

Hospital and Healthcare Waste Management Plan for Healthcare Units in Angola

Autor: Eng^o. Francisco Manuel Vuia, MSc. | Franciscovuia356@gmail.com | Master's degree in Environmental Engineering from the Faculty of Engineering at Agostinho Neto University in 2015; | <https://orcid.org/0009-0007-4063-6002>

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RESUMO

Estudos demonstram que a produção de resíduos hospitalares e de serviços de saúde faz parte da evolução humana e é inevitável. Com o crescimento económico e populacional, e devido à falta de saneamento básico, a sua produção e consequências aumentam. Assim, o objetivo deste trabalho foi avaliar a situação atual quanto à produção e destino final desses resíduos e propor um plano de gestão para preservar o meio ambiente e a saúde pública, visando a sua generalização em todo o país. Para compreender a situação atual, foi realizado um estudo de caracterização de resíduos no Hospital Provincial do Uíge, contabilizando 628.17 kg de resíduos sólidos equivalentes a resíduos urbanos e 351.8 kg de resíduos de serviços de saúde em uma semana. Durante este período, foram atendidos 1643 pacientes, com 1443 consultas e 1105 internamen-

tos. Estes dados permitiram determinar o índice de geração de resíduos por cama em 0.89 kg/cama; 0.57 kg/paciente atendido e 0.68 kg/consulta de paciente. Contudo, conclui-se que apenas uma percentagem muito pequena de resíduos hospitalares tem o mesmo destino que os resíduos domésticos, sendo a maioria queimada a céu aberto. Além disso, com base nos dados do Censo de 2014, foi possível contabilizar 162 incineradoras ainda por construir, uma por município, a um custo total de US\$13,070,484. Os custos foram contabilizados em dólares americanos devido ao desequilíbrio do Kwanza.

Este estudo constitui um contributo prático para o estabelecimento de um plano de gestão de resíduos hospitalares.

Palavras-chave: : Gestão de Resíduos Hospitalares

ABSTRACT

Studies demonstrate that the production of hospital and healthcare waste is part of human evolution and is inevitable. With economic and population growth, and due to the lack of basic sanitation, its production and consequences increase. Therefore, the objective of this work was to evaluate the current situation regarding the production and final destination of this waste and to propose a management plan to preserve the environment and public health, aiming at its generalization throughout the country. To understand

the current situation, a waste characterization study was carried out at the Uíge Provincial Hospital, accounting for 628.17 kg of solid waste equivalent to urban waste and 351.8 kg of healthcare service waste in one week. During this period, 1643 patients were treated, with 1443 consultations and 1105 hospitalizations. These data allowed us to determine the waste generation index per bed at 0.89 kg/bed; 0.57 kg/patient treated and 0.68 kg/patient consultation. However, it is concluded that only a very small percentage of

hospital waste has the same destination as household waste, with the majority being burned in the open air. Furthermore, based on data from the 2014 Census, it was possible to count 162 incinerators yet to be built, one per municipality, at a total cost of US\$13,070,484.

The costs were accounted for in US dollars due to the imbalance of the Kwanza.

This study constitutes a practical contribution to the establishment of a hospital waste management plan.

Keywords: Hospital Waste Management

INTRODUCTION

Waste production has been increasing in quantity and diversity in recent decades worldwide, as a result of population growth, economic growth, and increased purchasing power of families, and may also be a symptom of overuse of resources. However, with economic development and population growth, the production of this waste also increases. Therefore, for these reasons and due to a lack of basic sanitation, this issue represents an environmental, social, and economic challenge, not only at the scale of the municipality of Uíge, but throughout the country (Angola-Afrika). In fact, Angola has been experiencing economic growth in the last decade due to the establishment of peace in the country, which created the conditions for this development, with public investment supported by the oil sector and foreign investment driving this economic growth. The construction of hospitals, health centers, and clinics throughout the country has also contributed to more people receiving healthcare, leading to the concentration of enormous quantities of hospital waste, mostly poorly managed, with consequences for public health and the environment.

Therefore, given that hospitals produce hazardous waste of diverse origins, and those that most concern people, particularly those from the health sector, deserve proper attention and management. Electrical and Electronic Equipment from the Health Sector is a simple example of hazardous waste that often ends up in landfills. The improper disposal of this waste can endanger and compromise natural resources and the quality of life of current and future generations (COSTA, 2009).

1.1 - Motivation for the topic

The waste produced was essentially of animal or vegetable origin, which, upon returning to the ear-

th, naturally decomposed its constituents, reintegrating them into the life cycle;

Change in the landscape throughout the 20th century due to industrialization;

Production of new materials resulting from technological development;

Lack of incinerators for hospital waste;

Lack of effective plans for the management of hospital and healthcare waste;

Burning of hospital waste in the open air.

1.2 - Consequences:

Environmental pollution;

Increase in Carbon and Ecological Footprints;

Need for the application and execution of management plans, as is the case with PESGRU (Angola – Afrika);

Increase in diseases caused by poor waste management;

Quantities of hospital and healthcare waste in municipal waste containers;

Adoption by citizens of inadequate practices to conserve the environment;

1.3-Problem

The lack of a hospital and healthcare waste management plan for health units in Angola has contributed to the mismanagement of this waste. For this reason, it is common to observe hospital and healthcare waste in municipal solid waste containers, as well as open-air burning, with visible consequences for the soil, the atmosphere, and public health.

1.4-General Objectives

This work aims to evaluate the baseline situation re-

garding the production and final destination of hospital and healthcare waste in the municipality of Uíge and to propose a management plan to preserve the environment and public health.

1.5-Analysis of the Baseline Situation

1.5.1-Pollution

Pollution is the addition of foreign elements to air, water, soil, or food, in such a way and in quantities that harm health, survival capacity or the activity of humans or any other living being (Simões, Querós, & Simões, 1999).

1.5.2-Waste

Waste is defined as substances or objects that the holder discards or intends or is legally obliged to discard, which contain risk characteristics because they are flammable...or because they present any other characteristic that constitutes a danger to the life or health of people and to the environment...as per the list established in Annex X (Angolan List of Waste) paragraph s) of Article 3 of Presidential Decree No. 190/12. explained by (Dias, 2013)

1.5.3-Hospital Waste

Hospital waste is waste resulting from medical activities carried out in healthcare units, in prevention, diagnosis, treatment, rehabilitation and research activities related to humans or animals, in pharmacies, in forensic medical activities, teaching and any other activities involving invasive procedures, such as acupuncture, piercings and tattoos (RUSSO, 2012). This definition is also explained in Decree-Law No. 178/2006, of September 5 (Portugal) cited by (MONTEIRO, 2009).

CHAPTER 2 - MATERIALS AND METHODOLOGIES

2.1 - Characterization of the Study Site

The research was conducted in the capital city of Uíge province, which has a population of 493,529 in habitants (INE, 2014). The territorial extension comprises an area of approximately 58,698 square kilometers, extending between the parallels 5° 50' and 8° 20' south latitude and the meridians 14° 50' and 17° 10' east lon-

gitude of Greenwich (BIGBOY, S/Data).

2.2-Work Methodology

The current project aims to present a set of information for establishing hospital waste management plans and the construction of community incinerators. Therefore, for the construction of a community incinerator, the materials required are those listed in Table 3.3, and for the gravimetric characterization work, the following support materials were used:

Plastic bags for depositing each type of waste and for weighing;

A sturdy tarp for sorting waste

Scale with a capacity of approximately 100 kg;

Personal hygiene and protection equipment

PPE (gloves, caps, boots, overalls, goggles and boots)

An analysis form;

Directed survey forms, medical posts.

The main methods used are experimentation and observation, supported by interviews and questionnaires. The questionnaires were applied at the Provincial Hospital and in some health posts.

2.3-Legal Framework

Presidential Decree 190/12 of August 24th, General Waste Regulation;

Polluter Pays Law, Decree No. 194/11 of July 7th, on liability for environmental damage;

Law No. 5/98 of June 19th, Basic Law on the Environment;

Decree No. 117/20 of April 22nd, on EIA and Licensing;

Presidential Decree 160/14 of June 18, on Regulations for the Management of Hospital and Healthcare Waste;

Definitive data from the 2014 Census (Angola – Africa)

3-RESULTS AND DISCUSSIONS

2.1-Baseline Situation for Characterization

In the second half of 2014, from September 8 to 14, technical visits and waste characterization work were carried out at the Uíge Provincial Hospital. The objective of the visits was to determine the quantity of solid waste produced in the hospital unit and to find out if there is a Healthcare Waste Management Plan – PGRSS.

3.1-Gravimetric Characterization of Waste

The gravimetric characterization of the waste produced at the Uíge Provincial Hospital was carried out based on the separation at the source of healthcare waste according to its characteristics. For this purpose,

15-liter boxes and buckets were used to separate the waste according to its hazardous characteristics, and subsequently weighed. The urban waste produced in the hospital kitchen was then deposited in a 1.1 m³ container, from which it was sorted for weighing into 15-liter buckets, as shown in Figure 3.1.



Figure 3.1 - Weighing of hospital waste

Regarding the waste produced at the provincial hospital over a week, 628.17 kg of waste equivalent to urban waste and 351.8 kg of healthcare waste were counted, totaling 979.97 kg, as shown in Table 3.2. and the Figure 3.2 shows the gravimetric characterization of urban solid waste carried out at the Uíge Provincial Hospital.

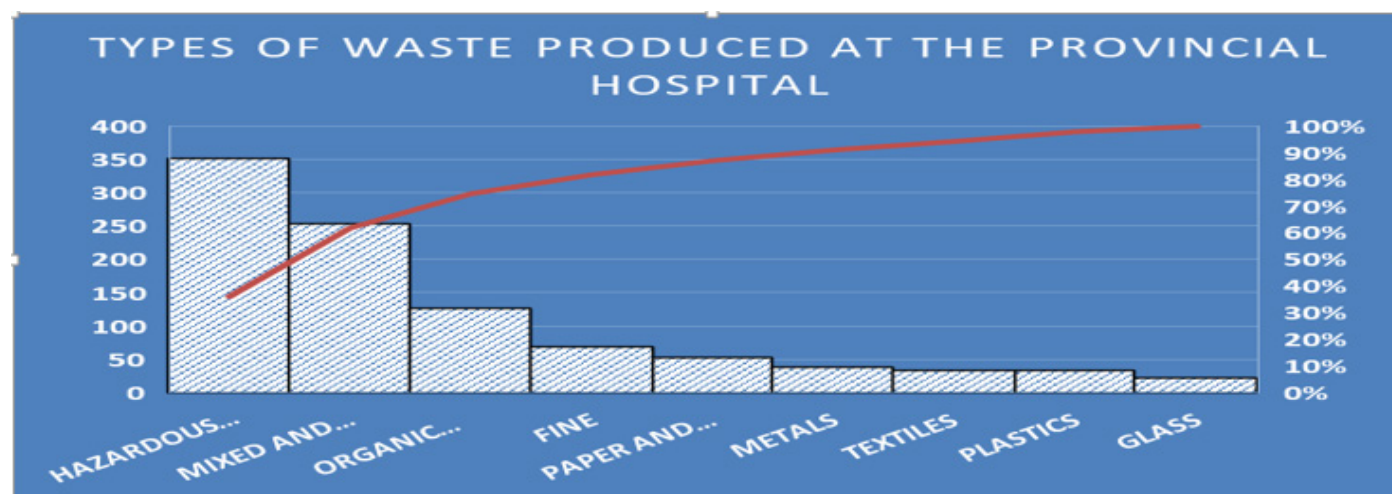


Figure 3.2 Percentage distribution by category
Mixed and organic waste (fermentable materials) constitute the largest fraction of MSW produced at the Hospital. In terms of hazardousness, it is presented in



Figure 3.3 – Distribution of waste by hazard category

Table 3.2 - Characterization of Solid Waste during 7 days

Component	Weighing	Mass of Waste Samples (Kg)						
		08/09/2014	09/09/2014	10/09/2014	11/09/2014	12/09/2014	13/09/2014	14/09/2014
PAPER AND CARDBOARD	1ª	2,5	3	4	1	5	4,1	6,4
	2ª	2,1	1	0	1	0,5	6	4
	3ª	5	0	0	0	0	6,1	0,8
	Total	9,6	4	4	2	5,5	16,2	11,2
ORGANIC MATTER	1ª	6,2	6	8,7	6,1	8,8	5,3	9
	2ª	6,6	5,9	5,4	11	10	6	6,7
	3ª	4,2	4,5	0	5,8	4	3,8	2,3
	Total	17	16,4	14,1	22,9	22,8	15,1	18
MIXED AND OTHER	1ª	11,5	6	12,6	11,3	7,4	11	10,1
	2ª	15	8	1,4	13	8	10	12
	3ª	12,1	11	0	10	6,7	0	13,1
	4ª	10,7	7	0	0	11	3,1	8,6
	5ª	8,3	0	0	0	0	9,3	5,7
	Total	57,6	32	14	34,3	33,1	33,4	49,5
PLASTICS	1ª	2,9	1,7	2,5	2,4	0,8	2,8	4
	2ª	2,6	0	1,8	4	0	5	2,3
	Total	5,5	1,7	4,3	6,4	0,8	7,8	6,3
GLASS	1ª	4,2	2	0,9	1,7	3,1	8	1,9
METALS	1ª	6,9	2,1	1	8	2	10	8,4
FINE	1ª	8	8,7	10,1	8,1	12	11,2	11,4
TEXTILES	1ª	6,07	4	4	3	3,8	7,5	4,6
Subtotal - 1		114,87	70,9	52,4	86,4	83,1	109,2	111,3
Weighing		HAZARDOUS WASTE						
	1ª	15,5	31	14,7	13	13	11,2	24
	2ª	22,2	18,8	25	6,1	17	14	12
	3ª	30,8	2,5	2	33	9,4	21	15,6
Subtotal - 2		68,5	52,3	41,7	52,1	39,4	46,2	51,6
Grand total (1+2)		183,37	123,2	94,1	138,5	122,5	155,4	162,9

It can be seen that about 1/3 of the waste produced in the hospital is hazardous and therefore amenable to appropriate thermal treatment.

3.2- Materials and Costs for the Construction of a Community Incinerator

This information was provided by the Angolan company, (CapGest, 2020) and is detailed in Table 3.3

Table 3.3-Materials for the construction of an incinerator

UNIT COSTS OF COMMUNITY INCINERATOR				GENERAL COSTS OF AN INCINERATOR	
N/O	DE SIGNATION	VALUES (USA)	%	Number of Municipalities	Total Costs
1	Electric Generator for Heating	16136,40	20,00	162	13 070 484,00
2	Face Brik Bricks	8068,20	10,00		
3	Refractory Cement Bags	8068,20	10,00		
4	Metal beams	5647,74	7,00		
5	Block Coverage	4840,92	6,00		
6	Metal Roofing	6454,56	8,00		
7	Metal Frame Gate	8068,20	10,00		
8	Exterior Arrangements	4840,92	6,00		
9	Transport	3227,28	4,00		
10	Labor	12102,30	15,00		
11	Training of 4 Technician Operators	3227,28	4,00		
TOTAL VALUE		80 682,00	100	162	13 070 484,00

Therefore, the costs were accounted for in US dollars, due to the Kwanza being a currency without stability in the Angolan financial market

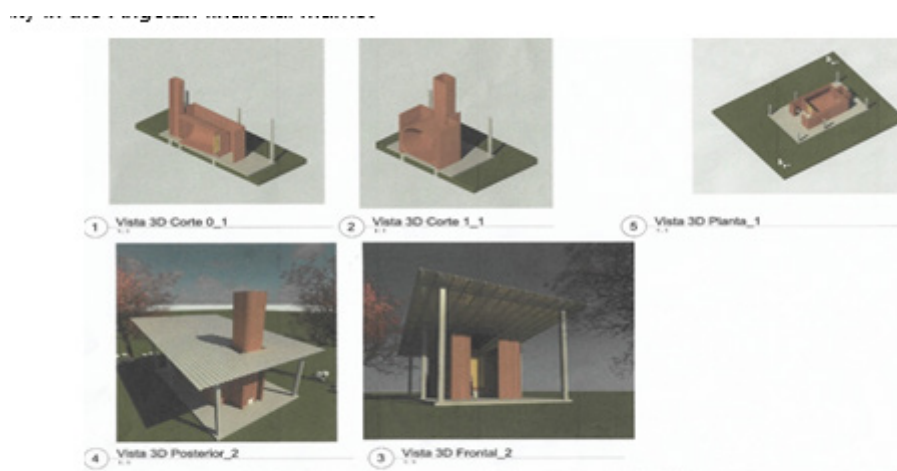


Figure 3.4 - Image of an incinerator (Source: (CapGest, 2020).

3.3 - Impacts of Hospital and Hazardous Waste Management in Uíge

Hazardous waste from the Uíge provincial hospital is transported to the municipal landfill, located on the road from the municipality of Uíge to the municipality of Songo, 12.2 km from the city of Uíge, where it is incinerated in the open air. Waste equivalent to urban waste has the same destination, where it is deposited unsafely and sometimes burned in the open air. Me-

anwhile, in private health units, healthcare waste is incinerated in the open air, and the ashes and MSW are deposited in a common container with a capacity of 1.1 m³, which fills up in about two weeks and is then transported to the municipal landfill. Therefore, both practices pollute surface water, groundwater, and the atmosphere with gases from the burning of hazardous and non-hazardous waste, and from the decomposition of biodegradable organic matter. It was also fou-

nd that in both health sectors, cleaning staff lack PPE, especially boots, rubber gloves, masks appropriate for the activity, and goggles, putting them at serious risk.

3.4-Hospital Surveys

Two health units (A and B) were surveyed. The questions asked are in Appendix Table A-1. Regarding the

number of inpatients, they did not provide precise data because most patients opt for outpatient treatment, and in cases of serious health conditions, the patient is transferred to the provincial hospital. Contacting the Statistics Section of the Provincial Hospital, we obtained the data presented in Table 3.4.

Table 3.4 - Epidemiological data

SOURCE OF DATA: UÍGE PROVINCIAL HOSPITAL								
HOSPITAL MOVEMENT				PERIOD REPORT				
HEALTH INFORMATION				LOCATION				
				PROVINCE				
DESIGNATION	SERVICE CODE							
	Filas	Med	Pediat	Mater	Cirurg	Orthop	CNT	Total
Previous existence	1	52	43	46	53	35	15	844
Admitted	2	78	242	387	55	28	9	799
Rights	3	78	242	387	55	28	9	799
Outputs	4	71	202	381	54	34	8	750
They continue to exist	5	59	83	52	54	29	16	293
Media Real beds	6	44	109	55	64	35	13	320
bed days	7	264	763	385	468	245	91	2317
Sick days	8	189	382	833	336	208	95	1443
Days of stay	9	191	384	235	337	210	97	1105
TOTAL NUMBER OF PATIENTS TREATED IN ONE WEEK								1643

This information allowed us to determine the waste generation ratio per user (admitted and existing), per bed (average number of patients per bed), per length of stay, and per patient seen, as described in Table 3.5.

Table 3.5 - Waste generation ratio per patient

Designation	Quantities	Calculations	Results
Average number of beds (beds)	320	1033,17:320	3 Kg / Bed
Average number of patients per bed.	1643	1643:320	5 Patient / Bed
Hospital on stay	1105	1033,17:1105	0,89 Kg / Stay
Consulted at the hospital	1443	1033,17:1443	0,68 Kg / Consulted
Hospital patients	1643	1033,17:1643	0,57 Kg / Patients
Waste quantities	979,97 Kg		

3.5-Treatment of Hospital Waste

The management of hospital waste consists of a set of management procedures, planned and implemented from a legal, technical and scientific basis, with the objective of providing the generated waste with safe and efficient disposal, aiming at human protection, the preservation of the environment, natural resources and public health. The stages of hospital waste management, according to ANVISA 306 (2004) in Brazil cited by (COSTA, 2009) are: identification, segregation, packaging, internal transport, temporary storage, external storage, collection and external transport, treatment and final destination.

According to CONAMA 358 (2005), cited by (COSTA, 2009) regarding the final destination of health service waste, the type of treatment depends on the type of material to be discarded. The types of treatment are: decontamination using steam at high temperatures; treatment using low or high frequency microwaves; and thermal treatment by incineration. Here are some guidelines regarding waste treatment:

Regarding Angolan legislation, the management of hospital waste from Groups B, C, and D can be treated

by decontamination (autoclaving or germicidal disinfection, microwaves) or by incineration, or sent to a hazardous waste landfill according to their typology. Group E waste will have specific treatments. Groups B, C, D, and E can also be grouped together; for hazardous waste, incineration is mandatory, and for Group A waste, some can be landfilled, others recycled, and composting can be applied to organic plant matter.

However, if we consider Portuguese legislation (recommended), which only has four classes I, II, III, and IV, waste from classes II, III, and IV is considered hazardous, and class I is non-hazardous.

However, class II waste, with good sorting at the source, can be considered non-hazardous; Class III waste, after pre-treatment with autoclaving and chemical disinfection with germicide, can also be considered non-hazardous. In this context, only two groups can be considered, one non-hazardous and the other hazardous, thus reducing waste treatment costs. Some disposal and recovery methods are indicated in Table 3.6 (MONTEIRO, 2009), and figure 3.6 (RUSO, 2015).

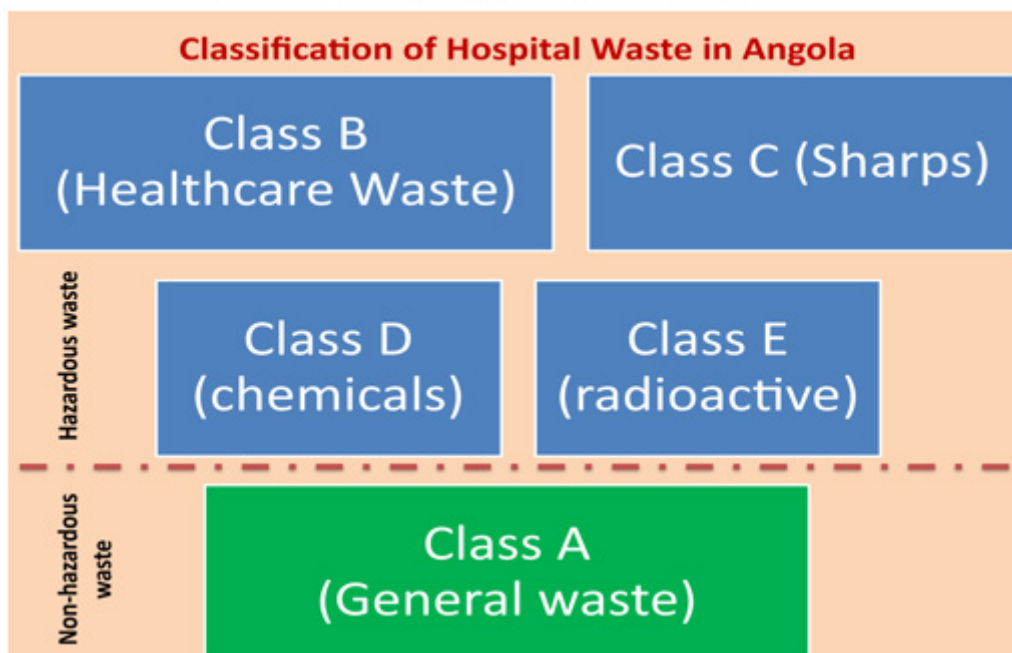


Table 3.5 – Methods for Disposing of Hospital Waste Source (Monteiro, (2009)

Table 3.6 – Methods for Disposing of Hospital Waste Source (Monteiro, (2009)

GROUP DESIGNATION	VALUATION METHODS	
Group I and II	Landfill, Incineration	Composting
Group III	Autoclaving, Chemical Disinfection with Germicide	
Group IV	Incineration Only	

Classification of Healthcare Waste in Portugal

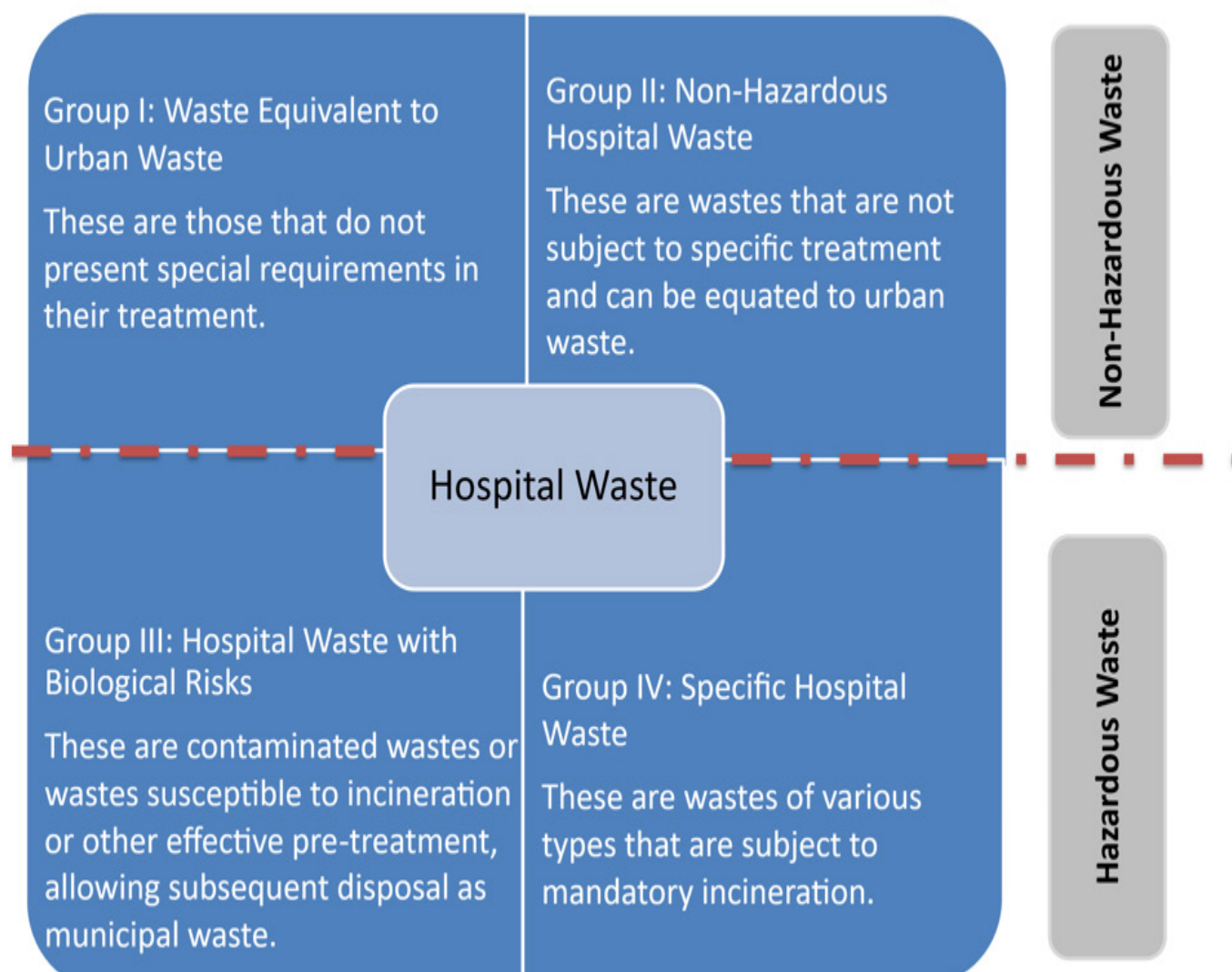


Table 3.6 – Methods for Disposing of Hospital Waste Source (Monteiro, (2009))

3.5 - Hospital Waste Management Plans

The correct management of hospital waste requires the establishment of specific sectoral plans in order to address the numerous illegal and harmful situations to the environment and human and animal health. A proposed hospital waste management plan for the municipality of Uíge comprises several phases or stages, which are summarized in the plan's content, whose source is PERSU 2020, cited by (Russo, 2015):

a) Diagnosis

The diagnosis can be made through a survey, interview, and observation, gaining knowledge of people's behavior regarding the issue in question.

b) Objectives and Strategic Goals

These focus on the training of waste managers, raising citizen awareness, implementing the treatment model, and defining timelines.

c) Plan Characteristics

Flexible: Its application can be adapted to local characteristics and needs;

Integrative: It leads to the participation of the population in management solutions.

d) Actions, Goals and Responsible Parties for Implementation

The actions to be implemented aim to fulfill the operational objectives. Therefore, quantitative and temporal goals must be established, as well as the stakeholders responsible for their execution and monitoring.

3.5.1-Content of the Plan

The content for the preparation of a management plan is duly structured in seven chapters:

Chapter 1 – “Introduction”, which presents the scope, objectives and organization of the Plan.

Chapter 2 - “Evolution of waste management policies”;

Chapter 3 – “Summary of the diagnosis of the baseline situation”, which briefly presents the situation at the level of waste management in the municipality.

Chapter 4 – “Summary of the analysis of international strategies”, which briefly presents the strategies developed by other countries in the context of formalizing their waste management policy (hospital and hazardous waste).

Chapter 5 – “Vision and strategic objectives for the management of hospital and hazardous waste”, which proposes the vision that will guide the waste policy for

the coming years, and from which the strategic objectives and respective targets for the period of validity of the Plan result.

Chapter 6 – “Operational objectives and actions”, which presents the operational objectives that will contribute to achieving the targets defined for the strategic objectives. Additionally, concrete actions and specific targets are proposed for the fulfillment of the operational objectives.

Chapter 7 – “Evaluation and review of the Plan”, which addresses the frequency of evaluation and review of the Plan and the indicators involved.

3.5.2 - Procedures for Developing the Plan

To develop a Hospital Waste Management Plan, according to (Russo, 2015), a set of information must be obtained through surveys from various sources, including:

- 1) Survey of hospitals, health centers, clinics and laboratories existing in the city and their location on Google;
- 2) Gross construction area (or usable area) of each unit;
- 3) Regulations/guides for waste handling procedures;
- 4) Number of employees (doctors, nurses, medical assistants, cleaning staff, administrative staff);
- 5) Number of beds for inpatient care in each health facility;
- 6) Number of nursing/outpatient rooms and number of medical offices;
- 7) Number of patients in medical consultations per year and (inpatient) (patient day/year);
- 8) In each health unit, canteens or restaurants, cafes: average number of meals served per day or per year;
- 9) Quantity of waste produced by category (kg/day or liters per day on average);
- 10) Number and type of existing containers (container capacity);
- 11) Current disposal location with georeferencing (Google);
- 12) Transporter (company, hospital vehicle);
- 13) Veterinary clinics and their location on Google;
- 14) Area of each veterinary clinic or number of animals treated per year

3.5.2.1-Fundamental Requirements for Waste Management

- 1-Specialized personnel
- 2-Segregation
- 3-Identification
- 4-Packaging

- 5-Storage
- 6-Collection and external transport
- 7-Final destination
- 8-Hospital Waste Management Flowchart

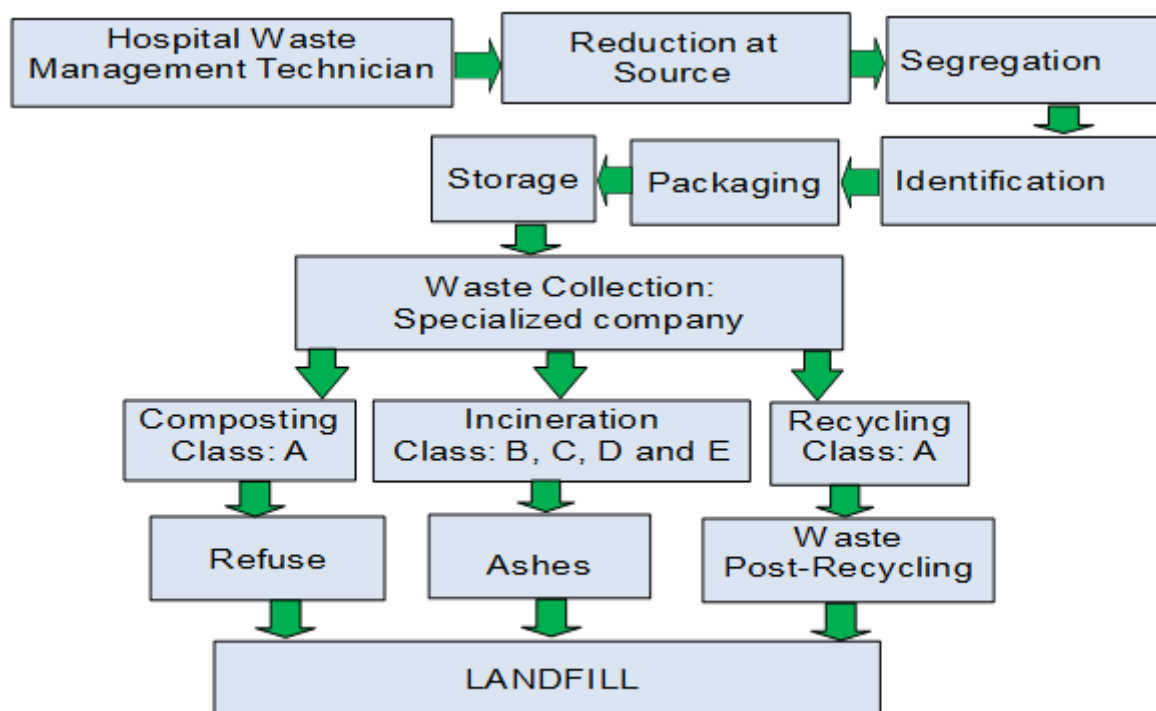


Figure 3.5 - Flowchart of the Hospital Waste Management Plan

CONCLUSIONS AND RECOMMENDATIONS

This work allowed us to gain an understanding of the situation regarding hazardous waste management in the municipality of Uíge, specifically healthcare waste, used mineral oils, and waste electrical and electronic equipment, as well as to identify the most prevalent diseases at the Uíge Provincial Hospital. It was possible to characterize the waste produced in one week at the municipal hospital. The information generated from the study's diagnosis allowed us to define the best alternatives for the collection and proper final disposal of hazardous waste in the municipality of Uíge, and recommendations for the implementation of a proposed Hazardous Waste Management Plan in the municipality, thus enabling the improvement of environmental and social conditions. For proper hazardous waste management, it is necessary to:

Establish municipal sectoral plans in conjunction with provincial waste management plans;

Deepen awareness campaigns among the population (door-to-door or other means);

Implementation of existing environmental management standards in the country and creation of specific standards for the management of lubricating oils, HR and WEEE;

Public entities of the municipal administration in the environmental area must have specialized personnel in the field of hazardous hospital and non-hospital waste;

Establishment of a waste service tariff to finance the sector, preventing its collapse due to lack of financial resources;

Effective oversight to enforce the country's legislation.

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APPENDIX

Appendix A.1 - Survey form addressed to Clinics, Posts and Medical Centers

SURVEY FORM FOR MEDICAL POSTS	
Date-----/-----/2015, Health center or post Within the scope of the ongoing investigation, it becomes necessary to... Collaboration in responding to this confidential inquiry.	
QUESTIONNAIRE	DESIGNATION
1 - What is the final destination of the municipal solid waste produced?	
Container-----	
Burned in the open air -----	
Bin -----	
Buried -----	
2 - What is the final destination of the healthcare waste produced?	
Container-----	
Burned in the open air -----	
Bin -----	
Buried -----	
3 - How many days does it take to fill the garbage container?	
Urban -----	
Hospital	
4 - What is the average number of patients hospitalized in a week?	
Newborn	
From 1-11 Months-----	
1-4 year-----	
5-9 year-----	
10-15 year-----	
15-25 year-----	
25- 49 year-----	
50 Years and Up	