de ensino em Brasília. *Com. Ciências Saúde*, 22, 305-314.
- Ferreira, M. A., Oliveira, U. R., & Garcia, P. A. A. (2014). Quatro ferramentas administrativas integradas para o mapeamento de falhas: um estudo de caso. *Revista Uniabeu*, 7, 300-315.
- Fornari Junior, C. C. M. (2010). Aplicação da Ferramenta da Qualidade (Diagrama de Ishikawa) e do PDCA no Desenvolvimento de Pesquisa para a reutilização dos Resíduos Sólidos de Coco Verde. *INGEPRO – Inovação, Gestão e Produção*, 2, 104-112.
- Hamadama, N; Mohammendb, A. H.; Awanga, M; Rahmana, M. S. A.; Roslia, N. W.; Laha, N. M. I. N. (2012) The Implementation of Clinical Waste Handling in Hospital Sultanah Aminah Johor Bahru (HSAJB). *Procedia - Social and Behavioral Sciences*, 65, 802-807.
- Jin, H., Huang, H., Dong, W., Sun, J., Liu, A., Deng, M., Dirsch, O., & Dahmen, U. (2012). Preliminary Experience of a PDCA-Cycle and Quality Management Based Training Curriculum for Rat Liver Transplantation. *Journal of Surgical Research*, 176, 409-422.
- Makajic-Nikolic, D; Petrovica, N; Belica, A; Rokvica, M; Radakovica, J. M & Tubicb, V. (2016). The fault tree analysis of infectious medical waste management. *Journal of Cleaner Production*, 113, 365-373.
- Omara, D.; Nazlib, S. N. & Karuppananb, S. A. L. (2012). Clinical Waste Management in District Hospitals of Tumpat, Batu Pahat and Taiping. *Procedia - Social and Behavioral Sciences* 68, 134-145.





- Rodrigues, M. V. Entendendo, aprendendo e desenvolvendo Sistema de Produção Lean Manufacturing, São Paulo: Campus, 2016.
- Saurabh, G., Boojh, R., Mishra, A., & Chandra, H. (2009). Rules and management of biomedical waste at Vivekananda Polyclinic: a case study. *Waste Management*, 29(2), <http://dx.doi.org/812-819>.doi:10.1016/j.wasman.2008.06.009
- Schneider, V. E., Caldart, V., Orlandin, S. M., & Emmerich, R. C. (2004). *Manual de gerenciamento de resíduos sólidos em serviços de saúde*. 2ed.rev.ampl. 189 p. Caxias do Sul, RS: EDUCS.
- Schneider, V. E., Rêgo, R. C. E., Caldart, V., & Orlandin, S. M. (2001). *Manual de Gerenciamento de Resíduos Sólidos de Serviços de Saúde*. 175 p. São Paulo: CLR Balieiro.
- Schneider, V. E., Stedile, N. L. R., Bigolin, M., & Paiz, J. C. (2013). Sistema de informações gerenciais (SIG): ferramenta de monitoramento do gerenciamento de resíduos de serviços de saúde (RSS) e dos custos de tratamento. *Revista de Gestão Ambiental e Sustentabilidade: GeAs*, 2(1), 166-188.
- Silva, C. E., & Hoppe, A. E. (2005a). Diagnóstico dos Resíduos de Serviços de Saúde no Interior do Rio Grande do Sul. *Revistade Engenharia Sanitária e Ambiental*, 10(2), 146-151. <http://dx.doi.org/10.1590/S1413-41522005000200008>
- Silva, C. E., Hoppe, A. E., Ravello, M. M., & Mello, N. (2005b). Medical wastes management in the south of Brazil. *Waste Management*, 25(6), 600-605.<http://dx.doi.org/10.1016/j.wasman.2004.03.002>
- Velloso, M. P. (2008). Os restos da história: percepções sobre resíduos. *Ciência & Saúde Coletiva* 13, 1953-1964.
- Windfeld, E. S. & Brooks, M. S. (2015) Medical waste management: A review. *Journal of Environmental Management*, 163, 98-108.
- Zajac, M. A. L., Fernandes, R. O., David, C. J. & Aquino, S. (2016). Logística reversa de resíduos da classe D em ambiente hospitalar: monitoramento e avaliação da reciclagem no Hospital Infantil Cândido Fontoura. *Revista de Gestão Ambiental e Sustentabilidade: GeAs*, 5(1), 78-93.

