

HOSPITAL WASTE (HEALTH CARE WASTE)



OUTLINE:

- Introduction
- Classification
- Sources of hospital waste
- Health Hazards of Hospital Waste
- Management of Hospital Waste
- Types of treatment systems
- Conclusion

INTRODUCTION:

Definitions

Waste is almost anything that has served its original intended purpose and is being discarded or stored prior to being discarded.

Health care (Hospital) waste includes all the waste generated by health-care establishments, research facilities, and laboratories.



Intro cont...

- In addition, it includes the waste originating from “minor” or “scattered” sources-such as that produced in the course of health care undertaken in the home (dialysis, insulin injections, etc.).

Cont...

- **Between 75% and 90% of the waste produced by health-care providers is non-risk or “general” health-care waste**, comparable to domestic waste.
- It comes mostly from the administrative and housekeeping functions of health-care establishments and may also include waste generated during maintenance of health-care premises.
- The **remaining 10-25% of health care waste is regarded as hazardous and may create a variety of health risks.**

Cont...

- Hospital waste **is the second most hazardous waste** after radioactive waste.
- The improper management of hospital wastes causes serious environmental problems in terms of air, water and land pollution.
- The nature of pollutants can be classified as biological, chemical and radioactive.
- Environment problems can arise from the mere generation of hospital waste and from the process of handling, treatment and disposal.



Cont...

- Hospital-waste handling is a hazardous activity which requires a high standard of training.
- It calls for specific training that depends on the nature of the work in the hospital, the hazards and possibility of worker exposure, and the responsibilities of individual workers.
- Training of health care workers is the core of health care waste management programs.

Classification

- Hospital wastes are categorized according to their weight, density and constituents. The World Health Organization (WHO) has classified medical waste into different categories. These are:
 1. **Infectious:** material-containing pathogens in sufficient concentrations or quantities that, if exposed, can cause diseases e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients excreta
 2. **Sharps:** disposable needles, syringes, infusion sets, saws, blades, broken glasses, nails or any other item that could cause a cut;
 3. **Pathological:** tissues, organs, body parts, human flesh, fetuses, blood and body fluids;

Cont...

- 4. Pharmaceuticals:** drugs and chemicals that are returned from wards, spilled, outdated, contaminated, or are no longer required (bottles, boxes).
- 5. Genotoxic Waste:** waste containing substances with genotoxic properties e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals;
- 6. Chemical waste:** waste containing chemical substances e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents

Cont...

7. **Radioactive:** solids, liquids and gaseous waste contaminated with radioactive substances used in diagnosis and treatment of diseases e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper;
8. **Wastes with high content of heavy metals:** batteries; broken thermometers; blood-pressure gauges; etc.
9. **Pressurized containers:** Gas cylinders; gas cartridges; aerosol cans;
10. **Others:** waste from the offices, kitchens, rooms, including bed linen, utensils, paper, etc.

Types of HCW Generated

- Among all the categories for HCW produced in the medical institutions, the large hospitals (Referral, Regional and District), in which almost all the ranges of medical activities are practised, produce the following categories of HCW:
- **Non – risk HCW or domestic waste** made of all waste that are not contaminated with infectious or pathogen agents (food residues, paper, cardboard and plastic wrapping);
- **Pathological waste, infectious waste** as well as items that have been used for medical care and also not necessarily contaminated that have been collected together. Some interlocutors call these categories of waste “soft waste” or clinical waste “
- **Anatomical waste and placenta** that are managed separately from the clinical waste;
- **Sharps**, mainly, but not exclusively, auto-disable or disposal syringes with needles that are collected in general in separate cardboard boxes;
- **Pharmaceutical waste** that consists in outdated drugs. \They are specifically managed by the Medical Stores Department (MSD);
- **Specific hazardous HCW (radioactive, cytotoxic)** that are produced in a limited number of specialised medical institutions.

Sources of hospital waste

- The sources of health-care waste can be classified as MAJOR or MINOR according to the quantities produced.



Major sources

Hospitals

- University hospital
- General hospital
- District hospital

Other health-care establishments

- Emergency medical care services
- Health-care centers and dispensaries
- Obstetric and maternity clinics
- Outpatient clinics
- Dialysis centers
- First-aid posts
- Transfusion centers
- Military medical services

Cont...

Related laboratories and research centers

- Medical and biomedical laboratories
- Biotechnology laboratories and institutions
- Medical research centers

Mortuary and autopsy centers

Animal research and testing

Blood banks and blood collection services

Nursing homes for the elderly

Minor sources

Small health-care establishments

- Physicians' offices
- Dental clinics
- Acupuncturists
- Chiropractors

Specialized health-care establishments and institutions with low waste generation

- Convalescent nursing homes
- Psychiatric hospitals
- Disabled persons' institutions

- While minor and scattered sources may produce some health-care waste in categories similar to hospital waste, their composition will be different.
- For example:
 - they rarely produce radioactive or cytostatic waste;
 - human body parts are generally not included;
 - sharps consist mainly of hypodermic needles.

- The composition of wastes is often characteristic of the type of source. For example, the different units within a hospital would generate waste with the following characteristics:
 - **Medical wards:** mainly infectious waste such as dressings, bandages, sticking plaster, gloves, disposable medical items, used hypodermic needles and intravenous sets, body fluids and excreta, contaminated packaging, and meal scraps.
 - **Operating theatres and surgical wards:** mainly anatomical waste such as tissues, organs, fetuses, and body parts, other infectious waste, and sharps.

HEALTH HAZARDS OF HOSPITAL WASTE.

Waste is hazardous if it exhibits one or more of the following four characteristics:

- **IGNITABILITY** : waste capable of burning or causing fire. They can irritate the skin, eyes, and lungs and may give harmful vapors. Examples include gasoline, industrial alcohols, paint, furniture polish.
- **CORROSIVITY** : waste capable of corroding metals and burning human tissues on contact. E.g. alkaline cleaners, some chlorides, fluorides, and acids.
- **REACTIVITY** : materials capable of reacting with other chemicals in air or water, causing an explosion or release of poisonous fumes. E.g. peroxides, isocyanides, cyanides, and chlorine.
- **TOXICITY**: toxic wastes are harmful or fatal when ingested or absorbed. E.g. heavy metals such as lead and mercury, and pesticide wastes.

HEALTH HAZARDS OF HOSPITAL WASTE.

- If hospital waste is not managed properly it proves to be harmful to the environment.
- It not only poses a threat to the employees working in the hospital, but also to the people surrounding that area.
- Infectious waste can cause diseases like Hepatitis A & B, AIDS, Typhoid, Boils, etc.

Cont...

- Exposure to hazardous hospital waste can result in disease or injury.
- Hospital waste contaminated by chemicals used in hospitals is considered hazardous.
- These chemicals include formaldehyde and phenols, which are used as disinfectants, and mercury, which is used in thermometers or sphygmomanometer.

Cont...

- All individuals exposed to hazardous health-care waste are potentially at risk, including those within health-care establishments that generate hazardous waste, and those outside these sources who either handle such waste or are exposed to it as a consequence of careless management.

Cont...

- The main groups at risk are:
 - medical doctors, nurses, health-care auxiliaries, hospital maintenance personnel, workers in support services allied to health-care establishments, such as laundries, waste handling, and transportation, workers in waste disposal facilities (such as landfills or incinerators), including scavengers.
 - patients in health-care establishments or receiving home care.
 - visitors to health-care establishments.

Hazards from specific groups

1. Hazards from infectious waste and sharps

Infectious waste may contain any of a great variety of pathogenic microorganisms. Pathogens in infectious waste may enter the human body by a number of routes:

- through a puncture, abrasion, or cut in the skin;
- through the mucous membranes;
- by inhalation;
- by ingestion.

Examples of infections that can be caused by exposure to health care waste are :

- *Mycobacterium tuberculosis*
- *Viral hepatitis B*
- *Human Immunodeficiency Virus (HIV)*

2. Hazards from chemical and pharmaceutical waste

- Many of the chemicals and pharmaceuticals used in health care establishments are hazardous (e.g. toxic, genotoxic, corrosive, flammable, reactive, explosive, shock-sensitive). They may cause intoxication, either by acute or by chronic exposure, and injuries including burns which are commonest.
- Disinfectants are particularly important members of this group: they are used in large quantities and are often corrosive forming highly toxic secondary compounds.
- Chemical residues discharged into the sewerage system may have adverse effects on the operation of biological sewage treatment plants or toxic effects on the natural ecosystems of receiving waters.

Cont...

- Obsolete pesticides, stored in leaking drums or torn bags, can directly or indirectly affect the health of anyone who comes into contact with them.
- During heavy rains, leaked pesticides can seep into the ground and contaminate the groundwater.
- Poisoning can occur through direct contact with the product, inhalation of vapors, drinking of contaminated water, or eating of contaminated food.

Hospital Waste Management (HWM)

- HWM means the supervision of waste produced by hospitals using techniques that will help to check the spread of diseases through it.
- The management of waste poses to be a major problem in most of the countries, especially hospital waste. It is an ongoing problem for many countries. In recent years, medical waste disposal has posed even more difficulties with the appearance of disposable needles, syringes, and other similar items.
- Single use, or disposable, health care products help hospitals avoid the environmental problems with laundry and sterilising operations associated with traditional products, which consume chemical and energy resources and emit waste water and greenhouse gases.

Cont...

- Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment.
- The proper management of health-care waste also depends largely on good administration and organization as well as active participation by trained and informed staff.
- The head of the hospital should form a **waste management team (WMT)** to develop a **waste management plan (WMP)**.

DEVELOPMENT OF A WASTE MANAGEMENT PLAN

Waste management plan should address the following issues:

- Existing situation (waste management practices, personnel and equipment involved)
- Quantities of waste generated
- Possibilities for waste minimization, reuse, and recycling
- On-site handling, transport, and storage practices
- Training for personnel involved
- Estimation of costs relating to actual situation and proposed options

1. Minimize the production of HCW
<ul style="list-style-type: none"> ▪ Improve purchasing practices ▪ Rationalise stock management
2. Ensure adequate segregation, packaging and labeling
<p>Set-up a three-bins system and a colour coding system for</p> <ul style="list-style-type: none"> ▪ Non-Risk HCW ▪ Clinical Waste ▪ Sharps
Consider Special categories of waste
<ul style="list-style-type: none"> ▪ Highly infectious Waste ▪ Cytotoxic and Hazardous Pharmaceutical Waste ▪ Placentas and other pathological waste

Figure 2: the first steps for rationalizing HCWM

Development of a waste management plan

WHAT ARE THE CHARACTERISTICS OF A GOOD PLAN?

A good waste management plan shall include but not restricted to the following;

- **Waste segregation:** careful segregation (separation) of waste matter into different categories helps to minimize the quantities of hazardous waste.

Cont...

- Segregation is one of the most important steps to successfully manage Hospital wastes.
- Given the fact that only about 10-25% of the hospital wastes is hazardous, treatment and disposal costs could be greatly reduced if a proper segregation were performed. Segregating hazardous from non-hazardous waste reduces also greatly the risks of infecting workers handling hospital wastes.
- Actually, the part that is hazardous and requires special treatment could be reduced to some 2-5% if the hazardous part were immediately separated from the other waste.

Cont...

- The segregation consists in separating the different waste streams based on the hazardous properties of the waste by sorting the waste into color-coded and well-labeled bags or containers.
- All the specific procedures of hospital wastes segregation, packaging and labeling should be explained to the medical and ancillary staff and displayed in each department on charts located on the walls nearby the hospital wastes containers that should be specifically suited for each category of waste.

Cont...

- Segregation should always take place at the source i.e. at the ward bedside, Operation Theatre, Medical Analysis Laboratory, or any other room or ward in the hospital where the waste is generated;
1. Be simple to implement for the medical and ancillary staff and applied uniformly throughout the country;
 2. Be safe and guaranty the absence of infectious hospital wastes in the domestic waste flow;
 3. Be well understood and well known by the medical and ancillary staff of the HCFs;
 4. Be regularly monitored to ensure that the procedures are respected.

- The key to minimization and effective management of health-care waste is segregation (separation) and identification of the waste. Appropriate handling, treatment, and disposal of waste by type reduces costs and does much to protect public health. Segregation should always be the responsibility of the waste producer, should take place as close as possible to where the waste is generated, and should be maintained in storage areas and during transport. The same system of segregation should be in force throughout the country.
- The most appropriate way of identifying the categories of health-care waste is by sorting the waste into colour-coded plastic bags or containers.

In addition to the colour coding of waste containers, the following practices are recommended:

- General health-care waste should join the stream of domestic refuse for disposal.
- Sharps should all be collected together, regardless of whether or not they are contaminated. Containers should be puncture-proof (usually made of metal or high-density plastic) and fitted with covers
- Bags and containers for infectious waste should be marked with the international infectious substance symbol
- Highly infectious waste should, whenever possible, be sterilized immediately by autoclaving. It therefore needs to be packaged in bags that are compatible with the proposed treatment process: red bags, suitable for autoclaving, are recommended.
- Cytotoxic waste, most of which is produced in major hospital or research facilities, should be collected in strong, leak-proof containers clearly labelled "Cytotoxic wastes".
- Small amounts of chemical or pharmaceutical waste may be collected together with infectious waste.

Cont..

- Large quantities of obsolete or expired pharmaceuticals stored in hospital wards or departments should be returned to the pharmacy for disposal. Other pharmaceutical waste generated at this level, such as spilled or contaminated drugs or packaging containing drug residues should *not* be returned because of the risk of contamination.
- Large quantities of chemical waste should be packed in chemical resistant containers and sent to specialized treatment facilities (if available). The identity of the chemicals should be clearly marked on the containers: hazardous chemical wastes of different types should never be mixed.
- Waste with a high content of heavy metals (e.g. cadmium or mercury) should be collected separately.
- Aerosol containers may be collected with general health-care waste once they are completely empty, provided that the waste is not destined for incineration.
- Low-level radioactive infectious waste (e.g. swabs, syringes for diagnostic or therapeutic use) may be collected in yellow bags or containers for infectious waste if these are destined for incineration.

Clinical Waste	Sharp	Non-risk waste
<p>Gloves, gowns, masks gauze, dressing, swabs spatulas that are visually contaminated with blood or body fluids</p> <p>Urine, blood bags, sump tubes, suction canisters, disposable bowls and containers used for medical purposes, Haemodialysis tubing, Intravenous (IV) lines, bags Foley catheters</p> <p>Pre-treated highly infectious waste from medical laboratories, isolation wards</p> <p>Are considered as potentially infectious waste but are managed separately for technical reasons; Human tissue placentas, body parts</p>	<p>Needles , Needle and Syringe assemblies, Lancets, scalpels, blades, Scissors</p> <p>Broken glass, ampoules</p> <p>Intravenous catheter</p> <p>Glass slides, cover slips</p>	<p>Gloves, gowns, masks, gauze, dressings, swabs, spatulas that are contaminated neither with blood nor body fluids</p> <p>Sanitary napkins, Incontinence pads (except in isolation wards)</p> <p>Packages, boxes, Wrappings Newspapers, Magazines Disposable plates, cups, food utensils, left over food and packaging, canisters</p> <p>Tissues, paper towels, intravenous bottles, packs</p>

Table 3: Practical segregation examples

WASTE MINIMIZATION

- May be encouraged by the implementation of certain policies and practices, including the following:
- **Source reduction:** measures such as purchasing restrictions to ensure the selection of methods or supplies generate less hazardous waste.
- **Recyclable products:** use of materials that may be recycled, either on-site or off-site.
- **Good management and control practices:** apply particularly to the purchase and use of chemicals and pharmaceuticals.



RECYCLING AND REUSE

- Medical equipments used in a health-care establishment may be reused provided that they are designed for that purpose and will withstand the sterilization process. E.g. scalpels and hypodermic needles, syringes, glass bottles.

HANDLING, STORAGE, AND TRANSPORTATION

- Appropriate handling, storage, transportation, and treatment of waste by type reduces costs and does much to protect public health.

Cont...

- The best way to manage safe and cost-effective waste disposal is through segregation of wastes into “contaminated” and “general” wastes.
- The general waste can be disposed of cost-effectively through normal means and taken to landfill, and contaminated waste can be handled and treated safely before disposal in landfill.
- If a product has become soiled with blood or other body fluids, it's treated as 'contaminated waste', and either incinerated or treated chemically and landfilled as general waste

MANAGEMENT OF HOSPITAL WASTES

- **On-site collection**
- **Storage of waste**
- **Transportation to a disposal site**

MANAGEMENT cont...

Collection

- *Wastes should not be allowed to accumulate at the point of production*
- No bags should be removed unless they are labeled with their point of production (hospital and ward or department) and contents
- A supply of fresh collection bags or containers should be readily available at all locations where waste is produced

MANAGEMENT cont...

- *On-site transport*
- Health-care waste should be transported within the hospital or other facility by means of wheeled trolleys, containers, or carts that are not used for any other purpose and meet the following specifications:
 - easy to load and unload;
 - no sharp edges that could damage waste bags or containers during loading and unloading;
 - easy to clean.
- The vehicles should be cleaned and disinfected daily with an appropriate disinfectant.
- All waste-bag seals should be in place and intact at the end of transportation

STORAGE

- A storage location for health-care waste should be designated inside the health-care establishment.
- The wastes should be stored in a separate area, room, or building of a size appropriate to the quantities of waste produced and the frequency of collection.

REQUIRED STORAGE CONDITIONS.

- The storage area should have an impermeable, hard-standing floor (easy to clean and disinfect) with good drainage system.
- There should be adequate water supply for cleaning purposes.
- The storage area should afford easy access for staff in charge of handling the waste.
- It should be possible to lock the store to prevent access by unauthorized persons.

Cont...

- Easy access for waste-collection vehicles is essential.
- The storage area should be inaccessible to animals, insects, and birds.
- There should be good lighting and at least passive ventilation.
- The storage area should not be situated in the proximity of fresh food stores or food preparation areas.
- A supply of cleaning equipment, protective clothing, and waste bags or containers should be located conveniently close to the storage area.

Off-site transportation

- Off-site transportation is required when hazardous hospital wastes is treated outside the HCF. The waste producer is then responsible for the proper packaging and labeling of the containers that are transported.
- One of the reasons for labeling hospital wastes bags or containers is that in case of an accident, the content can be quickly identified and appropriate measures taken.

Cont...

- The transportation should always be properly documented and all vehicles should carry a consignment note from the point of collection to the treatment facility.
- Furthermore, the vehicles used for the collection of hazardous / infectious hospital wastes should not be used for any other purpose.
- They shall be free of sharp edges, easy to load and unload by hand, easy to clean / disinfect, and fully enclosed to prevent any spillage in the hospital premises or on the road during transportation.

Steps	Location	Health – Care Waste Stream
Step 1	<i>In medical unit</i>	Generation
Step 2		Segregation at source
Steps 3	<i>Within the facility</i>	Collection & on-site transportation
Step 4		Treatment and disposal
Step 5	<i>Outside the facility</i>	Offsite transportation and treatment or disposal

Figure 1: Synopsis of the HCW stream

Treatment and disposal technologies for health-care waste

1. INCINERATION

used to be the method of choice for most hazardous healthcare wastes and is still widely used. However, recently developed alternative treatment methods are becoming increasingly popular. The final choice of treatment system should be made carefully, on the basis of various factors, many of which depend on local conditions:

- disinfection efficiency;
- health and environmental considerations;
- volume and mass reduction;
- occupational health and safety considerations;
- quantity of wastes for treatment and disposal/capacity of the system;
- types of waste for treatment and disposal;

INCINERATION cont....!

- Infrastructure requirements;
 - locally available treatment options and technologies;
 - options available for final disposal;
 - training requirements for operation of the method;
 - operation and maintenance considerations;
 - available space;
 - location and surroundings of the treatment site and disposal facility;
 - investment and operating costs;
 - public acceptability;
 - regulatory requirements.

Incineration

- Principle of Incineration are a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very significant reduction of waste volume and weight
- The combustion of organic compounds produces mainly gaseous emissions, including steam, carbon dioxide, nitrogen oxides, and solid residues in the form of ashes.
- This process is usually selected to treat waste that cannot be recycled, reused, or disposed off in a landfill site.
- Incineration is done at temperatures between 900 and 1200°C.
- Incineration has been the treatment method of choice for medical waste for two important reasons.
- First, incineration has always been thought to be **the best method of eliminating any infectious organisms that are present in medical waste.**
- Second, incineration has been **economical for hospitals because it substantially reduces the volume to be disposed of in a landfill**

WASTES SUITABLE FOR INCINERATION

- Low heating value: above 2000 kcal/kg (8370 kJ/kg)
- Combustible matter above 60%.
- Non-combustible solids below 5%.
- Moisture below 30%.

Waste types not to be incinerated

- **Pressurized containers;** Explosion may occur and cause damage to the equipment.
- **Halogenated plastics** (e.g. Poly Vinyl Carbon) release gases that contain hydrogen chloride and may contain dioxins.
- **Wastes with high content of heavy metals** (e.g. thermometers, batteries). Incineration will cause emission of toxic metals (e.g. lead, cadmium, mercury) into the atmosphere.
- **Radioactive waste** :treatment does not affect radioactive properties and may disperse radiation.

CHEMICAL DISINFECTION

- Aim is to eliminate microorganisms or at least reduce their numbers to a “satisfactory” level.
- Some disinfectants are effective in killing or inactivating specific types of microorganisms and others are effective against all types.
- Chemicals used for disinfection of health-care waste mostly are aldehydes, chlorine compounds, ammonium salts, and phenolic compounds.
- The use of ozone (O₃) for disinfection of waste is currently being investigated. This disinfectant is strong and relatively safe.

Cont...

- Disinfectants are often hazardous and toxic; many are harmful to skin and mucous membranes.
- Users should therefore wear protective clothes, including gloves and protective eye glasses or goggles.
- Disinfectants are also aggressive to certain building materials and should be handled and stored accordingly.

Treatment cont....

3. Autoclaving

Autoclaving is an efficient wet thermal disinfection process. Typically, autoclaves are used in hospitals for the sterilization of reusable medical equipment. They allow for the treatment of only limited quantities of waste and are therefore commonly used only for highly infectious waste, such as microbial cultures or sharps. Effectively inactivates all vegetative microorganisms and most bacterial spores. Requires a 60-minute cycle at 121°C (minimum) and 1 bar (100kPa). This allows for full steam penetration of waste material.

4. Microwave irradiation

Most microorganisms are destroyed by the action of microwaves of a frequency of about 2450 MHz and a wavelength of 12.24cm. The water contained within the wastes is rapidly heated by the microwaves and the infectious components are destroyed by heat conduction.

Treatment cont....

5. Land disposal

- ***Municipal disposal sites***

If a municipality or medical authority genuinely lacks the means to treat wastes before disposal, the use of a landfill has to be regarded

- ***Open dumps***

Health-care waste should not be deposited on or around open dumps.

- ***Sanitary landfills***

are designed to have at least four advantages over open dumps: geological isolation of wastes from the environment, appropriate engineering preparations before the site is ready to accept wastes, staff present on site to control operations, and organized deposit and daily coverage of waste.

- ***Safe burial on hospital premises***

The burial site should be lined with a material of low permeability, such as clay, if available, to prevent pollution of any shallow groundwater that may subsequently reach nearby wells





Treatment cont....

Encapsulation

Encapsulation is recommended as the easiest technology for the safe disposal of sharps. Sharps are collected in puncture-proof and leak-proof containers, such as high-density polyethylene boxes, metallic drums, or barrels. When a container is three-quarters full, a material such as cement mortar, bituminous sand, plastic foam, or clay is poured in until the container is completely filled. After this material has dried, the container is sealed and may be land filled, stored, or buried inside the hospital premises. It is also possible to encapsulate chemical or pharmaceutical residues together with sharps.

Advantages

- Simple and safe.
- Low costs.
- Also applicable to chemicals and pharmaceuticals.

Drawbacks

- Not recommended for non-sharp infectious waste.

CONCLUSION

- Steps should be taken for the minimization of hospital waste.
- Medical waste management, consistent and scientifically based definitions must be established as to what is meant by medical waste and its components, and what the goals are, plans and policies should be laid down for this purpose.
- Imposing segregated practices within hospitals to separate biological and chemical hazardous waste will result in a clean solid waste stream, which can be recycled easily.
- Emphasis should be put on the reduction of waste, workers' safety should be ensured through education, training and proper personal protective equipment.

References

- www.healthcarewastre.org.
- Ministry of Health and Social Welfare; Standard and Procedures of Health Care Waste Management in Tanzania
- Ministry of Health and Social Welfare; Tanzania National Health Care Waste Management Plan (2007)
- <http://www.wwfpak.org/www.medwastecontest.org>.
- WHO's *Safe **management** of wastes from health-care activities* at:
http://www.who.int/water_sanitation_health/medicalwaste/wastemanag/en