Project: "Promotion of BAT/BEP to reduce uPOPs releases from waste open burning in the participating African countries of SADC sub-region"

Module 9

COVID-19 and the sound management of medical/healthcare waste

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I. Definitions and classifications

What is health-care / sanitary waste?

- All the waste generated within health-care facilities, research centers and laboratories related to medical procedures.
- In addition, the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g., home dialysis, self-administration of insulin, recuperative care).

Health care wastes are considered the second most **hazardous** wastes globally after radiation waste.

The management of health care waste is an integral part of A NATIONAL HEALTH CARE SYSTEM.

but WHO assessment studies found that many countries DO NOT HAVE MINIMUM STANDARDS OR PRACTICES, particularly in developing countries.

World Health Organisation. 2014. "Safe management of wastes from health-care activities" 2nd ed.

I. Definitions and classifications

What is health-care / sanitary waste?

Between 75% and 90% of HCW is similar to domestic waste and usually classified as "non-hazardous" or "general health-care waste".

It comes from the administrative, kitchen and housekeeping functions at health-care facilities and may include packaging waste and waste generated during maintenance of buildings.

THE REMAINING 10–25% OF HEALTH-CARE WASTE IS REGARDED AS "HAZARDOUS" AND MAY POSE A VARIETY OF ENVIRONMENTAL AND HEALTH RISKS.

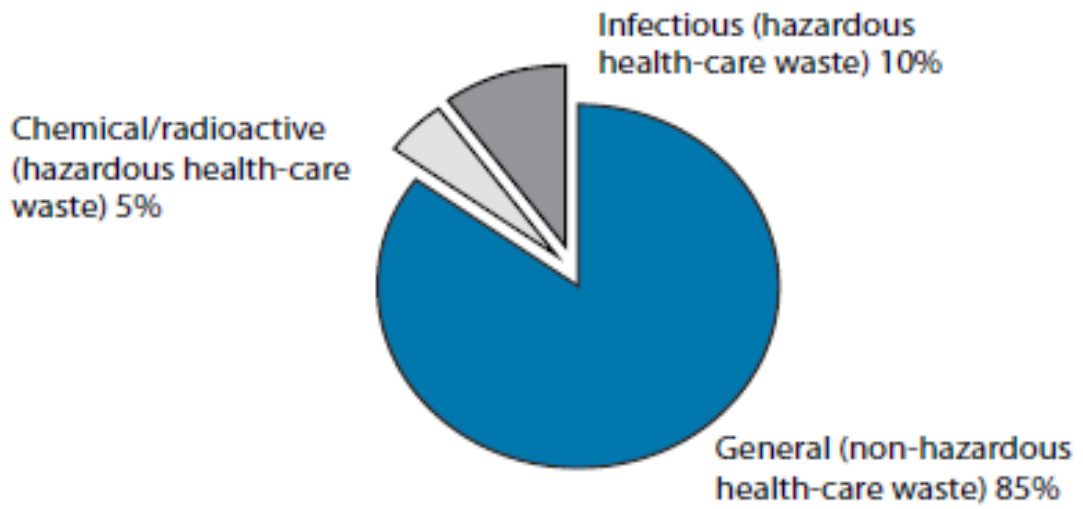


Figure 2.1 Typical waste compositions in health-care facilities

World Health Organisation. 2014. "Safe management of wastes from health-care activities" 2nd ed.

I. Definitions and classifications

Major sources of health-care waste

1. Hospitals
2. University hospital
3. Other health-care facilities
4. Emergency medical care services
5. Health-care centres and dispensaries
6. Obstetric and maternity clinics
7. Outpatient clinics
8. Dialysis centres
9. Long-term health-care establishments and hospices
10. Transfusion centres

1. Military medical services
2. Prison hospitals or clinics
3. Related laboratories and research centres
4. Medical and biomedical laboratories
5. Biotechnology laboratories and institutions
6. Medical research centres
7. Mortuary and autopsy centres
8. Animal research and testing
9. Blood banks and blood collection services
10. Nursing homes for the elderly

I. Definitions and classifications

Waste classifications

World Health Organization Classifications

Biological (infectious) risks			Chemical risks			Low risk
Sharps Waste	Infectious Waste	Pathological Waste	Pharmaceutical Waste	Chemical Waste	Radioactive Waste	Non-Hazardous General Waste
EXAMPLES			EXAMPLES			
Needles Blades Broken glass	Waste contaminated with blood Cultures Isolation waste	Body parts Human tissue Animal carcasses	Expired drugs Expired vaccines Cytotoxic waste	Chemical solvents Mercury Cleaners Batteries	Radio-nuclides Vials with radioactive residues	Recyclable and compost-able waste Non-recyclable waste

I. Definitions and classifications

Table 2.1 Categories of health-care waste

Waste category	Descriptions and examples
Hazardous health-care waste	
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)
Infectious waste	Waste suspected to contain pathogens and that poses a risk of disease transmission (see section 2.1.2) (e.g. waste contaminated with blood and other body fluids; laboratory cultures and microbiological stocks; waste including excreta and other materials that have been in contact with patients infected with highly infectious diseases in isolation wards)
Pathological waste	Human tissues, organs or fluids; body parts; fetuses; 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	Waste that does not pose any particular biological, chemical, radioactive or physical hazard

I. Definitions and classifications

What are the main types of hazards associated with health-care waste?

Examples of hazards associated with waste:

- **Infectious disease transmission (15%):** from waste contaminated with blood and body fluids
- **Physical injury (1%):** from all types of sharps waste
- **Chemical exposure (3%):** from chemicals used during medical or laboratory activities, such as solvents and mercury.
- **Exposure to radiation, heavy metals (1%):** handling of active sources or contact with contaminated surfaces. The nature of illness caused by radioactive waste is determined by the type and extent of exposure. It ranges from headache, dizziness and vomiting to much more serious problems.

II. HCW management

Proper HCW management is important because

The waste represents hazards to human health and the environment: the latest available data (2019) indicate that 1 in 3 healthcare facilities globally do not safely manage healthcare waste (WHO – 2022)

The main groups of people at risk are critical to our society:

- medical doctors, nurses, health-care auxiliaries and hospital maintenance personnel
- patients in health-care facilities or receiving home care
- visitors to health-care facilities
- workers in support services, such as cleaners, people who work in laundries, porters
- workers transporting waste to a treatment or disposal facility
- in waste management facilities (such as landfills or treatment plants), as well as informal recyclers (scavengers).
- the general public could also be at risk whenever hazardous health-care waste is abandoned or disposed of improperly.
- the hazards associated with scattered, small sources of health-care waste should not be overlooked.

II. HCW management

KNOWING THE TYPES AND QUANTITIES of waste produced in a health-care facility is the first step in safe disposal, to estimate the required capacities for containers, storage areas, transportation and treatment technologies.

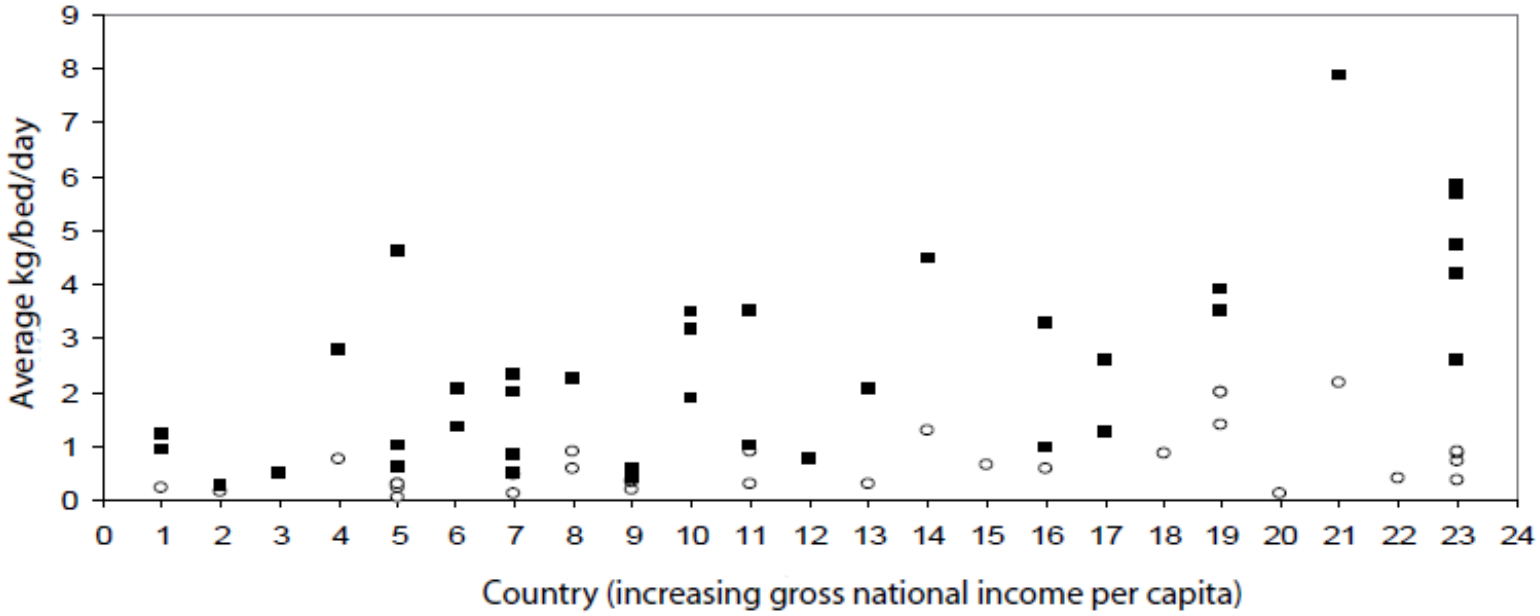
- Developed countries generate on average up to **0.5 kg** of hazardous health care waste per hospital bed per day;
- Low-income countries generate on average **0.2 kg** of hazardous health care waste per hospital bed per day.

Many factors affect the rate of waste generation, including:

- level of activity (# occupied beds, # patients per day, and/or # staff)
- type of department (e.g., general ward, surgical theatre, office)
- type or level of facility (e.g., clinic, provincial hospital)
- location (rural or urban)
- regulations or policies on waste classification
- segregation practices within hospitals/laboratories
- level of infrastructure development of the country.

Healthcare waste quantity increases with national income

Total and infectious waste generation in selected hospitals (kg per bed per day)



According to an assessment by UNDP of five Asian cities, COVID-19 increased the amount of **hazardous** healthcare waste by 3.4 kg/bed/day.

Approximately 10 times more than the average volume of hazardous healthcare waste.

■ = total health-care waste; o = infectious waste; points represent averages; vertical columns are ranges of data
1-Bangladesh (includes clinics), 2-Cambodia, 3-Lao PDR, 4-Nigeria, 5-Vietnam, 6-Pakistan, 7-India, 8-Guyana, 9-Philippines, 10-Jordan, 11-Colombia, 12-Peru, 13-Thailand, 14-Iran, 15-Bulgaria, 16-Brazil (includes health centres and laboratories), 17-Turkey; 18-Taiwan (China), 19-Portugal, 20-Hong Kong (China), 21-Kuwait, 22-Italy, 23-United States of America
Source: Emmanuel (2007)

World Health Organisation. 2014. "Safe management of wastes from health-care activities" 2nd ed.

II. HCW management

WHO's HCW management general principles

- Governments should
  - allocate a budget to cover the costs of establishment and maintenance of sound HCW management systems;
  - request donors, partners and other sources of external financing to include an adequate contribution towards the management of waste associated with their interventions;
  - implement and monitor sound HCW management systems, support capacity building, and ensure worker and community health.

- Donors and partners should
  - include a provision in their health programme assistance to cover the costs of sound HCW management.

- NGOs should
  - include the promotion of sound HCW management in their advocacy;
  - undertake programmes and activities that contribute to sound HCW management.

- The private sector should
  - take responsibility for the sound management of HCW associated with its products and services, including the design of products and packaging.

II. HCW management

Minimum and initial approach to overall management of HCW

- All personnel dealing with HCW should be familiar with the main categories of health-care waste as set out in either national or local regulations on waste classification.
- As a minimum, managers responsible for HCW should conduct a walk-through of the facility to identify the medical areas that produce waste, to obtain an initial estimate of the types and quantities of waste generated, and to understand how the waste is handled and disposed of.
- A rapid assessment, combining observations with interviews and survey questionnaires, should provide sufficient data to identify problems and begin the process of addressing them.

Develop a **HCW MANAGEMENT PLAN** for each facility.

II. HCW management

Elements of a HCW management Plan

- ✓ Location and organization of per HCW type segregated collection and storage facilities.
- ✓ Decide on containers specifications
- ✓ Required equipment (containers, trolley, storage areas…) and human resources needed to manage collection
- ✓ Responsibilities, duties and codes of practice for:
  - the personnel of the hospital who generate HCW and are involved in the segregation, storage and handling of HCW;
  - attendants and ancillary staff who collect and handle HCW.
- ✓ Procedures and practices: for HCW segregation; monitoring of procedures…
- ✓ Training

II. HCW management

Source segregation

Proper segregation of HCW at (or near) to the point of production is one of the most essential factors in safe, sustainable HCW management: globally 3 out of 10 healthcare facilities lack systems to segregate waste (WHO, 2022).

It is recommended that bins should be provided in all locations where HCW is generated to segregate at least the following categories:

- **Sharps bins and needle/hub cutters:**
  - For used needles from blood tests and injections (cutting the hubs and needles from syringes prevents needle stick injuries and illicit reuse of syringes)

- **High-risk waste, provide bins for**
  - infectious waste (such as cultures and swabs from infected patients)
  - high-risk pharmaceutical waste

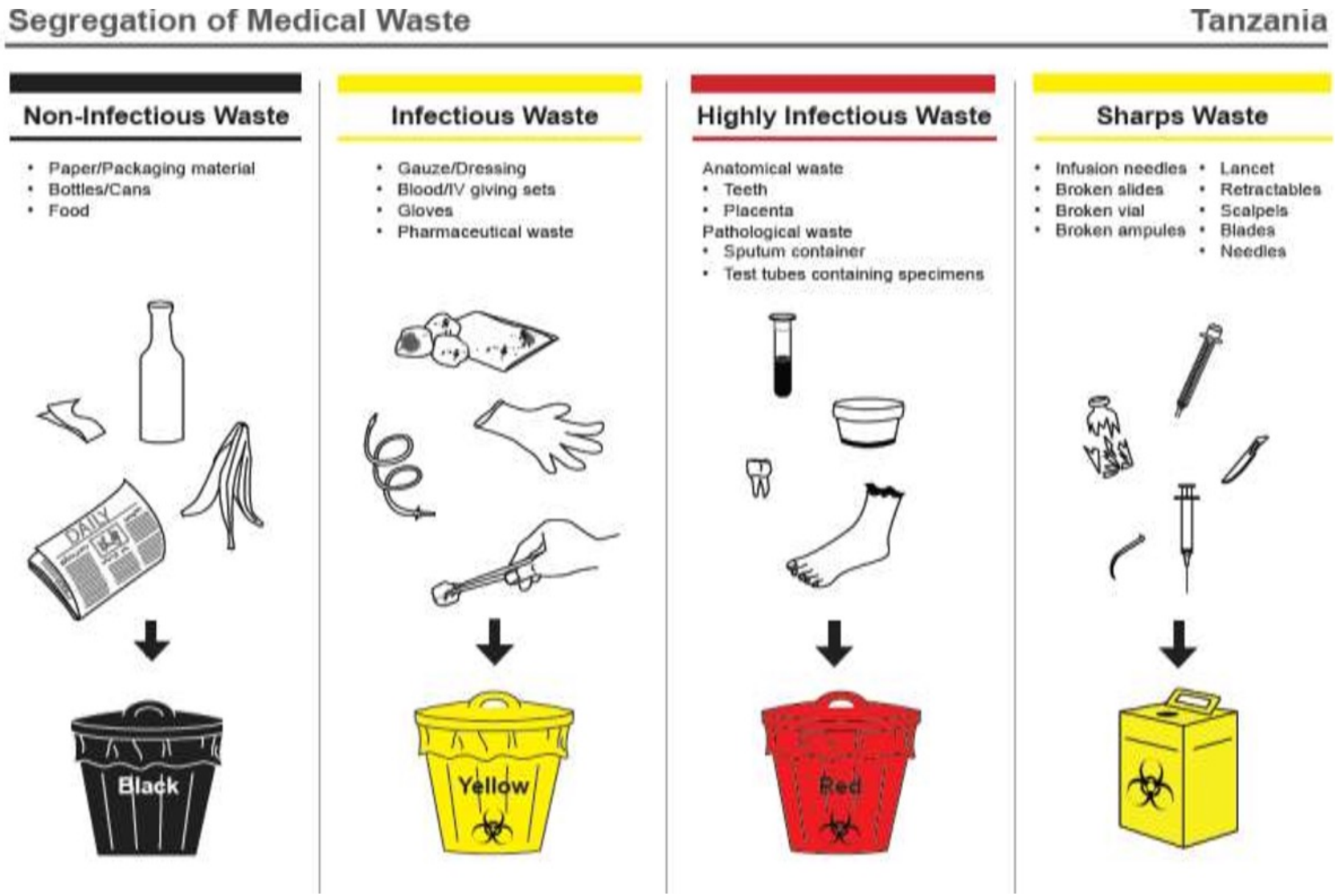
- **Low-risk waste bins for**
  - pathological waste (including samples from non-infected patients)
  - low-risk pharmaceutical waste

- **General waste bins (for MSW and recyclable waste)**

Source segregation of HCW

aims at minimising the risk of spreading infections to the other types of waste

II. HCW management



Z. Izaac. 2016 "**Medical waste management practices among health workers as the way to reduce NOSOCOMIAL infections in Tanzania hospitals: a case of Bukombe district council hospital**"

II. HCW management

Interim storage

All HCW storage areas must have enough capacity to hold the waste generated until it can be disposed of properly.

Hazardous HCW should be stored in utility rooms, which are designated for cleaning equipment, dirty linen and waste.
From here, the waste can be kept away from patients before removal, then collected conveniently and transported to a central storage facility.

If utility rooms are not available, waste can be stored at another designated location near to a medical area but away from patients and public access.

Another possibility for interim storage is a closed container stationed indoors, within or close to a medical area. A storage container used for infectious waste should be clearly labelled and preferably lockable.

Interim waste storage ready for collection

Transport documentation

Before sending hazardous HCW offsite, transport documentation (commonly called a "consignment note" or "waste tracking note") should be prepared and carried by the driver.

A consignment note should be designed to take into account the control system for waste transportation in operation within the Country.

III. HCW treatment and disposal

Treatment Approaches

- ON-SITE: healthcare facility treats its own waste.
- CLUSTER TREATMENT: hospital treats its waste plus waste from other health facilities in a small área.
- CENTRAL TREATMENT: dedicated treatment plant collects and treats wastes from many health facilities in an urban center or region.

III. HCW treatment and disposal

MAIN HCW TREATMENT AND DISPOSAL TECHNOLOGIES

The most established waste-management technologies FOR WASTE POSING INFECTION RISK focus on DISINFECTION / STERILISATION: the reduction or removal of disease-causing microrganisms (pathogens) to minimize the potential for disease transmission.

- **THERMAL:**
  - high income Countries: the dominant solution is incineration, high temperature (above 800 °C) , generally in plants already treating SWM; it is expensive and requires careful control of emissions;
  - low and medium income Countries :iLow Temperature (100-180°C) autoclaving and friction-heat
- **FRICTION - HEAT**
- **MECHANICAL:** not sufficient by itself, used for pre- or post-treatment to facilitate disinfection and disposal
- **CHEMICAL:**
  - Uses chemical disinfectants such as dissolved chlorine dioxide, bleach (sodium hypochlorite), peracetic acid, lime solution, ozone gas, or dry inorganic chemicals

III. HCW treatment and disposal

MAIN HCW TREATMENT AND DISPOSAL TECHNOLOGIES

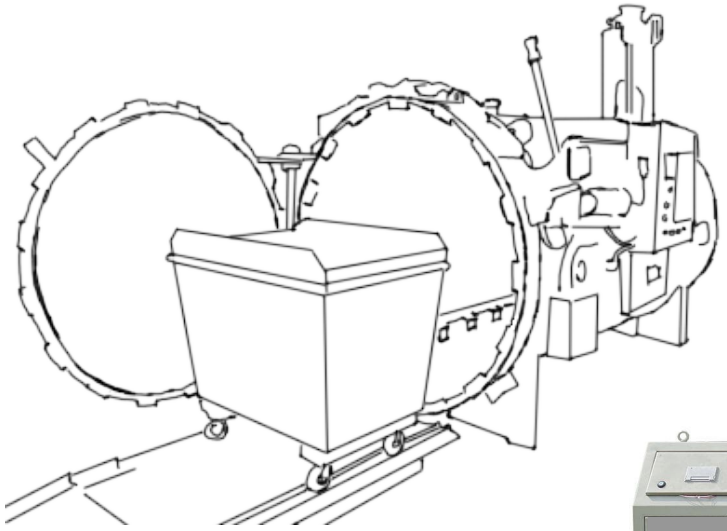
THERMAL TREATMENT: HEAT TO DESTROY PATHOGENS

Low-heat (100-180°C)

All infective HCW and sharps

AUTOCLAVING high pressure steam (120-130°C). Widely used and highly flexible, it comes in a variety of sizes and configurations. After the disinfection treatment, waste is compacted and sent to a landfill or incineration. It can be performed on-site or in a central facility.

MICROWAVING cannot be used on waste containing metal.



on-site autoclaving

III. HCW treatment and disposal

Example of a Medium-Size AUTOCLAVE in Tanzania

Autoclaves excludes the treatment of chemical waste (e.g. mercury containing HCW).

And they are generally not used
for large anatomical remains (body parts) since it is difficult to determine beforehand the time and temperature
parameters needed.

III. HCW treatment and disposal

MAIN HCW TREATMENT AND DISPOSAL TECHNOLOGIES

FRICTION-LOW HEAT TREATMENT

All infective HCW and sharps

This method has been recognised as alternative to incineration: the shredding reduces the volume and heat generated by the friction heats the waste up to 150°C

Frictional heating units are found in Botswana, Brazil, Bulgaria, Canada, Chile, China, Dominican Republic, Egypt, France, Greece, Hungary, Iran, Kazakhstan, Mexico, Netherlands, Paraguay, Poland, Romania, Russian Federation, Spain, Turkey, Uruguay and other countries

Sources: Newster, Ompeco

III. HCW treatment and disposal

MAIN HCW TREATMENT AND DISPOSAL TECHNOLOGIES

MECHANICAL PROCESSES: include several shredding, grinding, mixing and compaction technologies that reduce waste volume.

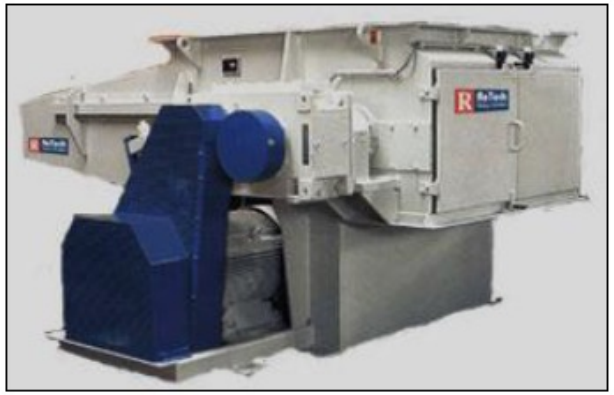
These are not stand-alone HCW but supplement other treatment methods. Mechanical destruction can render a waste unrecognizable and can be used to destroy needles and syringes (depending on the type of shredding).
They reduce the volume of waste, make it unrecognisable, and prevent unauthorised reuse.

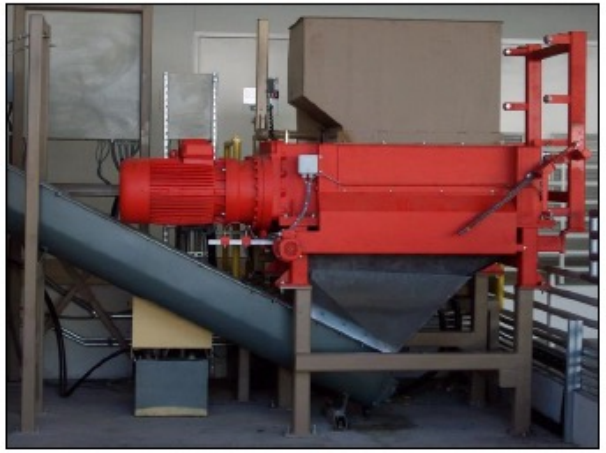
Shredding before disinfection can only be done in a closed system to avoid releasing any pathogens into the air.

MECHANICAL PROCESSES: for pre-treatment ONLY IN closed apparatus coupled with disinfecting processes (on-site)

III. HCW treatment and disposal

Post-Treatment Shredders Designed for Healthcare Waste





Source: Mercodor, Mark Costello/Vecoplan, Aduromed

III. HCW treatment and disposal

Hybrid Steam System: Rotating Autoclave with Internal Mixing-Fragmenting, Drying and Post-treatment Shredding

Hybrid or integrated technologies have been developed to achieve more uniform heating of waste, rendering waste unrecognizable, and/or making the whole treatment a continuous process.

Rotating autoclave used in American Samoa, Canada, Latvia, Mexico, United Kingdom, United States and other countries

MAIN HCW TREATMENT AND DISPOSAL TECHNOLOGIES

CHEMICAL TREATMENT

For these HCW shredding is necessary to increase the surface of contact with the disinfectants and reduce the amount of microorganism to acceptable levels.

The most common technologies are chlorine-based chemical treatment systems using either dissolved chlorine dioxide or sodium hypochlorite (bleach).

Many chemical disinfectants are themselves hazardous and toxic, so proper precautions should be exercised and PPE worn for safety.

III. HCW treatment and disposal

MAIN HCW TREATMENT AND DISPOSAL TECHNOLOGIES

CHEMICAL TREATMENT OF INFECTIOUS HCW

Used for anatomical waste (body parts), organs, tissues, placenta, contaminated animal waste, and Cadavers.

Examples of Alkaline Hydrolysis Systems

4500 kg units

Typical residues from alkaline hydrolysis

21 kg units

Sources: WR2, BioSafe Engineering, PRI, Bio-Response, Peerless

III. HCW treatment and disposal

TREATMENTS OF CHEMICAL HCW

A lower percentage of total HCW is made up of pharmaceutical, cytotoxic and chemical wastes including mercury as well as radioactive waste. They consist of discarded solid, liquid, and gaseous chemicals, for example from diagnostic and experimental work and from cleaning and disinfecting procedures.

Chemical waste from health care is considered to be hazardous if it has at least one of the following properties: toxic; corrosive (e.g. acids of pH < 2 and bases of pH > 12); flammable; reactive (explosive, water-reactive, shock-sensitive).

In many countries, the storage, treatment and disposal of these types of waste are covered under regulations dealing with the safe management of chemicals or nuclear waste, which are different from regulations pertaining to infectious wastes.

Chemical waste treatment technologies include neutralization, chemical oxidation, chemical reduction, wet air oxidation, electrolysis, photoytic reaction, amalgamation, chemical precipitation, encapsulation and stabilization, vitrification, hazardous waste incineration, gasification, plasma pyrolysis, hydrogenation, hydrolysis, a range of biological treatment technologies, and disposal in hazardous waste landfills.

These technologies are beyond the scope of this presentation.

UNEP. 2013. "Compendium of Technologies for Treatment/Destruction of Healthcare Waste"

III. HCW treatment and disposal

In all cases, remember to separately collect and store MERCURY containing waste due to its special long-term hazards: thermometers, blood-pressure gauges, dental amalgam, etc.

- Store it safely on location in closed containers in a locked room, until final disposal
- Await government instructions for its proper final disposal (generally export for final retirement)
- **Avoid future use of mercury-added products and materials**; alternatives are readily available and recommended by WHO

III. HCW treatment and disposal

FINAL DISPOSAL METHOD

Healthcare wastes properly treated in autoclaves, hybrid steam-based systems, microwave units, frictional heat systems, and dry heat systems:

1. are sterilized or decontaminated to high disinfection levels
2. have far fewer microorganisms or practically no microorganisms compared to household waste
3. can be discarded with regular waste in a landfill.

IV. Health and safety practices

HEALTH AND SAFETY PRACTICES FOR HEALTH-CARE PERSONNEL AND WASTE WORKERS

The production, segregation, transportation, treatment, and disposal of HCW involve the handling of potentially hazardous material.

Protection against personal injury is essential for all workers.

HCW management policies should include provision for the continuous monitoring and enhancement of workers' health and safety.

Examples of Specific Training

- Handling sharps containers
- Handling contaminated linen
- Handling cytotoxic or radioactive waste and mercury
- Response to injuries
- Personal hygiene including hand hygiene
- Donning, removing and cleaning PPE
- Initial and annual refresher

IV. Health and safety practices

Personal Protective Equipment (PPE)

- Face masks
- Eye protectors (safety goggles)
- Overalls (coveralls)
- Industrial aprons
- Leg protectors and/or industrial boots
- Disposable gloves (medical staff) or heavy-duty gloves (waste workers)
- Arm covers

IV. Health and safety practices

Health and safety practices for health-care personnel and waste workers

Example – Uganda

"Previous research indicate that HCW management may be affected by lack of formal training, lack of knowledge on HCW management, limited interest from hospital administration".

"Our findings show that the majority of the health workers had high knowledge on HCW management; knew how wastes are segregated and the risk to health. Most of them, used waste bins and wore personal protective wear when handling HCWs. A high proportion had satisfactory HCW management practices".

Wearing personal protective equipment (PPE) such as gloves, masks, clinical coats, shoes helps to minimise exposure to infections and injuries. In this study, most health workers wore appropriate PPE.

Our findings did not corroborate with findings of a cross sectional study conducted in an African Municipality in which most health workers did not wear appropriate personal protective gear.

The low usage in the aforementioned study was attributed to the fact that health workers were not provided with protective gear by their employees. It is appropriate to ensure adequate provision of PPE and then supervision for proper and consistent use".

Wafula S.T et al. 2019. "Health care waste management among health workers and associated factors in primary health care facilities in Kampala City, Uganda: a cross-sectional study" BMC Public Health **volume 19**, Article number: 203 (2019)

IV. Health and safety practices

Health and safety practices for health-care personnel and waste workers

Example – Uganda (contd)

"Health workers who had received training on HCW management were more likely to have satisfactory practices.

A possible explanation may be because they are able to put into practice what they have trained in.

Our findings also support the findings of a similar study in Ethiopia which revealed that health workers trained on healthcare waste management were more likely to exhibit satisfactory practices on HCW management.

Trainings should therefore be intensified as they have shown to improve practices of health workers regarding how they handle HCW."

Wafula S.T et al. 2019. "Health care waste management among health workers and associated factors in primary health care facilities in Kampala City, Uganda: a cross-sectional study" BMC Public Health **volume 19**, Article number: 203 (2019)

V. HCW and COVID-19

COVID-19
IS ADDING TO THE SWM PROBLEM

- ✓ COVID-19 increased the amount both of non-recyclable solid waste and of HCW: PPE and other equipment, such as respirator, or biomedical waste
- ✓ The pandemic has generated 87,000 tons of PPE waste, of which 38,000 are non-essential PPE.
- ✓ In 2020, up to 3.4 billion single use masks were discarded each day, resulting in a sizable, additional volume of plastic waste.
- ✓ 26,000 tons of protective personal equipment thrown cannot be stored or bagged soundly because of the lack of biohazard bags.
- ✓ COVID-19 increased the risk for SWM workers, particularly for the informal workers

V. HCW and COVID-19

Main types of Covid-19 related HCW

Item	Type of waste	Requires safe handling and treatment
Mask	Infectious	Yes
Gloves	Infectious	Yes
Gown	Infectious	Yes
SARS-CoV-2 rapid antigen test	Nonhazardous	Most components are recyclable; a very small volume of reagent may require safe handling and disposal if dealing with large numbers of tests.
PCR testing cartridge	Chemical	Yes (contains guanidinium thiocyanate)
Vaccine vial	Nonhazardous	No
Vaccine needle	Sharps	Yes (packaging material is recyclable)
Plastic packing and containers	Nonhazardous	No

COVID-19 has multiplied by 10 the amount of hazardous healthcare waste, estimated to **3.4 kg/bed/day**

WHO, 2022. "Global analysis of healthcare waste in the context of COVID-19"

V. HCW and COVID-19

The management of PPE waste during COVID-19

Many facilities and countries mistakenly classified 100% of COVID-19 healthcare waste as hazardous, rather than the 10–15% level typically generated from routine health service provision. Thus WHO stated that extra or special procedures beyond normal classification into infectious and non-infectious are not needed for waste from COVID-19 patients.

In general, service providers for waste collection and management organised properly and were able to continue their activity and the operation of facilities during the pandemic.

Properly managed Solid Waste and HCW were NOT found to be vectors of infection.

Service providers issued warnings and specifications to citizens and workers:

- the disposal of PPE into the bins for plastics recycling was PROHIBITED
- PPE can be segregated by disposing them only in bins for residual waste and incineration was favored (when facilities were already operating) over landfilling
- Specific procedures were issues in all operating plant for workers protections.

Examples of material recycling by hospitals were demonstrated: from plastics elements of COVID HCW

The management of PPE waste during COVID-19

COVID SELF-TEST KITS: WHAT TO DO WITH THE WASTE

Whether the result is positive or negative, the used items from each test – including the testing strip, swab and extraction tube – should be put in the small plastic bag that comes with the pack. This bag should then go straight into your normal rubbish bin.

The kits are not considered clinical waste requiring a special collection but they should be disposed with residual waste, **they should not** be recycled.

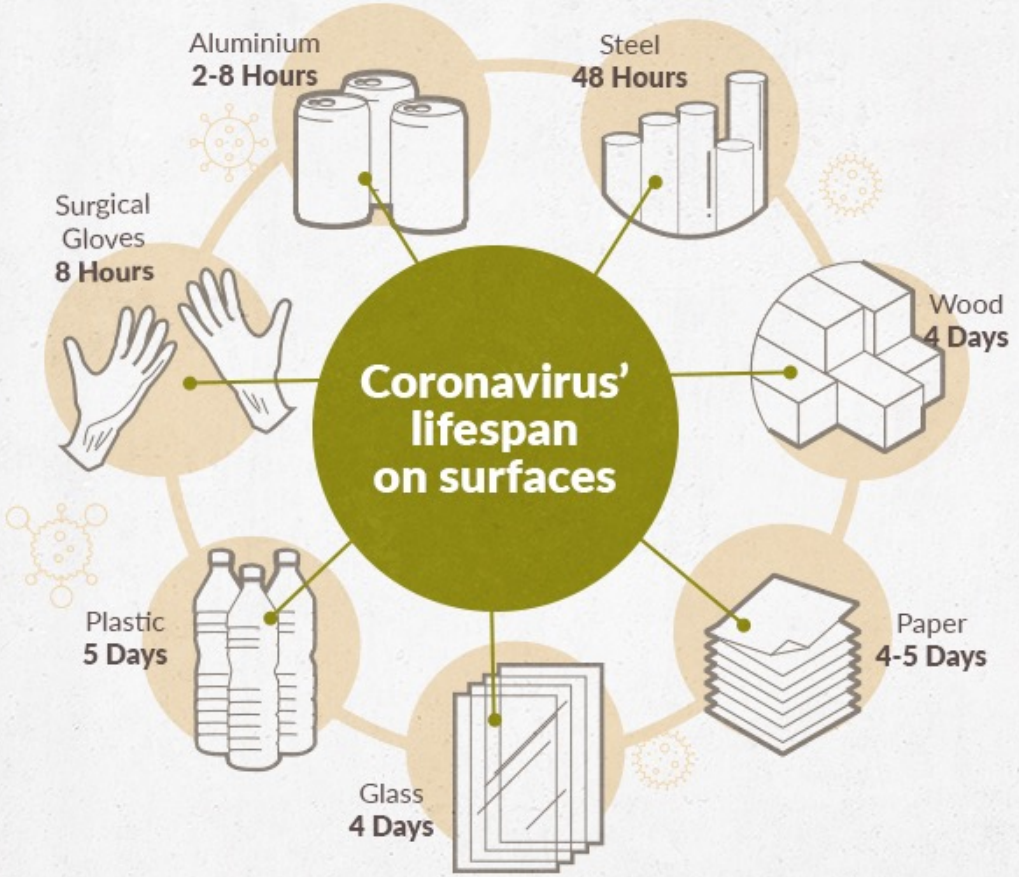
If a test result is positive, as well as following the reporting instructions included in the test kits, people should make sure they then treat their personal waste appropriately.

From https://www.somersetwaste.gov.uk/covidkits/

CORONAVIRUS AND WASTE PICKERS:
DECREASING THE RISKS

March 23, 2020

Always respect local public health and lockdown orders.



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WIEGO

CORONAVIRUS AND WASTE PICKERS:
DECREASING THE RISKS

March 23, 2020

Always wash your hands

Always respect local public health and lockdown orders.

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WIEGO

CORONAVIRUS AND WASTE PICKERS:
DECREASING THE RISKS

March 23, 2020

For workers

Always respect local public health and lockdown orders.

Tie your hair back to avoid contaminating your face.

Never touch your face with your hand or glove.

Cover your face with the inside of your elbow when you cough or sneeze.

Wear masks and change them frequently during the course of the day.

Avoid storing gloves inside your bag or pockets.

Do not greet people with handshakes, hugs or kisses. Try to maintain one meter or more distance from anyone.

Wash your hands frecuently.

Stay home if you or your family develop symptoms.

For further information about **WIEGO's Cuidar Project**, visit www.wiego.org/cuidar-project or reach out to us at cuidar@wiego.org.

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