# Infection Prevention and Control

## Standard precautions:

## Waste management

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Contents

## Standard precautions: Waste management

**Overview**: In this course, we will learn about health care waste includes all waste generated by health, research, and laboratory facilities in the course of providing health care services. Health care waste in a facility should be managed from the point of generation to final disposal and removal.

Medical waste management is an important public health concern worldwide. One of the first critical steps in the process of developing a reliable waste management plan requires a comprehensive understanding of the quantities and qualities of the wastes that needs to be managed. **Learning objectives**: By the end of this course, you should be able to:

- Identify the categories and sources of waste at a health care facility;
- Describe the best practices for minimizing, segregating, collecting, transporting and storing health care waste and disposal (off-site and on-site); and
- Identify the recommended treatment and final disposal methods for health care waste.

**Risks associated**

Inadequate and inappropriate handling of health-care waste may have serious public health consequences and a significant impact on the environment. Sound management of health-care waste is thus a crucial component of environmental health protection. All individuals exposed to hazardous Healthcare waste are potentially at risk of being injured or infected. They include:

- **Medical staff:** doctors, nurses, sanitary staff and hospital maintenance personnel;
- **In- and out-patients** receiving treatment in healthcare facilities as well as their visitors;
- Workers in support services linked to healthcare facilities such as **laundries, waste handling, and transportation services;**
- **Workers** in waste disposal facilities, including **scavengers**;
- The general public and, more specifically, **children** playing with the items they can find in the waste outside the healthcare facilities when it is directly accessible to them.

## Categories & sources of waste

Healthcare waste is divided into two main categories: hazardous and non-hazardous. If waste is not segregated correctly, hazardous waste can contaminate non-hazardous waste. This can make collection, transport, treatment, and disposal of waste difficult and hazardous. Also, treating non-hazardous waste as though it is hazardous results in wasted resources and effort.

**Category 1: Hazardous waste**

Hazardous waste can harm people and the environment. The types of hazardous waste in a facility vary according to the size of the facility and the services offered. Examples of hazardous waste are listed below.

**Examples of infectious waste:**

- **Sharps waste** is used or unused sharp items that could cause cuts or puncture wounds that can lead to infection. Examples include instruments (such as scalpels and blades), needles, syringes, and broken glass or ampoules;
- **Pathological waste (anatomical waste)**. Examples include human tissues or fluids (such as blood and body fluids), organs (body parts), placentas and fetuses and unused blood products;
- **Other infectious waste**. Examples include soiled gloves, gauze, or bandages that are contaminated with blood, body fluids, viruses, or parasites.

**Examples of other hazardous waste:**

- **Pharmaceutical waste** is used, expired, or no longer needed pharmaceutical products (such as vaccines and drugs);
- **Chemical waste**. Examples include chemical substances (such as laboratory reagents or film developer), expired disinfectants, solvents and waste with high heavy-metal content (such as batteries, broken thermometers, and blood pressure gauges);
- **Genotoxic** (harmful to human genes) and **cytotoxic** (harmful to human cells) waste isn't common unless the facility treats cancer patients. It includes drugs used in cancer treatment, body fluids from patients exposed to chemotherapy or cytotoxic drugs, and other material contaminated by these agents.
- **Radioactive waste:** radioactive substances (such as unused liquids from radiotherapy or laboratory research), glassware, packages, or absorbent paper contaminated with a radioactive substance, urine, and excreta from patients treated or tested with radionuclides and sealed sources (containers in which radioactive substances are stored and sealed).

**Category 2: Non-hazardous waste**

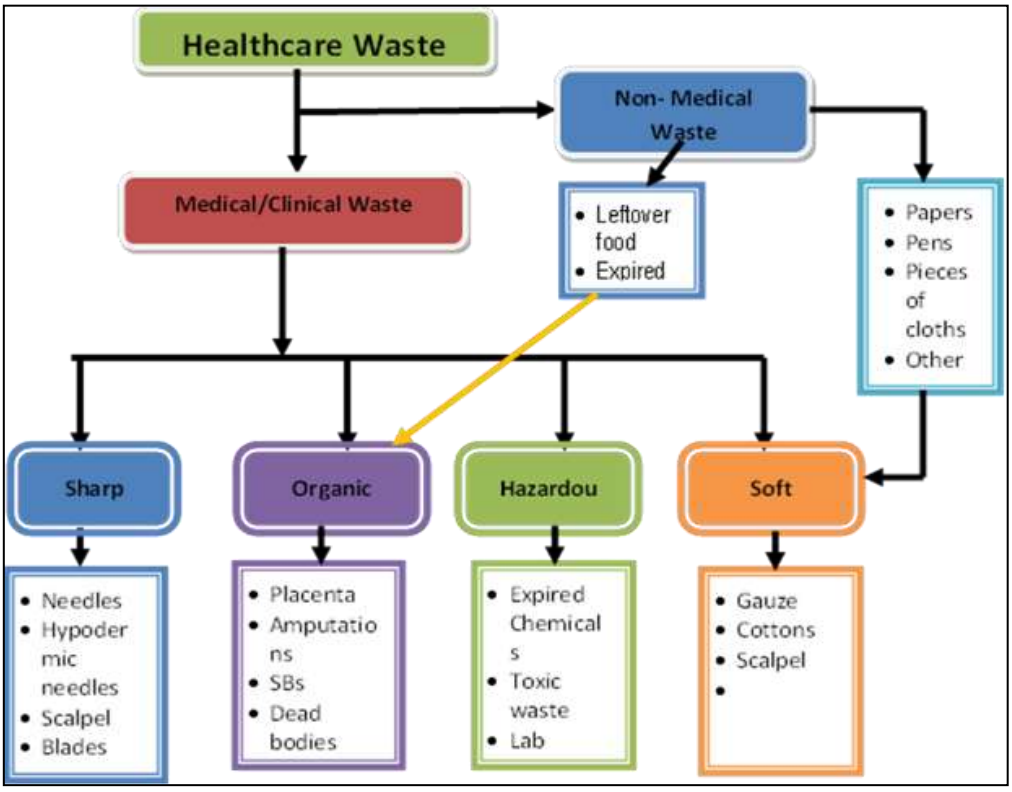
Non-hazardous waste does not pose a biological, chemical, radioactive, or physical risk to people or the environment, and can be disposed of as municipal waste. The *municipal waste is general waste generated mainly by households and commercial activities, and ideally collected by municipalities (e.g., local villages or cities) for disposal. Municipal waste should not contain untreated health care waste.*

**Examples** include paper, boxes, bottles, plastic containers, and personal protective equipment (PPE) that have not been contaminated with bodily fluids or used in an isolation area.

**Solid Waste Management**

Let us take a look at the steps of the waste management process.


These next several learning activities will cover the steps in the waste management process in more detail. We will start by looking at how to minimize waste.




**Minimizing waste**

Where feasible, minimizing the amount of waste that is produced by a health care facility is a proper waste management practice. Waste minimization is most commonly applied at the point of generation, but it can also happen before items even enter the health care facility. Some examples of good waste minimization practice include:

- Select materials with minimal packaging.
- Choosing equipment that can be reprocessed locally—that is, appropriately cleaned, disinfected, and/or sterilized for reuse.
- Changing (or substituting) products, for example, using steam sterilization in place of a toxic chemical disinfectant (i.e., glutaraldehyde).

**Segregating waste**

Waste segregation can substantially reduce the quantity of healthcare waste that requires specialized treatment. Health care facilities should segregate waste when and where it is generated, such as before leaving a patient's room, examination room, operating theatre, or laboratory. Staff should discard waste in the appropriate color-coded containers, based on the potential hazard of the waste and the treatment and final disposal methods. This step prevents staff from having to handle and separate waste later by hand—which is dangerous and should never be done.

| Type Of Waste | Colour of container and Markings | Types of container |
|---|---|---|
| Infectious Medical Waste | Yellow – marked infectious or with biohazard symbol (Marked "SHARPS" if it contains sharps.) | Leak proof plastic bag or puncture proof containers |
| Radioactive Medical Waste | Colour varies in different countries but is always marked with radioactive symbol | Sealed lead container. |
| Hazardous Medical Waste | Yellow or red depending on country | Puncture proof container |
| General Medical Waste | Black | Plastic bag inside of a container or on its own. |

Segregate waste by employing, at a minimum, a three-bin system. Use labeled or color-coded waste containers.


Let us now read about WHO's recommended segregation scheme.

**General waste**

Put general health care waste, such as food scraps and office waste, in a black colored container lined with a plain plastic bag. Do not put this kind of waste in containers or bags with biohazard symbols on them. Look at this ward's color-coded waste segregation system.

**Hazardous sharps waste**

Dispose of hazardous sharps waste, such as syringes, scalpels, suture needles, and glass, in a puncture-resistant sharps container to prevent needlesticks, cuts, and puncture injuries. Sharps containers should be **labeled with a biohazard symbol and designated "sharps."** Sharps containers should be located within arm's reach of where sharps are used. Avoid overfilling sharps containers- seal and discard them when they're three-quarters full to prevent needlestick injury. The single use sharps containers should not be used again, while disinfect reusable sharps boxes with 0.5% chlorine solution before putting back into circulation. Cardboard sharps boxes are incinerated and not returned to circulation.

There are two appropriate sharps containers in this photo—one on the left side of the table and one on the right; in this case, they happen to be yellow. The sharps bin on the left has a hard plastic top with a sealable lid. The sharps bin on the right looks a bit different—it is made of cardboard, and sharps are inserted through a hole in the top. Both serve the same purpose. Note that they are located at the point of care, close to the patient's bedside, for safe and secure disposal.

If the procurement of suitable sharps containers is difficult, you can provide low-cost options. Make improvised sharps containers from metal containers, plastic bottles, or durable cardboard boxes. Label them as "sharps waste." Make sure you can completely close and tightly seal this container when it is three-quarters full to prevent it from being opened before final disposal.

**Note:** There are advantages and disadvantages to different types of sharps boxes. Cardboard is easier to burn and cheaper to procure but might be less suitable in humid conditions. Rigid plastic boxes are sturdier and are designed to remain closed once the lid is secured.

**Hazardous waste**

Other hazardous waste, such as pathological and infectious waste, should go in a separate container that is:

- Leakproof and puncture-resistant;
- Covered with a lid;
- Appropriately labeled with the biohazards symbol and color-coded. Provide a red bin with a red plastic liner in convenient locations across the health facility;
- Lined with a plastic bag that is closed and discarded when three-quarters full to enable bag closure and safe transport;
- Disinfect the red bins with 0.5% active chlorine solution before putting back into circulation.

Look at this example of waste segregation. It is easy to see that the red bin is labeled as infectious waste. The blue bin for non-infectious waste should be more significant since 85% of waste is non-infectious.

**Key Point:** *In your facility, the color of the container might be different than the color coding described here. What is crucial is that the color-coding is standardized, and the container is labeled with the type of waste and that health care personnel know which types of waste go in which container.*

### Other hazardous waste

Other hazardous waste like chemical, pharmaceutical, and radioactive waste should be packaged and labeled with the appropriate hazard symbol. Make sure that the packaging material does not react with the hazardous components of the waste.

### Collecting, transporting & storing waste

After waste is segregated, designate staff for each ward or unit to collect and transport it for disposal or transport it to a dedicated storage area to await disposal. We will now look at the collection, transportation, and storage steps in the waste management process.

#### Collection

When handling hazardous or infectious waste, always wear PPE. PPE should include:

The following materials should be used in the process of cleaning and disinfection:

- PPE for cleaners
- Scrubs
- Apron
- Face shield/visor
- Rubber boots
- Examination gloves
- Heavy-duty gloves
- Soap, water
- Chlorine solution
- Mops
- Mop buckets
- Disposable towels
- Infectious waste bin
- General waste bin

Bin for reusable PPE, such as aprons, gloves, and gumbootsRemember to remove PPE and perform **hand hygiene** after handling waste.

If you are collecting bags, tie them securely closed. Do not shake or squeeze bags to create more space in the bag when sealing them. Carry sealed bags at the top—that is, by the neck—and away from your body. Lifting or holding bags by the bottom or sides could cause

injury (such as by sharp objects piercing through the bag), especially if they contain waste that was incorrectly discarded. Be sure that the bags are not broken, opened, dropped, or thrown.

**Transportation**

Equipment in the health care facility that holds and transports waste should not be used for any other purpose. If available, use separate equipment, such as a trolley or a wheelbarrow, to transport hazardous and non-hazardous waste separately. Dedicated equipment should be:

- Easy to load and unload
- Not have sharp edges that might tear bags or damaged containers
- Easy to clean
- Clearly labeled

The **internal waste collection** should have the following considerations:

- **Waste transport** should take place during less busy times whenever possible;
- Set **routes** should be used to prevent exposure to staff and patients and to **minimize the passage** of loaded carts through patient care and other clean areas;
- Regular transport routes and **collection times** should be fixed and followed;
- Transport staff should wear **adequate personal protective equipment**, gloves, strong and closed shoes, overalls and masks.
- **Hazardous** and **non-hazardous** waste should always be transported separately.
- **Hazardous and non-hazardous waste should always be transported separately. In general, there are three different transport systems:**
- Waste transportation trolleys for general waste should be painted **black**, only be used for non-hazardous waste types and labeled clearly “General waste” or “Non-hazardous waste”;
- Infectious waste can be transported together with used sharps waste. Infectious waste should not be transported together with other hazardous waste, to prevent the possible spread of infectious agents.

**Storage**

Store waste until it can be either treated or transported offsite. Health care facilities should have an operating plan for waste so that the need to store waste is minimized. When creating an operating plan, consider the volume of waste produced daily, waste management staffing needs, the size of storage areas, and the final disposal method.

Waste storage areas can be located within the health care facility or in a designated area on the grounds. Whether kept indoors or outdoors, waste should be secured from people and animals, and protected from the rain. Make sure the waste storage area is easily accessible by staff in charge of handling waste. If waste is transported offsite, consider placing the storage area where waste-collection vehicles have easy access. Waste storage areas should be of appropriate size for the volume of waste generated by the health care facility. Infectious waste should not exceed the following periods:

| **Temperate climate:** | **Warm climate:** |
|---|---|
| ▪ 72 hours in winter<br>▪ 48 hours in summer | ▪ 48 hours during the cool season<br>▪ 24 hours during the hot season |

If a refrigerated storage room is available, infectious waste can be stored for more than a week, cooled to a temperature no higher than 3°C to 8°C.

**Waste Storage considerations**

- **Storage containers** should have **lids** and should be watertight in order to hold liquids;
- Open cardboard boxes are **not recommended** since these can easily be tipped over and they disintegrate easily;
- The size of the container will depend on the **volume of waste** generated in each location but should be easy to handle and transport;
- It is recommended that containers of **uniform color** be provided for each type of waste through the health facility;
- Facilitates ease of **identification** and helps to **avoid confusion;**
- Containers should be **labeled**, especially when containing infectious waste or sharps. Sharps (needles, blades, etc.) should be stored in sharp boxes (temporary or plastic).

This picture represents a situation that should be avoided—there is a large volume of general and infectious waste that has accumulated over time and a collector searching for recyclables.

**Treating & disposing of waste**

After collection, health care waste is treated and/or disposed of according to its type. WHO recommends treating hazardous waste before disposal to minimize risk and hazard. The disposal method depends on how it has been treated, as well as on the type and quantity of waste, available space on site, and access to off-site disposal options.

While general non-hazardous health care waste (municipal waste) can be disposed of without treatment, hazardous waste should be treated before final disposal. Health care facilities should conduct a risk assessment based on the type and quantity of waste and access to resources, and choose the methods that will pose the least risk to the community and the environment.

| Category of Healthcare Waste | Treatment method | Disposal |
|---|---|---|
| Infectious clinical | Alternative treatment or hazardous waste incineration | Energy from waste or landfill |
| Offensive waste | | Energy from waste or Landfill |
| Non-medicine contaminated sharps | Alternative treatment or hazardous waste incineration | Residual ash recovery or landfill |
| Medicine contaminated sharps | Hazardous waste incineration | Incineration |
| Cytotoxic & cytostatic | Hazardous waste incineration | Incineration |
| Medicine waste | Hazardous waste incineration | Incineration |
| Medicine contaminated infectious clinical waste | Hazardous waste incineration | Incineration |
| Domestic or municipal waste | | Re-use, recycle, energy from waste or landfill |

**Thermal methods**

Thermal methods, which destroy microorganisms in waste through heat, include low- and high-heat technologies.

- Non-combustion (low-heat) processes, like autoclaves* and steam-based treatment systems, operate at 100–180 °C (212–356 °F). This is a picture of autoclaves, which use steam to decontaminate medical waste.

**Autoclaves: A process that achieves a specified heat and pressure to inactivate a range of infectious waste, including sharps, materials contaminated with organic materials, cultures from the laboratory, and other potentially infectious patient care waste. To guarantee full decontamination of infectious materials, the process needs to be validated. The validation process consists of verifying in a certified and documented manner that a process meets the requirements for which it was designed. Part of this is regular testing using biological, chemical, and physical test parameters.*

**Disposal sites**

In the previous section, we mentioned various types of disposal sites. We will now learn about these sites in more detail.

**Landfills**

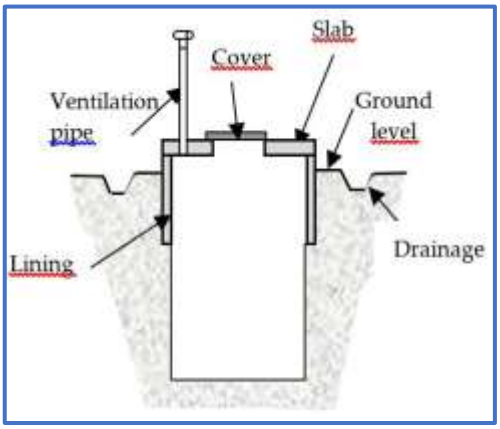
If done correctly, the disposal of health care waste—both treated and untreated—in landfills can protect staff, the community, and the environment. Landfills are specifically designed and engineered for the safe disposal of waste on land. Properly built landfills:

- Restrict access to prevent scavenging
- Prevent infiltration by water
- Are lined with a low-permeability material (such as clay)

Ideally, by the end of each working day, waste should be spread in thin layers, compacted, and covered with soil. Gases should not be allowed to accumulate to the extent they become hazardous.

**Placenta pits**

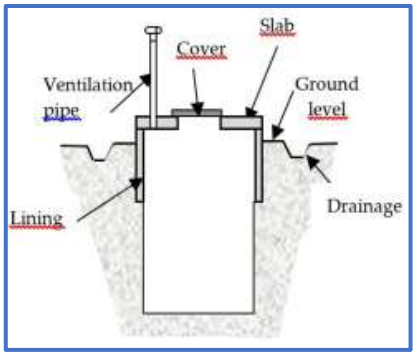
In many cultures, burying placentas is a vital custom. In low-resource settings, a placenta pit is a useful option for safe disposal. The site for a placenta pit should minimize public accessibility; the size will depend upon the number of daily childbirths at the facility. On average, one placenta and its associated fluids will require 5 liters (1.5 gallons) of pit capacity. Natural degradation and the draining of liquid into the subsoil significantly reduce the volume of waste in the pit and facilitates the inactivation of pathogens. Small quantities of anatomical waste (body parts) can also be disposed of in placenta pits if other treatment options are not available, or if socio-cultural or religious norms prohibit other forms of treatment.



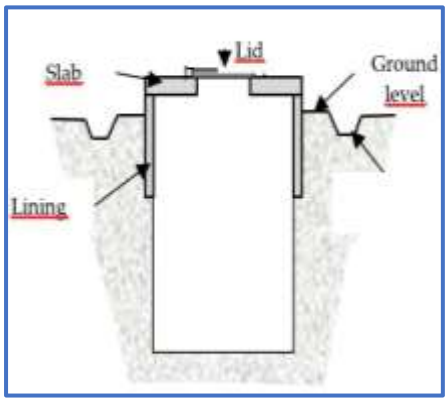

The pit should be designed to prevent waste from contaminating the surrounding groundwater. A distance of at least 1.5 meters (approximately 5 feet) from the bottom of the pit to the groundwater level is recommended. Placenta pits are not recommended for sites where the water table is near the surface, or in areas prone to flooding.

**Sharps pits**

Even after decontamination, sharps waste could still pose physical risks. There could also be a risk of reuse. Decontaminated sharps waste can be disposed of in concrete-lined sharps pits on facility premises or encapsulated by mixing waste with immobilizing material, such as cement, before disposal. These procedures are recommended only in cases where the waste is handled manually, and the landfill for general waste is not secured.



**Ash pits**




Ash from incineration is conventionally considered to be hazardous under its likely heavy metal content and the dioxins and furans it may contain. It should preferably be disposed of in sites designed for hazardous wastes, e.g., designated cells at engineered landfills, encapsulated and placed specialized mono-fil sites, or disposed of in the ground in an ash pit. The ash pit should be concrete-lined, not accessible to the public, and at least 1,5 meters above the water table.

**Small burial sites for waste disposal**

At health care facilities with limited resources, the short-term, safe burial of waste on or near the facility might be the only option available for waste disposal. Safe onsite burial is practical for only limited periods (1–2 years) and relatively small quantities of waste. The burial can be used as a method of waste disposal only where the water table is more than 4 meters (12 feet) below the surface. During this time, the health care facility should continue to look for better, more permanent methods for waste disposal.

- Combustion (high-heat) processes operate at about 200 °C (392 °F) to more than 1,000 °C (1,800 °F). The most common example of this method is incineration**.

***Incineration: The controlled and complete burning of combustible (burnable) waste. Burning can be facilitated by the addition of fuels, such as kerosene.*

Incinerators can range from extremely sophisticated, high-temperature models to fundamental units that operate at much lower temperatures. All types of incinerators, if appropriately operated, eliminate microorganisms from waste and reduce the waste to ashes. Incinerators can be efficient and affordable. This is a picture of a functioning incinerator. Notice that no items are sitting outside of the incinerator, and there is no accumulation of waste.

Following the Stockholm Convention, use the best available technology to achieve recommended levels of dioxin and furan emissions:

- 2 burning chambers (1st: 850 °C and 2nd: 1,100°C);
- Auxiliary burners;
- Sufficient resident time of air in the 2nd chamber;
- Sufficient oxygen content and high turbulence of exhaust gases;
- As well as flue gas treatment.

For health care facilities with limited resources, and where high-temperature incinerators are not affordable or feasible, De Montfort brick (double-chamber) incinerators are often used. Double-chamber incinerators allow for higher temperatures, which incinerates waste more effectively and reduces toxic emissions. Drum (single-chamber) incinerators can also be used but are not recommended. Low-temperature incinerators are considered a better option than open burning.

Avoid open burning of health care waste—it releases toxic gases and does not entirely destroy infectious waste because it cannot reach high enough temperatures. However, it can be used in emergencies, such as outbreaks of communicable disease, until incinerators or other treatment methods (such as autoclaves) become available.

**Chemical methods**

With chemical methods, waste is exposed to a chemical agent that kills microorganisms, like chlorine dioxide, sodium hypochlorite, lime solution, or calcium oxide powder. Chemical disinfection is most suitable for treating liquid waste such as blood, urine, stools, or hospital sewage. The manual chemical disinfection of solid waste is not recommended.

**Irradiation methods**

Irradiation methods use ultraviolet radiation or microwaves to destroy microorganisms. They supplement other disposal methods and are not easily accessible in low- and middle-income countries.

**Biological methods**

Biological methods, which include composting and burial, rely on the natural decomposition of organic matter. These processes are recommended for the placentas.

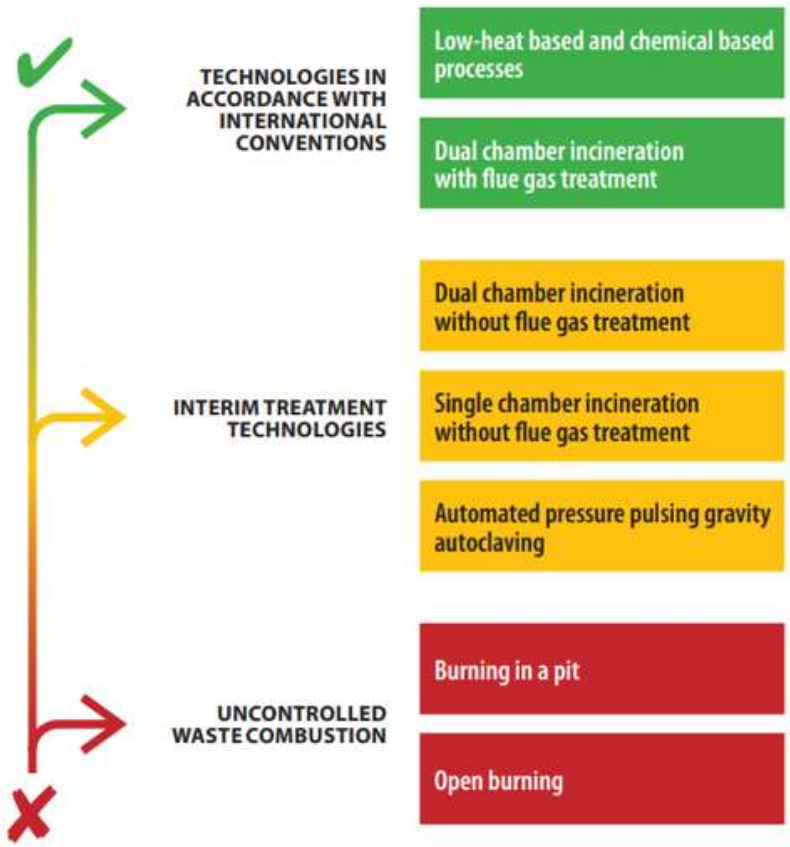
**Mechanical methods**

Mechanical methods include shredding, grinding, mixing, and compacting technologies that reduce waste volumes but do not destroy microorganisms; they usually supplement other treatment methods. These processes can be used to destroy needles and syringes. Use them only after the waste has been disinfected, or as part of a closed system.

If the treatment methods listed above are not available, small quantities of waste can be buried onsite for the short term, in an appropriately constructed burn pit, while treatment options are being identified.

**Infectious Waste Treatment and Disposal**

The figure shows the treatment technologies ladder for infectious and sharp waste: preferred options, interim treatment options, and uncontrolled – to be prevented – options.




This table shows the different methods for treating and disposing of infectious waste.

| Treatment | Disposal |
|---|---|
| Autoclave (with or without shredder) | Landfill |
| Incinerator | Ash: Ash pit / Hazardous waste landfill |

Specific types of infectious, non-sharps waste require different methods for treatment and disposal.

**Pathological/anatomical waste:** Waste in these categories is traditionally buried or cremated in incinerators. Sociocultural and religious norms might bound treatment and disposal of pathological and anatomical waste. For example, placenta waste can be buried in pits or taken home.

**Liquid infectious waste:** This type of waste includes liquid culture media, blood, body fluids, human excreta, and rinsing liquids from operating theatres. Autoclaves and incineration technologies typically available in low-resource settings are not useful for large quantities of liquids. Liquid infectious waste can be disposed of directly into a closed sewer system (such as a utility sink drain or flushable toilet) or onsite septic tank system by staff wearing PPE and taking precautions to avoid splashing. If neither is available, this waste should be poured directly into a pit latrine. Disposing of liquid infectious waste into pipes that go to open drainage canals should not be conducted without pre-treatment.

If you use the sink or toilet for disposal of liquid infectious waste, be sure to rinse with water thoroughly and clean and disinfect the sink or toilet using a 0.5% chlorine solution to remove residual waste.

**Other Hazardous Waste Treatment and Disposal**

Chemical, pharmaceutical, and radioactive waste should be included in the national strategy for hazardous waste and should be treated following international and local regulations.

Ash from incineration is considered to be hazardous because it can contain heavy metals and other toxic materials. Ash should be disposed of properly at hazardous waste sites (such as engineered landfills), encapsulated and buried, or disposed of in a concrete-lined ash pit. Avoid direct contact and inhalation, and wear appropriate PPE (such as utility gloves, plastic apron, goggles, and mask or N95 respirator).

**Other Treatment and Disposal Options**

If health care facilities cannot treat waste or return it to the manufacturer, encapsulation or inertization can be used to dispose of small quantities of sharps, chemicals, or pharmaceutical waste. These methods can reduce the risk of injury to people and minimize the risk of toxic substances migrating into surface or groundwater. These methods are rarely used.

- **Encapsulation** is a process that seals waste containers with an immobilizing material, such as cement. After hardening, the containers can be safely disposed of in a landfill.
- **Inertization** involves the mixing of waste (such as pharmaceutical and high-metal-content ash) with water, lime, and cement before disposal to reduce the risk of toxic substances leaching into surface and groundwater. Pharmaceuticals must be removed from their packaging and ground before being mixed.

**Resources**

**Waste management resources**

*The following are additional waste management resources available for download.*

- 2014 Safe management of wastes from health-care activities, 2nd ed. The new Blue Book is designed to continue to be a source of impartial health-care information and guidance on safe waste-management practices.
- 2017 Safe management of wastes from health-care activities: a summary. This document highlights the key aspects of safe health-care waste management to guide policy-makers, practitioners, and facility managers to improve such services in health-care facilities.
- 2019 Overview of treatment technologies for infectious and sharp waste from health care facilities is two-fold. The first is to provide criteria for selecting technologies to facilitate decision making for improved health care waste management in health care facilities. The second is to provide an overview of specific health care waste technologies for the treatment of solid infectious and sharp waste for health care facility administrators and planners, WASH and infection prevention control staff, national planners, donors, and partners.
- For additional resources and training, please visit WASH in health care facilities co-managed by WHO and UNICEF.

**General**

- WHO Core Components support countries as they develop and execute their national antimicrobial resistance (AMR) action plans, among other aspects of health system strengthening.
- WHO Core Components Guidelines cover eight areas of IPC and comprise 14 recommendations and best practice statements.
- Improving Infection Prevention and Control at the Health Facility Guide is a practical manual that outlines how to implement the Core Component Guidelines.
- WHO Multimodal Strategy consists of several elements (3 or more; usually 5) implemented in an integrated way to guide action and provide a clear focus for the implementer.
- WHO Infection Prevention and Control Assessment Framework (IPCAF) is a tool that can provide a baseline assessment of IPC program activities within a health care facility as well as ongoing evaluations through repeated administration to document progress over time.
- Interim Practical Manual Supporting National Implementation of the WHO Guidelines on Core Components of Infection Prevention and Control Programmes is a resource to strengthen IPC and improve the quality and safety of health service delivery through the establishment of evidence-based and locally adapted integrated IPC programs.
- Report on the Burden of Endemic Health Care-Associated Infection Worldwide presents the evidence available from the scientific literature on the endemic burden of the most frequent types of HCAI. It provides an assessment of epidemiological differences among

countries according to income levels. The report also aims to identify major obstacles and gaps to assess the magnitude of the HCAI burden worldwide and to identify solutions and future perspectives for improvement.