

# Clean + Hospitals

## Clinical Waste Management Guidelines for Healthcare Facilities

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Infrastructure and Energy Sector

Social Protection and Health  
Division

Water and Sanitation Division

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# CLEAN + HOSPITALS

CLINICAL WASTE MANAGEMENT  
GUIDELINES FOR HEALTHCARE FACILITIES

Pilar Tello - Carlos Henriquez - Ignacio Astorga - Alfredo Rihm



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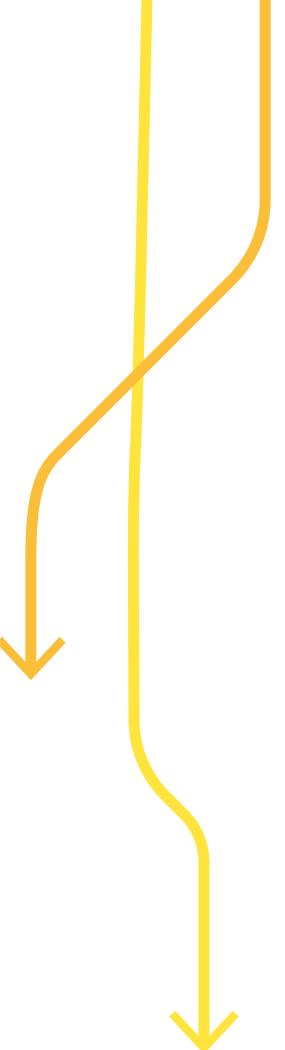
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# Background



In 2017, the management of the Infrastructure and Energy Sector (INE/INE) and the Social Sector (SCL/SCL) at the Inter-American Development Bank (IDB) agreed to create the Social Infrastructure Unit to provide specialized technical support in Social Sector programs and projects that have infrastructure components.

The main objectives of the Social Infrastructure Unit are the following: i) strengthen the project teams, and through them the executing units, offering them technical expertise for the preparation, execution and supervision of the infrastructure components included in the operations; and ii) generate knowledge aimed at promoting best practices in the planning, procurement, design, construction, and supervision of social infrastructure.

Healthcare facilities are significant generators of general, biological, and hazardous waste, and managing it

presents a challenge for the countries in Latin America and Caribbean (LAC). Inadequate waste management creates risks for people and the environment, as well as high costs in the operations phase. The situation created by the COVID-19 pandemic, including the mass vaccination plans, has substantially increased the use of materials that must be discarded, thereby overloading weak management systems and making the search for sustainable management solutions even more urgent.

Along these lines, CLEAN + HOSPITALS seeks to support the implementation of healthcare infrastructure projects in the region, specifically in relation to waste management, throughout the project planning phase and during their execution and subsequent operation.

These guidelines were developed in a multi-sectoral manner, based on the work prepared by Pilar Tello Espinoza and with the general coordination of Carlos

Henríquez, Ignacio Astorga, and Alfredo Rihm, from the Social Infrastructure Unit, the Health and Social Protection Division, and the Water and Sanitation Division at the IDB, respectively. The final review and modifications to the document were made with the invaluable contributions of Luis Buscarons Cuesta, Serge-Henri Troch, Marcela Zambrano Polanco, Livia Minoja, Wilhelm Dalaison, Juan del Barrio, Beatriz Toribio, Jimena Sánchez, and Ashley Morales.

The authors thank all those who participated in preparing this document, which is expected to be helpful in the effort to improve lives in the region.

# Introduction

The effective management of healthcare waste (HCW) must be addressed in a timely and informed manner throughout the life cycle of a hospital infrastructure project, from planning through to operation. These guidelines set forth the main concepts and items that should be considered when undertaking projects of this type to ensure efficient HCW management and to guarantee appropriate hygiene and safety for workers and users of the healthcare facilities (HCFs).

The acronym HCW used in this document encompasses the terms used in the different countries of the region that refer to waste generated in healthcare treatment centers, medical centers, hospitals, and healthcare facilities, among others. This waste can be classified into: general, infectious, sharps, anatomical and hazardous (such as chemical and genotoxic, flammable, and corrosive substances). The designation of the waste and the different concepts in this matter vary from one country to another. This document will primarily address the designations established by the World Health Organization (WHO).

This document focuses mainly on the management of the biological waste generated in healthcare facilities:  
**infectious, sharps, and anatomical waste.**

This criterion is used because, after general waste, the aforementioned are the types with the highest production volume in HCFs and also, in many cases, their treatment takes place on-site.

The effective management of medical waste is based on three fundamental basic principles: a) the reduction of unnecessary waste, b) the separation between general and hazardous waste, and c) the treatment of waste in order to reduce the risks for healthcare workers and the community.

The HCFs must ensure and guarantee that their professionals work in a safe environment and that they provide quality care, where the dignity and human rights of each person seeking medical care are respected.<sup>1</sup>

This guide allows us to understand the processes involved in the effective management of HCW, from its origin to final disposal and also provides specific

technical information and practical tools for effective handling.

The guide is organized in six chapters:

**1. Definitions and basic concepts:**

Including the classification, the designation by country and the estimated generation volumes according to the type of HCW, among other factors. This chapter helps guide the reader in understanding and using the subsequent guidelines.

**2. The legal framework** framework that governs the management of HCW in the 26 IDB borrowing countries,<sup>2</sup> including links to the regulations and laws in force that regulate the management of HCW in each country.

**3. A theoretical framework** that defines the waste management process in the HCF, from its generation to its final disposal. This chapter explains in detail the different stages that must be considered in the effective management of HCW.

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**4. An analysis tool** for diagnosing the status of HCW management in an existing HCF or evaluating whether all the variables necessary for effective HCW management have been considered for a project under development.

**5. A guide for the development of HCW management plans**, in which the necessary contents of a plan and the factors that must be considered for its preparation are presented.

**6. Tools for an economic evaluation** that allows for comparison between alternatives for a HCW management project. This chapter presents the technical (for example, types of treatment solutions) and methodological (outsourcing of services versus internal management, networked versus individual management, etc.) variables in a practical way.

Additionally, the appendices include a series of tools and forms the user can apply and/or adapt when following the guidelines.

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<sup>1</sup> WHO/UNICEF, WASH in healthcare facilities Global Baseline Report (Geneva, 2019).

<sup>2</sup> Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guyana, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

# 1. Definitions and basic concepts

## 1.1. Definition of waste in healthcare facilities

According to the WHO, HCW is designated as **medical waste** and includes all waste generated in HCFs, research centers, and laboratories related to medical procedures. In addition, the designation includes the same types of waste from minor and dispersed sources, as well as waste produced in the course of healthcare performed at home (for example, home dialysis, insulin self-administration, recovery care, etc.).<sup>3</sup>

## 1.2. HCW classification

According to the WHO, HCW are classified as shown in Table 1.

As a general rule, infectious, sharps, and anatomical waste can be treated with relatively simple sterilization methods, for later disposal comparable to household waste. This group of wastes is generally called **biological waste**.

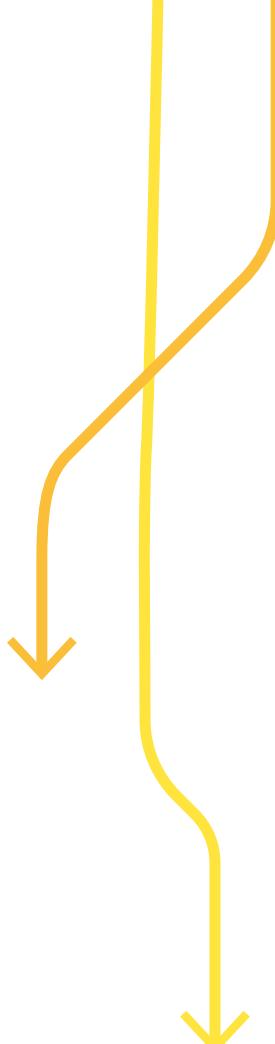
<sup>3</sup> WHO, Safe management of wastes from healthcare activities (Geneva, 2014)..

Table 1. Classification of waste in healthcare facilities.

HCW categories		Description and examples
<b>General waste</b>	General waste	Waste that does not present any type of biological, chemical, radioactive or physical risk and is comparable to household waste. For example: cardboard, plastic wrap, paper, office products, etc.
<b>Biological waste</b>	Infectious waste	Wastes known or suspected to contain pathogens and that pose a risk relating to disease transmission. For example, gauze, textiles, or other materials contaminated with blood and other body fluids. Highly infectious waste is also included such as laboratory cultures and microbiological reference materials, excrement and other materials that have been in contact with patients with infectious diseases.
	Pathological (anatomical) waste*	Human tissues, organs or fluids, body parts, placentas, fetuses, unused blood products.
	Sharps waste	Used or unused sharps or cutting objects. For example, hypodermic, intravenous or other needles, self-disabling syringes, syringes with attached needles, infusion sets, scalpels, pipettes, knives, blades, broken glass.
<b>Hazardous waste</b>	Pharmaceutical, cytotoxic, and genotoxic	Pharmaceuticals that are expired or no longer needed; Contaminated items containing pharmaceuticals. Cytotoxic waste containing substances with genotoxic properties. For example, waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals.
	Chemical waste	Waste containing chemical substances. For example, laboratory reagents; film developer; disinfectants that have expired or are no longer needed; solvents. Waste with a high heavy metal content. For example, broken batteries, thermometers, and blood pressure meters.
	Radioactive waste	Waste containing radioactive substances. For example, unused fluids from radiation therapy and nuclear medicine or laboratory research; contaminated glassware, containers, or absorbent paper; urine, and stool from patients treated or tested with unsealed radionuclides; sealed sources.

Source: Prepared by the authors based on WHO data.

\* For the practical purposes of these guidelines, pathological waste will be referred to simply as anatomical. They are equivalent concepts (anatomical-pathological).



On the other hand, pharmaceutical, cytotoxic, chemical, and radioactive wastes require more complex treatments, which involve specialized companies and specific regulations for each country. With that in mind, and for simplification purposes, in these guidelines the latter will be considered to be within a single classification: **hazardous waste**.

As already mentioned, these guidelines focus on the management of biological waste (**infectious, sharps, and anatomical**), as it is the largest volume of waste generated by an HCF, after general household-comparable waste. The management of hazardous waste varies according to the regulations in each country and requires more complex processes, which are usually delegated directly to a specialized company. For this reason, although these guidelines refer to this type of waste, its management process is not addressed in the same depth.

The countries of the region use different names in their legislation to refer to HCW and their subclassification. In Appendix 1, these names are detailed by country, standardized to WHO terminology.

### 1.3. Composition of waste generated in HCFs

According to the WHO, between **75%** and **90%** of the waste generated in a HCF is **medical waste comparable to general or non-hazardous wastes**. Approximately between **25%** and **10%** are classified as **biological** (infectious, sharps, and anatomic) and of those, **5% as hazardous** (pharmaceutical, cytotoxic, chemical, and radioactive) that can constitute a serious risk if not correctly handled.<sup>4</sup> These percentages depend on the type of HCF, its level of complexity, and its size and may vary.

<sup>4</sup> WHO, Safe management of wastes from healthcare activities: A summary (Geneva, 2017).

According to a study carried out by the WHO in 2020, approximately 66% of the biological waste component corresponds specifically to infectious waste, 30% to sharps waste and 4% to anatomical waste, percentages measured by mass.<sup>5</sup>

### 1.4. Generation per capita

The per capita generation value allows the volume of waste generated in an HCF to be determined, based on the number of available beds.

Thus, a study by the International Commission of the Red Cross (ICRC) indicated that **a hospital with 100 beds will produce an average of 1.5 kg to 3 kg of waste per patient per day**, depending on the context (all categories combined and including household comparable waste).<sup>6</sup>

<sup>5</sup> P. Tello, Management of hospital waste and occupational health and safety aspects in hospitals in Nicaragua (Managua, 2020).

<sup>6</sup> ICRC, *Medical waste management* (Geneva, 2011).

## 1.5. Levels of care in healthcare facilities

Depending on the level of complexity of the care provided in the HCF, the type of waste and the amount produced will be different. In tertiary care facilities with more complex procedures, the production per bed will be higher than in a first-level care facility.

In general, these levels of care are classified as follows:

**Level 1:** These are HCFs that provide outpatient care; they are dedicated to healthcare, prevention, and promotion and are well-known by the general public. This level includes healthcare centers, medical posts and clinics. In these HCFs there may in some cases be two or three beds for outpatient care, but only for a stay of no more than 24 hours.

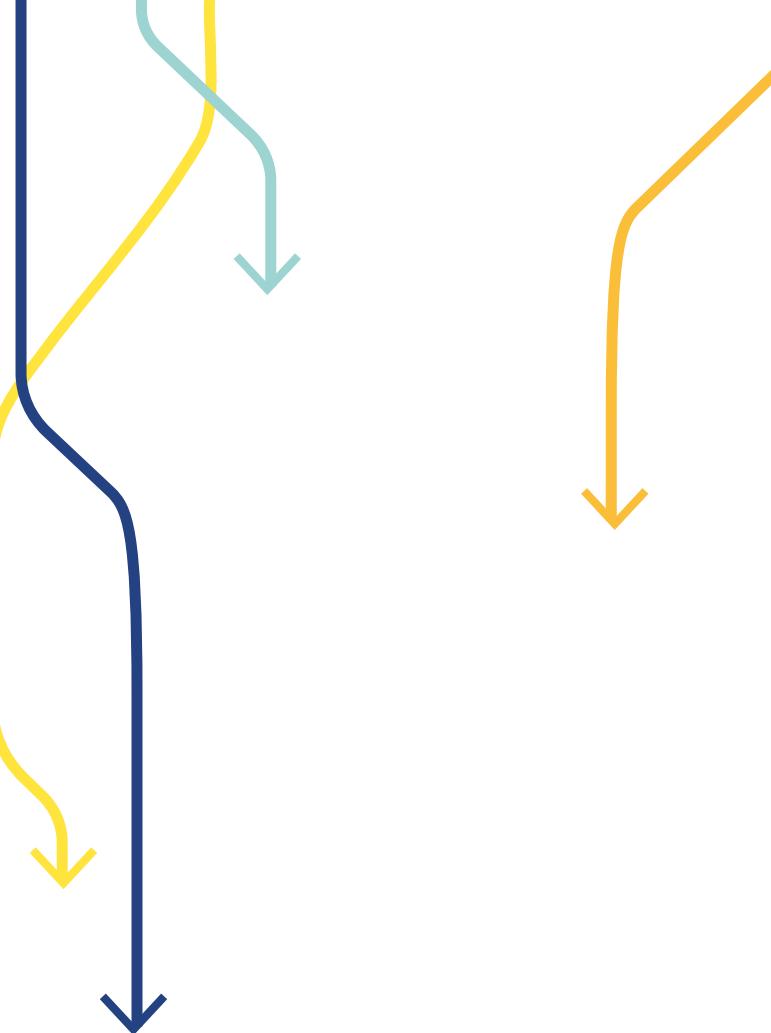
**Level 2:** These are healthcare institutions that have inpatient wards for basic services: medical clinic, pediatrics, general surgery, and maternity, in addition to the necessary infrastructure to offer complementary tests and basic diagnoses.

**Level 3:** Includes institutions with inpatient wards, surgery, medical clinic, specific surgical specialties (traumatology, neurosurgery, cardiovascular surgery, cancerology, and others); infrastructure for carrying out more complex complementary studies; intensive care unit, and coronary units.<sup>7,8</sup>

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7 See <https://sites.google.com/site/lasaludcomoderechosocial/niveles-de-atencion-medica>.

8 WHO, Basic standards of environmental hygiene in healthcare (Geneva, 2016).



## 2. Legal framework

The regulations that exist relating to HCW in the countries of the region are very heterogeneous. Although all the IDB borrowing countries have environmental legislation that refers to

waste in general, only 15 have specific regulations on HCW, four have official technical standards, four have a legal instrument where HCW is mentioned, and three lack any specific legal instrument

related to these wastes. It was also observed that in five of them there is no classification of waste within their current regulations.

Table 2 indicates the legal instrument that governs the management of HCW for each LAC country. Appendix 2, at the end of the guide, includes a detailed list of the organizations that issue and regulate these legal instruments, as well as the publication and modification dates.

**Table 2. Legal instruments in effect in the countries of the region for the management of HCW.**

No.	Country	Legal instrument	Category
1	<b>Argentina</b>	MSN Resolution 134/2016 National Guidelines for the Management of Waste from Healthcare Facilities	Specific regulation
2	<b>Bahamas</b>	Regulations on the Collection and Disposal of Waste from Environmental Healthcare Services	Specific regulation
3	<b>Barbados</b>	Health Services (Waste Collection and Disposal) Regulations, 1975	Specific regulation
4	<b>Belize</b>	Hazardous Waste Act	Specific regulation
		National Guidelines on Infection Prevention and Control for Healthcare Facilities	
5	<b>Bolivia</b>	Regulation for the management of solid waste generated in healthcare facilities; Ministerial Resolution No. 1144	Specific regulation
6	<b>Brazil</b>	Decree 222; Regulation of good healthcare waste management practices and other measures to be taken	Specific regulation
7	<b>Chile</b>	Decree 6:Regulation on waste management in healthcare facilities (REAS)	Specific regulation
8	<b>Colombia</b>	Decree 2676; Regulating the comprehensive management of hospital and similar waste	Specific regulation
9	<b>Costa Rica</b>	Executive Decree 30965; Regulation on the management of the infectious-contagious waste generated in healthcare and related facilities	Specific regulation
10	<b>Ecuador</b>	Ministerial Agreement 323; Regulation on management of waste generated in healthcare facilities	Specific regulation
11	<b>El Salvador</b>	Agreement No. 1251; Salvadoran technical regulations for the management of biohazardous waste	Specific regulation
13	<b>Guatemala</b>	Governmental Agreement No. 509-2001; Regulation for the management of solid hospital waste	Specific regulation

**Table 2. Legal instruments in effect in the countries of the region for the management of HCW. Continuation**

No.	Country	Legal instrument	Category
12	Guyana	Hazardous Waste Management Regulations	No specific legal instrument
14	Haiti	Organization and operation of the national solid waste management service (SPERS)	No specific legal instrument
15	Honduras	Agreement No. 07; Regulations for the management of the hazardous waste generated in healthcare facilities	Specific regulation
16	Jamaica	National Solid Waste Management Act	No legal instrument
17	Mexico	Official Mexican Standard Nom-087-Semarnat-SSA1-2002, environmental protection-environmental health-hazardous biological-infectious waste: classification and management specifications	Specific regulation
18	Nicaragua	NTON 05 015-02; Technical standard for the management and disposal of hazardous solid waste; certification	
19	Panama	Executive Decree 111; Regulation for the management and handling of the solid waste produced by healthcare facilities. Resolution 560; Regulating the hazardous waste and/or solid waste treatment systems from public and private healthcare facilities nationwide	Specific regulation
20	Paraguay	Law 3361/07; Regulating the comprehensive management of the waste generated in healthcare and related facilities, which come from human and animal healthcare	Specific regulation
21	Peru	Ministerial Resolution No. 1295-2018-MINSA; Technical Health Standard: integral management and solid waste management in healthcare facilities, medical support services and research centers	Specific regulation
22	Dominican Republic	Decree No. 126-09; Regulation on the waste and residues generated by healthcare centers and related facilities	Specific regulation
23	Surinam	Environment Act	No legal instrument
24	Trinidad and Tobago	Environment Act Waste management standard	No specific legal instrument
25	Uruguay	Decree No. 586/009; Regulation on healthcare waste	Specific regulation
26	Venezuela	Decree No. 2,218, Through which the standards for the classification and management of waste in healthcare facilities are issued	Specific regulation

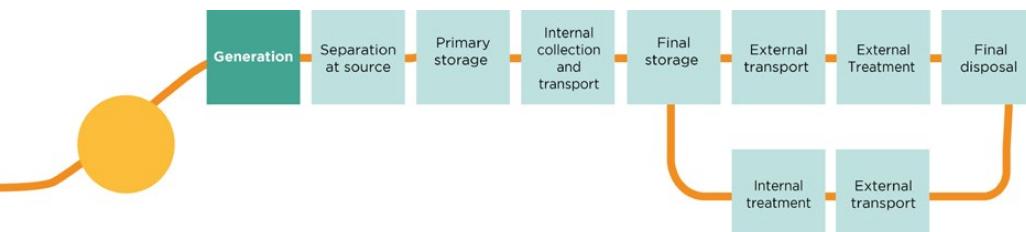
Source: Prepared by the authors (see Appendix 2).

### 3. Waste management in healthcare facilities

**H**CW management is a set of processes designed to guarantee adequate hygiene and safety for workers and users of healthcare services, as well as for the community in general. These processes may vary from one country to another in form, depending on their specific environmental regulations,

but in general, and in accordance with WHO directives, the structure detailed below should be respected.

The process includes the following activities depending on the type of waste and the complexity of the healthcare facility:



**Table 3. Characterization of the stages in waste management in healthcare facilities.**

Stage	Description
<b>Generation</b>	The waste is generated.
<b>Separation at source</b>	Consists of segregating each waste according to its classification in the container or bins designated for this purpose in the place where it is generated.
<b>Primary storage</b>	Storage of the segregated HCW, in the place where it is generated or in specially equipped rooms.
<b>Internal collection and transport</b>	This is the process of collecting general, biological, and hazardous waste at the point of generation and its transport to the final storage area in the HCF, using mobile equipment (carts or containers with wheels).
<b>Final storage</b>	Storage of the segregated HCW according to its classification, in specially enabled spaces within the HCF.
<b>Internal or external treatment</b>	The treatment of general and biological waste can be performed in the HCF individually or in specialized centers (networked management). The treatment must guarantee the elimination of pathogenic microorganisms in the waste making it compatible with general waste for its safe final disposal. In the case of hazardous wastes, these must be treated by specialized companies, in accordance with the regulations in each country.
<b>External transport</b>	Collection and transport of the HCW from the HCF to the external treatment and/or final disposal site.
<b>Final disposal</b>	The treated general and biological waste, generated in the HCF, must be taken to an authorized final disposal site (sanitary landfill), where it can be deposited in the general cell for municipal solid waste (MSW). In some countries, the disposal of untreated HCW in cells specially enabled for this in duly regulated sanitary landfills is permitted. In some specific cases, on-site waste disposal is also permitted (such as in isolated healthcare outposts, for example), but these must be approved by the respective healthcare authority, in accordance with the specific regulations of each country. Similarly, hazardous waste must be disposed of according to its level of danger in sites duly authorized by the healthcare authority in each country.

Source: Prepared by the authors based on WHO data.

Figure 1 shows the stages in the management system depending on the types of HCW.

The following sections provide a detailed description of each of the stages of HCW management.

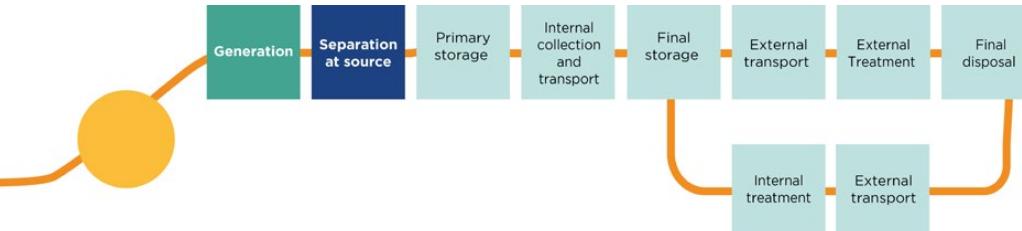
### 3.1. Separation at source

Separation at source consists of storing each waste according to its classification in the designated container or bin, in the place where it is generated. This is a key activity in the process, since the entire subsequent cycle depends on this activity having been properly executed. Correct segregation of waste at source prevents the general waste generated in the HCF from being contaminated or mixed, thereby reducing treatment costs.

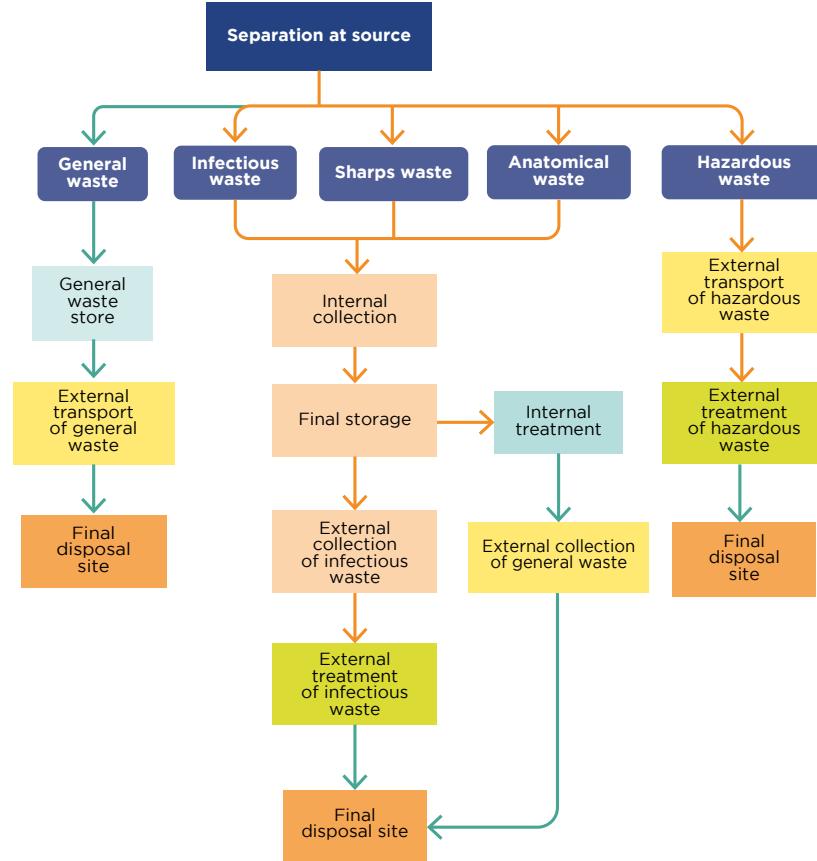
In practice, HCW should be segregated into at least **five groups**, because the management is different in each case: i) general waste, ii) sharps waste, iii) infectious waste, iv) anatomical waste and v) hazardous waste.

This segregation is performed using colored bags or containers for their clear differentiation. Each country has a color code based on the waste, but as a general rule, red is used for infectious waste, yellow for anatomical waste, white for sharps and black for general waste. Likewise, all waste containers and bags must be properly labeled; for example, they should contain the biohazard symbol for infectious, sharps, and anatomical waste. Hazardous waste will be segregated, stored, treated and disposed of according to its level of danger, in accordance with the regulations in force in the country.

Table 4 shows the types of containers by waste type.



**Figure 1. Waste management flow diagram in healthcare facilities.**



Source: Prepared by the authors.

**Table 4. At-source collection and separation scheme recommended by WHO.**

Waste categories	Type of container	Example
<b>Infectious waste</b>	<ul style="list-style-type: none"> <li>Plastic bags should be at least 70 Qm thick, chlorine-free, and preferably translucent.</li> <li>Containers can be made of plastic or metal; they must be resistant and leak-proof and chlorine-free.</li> <li>They should also have tight-fitting, hand-removable or pedal-operated lids.*</li> </ul>	
<b>Sharps waste</b>	<ul style="list-style-type: none"> <li>Containers can be plastic or cardboard containers, must be puncture resistant and leak proof and chlorine-free; they must also have a special opening to receive syringes of all sizes, which can be opened and closed.**</li> <li>Ideally, they should have a system for removing the needles from syringes.</li> </ul>	
<b>Anatomical waste</b>	<ul style="list-style-type: none"> <li>Plastic bags must be at least 70 Qm thick and must be chlorine-free.</li> <li>Containers can be plastic and metal, lined with bags. They should also have tight-fitting, hand-removable or pedal-operated lids.***</li> </ul>	
<b>General waste****</b>	<ul style="list-style-type: none"> <li>The plastic bag should be of a different color from those used for other waste (it is usually black).</li> <li>Containers/bins should preferably have a pedal lid.</li> </ul>	
<b>Hazardous waste</b>	<ul style="list-style-type: none"> <li>Hazardous waste will be disposed of and labeled according to the type of waste and the specific regulations of each country in accordance with its danger.</li> </ul>	

\* WHO, Safe management of wastes from healthcare activities, 2nd edition (Geneva, 2014).

\*\* See [https://www.who.int/immunization\\_standards/vaccine\\_quality/who\\_pqs\\_e10\\_sb01.pdf](https://www.who.int/immunization_standards/vaccine_quality/who_pqs_e10_sb01.pdf).

\*\*\* WHO/UNICEF, WASH in healthcare facilities Global Baseline Report, Geneva (2019).

\*\*\*\* General waste can also be separated at source according to its type; for example, organic or recyclable waste (cardboard, metal and glass).

## 3.2. Primary storage

Primary storage refers to the temporary storage of segregated HCW, in the place where it is generated. This procedure is carried out in the same service or department as where the HCW is generated while awaiting collection and transport to the specially conditioned final storage enclosures in the same HCF. For primary storage, containers designated by type of waste are used, properly segregated as indicated in the previous section. In some

cases, the wastes can be stored in cleaning rooms or other spaces adapted for this purpose.

## 3.3. Internal collection and transport

The process of collecting and transporting the general, biological and hazardous waste generated in a specific service or department until final storage within the HCF. This process involves using mobile

equipment (containers with wheels or trolleys), which must have compartments to receive the different types of HCW separately. The waste will be transferred following the waste collection route established in the HCF, which must be properly marked.

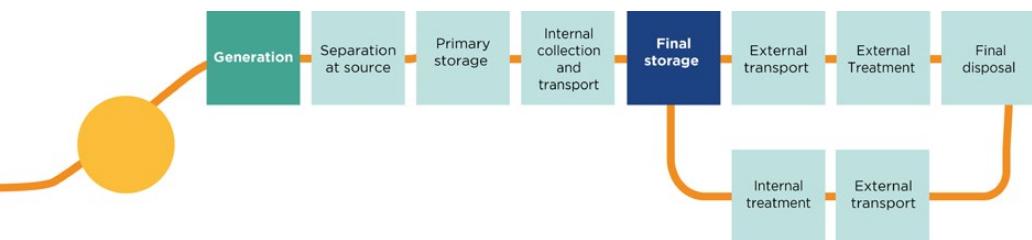
There should be designated collection routes that avoid contact with areas where infectious waste is not generated, in order to avoid exposing staff and patients. The collection should not take place during meal delivery times, medical visits, or surgical procedures. It is advisable to carry out the collection at the same time as the change in each shift to avoid the waste exceeding the capacity of the containers; in addition, the collection must be carried out on a regular schedule.<sup>9</sup>

The collection trolleys must be kept clean, without cracks, with the lid and wheels in good condition. Their cleaning and disinfection, as well as that of the containers, must be performed at the end of each day.

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<sup>9</sup> WHO, Manual of procedures for the comprehensive management of waste generated in healthcare and related facilities (Washington, DC, 2011).

**Image 1. Containers for internal collection and transport of waste in healthcare facilities.**



**Figure 2. Distribution scheme for a final storage area.**



Source: Prepared by the authors.

Hazardous waste must be collected and transported internally in accordance with local regulations, depending on the level of hazard posed by each one of them. In this sense, the transport containers and their specific handling will depend on the type of waste. For example, radioactive waste will have to comply with strict containment for its transport, in accordance with the regulations established by the responsible agencies in each country.

### 3.4. Final Storage.

Final storage in the HCF is performed centrally in areas specially conditioned and marked for this purpose. These areas must have physically separate spaces for the segregated storage of general waste, hazardous waste and another that jointly incorporates biological waste (infectious, anatomical, and sharps). Access must be restricted, especially in the case of hazardous waste, which includes chemical, radioactive or similar substances.

Additionally, it is recommended there is an area for cleaning waste storage containers and bins in the services and the internal collection carts. This area should be a separate enclosure, but ideally it should be adjacent to the storage area.

The waste storage must be separate and away from the areas for patient care, wards, kitchen, dining room, healthcare facilities, sterilization areas, laboratories, etc.

A schematic diagram with the layout of a final storage area is shown in Figure 2.

The storage must meet certain **minimum design conditions**:

- A.** Have restricted access and remain permanently locked, opening only to deposit and remove waste. Access and unlocking can only be performed by authorized personnel.
- B.** Be covered and located where there is no possibility of flooding.
- C.** Have a ramp for easy access for the internal collection carts.
- D.** Have fire extinguishing systems (ABC type extinguishers).

**Table 5. Storage time of anatomical waste.**

Weather	Storage time of human or animal anatomical waste
Temperate/continental	72 hours in winter
	48 hours in summer
Warm/tropical	48 hours during the cool season
	24 hours during hot season

Source: Prepared by the authors with data from WHO, Safe management of wastes from health-care activities (Geneva, 2014).

**Image 2. Biological waste store within a healthcare facility.**



Source: Prepared by the authors.

**E.** Have adequate signage, including a notice indicating the type of waste stored, with the universal biohazard symbol. In addition, it must have signs, notices and/or symbols indicating the danger, in visible places and in a visible manner.

**F.** Have smooth walls and floors, easy to wash and disinfect, in addition to having good drainage and being watertight.

**G.** There should be no openings or vents; in case of having them, there must be a protection mesh against vectors.

**H.** Have a scale for weighing the waste and a recording system.

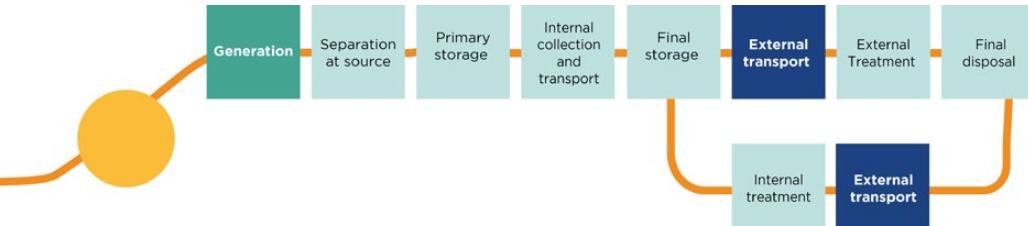
**Storage time:** The waste storage time may vary, depending on: i) the type of waste (times are shorter for waste with higher organic content); ii) the volume of generation and iii) the frequency of removal. In some countries it is considered that for Level 1 HCFs, the storage can be a maximum of 30 days and for Level 2 and 3 hospitals, it can be a maximum of seven days.

For the storage of anatomical waste, a refrigerator or freezer should be available that keeps the temperature below 4 °C. The storage period for this type of waste depends on the climate where the HCF is located. Table 5 presents the criteria established by the WHO for this type of waste.

The **hazardous waste store** must have separate areas for storing radioactive, genotoxic, cytotoxic, and chemical waste, all properly conditioned in specific containers, whose characteristics must comply with local regulations.

Pharmaceutical waste should preferably be stored in a separate space within the hazardous waste store. The hazardous waste store must meet at least the same specifications as those recommended for the biological waste store, in addition to applying the conditions required by the healthcare authority of each country for each type of specific hazardous waste.

The **general waste store** must comply with the same conditions as the biological waste store mentioned above.



**Image 3. Truck for transporting untreated healthcare facility waste.**



### 3.5. External transport

The vehicles that transport the biological waste generated in the HCF must comply with the technical specifications in the local regulations on the transport of infectious waste; also, in general, they must observe the following conditions:

- A. Be a closed box.
- B. Have a runoff capture system.
- C. Have a loading and unloading system.
- D. Have a minimum interior height in the cargo space of 2 meters, so that a person of average height can work standing up.
- E. Have a locking system to guarantee the security of the cargo during transport.
- F. Have doors located at the back of the cargo box that can be opened 180 degrees.

G. Carry signs indicating the presence of hazardous material and the universal biohazard logo.

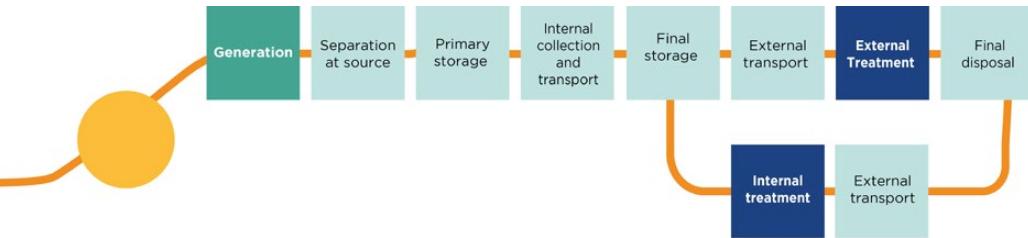
H. Have containers for the transport of waste bags.

I. Have a permanent 4 °C cooling system, especially in cases where distances are long, the temperature in the area is high or the waste remains in the vehicle for more than 8 hours.

In no case should compactor trucks or open box trucks be used to transport biological waste.

Hazardous waste will be transported by a specialized external company, in accordance with the country's healthcare regulations and separately from other wastes (general and biological).

General waste will be transported using the local household waste collection system.



**Image 4. Autoclave for hospital waste treatment.**



## 3.6. Waste treatment

### 3.6.1. Treatment of biological waste

The HCW can be treated individually within a single HCF (internal treatment) or collectively together with the waste from a number of HCFs in a centralized external treatment plant (external treatment).

The treatment method must guarantee the elimination of pathogenic microorganisms and, in general (in accordance with the legislation of each country), leave the waste unrecognizable for its subsequent final disposal in authorized sites as waste comparable with general or household waste.

The most widely used treatment methods for biological waste are autoclaving and incineration, while microwave treatment and chemical disinfection are two less used treatment systems.

#### A. Autoclave

An autoclave is a piece of equipment that sterilizes HCW with steam at high pressure and temperature eliminating the pathogenic microorganisms present in the waste. At the international level, this system is considered one of the most effective for treating infectious waste.

Table 6 describes the referential technical characteristics for this type of equipment, although they may vary depending on the make and model. The advantages and disadvantages of this system are also described.

As mentioned in Table 6, in conjunction with the autoclave it is advisable to consider the use of shredders to reduce the volume and leave the HCW unrecognizable once sterilized. There are two types of shredders:

- Internal shredder: This is the case for autoclaves with an integrated shredder, the advantage is that no additional equipment is required. However, there is a risk that if the shredder is damaged, the autoclave will also be out of operation.

**Table 6. Technical characteristics of an autoclave.**

Requirements	Information
Types of waste treated	Sharps and infectious.
Type of treatment	Steam and pressure.
Temperature	Equal to or greater than 121 °C.
Required pressure	Steam pressure not less than 1 kg/cm (100 kPa).
Air tightness	It should have a hermetic seal on the door to minimize heat loss and maximize thermal efficiency.
Safety system	It must have a diaphragm safety valve and a safety shutdown control system.
Energy	It requires a total installed electrical power of 14 kW, 440 V at 60 Hz.
Process water consumption	20 m <sup>3</sup> /h of drinking water at 5 bar max.
Cooling water consumption:	From 5 - 30 m <sup>3</sup> /h of water at 5 bar max.
Advantages	<ul style="list-style-type: none"> <li>• It is a proven and accepted technology, with extensive information on its application in the treatment of special waste.</li> <li>• There is equipment available for a wide variety of capacities.</li> <li>• Relatively low investment and operating costs.</li> <li>• Easy operation.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Risks of burns if misused.</li> <li>• Additional equipment is required for the steam supply.</li> <li>• Not suitable for treating anatomical waste.</li> <li>• Can generate aerosols containing chemicals and pathogens.</li> <li>• Does not significantly reduce the volume of waste.</li> <li>• The waste remains recognizable after treatment, so additional treatment may be necessary to shred it before final disposal (which would also reduce the volume).</li> </ul>

- External shredder: The external shredding system is the most recommended. These devices should use two to four shafts with shredding discs. A blade system is not recommended because they get clogged with bags, bandages, and other debris.

There is a wide variety of autoclave models, which differ in terms of their operation, sterilization times and mode of action. Autoclaves are classified as follows: i) according to their operating system (manual, semi-automatic, or

automatic); ii) according to the steam supply (autoclaves that generate the steam required for their operation or autoclaves that receive steam from an external source), and iii) according to their operation (displacement by gravity, with previous vacuum, pulsating system).

At the commercial level, there is equipment capable of treating quantities ranging from 20 kg to more than 1 ton per cycle, so they can meet the needs of smaller facilities and also be used in centralized HCW treatment

**Image 5. External shredding of waste in healthcare facilities.**



**Image 6. Mobile autoclaving waste treatment station.**



**Image 7. Hospital incinerators.**



plants. There are also mobile autoclave systems, which consist of a truck-trailer equipped with an autoclave pressure chamber and a central service station where the disinfecting process is carried out.<sup>10</sup>

#### B. Incinerator

Incineration is a process in which waste is burned under controlled conditions at high temperatures, producing the oxidation of organic compounds into CO<sub>2</sub>, water, and other secondary reaction products. Inorganic components are mineralized and turn to ash, unless they become part of the flue gas.

Table 7 summarizes the reference technical characteristics of an incinerator.

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<sup>10</sup> Chilean Ministry of Health, Waste Management in Healthcare Facilities (Santiago de Chile, 2009).

As indicated in Table 7, emission control equipment is not always part of the incinerator and, on some occasions, depending on the model and type of incinerator, it is necessary to purchase them separately. This equipment neutralizes harmful gases with water sprays that carry the particulates into a sludge tank. There is also the possibility of using filters that capture harmful particulates, but these can only withstand temperatures up to 400 °C.

In any case, for the use of these systems, local regulations must always be consulted, with regard to the control of particulate emissions into the atmosphere and the environmental licenses necessary for their use.

In general, although this system is effective, its use is discouraged, as it is a contaminating solution, and instead the use of autoclaves with shredders is considered preferable.

**Table 7. Technical characteristics of an incinerator.**

Requirements	Information
Types of waste treated	Sharps, infectious and anatomical.
Type of treatment	High temperature thermal oxidation treatment.
Shredding	A shredding system is not required.
Primary chamber	Temperatures 500 °C to 800 °C for a period of 30 to 120 minutes.
Secondary chamber	Temperatures from 1,000 °C to 1,200 °C.
Fuel	Diesel, LP gas, or natural gas
Safety system	Safety shutdown control system.
Air tightness	Hermetic door seal to minimize heat loss and maximize thermal efficiency.
Incinerator body	Made of steel sheets of a minimum 2 cm thickness in the chambers and the body of the incinerator, including the exhaust.
Insulating system for both chambers	The thermal insulation capacity must be a minimum of 1,600 °C.
Ash chamber	Ash reception chamber integrated into the incinerator, with a hermetically sealed door that has a safety system preventing it from opening if the combustion chambers are lit or the temperature is higher than 100 °C. The chamber and the door must also be insulated, in order to preserve the temperature in the rest of the incinerator.
Chimney	The chimney needs to reach the appropriate height to allow the gases to be expelled out of the building. Must have a sampling port to measure emissions.
Advantages	<ul style="list-style-type: none"> <li>• Proven technology and commercially available.</li> <li>• Reduces the waste volume by 90%.</li> <li>• Destroys all types of organic matter, including pathogens.</li> <li>• There is no need to treat the waste prior to the process.</li> <li>• Possibility of energy recovery.</li> <li>• Leaves treated waste unrecognizable.</li> <li>• It is possible to treat anatomical waste.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Requires highly trained personnel for operation and maintenance.</li> <li>• High investment, operation and maintenance costs.</li> <li>• Potential emission of toxic substances into the atmosphere (local regulations must be reviewed).</li> <li>• Some models require gas scrubbing systems.</li> <li>• The ashes generated require special disposal in accordance with the country's regulations.</li> </ul>

Source: Chilean Ministry of Health, Waste Management in Healthcare Facilities (Santiago de Chile, 2009).

**Table 8. Microwave technical characteristics.**

Requirements	Information
Type of waste treated	Infectious and sharps waste.
Type of treatment	Microwave and steam.
Electric power	60 kW for 100 kg/hour.
Shredding	Double system.
Advantages	<ul style="list-style-type: none"><li>• There is no need to pre-treat the infectious waste.</li><li>• Low risk to the operation.</li><li>• There are no effluents or hazardous gaseous emissions (if the waste treated is just infectious materials)</li></ul>
Disadvantages	<ul style="list-style-type: none"><li>• Low effectiveness: the layer of waste that passes through the microwave must be thin, so it can act more effectively, which requires a longer operating time.</li><li>• Mechanical problems with the prior shredding.</li><li>• Not all parasites or spore bacteria are destroyed.</li><li>• Trained personnel are required.</li><li>• High investment and maintenance costs (higher than autoclaves).</li><li>• It is not suitable for sharps or waste containing metal components.</li></ul>

**Image 8. Hospital microwave treatment system.**

### C. Microwaves

A microwave disinfection system involves shredding the waste and the subsequent internal heating of the shredded mass through the use of microwaves. During the shredding process, water is added, which, thanks to the action of the microwaves, heats up and turns into steam, contributing to the disinfection of the waste.

Table 8 shows the referential technical characteristics for a waste treatment microwave system.

### D. Chemical disinfection

Chemical disinfection basically consists of the destruction of pathogens through contact of the waste with a broad-spectrum disinfectant. This technology is useful for HCFs whose daily waste generation does not exceed 50 kg.<sup>11</sup> The HCW is deposited in a container where it is mixed with the liquid disinfectant; after a period of contact with the chemical agent, it is removed and drained and then transported to a sanitary landfill.

11 Chilean Ministry of Health, Waste Management in Healthcare Facilities (Santiago de Chile, 2009).

The effectiveness of the treatment depends on the type of pathogens to be deactivated or disinfected, the degree of contamination, the amount of protein material present, the type of chemical used and its concentration, the contact time, and other factors such as temperature, pH, and degree of stirring required.

The selected chemical agent must be compatible with the other substances or materials that may be present in the waste load, so that its effectiveness is not reduced, and also to avoid the formation or release of toxic or hazardous products. The latter must be described in the safety sheets of the selected agent. Likewise, international and local safety and hazardous substances management regulations must be followed.

Because this type of treatment only provides disinfection, but leaves recognizable waste, a previous shredding process is necessary. This requires the use of external shredders. Table 9 provides details of this system.

**Table 9. Technical information for a chemical disinfection system.**

Requirements	Information
Type of waste treated	Infectious and sharps waste.
Type of treatment	Disinfection through chemical products.
Contact time	For the disinfection of sharps, except needles, sodium hypochlorite can be used, among other substances, in a concentration that varies from 0.25% to 2.5%, depending on the amount of blood present. This solution should completely cover the waste in the storage container. The solution must be fresh, that is, it must have been prepared less than 24 hours prior to treatment, and it must remain in contact with the objects to be disinfected for at least 20 minutes.
Shredder	This process must be performed separately using an external shredder.
Advantages	<ul style="list-style-type: none"> <li>• Low cost.</li> <li>• The process can be performed at the generation source.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• May be ineffective against pathogens resistant to a certain chemical.</li> <li>• Hazardous substances are generally used which require special care for their handling.</li> <li>• Liquid waste is generated which may require treatment prior to discharge.</li> <li>• It is necessary to treat the waste before the process.</li> <li>• Contact time is required between the waste and the chemical agent.</li> <li>• There is no reduction in the volume of waste; the volume may increase.</li> <li>• The chances of disinfecting the inside of a needle are very low.</li> </ul>

### 3.6.2. Hazardous waste treatment

The treatment of hazardous wastes, chemicals, expired drugs,<sup>12</sup> genotoxic or cytostatic drugs requires the intervention of a specialized service provider that has authorization for the management and treatment of these hazardous wastes in accordance with the regulations in force in the country.

<sup>12</sup> The treatment of expired medicines must comply with the manufacturer's instructions and national regulations, since not all of them are hazardous.

The treatment and disposal of radioactive waste usually comes under the jurisdiction of each country's nuclear regulatory agency. In the case of low-level radioactive waste, it can be handled and stored within the HCF, but it should always be referred to the healthcare authority of the respective country.

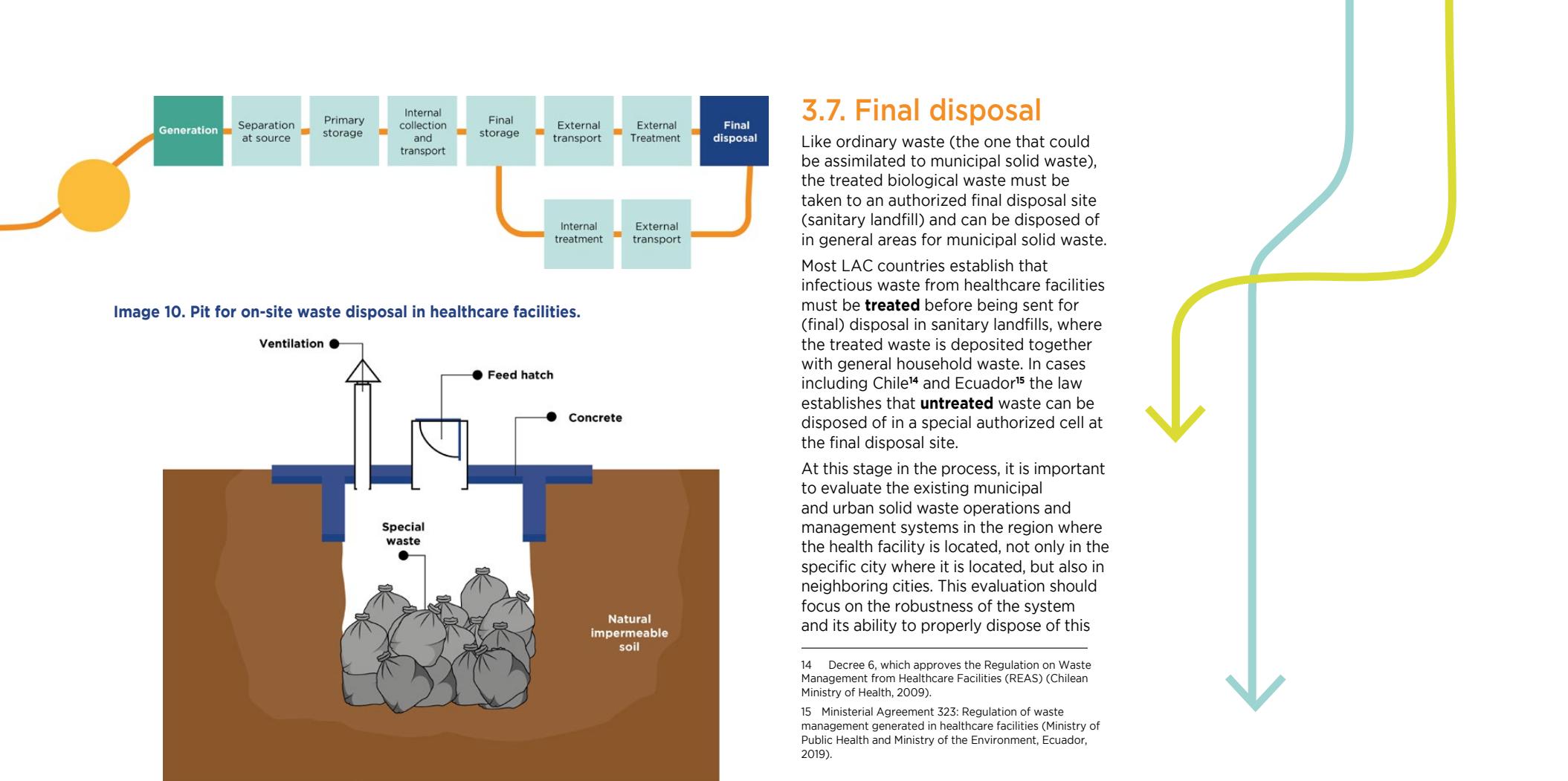
### 3.6.3. General waste

General waste **does not require treatment** and can be transported directly to a sanitary landfill for final disposal.<sup>13</sup>

<sup>13</sup> In countries where there are officially established recycling systems, it is recommended the different types of general waste (paper and cardboard, metal, plastic, etc.) are separated to facilitate this task.

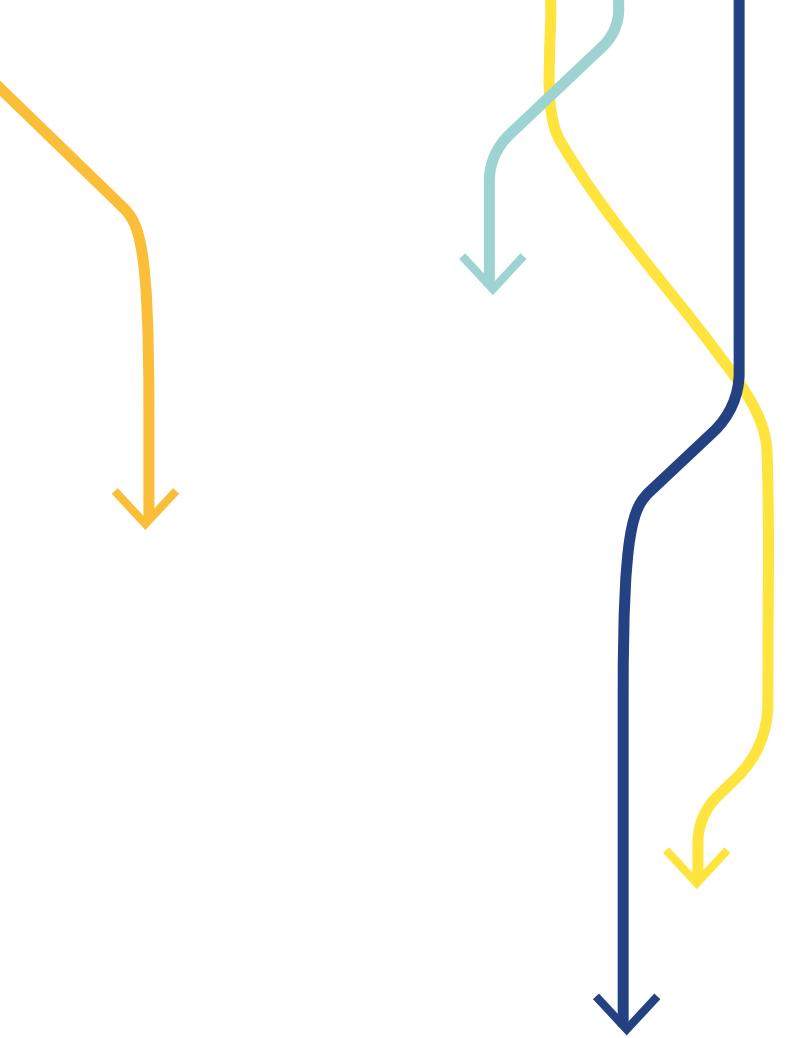
**Image 9. Examples of containment for the transport of hazardous waste.**





<sup>14</sup> Decree 6, which approves the Regulation on Waste Management from Healthcare Facilities (REAS) (Chilean Ministry of Health, 2009).

<sup>15</sup> Ministerial Agreement 323: Regulation of waste management generated in healthcare facilities (Ministry of Public Health and Ministry of the Environment, Ecuador, 2019).



type of waste. It is advisable to analyze, for example, the type of infrastructure that these systems have, the management mechanism under which they work, the existing sanitary conditions, the availability of services they provide, and also study whether environmental regulations allow the municipal or urban management systems to temporarily or continuously receive HCW.

#### **Final on-site disposal**

In extreme cases in which there is no final disposal system, or in which transportation to said centers is impossible, some regulations enable a final disposal system to be considered on site.

Although this solution is not recommended and should only be considered in extreme situations, in these cases, the **treated** waste is disposed of

in pits separated by type of waste (pits for infectious waste, pits for sharps, and pits for anatomical waste). These pits are properly covered, protected by reinforced concrete slabs and must have feeding hatches that do not allow the entry of vectors, animals, people, or rainwater (or runoff). They must only be accessible to the personnel in charge of waste disposal at the HCF and must be located in properly protected areas with security fences. Anatomical waste, such as placentas, human tissue, etc., must be adequately covered with layers of lime and earth.

In cases where there is no other option, and depending on the regulations in each country, these remains can also be disposed of in the mass graves in cemeteries.



## 4. Diagnosis: Is the healthcare facility waste management adequate in the case of my project?

### 4.1 Analytical tool

Whether it is an HCF in operation or a new HCF project, it is necessary to analyze the waste management system in order to find opportunities for improvement or to design a suitable system. It is essential that the analysis is carried out in a comprehensive manner and evaluating all the different phases discussed in Chapter 3.

This chapter includes a tool designed to gather, organize, and analyze information that facilitates decision-making and the development of a HCW management strategy during the planning and operational stages. This is a reference tool and does not replace the official evaluation standards or mechanisms that may exist in each country. It is the responsibility of the project manager to verify whether a local evaluation tool is available.

The objective of this tool is to determine whether the current (or future) activities carried out at an HCF to manage its HCW, as well as the existing or proposed equipment and infrastructure, are adequate and comply with national and international standards.

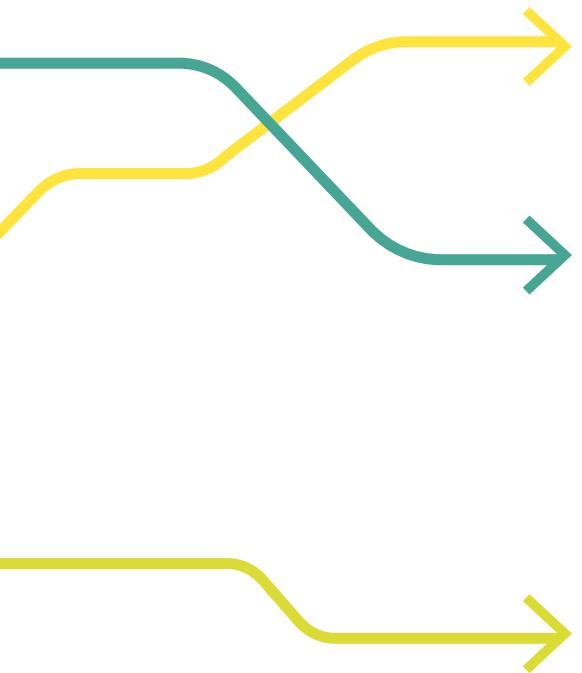
It is recommended that this analysis be performed by the personnel in charge of the environmental health area in the case of new projects or by those responsible for the HCF in the case of projects in operation.

### 4.2. Forms

This tool consists of two forms that will be scored to determine the degree of compliance by the projects in terms of HCW management. One form corresponds to new projects and the other to projects that are already in operation. The detailed forms are included in Appendices 3 and 4, respectively.

Each form is divided into five blocks:

- **General information:** Some basic information is gathered here, such as the location of the HCF, the type of service, and the type of project.
- • **Legal aspect:** This section is to verify that the laws applicable to the project and/or HCF are known.
- **Administrative aspect:** This is where the planning capabilities, human resources, training, personal protective equipment, maintenance programs, and logs are recorded.
- • **Financial aspect:** this space records the financial capacity to adequately manage either a project under development or an HCF in operation.
- **Technical aspect:** This section collects information on source separation, internal collection, final storage, treatment, and final disposal.



**Table 10. Categorization according to scores obtained for waste management in healthcare facilities.**

Compliance Category	Score	Category description
Non-compliant	0-15	The HCF does not meet or insufficiently meets the minimum requirements, whether legal, administrative and/or technical for adequate management of the HCW. More input and the implementation of an appropriate management plan is required. In the case of a new project, this means the design must review aspects that are not being addressed.
Poor compliance	15-30	The HCF complies with a minimum of legal, administrative and technical requirements for the management of the HCW; however, the management system and infrastructure need improvement. In the case of a new project, it means the design must improve aspects that are being insufficiently addressed.
Good compliance	30-38	The HCF exhibits good management of the HCW, has infrastructure and human resources, and the management system is effectively implemented. In the case of a new project, the planned design and management aspects are deemed to be broadly and sufficiently incorporated.

## 4.3. Evaluation

Each form establishes a series of questions that seek to determine the extent to which the management of the HCW complies with the basic standards provided in these guidelines. The proposed scoring system requires the respondent assigns a value between 1 and 0 for compliance or non-compliance with each condition. Once the form is completed, the total score is calculated and the value obtained is verified according to the criteria in Table 10.

These value scales are capable of being recalibrated on the basis of local experiences or sensitivities (with respect to the relative degrees of importance regarding the variables analyzed). For example, depending on the proposed system, the same importance is given to the use of colored bags for separation at source (1) as to the use of an incinerator for the treatment of biological waste (1).

# 5. Designing solid waste management plans in healthcare facilities

A HCW management plan must describe the technical and administrative procedures necessary to ensure that the entire process, from generation to final disposal, is performed with the least possible risk to people as well as the environment.

A HCW management plan must describe the technical and administrative procedures necessary to ensure that the entire process, from generation to final disposal, is performed with the least possible risk to people as well as the environment.

El plan de gestión debe ser diseñado para todo el personal de los ES, así como para los pacientes, sus familiares y los proveedores de servicios, con la finalidad de que todos ellos adopten un modelo de seguridad en el manejo de los RES en cada etapa del proceso.

The management plan must be designed for all HCF staff, as well as for patients, their families, and service providers, with

the aim that all of them adopt a safety model in the management of HCW at each stage in the process.

In the case of a new project, the plan will be initially designed in a preliminary way and should be adjusted and used as a design planning tool. In all cases, the requirements of the authorities or local regulations must be taken into consideration when drawing up these management plans.

## 5.1. General plan considerations

The HCW management plan must consider all the waste generated in the HCF: general, biological, and hazardous. Similarly, it must include all the wastes generated within the facility, even when it is produced as a result of a service provided by third parties.

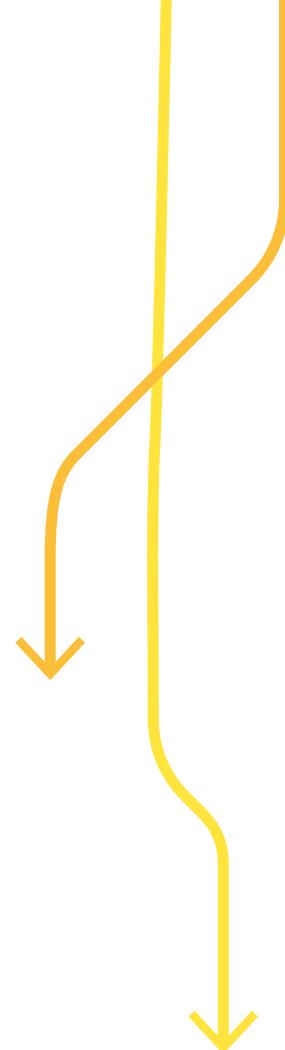
The plan must contain and develop in a clear and concise manner all the factors

that the HCF staff must consider to effectively handle HCW during the entire management process: separation at the point of origin, internal transport, storage, and treatment.

For the cases where the HCW treatment is carried out within the HCF (autoclave and incineration), the personnel must receive the proper training to operate the equipment, perform maintenance work, complete the documentation to keep the operation control (logbooks and records), and comply with the necessary safety protocols and controls.

When the treatment of the HCW is performed outside the HCF, the procedure for contracting external companies for transport, storage, treatment, and final disposal must be stated. In addition, the permits, authorizations, and safety and control protocols required by these companies must be established.

Table 11 shows the HCW management stages, by waste type.



**Table 11. Stages of waste management in healthcare facilities by waste type.**

Stage	General waste	Biological		Hazardous
		Sharps and infectious	Anatomical parts	
Source separation and primary storage	Deposit in the identified containers for general waste placed throughout the hospital.	Containers will be installed in consultation areas, operating rooms, chemotherapy areas, nursing stations, and other areas as required.	Segregate in dedicated containers to be taken immediately to the freezers in the final storage area. There is no primary storage in this case.	Segregate in dedicated containers to be sent to the point from where they are removed.
Internal collection and transport	Collect in bags or black containers to be sent directly to the general waste area.	Collect in rigid and closed containers to be sent to final storage, in order to avoid contact with unauthorized personnel.	Collect in bags, identified, closed and sent to the freezers within the final store to be kept at 4 °C.	Collect in bags or closed containers to be sent to their final store.
Final storage	The general waste storage area should be kept clean to prevent vectors, and to ensure easy access for external companies or the municipal cleaning service that collect this waste.	Keep in a closed store with restricted access, in marked and closed containers, free of vectors. Avoid placing directly on the floor and keep dry.	Keep in freezers, in a closed store with restricted access.	Keep in a closed store with restricted access, in marked and closed containers, free of vectors. Avoid placing directly on the floor and keep dry.
External transport	Use compactor vehicles for transfer or containers covered with canvas to prevent dispersal during transfer.	Use easy to clean vehicles with closed box, refrigerator, mechanical ramp, and container to retain leachate.	Use easy to clean vehicles with closed box, refrigeration system, mechanical ramp, and container to retain leachate.	Use easy to clean vehicles with closed box, mechanical ramp, and container to retain liquids.
Internal treatment	No treatment is performed within the HCF.	If the HCF has an autoclave or incinerator for treatment prior to leaving the HCF, ensure the waste does not contain a biohazard and that it is destroyed so that it cannot be reused.	If the HCF has an incinerator for treatment prior to leaving the HCF, ensure there is no biohazard and that the material is destroyed.	No treatment is performed within the HCF.

**Table 11. Stages of waste management in healthcare facilities by waste type. Continuation**

Stage	General waste	Biological		Hazardous
		Sharps and infectious	Anatomical parts	
External treatment	If the country has systems for the recovery of general waste through incineration, it may be treated by external companies.	May be sent to external companies to be treated or co-treated.	May be sent to external companies to be incinerated.	May be sent to external companies to be treated, co-treated or neutralized.
Final disposal	May be sent to a sanitary landfill.	Treated waste may be sent as household comparable waste to landfill. In some cases, when local regulations allow, untreated waste may be sent to safety cells within the sanitary landfill, if they exist.	The treated waste may be sent to sanitary landfill. In some cases, when regulations allow, untreated waste may be sent to safety cells within a sanitary landfill or to cemeteries.	Specialized company.

Source: Prepared by the authors.

## 5.2. Diagnosis regarding waste generation and management in healthcare facilities

Before preparing a management plan, it is advisable to perform or ensure there is a diagnosis regarding the waste management in each service or

department, and for the entire facility. The tool developed in the previous chapter can be very useful for this purpose. Likewise, an inventory of the nature and quantity of the waste generated must be established. The procedure should include the following minimum activities.

- A.** Identify the sources and categories of waste that are generated in each of them.

**B.** Determine the average amount of waste generated in the different services by category.<sup>16</sup>

- C.** Obtain information on the administrative and operational aspects of the waste management in the facility; for example, staff responsibilities (tasks, areas of

expertise, etc.), assigned resources, applicable policies, standards, procedures, or instructions.

- D.** Collect information on the costs associated with disposing of each type of waste.

<sup>16</sup> This activity may require from several days to two or three weeks to be carried out, due to the fluctuations in the composition and quantity of the waste generated, which may vary according to the day of the week, the month or the season of the year.

## 5.3. Elements in a management plan

As indicated above, the HCW management plan must include all the technical and administrative procedures necessary to ensure the internal management and disposal of the waste is performed with the least possible risk. The elements that such a plan must have are detailed below.

### 5.3.1. Facility identification

Identify the facility, the activities conducted, and the person responsible for implementing the management plan.

### 5.3.2. Amount of waste generated

Include an estimate of the amount generated in each service or area of the facility, by waste category. Table 12 shows an example of how to present the required information.

### 5.3.3. Facility plans

Include simplified drawings of the HCF with the following information as a minimum:

- Identification of services and waste generation areas.
- Location of primary storage sites.
- Final storage room location.
- Location of treatment facility, if applicable.
- Routes established to transfer the waste from the services or generation areas to the final store and treatment facility (if applicable).

### 5.3.4. Internal management procedures

Detailed procedures for internal waste management must be included at each stage of the process and for each of the categories of waste generated in the HCF.

- Separation at origin: The measures and actions considered to ensure adequate segregation of waste at the time of its generation must be described, identifying the human and material resources assigned, such as - for example - containers, labels, bags, etc.

**Table 12. Estimate of the amount of waste generated.**

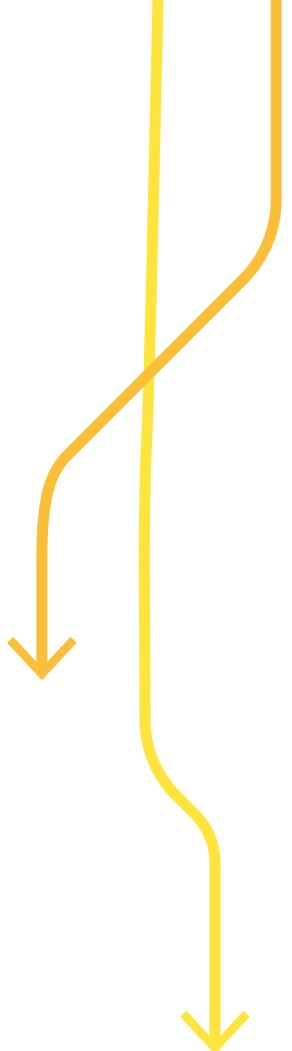
Name of the Service or Waste Production Area	Waste Code a/	Waste Name	Waste Description	Amount Generated (kg/day)
E.g. Internal Medicine	E.g. HCW001			
	E.g. HCW002			
	E.g. HCW003			
E.g. Dermatology	E.g. HCW001			
	E.g. HCW004			

Waste Code	Amount Generated (kg/day)	Waste type				Risk class	External identification code if applicable
		1	2	3	4		
HCW001							
HCW002							
HCW003							
HCW004							

- Internal transport: The measures and actions considered should be described to ensure the timely removal of waste from the services or areas where it is generated and to ensure that its transfer is undertaken with the least possible risk through a safe working procedure, identifying

the human and material resources assigned (carts, containers, labels, bags, personal protective equipment, etc.).

- Primary and final storage: The measures and actions considered must be described to ensure that the waste storage is carried out with



the least risk and the least amount of inconvenience possible, identifying the human and material resources assigned, such as - for example - containers, labels, bags, equipment, personal protection, hygiene, etc.

- On-site treatment and final disposal: For treatment facilities already in place, the treatment operations must be described according to the categories of waste treatment. Provide details of the measures and actions considered to ensure that the treatment and final disposal is performed with the least risk possible and in compliance with an operation plan or ad hoc operating procedure for said equipment. Consideration should be given to keeping records referring to the treated waste and the relevant parameters of the treatment equipment operation.
- External treatment and final disposal: The plan must include the procedures for handing over the waste to authorized third parties for transport, treatment, and/or disposal. Procedures should be described to ensure the waste is removed and

transported through licensed carriers, and that treatment and final disposal are carried out at disposal facilities that are properly licensed to include such waste. It is advisable to keep a record stating the date of shipment of the waste for disposal, the quantity sent by weight or volume, the type of waste, the place to which it is sent, the carrier, and the vehicle used. The plan must include the procedures that must be followed associated with the monitoring of the wastes.

The measures and availability of equipment to control any emergency situations due to waste management must be described in a contingency plan for the facility, as exemplified in Section 5.3.9.

### 5.3.5. Waste recording system

A record system for waste entering the storage room must be kept, with the following information included:

- Generating service or area.
- Amount stored and category of waste.

- Date of entry to the storage room.
- Shipment date and quantity dispatched for disposal.

## 5.3.6. Staff profile and responsibilities description

The HCF should designate a person responsible for managing the plan and for the performance of the personnel in charge of waste management. The profile and responsibilities of the manager and other personnel must be defined in the plan. It is recommended to detail at least the following:

- The level of instruction and knowledge of the waste manager and other personnel responsible for implementing the plan, considering the size and complexity of the facility.
- The management structure, hierarchy, responsibilities, functions, and assignments of each of the actors that will participate in the management system.

The properly defined assignment of responsibilities to each worker is important to ensure the tasks are effectively performed. It is recommended that the plan specify the individual responsibilities for all the procedures

considered in 5.3.4, ensuring there is at least one person in charge (or manager) for the operation and maintenance of the storage room.

Regarding waste management, the roles and responsibilities of the HCW staff must be specified, as shown in Table 13.

### 5.3.7. Training program

A training program should be included to inform management personnel about the risks involved in their work, preventive measures and correct working methods. The content of the training program should be periodically reviewed and updated when necessary.

It is recommended consideration is given to repeating the training courses periodically to renew acquired knowledge and train new staff and existing staff who have been assigned new duties.

Instructors should have teaching and training experience and be familiar with the risks and practices relating to waste management. Training needs will depend on the type of operations the staff perform.

Depending on the respective obligations, training will be required on specific areas (for example, incinerator operation). In general, it is recommended that the personnel in charge of handling the HCW be trained, at least, in the following topics:

- Information on environmental and health risks related to waste management.
- Instructions on the use of personal protection equipment.
- Current environmental and healthcare regulations.
- Management plan prepared by the generator.
- Internal management procedures.
- Assigned responsibilities.
- Procedures to be observed in the event of spills and accidents.

### 5.3.8. Health and safety surveillance program

A health surveillance program should be included for personnel who carry

out collection, storage, transport and/or treatment activities. The program should include prevention (immunization, identification of immune status), investigation, control, and monitoring of the health of workers (application of a health survey, basic and specific examinations, medical evaluation, referral to a specialist if merited), in order to prevent them from contracting diseases as a result of handling waste.

For the HCW management plan to be implemented correctly, it must be constantly monitored and evaluated, to ensure control regarding the generation, management, and final disposal of the HCW in an environmentally safe way while avoiding health risks to the population and the HCF staff.

The following activities should be conducted as monitoring and control measures:

- Inspection visits: Visits must be carried out in the HCF at least once a month to observe the handling of the waste from the point of origin to final treatment and/or disposal. Record all inspection visits.

- Reports by personnel involved: The personnel involved in handling the HCW should be encouraged to report any conditions they consider to be risky or hazardous or that require a change to improve the HCW management system.

- HCW management record: Control logs must be completed on waste generation, operation, treatment system maintenance, fuel and electricity consumption, service and operations carried out by external personnel, etc.

- Annual reports on HCW management: The results obtained in the course of a year should be plotted and presented to the environmental management group, for comparison with the previous year, in such a way that goals and objectives can be established to be achieved in the following year and thus improve the management plan.

Table 14 presents the objectives, indicators, goals, and reasons for changing or updating the actions to be performed in the HCW management plan.

**Table 13. Roles and responsibilities of the personnel in charge of waste management in healthcare facilities.**

<b>Actor</b>	<b>Roles and responsibilities</b>
Management staff (director, heads of areas/departments)	<p>Manage and control a comprehensive management system for HCF waste.</p> <p>Manage the information generated in the comprehensive HCF waste management system.</p> <p>Manage the financial, human, and material resources required to operate the comprehensive HCF waste management system (fuel, electricity, personal protective equipment (PPE), waste containers, waste carts, personnel involved in waste management, etc.).</p> <p>Guarantee the control of external HCF personnel who are involved in waste management (collection, transport, treatment, and final disposal).</p>
Care personnel (doctors, nurses, orderlies)	<p>This group generates HCW during general medical care, in operating rooms, laboratories, among others, so it is necessary they are trained in waste management and comply with the standards established in the workplace to effectively manage, classify, label, and dispose of the HCW.</p>
Responsible for the execution of the HCW management plan	<p>Direct and control the personnel in charge of managing HCW.</p> <p>Provide and replace the materials that are needed for the management of HCW (containers, carts, cleaning supplies, uniforms, etc.)</p> <p>Provide and replace personal protective equipment required by personnel to perform their work.</p> <p>Check the condition of the waste containers and, when necessary, replace them.</p> <p>Guarantee the security of the external waste store of the HCF to prevent anyone from having access or mixing the waste.</p> <p>Guarantee compliance with the measures established for the operation of the system.</p>
HCW handling staff	<p>The personnel in charge of the internal handling of the HCW will carry out cleaning, collection, and storage activities.</p> <p>These personnel are at greater risk due to occupational exposure, since they are the ones who handle the HCW containers from the source of generation to the treatment area and/or secondary storage. They must have adequate training in handling, classification, labeling and disposal of the HCW. Likewise, they must have the necessary PPE and must be trained in its proper use when handling HCW, in accordance with current regulations.</p>
HCW treatment system operating staff	<p>These are the personnel in charge of operating the HCW treatment equipment (autoclave and incinerator).</p> <p>They are trained in handling HCW and ensuring it loses its hazardous characteristics.</p> <p>They keep a record of the treated waste.</p> <p>They keep a record of the fuel used in the treatment system.</p> <p>They control the autoclave's water treatment system.</p>
HCW treatment system maintenance personnel	<p>They must control and monitor the maintenance program of the HCF's treatment systems.</p> <p>They are in charge of controlling the spare parts required for preventive maintenance.</p> <p>They must control and monitor external personnel performing major maintenance tasks on the HCF treatment system.</p>
Patients and relatives	<p>They must know and comply with the rules the HCF establishes regarding the generation and separation at source of the waste.</p>
Healthcare and environmental authorities	<p>They are charged by the government with ensuring compliance with environmental and health regulations related to best practices and obligations in solid waste management.</p>

**Table 14. Objectives, indicators, goals, and reasons to change or update the HCW management plan.**

Perspective	Objective	Indicator	Goal	Reasons for changes or updates
Generation control	Record the volume or weight by waste type.	Record the waste generated by area.	Have a waste generation log by area.	When there is a failure to report during a period of three months, the personnel in charge of managing HCW will face penalties.
		Record the annual generation of waste.	Keep annual records on waste generation by type and area.	When there is a failure to report for two consecutive years, the personnel in charge of HCW will be changed out.
		Review the generation of waste every three months with the personnel in charge of waste management.	Have a generation report that can be submitted every three months to the HCF and can be published.	When there is a failure to report for two consecutive periods (six months), the personnel in charge of managing HCW will be changed.
Segregation quality	General waste	The HCF staff, the patients, and relatives of the patients deposit their general waste in the assigned containers.	The general waste bins throughout the HCF are kept free of other types of waste.	Conduct awareness campaigns on a more regular basis to raise awareness among HCF staff, patients, and patients' families, so they do not mix general waste.
	Sharps and infectious waste	The HCF staff deposit the sharps and infectious waste in the assigned containers.	All sharps and infectious waste are separated and not mixed with other waste throughout the HCF.	Perform a review of the containers by area and take corrective measures, including penalties, if necessary, when there is mixing of waste.
	Anatomical waste	The HCF staff must take this type of waste to the designated HCF freezer.	The anatomical waste is separated and not mixed with other waste.	Perform a review of the containers by area and take corrective measures, including penalties, if necessary, when there is mixing of waste.
	Hazardous waste	HCF staff must deposit hazardous waste in designated areas for storage and collection within the HCF.	Hazardous wastes are separated and not mixed with other wastes.	Perform a review of the containers by area and take corrective measures, including penalties, if necessary, when there is mixing of waste.

**Table 14. Objectives, indicators, goals, and reasons to change or update the HCW management plan. Continuation.**

Perspective	Objective	Indicator	Goal	Reasons for changes or updates
Internal management	Internal collection and transport	Establish an internal collection and transport schedule, on designated routes within the HCF, using separate carts that are washed daily.	Waste does not accumulate within the HCF areas and that they are kept separate to avoid a health risk in the HCF.	Perform a review of the containers throughout the HCF and, if there is accumulation, take corrective measures, including penalties against the personnel in charge of the internal collection and transport, if necessary.
	Storage	All waste is deposited into the final store separately, avoiding mixing, spilling, or leakage in the store.	The personnel in charge of managing HCW keep the HCF tidy.	Review of the HCW storage areas and, in the event of non-compliance with the storage regulations, take corrective measures, if necessary, towards the personnel in charge of the final storage.
	Internal treatment	All the HCWs are treated before they leave the HCF.	The personnel in charge of operating the treatment equipment (autoclave and incinerator) eliminate the danger posed by the HCW before it is handled as general waste.	Review of the HCW treatments that are performed within the HCF and, if the provisions are not met, speak with the supplier of the autoclave and the incinerator to verify the cause that prevents the treatment of the HCW.
Quality of HCW inactivation	General waste	Waste is sent to sanitary landfills authorized by the corresponding authority and does not generate an environmental risk.	Personnel in charge of managing the HCW ensure that general waste is sent to authorized sites.	Assess the sanitary landfill to verify that the waste is managed to prevent health risks. In case of mishandling, look for ways to correct this during final disposal.
	Sharps and infectious waste	Treat waste by autoclaving and shredding to eliminate hazard.	The personnel in charge of the autoclave verify the indicators relating to the elimination of hazards posed by the HCW treated by this system.	Perform a review on the inactivation of the HCW by using autoclaving and shredding; in case of non-compliance, verify with the supplier to find the reason for the failure to comply with the HCW treatment.
		Burying sharps and infectious waste when a treatment system is not available.	Waste is deposited in security cells (or dedicated) in a sanitary landfills and buried to avoid exposure to the environment.	Assess the landfill to ensure the waste is managed and there are no resulting health risks. In case of mishandling, look for ways to correct this during final disposal

**Table 14. Objectives, indicators, goals, and reasons to change or update the HCW management plan. Continuation.**

Perspective	Objective	Indicator	Goal	Reasons for changes or updates
Quality of HCW inactivation	Anatomical waste	Treat waste by incineration to eliminate the hazard.	Personnel in charge of the autoclave verify the destruction of the waste before its final disposal.	Conduct a review on the inactivation of the HCW through the use of the incinerator; in case of non-compliance, verify with the supplier the reason why the HCW treatment is not being complied with.
		Burying anatomical waste when a treatment system is not available.	The waste is deposited in safety cells (or dedicated cell) in a sanitary landfills and/or cemeteries and is buried to avoid exposure to the environment.	Asses the sanitary landfill to verify that the waste is managed and to avoid health risks. In case of mishandling, look for ways to correct this during final disposal.
	Hazardous waste	Send HCW to external companies to be treated, co-treated, or neutralized.	The personnel in charge of managing the HCW ensures it is eliminated and deposited in suitable places for final disposal.	Assess the treatment and final disposal of hazardous waste; in case of problems, look for external companies that can give proper management to HCW.
Cost of collection and external treatment	Quotes from external companies dedicated to the collection and treatment of HCW.	Request quotes from many external transport and treatment companies that work with HCW.	The personnel in charge of managing the HCW evaluate all the waste management proposals sent by external companies.	Not applicable.
	Contracting an external company to collect and treat the HCW.	Establish a contract between an external company and an HCF that ensures the service and removes the HCW.	The personnel in charge of managing the HCW establish a contract with the external company that they consider best.	Not applicable.
	Delivery, monitoring, and evaluation of the destruction and/or treatment of the HCW delivered to external companies.	Establish a procedure for monitoring and evaluating the management of the HCW delivered to external companies.	The personnel in charge of managing the HCW evaluate and report on the management of the waste delivered to external companies to the HCF.	Conduct constant evaluation of the management of the HCW by external contracted companies. In case of non-compliance, change company.
Final waste disposal costs	Determine the costs for the final disposal of the wastes in authorized sites.	Conduct a cost study on the final waste disposal to ensure proper management of the HCW.	The personnel in charge determine the real cost of the final disposal of the HCW to ensure it is managed in a way that guarantees it does not generate more risks.	Verify that the final disposal is cost-effective when there is no possibility of treating the HCW.

### 5.3.9. Contingency plan

An HCF contingency plan must be incorporated within the management plan, in which the measures to control any emergency situations related to waste management are described. The plan must include at least the following points:

- Control and/or mitigation measures.
- Staff training.
- Identification of staff responsibilities.
- Definition of a communication system, fixed or portable, to alert the competent authorities.
- Identification, location, and availability of personnel and equipment to attend to emergencies.
- Updated list of public agencies and personnel who should be notified immediately in the event of an emergency.

The contingency plan must include a diagram of the internal organization of the HCF in terms of contingencies and define the scope of responsibilities, functions, and duties for each of the

participating actors. An alarm notification scheme should be included in the event of contingencies.

The emergency response provisions must guarantee, as far as possible, the limitation of the exposure of personnel during operations and the impact on the environment.

## 5.4. Socio-environmental management plans focused on waste management in healthcare facilities

HCW management plans are one of the priority issues for the IDB, and the projects it finances are required to comply with specific standards for conducting Environmental and Social Impact Assessments (ESIA), Strategic Environmental and Social Assessments (SESA), Environmental and Social Management Plans (ESMP) and

environmental and/or social analysis.<sup>17</sup>

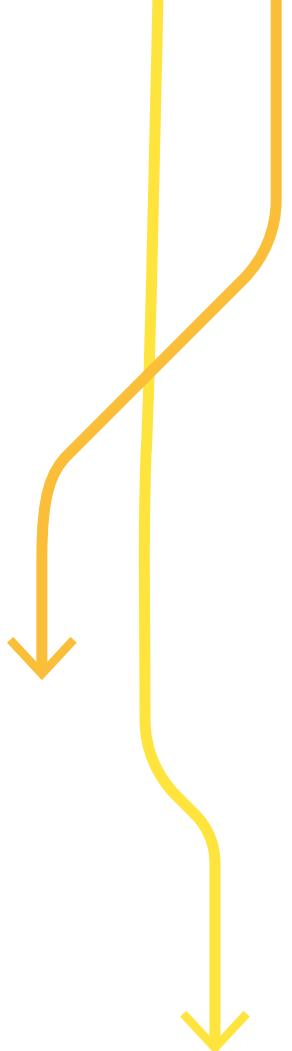
An ESMP and environmental and/or social analysis are carried out in the case of operations capable of mainly causing localized and short-term negative environmental impacts, including associated social impacts, and for which effective mitigation measures are already available. For this reason, the ESMP should be focused on determining the environmental and social risks and impacts derived from management of the following:

- General HCF waste.
- Sharps and infectious waste from the HCF.
- Anatomical waste produced by the HCF.
- Hazardous waste from the HCF.

The Bank's environmental and social safeguard policies help prevent environmental and social damage, improve the level of development of stakeholders, and comply with good international practices in the borrowing countries.

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<sup>17</sup> IDB, Environmental Policy and Safeguards Compliance (Washington, DC, 2006).



Environmental impacts are defined as changes to the environment, positive or negative, caused by the action of humans or nature,<sup>18</sup> and social impacts are all the changes and consequences, positive or negative, resulting from human or natural actions and that may affect the way of life of the exposed population. Among the socio-environmental impacts that can be generated by waste management, the following can be highlighted:

- A.** Risk of soil contamination due to the generation of HCW inside and outside the HCF.
- B.** Risks of contamination of the atmosphere due to burning and the generation of odors from the HCW inside and outside the HCF.
- C.** Risks of contamination of surface and underground water due to the mismanagement of HCW inside and outside the HCF.

<sup>18</sup> SEMARNAT, General Law on Ecological Balance and Environmental Protection (Mexico City, 2021).

**D.** Risks of visual contamination, due to poor handling, treatment and/or final disposal of HCW.

**E.** Health risk for the internal population of the HCF (patients, staff and relatives) and neighbors, as well as for the population that is exposed in the process for the transportation and final disposal of the HCW.

**F.** Health risk due to the reuse of materials and equipment considered HCW.

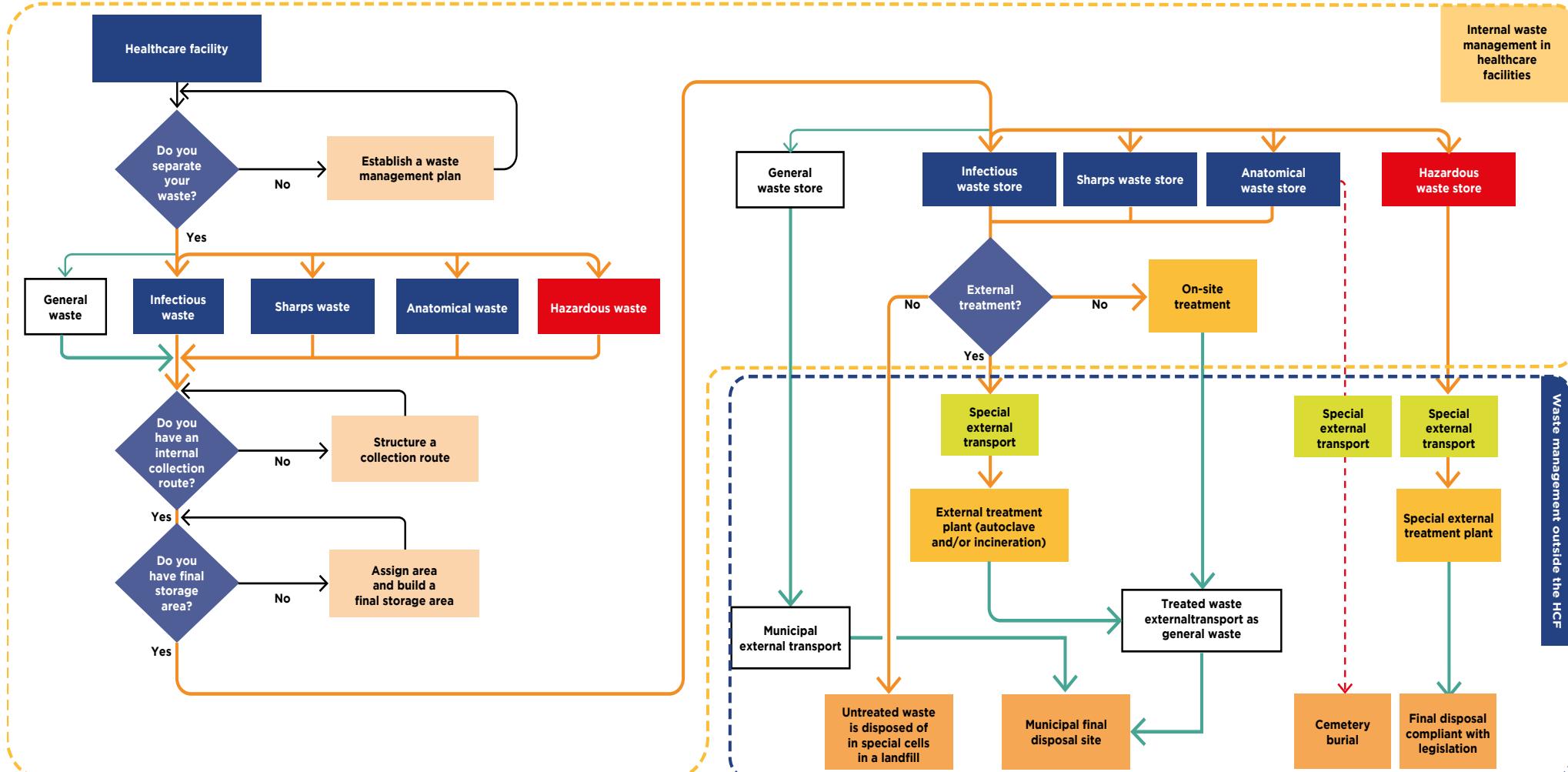
**G.** Health risk to the population due to inadequate treatment and final disposal of HCW.

The mitigation, prevention and compensation measures for the management of HCW are focused on being able to reduce the environmental and social risks that affect, among others, people (HCF staff, personnel in charge of the handling the HCW, patients, family members and the population in general)

and fauna and flora. The activities or actions that have to be undertaken to minimize, prevent, and compensate for the management of the HCW should be described in detail; as well as the form of evaluation, registration, and control to ensure that the goals and objectives are being met. In Appendix 5, at the end of the guide, a detailed chart shows the key direct and indirect impacts and risks in HCW management.

Figure 3 shows a detailed flow chart with the stages in the HCW management process.

**Figure 3. Detailed flow chart of the stages in HCW management.**



## 6. Economic evaluation of the treatment and management of waste in healthcare facilities

Economic evaluation is key to the planning and operation of a HCW management plan, since it allows the best long-term alternative to be identified and selected, taking into account the necessary economic resources, which is one of the most restrictive factors in project operation.

This is important in order to guarantee the sustainability of the plan, especially during the operational stage, since the management plan must be seen as a permanent activity throughout the life cycle of the project.

Economic evaluation is a tool to assess and compare alternatives, which must cover two stages:

- The technology for treating infectious and sharps waste,<sup>19</sup> that have alternatives for their inactivation at the level of the HCF.
- The organization of the waste collection, treatment and final

disposal system, considering on-site solutions or network responses.

Additionally, this chapter includes an exercise to determine the investment and operating costs for an individual project. The economic evaluation can be carried out in the different phases of a project preparation, namely:

**A. Profile:** corresponds to a conceptual analysis with macro estimates of costs. If there is robust evidence, the most suitable alternative can be selected. If not, a pre-feasibility study should be carried out.

**B. Pre-feasibility:** corresponds to an analysis that allows various options to be compared and the most suitable one identified, which will be developed in the feasibility phase.

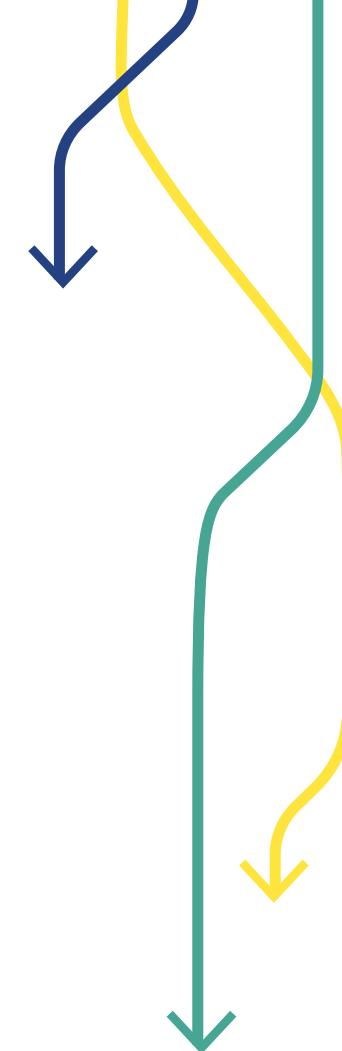
**C. Feasibility** (or preinvestment): in this phase the selected option is designed and detailed studies of investment, preinvestment

and operational requirements are conducted.

In each of the stages, information with a different level of detail will be required, sufficient to move on to the next phase or to re-analyze the options. The key to the analysis is to base it on market or observed information, which is feasible to verify, since if assumptions are used there is a risk the robustness of the conclusions and recommendations will not be as desired.

This chapter presents the criteria for preparing an economic evaluation, considering pre-feasibility levels and weighing the options that allow the best decisions to be made regarding the most beneficial alternative.

To carry out the comparison, the first step consists of estimating or understanding the waste generated by the HCF. If no production statistics are available, this can be estimated depending on the number of beds:



<sup>19</sup> Anatomical wastes have not been included since their treatment and disposal has medico-legal implications in some countries.

- **HCW generation per capita (GPC):** 2.47 kg/bed/day.<sup>20</sup>
- **HCW generation percentages:**<sup>21</sup>
  - » 85% general waste.
  - » 10% infectious waste (infectious, anatomical, sharps):
    - \* 66% infectious waste.
    - \* 4% anatomical waste.
    - \* 30% sharps waste.
    - » 5% hazardous waste (chemical, radioactive).
- **HCW general density:** 0.11 kg/L.<sup>22</sup>

For the calculations included in this document, a hospital with 200 beds has been studied as an example and different options for the treatment of 71.14 kg/day of infectious and sharps waste will be evaluated, as summarized in Table 15.

<sup>20</sup> M. Minoglou, S. Gerassimidou and D. Komilis, Healthcare Waste Generation Worldwide and Its Dependence on Socio-Economic and Environmental Factors. *Sustainability* 2017, 9, 220.

<sup>21</sup> Approximate average values. WHO, Safe management of waste from healthcare activities: A summary (Geneva, 2017).

<sup>22</sup> See [https://www.who.int/water\\_sanitation\\_health/microbialwaste/002to019.pdf](https://www.who.int/water_sanitation_health/microbialwaste/002to019.pdf)

## 6.1. Economic evaluation for on site treatment and final disposal options

Infectious and/or sharps waste can be treated in the HCF and in some cases, if legally possible, anatomical pieces can also be treated as infectious waste for treatment. The most frequently used options for treating this waste are: autoclave and incineration.<sup>23</sup> In the case of autoclave it's necessary to include (according to the regulations and community waste management system) the shredding of the residues.

This chapter will provide guidelines to compare options autoclave and incineration options.

The economic evaluation must consider the relevant variables<sup>24</sup> for each technology, considering the investment costs (equipment and infrastructure),

<sup>23</sup> It is necessary to verify whether the country's environmental regulations allow the incineration of waste at the level of each facility. If so, the technological or operational requirements must be verified (emission of gases in case of incineration, for example).

<sup>24</sup> The selection of the relevant variables corresponds to those that may have a different cost or performance depending on the selected technology, so the variables must be agreed upon during the initial phase.

**Table 15. Example of daily waste generation for a 200-bed hospital (reference values that illustrate the practical example).**

Item	Quantity
Number of beds	200
Estimated quantity, HCW (kg/day)	494
Estimated quantity, infectious (kg/day)	48.91
Estimated quantity, anatomical (kg/day)	2.96
Estimated quantity, sharps (kg/day)	22.23
Estimated quantity, general (kg/day)	419.90

Source: Prepared by the authors.

operations costs (personnel, maintenance and energy and water expenses), and final disposal costs.

The first piece of information to be determined is the amount of waste that is generated, so the daily production capacity must be defined for the same operating period, for example, 12 hours per day.

### 6.1.1. Investment cost<sup>25</sup>

**Equipment:** The investment cost must include the equipment located in the HCF and other relevant equipment necessary for its operation. The following costs are considered depending on the type and characteristics of the equipment:

<sup>25</sup> The values presented come from projects executed in various countries; however, they should be considered as referential, since there may be variations due to the elapsed time and between different countries and technologies.

**i. Autoclave without shredder:** The usual dimensions are:

1. Small: 25 liters/load; 5-7.5 kg/hour.
2. Medium: 150 liters/load; 45-67 kg/hour.
3. Large: 300 liters load; 100 kg/hour.

The sizing of the equipment will depend on the operating hours and the number of cycles. For a 200-bed hospital, large-scale equipment is estimated to cost US\$90,000.

**II. Shredder:** Equipment for 100 kg/hour, an approximate cost of US\$15,000 is estimated.<sup>26</sup>

<sup>26</sup> PATH (Program for Appropriate Technology in Health), Treatment alternatives for medical waste disposal (Seattle, WA, 2005).

**III. Autoclave with shredder:** A 300-liter machine with a 100 kg/hour shredder is estimated at an approximate cost of US\$125,000.

**iv. Incinerator.**

The usual dimensions are:

1. Small: 20 kg/hour.
2. Medium: 50-100 kg/hour.
3. Large: 200-300 kg/hour

It is estimated that a 200-bed hospital requires medium-sized equipment, at an approximate cost of US\$230,000. Additionally, the purchase of a gas scrubber must be included for US\$60,000 and HEPA filters (consumables), at a cost of US\$540 each.

**Infrastructure:** It includes the construction cost of the infrastructure necessary for the installation or operation of the equipment. The following surface areas are estimated to be required based on the type of equipment:

- i. Separate autoclave and shredder: 70 m<sup>2</sup>.
- ii. Autoclave with shredder: 60 m<sup>2</sup>.
- iii. Incinerator: 100 m<sup>2</sup>.

To estimate the cost of the infrastructure, the cost of construction must be included, which in this case is approximately US\$1,500 per m<sup>2</sup>.

### 6.1.2. Cost of operation:<sup>27</sup>

**Personnel needed to operate the equipment:** A person capable of operating the equipment with a salary of US\$500 per month is considered. Since coverage is required throughout the year, it was estimated that to meet this schedule there must be 1.4 contracts of eight hours each.

**Maintenance:** This cost depends on the treatment equipment, the management mode (internal or external), the type and frequency of maintenance. Comprehensive maintenance (preventive and corrective), with labor and spare parts has the following estimated costs:

- Autoclave: in the range of 0.05 to 0.1 US\$/kg.
- Incinerator: in the range of 0.173 to 0.25 US\$/kg.

**Water and energy:** The estimated cost is represented in Table 16, according to the following criteria:

<sup>27</sup> In this example, the cost is estimated for an operating term of 10 years, assuming linear costs without inflation and discount rate.

**Table 16. Reference electricity and fuel consumption by equipment type.**

Operating for eight hours	Autoclave with built-in shredder	Autoclave with external shredder	Incinerator
Water (m <sup>3</sup> )	20 m <sup>3</sup>	20 m <sup>3</sup>	No
Electricity (kW/h)	1600 kW	224 kW	16 kW
Diesel	No	No	13.63 L

- Electricity or fuel: the consumption is estimated in kW h or diesel per kg/ incinerator and their cost.
- Water consumption: the consumption per kg sterilized and the cost is estimated.

### 6.1.3. Final disposal cost

Depending on the technology selected, the waste could be ash (from incinerators) or sterile waste (from an autoclave). In both cases these wastes are considered general. For this calculation, the values were estimated from the publication **Situation Regarding Solid Waste Management in Latin America and the Caribbean** by the IDB, where it is estimated that the average cost for disposing of general or household waste is US\$0.05 per kg.

The formula detailed below is used to determine the average cost<sup>28</sup> per kg waste and to be able to compare the different technologies. Operation and final disposal costs, as well as waste production costs, are considered for a period of 10 years:

$$\text{Average cost} = \frac{\text{Investment Cost} \\ (\text{Equipment} + \text{Infrastructure.}) + \text{Operating} \\ \text{Cost} (\text{Personnel} + \text{Maintenance} + \text{Energy} \\ + \text{Transport} + \text{Disposal})}{\text{Waste production}}$$

<sup>28</sup> This is the basic analysis and, depending on the requirements, it can be made more complex, including social discount rates, reinvestments and other factors, if necessary.

There are options for the treatment or final disposal of HCW, which depend on legal regulations and the market supply of services. Some examples are:

- Sanitary cells for infectious waste: 1.35 US\$/kg (Ecuador).

- External collection and transport and treatment of infectious waste by incineration or autoclave:<sup>29</sup>
- » 0.45 US\$/kg (Mexico).

<sup>29</sup> Costs provided by the companies MEDAM Servicios, SA de CV, Biotratamiento México SA de CV, Planta incineradora de residuos bioinfecciosos, SA de CV, located in Mexico, and GADERE, a company located in Ecuador.

» 2.19 US\$/kg for infectious and 3.79 US\$/kg for anatomical (includes transport and treatment) (Ecuador).

Table 17 summarizes the final values in the comparative example for each treatment and disposal option.

According to this comparative example and the values used, the lowest cost is

the alternative of depositing the waste in sanitary cells, followed by the option of a separate autoclave and shredder and finally, the incinerator.

It is important to reiterate that these values are the result of a simulation exercise and that it is essential to carry out the simulations according to the reality of each country, region, or HCF.

**Table 17. Reference values depending on the type of waste treatment, 2021.**

	Autoclave with built-in shredder	Autoclave and separate shredder	Incinerator	Sanitary cells
Waste production				
Infectious: Kg/bed day	0.24	0.24	0.24	0.24
Sharps: Kg/bed day	0.11	0.11	0.11	0.11
Production 10 years: Kg	259,661	259,661	259,661	259,661
Kg day	71	71	71	71
1. Investment				
1.1 Equipment	125,000	105,000	490,540	
1.2 Infrastructure				
Surface area	60	70	100	
Cost per m <sup>2</sup>	1,500	1,500	1,500	
Infrastructure cost	90,000	105,000	150,000	
Subtotal investments	215,000	210,000	640,540	
2. Operation				
2.1 Personnel				
Number of annual contracts	1.40	1.40	1.40	
Annual cost per contract	6,000	6,000	6,000	

**Table 17. Reference values depending on the type of waste treatment, 2021. Continuation**

Subtotal personnel cost 10 years	84,000	84,000	84,000	
2.2 Maintenance				-
Cost per kg	0.10	0.10	0.25	
Subtotal maintenance cost 10 years	25,966	25,966	64,915	
2.3 Water and energy				-
Water consumption m3 per kg	0.27	0.27		
Water price x m3	1.75	1.75		
Water cost	122,235	122,235		
Electricity consumption per kW h/kg	2.69	0.38	0.03	
Electricity price kW h	0.04	0.04	0.04	
Electricity cost	27,940	3,916	270	
Diesel				
Consumption per L/kg			0.18	
Diesel price L			1.00	
Diesel cost 10 years			47,762	
Subtotal water and energy 10 years	150,175	126,151	48,032	
Final disposal	259,661	259,661	51,932	259,661
Cost per kg	0.05	0.05	1.35	1.35
Subtotal final disposal	14,190	14,190	51,932	350,542
Subtotal operation	274,332	250,308	248,880	350,542
<b>TOTAL COST INVESTMENT + OPERATION</b>	<b>489,332</b>	<b>460,308</b>	<b>889,420</b>	<b>350,542</b>
<b>4. Average cost USD/kg</b>	<b>1.88</b>	<b>1.77</b>	<b>3.43</b>	<b>1.35</b>



## 6.2 Economic evaluation of waste management options: single versus network solutions

There are two main option to treat and manage the clinical waste:

- **Single solution** where each HCF has its own HCW treatment and/or final disposal system. These systems can be managed by hospital staff or outsourced.
- **Network solution** where a set of HCFs in a territory share a common system to treat and dispose the clinical waste. Likewise, this type of service can be managed with personnel and equipment from the healthcare sector or be outsourced.

In this chapter we will provide guidelines to compare both options assuming the same number of HCF and waste volume, using the following criteria:

### 1. Network characterization:

Include all the facilities that are part of the network. For hospitals, the number of beds and complexity can be a source of information that can be used to estimate waste generation. Notwithstanding the fact that hospitals are the largest producers of waste, it is necessary to also include primary care and specialty outpatient HCFs that are part of the network.

### 2. Investment cost:

A. Equipment: for networked operation, equipment with a greater volume and processing capacity is considered.

i. Autoclave and shredder = US\$210,000.

ii. Incinerator (200m<sup>2</sup>) = US\$1,000,000.

B. Infrastructure: for networked operation, a surface area that matches the largest volume equipment is considered.

i. Autoclave and shredder = 150m<sup>2</sup>.

ii. Incinerator = 200m<sup>2</sup>

3. Cost of operation: Treatment for a network implies generating an organization for the collection, transfer, treatment, and final disposal of the waste, in addition to considering administration costs.

A. Personnel: in the networked model, it is necessary to add operational personnel and professional personnel for the technical and administrative management of the service. The cost of coordination is especially relevant for the networked model.

B. Energy and water: it is estimated that the networked model presents greater productive efficiency, with a reduction of between 50% and 70% in water and energy consumption, with respect to operation by an individual facility.

**C.** Maintenance: in the networked model, the maintenance cost can benefit thanks to a greater negotiation capacity, but the supporting information is not available.

**D.** External transport: the networked model includes costs generated by the transfer from the HCF to the HCW treatment center.

**E.** Final disposal: cost of fees; fees that must be paid to dispose of the HCW in a sanitary landfill authorized by the competent authority.

As in 6.1, the **average treatment cost** is calculated based on the formula described above for this economic evaluation.

Considerations for comparing options:

**i. Sizing.** For the individual model, waste production and investment and operating resources must be estimated for each HCF, while for the networked model, the size of a plant that is capable of processing the same volume of production must be dimensioned.

**ii. Continuity and quality of service.** A variable not included in the analysis and that can be considered if the economic analysis is similar for both options concerns the continuity and quality of the service. Continuity refers to the ability of equipment to stay operational over time, without failure. Quality implies the ability of the equipment to carry out the treatment appropriately, according to the standards established by local regulations.

**iii. Need for specialized and human resources.** HCW management is not a topic that is usually prioritized by a HCF, so there is a lack of specialized resources and professional staff in charge of management and timely maintenance, therefore, areas are often neglected and equipment is out of use.

Table 18 presents an example that compares infectious waste treatment options considering the options of autoclave and separate shredder and incinerator, in networked and individual facility strategies. For both technologies

(autoclave and incineration) the cost per kg. was lower for the network solution in comparison with the single solution. Additionally the autoclave technology was cheaper than the incineration.

## 6.3 Outsourcing

Regardless of whether the solution is individual or networked, these services can be **self-managed** (with staff, equipment and supplies from the HCF or the network) or **externally managed** (through the outsourcing of the services).

To make the decision, it is necessary to consider at least the following variables:

- **Private cost.** The monetary cost to the HCF or network for each of the options should be established. For example, whether it costs more to operate with in-house resources or to buy the services.
- **Quality of service.** The options that ensure continuity and quality of service should be analyzed. For example, the waste collection period.

- **Social cost.** The impact the outsourcing process will have on the cleaning staff and what professional growth options can be offered should be evaluated.

The purchase of services can be carried out individually, in a network or in a mixed way. To compare the options, it is recommended the expected scope of the service is precisely defined and existing prices or quotes compared:

- The scope of the service can include final storage in the facility, treatment (if necessary) and transfers to final disposal.
- In the individualized scheme, each HCF tenders its own contracts.
- The networked scheme involves a national or sub-national tender let by a network manager or a secretariat or ministry.
- The mixed scheme implies bidding in a framework agreement which the HCF can join or not, according to their interest and preference.

**Table 18. Estimated investment costs depending on the management model.**

	Network solution		Single solution	
	Autoclave and separate shredder	Incinerator	Autoclave and separate shredder	Incinerator
Waste production				
Infectious: Kg/bed day				
Sharps: Kg/bed day				
Production 10 years: Kg	2,596,610	2,596,610	2,596,610	2,596,610
Kg day	711	711		
1. Investment				
1.1 Equipment	210,000	1,000,000	1,050,000	4,905,400
1.2 Infrastructure				
Surface area	150	200	700	1,000
Cost m2	1,500	1,500	15,000	15,000
Infra cost	225,000	300,000	1,050,000	1,500,000
Subtotal investments	435,000	1,300,000	2,100,000	6,405,400
2. Operation				
2.1 Personnel				
Number of annual contracts	10	10		
Annual cost per contract	6.000	6.000		
Subtotal personnel cost 10 years	600.000	600.000	840.000	840.000
2.2 Maintenance				
Cost per kg	0,10	0,25	0,10	0,25
Subtotal maintenance cost 10 years	259.661	649.153	259.661	649.153
2.3 Water and energy				
Water consumption m3 per kg	0,13		0,27	
Water price x m3	1,75		1,75	
Water cost	611.177		1.222.354	

**Table 18. Estimated investment costs depending on the management model. Continuation.**

Electricity consumption per kW h/kg	2,69	0,03	2,69	0,03
Electricity price kW h	0,04	0,04	0,04	0,04
Electricity cost	279.395	2.700	279.395	270,05
Diesel			-	-
Consumption per L/kg		0,09	-	0,18
Diesel price L		1,00		1,00
Diesel cost 10 years		238.811	-	47.762,21
Subtotal water and energy 10 years	890.572	241.512	1.501.749	48.032
Final disposal kg	2.596.610	519.322	2.596.610	519.322
Cost per kg	0,05	1,35	0,05	1,35
3. Subtotal final disposal	141.905	519.322	141.905	519.322
Subtotal operation	1.892.138	2.009.986	2.503.077	2.488.797
TOTAL COST INVESTMENT + OPERATION	2.327.138	3.309.986	4.603.077	8.894.197
<b>4. Average cost USD/kg</b>	<b>0,90</b>	<b>1,27</b>	<b>1,77</b>	<b>3,43</b>

## 7. Conclusions

Managing healthcare waste (HCW) is a complex issue that involves a series of variables (technical, administrative, regulatory, financial) and actors (managers, administrators, specialized personnel). All of this largely depends on the complexity of the HCF, the context in which it is located, the technology and services available, as well as the specific regulations in each country.

This guide tries to condense these factors and order them in such a way that the user can have a global vision of the process and be able to evaluate by their own means the particular situation relating to their project, to establish the necessary plans for the effective management of their HCW. It is hoped that, in this way, the efficient functioning of the HCF will be ensured and the impact on the environment and people will be minimized.

Having cleaner hospitals is everyone's goal, so these guidelines are instruments to continue improving the performance of the healthcare networks in the region.



## Appendix 1: Denomination of waste types by country

No.	Country	Waste classification according to WHO							
		General		Infectious biological			Hazardous		
		Residential	Infectious	Pathological	Sharps	Pharmaceutical	Genotoxic / cytotoxic	Chemical	Radioactive
1	Argentina	General waste	Bio-pathological	Bio-pathological		Chemical		Chemical	Radioactive
2	Bahamas	Household / garbage / commercial	Medical waste	Medical waste	Medical waste				
3	Barbados	No specific legal instrument for waste classification							
4	Belize	Organic waste	Red waste	Pathological and infectious waste / yellow waste	Sharps	Chemical or hazardous waste		Chemical or hazardous waste	
5	Bolivia	Class C general waste	Infectious waste subclass A-1 Biological / Infectious waste subclass A-5 Carcasses or parts of contaminated animals / Infectious waste subclass A-6 Care for isolation patients	Infectious waste subclass A-2 blood, blood products and body fluids / Infectious waste subclass A-3 surgical, anatomical, pathological	Infectious waste Class A-4 Sharps	Special waste B-2 Pharmaceutical waste		Special waste B-3 Hazardous chemical waste	Special waste B-1 Radioactive waste
6	Brazil	Group D Household waste	Subgroup A4 Wastes with the presence of biological agents that pose a risk of infection	Subgroup A1, Subgroup A2, Subgroup A3 and Subgroup A5	Group E cutting or scarifying waste	Group B wastes containing chemical products		Group B wastes containing chemical products	Group C radioactive waste
7	Chile	Solid waste comparable to household	Cultures and stored samples.	Pathological special waste / Animal waste / blood and derived products	Sharps special waste		Hazardous waste Waste consisting of or contaminated by cytotoxic drugs		Low intensity radioactive waste

8	Colombia	Non-hazardous waste	Infectious waste or with biological-biosanitary risk	Infectious waste or with biohazard-anatomopathological risk / animal	Infectious waste or with biohazard-sharps risk	Chemical-drug wastes, partially consumed, expired, deteriorated, altered and/or surplus	Chemical-cytotoxic waste	Chemical waste	Radioactive waste
9	Costa Rica		Cultures and stored strains of infectious agents / Contaminated waste from patient care and laboratories	Blood and its derivatives / Pathological waste	Contaminated and uncontaminated sharps				
10	Ecuador	General waste	Healthcare-biological-infectious waste	Healthcare-anatomopathological waste	Sharps-healthcare waste	Pharmaceutical waste		Hazardous chemical waste	Radioactive waste
11	El Salvador		Infectious	Pathological	Biohazardous Sharps				
12	Guatemala	General waste	Infectious waste-biological materials	Infectious waste-anatomical, pathological and surgical waste / animal waste	Infectious waste-sharps waste	Special waste-pharmaceutical waste	Special waste-hazardous chemical waste	Special waste-hazardous chemical waste	Radioactive waste
13	Guyana		Clinical waste	Clinical waste	Clinical waste				
14	Haiti	No legal instrument							
15	Honduras	General	Hazardous-biohazardous-infectious	Hazardous-biohazardous-pathological	Hazardous-biohazardous-sharps		Hazardous-chemical-cytotoxic / genotoxic	Hazardous-chemical	Hazardous-radioactive
16	Jamaica	No legal instrument							
17	Mexico		Cultures and strains of biological-infectious agents / non-anatomical waste	Blood / pathological	Sharp objects				

18	Nicaragua		Infectious biological hazardous waste	Pathological waste				Hazardous waste	
19	Panama	General waste	Infectious waste	pathological waste	Sharp objects		Chemical waste	Chemical waste	Radioactive waste
20	Paraguay	Type I General waste	Type IV Non-anatomical	Type II Anatomical waste	Type III Sharps	Type V Chemical, drug and other hazardous waste		Type V Chemical, drug and other hazardous waste	
21	Peru	Class C General waste	Type A.1 Patient care / Type A.2 Biological / Type A.3 Bags with human blood and blood products	Type A.4 Surgical and pathological waste / Type A.6 Contaminated animals	Type A.5 Sharps	Type B.2 Pharmaceutical waste		Type B.1 Hazardous chemical waste	Type B.3 Radioactive waste
22	Dominican Republic	General waste	Infectious waste	Infectious waste	Infectious waste	Special waste	Special waste	Special waste	Radioactive waste
23	Surinam	No legal instrument							
24	Trinidad and Tobago	No specific legal instrument for waste classification							
25	Uruguay	General healthcare waste	Infectious-biological materials	Infectious - anatomical, pathological and surgical parts / animal parts	Sharps or cutters	Specials-chemicals and pharmaceuticals	Specials-oncological medication	Specials-chemicals and pharmaceuticals	Special-radioactive
26	Venezuela	General waste (type A)	Infectious waste (type C)	Organic or biological waste (type D)		Special waste (type E)		Special waste (type E)	Special waste (type E)

## Appendix 2: Health regulations on waste in healthcare facilities by country

No.	Country	Legal instrument	Issuing unit	Unit that applies and/or regulates	Publication date	Last reform
1	Argentina	MSN Resolution 134/2016 National Guidelines for the Management of Waste from Healthcare Facilities	Ministry of Health	Ministry of Health	February 26, 2016	Not indicated
2	Bahamas	Regulations on the Collection and Disposal of Waste from Environmental Healthcare Services	Ministry of Health	Department of Environmental Health Services	April 1, 2004	July 1, 2013
3	Barbados	Health Services (Waste Collection and Disposal) Regulations, 1975	Barbados Ministry of Health	Barbados Ministry of Health	September 1, 1975	1999
4	Belize	Hazardous Waste Act	Belize Ministry of Natural Resources and Environment	Belize Ministry of Natural Resources and Environment	July 27, 2009	Not indicated
		National Guidelines on Infection Prevention and Control for Healthcare Facilities	Ministry of Health	Ministry of Health Licensing and Accreditation Unit	August 2006	Not indicated
5	Bolivia	Regulation for the management of solid waste generated in healthcare facilities; Ministerial Resolution 1144	Ministry of Health and Sports	Ministry of Health	November 13, 2009	Not indicated
6	Brazil	Decree 222; Regulation of good healthcare waste management practices and other measures to be taken	Ministry of Health	National Health Surveillance Agency	March 29, 2018	Not indicated

7	<b>Chile</b>	<b>Decree 6; Regulation on management of healthcare facility waste (HCFW)</b>	Chilean Ministry of Health	Chilean Ministry of Health	December 4, 2009	March 10, 2017
8	<b>Colombia</b>	<b>Decree 2676; Regulating the comprehensive management of hospital and similar waste</b>	Ministry of Health, Colombia	Ministry of the Environment, Colombia	December 22, 2000	Decree 1669 of August 2, 2002
9	<b>Costa Rica</b>	<b>Executive Decree 30965; Regulation on the management of the infectious-contagious waste generated in healthcare and related facilities</b>	Ministry of Health, Costa Rica	Ministry of Health, through the Human Environment Protection Directorate	February 3, 2003	Not indicated
10	<b>Ecuador</b>	<b>Ministerial Agreement 323; Regulation on management of waste generated in healthcare facilities</b>	Ministry of Public Health, Ecuador	Ministry of the Environment, Ecuador	March 20, 2019	Not indicated
11	<b>El Salvador</b>	<b>Agreement 1251; Salvadoran technical regulations for the management of biohazardous waste</b>	Ministry of Health	Ministry of Health	September 7, 2015	Not indicated
13	<b>Guatemala</b>	<b>Governmental Agreement 509-2001; Regulation for the management of solid hospital waste</b>	Ministry of Public Health and Social Assistance, Guatemala	Ministry of Public Health and Social Assistance, Guatemala	December 28, 2001	Not indicated
12	<b>Guyana</b>	<b>Hazardous Waste Management Regulations</b>	Guyana Environmental Protection Agency	Guyana Environmental Protection Agency	November 28, 2000	Not indicated
14	<b>Haiti</b>	<b>Organization and operation of the national solid waste management service (SPERS)</b>	Ministry of the Environment	SNERS	September 21, 2017	Not indicated
15	<b>Honduras</b>	<b>Agreement 07; Regulations for the management of the hazardous waste generated in health facilities</b>	Secretary of State in the Office of Health	Directorate General for Health Regulation	July 2008	Not indicated

16	<b>Jamaica</b>	<b>National Solid Waste Management Act</b>	Be promulgated by Her Excellency the Queen, by and with the advice and consent of the Senate and House of Representatives of Jamaica, and by the authority thereof		20 de diciembre de 2001	No Indica
17	<b>Mexico</b>	<b>Official Mexican Standard Nom-087-Semarnat-SSA1-2002, environmental protection- environmental health- hazardous biological-infectious waste-classification and management specifications</b>	Ministry of Environment and Natural Resources	Ministry of Health	February 17, 2003	Not indicated
18	<b>Nicaragua</b>	<b>NTON 05 015-02; Technical standard for the management and disposal of hazardous solid waste; certification</b>	Ministry of the Environment and Natural Resources	Ministry of Health and Nicaraguan Institute for Municipal Development	November 5, 2002	Not indicated
19	<b>Panama</b>	<b>Executive Decree 111; Regulation for the management and handling of solid waste from healthcare facilities</b>	Ministry of Health	Ministry of Health	June 23, 1999	Not indicated
		<b>Resolution 560; Regulating the hazardous waste and/or solid waste treatment systems from public and private healthcare facilities nationwide</b>	Ministry of Health	Ministry of Health	June 19, 2017	Not indicated
20	<b>Paraguay</b>	<b>Law 3361/07; Regulating the comprehensive management of the waste generated in healthcare and related facilities, which come from human and animal healthcare</b>	Ministry of Public Health and Social Welfare	Ministry of Public Health and Social Welfare	November 21, 2007	Not indicated

21	<b>Peru</b>	<b>Ministerial Resolution 1295-2018-MINSA Technical Health Standard: integral management and solid waste management in healthcare facilities, medical support services and research centers</b>	Ministry of Health	General Directorate of Environmental Health and Food Safety	December 11, 2018	Not indicated
22	<b>Dominican Republic</b>	<b>Decree 126-09; Regulation on the waste and residues generated by healthcare centers and related facilities</b>	National Health System	Secretary of State for Public Health and Social Assistance	February 18, 2015	Not indicated
23	<b>Surinam</b>	<b>Environment Act</b>	National Environmental Authority	National Environmental Authority	May 7, 2020	
24	<b>Trinidad and Tobago</b>	<b>Environment Act</b>	Environmental Management Authority	Ministry of Health	August 24, 1973	December 31, 2016
	<b>Trinidad and Tobago</b>	<b>Waste management standard</b>	Environmental Management Authority	Environmental Management Authority	2018	Not indicated
25	<b>Uruguay</b>	<b>Decree 586/009; Regulation on healthcare waste</b>	Ministry of Public Health, Uruguay	Ministry of Housing National Directorate of Environment	January 5, 2010	Not indicated
26	<b>Venezuela</b>	<b>Decree 2,218, through which the standards for the classification and management of waste in healthcare facilities are issued</b>	Ministry of Health and Social Development	Ministry of Health and Social Development	April 27, 1992	Not indicated

Note: The content of this appendix refers to current data as of June 2020.

## Appendix 3: Form for the evaluation of projects in operation

### General information

Country: \_\_\_\_\_

City: \_\_\_\_\_

Location: \_\_\_\_\_

HCF name: \_\_\_\_\_

Name of the person filling out the form: \_\_\_\_\_

Indicate with an "X" the level of care the HCF has or the project will have:

First level: ( )

Second level: ( )

Third level: ( )

*A facility is considered first level when it has no beds or has a maximum of three beds for the care of feverish patients, but only for a 24-hour stay; second level, when it has basic inpatient services, medical clinic, pediatrics, general surgery, wards and maternity with laboratory service and basic diagnostics; third level, when it has inpatient wards, surgery, medical clinic, specific surgical specialties, infrastructure for laboratory and complex diagnostics, intensive care units and coronary units.*

Indicate type of specialty care (if applicable):  
\_\_\_\_\_  
\_\_\_\_\_

Indicate with an "X" the type of zoning where the project will be located:

Urban: ( )

Rural: ( )

## Form for the evaluation of projects in operation

**Note:** In all cases the answer NO is equal to zero. The **blue marks** indicate the answers where only **one option** will be scored.

Block	Question	Score	Description	Outcome
<b>Legal aspects</b>	Is there specific national regulation relating to HCW?	1	There is a specific national regulation for HCW and the HCF staff knows and applies it.	
<b>Subtotal legal aspects</b>				
<b>Administrative aspects</b>	Is there a HCW management plan in place within the HCF?	1	There is a document designated as a management plan that details the HCW management on the premises.	
	Are there personnel responsible for executing the HCW management plan?	1	There is a responsible person with the authority to execute the plan.	
	Is there a solid waste management training program? Care staff or cleaning staff or administrative staff.	1	There is a training program or evidence of training for doctors, nurses, laboratory workers, cleaning personnel, waste management and administrative personnel. (The score is obtained if a program is in place for at least one or all three training programs.)	
	Is there an induction program aimed at patients and/or relatives of patients?	1	There is a training program or evidence of training for patients or family members of patients. (The score is obtained if a program is available in at least one of the two cases.)	
	Do the personnel who handle the waste have PPE and use it?	1	HCF staff have PPE and use it.	
	Is there a log or record of the amount and type of HCW?	1	There is a current log or register where the waste generation data is recorded.	
	<b>Subtotal administrative aspects</b>			
<b>Financial aspects</b>	Is there funding for the induction and information of patients, relatives and staff on the management of HCW?	1	Funding is available to raise awareness, inform and promote the correct management of HCW in the HCF.	
	Is there funding for training the personnel involved in HCW management?	1	Funding is available to train the personnel in charge of managing the HCW. (In the case of internal management of the HCW.).	
	Is there funding for hiring personnel in charge of the different stages of HCW management, or contracting external companies to take charge of this process?	1	Financing is available for hiring personnel specialized in HCW management or for contracting external companies to take charge of this management.	
	Is there funding for personal protective equipment?	1	There is regular financing for the purchase of PPE.	

Block	Question	Score	Description	Outcome
Financial aspects	Is there financing available for the purchase and maintenance of HCW storage and collection equipment and supplies?	1	Financing is available for the purchase of equipment and supplies for storage, collection and internal transportation of HCW (containers, trolleys, bags, cleaning materials, etc.).	
	Is there the necessary financing for the operation and maintenance of HCW treatment equipment or financing for outsourcing these tasks?	1	Financing is available for the operation and maintenance of the HCW treatment equipment (incinerators, autoclaves, etc.) in the event that the treatment is carried out internally. Or, failing that, there is a financing plan for outsourcing this task.	
	Is there financing to pay for collection companies and external transportation of HCW?	1	Financing plans are in place for external companies in charge of collecting and transporting HCW to their external treatment or final disposal sites.	
	Is there financing available for contracting external companies that are responsible for the collection, treatment and disposal of hazardous waste?	1	Financing is available for the management of hazardous waste (chemical, radioactive, cytotoxic, etc.) through external companies	
	Is there financing available for the payment of fees and taxes for the final disposition of the HCW?	1	There is a financing plan for any fees and payments required for the disposal of HCW in sanitary landfills.	
<b>Subtotal financial aspects</b>				
Technical aspects (separation at source)	Are there at least three containers in all areas (general waste, infectious waste, sharps waste)?	1	There are at least three containers in all areas (general waste, infectious waste, sharps waste).	
	Are bags of different colors used to deposit general and infectious waste?	1	Different colored bags are used to deposit general and infectious waste.	
	Are there sharps waste containers with a mechanism to separate the needles from the syringe?	1	Sharps waste containers are available where needles are separated from syringes.	
	Does separation at source occur in the medical care and special services areas?	1	Separation is performed at source in the medical care and special services areas.	
	Are audits performed to verify that the waste is properly segregated and not mixed?	1	Audits are performed to verify that the waste is properly segregated and not mix.	

Block	Question	Score	Description	Outcome
<b>Subtotal separation at source</b>				
<b>Technical aspects (internal collection)</b>	Is there a predetermined HCW collection route?  Are there collection carts with a lid, with differentiated spaces, or separate trolleys for general and infectious waste, including sharps and anatomical waste?	1  1	There is a predetermined HCW collection route.  There are collection carts with a lid, with differentiated spaces, or separate trolleys for general and infectious waste, including sharps and anatomical waste.	
<b>Subtotal internal collection</b>				
<b>Technical aspects (final storage)</b>	Does the store have a minimum capacity, twice the volume of the average waste generated on a daily basis?	0.125	There is a minimum capacity, twice the volume of the average waste generated on a daily basis.	
	Is it covered?	0.125	The final storage is covered.	
	Does the store have a ramp for easy access to the internal collection carts?	0.125	There is a ramp for easy access of the internal collection carts to the final storage.	
	Does the store have fire extinguishers (at least one)?	0.125	There are fire extinguishers (at least one) in the final storage area.	
	Does the store have an identification notice and sign with the universal biohazard symbol?	0.125	There is an identification notice in the store and sign with the universal biohazard symbol.	
	Does the store have smooth walls and floors, easy to wash and disinfect?	0.125	The store has smooth walls and floors, easy to wash and disinfect.	
	Does the store have channels to collect and retain liquids inside (prior treatment system)?	0.125	There is a liquid retention collector inside the store (prior treatment system).	
	Is it permanently locked, and is it only opened to deposit and remove waste?	0.125	The store remains permanently locked and is only opened to deposit and remove waste. It has a door and a lock.	
	Is there a log to record the dates waste is removed from the final storage area?	1	There is a log to record the dates waste is removed from the final storage area.	
	Is there a refrigerator or freezer for anatomical waste?	1	It has a refrigerator or freezer for anatomical waste.	
	Is the refrigerator or freezer operational?	1	The refrigerator or freezer is operational.	
	Does the HCF have a general waste storage facility?	1	There is a general waste store in the HCF.	

Block	Question	Score	Description	Outcome
Technical aspects (final storage)	Is the general waste store a fenced room or area and does it have containers?	1	The general waste room or area is fenced and has containers.	
	Is the general waste store a metal or plastic container with wheels and a lid?	1	The general waste store is a metal or plastic container with wheels and a lid and is inside the HCF.	
	Is there a final hazardous waste storage area?	1	There is a final storage area for hazardous waste.	
<b>Subtotal final storage</b>				
Technical aspects (external collection)	Is the external collection service carried out by the HCF itself?	1	The external collection service is performed by the HCF itself.	
	Is the external collection service operated by a national or municipal government entity?	1	The external collection service is operated by a national or municipal government entity.	
	Is the external collection service contracted by a private company?	1	The external collection service is contracted by a private company.	
	Do the external collection vehicles for infectious waste have a closed box?	0.33	Infectious waste external collection vehicles with closed boxes are used.	
	Do the external collection vehicles for infectious waste have refrigeration?	0.33	Infectious waste external collection vehicles with refrigeration are used.	
	Do the external infectious waste collection vehicles have a mechanical loading ramp?	0.33	Infectious waste external collection vehicles are used that have a mechanical loading ramp.	
<b>Subtotal external collection</b>				
Technical aspects (treatment)	Is the <b>internal</b> treatment of infectious and sharps waste carried out by autoclave, incinerator or other system?	1	The internal treatment of infectious and sharps waste is carried out by autoclave, incinerator or other system.	
	Is the internal treatment or final disposal of anatomical waste carried out by incineration or burial?	1	The internal treatment or final disposal of anatomical waste is carried out by incineration or burial.	
	Is there an operation log for the treatment equipment?	1	An operation log is kept for the treatment equipment.	
	Is there a maintenance program for the treatment equipment?	1	There is a maintenance program for the treatment equipment.	
	Is <b>external</b> treatment of infectious, anatomical and sharps waste performed by autoclave, incinerator or other system?	1	External treatment of infectious, anatomical and sharps waste is performed by autoclave, incinerator or other mechanism, either in a public or private treatment center.	

Block	Question	Score	Description	Outcome
<b>Subtotal treatment</b>				
<b>Technical aspects (final disposal)</b>	Is the final disposal of infectious, anatomical and sharps waste carried out untreated in a special cell at a sanitary landfill according to country regulations?	1	The final disposal of infectious, anatomical and sharps waste is carried out in a sanitary landfill that complies with the country's regulations (or good practices) and is allowed to receive infectious, anatomical and sharps waste without prior treatment in specially designated cells.	
	Is the final disposal of infectious, anatomical and sharps waste treated and taken to landfill?	1	The infectious, anatomical and sharps waste is treated prior to disposal in a landfill.	
	If the infectious, anatomical and sharps waste is not treated, is the waste buried or disposed of in a protected pit as a method of final disposal?	1	The infectious, anatomical and sharps waste is buried or disposed of in a protected pit, without prior treatment, as long as this practice is accepted and regulated by the country's environmental regulations.	
	Is the infectious, anatomical and sharps waste burned in a protected pit as a method of final disposal?	0	The infectious, anatomical and sharps waste is burned in a protected pit as a method of final disposal. If the answer is affirmative, the score is zero	
	Is the final disposal of infectious, anatomical and sharps waste for it to be dumped in the open without treatment?	0	Infectious, anatomical and sharps waste is dumped or discharged in the open without treatment, as a final disposal method. If the answer is affirmative, the score is zero	
	Is the final disposal of infectious, anatomical and sharps waste for it to be burned in the open?	0	Infectious, anatomical and sharps waste is burned in the open air, as a final disposal method. If the answer is affirmative, the score is zero.	
	Is the infectious, anatomical and sharps waste left untreated and is the waste mixed with general waste as a final disposal method?	0	The infectious, anatomical and sharps waste is mixed with general waste without prior treatment and without authorization for such activity. If the answer is affirmative, the score is zero.	
	Does the final disposal of anatomical waste involve burial in a cemetery?	1	Burial in cemeteries is performed for anatomical waste as a method of final disposal. This practice is accepted and regulated by national regulations.	
<b>Subtotal final disposal</b>				
<b>TOTAL</b>				

# Appendix 4: Form for the evaluation of new projects

## General information

Country: \_\_\_\_\_

City: \_\_\_\_\_

Location: \_\_\_\_\_

HCF name: \_\_\_\_\_

Name of the person filling out the form: \_\_\_\_\_

Role of the person filling out the form: \_\_\_\_\_

Indicate with an "X" the level of care the HCF has or the project will have:

First level:

Second level:

Third level:

*A facility is considered first level when it has no beds or has a maximum of three beds for the care of feverish patients, but only for a 24-hour stay; second level, when it has basic inpatient services, medical clinic, pediatrics, general surgery, wards and maternity with laboratory service and basic diagnostics; third level, when it has inpatient wards, surgery, medical clinic, specific surgical specialties, infrastructure for laboratory and complex diagnostics, intensive care units and coronary units.*

Indicate type of care specialties (if applicable):  
\_\_\_\_\_  
\_\_\_\_\_

Indicate with an "X" the type of zoning where the project will be located:

Urban:

Rural:

## Evaluation table for new projects

Note: In all cases the answer NO is equal to zero. The boxes highlighted in **blue** indicate those answers where only **one option** will be scored.

Block	Question	Score	Description	Outcome
<b>Legal aspects</b>	Is there specific national regulation relating to HCW?	1	There is specific national regulation relating to HCW.	
<b>Subtotal legal aspects</b>				
<b>Administrative aspects</b>	Is there a HCW management plan in place within the HCF?	1	There is a document designated as a management plan.	
	Does the management plan consider the personnel responsible for executing the HCW management plan?	1	The plan includes a responsible person with the authority to execute the plan.	
	Does the management plan include a solid waste management training program? Care staff or cleaning staff or administrative staff.	1	There is a training program or evidence of training for doctors, nurses, laboratory workers, cleaning personnel, waste management and administrative personnel. (The score is obtained if at least one of the three types of training is performed)	
	Will there be an induction program aimed at patients and/or relatives of patients?	1	There will be a training program or evidence of training for patients or relatives of patients. (The score is obtained if there is one or both programs.)	
	Will the personnel handling the waste have PPE and use it?	1	HCF staff will have PPE.	
	Will there be a log or a record of the amount and type of HCW?	1	There will be a current log or register in which the waste generation data are recorded.	
	<b>Subtotal administrative aspects</b>			
<b>Financial aspects</b>	There is a financing plan for the induction and information of patients, relatives and staff on HCW management.	1	There is a financing plan to raise awareness, inform and promote the correct management of HCW in the HCF.	
	Is there a financing plan for training the personnel that participate in HCW management?	1	There is a financing plan in place to train the personnel in charge of managing HCW. (In the case of internal management of the HCW.)	
	Is there a financing plan for hiring personnel in charge of the different stages of HCW management, or for contracting external companies to take charge of this process?	1	There is a financing plan for hiring personnel specialized in HCW management or for contracting external companies to take charge of this management.	
	Is there a financing plan for PPE?	1	There is a plan for the regular financing of the purchase of PPE.	

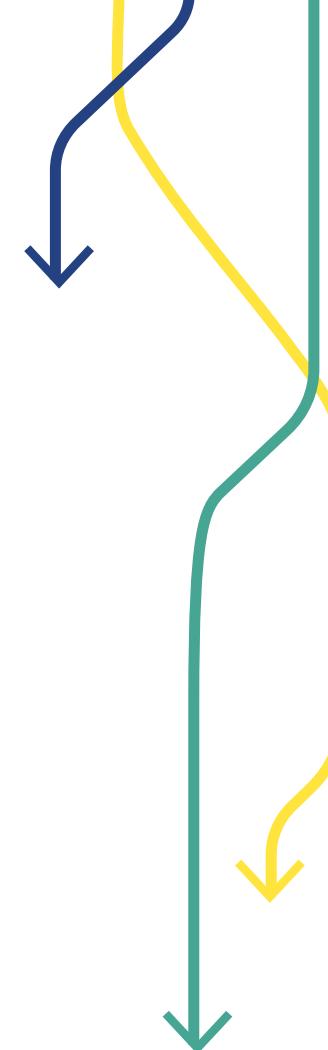
Block	Question	Score	Description	Outcome
Financial aspects	Is there a financing plan for HCW storage and collection equipment?	1	There is a financing plan for the purchase of equipment and supplies for HCW storage, collection and internal transport (containers, trolleys, bags, cleaning materials, etc.).	
	Is there a financing plan for HCW treatment equipment or financing to outsource these tasks?	1	There is a financing plan for the purchase of HCW treatment equipment (incinerators, autoclaves, etc.) in the event that the treatment is carried out internally. Or, failing that, there is a financing plan for outsourcing this task.	
	Are there financing plans for external HCW collection and transport companies?	1	Financing plans are in place for external companies in charge of collecting and transporting HCW to their external treatment or final disposal sites.	
	Is there a financing plan for contracting external companies that are responsible for the collection, treatment and disposal of hazardous waste?	1	There is a financing plan for the management of hazardous waste (chemical, radioactive, cytotoxic, etc.) through external companies specialized in this matter.	
	Is there a financing plan for the payment of fees and taxes for the final deposit of HCW?	1	There is a financing plan for any fees and payments required for the disposal of HCW in landfills.	
<b>Subtotal financial aspects</b>				
Technical aspects (separation at source)	Will the HCF have at least three containers in all areas (general waste, infectious waste, sharps waste)?	1	The management plan includes the three containers as a minimum in all the areas where they originate (general waste, infectious waste, sharps waste).	
	Will the HCF use different colored bags to deposit general and infectious waste?	1	The management plan includes the use of different colored bags to deposit general and infectious waste.	
	Will the HCF perform separation at source in the medical care and special services areas?	1	The management plan includes separation at source in the medical care and special services areas.	
	Will the HCF carry out audits to verify that the waste is properly segregated and not mixed?	1	The management plan includes undertaking audits to verify that the waste is properly segregated and not mixed.	
	Will the HCF have sharps waste containers that have a mechanism to separate the needles from the syringe?	1	The management plan includes sharps waste containers where the needles are separated from the syringes.	
<b>Subtotal technical aspects (separation at source)</b>				
Technical aspects (internal collection)	Will the HCF have a predetermined HCW collection path?	1	The HCF will establish a predetermined HCW collection route in its plans.	
	Will the HCF have lidded collection carts with differentiated spaces or separate carts for general and infectious waste including sharps and anatomical waste?	1	The management plan includes carts with a collection lid with differentiated spaces or separate carts for general and infectious waste, including sharps and anatomical wastes.	

Block	Question	Score	Description	Outcome
<b>Subtotal technical aspects (internal collection)</b>				
Technical aspects (final storage)	Will the HCF have a final storage area for HCW that meets a minimum capacity of twice the average volume of waste generated on a daily basis?	0.125	There will be a final storage area for HCW that meets a minimum capacity that is twice the average volume of waste generated on a daily basis.	
	Will the HCF have a covered final HCW store?	0.125	The final storage area for HCW will be covered.	
	Will the HCF have a final HCW store that has a ramp for easy access for the internal collection carts?	0.125	There will be a ramp for easy access for the internal collection carts to the final HCW store	
	Will the HCF have a final HCW store that has fire extinguishers (at least one)?	0.125	The HCF will have fire extinguishers (at least one) in the final HCW store	
	Will the HCF have a final HCW store that has an identification notice and sign with the universal biohazard symbol?	0.125	There will be a notice identifying the store and signage with the universal biohazard symbol.	
	Will the HCF have a final HCW store that has smooth walls and floors that are easy to wash and disinfect?	0.125	There will be smooth walls and floors that are easy to wash and disinfect.	
	Will the HCF have a final HCW store that has channels to collect and retain liquids inside the storage area (prior treatment system)?	0.125	There will be a liquid retention collector inside the store (prior treatment system).	
	Will the storage have a lockable door that prevents strangers from entering the place?	0.125	There will be a door with a lock that prevents strangers entering the place.	
	Will the HCF have a refrigerator or freezer for anatomical waste?	1	There will be a refrigerator or freezer for anatomical waste.	
	Will the HCF have a log to record the dates the waste is removed from the final storage?	1	The management plan includes the implementation of a log to control the entry and exit of waste from the final store.	
	Will the HCF have a space for washing and storing carts and HCW collection containers?	1	The management plan includes a space for washing and storing carts and HCW collection containers.	
	Will the HCF have a general waste store separate from biological and hazardous waste storage?	1	There will be a general waste store separate from the biological and hazardous waste storage (but within the same final storage structure).	
	Will the general waste store be a fenced room or area and will it have containers?	1	The general waste room or area will be fenced off and will have containers.	
	Will the general waste store be a metal or plastic container with wheels and a lid?	1	The general waste store will be a metal or plastic container with wheels and a lid.	
	Will there be a final store for hazardous waste?	1	There will be a final hazardous waste store separate from the infectious waste store and the general waste store.	

Block	Question	Score	Description	Outcome
<b>Subtotal technical aspects (final storage)</b>				
Technical aspects (external collection)	Will the external collection service be performed by the HCF itself?	1	The external collection service will be performed by the HCF itself.	
	Will the external collection service be operated by a public entity?	1	The external collection service will be operated by a public entity.	
	Will the external collection service be contracted with a private company?	1	The external collection service will be contracted with a private company.	
	Will the external collection vehicles for infectious waste have a closed box?	0.33	External infectious waste collection vehicles with closed boxes will be used.	
	Will the external collection vehicles for infectious waste have refrigeration?	0.33	External infectious waste collection vehicles with refrigeration will be used.	
	The external collection vehicles for infectious waste will have a mechanical loading ramp.	0.33	External infectious waste collection vehicles that have a mechanical loading ramp will be used.	
<b>Subtotal technical aspects (external collection)</b>				
Technical aspects (treatment)	Will the <b>internal</b> treatment of infectious and sharps waste be performed by autoclave, incinerator or other system?	1	The internal treatment of infectious and sharps waste will be performed by means of an autoclave, incinerator or other system.	
	Will the <b>internal</b> treatment of anatomical waste be performed by incineration or burial?	1	The internal treatment of anatomical waste will be performed by incineration or burial in accordance with the country's regulations.	
	Will there be an operations log for the treatment equipment?	1	The management plan includes the incorporation of a treatment equipment operations log.	
	Is a maintenance program foreseen for the treatment equipment?	1	The management plan includes the incorporation of a maintenance program for the treatment equipment.	
	Will the <b>external</b> treatment of infectious, anatomical and sharps waste be performed by autoclave, incinerator or another system? (specify)?	1	External treatment will be performed on infectious, anatomical and sharps waste by autoclave, incinerator or other system.	
<b>Subtotal technical aspects (treatment)</b>				
Technical aspects (final disposal)	Will the final disposal of infectious, anatomical and sharps waste be performed untreated at a sanitary landfill according to country regulations?	1	The final disposal of infectious, anatomical and sharps waste will be performed in a landfill that complies with the country's regulations, and allows infectious, anatomical and sharps waste to be received without prior treatment.	
	Will the infectious, anatomical and sharps waste be treated and taken to landfill as a method of final disposal?	1	The infectious, anatomical and sharps waste be treated prior to disposal in a landfill.	
	Will the infectious, anatomical and sharps waste be buried or disposed of untreated in a protected pit as a method of final disposal?	1	The infectious, anatomical and sharps waste will be buried or disposed of in a protected pit without being previously treated. This option must be supported by current national regulations.	
	Will the final disposal of anatomical waste include burial in a cemetery?	1	The anatomical waste will be buried in cemeteries as a method of final disposal. This option must be supported by current national regulations.	
<b>Subtotal technical aspects (final disposal)</b>				
<b>TOTAL</b>				

**Results categorization table for new and operating project forms**

Compliance Category	Score	Category description
Non-compliant	0-15	The HCF does not meet or insufficiently meets the minimum requirements, whether legal, administrative and technical, for proper management of its HCW. It requires greater investment and the implementation of an appropriate management plan. In the case of a new project, this means the design must review aspects that are not being addressed.
Poor compliance	15-30	The HCF complies with a minimum of the legal, administrative and technical requirements for the management of its HCW; however, its management system and infrastructure need improvement. In the case of a new project, this means the design must improve aspects that are being insufficiently addressed.
Good compliance	30-38	The HCF has good management control over its HCW, has infrastructure, human resources and its management system is properly implemented. In the case of a new project, it is considered that, in general terms, the planned design and management aspects are being incorporated to a sufficient extent.



## Appendix 5: Impacts and risks relating to waste management in health facilities

Aspects or stages	Condition	Impact and risk	Socio-environmental impacts
Waste collection at the source of generation	Sharps containers not properly closed when delivered.	Cleaning workers can be cut when collecting the waste.	Health risks for the internal population in the HCF and neighbors due to exposure to HCW.
	The bags or containers are of poor quality and break.	Risk to cleaning workers who will be directly exposed to the waste when cleaning a spill up. Risk for healthcare personnel and patients due to waste scattered on the floor.	Health risks for the internal population in the HCF and neighbors due to exposure to HCW.
	Mixed waste is delivered to the areas.	Mixed waste is a risk for people involved in the internal and external management of the HCW.	Health risks for the internal population in the HCF and neighbors due to exposure to HCW. Risk of visual contamination due to the mishandling, mistreatment and/or inadequate final disposal of the HCW.
The internal transport of the wastes in the areas	Poor condition of the collection trolleys or poor placement of the bags on the trolleys (overload).	The workers have to clean up the waste if it falls due to the poor condition of the carts. Exposure of people in passageways if bags drop or fall open.	Health risks for the internal population in the HCF and neighbors due to exposure to HCW. Risk of visual contamination due to the mishandling, mistreatment and/or inadequate final disposal of the HCW.
	Carts are not adequately washed.	Risk of contamination for cleaning workers as the carts will be dirty. Risk for patients, healthcare personnel and families due to the passage of dirty carts.	Health risks for the internal population in the HCF and neighbors due to exposure to HCW. Risk of visual contamination due to the mishandling, mistreatment and/or inadequate final disposal of the HCW. Risk of soil contamination due to the generation of HCW inside and outside the HCF.

<b>Aspects or stages</b>	<b>Condition</b>	<b>Impact and risk</b>	<b>Socio-environmental impacts</b>
Final storage	The store does not have adequate flooring.	Soil contamination by blood and other contaminating substances.	Risk of soil contamination due to the generation of HCW inside and outside the HCF.
	The store is connected to the center's drainage and it does not have a wastewater treatment plant nor does the municipality.	Liquids may enter rivers or be discharged onto agricultural land.	Risk of contamination of surface and underground water due to the mismanagement of HCW inside and outside the HCF.
	The store has windows or openings or is open.	Vectors and pests can enter to look for food, become contaminated, leave and come into contact with the population.	Health risks for the internal population in the HCF and neighbors due to exposure to HCW.  Risk of visual contamination due to the mishandling, mistreatment and/or inadequate final disposal of the HCW.
Waste treatment	The autoclave with built-in shredder does not shred sharps containers.	Risk for workers as the needles and other sharps have to be removed from the autoclave when they are still hazardous. Risk of needles and other sharps going to the final disposal site without shredding.	Health risks for the population due to inadequate final HCW treatment and disposal processes.  Risk of soil contamination due to the generation of HCW inside and outside the HCF.  Risk of contamination of the atmosphere due to burning HCW and generation of odors inside and outside the HCF.  Risk of contamination of surface and underground water due to the mismanagement of HCW inside and outside the HCF.  Health risks due to reuse of materials and equipment considered as HCW.
	The autoclave or incinerator does not function.	The worker who operates the equipment is contaminated because the equipment is not operational. The waste goes to the final disposal site contaminated because the equipment is not operational.	Health risk to the population due to inadequate treatment and final disposal of HCW.  Risk of soil contamination due to the generation of HCW inside and outside the HCF.  Risk of contamination of the atmosphere due to burning HCW and generation of odors inside and outside the HCF.  Risk of contamination of surface and groundwater due to mismanagement of HCW inside and outside the HCF  Health risk due to reuse of materials and equipment considered as HCW

<b>Aspects or stages</b>	<b>Condition</b>	<b>Impact and risk</b>	<b>Socio-environmental impacts</b>
Waste treatment	The incinerator emits gases and does not have a gas scrubber.	Affecting the health of the workers who operate the equipment and that do not have PPE. Patients, residents of the HCF and staff working in the HCF are going to be contaminated with toxic gases and particulates.	Health risk to the population due to inadequate treatment and final disposal of HCW. Risk of contamination of the atmosphere due to burning HCW and generation of odors inside and outside the HCF.
	The operator feeds the debris directly into the lit primary chamber.	The incinerator operator may receive heat radiation to the organs of the abdomen or suffer burns to their hands.	Health risk for the internal population of the HCF and neighbors due to exposure to HCW.
External transport	Liquids leak from the waste.	Pollution of the streets and the people and cars that pass by, contaminating shoes and tires.	Health risk for the internal population of the HCF and neighbors due to exposure to HCW. Risk of soil contamination due to the generation of HCW inside and outside the HCF.
Final disposal	Untreated waste is deposited in an open dump.	Risk of contamination of the soil or water bodies if it rains on the waste. Risk of puncture wounds.	Health risk due to reuse of materials and equipment considered HCW. Risk of soil contamination due to the generation of HCW inside and outside the HCF. Risk of contamination of the atmosphere due to burning HCW and generation of odors inside and outside the HCF. Risk of contamination of surface and underground water due to the mismanagement of HCW inside and outside the HCF.

<b>Aspects or stages</b>	<b>Condition</b>	<b>Impact and risk</b>	<b>Socio-environmental impacts</b>
Final disposal	Burning untreated waste.	Pollution by particulates and toxic gases for the people who carry out the burning. Pollution by particulates and toxic gases for the residents of the area.	Health risk due to reuse of materials and equipment considered as HCW  Risk of soil contamination due to the generation of HCW inside and outside the HCF.  Risk of contamination of the atmosphere due to burning HCW and generation of odors inside and outside the HCF.
	There are people recovering waste on the dumps or landfills (please note that in a sanitary landfill no informal recycling is not allowed)	The reclaimers get sick from being exposed to infectious waste.	Health risk due to the reuse of materials and equipment considered as HCW.
	Vectors exist at the final disposal sites.	Reclaimers come to look for food and become contaminated and carry the microorganisms in the waste on their bodies.	Health risk for the internal population of the HCF and neighbors due to exposure to HCW.



# CLEAN + HOSPITALS

CLINICAL WASTE MANAGEMENT  
GUIDELINES FOR HEALTHCARE FACILITIES

Pilar Tello - Carlos Henriquez - Ignacio Astorga - Alfredo Rihm

