# THE REPUBLIC OF SOUTH SUDAN

## THE MINISTRY OF HEALTH

# The National Health Care Waste Management Guidelines

# 2023

# Foreword

Recurrent Health system shocks arising from disease outbreaks and other emergency situations in the country have led to an improved awareness regarding healthcare waste management in the past few years. However, there is a need for systematic approach to it in terms of effective segregation, safe collection and storage, as well as ultimate treatment and final disposal. These guidelines seek to ensure that HCW is managed effectively in compliance with existing laws and regulations and others to be passed in future. These guidelines are an update of the 2012 edition which it replaces and it comes just after the formulation and launch of the national Infection Prevention and Control (IPC) guidelines and the two documents complement each other.

The guidelines, unlike the 2012 guidelines, outline the good HCWM practices in the context of South Sudan, and lays emphasis on waste generators, the health care facilities, taking full responsibility for waste management. It also lays emphasis on training and re-orienting healthcare workers on the different healthcare waste management activities, recognising the importance of waste minimization and segregation as the first key components of waste management hierarchy.

The technical recommendations in these guidelines are based on international health care waste management principles adapted to the country context. All healthcare facilities are expected to implement them, regularly review progress and identify gaps that should be addressed. It is envisaged that the HCWM systems in the Country will incrementally be strengthened over the years towards achieving the recommendations of the Stockholm convention. The guidelines describe in fair detail the minimum acceptable activities health care facilities should implement and outlines the different administrative roles at the different levels of governance.

Healthcare staff safety is specifically considered critical in these guidelines, safety concerns and guidance have been addressed to ensure measures are in place to limit exposure of staff and the general public to hazardous healthcare waste. As part of the implementation of these guidelines, all healthcare institutions should ensure their staff are trained and efforts should be made to provide them with the necessary personal protective equipment at all times and their use enforced during the performance of all activities that potentially generate infectious waste as well as for those that handle such waste.

Finally, effective implementation of any HCWM system requires concerted effort from various stakeholders, often beyond the health sector. This collaboration is anticipated and all healthcare institutions at various levels are encouraged to mobilize and rally relevant stakeholders of the

government, public partner agencies and other institutions, to facilitate the implementation of these guidelines.

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# Acknowledgements

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There were valuable inputs that came through from various stakeholders; the Ministry of Health acknowledges all these contributions and special thanks to the IPC core team at the ministry of Health who reviewed the content of these guidelines.

We also acknowledge health care facility managers from the various health facilities that were surveyed; most of the data for situational analysis originated from these sample facilities which included both public and private health facilities. It is our hope that these guidelines will facilitate an enhanced healthcare waste management in South Sudan.

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# Acronyms

| | |
|---|---|
| BCC | Behavior Change Communication |
| HBV | Hepatitis B Virus |
| HCF | Health Care Facility |
| HCW | Health Care Waste |
| HCWM | Health Care Waste HCWM |
| HCWMP | Health Care Waste Management |
| IPC | Infection Prevention Control |
| JTH | Juba Teaching Hospital |
| Kgs | Kilograms |
| MoH | Ministry of Health |
| PHCC | Primary Health Care Centre |
| PHCU | Primary Health Care Unit |
| PPE | Personal Protective Equipment |
| SoPs | Standard Operation Procedures |
| UNEP | United Nations Environmental Programme |
| WHO | World Health Organization |

# Chapter 1: Introduction

## Background

Healthcare service delivery processes and their underlying activities often generate wastes, which can constitute health hazards to patients, health care workers and the communities, as well as causing harm to the environment. Efficient and effective management of Healthcare Waste (HCW) is therefore, an integral part of quality healthcare service delivery. Depending on the level of their associated hazard, HCW shall be disposed according to some approved international standards.

According to a recent rapid assessment carried out by the Ministry of Health in partnership with WHO, to inform the formulation of the South Sudan national Infection Prevention and Control (IPC) guidelines, most health care facilities dispose of their waste by open burning or along with domestic wastes into landfills or municipal's open waste dumpsites. This increases the risk of human contacts with hazardous and highly infectious waste products and exposes the entire population to environmental pollution.

These guidelines provide a minimum standard for safe management of HCW to safeguard public health and the environment. It incorporates, as much as possible, the requirements of the existing South Sudan policies, laws and regulations governing HCWM and is designed for use by individuals, public and private establishments, and other entities involved in segregation, collection, handling, storage, treatment, and disposal of waste generated from heath care activities.

The guidelines, unlike in the 2012 guidelines, outline good HCWM practices in the context of South Sudan, and lays emphasis on the following key principles:

1. Full responsibility of the waste producer for the management of waste
2. Re-orientation and training of personnel on separate waste management activities, focusing on waste minimization and waste segregation as first key components of waste management hierarchy.
3. Establishment of separate waste collection system which ensures that wastes intended for different means of treatment and disposal are segregated into different 'streams'
4. Establishment of appropriate treatment and disposal system for each waste stream
5. Maintaining records of waste generation; costs of it management; and accidents related to waste handling
6. Monitoring the performance of the segregation and disposal arrangements
7. Taking corrective action if necessary.

The guidelines are recommended to all stakeholders in the health sector and in particular all those involved in delivery of health care services in South Sudan. The adoption of these guidelines should be reflected in the commitment of each health care facility towards incrementally improving their HCWM systems, through establishment of HCWM committees and development of HCWM plans to guide their processes for waste management.

## The specific objectives

1. Reduce occupational health and safety risks to all healthcare workers, and waste handlers
2. To ensure regulatory compliance with national and international legal frameworks and avoid long-term liability.
3. Establish uniform waste management practices throughout all healthcare institutions in South Sudan.
4. Ensure that all healthcare institutions have a Healthcare Waste Management Plan and an officer (or committee) responsible for the development and implementation of the Healthcare Waste Management Plan.
5. Enable better accounting of the types and quantities of wastes generated within healthcare institutions through a strengthened monitoring and evaluation framework.

## The Scope and Limitations

These guidelines cover all health care waste (HCW) as defined in the section below. Waste generated by establishments that are not considered as health care facilities (HCFs) or not carrying out health related activities are not covered by this guideline and shall be governed by the existing environmental laws and policies of the different governing agencies other than the Ministry of Health.

## Definition and classification of Health Care Waste [1]

- Health care waste is defined as the total waste stream from health care services that includes both potentially infectious waste and non-infectious waste materials.
- Infectious wastes include infectious sharps and infectious non-sharp materials.
- Infectious Sharps consist of syringes or needles, blades, infusion sets, broken glass or other items that can cause direct injury.

[1] Safe management of wastes from health-care activities: a summary. Geneva: World Health Organization; 2017 (WHO/FWC/WSH/17.05). Licence: CC BY-NC-SA 3.0 IGO.

- Infectious non-sharps include materials that have been in contact with human blood, or its derivatives, bandages, swabs or items soaked with blood, isolation wastes from highly infectious patients, bedding and other contaminated materials infected with pathogens. Human excreta from patients are also included in this category.
- Non-infectious wastes includes materials that have not been in contact with patients such as paper and plastic packaging, metal, glass or other wastes which are similar to household wastes.

Table 1. below elaborates this classification further.

**Table 1: Classification of healthcare waste and risk description**

| Waste classification | Type of waste | Waste description |
|---|---|---|
| **Non-Hazardous HCW** | Biodegradable | Biodegradable waste can be decomposed like left over food |
| | Non-Biodegradable | Non- Biodegradable waste does not decompose, but its large volume can be recycled. It includes bottles and cans, paper, different plastics and glass |
| **Hazardous HCW** | ✓ Sharps | Sharps are all objects and materials capable of cutting or penetrating the skin. These wastes pose a potential risk of injury and infection due to their puncturing or cutting properties. Examples of such wastes include all types of needles, broken glassware, ampoules, scalpel blades, lancets, cover slips, glass slides, vials without content. |
| | ✓ Pathological waste | Pathological waste consists of human body parts, organs and tissues. Examples of such wastes are tissue waste, removed organs, amputated body parts, placenta, blood, human fetus, animal and human carcasses obtained through medical settings. |
| | ✓ Infectious waste | This category includes waste contaminated with blood and other body fluids, laboratory cultures and microbiological stocks and waste including excreta and |

| | | |
|---|---|---|
| | | other materials that have been in contact with patients infected with highly infectious diseases.<br>Infectious wastes consist of pathogens and its contamination poses a risk of disease transmission. |
| | ✓ Pharmaceutical waste | Pharmaceuticals that have passed their recommended shelf life or pharmaceuticals that are unusable |
| | ✓ Cytotoxic waste | Cytotoxic wastes can arise by use (administration to patients) or by manufacture and preparation of pharmaceuticals with a cytotoxic effect. |
| | ✓ Chemical waste | Chemical waste is the waste with chemicals, which if managed or disposed improperly may pose substantial hazards to human health. It includes chemicals used in the laboratory, unused photo film, contaminants, solvents, batteries, broken thermometers and blood pressure measuring equipment. |
| | ✓ Pressurized containers | Gas cylinders, aerosol cans. |
| | ✓ Radioactive waste | Materials contaminated with radionuclides, which arise from the medical or research use of radionuclides. It includes unused sealed radiation source, liquid & gaseous material contaminated with radionuclides, excreta of patients who underwent radionuclide diagnostic, and therapeutic applications, paper cups, straws, needle syringes, test tubes and tap water used to wash paraphernalia. |
| | ✓ Incinerator ash/sludge and other by products of waste treatment | This is the waste generated from the combustion of hospital waste, which will have to be disposed of in a landfill site. |

The greater percentage of health care waste generated by health institutions are not hazardous (75-90%) and can be managed like household waste whilst the remaining percent (10 - 25 %) is considered hazardous. The hazardous component requires special arrangements for management (WHO, 2014).

**Sources of healthcare waste**

Sources of HCW include:

- Hospitals
- Primary health care centres (PHCCs), PHCUs and BHI services.
- Immunization campaigns, primary health care outreach clinics
- Private Clinics
- Laboratories and research centers
- Pharmacies and medical stores
- Ambulance and emergency care services
- Home based care

## Waste quantification

The quantity of waste produced by a health facility depends on the type and level of the health facility. Where these cannot be measured routinely, the HCWM committee can estimate the daily quantities using the guidance in Table 2 below.[2] A safety margin of 20% should be added to the total to cover fluctuations in waste generation rates.

**Table 2: Daily quantities generated by different levels of health care facilities**.

| Facility type | Infectious health care waste generation rate |
|---|---|
| **Hospitals** | 0.5kg/bed/day |
| **PHCCs** | 0.07kg/patient/day |
| **PHCUs and clinics** | 0.01kg/patient/day |

**Source: (WHO 2019: Overview of technologies for the treatment of infectious and sharp waste from health care facilities)**

Estimating the daily quantities of waste generated is important to guide future plans of health facilities to improve their treatment options. The amount of waste generated per day (kg/day) should be divided by the number of working hours per day of the waste treatment equipment to achieve the minimum

[2] WHO 2019: Overview of technologies for the treatment of infectious and sharp waste from health care facilities.

treatment capacity needed (kg/h). If the treatment technology is only operated on specific days (e.g. Monday to Friday) the required capacity can be adapted.

# Chapter 2: Legislative and legal frameworks

Currently there are no specific laws regulating HCWM, however, there are related legal frameworks, policies and conventions both national and international, that set the basis for these guidelines. These frameworks are as outlined below:

**The national instruments**

1. South Sudan National Health Policy

Advocates for institutionalization of quality of Care and safety measures in health service delivery to improve health outcomes and protect patients, staff and communities from hazards associated with health care.

2. The Infection Prevention and Control (IPC) strategic plan (2022- 2026) and the IPC guidelines 2023.

The IPC strategic plan aims at having the minimum IPC requirements in place within five years including a functional HCWM program and these guidelines are contributing to one of the main objectives of the IPC guidelines of preventing disease transmission to patients, healthcare providers and the community.

3. The South Sudan 2015- 2025 Environment Policy

This policy promotes environmental protection and conservation and invites all stakeholders to integrate environmental considerations into development programs at the community, government and private sector levels.[3]

4. The Transitional Constitution of the Republic of South Sudan, 2011

Article 41 of the constitution for the rights of the people of South Sudan to a clean and healthy environment; and that "every person shall have the obligation to protect the environment for the benefit of present and future generations".

**International conventions and agreements**

1. **The Basel Convention** on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (UNEP,1992).

[3] South Sudan National environment policy 2015-2025. https://climate-laws.org/document/national-environment-policy-2015-2025_b36c?q=&l=south-sudan

The main objectives of the Basel Convention are to minimize the generation of hazardous wastes, treat those wastes as close as possible to where they were generated and reduce transboundary movements of hazardous wastes. It stipulates that the only case where the cross-border movement of hazardous waste is legitimate is the export of waste from a country which does not have the expertise or the infrastructure for safe disposal to a country which does.

2. **Bamako Convention** (1991)

This treaty banning the importation of any hazardous wastes into Africa was signed by 12 nations.

3. **Stockholm Convention** on Persistent Organic Pollutants (UNEP, 2004)

This convention aims to reduce the production and use of persistent organic pollutants and to eliminate uncontrolled emissions of substances such as dioxins and furans.

**4. Sustainable Development Goals**

The Sustainable Development Goals (SDGs) are the United Nations' blueprint to achieve better and sustainable future for all. HCWM is specifically addressed by SDG No.3 on good health and well-being, SDG No. 6 on clean water and sanitation, and SDG No. 12 on responsible consumption and production.

5. **Agenda 21 (plan of action for the 21st century)** adopted by 173 heads of State at the Earth Summit held in Rio in 1992

To minimize the generation of waste, to re-use and recycle, treat and dispose of waste products by safe and environmentally sound methods, placing all residue in sanitary landfills.

6. **WHO and UNEP initiatives concerning mercury and Decision VIII/33** of the Conference of the Parties to the Basel Convention on mercury wastes

Measures should be taken as soon as possible to identify populations at risk of exposure to mercury and to reduce anthropogenic wastes.

## Key Concepts for HCWM

The following concepts, policies and principles are considered important for effective implementation of HCWM in all healthcare facilities and have been adapted as the basis for this guidelines.[4]

[4]Overview of technologies for the treatment of infectious and sharp waste from health care facilities. Geneva: World Health Organization; 2019. Licence: CC BY-NC-SA 3.0 IGO.

1. *Risk Management Concept*

The concept of risk management in the HCF setting is defined as the overall approach to identify, assess, and reduce the exposure to hazards of the patients, visitors and health care workers as a result of HCW generated.

2. *Water and Sanitation for Health Facility Improvement Tool (WASH FIT)*[5]

WASH FIT is a multistep, iterative process to facilitate improvements in WASH services, quality, and experience of care in all types of HCFs. One of its purposes is to identify areas for quality improvement within facilities, including strengthening HCWM policies and standards that will lead to lower infection rates, better health outcomes for patients and improved staff safety and morale.

3. *The Waste Management Hierarchy*

A concept in waste management in which it is most preferable to prevent the generation of waste at source and reduce the quantity generated by adopting different methods of safe re-use, recycling, and recovery. Proper treatment and residuals disposal are the end-of-pipe approach. In addressing HCWM, waste minimization utilizes the first two elements that could help reduce the bulk of HCW for disposal; hence, the most "desirable" management practice aims to address the problem at source rather than "end-of-pipe." 'Desirability' is defined in terms of the overall benefit of each method from their specific impacts on the environment, protection of public health, financial affordability, and social acceptability.

## General principles in this guideline

Principles of waste treatment and commitment of health workers:

1. **Duty of care principle**: It is the duty of the waste generator to dispose the generated waste safely. Therefore, it is the HCF that has ultimate responsibility for how waste is containerized, handled on-site and off-site and ultimately treated and disposed of.
2. **Precautionary principle**: when the magnitude of a particular risk is uncertain, it should be assumed that this risk is significant, and the measures to protect health and safety should be designed accordingly. It must therefore, always be assumed that waste is hazardous until it is proved to be safe. This is a key principle governing health and safety protection.

[5] Water and Sanitation for Health Facility Improvement Tool (WASH FIT): a practical guide for improving quality of care through water, sanitation and hygiene in health care facilities, second edition. Geneva: World Health Organization; 2022. Licence: CC BYNC-SA 3.0 IGO

3. **Proximity principle**: treatment and disposal of hazardous waste should be conducted at the closest possible location to the source to minimize the risks and financial cost involved in its transport. Similarly, any facility should recycle or dispose of the waste it produces inside its own territorial limits.
4. **Polluter pays principle (PPP)**: All waste producers are legally and financially responsible for the safe handling and environmentally sound disposal of the waste they produce. In case of accidental pollution, the organization is liable for the costs of cleaning it. The main purpose of this principle is to make the service providers committed toward waste management to reduce potential risks and to keep human health and environment safe from health care waste.

# Chapter 3: Steps in Health Care Waste Management

The following general principles relate to the control of waste flow from generation to disposal:

1. HCW is generated in a medical area and should be segregated into different types, based on their potential hazard and disposal route, by the person who produces each waste item.
2. HCW must be segregated, collected, stored, and transported in a safe manner considering the risk and occupational safety and in accordance with existing laws, policies, and guidelines.
3. Hazardous and general waste must not be mixed during collection, transport, and storage.
4. Separate containers should be available in each medical area for each segregated waste fraction.
5. Appropriate labelling, signage, route, and segregation system should be established. Waste containers when filled should be labelled to help managers control waste production.
6. Plastic liners preferably containing three-quarters full of waste should be sealed when being transported from waste generating source to the storage area.
7. The storage area must be designed based on the volume of waste generated by the HCF and must provide compartments for general, hazardous, and recyclable wastes. Closed local storage area inside or near to a medical area may be needed if wastes are not collected frequently.
8. A separate storage area for phase-out mercury containing devices and products should be provided
9. Staff must be well-trained on the risk and safety procedures on handling waste.

**Important considerations for HCWM committees**

HCWM is most effective when proper methods are employed at each step bearing in mind the following considerations:

- The nature of waste, level of toxicity to the environment and risk to health.
- The quantity of waste generated by each patient daily (kg/bed/day)
- Legal - the prevailing regulations on health and environment
- Financial – investment and running costs as against the facility's budget.
- Technical – best available techniques that are proven to be efficient, environmentally safe and the options exist and can be obtained efficiently.
- Sustainability – availability of energy sources and other utilities (e.g. fuel, water and electricity) to run equipment.

- Local community preferences – whilst some communities may be averse to certain treatment options because of cultural and religious reasons, others may welcome options because of their technical feasibility and environmental friendliness.

## Waste management hierarchy

Waste management to protect public health and environment can be achieved through various methods. Figure 1. below presents an order of preference called the "waste management hierarchy", with the most desirable method at the top to the least desirable at the base.

"Desirability" is defined in terms of the overall benefit of each method from its particular impacts on the environment, protection of public health, financial affordability and social acceptability. There are three hierarchical options:[6]

1. As illustrated, the most preferable approach is to avoid producing waste as much as possible and thus minimize the quantity entering the waste stream.
2. Where practicable, recovering waste items for secondary use is the next most preferable method.
3. Waste that cannot be recovered must then be dealt with by the least harmful options, such as treatment or land disposal, to reduce its health and environmental impacts.

In addressing HCWM, waste minimization basically utilizes the first two elements that could help reduce the bulk of HCW for disposal; so, the best waste management practice aims to address the problem at source rather than the end-of-pipe solution.

[6] WHO 2019. Overview of technologies for the treatment of infectious and sharp waste from health care facilities

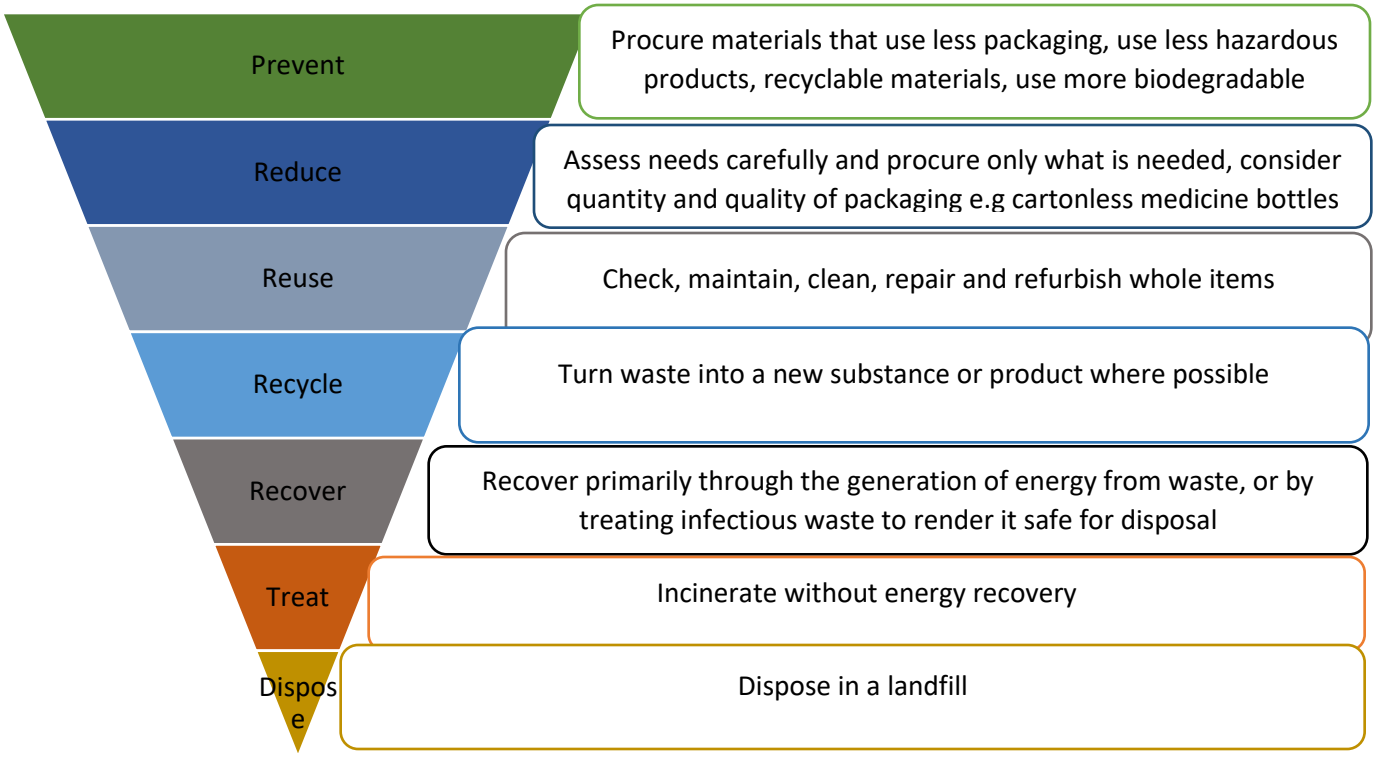



**Fig 1. Waste management hierarchy. Source: WHO 2019. Overview of technologies for the treatment of infectious and sharp waste from health care facilities**

## Health Care Waste Minimization

Processes and behaviors at the workplace often dictate the amount of waste generated. Waste minimization is defined as both the prevention as well as the reduction of waste production. It involves specific strategies of changes in management and behavior. Sustainable behaviors such as choosing reusable equipment over single use, sending e-mails instead of using letters or paper memos, using reusable cups over disposable ones etc. can lead to a minimization of waste. Waste minimization can therefore, be achieved through:

- Waste reduction at source (product substitution, product change, procedural change)
- Giving preference to recyclable and reusable items

Best practices in waste management will aim to avoid or to recover as much of the waste as possible in or around the HCF, rather than disposing of it by burning or burial. Working with medical staff to change clinical practices to ones that use less materials e.g using oral medication when parenteral route avoidable. Health care managers can also take measures to reduce the production of waste through adapting their purchasing and stock control strategies.

## The "3R's" of waste minimization: Reduce, Safe Re-use, Recycle programs.

**Reduce**

- Achieve near accuracy when ordering for supplies from the stores to ensure that there is no wastage or no material is sitting on the site for long periods to get damaged.
- Obtain resources that are just enough to cater for your needs. This is an effective way of conserving resources as it also lowers the costs.
- Use green Procurement principle: selecting products that are less wasteful with less packaging and/or come in packaging that can be recycled or that produce a less hazardous waste product
- Proper stock management of pharmaceutical products
    - More frequent ordering of relatively small quantities rather than large amounts at one time, to reduce the quantities used (particularly applicable to unstable products).
    - Use of the oldest batch of a product first.
    - Use of all the contents of each container.

- Checking of the expiry date of all products at the time of delivery, and refusal to accept short-dated items from a supplier.

**Safe re-use**

- Re-use is not only finding another use for a product but also reusing the product repeatedly for a given function as intended.
- Promoting re-use entails, the selection of reusable rather than disposable products whenever possible.
- Re-use also entails setting reliable standards for disinfection and sterilization of equipment and materials for use (please refer to the IPC guidelines).
- Reuse requires a realistic assessment of which practices are considered safe and which to avoid.
- When considering reuse, it is important to make a distinction between different types of products:
    - Non-medical supplies, disposable items (which should be avoided)
    - Medical devices that pose no cross-infection risk (e.g., blood pressure meters); and
    - Medical devices specifically designed for reuse (e.g., surgical instruments).
- Before the reuse of the product, it must undergo the following steps: (1) cleaning; (2) decontamination; (3) reconditioning; (4) disinfection; and (5) sterilization.
- Items that cannot be reused are the following:
    - Single-use devices or items, such as syringes and hypodermic needles, must not be reused because of the risk of cross-infection.
    - Plastic syringes and catheters should not be reused.
    - Disposable items such as gloves, masks and gowns should not be reused.

**Recycle**

Using leftover resources or those resources that have reached the end of their life minimizes the volumes of waste that reach the landfills. Thus, it is advisable to use materials that are recyclable as this creates a market for the resources that are recycled while also raising the price that recyclers pay for those resources.

**Box 1. Benefits of Waste minimization**

- Financial—Cost savings through effective waste management and more efficient use of natural resources (electricity, water, gas, and fuels); Additional income generated from sale of recyclable waste.
- Operational and Internal—Improved overall performance and efficiency
- External—Better public perception of the HCF; Reduction of the adverse environmental impact (i.e., land, air, and water pollution); Promoting environmental sustainability.

## Waste Segregation and containment

Waste segregation refers to the separation of different waste types at the source and keeping them apart during handling, collection, interim storage and transportation. Segregation of waste at point of generation is very crucial for a successful management of HCW. It is highly recommended to segregate HCW on-site at the time of waste generation, e.g. when an injection is given, needle and syringe are deposited in their respective, different waste containers.

To reduce the amount of infectious waste as low as possible, infectious waste should not be mixed with non-infectious waste. Separating hazardous waste from non-hazardous waste also significantly reduces the risk of infection for staff and healthcare workers dealing with HCW.

Segregation is an important step in HCWM for the following reasons:

- Segregation minimizes the amount of waste that needs to be managed as hazardous waste (since mixing non-hazardous waste with hazardous waste renders the combined waste as hazardous).
- Segregation facilitates waste minimization by generating a solid waste stream which can be easily, safely, and cost-effectively managed through recycling or composting.
- Segregation reduces the amount of hazardous substances released to the environment through disposal of general waste (i.e., by removing mercury from general waste).
- Segregation makes it easier to conduct assessment of the quantity and composition of different waste streams thereby allowing an HCF to obtain baseline data, identify options, determine waste management costs, and evaluate the effectiveness of waste minimization strategies.
- Segregation consists of clearly identifying the various types of waste and how they can be collected separately.

- The simplest way to identify the different types of waste and to encourage people to segregate them is to collect the various types of waste in separate containers or plastic bags that are color-coded and/or marked with a symbol. The international recommendations are as follows:[7]

| **Type of waste** | **Color coding & symbol** | **Type of container and the Bio-hazard symbol** |
|---|---|---|
| 0. General waste similar to household waste | Black | Plastic bag with 'recycling' symbol:  |
| 1. Sharps | Yellow & | Sharp's container  |
| 2. a. Waste entailing risk of contamination<br>b. Anatomical body parts | Yellow & | Plastic bag or container  |
| c. Highly Infectious waste and pathological body parts | Yellow marked "highly infectious" | Plastic bag or container which can be autoclaved   |
| 3. Chemical and pharmaceutical waste | Brown, marked with a suitable symbol | Plastic bag, container |

[7]Safe management of wastes from health-care activities: a summary. Geneva: World Health Organization; 2017 (WHO/FWC/WSH/17.05). Licence: CC BY-NC-SA 3.0 IGO.

**Setting up a 3-container sorting system (for sharps, potentially infectious waste and household refuse) is effective as a first step which is easy to do and provides a means of drastically reducing the major risks.**

### Recommended segregation strategy system for tertiary and state hospitals

A four or the three colour coding system has to be set up in all medical areas throughout the hospital. Additionally, the following segregation possibilities shall be provided for:

- Segregation of non-risk waste for recycling, especially for cardboard, plastic, glass throughout the hospital and especially at the non-medical areas, but only if it can be sold.
- Segregation of pharmaceutical waste at ward level (nursing station) and in the pharmacy.
- Segregation of chemical waste in the medical support areas such as laboratory and radiology department.
- Collection points for pathological waste at the operation theatres, pathology and at the maternity.
- Collection points for heavy metal waste, especially amalgam (dentist), batteries, fluorescent lamps.
- Collection points for cytotoxic waste (waste from cancer treatment) from oncology department services
- Radioactive waste might only be generated in selected facilities. A general collection system for this type of waste is not needed.

### Recommended segregation strategy system for county hospitals

A three colour coding system has to be set up in all medical areas throughout the county hospitals. Additionally the following segregation possibilities shall be provided for:

- Segregation of non-risk waste for recycling, especially for cardboard, plastic, glass throughout the hospital and especially at the non-medical areas, but only if it can be sold.
- Segregation of pharmaceutical waste at ward level (nursing station) and in the pharmacy.
- Segregation of chemical waste in the medical support areas such as laboratory and radiology department if existent.
- Collection points for pathological waste at the operation theatres, pathology and at the maternity.
- Collection points for heavy metal waste, especially amalgam (dentist), batteries, fluorescent lamps.

## Recommended segregation strategy system for Primary Health Care Centres and Primary Health Care Units

PHCC should set up the three-bin-system and a possibility for the recycling of valuable waste materials should be investigated. Additionally the PHCC should set up:

- Collection points for pathological waste especially arising from the obstetric services.
- One segregation point for the collection of pharmaceutical waste at a secured area.
- One segregation point for the collection of chemical waste at a secured area.

**Points to note:**

- ✓ In an emergency situation, during victim triage it is strongly recommended that all wastes generated by this activity be considered wastes entailing a risk of contamination and should be stored in appropriate containers (containers equipped with yellow bags).
- ✓ Household refuse, in black bags, must be put through the same treatment chain as municipal waste. But before this is done, recyclable waste and compostable materials must first be separated at source.
- ✓ The bags must be placed either in rigid containers. In certain circumstances, if no plastic bags are available, the containers should first be emptied, then washed and disinfected (with 5% active chlorine solution).
- ✓ Anatomical waste cannot always be collected in yellow plastic bags for cultural or religious reasons. It must be treated in accordance with local customs (often buried).
- ✓ There are two other important principles that must be followed during waste segregation:

1. Waste segregation must always be the responsibility of the entity that produces them. It must be done as close as possible to the site where the wastes are produced.
2. 'Do not correct mistakes': if non-hazardous material has been placed in a container for wastes entailing the risk of contamination, that waste must now be considered hazardous (precautionary principle).

## Containment

Segregated waste should be properly contained at the point of generation in a suitable storage container that fit the characteristics of the type of health care waste. Containment at the point of generation should be considered as an important first step in getting the waste into their rightful categories for onward

handling by assigned staff. For example, sharps are to be contained in puncture proof containers to prevent accidental injuries among waste handlers and keep the hospital environment clean and safe.

The following measures should be taken to ensure safe management of waste at the points of generation:

i. 40-60 litres pedal bins are recommended for containerization of general and infectious waste at the wards.
ii. Rigid containers should be lined with colour coded plastic bags with the opening folding outward over the rim to minimize contamination of the surrounding. The top of the container should have a wider diameter than the base.
iii. Storage time shall be reduced as much as practicable but not longer than one day.
iv. Multiple daily removals of the waste is recommended. Sharp waste containers shall be removed when ¾ (75%) full.
v. Disposable bags for infectious waste shall be of the appropriate size with a minimum of 570 microns and maximum of 100 microns in thickness
vi. Infectious and hazardous waste shall be segregated at the point of origin rather than at the transfer or external storage site to facilitate appropriate packaging, colour coding, and transportation
vii. Filled bags shall be sealed off using a plastic strip which when fastened cannot be re-opened; the bags should be sealed when ¾ full.
viii. Sharp waste:
    - Shall be stored in puncture-resistant containers made of thick cardboard, or strong plastic/or stainless steel
    - Shall not be manipulated by hand (e.g. by breaking or bending) before disposal and needles shall not be recapped before discarding.
    - Containers (puncture resistant) shall be placed as close as possible to the area where sharp items are used
    - Containers should be sealed when ¾ full.

viii. Pharmaceutical and chemical waste should be collected on demand and stored separately from other wastes.

## Waste collection and storage

Waste should be collected and transferred to the central storage within the health facility to prevent accumulation of waste before treatment and relocation. The maximum storage period for infectious waste before treatment or disposal is 48 hours during rain seasons and 24 hours in hot seasons.

- Waste must be collected regularly - at least once a day. It must never be allowed to accumulate where it is produced.
- Health facilities should provide collection bags or bins at the point of waste generation.
- A daily collection program and collection round must be planned.
- Each type of waste must be collected and stored separately.
- Anatomical wastes and placenta shall be collected separately and immediately in plastic or galvanized metal containers with a tight –fitting cover; and removed immediately.
- The personnel in charge of collecting and transporting wastes must be informed to collect only those yellow bags and sharps containers which the care staff have closed. They must wear gloves.
- The bags that have been collected must be replaced immediately with new bags.
- A specific area must be designated for storing medical waste and must meet the following criteria:

| **Minimum requirements for the waste storage facility** |
|---|
| ○ It must be closed, and access must be restricted to authorized persons only<br>○ It must be separate from any food store<br>○ It must be covered and sheltered from the sun<br>○ The flooring must be waterproof with good drainage<br>○ It must be easy to clean<br>○ It must be protected from rodents, birds and other animals<br>○ There must be easy access for on-site and off-site means of transport<br>○ It must be well aired and well lit<br>○ It must be compartmented (so that the various types of waste can be sorted) or Containers used for storage shall be labeled and covered with lids.<br>○ It must be near the incinerator, if incineration is the treatment method used<br>○ There must be wash basins nearby<br>○ The entrance must be marked with a sign (“No unauthorized access”, “Toxic”, or “Risk of infection” |

**Note: The storage time for infectious medical waste must not exceed 48 hours in the cool season and 24 hours in the hot season.**

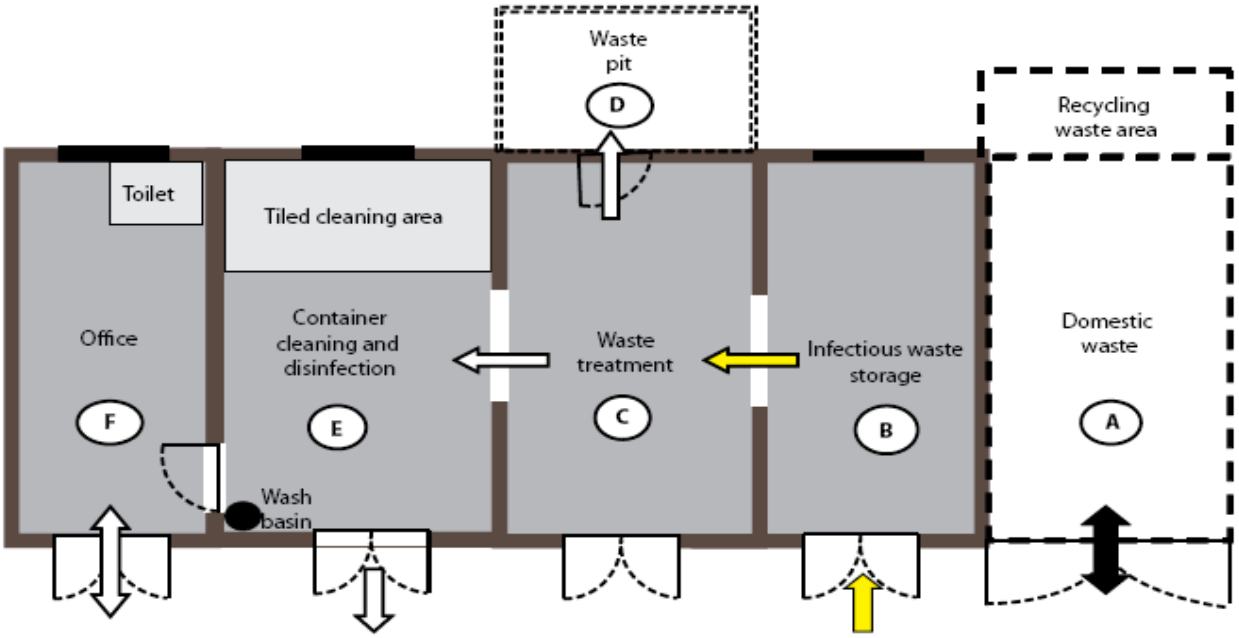



**Fig. 2. Sample sketch for waste storage area; Source: WHO -2019**

## Waste Transportation

**Vehicles and means of conveyance**

- As much as possible, the means used for transporting waste should be reserved for that purpose, and different means must be used for each type of waste (e.g. one wheelbarrow for general/ household waste and another one for infectious medical waste).
- These means of conveyance must meet the following requirements:
    - They must be easy to load and unload
    - They must not have any sharp corners or edges that might tear the bags or damage the containers
    - They must be easy to clean (with a 5% active chlorine solution)
    - They must be clearly marked.
- Furthermore, off-site means of transport must meet the following requirements:
    - They must be closed in order to avoid any spilling on the road
    - They must be equipped with a safe loading system (to prevent any spilling inside or outside the vehicle)
- The vehicles and means of conveyance must be cleaned daily.

| **Onsite transport** |
|---|

- Different means of conveyance may be used inside the facility – wheelbarrows, containers on wheels, carts
- Wastes must be transported during non-busy periods; the itinerary must be planned so as to avoid any exposure of staff, patients or the general public.
- The collected waste shall not be left even temporarily, anywhere other than at the designated central storage or disposal site.
- It must follow routes far from clean zones (sterilization rooms), sensitive areas (operating theatres, intensive care units) or public areas as much as possible. The collection route should be the most direct one from the collection points to the central storage, disposal sites

**Off-site transport**

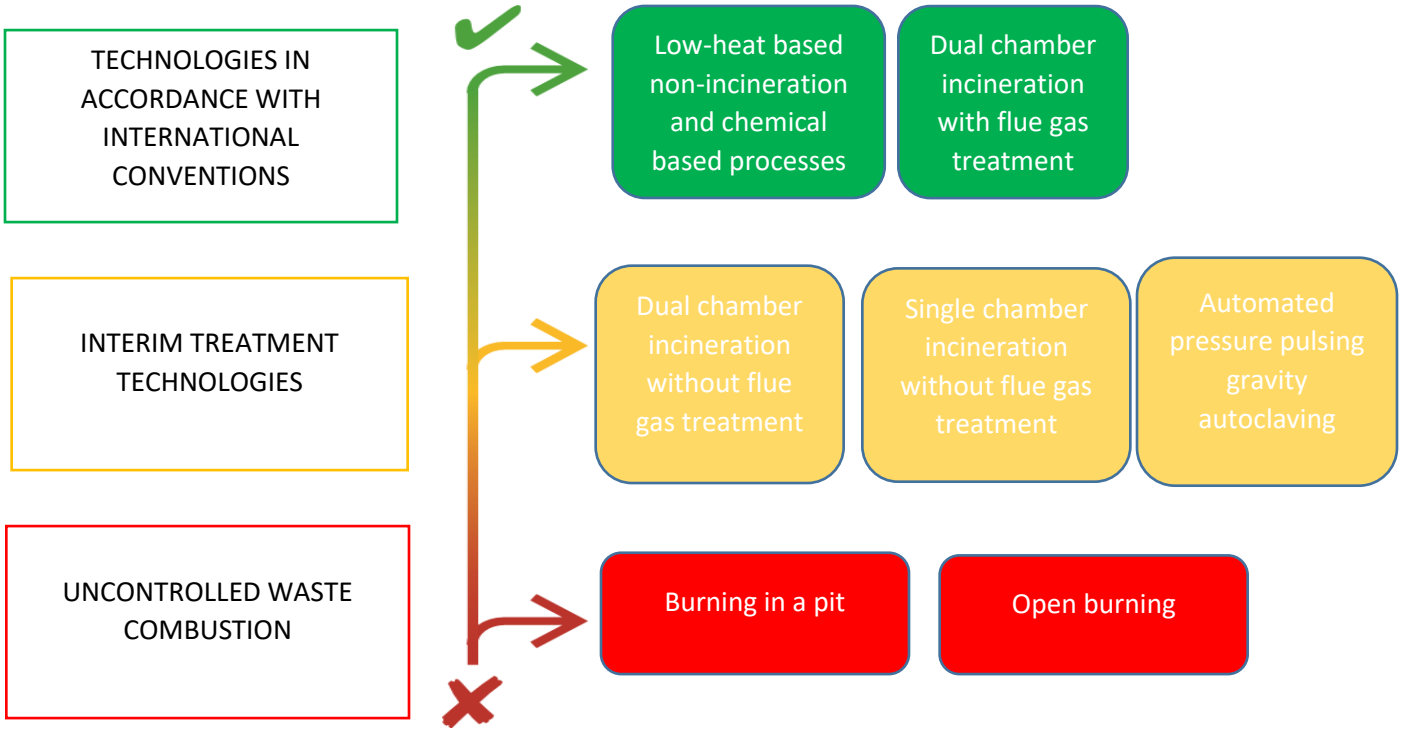
- The entity producing the waste is responsible for packaging and labelling the waste to be transported outside the facility.
- Packaging and labelling must be in conformity with national legislation on the transport of dangerous substances and with the Basel Convention in the case of cross-border transport.
- Off sight waste routes within the facility shall be designated to avoid the passage of waste through patient care areas
- The transportation should be properly documented and all vehicles should carry a consignment note from the point-of collection to disposal facilities.
- Vehicles used for the carriage of infectious waste should be disinfected prior to use for next service.

## Health care waste treatment and disposal

The overall objective of HCW treatment is to reduce the potential infectious nature posed by health care waste and to protect the environment. From the waste hierarchy, treatment is next to disposal, implying that all measure for minimization should be adopted to reduce the amount of waste substantially so that treatment will focus on a reduced volume of potentially infectious waste. To be effective, treatment must reduce or eliminate the risk present in the waste so that it no longer poses a hazard to persons who may be exposed to it.

- WHO has recommended a number of different types of technology for the treatment of hazardous healthcare waste. Each method has advantages and disadvantages that have been considered in updating this guidelines.
- After treatment, the waste residue should be properly packaged for land disposal, preferably at a landfill site.
- The following factors should be considered while selecting a treatment option:
    - Treatment efficiency
    - Occupational, health and safety and environmental considerations
    - Volume and mass reduction
    - Types and quantity of waste for treatment and disposal/capacity of the system
    - Infrastructure and space requirements
    - Locally available treatment options for final disposal
    - Operation and maintenance considerations
    - Location of the treatment site and disposal facility
    - Social and political acceptability; and
    - Regulatory requirements.
- Types of treatment technology include thermal, chemical, irradiation, biological processes, encapsulation, inertization, shredding and compaction/baling.
- Treatment solutions may involve a single technology or a combination of technologies.

## Treatment technologies ladder




**Source: WHO 2019: Overview of technologies for the treatment of infectious and sharp waste from health care facilities**

## Overview of Treatment technologies

| Low-heat based processes | | | | | | |
|---|---|---|---|---|---|---|
| | **Description** | **Advantages** | **Disadvantages** | **Environmental and Health impact** | **Installation requirements** | **Capacity** |
| **Vacuum autoclaves** | Waste is decontaminated at 121 °C to 134 °C therefore; the waste bags used in autoclaves must be heat resistant and must allow steam to enter the bag. Polyethylene bags – the most widely available type – can resist 121 °C, but polypropylene bags are needed for machines operating at 134 °C. | - Low environmental impacts<br>- No hazardous residues<br>- Complies with Stockholm Convention<br>- Some treated wastes can be recycled | - Reliable solid waste collection methods required<br>- Reliable water and electricity connection needed<br>- Water needs to be of certain quality to protect the equipment<br>- Temperature resistant waste bin or bags are needed<br>- Residue recognizable, can cause injuries (e.g. sharps) | - Produces significantly less air pollution than incineration processes | - Electricity: 380/400 Volt (smaller ones might require 220/230/240 Volt)<br>- Water connection<br>- Quality of water for steam generation: soft water /demineralized water<br>- Waste water connection<br>- Compressed air | 5-3000 kg/ hour |
| **Autoclaves with integrated shredding** | Pre-shredding allows better steam penetration | - Low environmental impact | - Reliable water and electricity | - Less air pollution but system needs to be | - Electricity: 400 Volts<br>- Water connection | 5-3000 kg/hour |

| | | | | | | |
|---|---|---|---|---|---|---|
| | and efficacy and renders the waste unrecognizable | - No hazardous residues<br>- Reduction of volume<br>- Residue is Unrecognizable<br>- Complies with Stockholm Convention | connection needed<br>- Water needs to be of certain quality to protect the equipment<br>- Higher costs for operations and maintenance<br>- Requires a skilled operator | enclosed to prevent emitting aerosols during the waste shredding process. | - Quality of water for steam generation: soft water/demineralized water<br>- Waste water connection<br>- Compressed air | |
| **Microwave-based technologies** | Microwave treatment systems consist of a treatment area or chamber into which microwave energy is directed from a microwave generator where the waste is heated up to 100 °C. | | | | | |
| **Batch wise microwaves** | System treats waste in batches in a closed waste decontamination unit | - Low environmental impacts<br>- No hazardous residues<br>- Complies with Stockholm Convention | - Reliable solid waste collection required<br>- Reliable electricity connection needed<br>- Waste needs a minimum humidity or | - Air emissions are very minimal | - Electricity: 400 Volt (smaller ones might require 220/230/240 Volt)<br>- Water connection<br>- Quality of water: tap water<br>- Waste water connection | 1-210 kg/hour |

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| | | | water needs to be added<br>- Special waste bins are needed | | | | |
| **Continuous Microwave Technologies** | Has integrated shredding. The waste particles are conveyed through a large metal auger (conveyor screw) where they are further exposed to steam and heated to 100°C by several microwave generators. | - Low environmental impacts<br>- Residue is non-hazardous<br>- Residue is unrecognizable<br>- Reduction of waste volume<br>- Complies with Stockholm Convention | - Reliable electricity connection needed<br>- Higher costs and maintenance (internal moving parts)<br>- Waste needs a minimum humidity or water needs to be added | - No pollutants emission<br>- The system needs to be completely enclosed to prevent emission of aerosols during the waste shredding process | - Electricity: 380/400 V | 100-800kg/hour |
| **Frictional heat treatment** | Technology is based on the use of heat generated by friction and impact of the waste by rotor blades, supplemented by resistance heaters to | - Low environmental impacts<br>- Residue is non-hazardous<br>- Reduction of waste volume | - Reliable electricity connection needed<br>- Higher maintenance (internal moving parts) | - No hazardous emissions or effluents are generated. | - Electricity: 400 Volt – 50 Hz<br>- Water connection: Yes<br>- Quality of water: Running water (should meet the quality specified by manufacturer)<br>- Waste water connection: Yes | 10-600kgs/hour |

| | | | | | | |
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| | ensure that the temperature can be adjusted if required. The waste is heated up to 150°C, while the waste is shredded into small, unrecognizable pieces. | - Residue is unrecognizable<br>- Complies with Stockholm Convention | | | | |
| **High heat incineration with flu gas treatment** | Primary measures for high-heat thermal incinerators include two burning chambers (850 °C/1100 °C), an auxiliary burner, sufficient resident time for air in the second chamber, sufficient oxygen content and high turbulence of exhaust gases. Additional flue gas treatment systems are needed as secondary measures. Are too expensive and not considered further in this guidelines but are planning for in the future. | | | | | |
| **Dual chamber incineration without flue gas treatment** | Consists of a primary combustion chamber and a secondary chamber. Waste is burned in the primary combustion chamber at or above 850 °C. The vapours produced in the primary | - Reduction of waste volume<br>- Residue is unrecognizable | - High environmental and health impact (air emissions and risk of burns)<br>- Bottom and fly ash is potentially hazardous<br>- Not in accordance with the | - Wide variety of pollutants, including dioxins and furans, are released into the atmosphere.<br>- Bottom ash residues are also generally contaminat | - Electricity: 220/230/240 Volt<br>- Fuel type: diesel, gas | 5-500kgs/hour |

| | | | | | | | |
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| | chamber are directed into a secondary chamber which has one or more burners to bring the temperature to the 1100 – 1200 °C | | Stockholm Convention | ed with dioxins, leachable organic compounds, and heavy metals and have to be treated as hazardous waste. | | | |
| **Single chamber incineration without flue gas treatment** | Are designed to meet an immediate need for public health protection where there are no resources to implement and maintain more sophisticated technologies. | - Residue is unrecognizable<br>- Reduction of waste volume | - Very high negative environmental and health impact (high air emissions)<br>- Pathogens can survive the process<br>- Bottom and fly ash is potentially hazardous<br>- Not in accordance with the Stockholm Convention | - A wide variety of pollutants are released into the atmosphere including dioxins and furans.<br>- Pathogens can also be found in solid residues and the exhaust of poorly designed and operated incinerators. | - Construction material: – Heat resistant refractory bricks and mortar<br>- High grade stainless steel metal parts<br>- Fuel type: Biomass (wood, coconut shells etc.) | | 5-50kg/ hour |

| | | | | | |
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| | | | | - In addition, the bottom ash residues are generally contaminated with dioxins, leachable organic compounds, and heavy metals and need to be treated as hazardous waste. | |
| Open burning | Open burning includes dump fires, pit burning and fires on plain soil/open ground. Due to the human and environmental harm this method of waste treatment can cause, it should be minimized and eventually eliminated. This guideline does not therefore, discuss it any further. | | | | |
| **Chemical Disinfection** | Sodium Hypochlorite-based technology. Contrary to manual treatment of infectious waste by chemicals, the process is automated and controlled | - Highly efficient disinfection under good operating conditions.<br>- Some chemical disinfectants are relatively inexpensive. | - Requires highly qualified technicians for operation of the process.<br>- Uses hazardous substances that require comprehens | - No adverse environmental effects | - Input: sodium hypochlorite and sodium thiosulfate<br>- Electricity connection: 380/400 V<br>- Water connection<br>- Waste water connection |

| | | | | |
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| | continuously, to ensure effective and safe decontamination of waste. | - Shredding process reduces volume (not mass) | ive safety measures.<br>- Shredders are subject to frequent breakdowns and poor functioning. | |

## Waste treatment approaches

In general, there are three approaches for the treatment of HCW:

1. On-site (OS)

This is the recommended treatment approach where a healthcare facility treats its own waste using its treatment technology within its premises. The facility does not receive waste from other facilities and therefore, operation and maintenance cost are the responsibility of the facility. The capacity of the selected technology is to meet the needs of the health facility only.

2. Cluster treatment (Cluster)

This approach is where a facility treats its waste plus waste from other health facilities in a small surrounding area. This can be done within a Payam where a PHCC treats wastes from the surrounding PHCUs or at county level where a county hospital treats waste from the surrounding PHCCs.

- This approach allows for a number of facilities to leverage on existing treatment technology in another facility to treat healthcare waste at an agreed fee among the facilities or free based on the hierarchy of health service.
- The benefits include reduced operation and maintenance cost to the facilities involved in the cluster. However, the challenges include the difficulties of transporting infectious waste and unwillingness to pay agreed fees for treatment.

3. Central treatment (CTF)

This is where a dedicated treatment plant with larger treatment capacity collects and treats wastes from many health facilities in an urban centre or at the regional/ state level.

- This approach can either be public or privately managed within the existing laws, polices and regulations.
- The benefits to the health sector are enormous since health facilities would avoid the challenges of meeting regulatory standards for treatment, transportation, operation and maintenance challenges but pay for services.
- The cost of setting-up a number of such treatment technologies at each facility is avoided and funds can be deployed to address other needs.
- This will ensure sustainability of the operation of such treatment technologies and contribute to safe healthcare waste management.

While non-incineration technologies are the preferred options for waste treatment, MoH recognizes that in many facilities this is not possible, like in many other countries, because of a lack of reliable water, electricity, and solid waste collection services.[8] Dual chamber and single chamber incinerators without flu gas treatment are the minimum recommended technology for waste treatment in all health facilities in South Sudan with the view of incrementally improving technologies while engaging in multi-sectoral efforts to strengthen systems change. With time, the Country should strive to dual chamber incinerators with flu gad treatment as described below according to Stockholm convention. Open burning in health care facilities should be minimized and eventually eliminated.

Where the treatment technology (e.g. autoclaves, incinerators etc.) in a particular facility has the capacity to handle more waste than the individual institution generates, it can be strategically located to serve more than one institution for optimization and cost reduction (e.g. in cluster or central treatment).

Where the volume of waste generated is minimal, segregation and transportation of waste to a cluster or central treatment facility may be much cheaper than procuring treatment technologies for a facility; such considerations are important to facilitate rational use of resources. This necessitates a process of micro planning at all levels.

**Siting of Waste Treatment Facilities**

- In determining a safe location for waste treatment facilities, it is important to take into account the safe transfer routes, average distances from waste sources and temporary storage requirements, as well as space needed by workers to maneuver safely around the treatment unit.
- The location of the facility should not cause traffic problems as waste is brought in and out.
- Odour, noise, visual impact of operations on patients and visitors, public access and security should also be considered.

### Treatment of infectious waste and sharps by incineration

Incineration of infectious medical waste oxidizes pathogenic agents. State of the art incinerators are normally two chamber systems, equipped with a wet or dry flue gas treatment system and a Continuous Emission Monitoring (CEM)-System. Gasification of the waste takes place in the first chamber, and then the gas is combusted in the second chamber at a temperature of 800 – 1200°C where pathogens are destroyed.

[8] WHO 2019. Overview of technologies for the treatment of infectious and sharp waste from health care facilities

One problem of the incineration of hospital waste is the high content of PVC. PVC incineration leads to the creation of highly corrosive HCl, and the formation of cancer causing substances like dioxins and furans. Incineration further creates the problem of the disposal of the generated ash. This incinerator ash must often be classified as potential toxic due to high contents of heavy metals, etc. Therefore incinerator ash should not be disposed of on an unsecured landfill without prior inertization and stabilization.

### *Minimum requirements for incineration of HCW according to the Stockholm Convention*

The Stockholm Convention is an international treaty with the goal of protecting human health and the environment from persistent organic pollutants. Under the Convention, the countries party to the treaty are required to use the best available techniques for new incinerators. The guidelines for best available techniques and best environmental practices limit the levels of dioxins and furans in air emissions to 0.1 ng I-TEQ/Nm3 at 11% $O_2$. Moreover, dioxins in the waste water of treatment plants treating effluents from any gas treatment scrubber effluents should be well below 0.1 ng I-TEQ per litre. In addition, the guidelines list primary and secondary measures to achieve the performance levels for removal of dioxins and furans. The primary measures are:

1. Introduction of the waste in the combustion chamber only at temperatures of ≥ 850 °C
2. Installation of auxiliary burners for start-up and shut-down operations
3. Avoid regular starting and stopping of the incineration process
4. Avoid combustion temperatures below 850°C and cold regions in the flue gas
5. Control of oxygen input depending on the heating value and consistency of feed material
6. Minimum residence time of 2 seconds above 850°C in the secondary chamber after the last injection of air or at 1100°C for wastes containing more than 1% halogenated organic substances (generally the case for medical waste) and 6% $O_2$ by volume
7. High turbulence of exhaust gases and reduction of excess air by injection of secondary air or re-circulated flue gas, pre-heating of the air-streams or regulated air inflow
8. On-line monitoring for combustion control (temperature, oxygen content, CO, dust), operation and regulation of the incinerator from a central console.

The secondary measures to further reduce dioxins and furans are an appropriate combination of dust removal equipment and other techniques, such as catalytic oxidation, gas quenching and wet or (semi-) dry adsorption systems. Furthermore, fly and bottom ash, as well as wastewater, should be treated appropriately. Carbon monoxide, oxygen in the flue gas, particulate matter, hydrogen chloride, sulphur

dioxide, nitrogen oxides, hydrogen fluoride, airflows and temperatures, pressure drops and pH in the flue gas should be routinely monitored according to national laws and manufacturer's guidance.

### General Maintenance and Operation of Incinerators

Healthcare waste incinerators should be maintained and operated in accordance with the following standards:

- The incinerator shall be operated so as to have no smoke (i.e. a non-visible emission), except during start-up, at which time smoke may not be discharged for more than five minutes, and during waste loading in which case smoke must not occur for more than three minutes in any hour of operation
- The incinerator stack shall allow free vertical discharge of waste gases to atmosphere
- Excess combustion air will be available to the incinerator's afterburner at all times
- Optimal operating temperatures in the afterburner (or secondary chamber) shall be maintained at a minimum of 1100°C and 1.0 second residence time at all times during which waste is loaded into the incinerator
- Primary chamber temperatures shall be maintained at between 650 and 950°C at all times. Waste must not be loaded into the primary chamber when temperatures are either above or below these limits
- Primary and secondary chamber temperatures shall be continuously monitored.
- Polyvinyl chloride plastics, photographic material, X-ray and other imaging materials, mercury thermometer, batteries, or Aerosols cans, or pressurized containers or ampoules or sealed vials and other items containing heavy metals shall not be burned or incinerated.
- Incinerator operators should wear the appropriate personal protective equipment at all times, including eye goggles, gloves, and work boots
- The incineration facility and area around it should be kept clean of any uncontained healthcare wastes or litter at all times.
- All incinerators or burning areas shall be fenced to prevent access by the community or animals. It shall be located away from houses and crops and shall be 30 meter away from the health care facility.
- Healthcare waste from damaged bins shall be repackaged and incinerated immediately; and
- No open burning of any healthcare waste is permitted at any time.

## Waste Disposal Systems

1. **Sharps Pit**

This method is especially suitable for the disposal of used sharps and syringes. The collected safety boxes filled with used sharps and needles will be deposited inside the concrete vault.

The following shall be observed when constructing the sharps pit:

- The site is isolated and at least 150 meters away from the water supply sources and dwelling units.
- Dig a pit (minimum size of 1m x 1m x 1.8m depth) enough to accommodate sharps/syringes for an estimated period of time.
- The pit should have concrete walls and concrete slab cover.
- Provide slab with opening/manhole for easy deposition of collected sharps and syringes. Manhole shall be extended a few centimeters above soil surface to overcome infiltration of surface water.
- Install security fence around the site with signage.

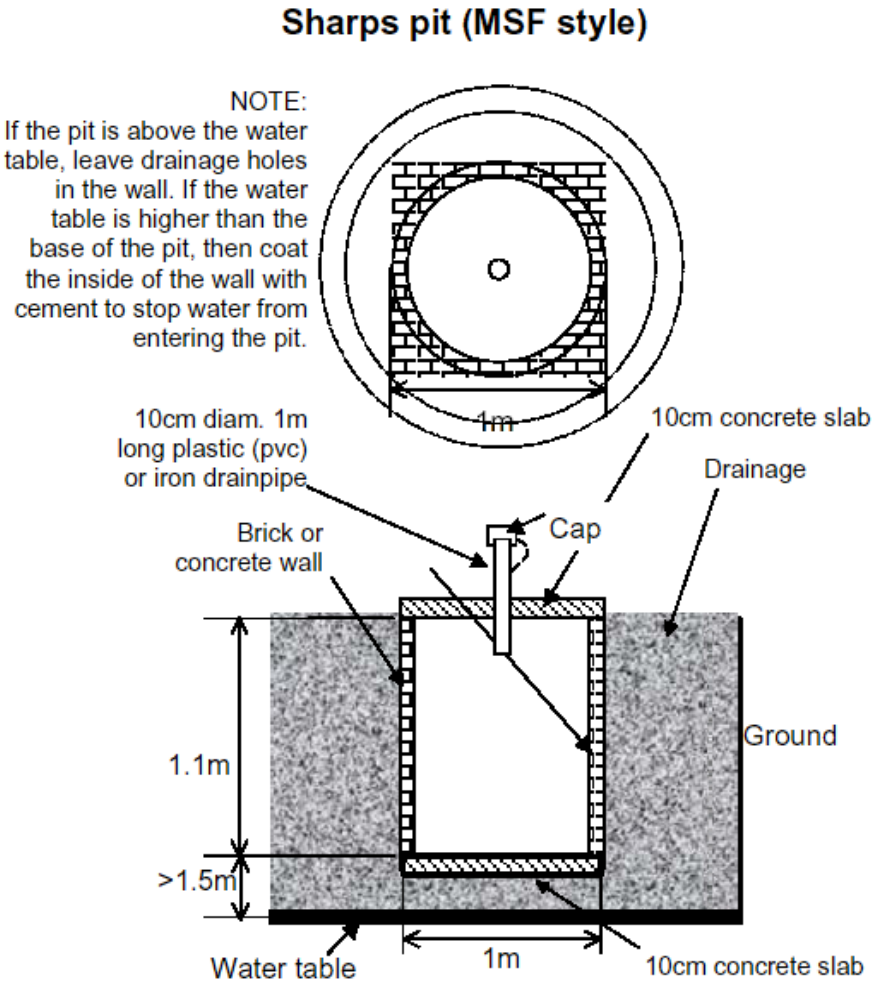


Fig. 4. Sample sharp pit design: Source: MSF

**2. Placenta Pit**

- It is recognized that in many communities, burying placentas is an important ritual and one option for disposal. If it is done safely, burial can protect the community from pathogens while respecting cultural and religious norms.
- The disposal of the placenta within the health facility can use concrete placenta pits. The process of biodegradation in the pit can destroy pathogenic microorganisms as the waste is subjected to changes in temperature, pH, and a complex series of chemical and biological reactions.
- The waste does not need to be treated with chemical disinfectants such as chlorine before being disposed of, because these chemicals destroy the microorganisms that are important for biological decomposition.
- In selecting the location of the placenta pit, the following should be considered:
    - Should be as far away as possible from publicly accessible areas and from hygienically critical areas (e.g. water wells, kitchens etc.)
    - Placenta pits should not be built too close to buildings due to possible odors
    - A safety distance of at least 1.5 meters from the bottom of the pit to the groundwater level is recommended.
    - Placenta pits are not recommended in sites where the water table is near the surface or in areas prone to flooding.

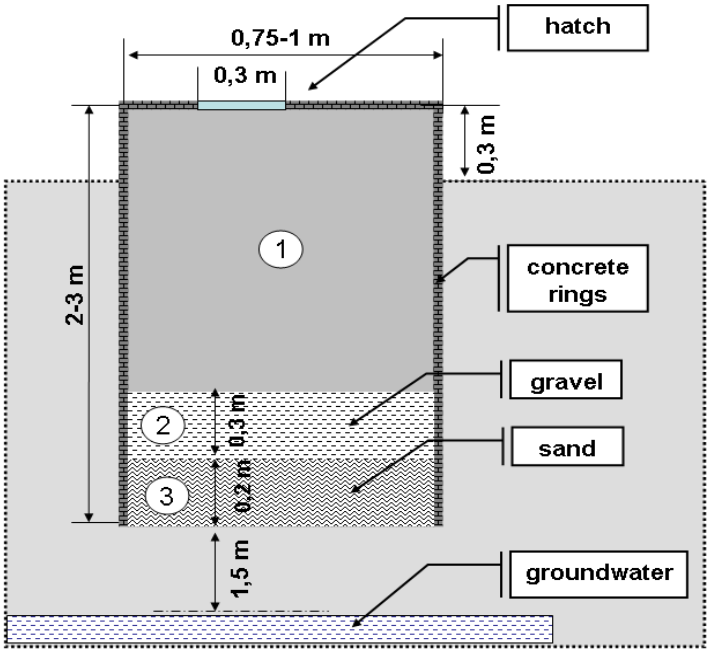


**Fig.5 Sample design for plancenta pit; source WHO 2014**

### 3. Safe On-site Burial at HCF

Safe burial of HCW within the HCF as a disposal method is applicable only to treated infectious waste, sharps waste, pathological and anatomical waste, small quantities of encapsulated/inertisized solid chemical and pharmaceutical wastes.

Safe burial may be implemented but should be considered transitional, interim solution. Safe burial of HCW shall only be allowed in the following situations:

- HCF is located in a remote and far-flung area
- Safe burial of HCW within the HCF premises is the only viable option at a specific period of time, e.g., during emergencies.

The following shall be the characteristics for the safe burial site:

- Not located in flood prone areas, downhill or down-gradient from any nearby wells and about 50 meters away from any water body such as rivers or lakes to prevent contaminating water source
- New water wells should not be dug near the disposal pit
- Bottom of the pit located at least 1.5 meters above groundwater level
- Secured (e.g., fenced with warning signs), accessible only to authorized personnel
- Lined with a material of low permeability, such as clay, to prevent pollution of shallow groundwater that may subsequently reach nearby wells
- Allow only hazardous HCW to be buried after treatment.
- Managed as a landfill, with each layer of waste covered with a layer of soil to prevent odor, as well as to prevent proliferation of rodents and insects

The HCF should keep a permanent record of the size and location of all their on-site burial pits to prevent construction workers, builders, and others from digging in those areas in the future.

Safe on-site burial is practicable only for a relatively limited period, about 1 to 2 years, and for relatively small quantities of waste, about 5 to 10 tons in total. When these conditions are exceeded, a long-term solution will be needed.

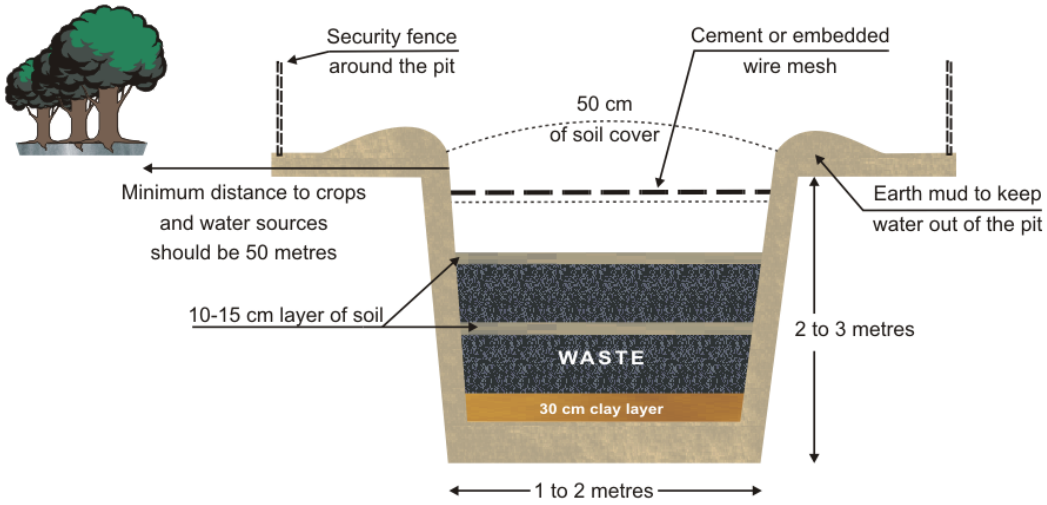


**Fig.3. Onsite safe waste burial pit design.**

## 4. Sanitary engineered Landfills

- HCW properly treated with the appropriate technology can be disposed in a sanitary landfill but not mixed with municipal wastes. Dedicated cells for treated HCW should be provided in the sanitary landfill.
- To allow the disposal of the HCW to the sanitary landfill, the following must be met:
    - The waste treatment facility/system for the treatment of infectious and sharps wastes passed the standards for microbial inactivation test; and the properly treated HCW passed the spore strip test.
- The landfill should:
    - Be accessible for easy delivery of material to be disposed
    - Have landfill personnel capable of effective control of daily operations
    - Have adequate sealing of the base and sides to minimize the movement of wastewater (leachate)
    - Have adequate mechanisms for leachate collection and treatment systems
    - Have an organized deposit of waste in a small area, allowing waste to be spread, compacted, and covered daily
    - Have surface water collection trenches around site boundaries
    - Have a construction of a final cover to minimize rainwater infiltration when each phase of the landfill is completed.

- Certain types of HCW, such as anatomical waste, will still have an offensive visual impact after treatment and preferably should not be landfilled. Disposing of such waste in landfill may also be culturally or religiously unacceptable. Such wastes should be placed in approved burial grounds or cremated.

## Management of wastes from home care services

- Home care generates waste that typically includes needles, syringes, lancets, other sharp objects, soiled bandages, gauze, disposable sheets, tubing, and used medical gloves.
- If improperly thrown in trash bags along with regular trash, these wastes can be a source of infection and injury to the public. The disposal of clinical waste in a patient's home, where the patient is treated by a Boma Health Worker (BHW) or a health care professional, is the responsibility of that BHW or the health care professional giving the treatment.
- If the waste is classified as non-hazardous, (non-infectious) and as long as it is double bagged in a small translucent/white bag and sealed, it is acceptable for the waste to be disposed of with household waste. This is usually the case with plasters, small dressings, sanitary towels and incontinence products.
- If the waste is classified as hazardous in the patient's home, the health care professional can remove that waste and transport it in approved containers (i.e. rigid, leak proof, sealed, secured etc.) and take it to the nearest HCF with HCW disposal units.
- The caregivers who are family members can also do the same procedure to dispose of hazardous and infectious waste ensuring always to follow the required type of containers.

## Management of wastes from immunization campaign and other outreach activities

Immunization activities generate sharps and infectious non-sharp wastes that should be properly managed on-site to avoid or reduce its negative health impacts on the community and the providers.

- Always segregate sharps from non-sharps at the source
- Prepare sufficient number of sharps safety boxes for the day
- Immediately after use, discard entire syringe with needle into a safety box without recapping needles
- Put safety boxes into plastic bags closed hermetically when full to avoid any leakage during transportation.
- Mark the bag clearly.
- Put empty vials into waste containers with plastic lining to avoid leakage.

- Seal/mark clearly when full. Once nearly full, put it aside and make sure that waste handlers close, seal it with adhesive tape and mark it before taking it away to the storage area and later transported to the nearest HCF for treatment and disposal.

## Healthcare waste management during emergencies

Local and/or national challenges and /or emergencies such as natural disasters and pandemics can cause unexpected increases in HCW. Developing a clear and well communicated business continuity plan (BCP) supports the understanding of measures that should be implemented in preparing for such scenarios. The following are key principles that need to be followed:

***Waste generation***

- Clinical waste volumes likely to increase – consider contingency storage facility
- Consider opportunities to minimize in-ward waste generation (i.e., reduce materials brought on to ward)
- Maintain accurate records of volumes and types of waste
- Prevent cross- contamination of PPE and packaging
- Understand transmission routes and whether waste management is a vector

***Waste classification and segregation***

- Classify infectious waste as it would be at any other time
- Stick to existing color coding principles
- Check requirements for waste to be double-bagged or kept in storage for specific periods of time
- Requirements may vary subject to whether the patient is infected or not

**Transport and packing**

- In accordance with relevant guidance and regulation, unless otherwise specified in response to specific pandemic
- There is likely to be a strain on support systems: collection and transport infrastructure

**Treatment and disposal**

- Logistics and waste treatment demand may be coordinated centrally where incident response team is established
- Consider opportunities for on-site treatment

- Likely to involve same treatment and disposal methods as other infectious wastes
- Check for temporary changes in regulation

**Summary of recommendations for treatment and disposal options for various waste types at the different levels of care**

| Waste type | Treatment at Health care facility level | Final disposal/ Recycle method |
|---|---|---|
| **Non-infectious General waste (food, paper, packing materials, plastics) etc.** | Recycling (cardboard, paper, plastics, glass), Bio digestion, Composting, handed over to municipal/ city council<br>- PHCC/PHCU/Clinic – Composting.<br>- County hospital– Composting, Bio digestion<br>- State and Tertiary/Teaching Hospitals – Bio-digestion, composting. | - Reuse/Recycling of plastics, papers, packaging materials, etc.<br>- Sanitary Landfill<br>- Protected pits |
| **Infectious Waste (Sharps, Patient waste)** | - Non-incineration (Autoclave, microwave) – All hospitals<br>- Incineration – PHCUs, PHCCs, All hospitals | - Sanitary Landfill with general waste (after treatment)<br>- Sharp pit<br>- landfill ash (ash) residues but requires treatment e.g encapsulation, Stabilization |
| **Highly Infectious Waste** | - Non-incineration (Autoclave, microwave) – All hospitals<br>- Incineration (high temperature) – PHCCs and all hospitals.<br>- Incineration (on-site and emergency cases) – All levels | - Land fill |
| **Pathological/organic Human tissue** | - Pathological/placenta pit – PHCC and all hospitals<br>- Approved Burial Grounds with chemical disinfection- PHCUs, PHCCs (with chemical disinfection for infected waste) | - Landfill |
| **Pharmaceutical waste (tablets and capsules Syrups and injectable Cytotoxic drugs, Vaccines)** | - High temperature (1100oC) incinerators | - Landfill |
| **Radioactive waste** | - Storage decay<br>- Immobilization in consultation with South Sudan FDCA – All levels | - Recovery, landfill |

| | | |
|---|---|---|
| **Chemical Acids, Alkali** | - Dilute with large volumes of water (12x) – All levels | - Wastewater treatment/ sewage system |
| **E-waste** | - Refer to E-waste regulation | |
| | | |

# Chapter 4: Waste water treatment and disposal

- Health care wastewater is any water that has been adversely affected in quality during the provision of health care services. It is mainly liquid waste produced during health care-related processes. Segregation, minimization, and safe storage of hazardous materials are just as important for liquid wastes as they are for solid wastes.
- The basic principle underlying effective wastewater management in healthcare facilities is a strict limit on the discharge of hazardous liquid to sewers. Waste water from healthcare facilities contains potentially hazardous elements including:
    - Microbiological pathogens (bacteria, viruses and helminths), which are easily transmitted through water
    - Small amounts of hazardous chemicals from cleaning and disinfection operations.
- Wastewater or sewage from healthcare facilities can be discharged into domestic (municipal or city) sewers without pre-treatment, provided that the following requirements are met:
    - The municipal sewers are connected to an efficiently operated sewage treatment plant that ensures at least 95% removal of bacteria.
    - The sludge resulting from the sewage treatment plant is subjected to anaerobic digestion, leaving no more than one helminth (parasite) egg per litre in the digested sludge.
- Hazardous wastewater with significant quantities of toxic chemicals (e.g. formaldehyde, pharmaceuticals, radionuclides, cytotoxic drugs and antibiotics) coming from laboratories, research centres, clinics, mortuary and autopsy centres, should be discharged to a pre-treatment/neutralization tank for neutralization and disinfection by chlorination prior to discharge or connection to the sewage treatment plant.

**Wastewater treatment on-site**

- It is recommended that healthcare facilities/institutions that do not have access to municipal wastewater (sewage) treatment should have their own wastewater septic tanks.
- The septic tank should provide for primary treatment, comprising a primary sedimentation tank and digestive chamber. This action results in partial biodegradation for organic pollutants.
- Septic tanks must be occasionally serviced by a vacuum tanker for final treatment and disposal of the sewage in a sewage treatment plant.

**Off-Site Treatment of Wastewater**

- Healthcare facilities situated where there is a main sewer line should connect to an approved off-site treatment facility.
- Healthcare facilities should have an inventory or database of all chemicals, disinfectants and detergents used. Each chemical should have a material safety data sheet.

**Summary of minimum Standards for Wastewater Treatment and Disposal**

- Healthcare facilities/institutions that do not have access to municipal wastewater (sewage) treatment should have their own wastewater treatment facilities.
- Healthcare facilities situated where there is a main sewer line should connect to an approved off-site treatment facility.
- Healthcare facilities should have an inventory or database of all chemicals, disinfectants and detergents used. Each chemical should have a material safety data sheet.
- Healthcare facilities/institutions must have a contingency plan for dealing with spillages/failures of wastewater treatment systems.

# Chapter 5: Health and safety practices

Healthcare waste management plans developed by each facility must include arrangements for the continuous monitoring of health and safety. This is to ensure that correct handling, treatment, storage and disposal procedures are being followed.

## Risk Assessment

Healthcare facilities should conduct risk assessments at least every six months. The assessment needs to follow the basic steps of:

- Hazard identification
- Exposure assessment: who might be harmed and how
- Dose response assessment: evaluate the risk and decide on proper precautions
- Risk characterization: create or review and update the assessment, as necessary.

## Training

Healthcare workers must be trained on healthcare waste management before starting work, and then on a routine basis (annually) to update their knowledge of prevention and control measures.

## Personal Protection

- All staff must be provided with, and use, appropriate PPE.
- Workers handling healthcare waste must, at the minimum, be provided with:
    - Heavy-duty gloves
    - Industrial aprons
    - Overalls (coveralls); and
    - Leg protectors and/or industrial boots.
- Incinerator operators must be provided with, and use, the following additional items of PPE:
    - Face masks; and
    - Noise protection.
- Healthcare facilities must ensure that a system is in place to monitor the correct use of PPE.

## Response to Injuries

- All healthcare staff must be trained to deal with occupational injuries and exposure.
- A program prescribing the actions to be taken in the event of an incident, injury or exposure must be put in place and should include (but not be limited to) the following:
    - Immediate first aid measures according to the national post exposure guidelines.
    - An immediate report of the incident to a designated responsible person

- Retention, if possible, of the item involved in the incident, with details of its source for identification of possible infection
- Additional medical attention in the accident and emergency unit as soon as possible
- Continued Medical surveillance
- Blood or other tests if indicated
- Recording of the incident
- Investigation of the incident
- Identification and implementation of remedial action to prevent a similar incident in the future.

### Reporting Accidents and Incidents

- Accidents or incidents, including near-misses, spillage, damaged containers, inappropriate segregation and any incidents involving sharps, should be reported to the Waste Management Committee/ IPC committee or Waste Management Officer.
- The report should include the following details:
  - The nature of the accident or incident
  - The place and time of the accident
  - The staff who were directly involved; and
  - Any other relevant circumstances.
- The waste management officer or other responsible officer should investigate the cause of the accident or incident, and take all possible action to prevent recurrence.

## Minimum Standards for Health and Safety Practices

- Healthcare facilities must conduct risk assessments at least every six months.
- All staff must be provided with, and use, appropriate PPE
- All healthcare staff must be trained to deal with occupational injuries and exposure.
- All accidents or incidents must be reported and investigated.

# Chapter 7: Administrative requirements of the health facility

The HCF has to comply with certain administrative requirements for a functional HCWM.

The following are the administrative requirements for the HCF:

1. Organization of a HCWM Committee if there is no existing IPC committee
    a) Clarify on functions, roles, and responsibilities
    b) Designation, identification, and appointment of core members
2. Formulation of a comprehensive HCWM Plan
    a) Assessment of waste generation and waste disposal
    b) Review of existing HCWM policies and procedures being implemented
    c) Formulation and drafting of HCWM Plan
3. Adoption of different approaches to waste management as tools in the development of HCWM Plan:
    a) Life Cycle Analysis (LCA) is a "cradle to grave" approach to estimate the cumulative environmental impacts associated with the life cycle (manufacture, use and maintenance to its final disposal) of a product, process, or service.
    b) Environmental Management System is a continuous process of improvement which involves environmental planning, implementation, checking and management review on the programs being implemented within the HCF in compliance with existing environmental and HCWM laws and policies.
4. Monitoring and Evaluation of the HCWM Plan – This is to validate the effectiveness and the efficiency of the HCWM Plan. The six major parameters that will be used to determine the extent of the plan implementation are the following:
    a) Waste Minimization Practices
    b) Waste Segregation
    c) Waste On-Site Collection, Transport and Disposal
    d) Waste Treatment On-Site
    e) Wastewater Management
    f) Administrative Controls
5. Communication and Training – All HCFs, the SMoH and the County Health Departments (CHDs) have the responsibility and a "duty of care" for the environment and public health, particularly in the institutionalization of awareness among HCW and the general public.

a) Methods of communication and training used

b) Training of health care workers

c) Training package for each target group

## Composition of a Hospital waste management committee in absence of an existing IPC committee[9]

A typical waste-management committee in a large hospital may contain the following members:

- Head of Hospital (as chairperson)
- Heads of hospital departments
- Infection-control officer
- Chief pharmacist
- Radiation officer
- Matron (or senior nursing officer)
- Hospital Administrator
- Hospital engineer
- Financial controller
- Waste-management officer (if one is designated).

## The responsibilities of the HCWM/IPC Committee

The HCWM Committee shall be responsible for the following functions:

i. Formulate a policy formalizing the HCF commitment to properly manage its waste with the goal of protecting health and the environment

ii. Establish baseline data and develop the HCWM Plan, which shall include a minimization plan, training, and written guidelines on waste management

iii. Implement the HCWM Plan; review and update the policy, plans, and guidelines on an annual basis

iv. Ensure adequate financial and human resources for HCWM Plan implementation

v. Conduct regular committee meeting and submit minutes of meeting

vi. Regularly monitor and evaluate the HCWM Plan efficiency and effectiveness

[9] In case, the facility already has an IPC committee, the functions will be performed by the IPC committee which should include a HCWM representative as a member. There will be no need to form a parallel committee for HCWM.

vii. Ensure strict compliance with existing laws, policies, and guidelines; instituting disciplinary actions against individuals who are non-compliant while rewarding/ recognizing excellent performance.

In an institution that is not directly involved in patient care, such as a medical research lab or the public health lab, the head of the establishment should use their discretion to appoint members of the Waste Management Team from among the relevant staff.

## Health facility waste management plan

- Hospitals should aim to establish a formal waste management plan. This is a document that contains the combined knowledge and decisions for all involved in the production, handling and treatment of wastes. A senior person at the HCF should be chosen and made responsible for preparing the plan, collecting ideas from others and, once agreed, promoting the way HCW should be managed to medical and ancillary staff.
- At a PHCC and PHCU level, the local plan would be a shorter description of the waste management arrangements that should be put in place in each medical area. It identifies who is responsible for good practices in each area, where the waste will go, and how it should be disposed of after a cleaner or porter has removed it.
- The waste management plan should be developed in close consultation with all members of the Waste Management Team. The plan should analyze existing practices in the HCF and its development should be based on the National HCWM guidelines. It should as a minimum consider the following:
    - ✓ Quantities of waste generated
    - ✓ Possibilities for waste minimization, reuse, and recycling
    - ✓ Waste segregation, on-site handling, transport, and storage practices
    - ✓ Identification, evaluation of waste treatment and disposal options (on- and off-site)
    - ✓ Training
    - ✓ Estimation of costs relating to waste management (actual situation and proposed options); and
    - ✓ Strategy for the implementation of the plan.