



Medical waste treatment

Introduction

Medical waste is any type of waste that is generated at healthcare facilities such as hospitals/clinics, dental practices, blood banks, medical research facilities, etc. according to the World Health Organization, 85% of this waste is non-hazardous and the rest (15%) is considered hazardous material that can be infectious, radioactive, or toxic. However, if not properly separated at the source, which is the case in most low- and medium-income countries, the percentage of generated hazardous healthcare waste can increase drastically.

According to a study carried out in 2019, about 43% of official hospitals in Iraq lack the availability of big containers for the collection and segregation of medical waste and the majority of health-care staff are not trained in proper management of hazardous and non-hazardous medical waste (including its segregation, handling, transportation, storage and final disposal).

It goes without saying that the importance of proper healthcare waste management lays in mitigating its hazards on human health by increasing the safety of employees and patients as well as protecting the environment.

Process

Medical waste is classified by the WHO into 4 classes as indicated in the following graph:

Medical waste categories:			
Group I: Similar to municipal waste Pathology, Organ, Paper, Stone, Other	Group II: Non-hazardous medical waste Protective equipment with liquid or body fluids, Medical instruments, equipment	Group III: Biohazardous medical waste All medical equipment, personal protection, and laboratory equipment contaminated with blood or body fluids	Group IV: Specific medical waste Cytotoxic, Sharp, Anatomical, Contaminated, Anesthetics, and sedatives, Anesthetics and gases, Anatomical parts

Classification of medical waste according to WHO

Overview

Input products

Non-hazardous health-care waste, infectious waste, pathological waste, sharps,

Output products

Non-hazardous waste/energy

Waste generation in Iraq

Between 1,4 and 1,7 kg/bed/day

Current management in Iraq

Low capacity treatment unit in hospitals /Landfilling/open burning

Technical characteristics

Small, medium and big scale technology | semi-automated and automated process | manual separation of waste

Useful links and literature

1. <https://www.who.int/news-room/fact-sheets/detail/health-care-waste>
2. https://www.who.int/water_sanitation_health/facilities/waste/module15.pdf?ua=1
3. https://www.who.int/water_sanitation_health/publications/wastemanag/en/

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Process

1. Source segregation

It is very important that healthcare waste is separated since its generation. Often, the following fractions are segregated during patient treatment:

- Sharps (including needles, syringes, etc.)
- Infectious waste (such as contaminated PPE, bandages, laboratory equipment, etc.)
- Pathological waste (such as body fluids, organs, body tissues, etc.)
- Waste similar to municipal waste

Each of these waste types shall be placed in a separate container with the appropriate labels and pictograms. A color code for waste bins and bags is recommended.

→ To set up a proper waste management system in a healthcare facility staff capacity building is essential. Nurses, doctors and cleaning staff shall be informed at all times with the best practices for waste management. Some common training sessions, among others, are:

- Waste definition and classes
- Appropriate waste handling practices such as the use of personal protection equipment, properly closing and carrying waste bags etc.
- Types of waste treatment technologies and how to choose the appropriate one for your facility

2. Logistics

As mentioned above, most healthcare facilities in Iraq lack proper waste storing containers. The below table illustrates WHO-recommended color scheme:

Colour	Type of container	Type of waste
Black	Plastic bag	General non-infectious and nonhazardous
Yellow with biohazard symbol	Plastic bag or container	
Yellow with biohazard symbol	Rigid plastic box	
Brown with warning symbol	Plastic container	Sharps
Any, with a radiation hazard symbol	Lead box	Radioactive

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3. Transportation

Waste transportation from healthcare facilities to treatment facilities requires a special license for hazardous waste transportation. The types of trucks is also important. The latter shall be closed from the top in winter seasons avoid water contamination with infectious waste. The vehicle shall also be labeled with the appropriate infectious waste pictogram.

4. Decentralized medical waste treatment facility

These technologies are available in small and medium sizes. They can be installed inside healthcare facilities to sterilize infectious waste and make it suitable for disposal with non-hazardous waste. Below presented technologies are coupled with shredders to minimize the waste size and result in the generation of shredded material that can be used as Refused Derived Fuel (RDF).

4.1. Autoclave

A standard process in hospitals to sterilize reusable instruments has relied on steam for years. This fact has been adapted for medical waste treatment in form of autoclaves and retorts. An autoclave consists of a metal chamber sealed by a charging door and surrounded by a steam jacket. Autoclaves can be used to process the large bulk of infectious waste produced at a hospital or clinic. They come in a wide range of sizes and capacities.



Dual autoclaves in Senegal



Electric or gas-powered autoclave in Tanzania (stationary and truck-mounted)



Hospital-based autoclave in the US



Solar-powered autoclave in India

Examples of small to medium size autoclaves



Examples of a medium size autoclave

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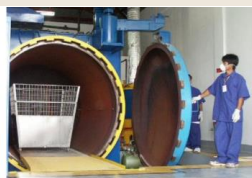
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Large-scale autoclave in the Philippines



5-tonne per hour autoclave in Vietnam



Large autoclave, 2.4 m dia x 9.7 m long



Two large-scale autoclaves in South Africa

Examples of large-scale autoclaves for central treatment plants

4.2. Microwave

Microwave disinfection system consists of the irradiation of materials fed into a system. This system relies on the water presence in waste, because the radiation works on water directly, not the solid components of the waste. For this reason, treatment units are often supplied with a humidifier. The entire process takes place within a single vessel.



Microwave units used in Austria, Bulgaria, Czech Republic, Ecuador, Ethiopia, France, Germany, Greece, Hungary, India, Indonesia, Iran, Kuwait, Latvia, Lithuania, Malaysia, Nigeria, Poland, Romania, Serbia, Turkmenistan, UK and other countries

Sources: Sinton, Meteka, Sterifant



Examples of small to medium size microwave systems



Large microwave units used in Brazil, France, Philippines, Russia, South Africa, South Korea, United States, Maghreb countries in North Africa, as well as other countries in South America, Middle East and Asia

Sources: Sanitec, Micro-Waste, AMB Ecosteryl



Examples of large-scale continuous microwave systems

5. Centralized medical waste treatment facility

These are large scale facilities that are suitable for the treatment of medical waste generated in a region or a group of healthcare facilities.

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5.1. Incineration

Medical waste incineration is the process of burning specific wastes, including pathological, trace chemotherapy and non-hazardous pharmaceutical wastes. This practice has been widely practised, but inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and the generation of ash residue. Incinerated materials containing or treated with chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Incineration of materials with high metal content (in particular lead, mercury and cadmium) can lead to the spread of toxic metals in the environment.

A proper thermal treatment of medical waste can only be made in modern incinerators operating at 850-1100 °C and fitted with special gas-cleaning equipment can comply with the international emission standards for dioxins and furans.



5.2. Co-incineration with hazardous waste in cement kilns

In some cases, medical waste is accepted in cement kilns where it would be thermally processed. The conditions in the cement kiln are appropriate to treat infectious and biologically active hospital wastes (they reach the required temperature of 950°C to treat infectious waste). However, as the disposal of healthcare waste requires special hygienic and work safety requirements on handling, packaging and transportation, cement kilns require special precautions on occupational health and safety in the supply chain of this type of waste.

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