

Medical Waste Management

While supporting any form of medical intervention, logistics personnel may be asked to manage a variety of medical waste. Medical waste isn't defined as just the health items that are found as damaged or expired while in storage or transport, but also the byproduct of routine activities that occur in health centres and hospitals as well.

Waste Categories	Descriptions and Examples	
Hazardous Health-care Waste	Infectious waste	Waste known or suspected to contain pathogens and pose a risk of disease transmission, e.g. waste and wastewater contaminated with blood and other body fluids, including highly infectious waste such as laboratory cultures and microbiological stocks; and waste including excreta and other materials that have been in contact with patients infected with highly infectious diseases in isolation wards.
	Sharps waste	Used or unused sharps, e.g. hypodermic, intravenous or other needles; auto-disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass.
	Pathological waste	Human tissues, organs or fluids; body parts; foetuses; unused blood products.
	Pharmaceutical waste, cytotoxic waste	Pharmaceuticals that are expired or no longer needed; items contaminated by, or containing, pharmaceuticals. Cytotoxic waste containing substances with genotoxic properties, e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals.
	Chemical waste	Waste containing chemical substances, e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents; waste with high content of heavy metals, e.g. batteries, broken thermometers and blood pressure gauges.
	Radioactive waste	Waste containing radioactive substances, e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources.
Non-hazardous or General Health-care Waste	General waste	Waste that does not pose any specific biological, chemical, radioactive or physical hazard.

Taken from: [WHO - Safe management of wastes from health-care activities](#)

Medical waste can pose specific threats to humans, animals and the environment, and must be handled appropriately. Infectious waste and pathological waste products in particular are highly sensitive and should only be handled by experts that understand the process, while all of the aforementioned medical waste items are likely subject to some form of regulation or control.

International conventions such as the [Basel Convention on the Control of Transboundary Movements of Hazardous Wastes](#) or the [Stockholm Convention on Persistent Organic Pollutants \(POPs\)](#) in particular define the waste management policies for signatories, however national or local laws may also outline the procedures. The important thing for logistics personnel to know is that any form of medical waste disposal must be done in a safe and lawful manner. Under no circumstances should medical waste be disposed of with general waste.

Traditionally, the aggregation and storage of medical waste is not the role of logistics personnel and is usually left to healthcare professionals operating in medical facilities. Due to limitations on personnel and resources, logistics staff in humanitarian field settings may be required to facilitate the handling, storage or transport of medical waste.

Segregation of Medical Waste

Though local conditions may vary, as a best practice healthcare facility should segregate waste into four categories, each of which should be stored, collected and disposed of separately. The four categories are:





1. Sharps waste (needles and scalpels, etc.), which may or may not be infectious.
2. Non-sharps infectious waste (anatomical waste, pathological waste, dressings, used syringes, and used single-use gloves, etc.).
3. Non-sharps non-infectious waste (paper and packaging, etc.).
4. Hazardous waste (expired drugs, laboratory reagents, radioactive waste and insecticides, etc.).

Almost 85% of medical waste in health centers or hospitals belong to the category of non-sharps non-infectious waste. Any waste item that is cross-contaminated with infectious waste should be considered infectious waste as well, and proper segregation of non-sharps non-infectious waste from infectious waste can significantly reduce the total amount of infectious waste in a health facility. However, in many humanitarian contexts hazardous and non-hazardous healthcare waste is often not separated. If proper segregation cannot be ensured at source, consider all mixed healthcare waste as hazardous.

Medical Waste Collection

Collection and storage of medical waste must be done using suitable storage containers. If no suitable containers are available, humanitarian organisations are strongly advised to procure the appropriate storage containers. As hazardous waste is collected, each container should be properly labelled, and collected waste should be placed in a pre-defined, secure location.

WHO has recommended coding and storage for some medical waste storage, including symbols, colour coding and marking. Recommendations for some common medical waste items are:

Type of Waste	Colour Coding	Symbol	Type of Container
Household refuse (non-sharps non-infectious waste)	Black	None	Plastic bag
Sharps	Yellow and marked with a biohazard symbol:		Sharps container
Waste entailing a risk of contamination and anatomical waste	Yellow and marked with a biohazard symbol:		Plastic bag or container
Infectious waste	Yellow marked "highly infectious" and marked with a biohazard symbol:		Plastic bag or container which can be autoclaved
Chemical and pharmaceutical waste	Brown, marked with a suitable symbol (example)		Plastic bag, container

Adapted from: [ICRC - Medical Waste Management Guidelines](#)

Common storage container examples and practices include:

- Sharps should be placed immediately after use in yellow puncture-proof, covered safe sharps containers, which are regularly collected for disposal. Containers must not be filled above the line indicated on the label, and they must be sealed using the integrated safety lock prior to disposal.
- Non-sharps infectious waste should be placed in yellow or red infectious waste bags or containers (15–40-litre capacity with lids). Bags should be collected and replaced after each intervention or twice daily. Containers should be emptied, cleaned and disinfected after each intervention or twice daily.
- Non-sharps non-infectious waste should be placed in black waste containers (20–60 litre capacity). The containers should be collected, emptied, cleaned and replaced daily; alternatively, plastic bags may be used as liners inside the containers.

Adapted from: [WFP Logistics Cluster - Downstream Logistics in Pandemics](#)

For each of these three waste categories, it is recommended that waste containers are kept no more than five metres from the point of waste generation. Two sets of containers should be provided for each location, for a minimum of three types of waste, or as is required by the activities in the health facility. In hospital wards, at least one set of waste containers should be

provided per 20 beds.

Example Sharps Container

Example Biohazard Bag



Personal Protective Equipment:

Any persons tasked with collecting and handling medical waste should have the proper and necessary personal protective equipment (PPE). This may include protective eyewear, rubber gloves, aprons, respirators, and the proper body covering. Prior to handling any and all medical waste, personnel should consult with the attending medical staff about the appropriate handling protective equipment. Remember: some health related waste can be extremely hazardous or even lethal if handled incorrectly. If ever logistics personnel are in doubt about the safety of handling medical waste, they should cease activities and consult with a trained professional.

Medical Waste Storage

The storage of medical waste can and will be regulated by prevailing local and national laws. Humanitarian organisations may also have internal guidelines or regulations on storage of medical waste. As an overall rule, humanitarian responders must check on local regulations before designing storage options. Medical waste should also be handled by experienced professionals when and wherever possible. Below are general best practices that *may* be adopted if needed:

General non-hazardous waste storage	<p>General non-hazardous waste should be stored and kept for collection to recycle (where possible), dispose at a communal landfill/dumpsite, or as a last resort destroyed at communal waste incinerator. It should be collected at least every week. The storage area should be enclosed, paved and connected to a public road. The gate should be big enough that the collection vehicles can enter. If available in the location, non-hazardous cardboards, metals, plastics, paper can be sorted and recycled by local contractors and avoid the need for disposing of in landfills or incineration.</p>
Infectious and sharp waste storage	<p>The storage place must be identifiable as an infectious waste area by using the biohazard symbol. Floors and walls should be sealed or tiled to allow easy cleaning and disinfection. Storage times for infectious waste (e.g. the time gap between generation and treatment) should not exceed the following periods:</p> <ul style="list-style-type: none"> • Temperate climate: 72 hours in winter/48 hours in summer. • Warm climate: 48 hours during the cool season/24 hours during the hot season. <p>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.</p>
Pathological waste storage	<p>Pathological waste is considered biologically active and gas formation during the storage should be expected. To Minimise the possibility of this happening, storage places should have the same conditions as for infectious and sharps wastes. Where possible, waste should be stored under refrigerated conditions. In some cultures, body parts are passed to the family for ritual procedures or are buried in designated places. Bodies should be placed in sealed bags prior to release to the family to reduce the risk of infection.</p>
Pharmaceutical waste storage	<p>Pharmaceutical waste should be segregated from other wastes. International and local regulations should be followed for storage. In general, pharmaceutical wastes can be hazardous or non-hazardous, liquid or solid in nature and each type should be handled differently. The classification should be carried out by a pharmacist or other expert on pharmaceuticals.</p>
Storage of other hazardous waste	<p>When planning storage places for hazardous chemical waste, the characteristics of the specific chemicals to be stored and disposed of must be considered (i.e. inflammable, corrosive, explosive). The storage area should be enclosed and separated from other waste storage areas. Storage facilities should be labelled according to the hazard level of the stored waste.</p>
Radioactive Waste Storage	<p>Radioactive waste should be stored in compliance with national regulations and in consultation with the radiation officer. It should be placed in containers that prevent dispersion of radiation and stored behind lead shielding. Waste that is to be stored during radioactive decay should be labelled with the type of radionuclide, date, period of time before full decay and details of required storage conditions.</p>

Taken from: [WHO - Safe management of wastes from health-care activities](#)

Treatment and Disposal

The process for safe and adequate disposal of pharmaceuticals and health related items in contexts where humanitarians may operate has evolved significantly over the past several decades. Many state and local authorities now have strict regulations on the process of disposing of health waste and may include requirements far beyond the capacities of most individual humanitarian organisations.

As a primary rule, aid agencies should seek to outsource the destruction of medical waste to licensed and recognised third parties, including private companies, or through state managed entities such as local Ministries of Health. Aid agencies should also seek to understand and respect all local laws wherever applicable. Proper disposal usually has a cost associated with it, and organisations should budget for potential disposal costs.

In any situation where waste is disposed of using a third party, or by the organisation following national protocols or WHO guidelines (subject to regulatory framework), proper documentation must be retained and backed up to prove disposal was undertaken in a lawful manner. When and wherever possible, the preferred methods of disposal will always remain going through local authorities, using a certified waste disposal company, or returning products to manufacturers.

In humanitarian contexts however, such options may not always be available. To remedy this, there are a few recommended solutions, including the WHO [Guidelines on Safe Management of Pharmaceutical Waste from Healthcare Facilities](#) and the [safe management of wastes from health-care activities](#). Where disposal is done informally in large scale emergencies, the process must be documented to avoid the suspicion of diversion or health related items, or to avoid the suspicion that expired, damaged, or recalled items were handed out to beneficiaries, or sold illegally. In the event that agencies must dispose of their own medical waste, they are encouraged to speak with local Ministries of Health or other relevant body and consult with representatives from the local health cluster if available.

The [Logistics Capacity Assessments](#) website can provide humanitarian organizations with contact details for licensed waste management companies, overviews on local regulations and procedures in country including medical waste, and lists the existing waste management and recycling facilities in country.

In some local contexts, local factories or industrial plants may use medical waste as a cheap fuel source to keep kilns or smelters running. In any place where medical waste is incinerated by a nontraditional third party, all employees must receive the appropriate training.

Medical Waste Disposal Options

High Temperature Incineration

Medical grade high-heat thermal incinerators are typically comprised of two chambers:

- One chamber of 850 °C
- One chamber of 1,100 °C

Other things to consider when using high temperature incineration:

- A flue gas treatment system may be used to capture hazardous gasses.
- Well-made high temperature incinerators may have remote monitoring to measure carbon monoxide output and temperature.
- Ideally incinerators should conform to emission control standard where available.
- Left over ash and residue should be treated as hazardous waste and must be disposed as

such.

- When burning pharmaceuticals, ensure that no more than 5% of all the materials fed to an incinerator at any given time are pharmaceuticals, and avoid any PVC or plastic packaging where possible.

In some local contexts, local factories or industrial plants may use medical waste as a cheap fuel source to keep kilns or smelters running. In any place where medical waste is incinerated by a nontraditional third party, all employees must receive the appropriate training.

Small Scale Incineration

If no other option is available, small-scale incineration (single-chamber, drum and brick incinerators) or burning in a protected pit can be used, but should be considered as a last resort only. Small scale incinerators and burn pits should only be used for small quantities of medical waste.

Burning medical waste in small scale incinerators or pits will release toxic pollutants. General rules include:

- Halogenated waste, including PVC blister packs and plastic packaging should be sorted removed prior to incineration.
- The ash from burning hazardous waste is considered as hazardous and must be disposed in an ash pit.
- A burning pit should be located at an isolated area, away from housing, fenced and covered with a layer of soil after usage (at least 30 cm).
- The burned waste should be recorded, and the location noted.

Adapted from: Safe Management of Pharmaceutical Waste from Healthcare Facilities

Immobilization

Immobilization is the process of converting waste into a stable, suitable medium by encapsulation or inertization. It reduces the potential for migration or dispersion of hazardous materials during transport and disposal stages of the waste. The immobilized pharmaceutical material can be disposed of on an engineered sanitary landfill for non-hazardous waste, as the hazardous components of the waste cannot leak into the environment.

Immobilization: Encapsulation

Encapsulation is a low-cost method of immobilizing pharmaceuticals in a solid, stable medium, after which it can be buried in a landfill. The process undertaken to encapsulate pharmaceutical waste is:

- Fill a vessel like a metal drum with pharmaceutical waste and inert fillers such as plastic foam, sand, lime, cement mortar, or clay is used to prevent human contact and the environmental risk associated with the pharmaceutical residues.
- Vessels / drums sizes of 30 - 200-litres are the most often used. For large amounts of pharmaceutical fully automated stationary and mobile encapsulation devices with different capacities (~5-16 m³) are available.
- Waste and inert fillers mixed manually with a shovel, or with a manual or automatic concrete mixer.
- The vessels should be cleaned before use and should not have previously contained explosive or hazardous materials.
- Vessels should only be filled to 75% capacity with solid and semisolid pharmaceuticals; the

remaining space is filled by pouring in a medium such as cement or cement/lime mixture, plastic foam or bituminous sand.

- Staff should wear proper PPE based on the kind of hazard, including gloves, mask, goggles, closed shoes and an overall or apron.
- The lids should then be sealed, ideally by seam or spot welding. The size of the vessel depends on how possible it is to handle once filled, as they can be heavy.

Immobilization: Inertization

Inertization is a variant of encapsulation and involves crushing pharmaceuticals and mixing them into a concrete or other paste and pouring the mixture into a safe place. The process requires the removing packaging materials, paper, cardboard, and plastic from pharmaceuticals, including blister packs, and crushing the pharmaceutical waste items using manual or automated means. This process significantly reduces the volumes of waste to be immobilized, but will be more time consuming.

The paste is either filled into drums or transported in liquid form to an engineered sanitary landfill, where it is decanted into the regular municipal waste stream. It is then placed at the base of the landfill and covered with fresh municipal solid waste. The process is relatively inexpensive and can be carried out with unsophisticated equipment. The main requirements are a grinder or road roller to crush the pharmaceuticals, a concrete mixer, and supplies of cement, lime and water.

- Highly toxic waste like antineoplastics or explosive materials like aerosol containers should not undergo Inertization due to the high risk of exposure to humans and the environment.
- Solid pharmaceuticals are ground, and a mix of water, cement and lime added to form a homogenous paste.
- The mixing of materials can be done manually or by concrete mixer. Workers need to be protected with protective clothing and masks are required as there may be a dust hazard.

The approximate ratio by weight used are as follows:

Materials	Percentage (weight)
Pharmaceutical Waste	65%
Lime	15%
Cement	15%
Water	5% or more to form a proper liquid consistency.

Taken from: *WHO - Safe Management of Pharmaceutical Waste from Healthcare Facilities*

Dumping and Landfills

When dumping products, there are two categories of waste disposal sites:

Engineered sanitary landfills - An engineered sanitary landfill is a waste disposal site that has been adequate engineered for the purpose of containing waste in a safe way. Engineered sanitary landfills prevent waste from contaminating environment, and in particular prevent waste from seeping into the below ground water table. Engineered hazardous waste landfills are rarely available in middle and low-income countries, but where available should be

explored as primary method for disposing of pharmaceuticals.

Uncontrolled dumpsite - An uncontrolled dumpsite is any solid waste disposal location that is not purpose-built or engineered to isolate or accommodate waste management. Uncontrolled dumpsites are probably the most commonly found dumpsites in locations where humanitarians operate.

As a general set of rules:

Where engineered landfills are not available...	Pharmaceuticals should be fully immobilized prior to dumping in an uncontrolled dumpsite.
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Where immobilization isn't a possibility...	Pharmaceuticals can be safely buried in an engineered landfill, as long as adequate security is in place.
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Where engineered landfills are not available AND immobilization isn't a possibility...	Pharmaceuticals should not be dumped in an uncontrolled dump site. Humanitarian actors should pursue other disposal options. Disposing non-immobilized pharmaceutical waste on uncontrolled landfills or dumpsites poses the risk of environmental contamination as well as the exposes risks to humans as products may be picked up, resold or consumed by other people.
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In the event that non-immunized wasted is dumped in an uncontrolled dumpsite:

- Waste should be unpacked to make it unrecognizable.
- The disposal area should be at least 30 meters away from water sources and other water bodies as well as human settlements.
- If hazardous waste is buried, the burial location waste should be documented. Hazardous waste may need to be moved as soon as possible to a safer place at a later state by authorities.

Dilution of Liquid Pharmaceuticals

Dilution and dumping of liquid pharmaceuticals should be avoided wherever possible, however there are some conditions in which dumping non-hazardous liquid pharmaceuticals down a sewer or drain are possible. Non-hazardous pharmaceuticals should be well diluted in water prior to any dumping in a drain or swage system.

Example non-hazardous liquid pharmaceuticals	Syrups used for human consumption and IV fluids.
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Example hazardous liquid pharmaceuticals

Anticancer medication, hormones/steroids, and controlled drugs.

Treatment and Disposal of Hazardous Biomedical Waste

Biomedical waste can be defined as:

- **Pathological** - Any waste which consists wholly or partly of human or animal tissue, blood, other body fluids, excretion, drugs or other pharmaceutical products, swabs or dressings, or syringes, needles or other sharp instruments, being waste which unless rendered safe may prove hazardous to any person coming into contact with it
- **Infectious** - Any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation treatment, care, teaching or research, or the collection of blood for transfusion, being waste which may cause infection to any person coming into contact with it.

Adapted from: [*The Controlled Waste Regulations 1992 of United Kingdom*](#)

Pathological and infectious biomedical waste derived from any activity in a humanitarian setting should always be treated as hazardous waste, and should be treated accordingly. Anytime biomedical waste is handled by personnel, proper protective equipment should be used, including gloves, face covering, and potentially proper aprons and body suits depending on the nature of the biomedical waste.

There are several treatments available for managing biomedical waste:

Local Companies/Authorities:

Wherever possible, humanitarian organizations should consult with local authorities to understand locally available processes and procedures to outsource the process of disposing of biomedical waste.

- There may be local and certified companies capable of collecting and disposing of biomedical waste in compliance with local laws.
- National health authorities may be able to collect or accept deliveries of biomedical waste, or have some sort of appointed collection agency.
- Local hospitals or clinics may be able to intake and dispose of biomedical waste.

Autoclaving:

Some biomedical waste can be decontaminated using autoclaves. Autoclaves are specialized equipment that uses high temperature and pressure to kill biological materials. The use of autoclaves requires special training or supervision of a trained professional. Many humanitarian organizations don't always have access to an autoclave, nor do they have proper training available to them, and should only consider autoclaving as an option where available. Properly autoclaved items can be considered as no longer hazardous and disposed of using the methods described for non-hazardous medical waste, however special considerations must be made:

- Autoclaving should only be undertaken for durable materials, such as used surgical equipment or sharps. Autoclaving cannot be used on bandages or cloth.
- Autoclaves are mostly useful for relatively small quantities of items due to the complexity and energy requirements.

- Prior to using an autoclave to decontaminate biomedical waste, consult with manufacturers of products and local health authorities.

Biomedical waste shall not be considered properly treated unless the time, temperature and pressure requirements have been met. If for any reasons, time temperature or pressure requirements are not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and time requirements are achieved.

General autoclave guidelines:

Gravity Flow Autoclave

- No less than 121 C° and pressure of 15 pounds per square inch (psi) for a time of no less than 60 minutes.
- No less than 135 C° and a pressure of 31 psi for a time of no less than 45 minutes.
- No less than 149 C° and a pressure of 52 psi for a time of no less than 30 minutes.

Vacuum Autoclave

- All medical waste shall be subjected to a minimum of one pre-vacuum pulse to purge the autoclave of all air.
 - No less than 121 C° and pressure of 15 psi for a time of no less than 45 minutes.
 - No less than 135 C° and a pressure of 31 psi for a time of no less than 30 minutes.
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Adapted from: [Solid Waste Management - Principles and Practice](#)

Incineration:

Incineration of biomedical waste should only be done using high temperature, two chamber incinerators.

- A flue gas treatment system should be used to avoid toxic biohazardous fumes.
- The duration of the incineration depends on the bio-waste, but there should be no remains of volatile organic compounds left in ash.
- All ash bioproduct of incinerated biomedical waste should be treated as hazardous, and will require immobilization or deep burial.

Deep Burial:

Deep burial should be considered a last resort for untreated biomedical waste in humanitarian settings. Biomedical waste cannot be disposed of through regular landfills, and instead requires deep burial.

The steps for deep burial include:

- A pit or trench should be dug a minimum of 2 meters deep. The pit should be half filled with biomedical waste, and then covered with lime within 50 centimeters of the surface, after which rest of the pit with soil.
- If the pit is filled incrementally over time, each time waste is added to the pit, a layer of 10 centimeters of soil be added to cover the successive layer.
- Ensured that animals do not have access to burial sites.
- Cover the burial site with galvanised iron/wire meshes - ideally the mesh can be laid on the lime under the soil.
- Burial must be performed under close and dedicated supervision.

- Burials site should not affect water tables, and should not be at least 30 meters from wells or water sources frequented by humans.
- Burial pits should be far from human habitation.
- The area should not be prone to flooding or erosion.
- The location of the site should be negotiated and authorized by local or regional authorities. Permission may be required from national health authorities as well.
- Records should be made and kept of any burial site for future reference.

Adapted from: [Solid Waste Management - Principles and Practice](#)

Treatment and Disposal Methods of Pharmaceuticals by Category

Treatment and disposal of pharmaceuticals and medical waste can generally be broken down into three categories:

- **Non-hazardous Pharmaceutical Waste** - not classified as hazardous but must still to be disposed of properly to prevent misuse or environmental damage.
- **Hazardous Pharmaceutical Waste** - wasted that poses a risk to health and the environment, due to harmful ingredients and interactions or hazardous characteristic, such as being poisonous, ecotoxic, toxic, carcinogen, flammable, corrosive, reactive, explosive.
- **Hazardous Controlled Substances** - needs to be specifically managed to prevent the diversion and non-medical use of those substances as well as the illicit use of drugs.

A summary table of the guidelines is below:

Category	Physical form	Treatment / disposal methods	Comments
Non-hazardous	Solids / liquids	Engineered sanitary landfill.	
		Municipal Incinerator (850 °C medium temperature).	
		Immobilization followed by disposal on uncontrolled landfill.	Prevention of scavenging
		Burial on non-engineered landfill.	Prevention of scavenging.
	Liquids	Sewerage system.	Only diluted small quantities over time, if no sewer or sewage treatment plant available.
	Aerosols / inhalers	Certified incinerators / emptying of cans and incineration / disposal as solid non-hazardous waste on a municipal landfill.	Prevents exploding / ignition of cans / prevent scavenging.

Category	Physical form	Treatment / disposal methods	Comments
	Ampoules / vials	Engineered sanitary landfill / immobilization followed by disposal on landfill.	Prevention of scavenging.
		Emptying and crushing followed by burial in a pit or on a landfill.	Liquids can be disposed with sewage, glass to be packed in drum or container before disposal.
Hazardous Antineoplastics	Solids / liquids	High temperature incinerator (>1,200°C) with flue gas treatment.	Preferred option. Safe disposal of ash.
		Encapsulation followed by disposal on landfill.	Preferred option. Prevention of scavenging. Designated area.
		Chemical decomposition and disposal with sewage.	Treatment by trained and knowledgeable experts.
Hazardous anti-infective drugs	Solids / liquids	High temperature incinerator (>1,100°C) with flue gas treatment.	Preferred option.
		Immobilization followed by disposal on landfill.	Preferred option. Prevention of scavenging. Designated area.
	Liquids	Diluted in water, left for two weeks and disposed to the sewer.	Emergency situations.
	Aerosols / inhaler	High temperature incinerator (>1,100°C) with flue gas treatment.	Preferred option. Constructed / licensed for the treatment of gaseous waste.
		High temperature incinerator (>1,100°C) with flue gas treatment or co-incineration.	Preferred options. Safe disposal of ash.

Category	Physical form	Treatment / disposal methods	Comments
Other hazardous waste	Solids / liquid	Immobilization followed by disposal on landfill.	Preferred option. Prevention of scavenging. Designated area.
		High temperature incinerator (>1,100°C) without flue gas treatment.	Interim solution. Safe disposal of ash.
		Disposal on an engineered or controlled landfill.	Interim solution. Disposal on designated area.

Taken from: *WHO - Safe Management of Pharmaceutical Waste from Healthcare Facilities*

Non-hazardous Pharmaceutical Waste

Non-hazardous waste is generally defined as having no direct threat to the environment, but may still be harmful to humans if consumed misused. The non-hazardous waste can be treated and disposed like municipal waste, however the illicit scavenging and reuse of products must be prevented. This may be done by making the products unrecognizable by removing products from packages (packaging, blister and leaflets). Please note, non-hazardous waste mixed with hazardous waste should be considered as hazardous.

Hazardous Pharmaceutical Waste

Antineoplastic (Cancer) Drugs

Antineoplastic drugs are designed to stop or kill growing cells and should be considered highly hazardous.

Antineoplastic waste treatment and disposal options are:

- Antineoplastic products should be returned to vendor wherever possible.
- If products cannot be returned to their vendor, they must be disposed of in a two-chamber incinerator rated for this kind of product, or encapsulation followed by disposal in a landfill – intertization is not permitted.

There are special considerations for antineoplastic during disposal that must be followed:

- Antineoplastics should be segregated from other pharmaceuticals and kept separately in clearly marked containers with solid walls.
- Incinerators must be high temperature and multi chamber. A flue gas treatment system is mandatory to capture toxic fumes.
- Ash from antineoplastic incineration is also considered hazardous waste and must be

disposed of through immobilization.

- Anyone handling antineoplastic drugs should avoid crushing containers or removing products from packages.

Encapsulation for antineoplastics should follow its own protocols:

- Drums used to encapsulate antineoplastics should be filled to a maximum of 50% capacity with waste drugs.
- A well-stirred mixture of lime, cement and water should be poured into the drums in the proportions of 15:15:5 (by weight).
- Filled drums should be sealed by seam or spot welding and left to set for 7 to 28 days.

Anti-Infective Products

Anti-infective products cannot be disposed of in an untreated form. The steps for disposing of anti-infective products include:

- Anti-infective products should be returned to vendor wherever possible.
- If products cannot be returned to their vendor, they must be disposed of in a two-chamber incinerator rated for this kind of product, or immobilization followed by disposal in a landfill.

Other Hazardous Medical Waste

For the disposal of other hazardous medical waste, the general rule is to incinerate the items using a high temperature incinerator, or immobilization. Other options include:

- Storage of waste until safe disposal is possible.
- Medium temperature incineration (≥ 850 °C) may be used for solid form pharmaceutical, however the pharmaceutical items must be intermixed with other non-hazardous waste.
- As a last resort, small quantities of solid and semi-solid pharmaceuticals can be disposed of in uncontrolled landfills, provided the overall volume makes up less than 1% of the total daily waste.

Hazardous Controlled Substances

Controlled pharmaceutical products may not be environmentally harmful, but they should always be considered harmful to humans, and must be treated as hazardous waste. Proper treatment of controlled pharmaceuticals includes high temperature incineration and encapsulation/intertization.

Controlled substances must never be disposed in a way that humans may gain uncontrolled access. Small or medium sized incinerators may be used, but should occur in a well-ventilated area away from humans or animals.

Disposal by Dosage Form

There are suggested disposal methods based on the dosage form/delivery mechanism of some common pharmaceutical items. These methods differ based on if the items contain hazardous or non-hazardous substances or compounds.

Ampoules and Vials

Non-hazardous substances in ampoules and vials	Glass ampoules and vials filled with non-hazardous pharmaceuticals can be disposed of in traditional landfills, or recycled. Non-hazardous substances contained in the vials may be dumped or diluted in accordance with the standard process for disposing on non-hazardous waste. Vials may also be crushed prior to disposal to save space, however crushing must be done in a safe manner – all persons involved in crushing must wear proper clothing, eye protection, mouth covering, and close toed shoes resistant to puncturing.
Hazardous substances in ampoules and vials	Glass ampoules and vials containing hazardous substances should not be opened or crushed. Any ampoules or vials containing hazardous substances must be incinerated in a high temperature incinerator rated for the product, or encapsulated and buried safely. Ampoules and vials should not be burnt or incinerated in medium or small-scale incinerators – vials may explode, while melted glass may build up and damage incinerators for future use.

Aerosol Cans and Gas Inhalers

Prior to disposing of inhalators or aerosol cans, always check the product manufacturer’s recommended guidelines first. Metered dose inhalers (MDIs) are pressurized containers and should not be punctured or incinerated, even when they appear to be empty, due to the risk of explosion.

Non-hazardous substances in aerosol cans and gas inhalers	Non emptied aerosol cans and inhalers containing non-hazardous substances can be emptied, and the empty canisters disposed of in traditional landfills or recycled if possible. The process of emptying canisters of non-hazardous substances should be in compliance with the standard process for disposing of non-hazardous compounds.
Hazardous substances in aerosol cans and gas inhalers	Non emptied aerosol cans and inhalers that contain hazardous substances should be destroyed by high temperature incinerators. Incinerators used for compressed containers must be specifically licenced and rated for this purpose.

Identifying Hazardous Pharmaceuticals

Please reference the below table for a comprehensive list of potential hazardous pharmaceutical products and their known dosage forms.

Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
Analgesics	Non-opioid Analgesics	L, S, SS		x
	Opioid Analgesics	L, S, SS		x
Anesthetics	Local Anesthetics	L, SS		x
	General Anesthetics	L, S, G		x
Antibacterials	Aminoglycosides	L		x
	Beta-lactam, Cephalosporins	L, S, SS		x
	Beta-lactam, Penicillin	L, S, SS		x
	Macrolides	L, S, SS		x
	Quinolones	L, S, SS		x
	Sulfonamides	S, SS, SS		x
	Tetracyclines	S, L, SS		x
Other Antibacterials	S, L, SS		x	
Anticonvulsants	Calcium Channel Modifying Agents	S		x
	Gamma-aminobutyric Acid (GABA) Augmenting Agents	S, L		x
	Glutamate Reducing Agents	S, L		x
	Sodium Channel Inhibitors	S, L		x
	Anticonvulsants, Other	S, L		x
	Cholinesterase Inhibitors	L, S		x
	Glutamate Pathway Modifiers	L.S		x
	Antidementia Agents, Other	L, S		x

Antidementia Agents				
Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
Antidepressants	Monoamine Oxidase Inhibitors	S		x
	Serotonin/Norepinephrine Reuptake Inhibitors	S, L		x
	Tricyclics	S		x
	Antidepressants, Other	S, L		x
Antidotes, chelators, Deterrents, and Toxicologic Agents	Antidotes	S, L		x
	Deterrents (Smoking Cessation Agents, Alcohol Deterrents)	S, L		x
	Toxicologic Agents (Opioid Antagonists)	S, L		x
Antiemetics	Antiemetics	S, L		x
Antifungals	Antifungals	S, L, SS		x
Antigout Agents	Antigout Agents	S, L		x
Anti-inflammatory Agents	Glucocorticoids	S, L		x
	Nonsteroidal Anti-Inflammatory Drugs	S, L, SS		x
Antimigraine Agents	Abortive	S, L, SS		x
	Prophylactic	S, L, SS		x
Antimyasthenic Agents	Parasympathomimetics	S, L		x
Antimycobacterials	Antituberculars	S, L		x
	Antimycobacterials, Other	S, L		x
	Alkylating Agents	S, L		x
	Antiangiogenic Agents	L		x
	Antiestrogens/Modifiers	L		x
	Antimetabolites	S, L		x

Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
Antineoplastics	Aromatase Inhibitors, 3rd Generation	L		x
	Molecular Target Inhibitors	L,		x
	Monoclonal Antibodies	L,		x
	Retinoids	L,		x
	Antineoplastics, Other	L,		x
Antiparasitics	Anthelmintics	S, L, SS		x
	Antiprotozoals	S, L, SS		x
	Pediculicides/ Scabicides	S, L		x
Antiparkinson Agents	Antiparkinson Agents	S, L, SS		x
Antipsychotics	Atypicals	S, L		x
	Conventional	S		x
Antispasticity Agents	Antispasticity Agents	S, L		x
Antivirals	Anti-cytomegalovirus (CMV) Agents	S, L		x
	Antihepatitis Agents	S, L, G		x
	Antiherpetic Agents	S, L		x
	Anti-human Immunodeficiency Virus (HIV) Agents, Fusion Inhibitors	S,		x
	Anti-HIV Agents, Non-nucleoside Reverse Transcriptase Inhibitors	S		x

Antivirals				
Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
	Anti-HIV Agents, Nucleoside and Nucleotide Reverse Transcriptase Inhibitors	S		x
	Anti-HIV Agents, Protease Inhibitors	S		x
Anxiolytics	Antidepressants	S		x
	Benzodiazepines	S		x
	Anxiolytics, Other	S, L		x
Bipolar Agents	Bipolar Agents	S, L		x
	Benzodiazepines	S, L		x
Blood Glucose Regulators	Antidiabetic Agents	S, L		x
	Glycemic Agents	S, L		x
	Insulins	L		x
Blood Products	Anticoagulants	S, L		x
	Blood Formation Products	L		x
	Coagulants	S, L		x
	Platelet Aggregation Inhibitors	S, L		x
	Alpha-adrenergic Agonists	S		x
	Alpha-adrenergic Blocking Agents	S		x
	Antiarrhythmics	S, L		x
	Beta-adrenergic Blocking Agents	S, L		x
	Calcium Channel Blocking Agents	S, L		x
	Diuretics	S, L		x

Cardiovascular Agents				
Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
	Dyslipidemics	S, L		x
	Renin-angiotensin-aldosterone System Inhibitors	S, L		x
	Vasodilators	S, L		x
	Cardiovascular Agents, Other	S, L		x
	Amphetamines	L		x
	Non-amphetamines, ADHD	L		x
	Non-amphetamines, Other	L		x
Dental and oral Agents	Dental and oral Agents	S, L, SS		x
Dermatological Agents	Dermatological Agents	L, SS		x
Enzyme Replacements/Modifier	Enzyme Replacements/Modifier	S, L, SS		x
	Antispasmodics, Gastrointestinal	S, L, SS		x
	Histamine2 (H2) Blocking Agents	S, L		x
	Irritable Bowel Syndrome Agents	S, L		x
	Protectants	S, SS		x
	Proton Pump Inhibitors	S, L		x
	Gastrointestinal Agents, Other	S, L, SS		x
	Antispasmodics, Urinary	S, L		x
	Benign Prostatic Hypertrophy Agents	S, L		x

Genitourinary Agents Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
	Phosphate Binders	S		x
	Genitourinary Agents, Other	S, L		x
Hormonal Agents, Stimulant/ Replacement/ Modifying (Adrenal)	Glucocorticoids/ Mineralocorticoids	S, L		x
Hormonal Agents, Stimulant/ Replacement/Modifying (Pituitary)	Hormonal Agents, Stimulant/Replacement/Modifying (Pituitary)	L		x
Hormonal Agents, Stimulant/ Replacement/ Modifying (Prostaglandins)	Hormonal Agents, Stimulant/Replacement/ Modifying (Prostaglandins)	S, L		x
Hormonal Agents, Stimulant/ Replacement/ Modifying (Sex Hormones/Modifiers)	Anabolic Steroids	S, L		x
	Androgens	S, L		x
	Estrogens	S		x
	Progestins	L		x
	Selective Estrogen Receptor Modifying Agents	S		x
Hormonal Agents, Stimulant/ Replacement/Modifying (Thyroid)	Hormonal Agents, Stimulant/Replacement/Modifying (Thyroid)	S		x
Hormonal Agents, Suppressant (Adrenal)	Hormonal Agents, Suppressant (Adrenal)	S, L		x
Hormonal Agents, Suppressant (Parathyroid)	Hormonal Agents, Suppressant (Parathyroid)	S, L		x

Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
Hormonal Agents, Suppressant (Pituitary)	Hormonal Agents, Suppressant (Pituitary)	S, L, G		x
Hormonal Agents, Suppressant (Sex Hormones/Modifiers)	Antiandrogens	S		x
Hormonal Agents, Suppressant (Thyroid)	Antithyroid Agents	S		x
Immunological Agents	Immune Stimulants	L		x
	Immune Suppressants	S, L		x
	Immunizing Agents, Passive	L		x
	Immunomodulators	S, L		x
Inflammatory Bowel Disease Agents	Glucocorticoids	S, L		x
	Salicylates	S		x
	Sulfonamides	S		x
Metabolic Bone Disease Agents	Metabolic bone disease agents	S, L		x
Ophthalmic Agents	Ophthalmic Anti-allergy Agents	L		x
	Ophthalmic Antiglaucoma Agents	L		x
	Ophthalmic Anti-inflammatories	L		x
	Ophthalmic Prostaglandin and Prostanoid Analogs	L		x
	Ophthalmic Agents, Other	L		x
Otic Agents	Otic agents	L		x

Category	Pharmacologic Classes	Dosage form: liquid (L), solid (S), semi-solid (SS), gaseous (G)	Non-hazardous	Hazardous
Respiratory Tract Agents	Antihistamines	S, L, SS,		x
	Anti-inflammatories, inhaled Corticosteroids	S, L, SS, G		x
	Antileukotrienes	S		x
	Bronchodilators, Anticholinergic	L, G		x
	Bronchodilators, Phosphodiesterase Inhibitors (Xanthines)	S, L		x
	Bronchodilators, Sympathomimetic	L		x
	Mast Cell Stabilizers	SS, G		x
	Pulmonary Antihypertensives			x
	Respiratory Tract Agents, Other	S, L, SS, G		x
Sedatives/Hypnotics	Sedatives/hypnotics	S, L		x
Skeletal Muscle Relaxants	Skeletal muscle relaxants	S, L		x
Therapeutic Nutrients/Minerals/ Electrolytes/ Metals	Electrolytes	S, L	x	
	Minerals	S, L	x	
	Vitamins	S, L	x	
	Metals	L		x

Taken from: *WHO - Safe Management of Pharmaceutical Waste from Healthcare Facilities*