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Sustainable health systems: A health services waste management plan for a university hospital in the south of Brazil

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Abstract

The Health Services Waste Management Plan (HSWMP) is the document part of the environmental license compliance certificate process, based on principles of non-waste generation, which recommends detailed actions for its handling. In accord with the current Brazilian legislation, the medical waste generators have to create and implement their own HSWMP. This paper presents an example of quality and quantitative exploratory research and intervention aimed to plan and implement the HSWMP at a medium business hospital (University Hospital, UH) in the Porto Alegre Region/Brazil. The study was conducted between June 2007 and July 2008, in two phases (Phase 1 was Diagnostics; Phase 2 was Implementation), covering the following procedures: (1) quantitatively and qualitatively characterizing waste generated by the hospital, and (2) creating an HSWMP covering all normative stages. 97% of the UH employees were trained and the waste characterization revealed a waste generation of 33,314.4 kg/month. Some measurements proposed during the planning were already implemented, resulting in changes in socio-environmental responsibilities. Finally, key performance indicators were selected such as Trained Staff Rate, Percentage of Solid Waste Generation and Average Quantity of Waste Generated by Day and Occupied Beds. The HSWMP proposal puts the UH into the right scenario to minimize the negative impacts generated, with the possibility of reaping economical and environmental benefits.

Keywords: Health Services; Waste Management; Key Performance Indicators; Training System; University Hospital; Sustainable Healthcare

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1. Introduction

According to Sisinno and Oliveira (2003), waste is a central theme for those who care about the environment with a view to ensuring the existence of future generations. In terms of the ecological impact of healthcare delivery, it proposes a vision for sustainable healthcare: "care without carbon" (Schroeder et al., 2013). Healthcare waste management has been identified as an area requiring extensive adoption of best practice. The National Health Service (NHS-England) generated 384,698 tonnes of waste in 2001 (Woolridge et al., 2005). In order the manage this waste effectively, strategic and tactical tools within the NHS were required, which is a large complex organisation. The study conducted in 26 UK hospitals by Blenkharn (2006) maybe can be identified as the milestone despite of the focus has just been the arrangements for bulk clinical waste handling already generated. The study offered important recommendations to the substantial improvement required in the management of clinical waste in hospitals. Hospital waste is special in that it has a higher potencial for infection and injury than other types of waste. The absence of propor waste disposal has been posing serius health hazards (Ngounou, 2004; Brebbia and Itoh, 2016).

According to the National Health Surveillance Agency/Brazilian Ministry of Health (ANVISA, 2006), the solid waste from health services, often called medical waste, represents 1% to 3% of the total municipal solid waste generated in a community. However, in view of its origin, health care waste is an actual or potential cause of harm to public health and the environment if it has no management, treatment and appropriate final destination. Health services waste (HSW) is a challenge with multiple interfaces. In addition to environmental issues inherent in any type of waste, HSW incorporates a greater concern with regard to infection control for the providers of services, as well as aspects of individual, occupational, public and environmental health (Schneider et al., 2004).

Health services waste management is a job that becomes increasingly important. However, being a relatively new activity in the health system, it still suffers from rejection and indifference. The common scenario is of hospital managers having very little accountability and not very worried about the issue. The awareness regarding the hazardous of medical waste is lacking both in public as well as in related professionals and workers (Ngounou, 2004; Sawalem et al., 2009). However, there are successful experiments. The Leicestershire Hospital (UK) since 2007 carries out a waste management plan with the staff participation. The team has come up with some ingenuous ideas for ensuring they can delivery sustainable health services without putting patients or anyone else at risk, a number of radical changes that can make positive impact (Dempsey et al., 2017) [I].

Therefore, the work of clarification of everyone involved in the generation of waste, whether employees or not, along with practicality and objectivity are essential for the implementation and proper functioning of this task, due to its importance for the environment and public health. Education and awareness are vitally important for improved waste management practices, with various writers such as Rushbrook et al. (2000), Phengxay et al. (2005) and Tudor et al. (2010) arguing for the importance of staff training.

The Sustainable Development Unit (NHS England-SDU, 2012) [II] having a systemic view, started also a programme to address the waste medicine by looking at primary and community care, particularly through service developments in the community pharmacy contractual framework, to improve the focus on optimising

the use of medicines by patients as a means to improve health outcomes. And the second step was to give focus on secondary care, where in-patient transfers, admission and discharge processes and the use of patients' own drugs present specific challenges to the effective management of medicines.

The health services waste management plan (HSWMP) has as one of its objectives to comply with Resolution 358/2005 (CONAMA, 2005) and the RDC 306/2004 (ANVISA, 2004) in order to improve safety measures and hygiene in the hospital environment, contribute to infection control by reducing the exposure to environmental and employee waste and occupational accidents, protect health and the environment, reduce the generation and the mass of contaminated waste, establish appropriate procedures for the management of each waste group and encourage the recycling of common waste not contaminated.

Importantly, the HSWMP is a document that shows and describes the actions relating to waste management, subject to its features and risks, in the context of the establishment, and covering all aspects relating to the generation, segregation, collection, storage, transport, treatment and final disposal as well as the protective actions to public health and the environment. Management of HSW is understood as the action to manage waste in their intra and extra-property aspects, from generation to final disposal.

The HSWMP is not just a record of intentions, but goes beyond, it addresses the conditions of implementation and monitoring, which requires several steps. The plan should be evaluated cyclically, as settings are subject to change (e.g., every year), according to the context of each municipality, region, state, whenever there are changes in legislation or guidance of health bodies and environment.

1.1. Health service waste

The concept of Health Services Waste (HSW) refers to materials generated in medical clinics, hospitals, health centers, laboratories, veterinary clinics and pharmacies. It refers to any kind of establishment capable of generating tissue waste, sharp equipment or materials contaminated with blood or faeces, including septic waste contaminated by pathogenic microorganisms and also waste from administrative services and restaurants (Naime, 2005; Tudor et al., 2010).

HSW is considered hazardous by Brazilian standardization and, according to Naime (2005), the danger is attributed both to toxicity and pathogenicity. According to the Pan American Health Organization (PAHO, 1997), the pathogenic potential of the waste and inefficiency of its management functions, including the generation, management, inadequate segregation and the lack of technology for its treatment and final provision, is a risk to the health of the hospital community and the general population, where patients and professionals of medical and paramedical areas, and the officials handling the waste, are potential targets of infections. To the extent that the solid waste from healthcare services are being deposited in the open, or in waterways, there is the risk of possible contamination of drinking water sources, whether surface or underground, spreading diseases through vectors which multiply these sites or make waste, through power supplies (Brilhante and Caldas, 1999).

Rahman et al. (2008) [III] and Da Silva et al. (2005) have found several factors that affect HSW generation rates, including the: type of facility and specialization, availability of waste segregation systems and prosperity

of the country. However, Rahman et al. (2008) contend that information on quantities and composition of HCW is the most important data for its management.

1.2. Management phases of health services wastes

According to ANVISA (2006), the minimum steps required to assist in waste management structure generated by health facilities in the course of their activities, were prepared, in chronological order, as follows:

- Formation of the Internal Committee of the Health Waste Management – made up of members from various sectors such as government, medical professionals, cleaning staff, members of the Internal Commission for Accident Prevention (ICAP), Committee of Hospital Infection Control (CHIC) and the Specialized Service in Engineering and Safety (SSES).
- Preparation of HWSMP – HWS generators should adopt a HWSMP, which constitutes a document integrating the environmental licensing process; shall consider the technical and legal structuring of the actions necessary to waste management, and environmental and health suitability of the property.
- Implementation of HWSMP – implementing the plan, it is necessary to carry out training and capacity building of various stakeholders in the HWSM process; and optionally, a change may be needed in setting such as, for example, physical reforms.
- Carry out of HWSM – is the implementation of activities under the HWSMP.

Control and Monitoring HWSM – for control, monitoring and evaluation of HWSM, the data collected qualitatively and quantitatively should be taken as parameters, during the development of management. According to ANVISA (2006), the items to be evaluated as indicators are: the rate of sharps injuries; variation of waste generation; variation in the proportion of the wastes from Group A (Infectious Waste), Group B (Chemical Waste), Group C (Radioactive Waste), Group D (Common Waste) and Group E (Needlestick Materials) (CONAMA, 2005; ANVISA, 2006); variation in the percentage of recyclable waste, resource persons in waste management and costs with HWS.

The article presents the work done in July 2007 to June 2008 in order to develop a health services waste management plan (HSWMP): phase 1 diagnostics and phase 2 implementation. For this, we used a medium-sized hospital in the metropolitan region of Porto Alegre, as a case study and reference for the provision and comparison of data required. The information reported here demonstrates the reality of the institution in terms of waste management of health services at the time of the research.

2. Materials and methods

2.1. Research universe

For realization of this study, the venue was the UH Ulbra Campus Canoas, which is situated in Farroupilha Avenue, nº. 8001, San Jose District, Canoas, Rio Grande do Sul, Brazil.

The hospital has ten floors, eight of which were already in operation at the time of completion of the work. The total area of land occupied by the hospital at the University is 2,037,260.22 m^2 and it has 39,331.49 m^2 of built area.

The total number of employees was 532 and the total number of beds in July 2008 was 277 beds registered. The hospital provides services to the Unified Health System (SUS), health plans and private patients.

2.2. Data collection procedure

The study was conducted in two phases: Phase I (Diagnostic) and Phase II (Implementation). In Phase I (Diagnostic), the area coordinators were identified, along with UH Waste Commission, and thirty-six semi-structured interviews took place. The interviews addressed the knowledge that the participants had in relation to waste management steps in the hospital and in the sector in which they operated. Visits were made to all sectors of the hospital. This information was documented using a photographic report.

Data was collected from the cleaning staff, with regard to segregation, packaging, internal collection, external collection and final provision of HWS. Visits took place with the companies responsible for the UH external collection as well as disposal.

The characterization and classification of waste was performed weighing the waste for eight consecutive days, from 06/08/2007 to 23/08/2007 in accordance with PAHO (1997), to determine the amount of generation of waste at source and its nature. The qualitative characterization, the description of the nature of the waste, was classified according to RDC No. 306/04 (ANVISA, 2004), waste of groups A (infectious), B (chemical), C (do not produce, only when chemotherapy is prescribed, coming from another unit of the institution), D (common), E (sharps) and recyclable waste classified with group D. During the qualitative characterization period there was an inventory of waste, waste bags were opened and dumped over a black canvas and after a classified description of waste, waste type and disposal site took place.

From the diagnostic management of the HWS and remarks on the classification, characterization, collection, transport and storage of waste, a proposal was made for the Health Service Waste Solids Management Plan for the UH covering the following items, according to ANVISA (2004): enterprise ID (corporate name, trade name, address, zip code, city, phone, fax, email, contact person); general information (medical specialties, total number of employees, building area, total land area, total number of beds, legal and technical establishing); technical information (handling, segregation, flow, quantification of total waste generated, treatment, types of packaging); staff training (preparation routines with instructions procedures for cleaning, handling, segregation and internal collection of waste); monitoring program HSWMP (semi-annual reports evaluating the HSWMP and spreadsheet referring to monthly waste generation, characterization, classification).

In Phase II, the implementation of HSWMP was realized, obeying all stages (distribution of responsibilities to the commission of the UH HSWMP; mobilization of the organization, setting goals, implementation period and basic actions). In the period from 10/04/2008 to 15/05/2008 training was held with the staff of the UH. A total of 517 people were trained with pre- and post-test as a tool for measuring the results of training, with the second weighing of waste happening thirty days after the last training was held in the period 16/06/2008 to 23/06/2008. The HSWMP document was delivered to the UH Waste Commission on 20/06/2008 with the following proposed flowchart (Figure 1).

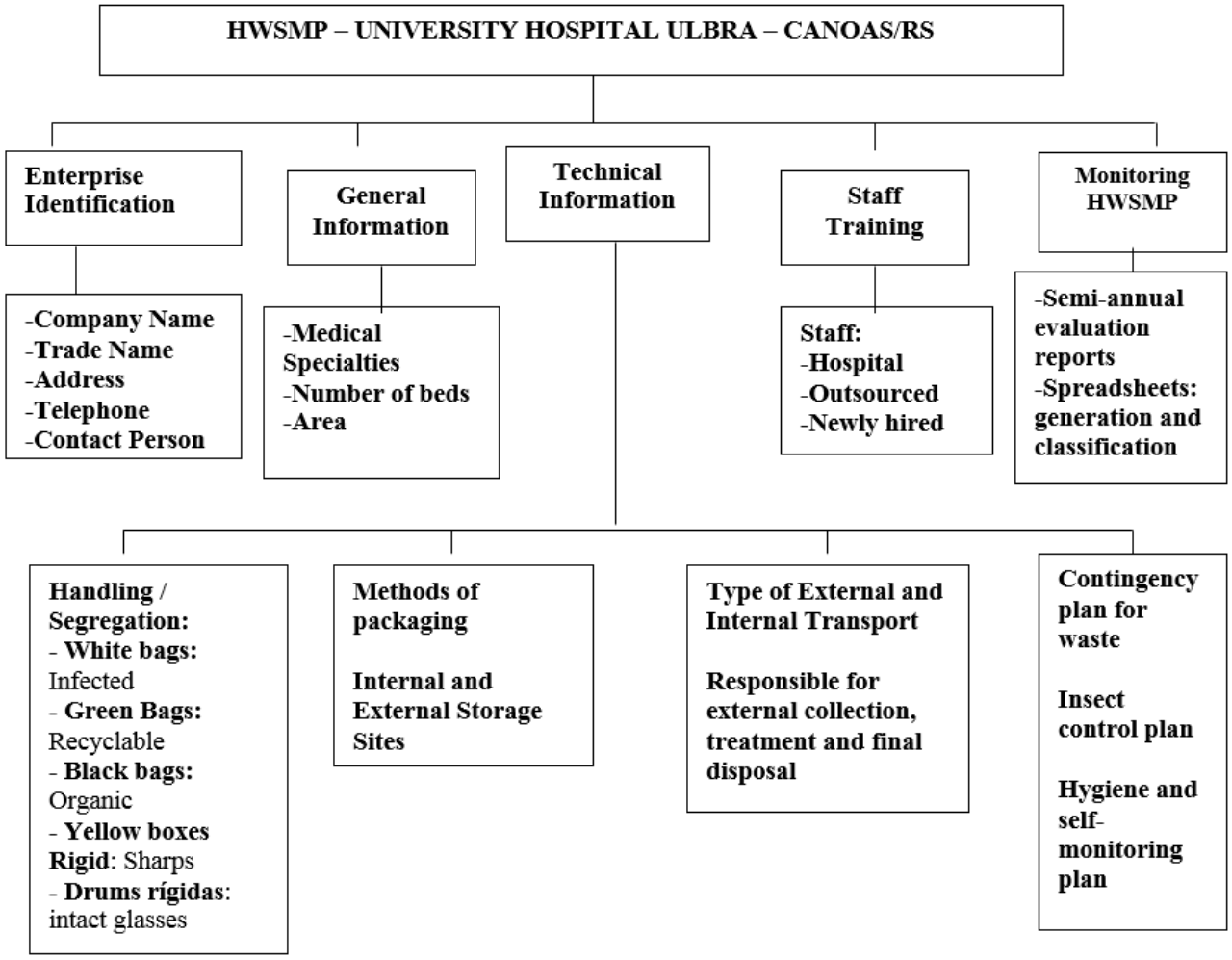

Figure 1. Flowchart of the waste management plan proposed for the UH

This study was submitted to the Research Ethics Committee of ULBRA University and approved.

2.3. Data analysis procedure

A triangulation of data was used between the observations, the data collected through interviews and the quantitative and qualitative data on waste generation. This triangulation occurred with support from na official literature review on the subject, guided by guiding concepts of the subject, with emphasis on health service waste. Also, we focused on the reading and analysis of normative instructions of the Brazilian legislation on the subject, drawn up by public and private institutions related to the environment and public health. According to Minayo (2007), the triangulation of methods can be understood as a form of dynamic research that integrates the analysis of structures, processes and outcomes.

The pre and post-test data were entered using Microsoft Excel version 2007. The typing error was avoided by double data entry with validation of the agreement between the clerks and to check the differences observed in the tests.

Some indicators for the assessment of HSWMP were listed. The indicators were defined: the variation of the generation of recyclable waste, average amount of waste generated per day related to the number of occupied beds (HWS/bed.day) and the number of people trained in waste management.

3. Results and discussion

3.1. Diagnostic phase

Table 1 shows the quantities of waste resulting from procedures performed on the property, according to the classification established by ANVISA 306/2004 (ANVISA, 2004) and CONAMA 358/2005 (CONAMA, 2005).

Table 1. Generation of solid wastes, according to the group (kg/week; kg/month) and volumetric liquid waste (l/month).

Solid Waste Groups	Amount (kg/week)	Amount (kg/month)
Group A	318,3	1273,2
Group B (sólidos)	12,8	51,2
Group C	Not generated	Not generated
Group D	1312,2	5248,8
Group E	98,8	395,2
Recyclable	226,1	1343,2

Wastes	Amount generated (l/month)
Fasteners	**32**
Buffer solution with silver nitrate	**3,0**
Chemical solution to reveal radiographs	**48**
Xylene Paraffin	**0,3**
Ethanol	**5,0**

It should be noted that the chemotherapy drugs are only administered to patients in the hospital. They come from another health facility complex.

In the diagnostic phase, the weigh-in was held from 06/08/2007 to 13/08/2007, totaling eight consecutive days, according to PAHO (1997). The result is found in Figure 2.

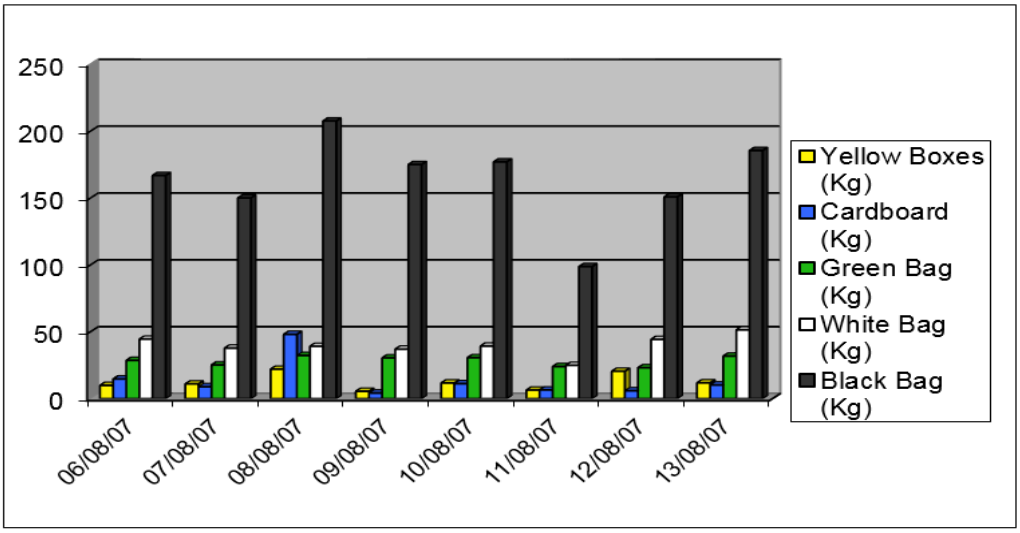

Figure 2. Daily generation of waste (kg) of the UH from 06 to 13/08/2007

It was observed, in Phase I, that the common waste was generated in larger quantities, in relation to other waste, accounting approximately for 63.4% of the total waste generated in the UH; 15.4% were hazardous and chemical waste; 11.0% were recyclable waste; 5.3% were cardboard that was accounted for only during and after the implementation of the study and 4.9% were sharps waste.

Referring to interviews with 36 coordinators of areas, it can be seen that the vast majority (86%) have detailed knowledge about the disposal of waste; "knowledge luggage" they bring from work done in other institutions. When asked what suggestions they had for improvements in their own work sector they suggested the following:

- That labels be placed on collection containers, identifying what should be discarded at each site due to the large number of outsourced professionals involved (this suggestion was cited by 67% of the interviews);
- That the institution develop a training plan for new employees and refresher training with the others (this suggestion was given by 42% of respondents);
- When asked about daily waste generation notions (in numbers of bags), only two respondents were aware of the number of waste bags generated by the industry, the others did not know the numbers;
- When questioning them on the intermediate storage of HWS and the place where residues are normally stored in the industry, it can be observed that the responses were unanimous that the hospital does not have intermediate waste storage locations and that they are usually placed in service stairwells or in utility rooms.

At the end of the interviews respondents were asked if they had an interest in actively participating in the HWSMP at their own institution, though only four respondents showed some interest in participating in the committee.

3.2. Thirty days after implementation

After thirty days of the implementation phase of the HWSMP, a reweigh took place in the period from 16/06/2008 to 23/06/2008, totaling eight consecutive days (Figure 3).

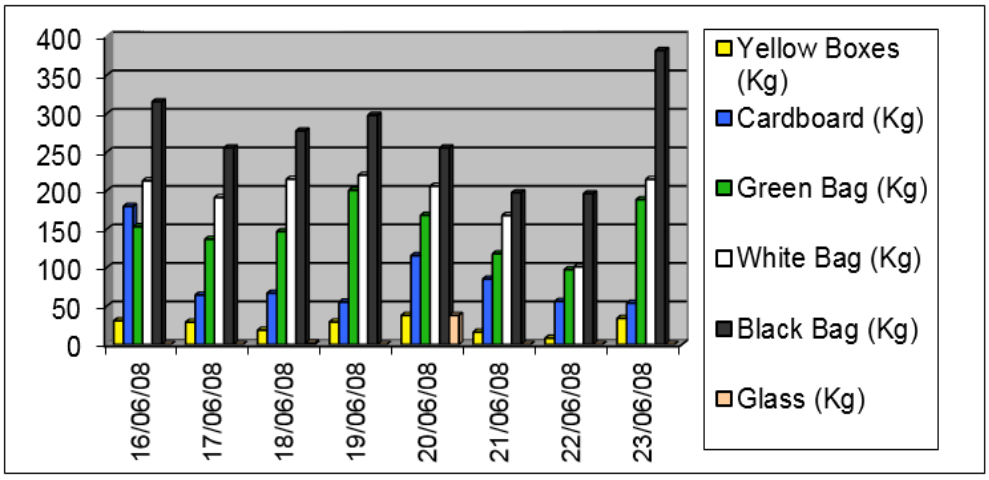

Figure 3. Daily generation of waste (kg) of the UH from 16 to 23/06/2008

There was a significant increase in waste generation due to the high number of new sectors starting their activities in the second Phase of the Project.

It was observed, in Phase II, that the common waste generated, in relation to other waste, accounted approximately for 57% of the total waste generated in the UH; 18% were hazardous and chemical waste; 15% were recyclable waste; 8% were cardboard and 2% were sharps waste.

Comparing the generation of waste/month in Phase I to Phase II, one can observe the decrease in weight of 159.2 kg related to sharps waste, due to the implementation in Phase II, of rigid drums for collecting integrity glasses, which were previously stored with sharps waste.

Another point to be noted is increased segregation in cardboard in Phase II, of which 2703.6 kg/month was separated and sent for recycling; whereas, prior to the implementation of the Plan, the cardboard totaled 438.8 kg/month.

3.3. Description of shares related to solid waste management

Below are listed the various steps and procedures used by the UH, the situation found when the study began, and the guidelines suggested as revision. Data and information were organized according to the steps in the management process of HWS.

Segregation: Current scenario - The UH put the waste in specific containers, according to the risk potential of waste generated. Future Scenario - Some procedures will have to be revised to optimize the separation of waste by patients and family, moving in large numbers around the hospital. I leave as a suggestion the idea of creating a folder in relation to the separation of waste and their disposal sites, to be delivered at the time of the family's admission. It is necessary that in waste packaging containers, in doctors' offices and in 20 additional rooms in the building (UH Annex to the building), Ground Floor, plastic stickers should be pasted, specifying the type of waste to be disposed of, thereby facilitating the disposal by individuals that work and circulate around there.

Packaging: Current scenario - Waste is already being stored, according to potential risk, in bags, plastic boxes and canisters. The sharps are packed in hard cardboard boxes and coated internally with plastic material (following the normative specifications). Future scenario - The UH must pay attention to make sure that solid waste is packaged in bags made of material resistant to rupture and leak, waterproof, based on NBR 9.191/2000 from ABNT (2000), respecting each bag's weight limits and prohibited the emptying or reuse. For ordinary waste, gray bags should be introduced the according to CONAMA 275/2001 (CONAMA, 2001). Liquid waste must be packaged in containers made of material compatible with the liquid stored, tough, hard and tight, threaded and resealable. The bottles and vials intact should be packed in rigid plastic pails. The institution shall make an agreement with recycling cooperatives, for gathering this material; this is necessary to involve the legal UH for drawing up a contract.

Identification: Current scenario - The residues are identified for their potential to risk and physical condition by securing devices: milky white bags for organic and black for common waste. Future scenario - Devices (other than the milky white bag already with its own identification) must be identified according to the risk potential and indicating the substances of danger to them.

Temporary internal storage: Current scenario - Closed bags and the units for removal are grouped on the floor in the utility room (purge), or in storage by cleaning materials or in interior corridors (access area to service stairs). Future scenario - This is being reviewed by the Hospital Waste Commission. There are two possibilities: the acquisition of small or medium-sized cars to be arranged along with utility rooms, or the preparation of a metal support (equivalent to a hamper). The room for temporary storage may be shared with the utility room; it should have minimum exclusive area to store the containers for collection, for further transportation to the external storage area. The UH has a pneumatic system of collection of waste and dirty clothes, which with its operation after completion of the project, will eliminate this.

Internal transport: Current scenario - The collection is carried out by cleaning staff, belonging to the third party "Strong Group" at the start of every shift. Common and infectious waste is packed into a single car that is suitable according to the standards for internal transport. Future scenario - Due to the great generation of waste, it is recommended that the collection is held twice a shift (when necessary) and that waste is transported separately with the acquisition of more waste transport cars.

Temporary external storage: Current scenario - The infective and / or chemical waste is stored in a room in the building next to the hospital, built partly as required by technical ABNT NBR 12.809/93 (ABNT, 1993b). Common waste and/or recyclable inert components do not have the storage location, the same are placed in containers on the patio of the institution. There are currently an insufficient number of drums for packaging infectious waste. Future Scenario - The storage room of infectious and / or chemical waste needs a sink, soap and paper towels dispenser, a drain and the floor repairing; it should be padlocked and the keys given to the employees who perform the conditioning of waste at this location, and a copy to the waste committee of the institution; after these observations the room will be within the technical regulation requirements. Referring to the common and / or recyclable waste, the Commission HWS, together with the engineering team, agreed the feasibility and construction of a storage location and shelter to meet the requirements of ABNT NBR 12.809/93 (ABNT, 1993b).

External transport: Current scenario - The company that performs the external transport of this waste is within the technical norms.

Treatment and final disposal: Current scenario - The following shows Table 2 regarding the packaging processes and final disposal of the HWS of the UH.

Table 2. Containment procedures and final disposal of the UH HWS

Waste	Packaging	Final Disposal
Infective (Biological) and Chemical	White bag	Sterilization and Industrial Landfill Outsourced company
Unused medicines	They weren't discarded	Indefinite
Empty Medicine and chemical bottles	White bag	Sterilization and Industrial Landfill Outsourced company
Fluorescent	Deposit Ulbra	Decontamination by outsourced company
Common Non-Recyclable	Black bag	Landfill - Municipality of Canoas/RS
Common Recyclable (cardboard)	Plywood box	Deposit Ulbra and subsequent sale
Sharps	Yellow Cardboard Box	Autoclaving and Industrial Landfill Outsourced company

Future scenario - The pharmacologist in charge of the sector should contact the laboratories or manufacturers of the products to deal with the expired products. The responsibility lies with the manufacturer or importer of products that generate waste classified in Group B to provide documented information regarding the inherent risk and the management and disposal of the product or waste. This information must accompany the product to the waste generator.

3.4. Staff training: training process

In continuing education programs it is necessary to take into account that the professionals who work in the process may not have, in their training, notions of environmental care. Generally, their training is specific, technical and does not provide the necessary preparation for the search conditions that allow the minimization of risks, both those that are inherent in the execution of their activities as well as those involving the environment.

Staff at the UH and outsourced (cleaning and security) were trained to carry out their actions related to segregation, packing and picking, but with an understanding of the totality of this management. In the end, five hundred and seventeen people trained. The training was based on CONAMA 358/2005 (CONAMA, 2005), RDC ANVISA 306/2004 (ANVISA, 2004) and the Ministry of Health script.

The instrument used to perform the pre-test and post-test approached the correct segregation of waste at the source and the personal responsibility of each employee for wastes. This instrument was developed based on the Ministry of Health's Guide (BRASIL, 2001).

The pre-test and post-test were applied to all officials who carried out the training, and consisted of identical questions, favoring the comparison and verification of the seizure of the contents explained in the same. The results found were: pre-test: 64% of correct answers and 36% wrong answers; post-test: 80% of correct answers and 20% wrong answers.

Referring to the test questions, it can be observed that the participants had difficulty answering two questions, the first one referred to the packaging of organic waste, and the second question to the waste group:

Question number 1.C (True or False):

( ) The HSW packaging should be done in white bags, tough, waterproof, at the time and place of its generation, as they are generated and identified with the group to which it belongs.

Pre-Test: 28% hits and 72% errors; Post-Test: 35% hits and 65% errors.

Question number 2 (Choose the correct alternative):

The HSW are divided into 4 groups, which according to its contamination are classified:

a. ( ) Group A (infectious); Group B (chemical); Group C (radioactive); Group D (common);

b. ( ) Group A (biological); Group B (chemical); Group C (radioactive); Group D (common);

c. ( ) Group A (biological); Group B (special); Group C (radioactive); Group D (household waste);

d. ( ) A and B are correct;

e. ( ) No alternative is correct.

Pre-Test: 33% hits and 67% errors; Post-Test: 42% hits and 58% errors.

It is observed the following that the percentage of errors was significant in the pre-test, with no significant change in the post-test.

3.5. Indicators

In order to ensure that the predetermined outcomes are achieved, the actions taken should be monitored and corrected, by the evaluation and the systematic control of the critical factors that affect the process. Proper monitoring serves also for management to know the potential for the organization of the establishment, the ability of staff to perform the necessary adjustments quickly and understand the importance of responding quickly to the needs. Indicators are statistical tools for the evaluation of environmental performance of a health facility.

In this context, a number of indicators were elected to assess and monitor the results achieved with the implementation of the project: personal rate with training (TSR), average amount of waste generated per day related to the number of occupied beds (HWS/bed.day).

Trained Staff Rate (TSR)

$$TSR = \frac{\text{nº of employees trained in the UH in the period}}{\text{Total employees in the same period and UH}} \times 100$$

TSR = 517/532 x 100 = 97.2% of UH employees received training. According to the Ministry of Health (BRASIL, 2001), the safety and well being of staff that handle the HWS depends, in large part, on the training and motivation of nurses, doctors, patients and all personnel who interact in generating such waste.

Average amount of waste generated per day related to the number of occupied beds

To assess this item, the Classical Management was used, where considered special waste are those classified by ABNT NBR 12.807/93 (ABNT, 1993a) as infectious waste. According to data presented in Table 3, it can be seen that the average bed/day of UH is approximately 0.74 to 1.67 kg/bed.day, referring to infectious waste.

Table 3. Infectious waste generation per bed occupied (kg/bed.day).

Day/ Month	Infectious waste (White) (Kg)	N° of occupied beds	Waste generation per bed occupied (kg/bed.day)
16/6/2008	212,7	127	1,67
17/6/2008	190,9	130	1,46
18/6/2008	214,6	140	1,53
19/6/2008	219,8	133	1,65
20/6/2008	205,7	131	1,57
21/6/2008	167,6	130	1,28
22/6/2008	101	136	0,74
23/6/2008	214,4	144	1,48

Table 4 reports the ratio of HWS/bed.day generated in the hospital, the results presented here refer to the weight of the waste from groups A + B + D + E.

Table 4 – Total generation of waste in Groups A + B + D + E (kg/bed.day).

Day/ Month	Wastes (Groups A,B,D,E)	N° Occupied beds	Waste generation per bed occupied (kg/bed.day)
16/6/2008	891,2	127	7,01
17/6/2008	676,4	130	5,20
18/6/2008	725,9	140	5,18
19/6/2008	802,3	133	6,03
20/6/2008	820,2	131	6,26
21/6/2008	583,9	130	4,49
22/6/2008	458,5	136	3,37
23/6/2008	872,2	144	6,05

The rate of solid waste generation at the UH is 3.37 to 7.01 kg/bed.day. According to Schneider et al. (2004), the quantities vary widely, e.g. the UK, where they were generated 1.5 to 2.5 kg/bed.day, Canada, 11.4 kg/bed.day. To Petranovich (1991), there is a growth estimate of solid waste generation by 3% per year. According to the author, the main causes of the progressive increase of these rates are the ever-increasing complexity of medical care and the increasing use of materials disposable. Another phenomenon fueled by the growth of the use of disposable 5% to 8% per year is due to the emergence of infectious diseases.

Studies conducted by PAHO (1997) reported that the average waste produced by health facilities in Latin America ranges from 1 kg to 4.5 kg/bed.day, depending on the complexity and frequency of services, the technology used and efficiency of those responsible for the services.

This study was conducted around 10 years ago, however it now finds the global context for its dissemination, when the international agencies try to put into practice a Public Health Ecological Model (Lang and Rayner, 2012). This HSW Management Plan is still practical, but special attention to changes in legislation is recommended. In its phase of preparation, each plan shall consider the technical and legal structuring of the actions necessary to waste management, and environmental and health suitability of property.

As limitations of the study, because they were not considered, three complementary plans are suggested for future work: contingency plan for waste incidents, insect control plan and hygiene and self-monitoring plan.

4. Conclusion

The HSWMP was designed and implemented following the norms and phases comprising a plan. The diagnostic phase provided the necessary contact with the institution, when it established links to the work to be done. The UH, after the implementation of HSWMP, was asked to give greater attention to the treatment of recyclable waste with respect to disposal thereof, seeking reduction of damage to the environment and public health. Some of the measures in the preparation of the plan have already been adopted by the hospital and resulted in socio-environmental changes.

Finally it is important to note that since the UH is an institution that cares for the health of the community, care for the management of waste is a priority. Based on this we can see the importance of the continuity of HSWMP for the institution, since the UH is in a phase of expansion of its staff and its service capacity.

Studies have shown that a crucial component in achieving enhanced waste management efficiency is the behavior of the individual. Individuals should understand the need for segregation and be aware of what happens to the waste they generate. Training and awareness should focus on effective waste minimization and segregation for healthcare staff.

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