Ministry of health

Kuwait

Manual for
Safe management of wastes
from health-care activities

2016

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Introduction

- Despite the fact that hazardous health-care waste poses the least percentage of the total quantity of waste, but it poses a significant threat to the individual, society and the environment in general and during the production collected, storage, transported or disposal
- The Ministry of Health aims to provide a healthy environment to the health of patients,workers, and members of the community in the external environment,
- it is important for anyone who is interested in or has a role in dealing with clinical waste management that it is an integral part of the Medical care and that many of the risks and negative effects on public health resulting from non-proper treated of this waste, which negatively affects the level of health care and public services
- hence the waste management process attracted the attention of the Ministry of Health and it is important that all who have relationship with waste how to manage these waste because it is an integral part of medical care
- So every health area (hospital or medical center) should be committed to the good management (Sorting / collection / transport / storage and processing) of wastes resulting from all procedures in accordance with the standards and required oy the Ministry of Public Health and to ensures the safety of the environment and health

This manual was extracted from original reference of WHO

(Safe management of wastes from health-care activities 2014)

and was presented , discussed and agreed from representative of the following directorates:

1. **Hotel services,**
2. **Infection control,**
3. **Laboratories,**
4. **Public health ,**
5. **Central Medical Stores**
6. **Pharmaceutical services**
7. **Medical licenses,**
8. **Radiation protection,**
9. **Blood bank**

in accordance to administrative decree from under secretary of MOH

No. 498 year 2016

1. Definition and characterization of health-care waste

The term health-care waste includes all the waste generated within health-care facilities, research centers and laboratories related to medical procedures. In addition, it includes 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).

Between 75% and 90% of the waste produced by health-care providers is comparable to domestic waste and usually called “non-hazardous” or “general health-care waste”. It comes mostly from the administrative, kitchen and housekeeping functions at health-care facilities and may also include packaging waste and waste generated during maintenance of health-care buildings. The remaining 10–25% of health-care waste is regarded as “hazardous” and may pose a variety of environmental and health risks

A. Non-hazardous general waste

Non-hazardous or general waste is waste that has not been in contact with infectious agents, hazardous chemicals or radioactive substances and does not pose a sharps hazard. A significant proportion (about 85%) of all waste from health-care facilities is non-hazardous waste and is usually similar in characteristics to municipal solid waste. More than half of all non-hazardous waste from hospitals is paper, cardboard and plastics, while the rest comprises discarded food, metal, glass, textiles, plastics and wood.

B. Hazardous waste

1. Sharps waste

Sharps are items that could cause cuts or puncture wounds, including needles, hypodermic needles, scalpels and other blades, knives, infusion sets, saws, broken glass and pipettes. Whether or not they are infected, such items are usually considered highly hazardous health-care waste and should be treated as if they were potentially infected.

2. Infectious waste

Infectious waste is material suspected to contain pathogens (bacteria, viruses, parasites or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. This category includes:

- waste contaminated with blood or other body fluids
- cultures and stocks of infectious agents from laboratory work
- waste from infected patients in isolation wards.

Waste contaminated with blood or other body fluids include free-flowing blood, blood components and other body fluids; dressings, bandages, swabs, gloves, masks, gowns, drapes and other material contaminated with blood or other body fluids; and waste that has been in contact with the blood of patients undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable towels, gowns, aprons, gloves and laboratory coats).

Laboratory cultures and stocks are **highly infectious waste**. Waste from autopsies, animal bodies, and other waste items that have been inoculated, infected, or in contact with highly infectious agents are highly infectious waste. Discarded instruments or materials that have been in contact with persons or animals infected with highly infectious agents are also to be considered infectious waste.

3. Pathological waste

Consists of tissues, organs, body parts, blood, body fluids and other waste from surgery and autopsies on patients with infectious diseases. It also includes human fetuses and infected animal carcasses. Recognizable human or animal body parts are sometimes called **anatomical waste**. Pathological waste may include healthy body parts that have been removed during a medical procedure or produced during medical research.

4. Pharmaceutical waste including genotoxic waste

Pharmaceutical waste includes expired, unused, spilt and contaminated pharmaceutical products, prescribed and proprietary drugs, vaccines and sera that are no longer required, and, due to their chemical or biological nature, need to be disposed of carefully. The category also includes discarded items heavily contaminated during the handling of pharmaceuticals, such as bottles, vials and boxes containing pharmaceutical residues, gloves, masks and connecting tubing.

Genotoxic waste

Genotoxic waste is highly hazardous and may have mutagenic (capable of inducing a genetic mutation), teratogenic (capable of causing defects in an embryo or fetus) or carcinogenic (cancer-causing) properties.

Genotoxic waste may include certain cytostatic drugs, vomit, urine or faeces from patients treated with cytostatic drugs, chemicals and radioactive material.

Cytostatic drugs can be categorized as follows:

alkylating agents: cause alkylation of DNA nucleotides, which leads to cross-linking and miscoding of the genetic stock;

antimetabolites: inhibit the biosynthesis of nucleic acids in the cell;

mitotic inhibitors: prevent cell replication

In specialized oncological hospitals, genotoxic waste (containing cytostatic or radioactive substances) may constitute as much as 1% of the total health-care wastes.

Common genotoxic products used in health care

Classified as carcinogenic

Chemicals: benzene

Cytotoxic and other drugs: azathioprine, chlorambucil, chlornaphazine, ciclosporin, cyclophosphamide, melphalan, semustine, tamoxifen, thiotepa, treosulfan

Classified as possibly or probably carcinogenic

Cytotoxic and other drugs:

azacitidine, bleomycin, carmustine, chloramphenicol, chlorozotocin, cisplatin, dacarbazine, daunorubicin, dihydroxymethylfuratrizine (e.g. Panfuran S – no longer in use), doxorubicin, lomustine, methylthiouracil, metronidazole, mitomycin, nafenopin, niridazole, oxazepam, phenacetin, phenobarbital, phenytoin, procarbazine hydrochloride, progesterone, sarcolysin, streptozocin, trichlormethine

5. Chemical waste

Chemical waste consists 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 (harmful)

corrosive (e.g. acids of pH <2 and bases of pH >12)

flammable

reactive (explosive, water reactive, shock sensitive)

oxidizing.

examples: Formaldehyde is a significant source of chemical waste in hospitals. It is used to clean and disinfect equipment (e.g. haemodialysis or surgical equipment); to preserve specimens; to disinfect liquid infectious waste; and in pathology, autopsy, dialysis, embalming and nursing units.

Photographic fixing and developing solutions are used in X-ray departments where photographic film continues to be used. The fixer usually contains 5–10% hydroquinone, 15% potassium hydroxide and less than 1% silver. The developer contains approximately 45% glutaraldehyde. Acetic acid is used in both “stop” baths and fixer solutions.

Wastes containing solvents are generated in various departments of a hospital, including pathology and histology laboratories and engineering departments. Solvents include halogenated and non-halogenated compounds.

Waste organic chemicals generated in health-care facilities include disinfecting and cleaning solutions, vacuum-pump and engine oils, insecticides and rodenticides.

Waste inorganic chemicals consist mainly of acids and alkalis, oxidants and reducing agents.

Non-hazardous chemical waste consists of chemicals with none of the above properties; for example, sugars, amino acids and certain organic and inorganic salts, which are widely used in transfusion liquids.

6. **Wastes from materials with high heavy-metal contents** represent a subcategory of hazardous chemical waste and are usually highly toxic. Mercury is an example of a highly toxic yet common substance in health-care facilities. Mercury wastes are typically generated by spillage from broken clinical equipment, but their volume is decreasing in many countries with the substitution of mercury-free instruments (e.g. digital thermometers, aneroid blood-pressure gauges). Whenever possible, spilt drops of mercury should be recovered. Residues from dentistry also have high mercury contents. Cadmium waste comes mainly from discarded batteries. Reinforced wood panels containing lead are still used in radiation proofing in X-ray and diagnostic departments.

7. **Pressurized containers**

   Many types of gas are used in health care and are often stored in portable pressurized cylinders, cartridges and aerosol cans. Many of these are reusable, once empty or of no further use (although they may still contain residues). However, certain types – notably aerosol cans – are single-use containers that require disposal. Whether inert or potentially harmful, gases in pressurized containers should always be handled with care; containers may explode if incinerated or accidentally punctured

8. **Radioactive waste**

   Materials contaminated with radionuclides. They are produced as a result of procedures such as in vitro analysis of body tissue and fluid, in vivo organ imaging and tumour localization, and various investigative and therapeutic practices.
   Radionuclides used in health care are in either unsealed (or open) sources or sealed sources. Unsealed sources are usually liquids that are applied directly,
   While sealed sources are radioactive substances contained in parts of equipment or encapsulated in unbreakable or impervious objects, such as pins, “seeds” or needles.
   Radioactive health-care waste often contains radionuclides with short half-lives (i.e. half of the radionuclide content decays in hours or a few days); consequently, the waste loses its radioactivity relatively quickly. However, certain specialized therapeutic procedures use radionuclides with longer half-lives; these are usually in the form of small objects placed on or in the body and may be reused on other patients after sterilization. Waste in the form of sealed sources may have a relatively high radioactivity, but is only generated in low volumes from larger medical and research laboratories. Sealed sources are generally returned to the supplier and should not enter the waste stream.

   The waste produced by health-care and research activities involving radionuclides and related equipment maintenance and storage can be classified as follows:

   - sealed sources;
   - spent radionuclide generators;
   - low-level solid waste (e.g. absorbent paper, swabs, glassware, syringes, vials);
   - residues from shipments of radioactive material and unwanted solutions of radionuclides intended for diagnostic or therapeutic use;
   - liquid immiscible with water, such as liquid scintillation counting;
   - residues used in radioimmunoassay, and contaminated pump oil;
   - waste from spills and from decontamination of radioactive spills;
   - excreta from patients treated or tested with unsealed radionuclides;

- low-level liquid waste (e.g. from washing apparatus);
- gases and exhausts from stores and fume cupboards.

Generation of health-care waste

Table (1) Examples of health-care waste from different sources

Major sources (hospitals and medical centers)

	Sharps	Infectious and pathological waste	Chemical, pharmaceutical and cytotoxic waste	Non-hazardous or general waste
Medical ward	Hypodermic needles, intravenous set needles, broken vials and ampoules	Dressings, bandages, gauze and cotton contaminated with blood or body fluids; gloves and masks contaminated with blood or body fluids	Broken thermometers and blood-pressure gauges, spilt medicines, spent disinfectants	Packaging, food scraps, paper, flowers, empty saline bottles, non-bloody diapers, non-bloody intravenous tubing and bags
Operating theatre	Needles, intravenous sets, scalpels, blades, saws	Blood and other body fluids; suction canisters; gowns, gloves, masks, gauze and other waste contaminated with blood and body fluids; tissues, organs, fetuses, body parts	Spent disinfectants Waste anesthetic gases	Packaging; uncontaminated gowns, gloves, masks, hats and shoe covers
Laboratory	Needles, broken glass, Petri dishes, slides and cover slips, broken pipettes	Blood and body fluids, microbiological cultures and stocks, tissue, infected animal carcasses, tubes and containers contaminated with blood or body fluids	Fixatives; formalin; xylene, toluene, methanol, methylene chloride and other solvents; broken lab thermometers	Packaging, paper, plastic containers
Pharmacy store			Expired drugs, spilt drugs	Packaging, paper, empty containers
Radiology			Silver, fixing and developing solutions; acetic acid; glutaraldehyde	Packaging, paper
Chemotherapy	Needles and syringes		Bulk chemotherapeutic waste; vials, gloves and other material contaminated with cytotoxic agents; contaminated excreta and urine	Packaging, paper
Vaccination campaigns	Needles and syringes		Bulk vaccine waste, vials, gloves	Packaging

Environmental services	Broken glass		Disinfectants (glutaraldehyde, phenols, etc.), cleaners, spilt mercury, pesticides	Packaging, flowers, newspapers, magazines, cardboard, plastic and glass containers, yard and plant waste
Engineering			Cleaning solvents, oils, lubricants, thinners, asbestos, broken mercury devices, batteries	Packaging, construction or demolition waste, wood, metal
Food services				Food scraps; plastic, metal and glass containers; packaging

Minor sources

Physicians' offices	Needles and syringes, broken ampoules and vials	Cotton, gauze, dressings, gloves, masks and other materials contaminated with blood or other body fluids	Broken thermometers and blood-pressure gauges, expired drugs, spent disinfectants	Packaging, office paper, newspapers, magazines, uncontaminated gloves and masks
Dental offices	Needles and syringes, broken ampoules	Cotton, gauze, gloves, masks and other materials contaminated with blood and other body fluids	Dental amalgam, spent disinfectants	Packaging, office paper, newspapers, magazines, uncontaminated gloves and masks
Home health care	Lancets and insulin injection needles	Bandages and other material contaminated with blood or other body fluids	Broken thermometers	Domestic waste

2. Legislative, regulatory and policy aspects of health-care waste

Importance of a national policy

- The most common first step by a government ministry is to describe the changes needed in a national health-care waste-management policy.
- an important step in creating a successful and sustainable health-care waste-management system, which all health-care facilities can work towards.
- A national policy should identify the needs and problems in the country, as well as taking into account the relevant international agreements and conventions adopted nationally that govern public health, sustainable development, the environment and safe management of hazardous waste.
- Once a national policy has been prepared, typically legislation and supporting regulations governing health-care waste management, if needed, should be developed.
- regulations should describe what is expected from health-care staff and explain the methods for their enforcement

Guiding principles

Five principles are widely recognized as underlying the effective and controlled management of wastes.

1. The “polluter pays” principle implies that all producers of waste are legally and financially responsible for the safe and environmentally sound disposal of the waste they produce. This principle also attempts to assign liability to the party that causes damage.
2. The “precautionary” principle Where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation
3. The “duty of care” principle stipulates that any person handling or managing hazardous substances or wastes or related equipment is ethically responsible for using the utmost care in that task.
4. The “proximity” principle recommends that treatment and disposal of hazardous waste take place at the closest possible location to its source to minimize the risks involved in its transport.
5. The “prior informed consent principle” It requires that affected communities and other stakeholders be apprised of the hazards and risks, and that their consent be obtained.

International agreements and conventions

The Basel Convention
The Bamako Convention
The Stockholm Convention
The environment and sustainable development conferences
United Nations Committee of Experts on the Transport of Dangerous Goods
United Nations Economic Commission for Europe
Aarhus Convention of the United Nations Economic Commission for Europe

Available guidance

World Health Organization Guidance
The International Solid Waste Association (ISWA)
ISWA policy document on health-care waste management
IAEA Safety Standards for Disposal of Radioactive Waste

National legislation

A national policy document should form the basis for developing the law and should be complemented by technical guidelines developed for implementation of the law. This legal "package" should specify regulations on the treatment of different waste categories; segregation, collection, storage, handling, disposal and transport of waste; and responsibilities and training requirements. The national policy should take into account the resources and facilities available in the country concerned and any cultural aspects of waste handling.

A national law on health-care waste management may stand alone, or constitute part of more comprehensive legislation, such as:

- a law on managing all forms of hazardous wastes, where the application to health-care waste is stated explicitly;
- a law on hospital hygiene and infection control, where a specific section should be devoted to health-care waste.
- A national law should include the following elements:

· a clear definition of hazardous health-care waste and its various categories;

· a precise indication of the legal obligations of the health-care waste producer regarding safe handling and disposal;

· specifications for record keeping and reporting;

· establishment of permit or licensing procedures for systems of treatment and waste handling;

· specifications for an inspection system and regular audit procedures to ensure enforcement of the law and for penalties to be imposed for contravention;

· designation of courts responsible for handling disputes arising from enforcement of, or non-compliance with, the law.

· Gradual implementation of the law is recommended in preference to any attempt to introduce all measures simultaneously, particularly where existing practices are inadequate.

Technical guidelines

Technical guidelines intended to aid the implementation of legislation should be practical and directly applicable to local managers and staff. They should contain sufficient detail to ensure that safe practices and appropriate standards can be achieved. They should outline the legal framework to be met for the safe management of health-care waste and how the guidance improves hospital hygiene, and occupational health and safety. Technical guidelines can be prepared by various organizations, both public and nongovernmental, and collectively address a broad of range of relevant topics:

- Responsibilities of public health authorities

- Safe practices for waste minimization

- Separation, handling, storage and transport of health-care waste

- Treatment and disposal methods for each category of health-care waste and for wastewater

- Limits of emission of atmospheric pollutants and measures for protection of water resources.

القوانين و اللوائح المحلية و الاقليمية:-

- قانون 25\1993 بالموافقة على اتفاقية بازل بشأن التحكم فى نقل النفايات الخطرة و التخلص منها عبر الحدود
- قانون 10\2006 بالموافقة على تعديل اتفاقية بازل بشأن التحكم فى نقل النفايات الخطرة و التخلص منها عبر الحدود
- اللائحة التنفيذية 21\1995 المعدل بقانون 16\1996 بانشاء الهيئة العامة للبيئة
- قانون 11\2006 بالموافقة على اتفاقية ستوكهولم بشأن الملوثات العضوية الثابتة
- قانون 42\2014 فى شأن اصدار قانون حماية البيئة
- مرسوم بقانون 131\1977 بشأن تنظيم الاشعة المؤينة و الوقاية من مخاطرها
- قرار وزارى 74\2002بشأن الاشتراطات الواجب توافرها فى الادارة السليمة لنفايات الرعاية الصحية
- قرار وزارى 522\2003 بشأن اللائحة الخاصة بتنظيم استخدام الاشعة المؤينة و الوقاية من مخاطرها
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- دليل معايير الاعتماد الوطنية
- كيفية التعامل مع النفايات ادارة حماية البيئة بوزارة الصحة 1993
- الادارة البيئية للنفايات الطبيية الهيئة العامة للبيئة 2006

3. Health-care waste minimization

- The preferred management solution is quite simply not to produce the waste, by avoiding wasteful ways of working.
- To achieve lasting waste reduction (or minimization), the focus should be on working with medical staff to change clinical practices to ones that use less materials.
- Although waste minimization is most commonly applied at the point of its generation, health-care managers can also take measures to reduce the production of waste through adapting their purchasing and stock control strategies

Examples of practices that encourage waste minimization

Source reduction

- Purchasing reductions: selecting supplies that are less wasteful where smaller quantities can be used, or that produce a less hazardous waste product.
- Use of physical rather than chemical cleaning methods (e.g. steam disinfection instead of chemical disinfection).
- Prevention of wastage of products (e.g. in nursing and cleaning activities).

Management and control measures at hospital level

- Centralized purchasing of hazardous chemicals.
- Monitoring of chemical use within the health centre from delivery to disposal as hazardous wastes.

Stock management of chemical and pharmaceutical products

- More frequent ordering of relatively small quantities rather than large amounts at one time, to reduce the quantities used (applicable in particular to unstable products).
- Use of the oldest batch of a product first.
- Use of all the contents of each container.
- Checking of the expiry date of all products at the time of delivery, and refusal to accept short-dated items from a supplier.

- Waste minimization usually benefits the waste producer: costs for both the purchase of goods and for waste treatment and disposal is reduced, and the liabilities associated with the disposal of hazardous waste are also lower.
- All employees have a role to play in this process and should be trained in waste minimization. This is particularly important for the staff of departments that generate large quantities of hazardous health-care waste.
- Suppliers of chemicals and pharmaceuticals can also become responsible partners in waste-minimization programs. The health centre can encourage this by ordering only from suppliers who provide rapid delivery of small orders, who accept the return of unopened stock, and who offer offsite waste-management facilities for hazardous wastes

4. Segregation, storage and transport of health-care waste

Guiding principles:

- Health-care facility managers have to ensure that waste is kept under control at all times within a health-care facility and disposed of safely either onsite or offsite.
- The following general principles of waste segregation, storage and transportation relate to the control of waste flow from generation to disposal:
    - Health-care waste is generated in a medical area and should be segregated into different fractions, based on their potential hazard and disposal route, by the person who produces each waste item;
    - Separate containers should be available in each medical area for each segregated waste fraction;
    - Waste containers when filled should be labeled to help managers control waste production;
    - Closed local storage inside or near to a medical area may be needed if wastes are not collected frequently; hazardous and non-hazardous wastes should not be mixed during collection, transport or storage;
    - Collected waste is often taken to central storage sites before onsite or offsite treatment and disposal;
    - Staff should understand the risks and safety procedures for the wastes they are handling.

Segregation systems

- The correct segregation of health-care waste is the responsibility of the person who produces each waste item, whatever their position in the organization.
- The health-care facility management is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adhere to the correct procedures.
- Segregation should be carried out by the producer of the waste as close as possible to its place of generation, which means segregation should take place in a medical area, at a bedside, in an operating theatre or laboratory by nurses, physicians and technicians.
- If classification of a waste item is uncertain, as a precaution it should be placed into a container used for hazardous health-care waste.
- The simplest waste-segregation system is to separate all hazardous waste from the larger quantity of nonhazardous general waste.
- To provide a minimum level of safety to staff and patients, the hazardous waste portion is commonly separated into two parts: used sharps and potentially infectious items. In the latter, the largest components are typically tubing, bandages, disposable medical items, swabs and tissues.
- Further types of containers can be used for other categories of wastes, such as chemical and pharmaceutical wastes, or to separate out pathological waste, where it is to be handled and disposed of in different ways from the other portions of the waste flow.

Waste containers, color codes and labels

- Ideally, the same system of segregation should be in force throughout a country, and many countries have national legislation that prescribes the waste segregation categories to be used and a system of colour coding for waste containers.
- A World Health Organization (WHO) scheme is available (Table 2)

Table (2) WHO-recommended segregation scheme

Type of waste	Colour of container and markings	Type of container
Highly infectious waste	Yellow, marked "HIGHLY INFECTIOUS", with biohazard symbol	Strong, leak-proof plastic bag, or container capable of being autoclaved
Other infectious waste, pathological and anatomical waste	Yellow with biohazard symbol	Leak-proof plastic bag or container
Sharps	Yellow, marked "SHARPS", with biohazard symbol	Puncture-proof container
Chemical and pharmaceutical waste	Brown, labeled with appropriate hazard symbol	Plastic bag or rigid container
Radioactive waste	Labelled with radiation symbol	Lead box
General health-care waste	Black	Plastic bag

- Color coding makes it easier for medical staff and hospital workers to put waste items into the correct container, and to maintain segregation of the wastes during transport, storage, treatment and disposal.
- Color coding also provides a visual indication of the potential risk posed by the waste in that container.
- Labeling of waste containers is used to identify the source, record the type and quantities of waste produced in each area, and allow problems with waste segregation to be traced back to a medical area.
- A simple approach is to attach a label to each filled container with the details of the medical area, date and time of closure of the container, and the name of the person filling out the label.
- Using an international hazard symbol on each waste container is also recommended.
- Several symbols are relevant to the different kinds of hazardous waste produced in a healthcare facility, and these are reproduced in Figure (1)

Figure (1) Biohazard, radiation and chemical hazard symbols

Biohazard symbol

Old radiation symbol

New radiation symbol

Note: The new radiation symbol was adopted by the United Nations in 2007, but the older symbol is still widely recognized and expected to remain in common use for many years.

Figure (2) Comparison of common hazardous waste symbols

Corrosive (C)

These substances attack and destroy living tissues, including the eyes and skin.

Highly flammable (F)

These substances easily catch fire (flash point: 21–55 °C). Never store flammable substances together with explosive ones.

Toxic (T)

These substances can cause death. They may have their effects when swallowed or breathed in, or when absorbed through the skin.

Harmful (Xn)

These substances are similar to toxic substances but are less dangerous.

Explosive (E)

An explosive is a compound or mixture susceptible to a rapid chemical reaction, decomposition or combustion, with the rapid generation of heat and gases with a combined volume much larger than the original substance.

Irritant (I)

These substances can cause reddening or blistering of skin.

Extremely flammable (F+)

Liquid substances and preparations that have an extremely low flash point (<21 °C) and therefore catch fire very easily.

Very toxic (T+)

Substances and preparations that, in very low quantities, cause death or acute or chronic damage to health when inhaled, swallowed or absorbed via the skin.

Oxidising (O)

These substances provide oxygen, which allows other materials to burn more fiercely.

Dangerous for environment (N)

Substances that, were they to enter into the environment, would present or might present an immediate or delayed danger for one or more components of the environment.

No direct equivalent; use harmful or irritant symbol as appropriate

Specific organ toxicity

These substances may cause:

- damage to organ or organs after single or repeated exposure
- respiratory sensitization
- allergy or asthma or breathing difficulties if inhaled.

Beyond basic segregation

- **Non-hazardous waste**

- Within each major category (e.g. non-hazardous, potentially infectious, used sharps), further segregation may be advantageous. For example, general non-hazardous waste can be broken down into recyclables, biodegradable waste and non-recyclable portions.
- If these are mixed at the point of generation, it may prevent recyclables from being recovered.
- Food wastes can be collected from medical areas and returned directly to the kitchens.
- Kitchen wastes can be composted or, where regulations allow, sterilized and used for animal feed. Non-hazardous biodegradable wastes (e.g. flowers) may be disposed of with kitchen waste.

- ***Hazardous waste***

- Highly infectious waste, such as diagnostic laboratory samples and waste from infectious patients in isolation, should be collected separately and autoclaved at the point of generation. Once disinfected, the waste would leave a medical area in the infectious health-care waste container.
- Anatomical waste, particularly recognizable body parts or fetal material, should be handled according to prevailing religious and cultural preferences (burial).
- Sharps waste (needle and syringe combination) should be placed directly into a sharps container.
- In some places, it is permitted for syringes to have their needles removed or destroyed before placing the syringe in an infectious waste bin. Any removed needles are placed in a puncture-proof container and dealt with accordingly.
- Various chemical and pharmaceutical wastes should be segregated and collected separately: subcategories include mercury, batteries, cadmium-containing wastes, photochemicals, stains and laboratory reagents, cytotoxic drugs and other pharmaceuticals. All should be clearly labelled with the type of waste and the name of the major chemicals, with any necessary hazard labels attached to corrosive, flammable, explosive or toxic chemicals. Liquid chemical wastes should never be mixed or disposed of down the drain, but should be stored in strong leak-proof containers.
- It may be possible to recover silver from photochemicals at a profit, and return of chemicals to suppliers should be practiced where possible. Silver is increasingly being used in medical products, but is rarely segregated due to a lack of dedicated disposal or metals recovery facilities.
- Low-energy light bulbs (compact fluorescents) contain small amounts of mercury. Both these and batteries should be segregated and treated by recycling processes, where suitable facilities exist.
- Mercury use is being reduced in health care and other applications around the world because of its toxicity and pollution potential. Since it is volatile, spilled mercury can be inhaled by staff and patients if it is not cleaned up properly, but a simple spill kit can be cheap and effective.
- Where mercury thermometers and sphygmomanometers are still in use, medical staff should be supplied with a spill kit and trained in how to use it. Any spill larger than a thermometer should be dealt with in consultation with the local health and safety

authority. Brushes and vacuum cleaners should never be used for spilled mercury. Mercury can be cleaned up easily from wood, linoleum, tile and similar smooth surfaces. It cannot be completely removed from carpets, curtains, upholstery or other absorbent materials. The affected portion should be isolated and disposed of in accordance with official guidelines.

- Unused pharmaceuticals should go back to the pharmacy for return to manufacturers or dispatched to specialist waste-treatment contractors.
- Pharmaceuticals should be kept in their original packaging to aid identification and prevent reaction between incompatible chemicals. Spilt and contaminated chemicals and pharmaceuticals should not be returned to the pharmacy but should go directly from the point of production to a waste store.
- Typically, they are stored and transported within a health-care facility in brown cardboard boxes and must be kept dry.
- Where specialist disposal services exist, they should collect and handle radioactive wastes. Otherwise, waste may be stored in secure, radiation-proof repositories (leak-proof, lead-lined and clearly labeled with the name of the radionuclide and date of deposition) where it should be left to decay naturally.

• Waste containers: specifications and siting

- Waste containers can come in many shapes and sizes and be made from different materials.
- Many modern waste containers are designed for automated systems that empty their contents into the waste-disposal system and wash and disinfect them mechanically.
- At the other end of the scale, waste containers may also be made out of reused plastic and metal containers.
- In all cases, they should be sturdy and leak-proof, and (except for sharps containers) lined with a sturdy plastic bag. The recommended thickness of bags for infectious waste is 70 μm (ISO 7765 2004).
- Plastics used for either containers or bags should be chlorine-free. Not all plastic bags can withstand temperatures of 121 °C, and some can melt during an autoclave process.
- Containers should have well-fitting lids, either removable by hand or preferably operated by a foot pedal.
- Both the container and the bag should be of the correct colour for the waste they are intended to receive and labeled clearly.
- Mixing colors – such as having yellow bags in black bins – should be avoided, because it will increase the potential for confusion and poor segregation.
- Since sharps can cause injuries that leave people vulnerable to infection, both contaminated and uncontaminated sharps should be collected in a puncture-proof and impermeable container that is difficult to break open after closure.
- The appropriate waste receptacle (bags, bins, sharps boxes) should be available to staff in each medical and other waste-producing area in a health-care facility. This permits staff to segregate and dispose of waste at the point of generation, and reduces the need for staff to carry waste through a medical area.
- Posters showing the type of waste that should be disposed of in each container should be posted on walls to guide staff and reinforce good habits.

- Segregation success can be improved by making sure that the containers are large enough for the quantity of waste generated at that location during the period between collections.
- Up-to-date waste audit data can be used to assess the volume and type of waste containers necessary, since waste managers also need to spend time with staff in medical areas identifying the type of work that is undertaken. No two areas will be the same.
- Medical staff should be encouraged to think of waste disposal as part of a patient's treatment, so all aspects of the care process are completed at the bedside or treatment room.
- If intervention at the bedside is required, a waste container should be taken to the bed.
- Sharps bins are also sometimes taken to a patient for drug administration or blood sampling.
- A mobile trolley with infectious waste and sharps containers may therefore be more versatile and should be given serious consideration. The alternative is establishing a limited number of locations in a medical area where general waste (black bags) and infectious health-care waste (yellow bags and sharps containers) are placed.
- The locations should be away from patients; typical sites are the sluice (utility) room, treatment room and nurses' station.
- Where containers for segregating hazardous and non-hazardous health-care wastes are in use, they should be located close together, wherever possible. Containers for infectious waste should not be placed in public areas because patients and visitors may use the containers and come into contact with potentially infectious waste items.
- Baskets with color-coded yellow bags could be located close to sinks (if needed) for staff to dispose off contaminated gloves and protective clothing, this is different from non-infectious receptacle with color-coded blue bags for disposal of paper towels used for drying hands .
- Containers should be of similar size to overcome the observed tendency for staff to put waste in the largest receptacle.
- It is possible to provide baskets close to the laundries The color-coded yellow healthy crew used to dispose of gloves and protective clothing contaminated if needed and be different from those used in the disposal of paper to dry hands and that you should be tagging blue color scheme
- Unless patients are known or suspected to have readily transmitted infections, the assumption should be that general waste generated in a medical area is of low risk.
- If there is a known communicable infection (e.g. methicillin-resistant Staphylococcus aureus, tuberculosis or leprosy), all waste used in and around the patient should be classed as an infection risk and placed in the yellow, potentially infectious waste container. This "blanket" approach to all waste being assumed to be infectious can be avoided where there is a high level of training and communication between the clinical and support staff. Waste from each patient should be treated according to their known infection status.

- ***Setting and maintaining segregation standards***

- Segregation methods should be clearly set out in the waste-management policy of a health-care facility.
- It is important that the waste-management policy is supported and enforced by senior staff and managers.
- Managers and medical supervisors should know the relevant legislation and understand how to implement waste audits, foresee possible problems and take pre-emptive remedial action.
- Medical staff and waste handlers should understand the reasons for, and operation of, segregation practices, waste auditing, spill management, and accident and injury reporting.
- Training should be repeated periodically to ensure that all staff are reminded of their responsibilities.
- The waste-management committee is responsible for seeing that segregation rules are enforced and waste audits carried out to quantify the amount of waste being produced.
- Also, segregation posters for medical and waste workers help to raise knowledge about segregation practices and improve the quality of separated waste components.
- Waste that has been poorly segregated should never be re-sorted, but instead should be treated as the most hazardous type of waste in the container.
- Corrective action taken should concentrate on ensuring that waste is segregated properly in the future. As well as confirming that waste is being segregated properly, waste audit data can be used to indicate the type, size and number of containers needed in each area.
- It should be used to estimate disposal capacity requirements and the amount of recyclables generated. Both are essential pieces of data for good waste management and cost control.
- It can also be used to track the entire waste stream through to final disposal.
- Hospital managers have a duty to prove that all wastes have been disposed of in accordance with the law, and health-care facilities have to obtain proof of treatment from authorized waste-disposal contractors.

- **Collection within the health-care facility**

- Collection times should be fixed and appropriate to the quantity of waste produced in each area of the healthcare facility.
- General waste should not be collected at the same time or in the same trolley as infectious or other hazardous wastes.
- Waste bags and sharps containers should be filled to no more than three quarters full. Once this level is reached, they should be sealed ready for collection.
- Plastic bags should never be stapled but may be tied or sealed with a plastic tag or tie.
- Replacement bags or containers should be available at each waste-collection location so that full ones can immediately be replaced.
- Waste bags and containers should be labeled with the date, type of waste and point of generation to allow them to be tracked through to disposal.
- Where possible, weight should also be routinely recorded.
- Collection should be daily for most wastes, with collection timed to match the pattern of waste generation during the day. For example, in a medical area where the morning routine begins with the changing of dressings, infectious waste could be collected mid-

morning to prevent soiled bandages remaining in the medical area for longer than necessary.
- Visitors arriving later in the day will bring with them an increase in general waste, such as newspapers and food wrappings; therefore, the optimum time for general and recyclable waste collection would be after visitors have departed.
- In comparison with this general type of medical area, a theatre would generate a high proportion of potentially infectious waste and could have several collections during the day to fit in with the schedule of operations.
- A child and maternal health clinic might generate primarily sharps waste from injections, which would be collected at the end of each working day.

- **Interim storage in clinical departments**
  - Where possible, hazardous waste generated in clinical areas 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.
  - This is known as interim or short-term storage.
  - 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.

Onsite transport of waste

- **General requirements**
  - Onsite transport should take place during less busy times whenever possible. Set routes should be used to prevent exposure to staff and patients and to minimize the passage of loaded carts through patient care and other clean areas.
  - Depending on the design of the health-care facility, the internal transport of waste should use separate floors, stairways or elevators as far as possible.
  - Regular transport routes and collection times should be fixed and reliable.
  - Transport staff should wear adequate personal protective equipment, gloves, strong and closed shoes, overalls and masks.
  - Hazardous and non-hazardous waste should always be transported separately.
  - In general, there are three different transport systems: Waste transportation trolleys for general waste should be painted black, only be used for non-hazardous waste types and labeled clearly “General waste” or “Non-hazardous waste”. Trolleys should be colored in the appropriate color code for infectious waste (yellow) and should be labeled with an “Infectious waste” sign. Other hazardous waste, such as chemical and pharmaceutical wastes, should be transported separately in boxes to central storage sites.
  - Infectious waste can be transported together with used sharps waste. Infectious waste should not be transported together with other hazardous waste, to prevent the possible spread of infectious agents.

- The use of waste chutes in health-care facilities is not recommended, because they can increase the risk of transmitting airborne infections.

• Transport trolleys

- Health-care waste can be bulky and heavy and should be transported using wheeled trolleys or carts that are not used for any other purpose.
- To avoid injuries and infection transmission, trolleys and carts should:
    - be easy to load and unload
    - have no sharp edges that could damage waste bags or containers during loading and unloading
    - be easy to clean and, if enclosed, fitted with a drainage hole and plug.
    - be labeled and dedicated to a particular waste type
    - be easy to push and pull
    - not be too high (to avoid restricting the view of staff transporting waste)
    - be secured with a lock (for hazardous waste)
    - be appropriately sized according to the volumes of waste generated at a health-care facility.
- Waste, especially hazardous waste, should never be transported by hand due to the risk of accident or injury from infectious material or incorrectly disposed sharps that may protrude from a container.
- Spare trolleys should be available in case of breakdowns and maintenance.
- The vehicles should be cleaned and disinfected daily.
- All waste bag seals should be in place and intact at the end of transportation.

• Routing

- Separate hazardous and non-hazardous routes should be planned and used.
- In general, a waste route should follow the principle “from clean to dirty”.
- Collection should start from the most hygienically sensitive medical areas
- (e.g. intensive care, dialysis, theatres) and follow a fixed route around other medical areas and interim storage locations .
- The frequency of collection should be refined through experience to ensure that there are no overflowing waste containers at any time. Biologically active waste (e.g. infectious waste) must be collected at least daily.
- A routing plan would be influenced by:
    - waste volume and number of waste bags or containers
    - waste types
    - capacity of the waste storage within medical areas and at interim storage areas
    - capacity of the transportation trolleys
    - transport distances and journey times between the collection points

Central storage inside health-care facilities

- Central storage areas are places within a health-care facility where different types of waste should be brought for safe retention until it is treated or collected for transport offsite.
- The storage area should:

- have an impermeable, hard-standing floor with good drainage (away from watercourses); the floor should be easy to clean and disinfect;
- include the facility to keep general waste separated from infectious and other hazardous waste;
- have a water supply for cleaning purposes;
- have easy access for staff in charge of handling the waste;
- be lockable to prevent access by unauthorized persons;
- have easy access for waste-collection vehicles;
- have protection from the sun;
- be inaccessible to animals, insects and birds;
- have good lighting and at least passive ventilation;
- not be situated in the proximity of fresh food stores and food preparation areas;
- have a supply of cleaning equipment, protective clothing and waste bags or containers located conveniently close to the storage area;
- have a washing basin with running tap water and soap that is readily available for the staff;
- be cleaned regularly (at least once per week);
- have spillage containment equipment;
- be appropriate to the volumes of waste generated from each health-care facility.

- Some types of waste storage for particular items (e.g. blood, radioactive substances, chemicals) are only likely to be required at large and specialized medical centers.

- **General requirements**

- A storage location for health-care waste should be designated inside the health-care facility.
- Space for storing wastes should be incorporated into a building design when new
- construction is undertaken.
- These storage areas should be sized according to the quantities of waste generated and the frequency of collection.
- The areas must be totally enclosed and separate from supply rooms or food preparation areas.
- Loading docks, space for compactors and balers for cardboard, staging areas for sharps boxes, recycling containers and secure storage (e.g. for batteries) should all be provided.
- Storage facilities should be labelled in accordance with the hazard level of the stored waste.
- In general, there are four different kinds of waste-storage areas:
    - Non-hazardous or general waste
    - Hazardous waste
    - Infectious and sharps waste
    - Chemical and hazardous pharmaceutical waste
    - Radioactive waste.

Figure (3) Example labels outside the storage facility

Hazardous waste storage

- **Infectious waste storage**
  - The storage place must be identified as an infectious waste area by using the biohazard sign.
  - Floors and walls should be sealed or tiled to allow easy disinfection.
  - If present, the storage room should be connected to a special sewage system for infectious hospital wastewater.
  - The compacting of untreated infectious waste or waste with a high content of blood or other body fluids destined for offsite disposal (for which there is a risk of spilling) is not permitted.
  - Sharps can be stored without problems, but other infectious waste should be kept cool or refrigerated at a temperature preferably no higher than 3 °C to 8 °C if stored for more than a week.
  - Unless a refrigerated storage room is available, storage times for infectious waste (e.g. the time gap between generation and treatment) should not exceed the following periods:
    - temperate climate
      - 72 hours in winter
      - 48 hours in summer
    - warm climate
      - 48 hours during the cool season
      - 24 hours during the hot season.

- **Pathological waste storage**
  - Pathological waste and the growth of pathogens it may contain are considered as biologically active waste, and gas formation during storage should be expected.
  - To minimize these possibilities, the storage places should have the same conditions as those for infectious and sharps wastes.
  - In some cultures, body parts are passed to the family for ritual procedures or are buried in designated places.
  - They should be placed in sealed bags to reduce infection risks before release to the public.

- **Pharmaceutical waste storage**
  - Pharmaceutical waste should be segregated from other wastes and local regulations followed for final disposal.
  - In general, pharmaceutical wastes can be hazardous or non-hazardous, and liquid or solid in nature, and each should be handled differently.
  - The classification should be carried out by a pharmacist or other expert on pharmaceuticals.
  - Pharmaceutical waste with non-hazardous characteristics that can be stored in a non-hazardous storage area
    - Ampoules with non-hazardous content (e.g. vitamins);
    - Fluids with non-hazardous contents, such as vitamins, salts (sodium chloride), amino salts;
    - Solids or semi-solids, such as tablets, capsules, granules, powders for injection, mixtures, creams, lotions, gels and suppositories;
    - Aerosol cans, including propellant-driven sprays and inhalers.
  - Hazardous waste that should be stored in accordance with their chemical characteristics (e.g. genotoxic drugs) or specific requirements for disposal (e.g. controlled drugs or antibiotics)
    - controlled drugs (should be stored under government supervision);
    - disinfectants and antiseptics;
    - anti-infective drugs (e.g. antibiotics);
    - genotoxic drugs (genotoxic waste);
    - ampoules with, for example, antibiotics.
  - Genotoxic waste is highly toxic and should be identified and stored carefully away from other health-care waste in a designated secure location. It can be stored in the same manner as toxic chemical waste, although some cytotoxic waste may also carry a risk of infection.

- **Chemical waste storage**
  - When planning storage places for hazardous chemical waste, the characteristics of the different chemicals to be stored and disposed of must be considered (inflammable, corrosive, explosive).
  - The storage place should be an enclosed area and separated from other waste storage areas .
  - When storing liquid chemicals, the storage should be equipped with a liquid- and chemical-proof sump.
  - If no sump is present, catch-containers to collect leaked liquids should be placed under the storage containers.
  - Spillage kits, protective equipment and first aid equipment (e.g. eye showers) should be available in the central storage area.
  - The storage area itself should have adequate lighting and good ventilation to prevent the accumulation of toxic fumes.
  - To ensure the safe storage of chemical wastes, the following separate storage zones should be available to prevent dangerous chemical reactions.
  - The storage zones should be labelled according to their hazard class.

- If more than one hazard class is defined for a specific waste, use the most hazardous classification:
    - Explosive waste
    - Corrosive acid waste
    - Corrosive alkali waste (bases)
    - Toxic waste
    - Flammable waste
    - Oxidative waste
    - Halogenated solvents (containing chlorine, bromine, iodine or fluorine)
    - Non-halogenated solvents.
- Liquid and solid waste should be stored separately. If possible, the original packaging should be taken for storage too.
- The packaging used to store and transport chemical wastes offsite should also be labelled. This label should have the following information: hazard symbol(s), waste classification, date, and point of generation (if applicable).
- The storage area for explosive or highly flammable materials must be suitably ventilated above and below, with a bonded floor and constructed of materials suitable to withstand explosion or leakage.

- **Radioactive waste**
    - Radioactive waste should be stored 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.
    - The decay storage time for radioactive waste differs from other waste storage, because the main target will be to store the waste until the radioactivity is substantially reduced and the waste can be safely disposed of as normal waste.
    - A minimum storage time of 10 half-life times for radioisotopes in wastes with a half-life of less than 90 days is a common practice. Infectious radioactive waste should be decontaminated before disposal.
    - Sharp objects such as needles, Pasteur pipettes and broken glass should be placed into a sharps container.
    - Liquids associated with solid materials, such as assay tube contents, should be decanted or removed by decay time.
    - All radioactive labeling should be removed on any items to be disposed of.
    - Radioactive waste with a half-life of more than 90 days must be collected and stored externally in accordance with national regulations.
    - Storage places must be equipped with sufficient shielding material, either in the walls or as movable shielding screens.
    - The storage must be clearly marked with “RADIOACTIVE WASTE”, and the international hazard label should be placed on the door.
    - The storage place should be constructed in a manner that renders it flame-proof and should have such surfaces on floors, benches and walls that allow proper decontamination.
    - An air-extraction system and radioactive monitoring system should be put in place.

- The International Atomic Energy Agency provides comprehensive guidance on all aspects of the safety of radioactive waste management in the Safety Standards Series.

Layout of waste storage areas

- If new health-care waste-management systems are developed and if new infrastructure is planned, a "waste yard" should be built.
- A waste yard is where all the relevant waste-management activities are brought together.
- To concentrate certain tasks, it is best to set up an area for waste-storage, a container cleaning and a clean office with lockers and toilets.

Documentation of the operation of storage places

- Keeping clear records of the wastes stored and their treatment and disposal dates is important to ensure a good control of waste management.
- Some countries have strict legal requirements to achieve a high level of safety.
- The following forms of additional documentation are suggested:
    - written spill contingency plan;
    - a weekly store inspection protocol;
    - protocols for using, repairing and replacing emergency equipment;
    - training system and documentation (names of trained staff, job descriptions, form of training, date of training, date for refresher or revalidation training);
    - hazardous waste storage documentation;
    - collection of relevant material safety data sheets.

Offsite transport of waste

- Offsite transport is the carriage of health-care waste on the public streets away from a health-care facility.
- Transporting hazardous health-care waste should comply with national regulations and with international agreements if wastes are shipped across an international frontier for treatment (Secretariat of the Basel Convention, 1992).

Logistic staff

- Drivers of vehicles carrying hazardous health-care waste should have appropriate training about risks and handling of hazardous waste.
- Training on the following issues should be included:
    - relevant legal regulations waste classifications and risks
    - safe handling of hazardous waste
    - labelling and documentation
    - emergency and spillage procedures.
- In addition, drivers should be declared medically fit to drive vehicles.
- In case of accident, contact numbers or details of the emergency services and other essential departments should be carried in the driver's cab.
- For safety reasons, vaccination against tetanus and hepatitis A and B is recommended, and vaccination and training details of staff should be recorded.

Vehicle requirements

- A fundamental requirement is for the vehicle transporting hazardous waste to be roadworthy and labeled to indicate its load, and its payload to be secured to minimize the risk of accidents and spillages.
- Any vehicle used to transport health-care waste should fulfill several design criteria:
    - The body of the vehicle should be of a suitable size commensurate with the design of the vehicle.
    - There should be a bulkhead between the driver's cabin and the vehicle body, which is designed to retain the load if the vehicle is involved in a collision.
    - There should be a suitable system for securing the load during transport.
    - Empty plastic bags, suitable protective clothing, cleaning equipment, tools and disinfectant, together with special kits for dealing with liquid spills, should be carried in a separate compartment in the vehicle.
    - The internal finish of the vehicle should allow it to be steam-cleaned and internal angles should be rounded to eliminate sharp edges to permit more thorough cleaning and prevent damage to waste containers.
    - The vehicle should be marked with the name and address of the waste carrier.
    - An international hazard sign should be displayed on the vehicle and containers, as well as an emergency telephone number.
    - The driver should be provided with details of the waste being carried.
- Vehicles or containers used for transporting health-care waste should not be used for transporting any other material.
- Vehicles should be kept locked at all times, except when loading and unloading, and kept properly maintained.
- Articulated or demountable trailers (temperature-controlled if required) are particularly suitable, because they can easily be left at the site of waste production.
- Other systems may be used, such as specially designed large, closed containers or skips.
- Open-topped skips or containers are unsuitable because they fail to isolate waste from the general public during transportation, and should not be used for health-care waste.
- Where the use of a dedicated vehicle cannot be justified, a bulk container that can be lifted onto a vehicle chassis may be considered.
- The container may be used for storage at the health-care facility and replaced with an empty one when collected.
- Refrigerated containers could be used if the storage time exceeds the recommended limits described previously, or if transportation times are long.
- The same safety measures should apply to the collection of hazardous health-care waste from scattered small sources, such as clinics and general practice surgeries.

Labeling of the transport vehicle

The transport vehicle should be labeled according to the type of waste that is being transported. The label that is displayed will depend on the United Nations classification of the waste.

Table (3) Selected United Nations packaging symbols

UN class	Name	Description of symbol	Symbol
3.1	Flammable Liquids	Black symbol: flame Background: red Class "3" in bottom corner	
5.1	Oxidizing Substances	Black symbol: flame over circle Background: yellow Class "5.1" in bottom corner	
6.1	Toxic Substances	Black symbol: skull and crossbones Background: white Class "6" in bottom corner	
6.2	Infectious Substances	Black symbol: three crescents superimposed on a circle Background: white Class "6" in bottom corner	

UN class	Name	Description of symbol	Symbol
7A	Radioactive Material Category I – White	Black symbol: trefoil Background: white Class "7" in bottom corner	
7B	Radioactive Material Category II – Yellow	Black symbol: trefoil Background: yellow Class "7" in bottom corner	
7C	Radioactive Material Category III – Yellow	Black symbol: trefoil Background: yellow Class "7" in bottom corner	
8	Corrosive Substances Category I – White	Black symbol: liquids spilling from two glass vessels and attacking a hand and a metal Background: upper half white, lower half black with white border Class "8" in bottom corner	
9	Miscellaneous Dangerous Substances Category I – White	Black symbol: seven vertical stripes in upper half Background: white, lower half black with white border Class "9" underlined in bottom corner	

Cleaning of container and vehicle

- Vehicles and transporting containers used for the transportation of waste should be cleaned and disinfected daily after use.
- Mechanical cleaning combined with soaps and detergents, which act as solubility promoting agents, can be used. Cleaning and disinfection have to be carried out in a standardized manner or by automated means that will guarantee an adequate level of cleanliness. A standard operating procedure for cleaning should be prepared and explained to cleaning staff. In addition, a schedule for preventive maintenance should be set up for all equipment and vehicles used in the transportation process.

Transport documentation

- Before sending hazardous health-care wastes 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 a country.
- If a waste regulatory authority is sufficiently well established, it may be possible to pre-notify the agency about a planned offsite transport and disposal of hazardous health-care waste and to obtain the agency's approval. Anyone involved in the production, handling or disposal of health-care waste should recognize that they have a general "duty of care"– that is, an obligation to ensure that waste handling, treatment and disposal and the associated documentation comply with the national regulations.
- The consignment note for a vehicle carrying a hazardous health-care waste load should include the following information in case of accidents or official inspection: *waste classes ,waste sources , pick-up date ,destination , driver name , number of containers or volume and receipt of load received from responsible person at pick-up areas.*
- This information allows quick and effective countermeasures to be taken in the event of an accident or incident.
- Weight of waste is useful for commercial treatment and disposal operators who bill health-care facilities for their waste services.
- On completion of a journey, the transporter should complete a consignment note and return it to the waste producer. A typical consignment note for carriage and disposal of hazardous waste and routing of the copies to waste producer, waste disposer and regulator

Driver documents ;

the driver should have training and preferably also a certificate indicating their confidence to transport hazardous wastes .

Minimum approach to segregation, storage and transport

- The minimum standard to segregating health-care wastes is to separate hazardous from non hazardous waste
- The basic features of a minimal level of waste segregation and storage are as follows:
    - Wastes are segregated at their place of production to reduce the health risk from the smaller potentially infectious factions (typically waste items contaminated with body fluids and used sharps).
    - Infectious and general waste are stored in separate colour-coded containers and locations within medical areas, and subsequently at a central storage site at a health-care facility.
    - Central storage area(s) are fenced, lockable and isolated from patients and the public.
    - Maximum storage times before treatment or disposal of infectious waste are not longer than:
        1. temperate climate: 72 hours in winter and 48 hours in summer
        2. warm climate: 48 hours during the cooler season and 24 hours during the hot season.
- Staff receive instruction on waste segregation and safe handling and storage of health-care wastes.
- Staff are aware of how to protect themselves from injuries and infection from waste.
- Waste containers and storage areas are cleaned regularly.
- The minimum measures for transporting health-care wastes are as follows:
    - General waste and infectious health-care waste is collected separately and at least once a day.
    - Collection is at regular times and is reliable.
    - Waste containers and onsite transport trolleys are closed with lids to isolate wastes from patients and the public.
    - Where wastes are transported offsite for disposal, the vehicle is able to carry wastes in a closed or covered container, and the driver knows what to do if there is an accident or incident during transportation on public roads.
    - Transport staff are vaccinated at least against hepatitis A and B, polio and tetanus.
    - Waste containers, trolleys and vehicles are maintained and cleaned regularly.
- In emergency situations, all waste from patients arriving at a health-care facility could be classified as potentially infectious to minimize the transmission of secondary infection.

Desirable improvement to the minimum approach

Enhancements of the minimal approach include:

- developing more detailed arrangements for waste storage and transport in a waste-management plan;
- exploring opportunities for reducing, reusing and recycling some portions of the health-care wastes produced at the facility;
- including waste-storage and transport expenses in the annual budgeting;
- instituting separate chemical and pharmaceutical waste segregation and storage management;
- developing a separate storage and documentation system for chemical wastes, which could include separate storage zones for:
    - flammable liquids
    - bio-toxic compounds
    - corrosive wastes - acids
    - caustic wastes - bases
    - chemical waste management included in training activities.

5. Treatment and disposal methods

The purpose of treatment is to reduce the potential hazard posed by health-care waste, while endeavoring to protect the environment

Selection of treatment methods

The choice of treatment system involves consideration of waste characteristics, technology capabilities and requirements, environmental and safety factors, and costs – many of which depend on local conditions. Factors to consider include:

- waste characteristics
- quantity of wastes for treatment and disposal
- capability of the health-care facility to handle the quantity of waste
- types of waste for treatment and disposal
- technology capabilities and requirements
- local availability of treatment options and technologies
- capacity of the system
- treatment efficiency
- volume and mass reduction
- installation requirements
- available space for equipment
- infrastructure requirements
- operation and maintenance requirements
- skills needed for operating the technology
- environmental and safety factors
- environmental releases
- location and surroundings of the treatment site and disposal facility
- occupational health and safety considerations
- public acceptability
- options available for final disposal
- regulatory requirements
- cost considerations
- equipment purchase cost
- shipping fees and customs duties
- installation and commissioning costs
- annual operating costs, including preventive maintenance and testing
- cost of transport and disposal of treated waste
- decommissioning costs.

There are five basic processes for the treatment of hazardous components in health-care waste, in particular, sharps, infectious and pathological wastes: thermal, chemical, irradiation, biological and mechanical

1-Thermal processes

These processes rely on heat (thermal energy) to destroy pathogens in the waste. They represent most treatment facilities in use across the world. This category can be further subdivided into low-heat and high-heat designs. Low-heat thermal processes are those that use thermal energy at elevated temperatures high enough to destroy microorganisms but not sufficient to cause combustion or pyrolysis of the waste. low-heat thermal technologies operate between 100 °C and 180 °C. The low-heat processes take place in either moist or dry-heat environments. Pyrolysis is a special case of thermolysis, and is most commonly used for organic materials. It occurs at high temperatures but does not involve reactions with oxygen.

2-**Chemical processes**

Chemical treatment methods use disinfectants such as dissolved chlorine dioxide, bleach (sodium hypochlorite), peracetic acid, lime solution, ozone gas or dry inorganic chemicals (e.g. calcium oxide powder). Chemical processes often involve shredding, grinding or mixing to increase exposure of the waste to the chemical agent.

3- **Irradiation technologies**

Irradiation treatment encompasses designs using irradiation from electron beams, cobalt-60 or ultraviolet sources. These technologies require shielding to prevent elevated occupational exposures to electromagnetic radiation. The pathogen destruction efficacy depends on the dose absorbed by the mass of waste.

4-**Biological processes**

These processes are found in natural living organisms but refer specifically to the degradation of organic matter when applied to health-care waste treatment. Some biological treatment systems use enzymes to speed up the destruction of organic waste containing pathogens.

5-Mechanical processes

Mechanical treatment processes include several shredding, grinding, mixing and compaction technologies that reduce waste volume, although they cannot destroy pathogens. In most instances, mechanical processes are not stand-alone health-care waste-treatment processes, but supplement other treatment methods. Mechanical destruction can render a waste unrecognizable and can be used to destroy needles and syringes

Steam treatment technologies

1. **Autoclaves**
   Autoclaves are capable of treating a range of infectious waste, including cultures and stocks, sharps, materials contaminated with blood and limited amounts of fluids, isolation and surgery waste, laboratory waste (excluding chemical waste) and "soft" waste (including gauze, bandages, drapes, gowns and bedding) from patient care.
2. **Integrated steam-based treatment systems**
   A second generation of steam-based systems has been developed for the purpose of improving the transfer of heat into the waste, achieving more uniform heating of the waste, rendering the waste unrecognizable and/or making the treatment system a continuous (rather than a batch) process.

Microwave treatment technologies

- Microwave technology is essentially a steam-based process where treatment occurs through the action of moist heat and steam generated by microwave energy. Water contained in the waste is rapidly heated by microwave energy
- A typical semicontinuous microwave system consists of an automatic charging system, hopper, shredder, conveyor screw, steam generator, microwave generators, discharge screw, secondary shredder and controls. The equipment includes hydraulics, HEPA filter and microprocessor-based controls protected in an all-weather steel enclosure.
- The types of waste commonly treated in microwave systems are identical to those treated in autoclaves: cultures and stocks, sharps, materials contaminated with blood and body fluids, isolation and surgery waste, laboratory waste (excluding chemical waste) and soft waste (e.g. gauze, bandages, gowns and bedding) from patient care.

Dry-heat treatment technologies

- Circulating hot-air ovens have been used to sterilize glassware and other reusable instruments for many years. This concept of dry-heat treatment has been applied to treatment of infectious health waste more recently
- They are not commonly used in large-scale facilities and usually treat only small volumes.

Incineration

Combustion, Pyrolysis and gasification

Incineration is a high-temperature, dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a significant reduction of waste volume and weight. High-heat thermal processes take place at temperatures from about 200 °C to more than 1000 °C. They involve the chemical and physical breakdown of organic material through the processes of combustion, pyrolysis or gasification.

A disadvantage of these technologies is the release of combustion by-products into the atmosphere and the generation of residual ash. The combustion of health-care waste produces mainly gaseous emissions, including steam, carbon dioxide, nitrogen oxides, a range of volatile substances (e.g. metals, halogenic acids, products of incomplete combustion) and particulate matter, plus solid residues in the form of ashes.

Incineration requires no pretreatment, provided the following waste types are not included:

1. pressurized gas containers;
2. large amounts of reactive chemical waste;
3. silver salts and photographic or radiographic wastes;
4. halogenated materials such as polyvinyl chloride (PVC) plastics (waste and packaging of waste should not contain PVC material)
5. waste containing mercury, cadmium and other heavy metals, such as broken thermometers, used batteries and lead-lined wooden panels;
6. sealed ampoules or vials that may implode during the combustion process;
7. radioactive materials;
8. pharmaceuticals thermally stable in conditions below 1200 °C (e.g. 5-fluorouracil).

Types of incinerators for health-care waste

- Starved-air incinerators
- Multiple chamber incinerators
- Rotary kilns
- Small-scale incinerators
- Co-incineration

Environmental control of incinerators

Incinerators require emission controls equipment to meet modern emission standards

Dust removal

Depending on the type of incinerator, it is likely to produce between 25 and 30 kg of dust per tons of waste (known as fly ash).

The most common types of dust removal equipment used at incinerator plants are:

cyclonic scrubbers
fabric dust removers (commonly called “baghouse filters”)
electrostatic precipitator

Removal of acids or alkalis

Three processes – wet, semi-dry and dry – are available for removing acids such as hydrofluoric acid (HF), hydrochloric acid (HCl), and sulfuric acid (H2SO4).

Wastewater from gas washing and quenching of ashes must undergo a chemical neutralization treatment before being discharged into a sewer. This treatment includes neutralization of acids and flocculation, and precipitation of insoluble salts.

Solid residues

Sludges from wastewater treatment and from cooling of fly ash should be considered as hazardous waste. They may either be sent to a waste-disposal facility for hazardous chemicals, or be treated onsite by drying, followed by encapsulation.

Solid ashes from health-care waste incineration (known as bottom ash) are often assumed to be less hazardous than fly ash and in the past have been reused in civil engineering works

Chemical treatment technologies

- Chemical disinfection, used routinely in health-care facilities to destroy or inactivate microorganisms on medical equipment and on floors and walls, is now being extended to the treatment of health-care waste. This treatment usually results in disinfection rather than sterilization. Chemical disinfection is most suitable for treating liquid waste such as blood, urine, stools or hospital sewage. Solid, even highly hazardous, health-care wastes, including microbiological cultures and sharps, may also be disinfected chemically with the following limitations:

1. Shredding or milling of waste is usually necessary before disinfection. The shredder is often the weak point in the treatment chain, being susceptible to mechanical failure or breakdown.
2. Powerful disinfectants are required, which can be hazardous and should be used only by well-trained and adequately protected personnel.
3. Disinfection efficiency depends on the operational conditions within treatment equipment.
4. Only the surface of intact solid waste items will be disinfected

- The aim of disinfection is to eliminate microorganisms or at least reduce their numbers to an acceptable level. Some disinfectants are effective in killing or inactivating specific types of microorganisms, and others are effective against all types.
- The types of chemicals used for disinfection of health-care waste are mostly chlorine compounds, aldehydes, lime-based powders or solutions, ozone gas, ammonium salts and phenolic compounds. Formaldehyde and ethylene oxide are no longer recommended for waste treatment due to significant hazards related to their use.
- Lime-based chemical treatment systems use dry powder or calcium hydroxide solutions.
- Some chemical treatment systems use proprietary disinfectants containing glutaraldehyde. Peracetic acid (peroxyacetic acid) has also been used for disinfecting medical instruments. It is a strong irritant but breaks down to form an acetic acid (vinegar) solution.

Alkaline hydrolysis

Alkaline hydrolysis or alkaline digestion is a process that converts animal carcasses, human body parts and tissues into a decontaminated aqueous solution. The alkali also destroys fixatives in tissues and various hazardous chemicals, including formaldehyde, glutaraldehyde and chemotherapeutic agents. The technology uses a steam-jacketed, stainless-steel tank and a basket.

Encapsulation and inertization

- Disposal of untreated health-care waste in municipal landfills is not advisable. However, if the health-care facility has no other option, the waste should be contained in some way before disposal. One option is encapsulation, which involves filling containers with waste, adding an immobilizing material, and sealing the containers.

- The process uses either cubic boxes made of high-density polyethylene or metallic drums, which are three quarters filled with sharps or chemical or pharmaceutical residues. The containers or boxes are then filled up with a medium such as plastic foam, bituminous sand, cement mortar, or clay material. After the medium has dried, the containers are sealed and placed into landfill sites

- The process of inertization involves mixing waste with cement and other substances before disposal to minimize the risk of toxic substances contained in the waste migrating into surface water or groundwater. It is especially suitable for pharmaceuticals and for incineration ashes with a high metal content

Emerging technologies should be carefully evaluated before their selection for routine use, not ready for routine application to health-care waste

- **Plasma pyrolysis**: makes use of an ionized gas in the plasma state to convert electrical energy to temperatures of several thousand degrees using plasma arc torches or electrodes. The high temperatures are used to pyrolyse waste in an atmosphere with little or no air. Another emerging technology uses superheated steam at 500 °C to break down infectious, hazardous chemical or pharmaceutical wastes. The vapours are then heated further in a steam-reforming chamber to 1500 °C. These technologies are expensive, and – like incineration – require pollution-control devices to remove pollutants from the exhaust gas.
- **Ozone (O3)**:Ozone gas is a strong oxidizer and breaks down easily to a more stable form (O2). Ozone systems require shredders and mixers to expose the waste to the bactericidal agent.
- **Promession**: is a new technology that combines a mechanical process and the removal of heat to destroy anatomical waste. It involves cryogenic freeze-drying using liquid nitrogen and mechanical vibration to disintegrate human remains into powder before burial. The process speeds up decomposition, reduces both mass and volume, and allows the recovery of metal parts
- Emerging technologies for destroying hazardous chemical waste: include gas phase chemical reduction, base-catalysed decomposition, supercritical water oxidation,

sodium reduction, verification, superheated steam reforming, ozonation, biodegradation, mechanochemical treatment, sonic technology, electrochemical technologies, solvated electron technology, and phytotechnology

- These emerging technologies are not ready for routine application to health-care waste.

Table (4) Applications of management and disposal of specific waste categories

Waste Category & Examples	Method of management e.g.Minimization, Segregation, collection, storage, transport, or pretreatment	Final disposal
A: non hazardous waste paper, cardboard and plastics, while the rest comprises discarded food, metal, glass, textiles, plastics and wood.	- general non-hazardous waste can be broken down into recyclables, biodegradable waste and non-recyclable portions. - Food wastes can be collected from medical areas and returned directly to the kitchens. -Non-hazardous biodegradable wastes (e.g. flowers) may be disposed of with kitchen waste.	- Send to municipal landfill - Kitchen wastes can be composted or, where regulations allow, sterilized and used for animal feed.
B: hazardous waste **1. Sharp waste** Sharps are items that could cause cuts or puncture wounds, including needles, hypodermic needles, scalpels and other blades, knives, infusion sets, saws, broken glass and pipettes.	- Sharps waste (needle and syringe combination) should be placed directly into a sharps container. - In some places,it is permitted for syringes to have their needles removed or destroyed before placing the syringe in an infectious waste bin. Any removed needles are placed in a puncture-proof container and dealt with accordingly. - Sharps can be stored without problems, but other infectious waste should be kept cool or refrigerated at a temperature preferably no higher than 3 °C to 8 °C if stored for more than a week.	- collected in safety yellow boxes and send for incineration - Alternatively, the sharps waste can be autoclaved, shredded and then encapsulated in cement blocks that later become useful items such as hospital benches
2. Infectious waste waste contaminated with blood or other body fluids cultures and stocks of infectious agents from laboratory work waste from infected patients in isolation wards **highly infectious waste**.Laboratory cultures and stocks ,Waste from autopsies, animal bodies, and other waste items that have been inoculated, infected, or in contact with highly infectious agents ,. Discarded instruments or materials that have been in contact with persons or animals infected with highly infectious agents	Highly infectious waste, such as diagnostic laboratory samples and waste from infectious patients in isolation, should be collected separately and autoclaved at the point of generation. Once disinfected, the waste would leave a medical area in the infectious health-care waste container. **Infectious waste storage**The storage place must be identified as an infectious waste area by using the biohazard sign.Floors and walls should be sealed or tiled to allow easy disinfection. If present, the storage room should be connected to a special sewage system for infectious hospital wastewater.The compacting of untreated infectious waste or waste with a high content of blood or other body fluids destined for offsite disposal (for which there is a risk of spilling) is not permitted. Unless a refrigerated storage room is available, storage times for infectious waste (e.g. the time gap between generation and treatment) should not exceed the following periods:temperate climate: 72 hours in winter, 48 hours in summerwarm climate: 48 hours during the cool season24 hours during the hot season.	send for incineration

3. Pathological waste tissues, organs, body parts, blood, body fluids and other waste from surgery and autopsies, human fetuses and infected animal carcasses, Recognizable human or animal body parts are sometimes called anatomical waste	Anatomical waste, particularly recognizable body parts or fetal material, should be handled according to prevailing religious and cultural preferences (burial) **Pathological waste storage-**Pathological waste and the growth of pathogens it may contain are considered as biologically active waste, and gas formation during storage should be expected - To minimize these possibilities, the storage places should have the same conditions as those for infectious and sharps wastes.- In some cultures, body parts are passed to the family for ritual procedures or are buried in designated places. - They should be placed in sealed bags to reduce infection risks before release to the public.	- According to socio cultural, religious and aesthetic norms and practicesinterment (burial) in cemeteries or special burial sites - A more recent option is alkaline digestion, especially for contaminated tissues and animal carcasses.
4. Pharmaceutical waste Expired, unused, spilt and contaminated pharmaceutical products, prescribed and proprietary drugs, vaccines and sera that are no longer required, discarded items heavily contaminated during the handling of pharmaceuticals, such as bottles, vials and boxes containing pharmaceutical residues, gloves, masks and connecting tubing.	- Before treatment, pharmaceutical waste should be labeled and sorted using proper personal protective equipment - Special consideration is needed for controlled substances (e.g. narcotics), anti-infective drugs, antineoplastic and cytotoxic drugs, and disinfectants. - Various chemical and pharmaceutical wastes should be segregated and collected separately: subcategories include mercury, batteries, cadmium-containing wastes, photochemicals, stains and laboratory reagents, cytotoxic drugs and other pharmaceuticals. - All should be clearly labelled with the type of waste and the name of the major chemicals,with any necessary hazard labels attached to corrosive, flammable, explosive or toxic chemicals - Liquid chemical wastes should never be mixed or disposed of down the drain, but should be stored in strong leak-proof containers - Unused pharmaceuticals should go back to the pharmacy for return to manufacturers or dispatched to specialist waste-treatment contractors. - Pharmaceuticals should be kept in their original packaging to aid identification and prevent reaction between incompatible chemicals - Spilt and contaminated chemicals and pharmaceuticals should not be returned to the pharmacy but should go directly from the point of production to a waste store. - Typically, they are stored and transported within a health-care facility in **brown cardboard boxes** and must be kept dry. **Pharmaceutical waste storage** Pharmaceutical waste should be segregated from other wastes and local regulations followed for final disposal. In general, pharmaceutical wastes can be hazardous or non-hazardous, and liquid or solid in nature, and each should be handled differently. The	**Options for small quantities of pharmaceutical waste:** - return of expired pharmaceuticals to the donor or manufacturer; - encapsulation and burial in a sanitary landfill; - chemical decomposition in accordance with the manufacturer's recommendations if chemical expertise and materials are available; - dilution in large amounts of water and discharge into a sewer for moderate quantities of relatively mild liquid or semi-liquid pharmaceuticals, such as solutions containing vitamins, cough syrups, intravenous solutions and eye drops. - Antibiotics or cytotoxic drugs should not be discharged into municipal sewers or watercourses **Options for large quantities of pharmaceutical waste:-** - encapsulation and burial in a sanitary landfill; - incineration in kilns equipped with pollution-control devices designed for industrial waste and that operate at high temperatures; - dilution and sewer discharge for relatively harmless liquids such as intravenous fluids (salts, amino acids, glucose).

	classification should be carried out by a pharmacist or other expert on pharmaceuticals. Pharmaceutical waste with non-hazardous characteristics that can be stored in a non-hazardous storage areaampoules with non-hazardous content (e.g. vitamins);fluids with non-hazardous contents, such as vitamins, salts (sodium chloride), amino salts; solids or semi-solids, such as tablets, capsules, granules, powders for injection, mixtures, creams, lotions, gels and suppositories; aerosol cans, including propellant-driven sprays and inhalers.Hazardous waste that should be stored in accordance with their chemical characteristics (e.g. genotoxic drugs) or specific requirements for disposal (e.g. controlled drugs or antibiotics)controlled drugs (should be stored under government supervision);disinfectants and antiseptics;anti-infective drugs (e.g. antibiotics);genotoxic drugs (genotoxic waste);ampoules with, for example, antibiotics.	
5. Genotoxic/ cytotoxic waste - cytostatic drugs, - vomit, urine or faeces from patients treated with cytostatic drugs, - chemicals and radioactive material, radioactive substances	- should first be minimized by careful segregation, purchasing optimal drug quantities, using proper spill containment and clean-up procedures, and substituting environmentally persistent drugs with degradable drugs, where possible. - Genotoxic waste is highly toxic and should be identified and stored carefully away from other health-care waste in a designated secure location. It can be stored in the same manner as toxic chemical waste, although some cytotoxic waste may also carry a risk of infection.	Cytotoxic waste is highly hazardous and should never be landfilled or discharged into the sewerage system. Disposal options include: - return to the original supplier - incineration at high temperatures Full destruction of all cytotoxic substances may require incineration temperatures up to 1200 °C - Chemical degradation in accordance with manufacturers' instructions. Chemical degradation methods, which convert cytotoxic compounds into non-toxic/non-genotoxic compounds, can be used for drug residues and for cleaning contaminated urinals, spillages and protective clothing - encapsulation or inertization may be considered as a last resort. -Alkaline hydrolysis and some of the emerging technologies may have useful applications in the destruction of cytotoxic waste.

6. Chemical waste discarded solid, liquid and gaseous chemicals; for example, from diagnostic and experimental work and from cleaning and disinfecting procedures **Non-hazardous chemical waste** consists of chemicals with none of the above properties; for example, sugars, amino acids and certain organic and inorganic salts, which are widely used in transfusion liquids **hazardous chemical waste e.g.** Formaldehyde, Photographic fixing and developing solutions,5–10% hydroquinone,15%potassium hydroxide,1% silver, glutaraldehyde, Acetic acid ,Wastes containing solvents	- Improving the management of chemical waste begins with waste minimization. Minimization options include: - substituting highly toxic and environmentally persistent cleaners and solvents with less toxic and environmentally friendly chemicals; - using minimum concentrations where possible; - ensuring good inventory control (i.e. "just-in-time" purchasing); -designing storage areas well; -integrating pest management; -keeping disinfecting trays covered to prevent loss by evaporation; -developing spill prevention and clean-up procedures; -recovering solvents using fractional distillation. - Various chemical and pharmaceutical wastes should be segregated and collected separately: subcategories include mercury, batteries, cadmium-containing wastes, photochemicals, stains and laboratory reagents, cytotoxic drugs and other pharmaceuticals. -All should be clearly labelled with the type of waste and the name of the major chemicals, with any necessary hazard labels attached to corrosive, flammable, explosive or toxic chemicals. -Liquid chemical wastes should never be mixed or disposed of down the drain, but should be stored in strong leak-proof containers -It may be possible to recover silver from photochemicals at a profit, and return of chemicals to suppliers should be practiced where possible. Silver is increasingly being used in medical products, but is rarely segregated due to a lack of dedicated disposal or metals recovery facilities - Hazardous chemical wastes of different composition should be stored separately to avoid unwanted chemical reactions. - Photochemicals should be collected separately because there is a recovery value from silver compounds contained in the solutions. **Chemical waste storage** - When planning storage places for hazardous chemical waste, the characteristics of the different chemicals to be stored and disposed of must be considered (inflammable, corrosive, explosive). The storage place should be an enclosed area and separated from other waste storage areas . - When storing liquid chemicals, the storage should be equipped with a liquid- and chemical-proof	-General chemical waste, such as sugars, amino acids and certain salts, may be disposed of with municipal waste or discharged into sewers -Hazardous chemical waste should not be discharged into sewerage systems -Unauthorized discharge of hazardous chemicals can be dangerous to sewage treatment workers and may adversely affect the functioning of sewage treatment works. -Petroleum spirit (volatilizes to produce flammable vapours), calcium carbide (produces flammable acetylene gas on contact with water) and halogenated organic solvents many compounds are environmentally persistent or ecologically damaging) should not be discharged into sewers. -Large amounts of chemical waste should not be buried, because they may leak from their containers, overwhelm the natural attenuation process provided by the surrounding waste and soils, and contaminate water sources. -Large amounts of chemical disinfectants should not be encapsulated, because they are corrosive to concrete and sometimes produce flammable gases -An option for disposing of hazardous chemicals is to return them to the original supplier who should be equipped to deal with them safely. Where such an arrangement is envisaged, appropriate provisions should be included in the original purchase contract for the chemicals. Preferably, these wastes should be treated by a specialist contractor with the expertise and facilities to dispose safely of hazardous waste

	sump.If no sump is present, catch-containers to collect leaked liquids should be placed under the storage containers. - Spillage kits, protective equipment and firstaid equipment (e.g. eye showers) should be available in the central storage area. - The storage area itself should have adequate lighting and good ventilation to prevent the accumulation of toxic fumes. - To ensure the safe storage of chemical wastes, the following separate storage zones should be available to prevent dangerous chemical reactions. - The storage zones should be labelled according to their hazard class. I- f more than one hazard class is defined for a specific waste, use the most hazardous classification: • explosive waste• corrosive acid waste• corrosive alkali waste (bases)• toxic waste• flammable waste• oxidative waste• halogenated solvents (containing chlorine, bromine, iodine or fluorine)• non-halogenated solvents. - Liquid and solid waste should be stored separately. If possible, the original packaging should be taken for storage too. - The packaging used to store and transport chemical wastes offsite should also be labelled. This label should have the following information: hazard symbol(s), waste classification, date, and point of generation (if applicable). - The storage area for explosive or highly flammable materials must be suitably ventilated above and below, with a bonded floor and constructed of materials suitable to withstand explosion or leakage.	

7. Waste with a high content of heavy metals high concentrations of cadmium from dry-cell batteries, and mercury from thermometers, sphygmomanometers, cantor tubes, dilators, mercury switches and some button-shaped batteries.	- developing safe mercury clean-up, handling and storage procedures; reducing unnecessary use of mercury equipment; replacing mercury-containing products with mercury-free alternatives; and supporting a replacement of the use of mercury-containing devices in the long term - It may be possible to recover silver from photochemicals at a profit, and return of chemicals to suppliers should be practised where possible. Silver is increasingly being used in medical products, but is rarely segregated due to a lack of dedicated disposal or metals recovery facilities - Low-energy light bulbs (compact fluorescents) contain small amounts of mercury. Both these and batteries should be segregated and treated by recycling processes, where suitable facilities exist. - Mercury use is being reduced in health care and other applications around the world because of its toxicity and pollution potential. Since it is volatile, spilled mercury can be inhaled by staff and patients if it is not cleaned up properly, but a simple spill kit can be cheap and effective. -Where mercury thermometers and sphygmomanometers are still in use, medical staff should be supplied with a spill kit and trained in how to use it.-Any spill larger than a thermometer should be dealt with in consultation with the local health and safety authority. -Brushes and vacuum cleaners should never be used for spilled mercury. - Mercury can be cleaned up easily from wood, linoleum, tile and similar smooth surfaces. It cannot be completely removed from carpets, curtains, upholstery or other absorbent materials. - The affected portion should be isolated and disposed of in accordance with official guidelines	- Wastes containing mercury or cadmium should not be burned or incinerated - can be sent to facilities that specialize in the recovery of heavy metal - send back the waste to the suppliers of the original equipment - Exporting the waste to countries with the expertise and facilities for its adequate treatment should also be considered but only within the rules laid down by the Basel Convention - If none of the above options are feasible, the wastes would have to go to a disposal or storage site designed for hazardous industrial waste
8. Pressurized containers portable pressurized cylinders, cartridges and aerosol cans.	Many of these are reusable, once empty or of no further use (although they may still contain residues). However, certain types – notably aerosol cans – are single-use containers that require disposal. Whether inert or potentially harmful, gases in pressurized containers should always be handled with care; containers may explode if incinerated or accidentally punctured.	Reusable: send back the waste to the suppliers for recycling single-use: compact and send for municipal landfill

9. Radioactive waste - Materials contaminated with radionuclides. They are produced as a result of procedures such as in vitro analysis of body tissue and fluid, in vivo organ imaging and tumour localization, and various investigative and therapeutic practices. - Radionuclides used in health care are in either unsealed (or open) sources or sealed sources. Unsealed sources are usually liquids that are applied directly, while sealed sources are radioactive substances contained in parts of equipment or encapsulated in unbreakable or impervious objects, such as pins, "seeds" or needles. **classified as follows:** · sealed sources; · spent radionuclide generators; · low-level solid waste (e.g. absorbent paper, swabs, glassware, syringes, vials); · residues from shipments of radioactive material and unwanted solutions of radionuclides intended for diagnostic or therapeutic use; · liquid immiscible with water, such as liquid scintillation counting; · residues used in radioimmunoassay, and contaminated pump oil; · waste from spills and from decontamination of radioactive spills; · excreta from patients treated or tested with unsealed radionuclides; · low-level liquid waste (e.g. from washing apparatus); · gases and exhausts from stores and fume cupboards.	- Radioactive waste is generally under the jurisdiction of a nuclear regulatory agency - Where specialist disposal services exist, they should collect and handle radioactive wastes. Otherwise, waste may be stored in secure, radiation-proof repositories (leak-proof, lead-lined and clearly labelled with the name of the radionuclide and date of deposition) where it should be left to decay naturally - The primary methods of waste minimization are source reduction, extended storage for decay of radioactivity, and substitution with a non-radioactive alternative - Containers used for storing radioactive waste should be clearly identified (marked with the words "RADIOACTIVE WASTE" and the radiation symbol) and labeled to show the activity of the radionuclide on a particular date, period of storage required, origin of the waste, surface dose rate on a particular date, quantity and responsible person. - Facilities should segregate radioactive waste according to the length of time needed for storage: short-term storage (half-lives less than 60 days) and long-term storage (half-lives more than 60 days). **Further practices for radioactive health-care wastes** -Disposable syringes containing radioactive residues should be emptied in a location designated for the disposal of radioactive liquid waste. Syringes should then be stored in a sharps container to allow decay of any residual activity, before normal procedures for disposal of syringes and needles are followed - It is not appropriate to disinfect radioactive solid waste by wet thermal or microwave procedures - Solid radioactive waste, such as bottles, glassware and containers, should be destroyed before disposal to avoid reuse by the public - The drains that serve sinks designated for discharge of radioactive liquids should be identified. If repairs become necessary, radiation levels should be measured when the drain or sewer is opened up, and appropriate precautions should be taken to avoid unacceptable radiation exposures - Higher-level radioactive waste of relatively short half-life (e.g. from iodine-131 therapy) and liquids that are immiscible with water, such as scintillation-counting residues and contaminated oil, should be stored for decay in marked containers, under lead shielding, until activities have reached authorized clearance levels. Water-miscible waste may then be discharged to the sewerage system, and immiscible waste may be disposed of by the methods recommended for large quantities of hazardous chemical waste. - Radioactive waste resulting from cleaning-up	**Unsealed sources – short-lived radionuclides** For low-level radioactive waste: 1- "decay in storage", which is the safe storage of waste until its radiation levels are indistinguishable from background radiation; a general rule is to store the waste for at least 10 times the half-life of the longest lived radionuclide in the waste -Dispose as normal waste after radioactivity is substantially reduced . - Infectious radioactive waste should be decontaminated before disposal. 2- return to supplier; 3- long-term storage at an authorized radioactive waste disposal site **Sealed sources and long-lived radionuclides** - should be returned to the producer or supplier of their original form - Health-care facilities planning to import a sealed source with a radioactivity greater than 100 MBq should require the supplier to accept the source back after expiration of its useful lifetime and within a year after a notification is made. - If this is not possible, the waste must be stored in an approved long-term storage facility in keeping with international guidelines - Whether the waste is returned or stored in a long-term facility, the waste should first be "conditioned" to make it suitable for handling, transportation and storage. -Conditioning may involve immobilization in concrete, securing the waste in suitable containers and providing additional packaging.

	operations after a spillage or other accident should be retained in suitable containers, unless the activity is clearly low enough to permit immediate discharge. If excessive activity enters the sewer accidentally, a large volume of water should be allowed to flow to provide dilution to about 1 kBq per liter. - It is not usually necessary to collect and confine patients' excreta after diagnostic procedures, although ordinary toilets used by such patients should be checked regularly for accumulation of radioactive contamination. Or use of separate toilets equipped with delay tanks, also called holding tanks, or special treatment systems for patients undergoing radiotherapy. **Radioactive waste storage** - Radioactive waste should be stored 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. - The decay storage time for radioactive waste differs from other waste storage, because the main target will be to store the waste until the radioactivity is substantially reduced and the waste can be safely disposed of as normal waste. - A minimum storage time of 10 half-life times for radioisotopes in wastes with a half-life of less than 90 days is a common practice. Infectious radioactive waste should be decontaminated before disposal. - Sharp objects such as needles, Pasteur pipettes and broken glass should be placed into a sharps container. - Liquids associated with solid materials, such as assay tube contents, should be decanted or removed by decay time. - All radioactive labeling should be removed on any items to be disposed of. - Radioactive waste with a half-life of more than 90 days must be collected and stored externally in accordance with national regulations. - Storage places must be equipped with sufficient shielding material, either in the walls or as movable shielding screens. - The storage must be clearly marked with "RADIOACTIVE WASTE", and the international hazard label should be placed on the door. - The storage place should be constructed in a manner that renders it flame-proof and should have such surfaces on floors, benches and walls that allow proper decontamination. - An air-extraction system and radioactive monitoring system should be put in place.	

	- The International Atomic Energy Agency provides comprehensive guidance on all aspects of the safety of radioactive waste management in the Safety Standards Series	

N.B. Every department and specialty producing any type of waste is completely responsible for implementing all rules mentioned in this Manual to manage that waste generated in it

Land disposal

There are two distinct types of waste disposal to land:

- **Uncontrolled dumping** is characterized by the scattered, uncontrolled deposit of wastes at a site. It is a practice that almost always leads to acute pollution problems, fires, higher risks of disease transmission and open access to scavengers and animals. **Health-care waste should not be deposited on or around uncontrolled dumps.**
- **Controlled landfilling** represents various types of disposal to land characterized by better operating practices and design improvements to reduce health and environmental impacts. The first step to improvement is "controlled dumping", where small improvements can restrict environmental consequences and physical access to waste. This is followed by "engineered landfill" where increasing standards of engineering are used to improve geological isolation of wastes from the environment and to allow wastes to be covered daily. Disposing of certain types of health-care waste (infectious and small quantities of pharmaceutical wastes) in engineered landfills is possible within the constraints of local regulations. A well-engineered landfill is designed to minimize contamination of soil, surface water and groundwater;

Municipal and other external disposal sites

- **Without treatment**

  If a municipality or health-care facility lacks the means to treat wastes before disposal, the use of a landfill is a realistic option to protect public health

- **After treatment**

In more developed situations where health-care waste is treated, the residual material is typically disposed of in landfill sites. Upgrading from open dumping directly to more sophisticated sanitary landfills may be technically and financially difficult for many municipalities. However, there is no reason for municipal authorities to abandon the move towards more controlled and safer land-disposal techniques.

- **Essential elements for the design and operation of sanitary landfills**
  - Controlled access to the site; designation and supervision of working areas for waste delivery.
  - Presence of personnel capable of effective control of daily operations.
  - Division of the site into manageable phases of operation, each appropriately prepared before landfilling starts in each phase.
  - Adequate sealing of the base and sides of the site to minimize the movement of wastewater (leachate) off the site.
  - Adequate mechanisms for leachate collection and, where necessary, treatment systems to reduce the pollution potential before discharge offsite.
  - Organized deposit of wastes in small working areas, which allow waste to be spread, compacted and covered daily.
  - Surface waste drainage trenches around site boundaries.

- Placement of final cover to minimize rainwater infiltration when each phase of the landfill is completed.

- Certain types of health-care waste, such as anatomical waste, will still have an offensive visual impact after treatment and preferably should not be landfilled. Disposing of such waste in landfill may also be culturally or religiously unacceptable in many countries. Such wastes should be placed in approved burial grounds or cremated. If this is not possible, these wastes could be placed in containers or rendered unrecognizable before disposal. In some countries, cemetery design must also meet minimum official standards.

- Ash from incineration is conventionally considered to be hazardous by virtue of its likely heavy metal content and the dioxins and furans it may contain. Ash should preferably be disposed of in sites designed for hazardous wastes; for example, placed in designated cells at engineered landfills, encapsulated and placed in specialized monofill sites, or disposed of in an ash pit in the ground

6. Classification and disposal of water waste

Characteristics of health-care wastewater

Divided into the following three categories:

- **Black water**(sewage) is heavily polluted wastewater that contains high concentrations of faecal matter and urine.
- **Grey water** (sullage) contains more dilute residues from washing, bathing, laboratory processes, laundry and technical processes such as cooling water or the rinsing of X-ray films.
- **Storm water** is technically not a wastewater itself, but represents the rainfall collected on hospital roofs, grounds, yards and paved surfaces. This may be lost to drains and watercourses and as groundwater recharge, or used for irrigating hospital grounds, toilet flushing and other general washing purposes.

Quality of wastewater by hospital department

Wastewater from health-care facilities contains organic particles (faeces, hairs, food, vomit, paper, fibres), soluble organic material (urea, proteins, pharmaceuticals), inorganic particles (sand, grit, metal particles), soluble inorganic material (ammonia, cyanide, hydrogen sulfide, thiosulfates) and other substances. The composition depends on the source of origin.

General medical areas generate wastewater comparable to domestic wastewater. The urine of patients from some wards (oncology, infectious disease) will probably contain higher amounts of antibiotics, cytotoxics, their metabolites and X-ray contrast media. Additionally, higher concentrations of disinfectants can be found.

Kitchens at hospitals often generate a polluting wastewater stream containing food leftovers, waste from food processing and high concentrations of disinfectants and detergents. Starch, grease, oil and an overall high organic content have the potential to create problems during wastewater management

Laundries are places where the highest quantity of greywater is produced. Often, the wastewater is hot, has a high pH (alkaline) and may contain high rates of phosphate and AOX if chlorine-based disinfectants are used. Shower blocks also create large volumes of greywater containing dilute concentrations of detergents.

Theatres and intensive-care units generate wastewater with high contents of disinfectants (glutaraldehyde), detergents and pharmaceuticals. Additionally, the organic content can be high due to the disposal of body fluids and rinsing liquids (such as those from suction containers).

Laboratories are a possible source for chemicals in the wastewater stream. Of special relevance are halogenated and organic solvents, colorants from histology and haematology (Gram staining), cyanides (haematology) and formaldehyde and xylene (pathology). Laboratories may also contribute to the presence of blood in wastewater from the emptying of samples into the sinks.

Radiology departments are the main generator of photochemical (developing and fixing) solutions in wastewater and potentially contaminated rinsing water. In some countries, this source of wastewater contamination is declining due to the increasing use of digital X-ray technology.

Haemodialysis requires the disinfection of the dialysers and sometimes the used filters. Accordingly, the concentration of disinfectant in the wastewater can be high.

Dental departments can contaminate wastewater with mercury (amalgam) from the filling of dental cavities if no amalgam separators are installed in the sink waste pipe system.

Central sterile supply departments are one of the main consumers of disinfection solutions, including aldehyde-based disinfectants. Hot water from the sterilizers and detergents from the CD-machine (cleaning and disinfectant) might also increase pollution load in the wastewater

Collection and pretreatment of liquid health-care waste

- Segregation, minimization and safe storage of hazardous materials are just as important for liquid wastes as they are for solid wastes.

- Typically, a system of sewer pipes linked to form a sewerage system will collect wastewater from around a health-care facility and carry it below ground to a central location for treatment or disposal.
- This treatment plant may be located at a health-care facility or some distance away, where it will also provide treatment for the wider community or municipality. This is known as a “central system”.
- Where a main sewerage system has not been constructed, wastewater may be collected from medical areas by pipe system and passed into cesspits or septic tanks.
  This is a “decentralized” collection arrangement, where the wastewater is removed periodically from the pits by a tanker fitted with a sludge pump and taken for treatment and disposal.
  A decentralized collection and treatment system is not the preferred approach for health-care facilities.

Pretreatment of hazardous liquids

- The basic principle of effective waste water management is a strict limit on the discharge of hazardous liquids to sewers.
- Chemical waste, especially photochemicals, aldehydes (formaldehyde and glutaraldehyde), colorants and pharmaceuticals, should not be discharged into wastewater but should be collected separately and treated as a chemical health-care waste.
- Pretreatment is recommended for waste water streams from departments such as medical laboratories.
- This pretreatment could include acid–base neutralization, filtering to remove sediments, or autoclaving samples from highly infectious patients.
- Non-hazardous chemicals such as syrups, vitamins or eye drops can be discharged to the sewer without pretreatment
- A grease trap can be installed to remove grease, oil and other floating materials from kitchen wastewater. The trap and collected grease should be removed every 2–4 weeks..
- Collected body fluids, small quantities of blood and rinsing liquids from theatres and intensive care can be discharged in the sewer without pretreatment. Precautions against blood spatter should always be taken (e.g. wearing personal protective equipment [PPE] and following standardized handling procedures), and care should be taken to avoid blood coagulation that could block pipes.
- Larger quantities of blood may be discharged if a risk assessment shows that the likely organic loading in the wastewater does not require pretreatment. Otherwise, blood should be first disinfected, preferably by a thermal method, or disposed of as pathological waste.
- Blood can also be disposed of directly to a septic tank system if safety measures are followed.
- 5% sodium hypochlorite (NaOCl – bleach) is not effective for disinfecting liquids with a high organic content such as blood and stools.
- Sodium hypochlorite should never be mixed with detergents or used for disinfecting ammonia-containing liquids, because it might form toxic gases.
- Lime milk (calcium oxide) can be used to destroy microorganisms in liquid wastes with high organic content requiring disinfection (e.g. stool or vomit during a cholera outbreak). In these cases, faeces and vomit should be mixed with the lime milk in a ratio of 1:2, with a minimum contact time of six hours. Urine can be mixed 1:1, with a minimum contact time of two hours
- Wastewater from the dental department should be pretreated by installing an amalgam separator in sinks, particularly those next to patient treatment chairs.
- Mercury waste must be safely stored. Where there is no existing national system for storing mercury, health-care facilities can follow general guidelines for safe storage.
- Radioactive wastewater from radiotherapy (e.g. urine of patients undergoing thyroid treatment) should be collected separately and stored in a secured place until the levels of radioactivity have decreased to background concentrations. After the required storage time, the wastewater can be disposed of into a sewer.

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

Guiding principles

- The occupational safety of health-care personnel and workers handling waste is often overlooked.
- Health-care waste-management policies or plans should include arrangement for the continuous monitoring of workers' health and safety.
- This is to ensure that correct handling, treatment, storage and disposal procedures are being followed.
- Sensible occupational health and safety measures include the following:
    - Develop a standardized set of management rules and operating procedures for health-care waste;
    - Inform and train waste workers so that they perform their duties properly and safely;
    - Involve waste workers in the identification of hazards and recommendations for prevention and control;
    - Provide equipment and clothing for personal protection;
    - Establish an occupational health programme that includes information, training and medical measures when necessary, such as immunization, post-exposure prophylactic treatment and regular medical surveillance.
- Standardized and written health-care waste-management procedures, when respected by personnel and monitored by the hospital management, can dramatically reduce the risk of accidents.
- Hospital staff should be taught and kept informed about the health-care waste-management system and procedures that are in place.
- Workers at risk from infection and injury include health-care providers, hospital cleaners, maintenance workers, operators of waste-treatment equipment, and all personnel involved in waste handling and disposal within and outside health-care facilities.
- Training in health and safety is intended to ensure that workers know of and understand the potential risks associated with health-care waste, and the rules and procedures they are required to respect for its safe management.
- They should be informed on the importance of consistent use of personal protective equipment (PPE) and should be aware of where to obtain post-exposure follow-up in case of a needle-stick injury or other blood exposure.
- Health-care personnel should be trained for emergency response if injured by a waste item, and the necessary equipment should be readily available at all times.
- Written procedures for the different types of emergencies should be drawn up.
- For dangerous spills of hazardous chemicals or highly infectious materials, the clean-up operation should be carried out by designated personnel specially trained for the purpose.
- To limit the risks, the hospital management must set up management rules and operating procedures for health-care waste and establish standardized emergency procedures.
- It is the responsibility of everybody involved in handling waste to know the emergency procedures and to act accordingly.
- One person should be designated as responsible for the handling of emergencies, including coordination of actions, reporting to managers and regulators, and liaising with emergency services.
- A deputy should be appointed to act in case of absence.

Occupational health risks

- Health-care waste handlers are at greatest risk from infectious hazards, especially sharps that are not disposed of into puncture-resistant containers.
- The risk of acquiring a secondary infection following needle-stick injury from a contaminated sharp depends on the amount of the contamination and nature of the infection from the source patient.
- The risk of infection with hepatitis B is more than 10 times greater than for hepatitis C, and up to 100 times greater than for human immunodeficiency virus (HIV)
- Actual cases of non-sharps waste being demonstrated to cause an infection in health-care staff and waste workers are rarely documented.
- However, it is known that waste handlers were infected by tuberculosis (TB) at a medical waste-processing facility in Morton, Washington, in the United States of America, as a result of exposure to healthcare waste.

Health hazards

Other hazards to health-care waste workers include chemical exposures such as chemotherapeutic drugs, disinfectants and sterilants; physical hazards such as ionizing radiation; and ergonomic hazards such as manual lifting and transporting of heavy waste loads

Cytotoxic safety

- The senior pharmacist at a health-care facility should be made responsible for ensuring the safe use of cytotoxic drugs.
- Large oncological hospitals may appoint a full-time genotoxic safety officer, who should also supervise the safe management of cytotoxic waste. The following measures are important to minimize exposure:
    - Written procedures that specify safe working methods for each process;
    - Data sheets, based on the suppliers' specifications, to provide information on potential hazards and their minimization;
    - Established procedure for emergency response in case of spillage or other occupational accident;
    - Appropriate education and training for all personnel involved in the handling of cytotoxic drugs.
- These measures are unlikely to be needed in rural or smaller district hospitals that do not typically use genotoxic products, either cytotoxic or radioactive.
- Limit the use of those substances to a small number of specialized (e.g. oncological) hospitals that are better able to implement appropriate safety measures.
- In hospitals that do use cytotoxic products, specific guidelines on their safe handling should be established for the protection of personnel.
- These guidelines should include rules on the following waste-handling procedures:
    - Separate collection of waste in leak-proof bags or containers and labelling for identification; return of outdated drugs to suppliers;
    - Safe separate storage of genotoxic waste away from other health-care waste;
    - Arrangements for the disposal of contaminated material, the decontamination of reusable equipment and the clean-up of spillages;
    - Arrangements for the treatment of infectious waste contaminated with cytotoxic products, including excreta from patients, disposable linen and absorbent material for incontinent patients.
- Minimal protective measures for all waste workers who handle cytotoxic waste should include protective clothing, gloves (chemical barrier), goggles and face masks.

- Hospital staff should ensure that the families of patients undergoing chemotherapy at home are aware of the risks and know how they can be minimized or avoided.

Exposure prevention and control

- All health-care workers are at risk of exposure to blood at work and should be immunized against the hepatitis B virus before commencing employment.
- A proper and safe segregation system for hazardous waste is the key to occupational safety and environmental sound handling.
- Implementing a proper segregation system must be accompanied by safe and standardized handling procedures

The responsible authorities for occupational safety:

1. The contracted company for waste management
2. Hotel service department
3. Infection control Department
4. Preventive medicine department
5. Safety officer of the laboratories
6. Radiation officer
7. Nuclear medicine officer
8. Chief pharmacist
9. Hospital and Regional Health Directors

Hierarchy of control (applied to blood borne pathogens)

Methods to control occupational hazards have traditionally been discussed in terms of hierarchy and presented in order of priority for their effectiveness in preventing exposure to the hazard or preventing injury resulting from exposure to the hazard.

Dealing with spillages

- Spillages require clean-up of the area contaminated by the spilt waste.
- For spillages of highly infectious material, it is important to determine the type of infectious agent, because immediate evacuation of the area may be necessary in
- some cases.
- In general, the most hazardous spillages occur in laboratories rather than in medical care departments.
- Procedures for dealing with spillages should specify safe handling operations and appropriate protective clothing.
- Appropriate equipment for collecting the waste and new containers should be available, as should means for disinfection.
- In case of skin and eye contact with hazardous substances, there should be immediate decontamination.
- An exposed person should be removed from the area of the incident for decontamination, generally with copious amounts of water.
- Special attention should be paid to the eyes and any open wounds.

- In case of eye contact with corrosive chemicals, the eyes should be irrigated continuously with clean water for 10–30 minutes; the entire face should be washed in a basin, with the eyes being continuously opened and closed.

Reporting accidents and incidents

- All waste-management staff should be trained in emergency response and made aware of the correct procedure for prompt reporting.
- Accidents or incidents, including near misses, spillages, damaged containers, inappropriate segregation and any incidents involving sharps, should be reported to the waste-management officer (if waste is involved) or to another designated person. The report should include details of:
    - the nature of the accident or incident
    - the place and time of the accident or incident
    - the staff who were directly involved
    - any other relevant circumstances.
- The cause of the accident or incident should be investigated by the waste-management officer (in case of waste) or other responsible officer, who should also take action to prevent recurrence.
- The records of the investigation and subsequent remedial measures should be kept.

Protective equipment

- The most effective PPE in reducing risk of injury are gloves to protect from exposure to blood, other potentially infectious materials and chemicals; particulate masks (respirators) to protect from respiratory infections hazards and particulates from burning waste; and boots for waste handlers to protect from sharps injuries to the foot.
- Availability and access to soap and water, and alcohol hand rub, for hand hygiene are also important to maintain cleanliness and inhibit the transfer of infection via dirty hands.
- The type of protective clothing used will depend to an extent upon the risk associated with the health-care waste, but the following should to be made available to all personnel who collect or handle waste:
- **obligatory**
    - disposable gloves (medical staff) or heavy-duty gloves (waste workers)
    - industrial aprons
    - overalls (coveralls)
    - leg protectors and/or industrial boots
- **depending on type of operation**
    - eye protectors (safety goggles)
    - face masks (if there is a risk of splash into eyes)
    - helmets, with or without visors.
- Industrial boots and heavy-duty gloves are particularly important for waste workers. The thick soles of the boots offer protection in the storage area, as a precaution from spilt sharps, and where floors are slippery.
- If segregation is inadequate, needles or other sharps items may have been placed in plastic bags; such items may also pierce thin walled or weak plastic containers. If it is likely that health-care

waste bags will come into contact with workers' legs during handling, leg protectors may also need to be worn.

Occupational post-exposure prophylaxis

- Post-exposure prophylaxis (PEP) is short-term antiretroviral treatment (for HIV) or immunization (for hepatitis B) to reduce the likelihood of infection after potential exposure, either occupationally or through sexual intercourse.
- Within the health sector, PEP should be provided as part of a comprehensive universal precautions package that reduces staff exposure to infectious hazards at work.
- PEP for HIV comprises a set of services to prevent development of the infection in the exposed person.
- These include first-aid care; counselling and risk assessment; HIV blood testing; and, depending on the risk assessment, the provision of short-term (28 days) antiretroviral drugs, with follow-up and support.
- Most incidents linked to occupational exposure to bloodborne pathogens occur in health-care facilities.
- WHO recommends that :
    - PEP should be provided as part of a package of prevention measures that reduce staff exposure to infectious hazards.
    - PEP should be available to health-care workers and patients.
    - Occupational PEP should also be available to all workers who could be exposed while performing their duties (such as social workers, law enforcement personnel, rescue workers, refuse collectors).
    - Countries should include occupational PEP in national health-care plans. Appropriate training to service providers should ensure the effective management and follow-up of PEP.
    - PEP should be initiated as soon as possible within the first few hours and no later than 72 hours after exposure to potentially infected blood or body fluids.
    - PEP should not be prescribed to a person already known to be infected with HIV.
    - In addition, risk evaluation, and counseling on side effects, and benefits of adherence and psychosocial support is needed.
    - Any occupational exposure to HIV should lead to evaluation and, where relevant, strengthening of safety and working conditions.

Training

- Health-care waste workers should be trained before starting work handling waste, and then on a routine basis (e.g. annually) to update their knowledge of prevention and control measures.
- Training should include awareness raising about the potential hazards from waste, the purpose of immunization, safe waste-handling procedures, reporting of exposures and injuries, preventing infection following an exposure with PEP, and the use of PPE.

Needlestick and Sharp Object Injury Report

Ministry of Health

This form is adopted from Exposure Prevention Information Network (EPINet)

Injury ID: *(for office use only)* S_____ Completed by: _____

Name: _____ Gender: 1☐ M 2☐ F

Civil ID: _____ Nationality: 1☐ K 2☐ NK

Facility name: _____ Telephone : _____

Health region: _____

1) Date of injury: ☐☐ ☐☐ ☐☐☐☐ 2) Time of injury: ☐☐ ☐☐

3) Department where incident occurred: _____

4) Home/Employing department: _____

5) What is the job category of the injured worker? (check one box only)

- ☐ 1 Doctor *(attending/staff)*; specify specialty_____
- ☐ 2 Doctor *(intern/resident/fellow)* specify specialty _____
- ☐ 3 Medical student
- ☐ 4 Nurse: specify ⟶ ☐ 1 RN ☐ 2 LPN ☐ 3 NP ☐ 4 CRNA ☐ 5 Midwife
- ☐ 5 Nursing student
- ☐ 18 CNA/HHA
- ☐ 6 Respiratory therapist
- ☐ 7 Surgery attendant
- ☐ 8 Other attendant
- ☐ 9 Phlebotomist/Venipuncture/IV team
- ☐ 10 Clinical laboratory worker
- ☐ 11 Technologist *(non-lab)*
- ☐ 12 Dentist
- ☐ 13 Dental hygienist
- ☐ 14 Housekeeper
- ☐ 19 Laundry worker
- ☐ 20 Security
- ☐ 16 Paramedic
- ☐ 17 Other student
- ☐ 15 Other, describe: _____

6) Where did the injury occur? (check one box only)

- ☐ 1 Patient room
- ☐ 2 Outside patient room *(hallway, nurses station, etc.)*
- ☐ 3 Emergency department
- ☐ 4 Intensive/Critical care unit: specify type: _____
- ☐ 5 Operating room/Recovery
- ☐ 6 Outpatient clinic/Office
- ☐ 7 Blood bank
- ☐ 8 Venipuncture room
- ☐ 9 Dialysis facility *(hemodialysis and peritoneal dialysis)*
- ☐ 10 Procedure room *(x-ray, EKG,etc)*
- ☐ 11 Clinical laboratories
- ☐ 12 Autopsy/Pathology
- ☐ 13 Service/Utility *(laundry,central supply, etc)*
- ☐ 16 Labor and delivery room
- ☐ 17 Home-care
- ☐ 14 Other, describe: _____

7) Was the source patient identifiable? (check one box only)

☐ 1 Yes ☐ 2 No ☐ 3 Unknown ☐ 4 Not applicable

8) Was the injured worker the original user of the sharp item? (check one box only)

☐ 1 Yes ☐ 2 No ☐ 3 Unknown ☐ 4 Not applicable

9) The sharp item was: (check one box only)

- ☐ 1 Contaminated (known exposure to patient or contaminated equipment) ⟶ **was there blood on the device?** ☐ 1 Yes ☐ 2 No
- ☐ 2 Uncontaminated (no known exposure to patient or contaminated equipment)
- ☐ 3 Unknown

10) For what purpose was the sharp item originally used? (check one box only)

- ☐ 1 Unknown/Not applicable
- ☐ 2 Injection, intra-muscular/subcutaneous, or other injection through the skin *(syringe)*
- ☐ 3 Heparin or saline flush *(syringe)*
- ☐ 4 Other injection into *(or aspiration from)* IV injection site or IV port *(syringe)*
- ☐ 5 To connect IV line *(intermittent IV/piggyback/IV infusion/other IV line connection)*
- ☐ 6 To start IV or set up heparin lock *(IV catheter or winged set-type needle)*
- ☐ 7 To draw venous blood sample
- ☐ 8 To draw arterial blood sample ⟶ **if used to draw blood was it?** ☐ 1 Direct stick? ☐ 2 Draw from a line?
- ☐ 16 To place an arterial /central line
- ☐ 9 To obtain a body fluid or tissue sample *(urine/CSF/amniotic fluid/other fluid, biopsy)*
- ☐ 10 Finger stick/Heel stick
- ☐ 11 Suturing
- ☐ 12 Cutting
- ☐ 17 Drilling
- ☐ 13 Electrocautery
- ☐ 14 To contain a specimen or pharmaceutical *(glass item)*
- ☐ 15 Other; describe

11) Did the injury occur? (check one box only)

- ☐ 1 Before use of item *(item broke/slipped, assembling device, etc.)*
- ☐ 2 During use of item *(item slipped, patient jarred item, etc)*
- ☐ 15 Restraining patient
- ☐ 3 Between steps of a multi-step procedure *(between incremental injections, passing instruments, etc.)*
- ☐ 16 Device left on floor, table, bed or other inappropriate place
- ☐ 8 Other after use-before disposal *(in transit to trash, cleaning, sorting, etc.)*
- ☐ 9 From item left on or near disposal container
- ☐ 10 While putting item into disposal container

- ☐ 4 Disassembling device or equipment
- ☐ 5 In preparation for reuse of reusable instrument *(sorting, disinfecting, sterilizing, etc.)*
- ☐ 6 While recapping used needle
- ☐ 7 Withdrawing a needle from rubber or other resistant material *(rubber stopper, IV port, etc.)*
- ☐ 11 After disposal, stuck by item protruding from opening of disposal container
- ☐ 12 Item pierced side of disposal container
- ☐ 13 After disposal, item protruded from trash bag or inappropriate waste container
- ☐ 14 Other: describe: _____

12) What type of device caused the injury? (check one box only)

- ☐ Needle-*hollow-bore*
- ☐ Surgical
- ☐ Glass

Which device caused the injury? (check one box from one of the three sections only)

Needles *(for suture needles see "surgical instruments")*

- ☐ 1 Disposable syringe
  - ☐ a Insulin
  - ☐ b Tuberculin
  - ☐ c 24/25-gauge needle
  - ☐ d 23-gauge needle
  - ☐ e 22-gauge needle
  - ☐ f 21-gauge needle
  - ☐ g 20-gauge needle
  - ☐ h "Other"
- ☐ 2 Pre-filled cartridge syringe (includes Tubex™, Carpuject ™ -type syringes)
- ☐ 3 Blood gas syringe (ABG)
- ☐ 4 Syringe, other type
- ☐ 5 Needle on IV line *(includes piggybacks & IV line connectors)*
- ☐ 6 Winged steel needle *(includes winged-set type devices)*
- ☐ 7 IV catheter stylet
- ☐ 8 Vacuum tube blood collection holder/needle *(includes Vacutainer™–type device)*
- ☐ 9 Spinal or epidural Needle
- ☐ 10 Unattached hypodermic needle
- ☐ 11 Arterial catheter introducer needle
- ☐ 12 Central line catheter needle *(cardiac, etc.)*
- ☐ 13 Drum catheter needle
- ☐ 14 Other vascular catheter needle *(cardiac, etc.)*
- ☐ 15 Other non-vascular catheter needle *(ophthalmology, etc.)*
- ☐ 28 Needle, not sure what kind
- ☐ 29 Other needle, please describe: _____

Surgical instrument or other sharp items *(for glass items see "glass")*

- ☐ 30 Lancet (finger or heel sticks)
- ☐ 31 Suture needle
- ☐ 32 Scalpel, reusable *(scalpel, disposable code is 45)*
- ☐ 33 Razor
- ☐ 34 Pipette *(plastic)*
- ☐ 35 Scissors
- ☐ 36 Electro-cautery device
- ☐ 37 Bone cutter
- ☐ 38 Bone chip
- ☐ 39 Towel clip
- ☐ 40 Microtome blade
- ☐ 41 Trocar
- ☐ 42 Vacuum tube *(plastic)*
- ☐ 43 Specimen/Test tube *(plastic)*
- ☐ 44 Fingernails/Teeth
- ☐ 45 Scalpel, disposable
- ☐ 46 Retractors, skin/bone hooks
- ☐ 47 Staples/Steel sutures
- ☐ 48 Wire *(suture/fixation/guide wire*
- ☐ 49 Pin *(fixation, guide pin)*
- ☐ 50 Drill bit/bur
- ☐ 51 Pickups/Forceps/Hemostats/Clamps
- ☐ 58 Sharp item, not sure what kind
- ☐ 59 Other sharp item: Describe: _____

Glass

- ☐ 60 Medication ampule
- ☐ 61 Medication vial *(small volume with rubber stopper)*
- ☐ 62 Medication/IV bottle *(large volume)*
- ☐ 63 Pipette *(glass)*
- ☐ 64 Vacuum tube *(glass)*
- ☐ 65 Specimen/Test tube *(glass)*
- ☐ 66 Capillary tube
- ☐ 67 Glass slide
- ☐ 78 Glass item, not sure what kind
- ☐ 79 Other glass item: Describe: _____

12a) Brand/Manufacturer of product: (e.g. ABC Medical Company) _____

12b) Model:

- ☐ 98 Please specify: _____
- ☐ 99 Unknown

13) If the item causing the injury was a needle or sharp medical device, was it a" safety design" with a shielded, recessed, retractable, or blunted needle or blade?

- ☐ 1 Yes
- ☐ 2 No
- ☐ 3 Unknown

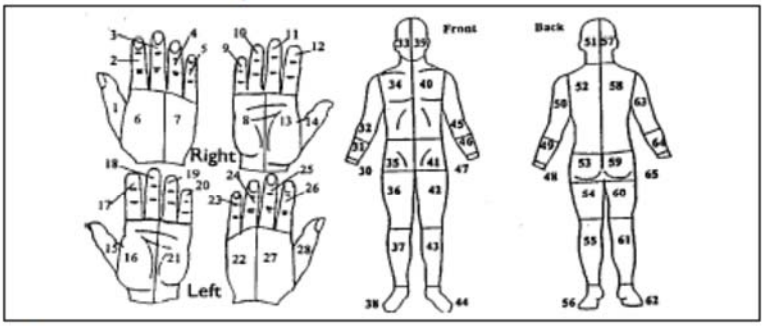
13a) Was the protective mechanism activated?

- ☐ 1 Yes, fully
- ☐ 2 Yes, partially
- ☐ 3 No
- ☐ 4 Unknown

13b) Did injury incident happen?

- ☐ 1 Before activation
- ☐ 2 During activation
- ☐ 3 After activation
- ☐ 4 Unknown

14) **Mark the location of the injury:**



15) **Was the injury?**
- ☐ 1 Superficial *(little or no bleeding)*
- ☐ 2 Moderate *(skin punctured, some bleeding)*
- ☐ 3 Severe *(deep stick/cut, or profuse bleeding)*

16) **If injury was to the hand, did the sharp item penetrate?**
- ☐ 1 Single pair of gloves
- ☐ 2 Double pair of gloves
- ☐ 3 No gloves

17) **Dominant hand of the injured worker:**
- ☐ 1 Right-handed
- ☐ 2 Left-handed

18) **Describe the circumstances leading to this injury** *(please note if a device malfunction was involved)*:

_____
_____
_____

19) **For injured healthcare worker: If the sharp had no integral safety feature, do you have an opinion that such a feature could have prevented the injury?** ☐ 1 Yes ☐ 2 No ☐ 3 Unknown

Describe: _____
_____
_____
_____

20) **For injured healthcare worker: Do you have an opinion that any other engineering control, administrative or work practice could have prevented the injury?** ☐ 1 Yes ☐ 2 No ☐ 3 Unknown

Describe: _____
_____
_____
_____

Cost:

_____ Lab charges (Hb, HCV, HIV, other)
_____ Healthcare worker
_____ Source
_____ Treatment prophylaxis (HBIG, Hb vaccine, tetanus, other)
_____ Healthcare worker
_____ Source
_____ Service charges (Emergency Dept, Employee Health, other)
_____ Other costs (Worker's Comp, surgery, other)
_____ TOTAL (round to nearest KD)

Blood and Body Fluid Exposure Report

Ministry of Health

This form is adopted from Exposure Prevention Information Network (EPINet)

Exposure ID: *(for office use only)* B_____ **Completed by:** _____

Name: _____ **Gender:** 1☐ M 2☐ F

Civil ID: _____ **Nationality:** 1☐ K 2☐ NK

Facility name: _____ **Telephone :** _____

Health region: _____

1) Date of exposure: ☐☐ ☐☐ ☐☐☐☐ **2) Time of exposure:** ☐☐

3) Department where incident occurred: _____

4) Home/Employing department: _____

5) What is the job category of the exposed worker? (check one box only)

- ☐ 1 Doctor *(attending/staff)*; specify specialty _____
- ☐ 2 Doctor *(intern/resident/fellow)* specify specialty _____
- ☐ 3 Medical student
- ☐ 4 Nurse: specify → ☐ 1 RN, ☐ 2 LPN, ☐ 3 NP, ☐ 4 CRNA, ☐ 5 Midwife
- ☐ 5 Nursing student
- ☐ 18 CNA/HHA
- ☐ 6 Respiratory therapist
- ☐ 7 Surgery attendant
- ☐ 8 Other attendant
- ☐ 9 Phlebotomist/Venipuncture/IV team
- ☐ 10 Clinical laboratory worker
- ☐ 11 Technologist *(non-lab)*
- ☐ 12 Dentist
- ☐ 13 Dental hygienist
- ☐ 14 Housekeeper
- ☐ 19 Laundry worker
- ☐ 20 Security
- ☐ 16 Paramedic
- ☐ 17 Other student
- ☐ 15 Other, describe: _____

6) Where did the exposure occur? (check one box only)

- ☐ 1 Patient room
- ☐ 2 Outside patient room *(hallway, nurses station, etc.)*
- ☐ 3 Emergency department
- ☐ 4 Intensive/Critical care unit: specify type: _____
- ☐ 5 Operating room/Recovery
- ☐ 6 Outpatient clinic/Office
- ☐ 7 Blood bank
- ☐ 8 Venipuncture room
- ☐ 9 Dialysis facility *(hemodialysis and peritoneal dialysis)*
- ☐ 10 Procedure room *(x-ray, EKG,etc)*
- ☐ 11 Clinical laboratories
- ☐ 12 Autopsy/Pathology
- ☐ 13 Service/Utility *(laundry,central supply, etc)*
- ☐ 16 Labor and delivery room
- ☐ 17 Home-care
- ☐ 14 Other, describe: _____

7) Was the source patient identifiable? (check one box only)

☐ 1 Yes ☐ 2 No ☐ 3 Unknown ☐ 4 Not applicable

8) Which body fluids were involved in the exposure? (check all that apply)

- ☐ Blood or blood products
- ☐ Vomit
- ☐ Sputum
- ☐ Saliva
- ☐ CSF
- ☐ Peritoneal fluid
- ☐ Pleural fluid
- ☐ Amniotic fluid
- ☐ Urine
- ☐ Other, describe: _____

8a) Was the body fluid visibly contaminated with blood? ☐ Yes ☐ No ☐ Unknown

9) Was the exposed part? (check all that apply)

- ☐ Intact skin
- ☐ Non-intact skin
- ☐ Eyes (*conjunctiva*)
- ☐ Nose (*mucosa*)
- ☐ Mouth (*mucosa*)
- ☐ Other, describe: _____

10) Did the blood or body fluid? (check all that apply)

- ☐ Touch unprotected skin
- ☐ Touch skin between gap in protective garments
- ☐ Soak through barrier garment or protective garment
- ☐ Soak through clothing

11) Which barrier garments were worn at the time of exposure? (check all that apply)

- ☐ Single pair latex/vinyl gloves
- ☐ Double pair latex/vinyl gloves
- ☐ Goggles
- ☐ Eyeglasses *(not a protective item)*
- ☐ Eyeglasses with side shields
- ☐ Face shield
- ☐ Surgical mask
- ☐ Surgical gown
- ☐ Plastic apron
- ☐ Lab coat, cloth *(not a protective garment)*
- ☐ Lab coat, other, describe: _____
- ☐ Other, describe: _____

12) **Was the exposure the result of?** (check one box only)

- ☐ 1 Direct patient contact
- ☐ 2 Specimen container leaked/spilled
- ☐ 3 Specimen container broke
- ☐ 4 IV Tubing/Bag/Pump leaked/broke
- ☐ 10 Feeding/Ventilator/Other tube separated/leaked/splashed. Specify tubing: _____
- ☐ 5 Other body fluid container spilled/leaked
- ☐ 6 Touched contaminated equipment/surface
- ☐ 7 Touched contaminated drapes/sheets/gowns, etc.
- ☐ 8 Unknown
- ☐ 9 Other, describe: _____

If equipment failure, please specify: **Equipment type**: _____

Manufacturer: _____

13) **For how long was the blood or body fluid In contact with your skin or mucous membranes?** (check one)

- ☐ 1 Less than 5 minutes
- ☐ 2 5-14 minutes
- ☐ 3 15 minutes to 1 hour
- ☐ 4 More than 1 hour

14) **How much blood/body fluid came in contact with your skin or mucous membranes?** (check one)

- ☐ 1 Small amount (up to 5 cc, or up to 1 teaspoon)
- ☐ 2 Moderate amount (up to 50 cc, or up to quarter cup)
- ☐ 3 Large amount (more than 50 cc)

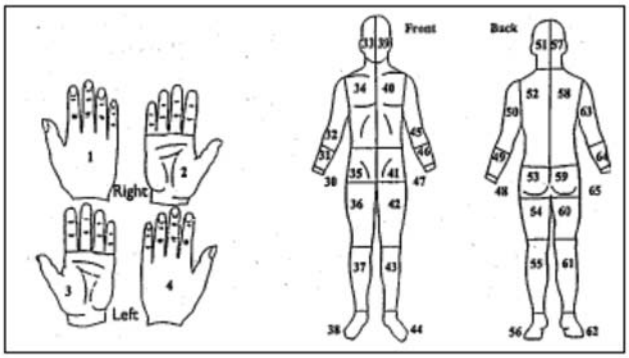
15) **Location of the exposure:**

Write the number of the location of up to three exposed body parts in the blanks below.

Largest area of exposure: _____

Middle area of exposure: _____

Smallest area of exposure: _____



16) **Describe the circumstances leading to this exposure:** *(please note if a device malfunction was involved):*

_____
_____
_____
_____
_____

17) **For exposed worker: Do you have an opinion that any other engineering control, administrative or work practice could have prevented the exposure?** ☐ 1 Yes ☐ 2 No ☐ 3 Unknown

Describe: _____
_____
_____
_____

Cost:

_____ Lab charges *(Hb, HCV, HIV, other tests)*
_____ Healthcare worker
_____ Source
Treatment Prophylaxis *(HBIG, Hb vaccine, tetanus, other)*
_____ Healthcare worker
_____ Source
_____ Service charges *(Emergency dept, Employee health, other)*
_____ Other costs *(Worker's comp, surgery, other)*
_____ TOTAL *(round to nearest KD)*

8.Training, education and public awareness

Importance of training and education

Training and continuing education are integral parts of the health-care waste-management system.

The overall goals of training are to:

- prevent occupational and public health exposures to the hazards associated with health-care waste;
- raise awareness of the health, safety and environmental issues relating to health-care waste;
- ensure that health-care staff are knowledgeable about best practices and technologies for health-care waste management and are able to apply them in their daily work;
- foster responsibility among all health-care workers for health-care waste management

Planning and implementation

The following are recommended steps in the planning and preparation of a training programme. These steps are not in chronological order and are interrelated:

- Identify and prioritize the employees to be trained.
- Define the specific learning objectives for each target audience.
- Explore multiple training delivery options to maximize outreach, considering the work schedules of the participants (e.g. short 30-minute or 1-hour in-service training sessions once a week for several weeks; on-the-job coaching and mentoring; an intensive three-day workshop; self-paced study using printed materials or CDs; web-based or video-conference training; classes in an academic institution).
- Develop a detailed curriculum specifying the following for each session: topic, expected outcomes, duration, teaching/learning method, teaching/learning aids, participant assignment before the session (if any), facilitator/ learner activities, assessment, and resources
- Incorporate pre-evaluation and post-evaluation of learners, evaluation of trainers, follow-up activities, and documentation into the training programme.
- Develop training content or adapt available training materials; tailor training content to specific target audiences.
- Identify potential trainers and build training skills.
- Develop a budget and secure funding.
- Explore incentives for training (e.g. training in collaboration with a health professional society or academic institution that can award certificates, academic credits or professional credentials).
- Send out announcements and build interest in the training programme among target participants.

Employees to be trained

- hospital managers and administrative staff responsible for implementing regulations on health-care waste management;
- medical doctors;
- nurses, nursing assistants and allied professions;
- cleaners, porters, auxiliary staff and waste handlers

Content of education programmes

- information on, and justification for, all aspects of the health-care waste policy;
- information on potential infection risks posed by health-care waste;
- information on the role and responsibilities of each staff member to follow waste-management procedures;
- technical instructions on the application of waste-management practices relevant to particular types of work by some medical or support staff;
- information on monitoring, record keeping and maintenance of equipment

Follow-up and refresher courses

Periodic repetition of courses will provide an opportunity to instruct new employees, and "refresher" courses for existing employees can remind them of practices and inform about changes or new responsibilities. Follow-up training is instructive for trainers; too, indicating how much information has been retained by course participants and for revising the scope of future refresher courses.

Training responsibility

- The waste-management officer (hotel services), in cooperation with the infection-control officer, Safety officers of Lab., radiology, nuclear medicine & chief Pharmacist

is typically given responsibility for all training related to health-care waste.

The waste-management officer should ensure that staff at all levels are aware both of waste-management methods in use, and of their own responsibilities and obligations.

A record should be kept of all training sessions and the members of staff who completed each course successfully.

The content of training programmes should be periodically reviewed with the infection-control officer and, if possible, regulators and waste contractors, and updated where necessary.

- Medical staff working in clinics and similar places with smaller sources of health-care waste should also receive training.

This could be offered centrally by larger health-care facilities or by regional public health organizations.

Implementation of a training course

The training package

- National training package could be developed by the government agency responsible for health care or the environment. Alternatively, a certified programme in health-care waste management could be delivered by public health or training institutions through locally prepared courses or by home study and distance learning, or even by tailoring training materials already available from an international organization, a development agency or another country.

- The package should be suitable for various types of health-care facilities, including government, private, teaching, general hospitals, polyclinics, health centers, health-care research institutions and clinical laboratories. It could also be useful for more general educational establishments and for organizations that provide services for the health-care waste sector.

Selection of participants

The ideal number of participants on a training course is 20 to 30. Larger groups may make effective discussions and exercises difficult to operate. Courses should be aimed at all categories of personnel. Discussions may be easier and more useful if the group is composed of trainees from various disciplines (e.g. supervisors, medical and nursing staff, laboratory staff, engineers, ancillary staff), or at least contain one or two medical assistants and nurses. It may also be valuable to include senior administration staff and heads of departments in certain training groups to demonstrate their commitment to the waste-management policy and to show the relevance of the policy to all personnel of health-care facilities

Training health-care waste handlers

- The minimum training for health-care waste handlers should include:

  - information on the techniques and risks associated with the handling of health-care waste
  - procedures for dealing with spillages and other accidents
  - instructions on the use of protective clothing.

- The training needs will obviously depend on the type of waste operations performed, but may include specific topics such as operation of treatment technologies and waste transportation.

Health-care personnel

Training should provide an overview of the waste-management policy and its underlying rationale, and information on practices relevant to the targeted group of trainees. Waste segregation is a key element in waste-management training for personnel who provide health care.

Cleaning staff

Topics to be covered may include the waste-management policy, health hazards, onsite transportation, storage, safety practices and emergency response. Awareness of the need for safety may decrease with time among staff who routinely handle health-care waste, which will, in turn, increase the risk of injury. Periodic short informal reminders and refresher training are suggested.

Staff who transport waste

A health-care facility itself may carry out the transportation of waste or it may contract this operation to an "authorized" waste transporter. In many countries, waste is transported to a central treatment or disposal site. Drivers and waste handlers should be aware of the nature and risks associated with the waste they transport. In particular, transport staff should be trained to be able to carry out all waste-related procedures in accordance with instructions, and without help from others.

Treatment plant operators

- Qualified operators are needed for incinerators, autoclaves and microwave and other treatment facilities. If no qualified operators are available, managers of health-care facilities should arrange to train an adequate number of personnel.
- Treatment plant operators should have received technical education to at least secondary school level.

Landfill operators

In many middle- and lower-income countries, "safe burying" will continue to be used for the disposal of health-care waste until there is sufficient capacity for incineration or other treatment method. Training landfill operators is important for limiting the risks associated with buried health-care waste, in relation to both scavenging and the quality of groundwater. Landfill operators should therefore be trained in similar issues outlined for treatment plant operators

Integrating training with public education on risks of health-care waste

- Promotion of safe and sensible waste handling and disposal is relevant both to users of health-care facilities and to the wider community as one approach to achieve a better understanding of health public. A training and public awareness programme should contain two aspects.
- The first is to create awareness and foster responsibility for good hygiene among all workers, patients and visitors at health-care facilities.
- The public awareness programme can go further and explain how good health-care waste management protects public health.
- The second aspect is to inform the public in general about the risks from poor hygiene and health-care practices, with particular regard to people living or working in close proximity to health-care facilities, families of patients treated at home, and scavengers working at disposal sites.
- Various methods can be used to promote public education on health-care waste. Commonly used approaches include the following:
    - Poster exhibitions can be used to educate about health-care waste issues, such as the risks involved in reusing syringes and hypodermic needles or the infection-control benefits of waste segregation and treatment.
    - Medical staff can explain to new patients and visitors their personal responsibilities to help maintain good hygiene and safe waste management. This may be difficult to achieve with people who have entrenched views, and face-to-face discussion should be supplemented with diagrams, posters and leaflets.
    - Information signs and pictograms can be used in hospitals, at strategic points such as waste-bin locations, giving instructions on waste segregation. Signs should be explicit, using diagrams, illustrations and consistent colour coding to convey the message to a broad audience, including illiterate people and those with a lower educational capacity.

- For maximum effectiveness, all information should be displayed or communicated in an attractive manner to hold people's attention and increase the likelihood they will remember the important messages to be conveyed by an information campaign.
- In medical areas, general health-care waste bins should be easily accessible for patients and visitors, and signs should explain clearly what they should do with other categories of waste.
- Growing awareness of health and environmental hazards has increased across the world, leading to higher public demand for information and guidance on these issues. Demand has intensified in some countries due to a rise in the prevalence of HIV/AIDS, viral hepatitis B and other well-publicized illnesses. Health-care facilities should set an example to society by demonstrating that they are managing their waste in a manner designed to protect health and the environment.

9. Assignment of responsibilities

The effective management of health-care waste is one aspect of the continuous need to control infections. Health-care waste management should be viewed as part of infection control, and a local waste-management plan could be developed by infection-control staff where they are present. In the larger health-care facilities where large quantities of waste are generated, a separate waste-management group or committee may be formed instead.

A typical waste-management committee in a large hospital may contain the following members:

Hospital administrator or deputy (as chairperson)
Waste-management officer from hotel services department (as coordinator)
Heads of hospital departments
Infection-control officer
Chief pharmacist
Radiation officer
Nuclear medicine officer
Lab. safety officer
Matron (or senior nursing officer)
Hospital engineer
Financial controller

- The Hospital administrator or deputy should formally appoint the members of the waste-management team in writing, informing each of their duties and responsibilities (outlined in the following sections).
- The head should appoint a waste-management officer who will have overall responsibility for developing the health-care waste-management plan, and for the day-to-day operation and monitoring of the waste-disposal system. Depending on availability of relevant staff, this post may be assigned to the hospital engineer, hospital manager, or any other appropriate staff member at the discretion of the head of hospital.
- In an institution that is not directly involved in patient care, such as a medical research institution, the head of the establishment should use their discretion to appoint members of the waste-management team from among the relevant staff.
-

Hospital Administrator or deputy

Hospital Administrator or deputy is responsible for the following tasks:

- Form a waste-management team to develop a written waste-management plan for the hospital. The team should consist of representatives from clinical and non-clinical areas of the organization, in addition to those who are involved in the removal and management of waste. The plan should clearly define the duties and responsibilities of all members of staff, both clinical and non-clinical, in respect to handling health-care waste and to establishing lines of accountability.
- Oversee and approve a waste-management plan.

- Designate a waste-management officer to supervise and implement the waste-management plan. The head of hospital retains overall responsibility for ensuring that health-care and other wastes are disposed of according to national guidelines.
- Keep the waste-management plan updated by setting regular (e.g. annual) review dates.
- Allocate financial and personnel resources to ensure efficient operation of the plan. For example, sufficient staff should be assigned to the waste-management officer to ensure efficient operation of the waste-management plan.
- Ensure that monitoring procedures are incorporated in the plan. The efficiency and effectiveness of the treatment and disposal system should be monitored so that the system can be updated and improved when necessary. Any changes should eventually be incorporated into a revised management plan.
- Appoint a successor in the event of personnel leaving key positions in the waste-management team (or temporarily assign responsibility to another staff member until a successor can be appointed).
- Ensure adequate training for staff members, and designate the staff responsible for coordinating and implementing training courses.

Waste-management officer from hotel services department

- The waste-management officer is responsible for the day-to-day operation and monitoring of the waste-management system
- It is therefore important that the waste-management officer has direct access to all members of the hospital staff
- The role should be held by a senior member of staff and should be responsible to the head of hospital.
- The waste-management officer should liaise with the infection-control officer, the chief pharmacist , the radiaology officer, nuclear medicine officer and Lab. Safety officer so that they become familiar with the correct procedures for handling and disposing of pathological, pharmaceutical, chemical and radioactive wastes.

To manage waste collection, storage and disposal, the waste-management officer should:

- control internal collection of waste containers and their transport to the central waste-storage facility of the hospital on a daily basis;
- liaise with the supplies department to ensure that an appropriate range of bags and containers for health-care waste, protective clothing and collection trolleys is available at all times;
- ensure that hospital attendants and ancillary staff immediately replace used bags and containers with the correct new bags or containers;
- directly supervise hospital attendants, ancillary workers and waste handlers assigned to collect and transport health-care waste;
- ensure the correct use of the central storage facility for health-care waste, which should be kept locked but should always be accessible to authorized hospital staff;
- coordinate and monitor all waste-disposal operations;
- monitor methods of transportation of wastes both onsite and offsite, and ensure that wastes collected from the hospital are transported by an appropriate vehicle to the designated treatment and disposal site;

- ensure that waste is not stored for longer than specified in the guidelines and that the transport organization (which may be the local authority or a private contractor) collects the waste with the required frequency.
- To organize staff training and information,

The waste-management officer should be responsible for the following actions:

- Liaise with the matron (or senior nursing officer) and the hospital manager to ensure that the nursing staff and medical assistants are aware of their own responsibilities for the segregation and storage of waste, as well as for the correct closing and sealing of bags and containers. The waste-management officer also defines the duties of hospital attendants and ancillary staff on the handling and transport of sealed waste bags and containers.
- Liaise with department heads to ensure that all doctors and clinical staff are aware of their own responsibilities regarding waste segregation, and storage and closing and sealing of waste bags, to minimize infection risks, as well as the responsibilities of hospital attendants and ancillary staff regarding the handling and transport of sealed bags and containers.
- Ensure that waste handlers are properly trained in waste collection and treatment, as well as safe and sufficient disposal methods, including how to operate and maintain machines and technology. Refresher courses should be provided on a routine basis.
- Ensure compliance with occupational health measures, including current practices for post-exposure prophylaxis, as well as the provision and use of personal protective equipment for health workers and waste handlers.

To prepare for incident management and control, the waste-management officer should:

- Ensure that written and pictorial emergency and contingency procedures are available, that they are in place at all times, and that personnel are aware of the action to be taken in the event of an emergency;
- Investigate and review any reported incidents concerning the handling of health-care waste (in liaison with the infection-control department).

Parameters to be monitored by the waste-management officer

- Waste generated each month, by waste category: in each department
- treatment and disposal methods.
- Waste handled safely and in accordance to the safety operation procedures:
- occupational safety (e.g. personal protective equipment)
- use of proper and clean equipment and marking equipment
- proper segregation at source
- internal safe transport and storage
- internal safe treatment methods
- Financial aspects of health-care waste management:
- direct costs of supplies and materials used for collection, transport, storage, treatment, disposal, decontamination and cleaning
- training costs (labour and material)
- costs of operation and maintenance of onsite treatment facilities
- costs for contractor services.
- Public health aspects:
- Incidents resulting in injury, “near misses” or failures in the handling, segregation, storage, transport or disposal system should be reported to the infection-control officer and the waste-

management officer. This information should be used to decide the preventive measures to avoid recurrences.

Department heads

Department heads are responsible for the segregation, storage and disposal of waste generated in their departments. **They should**:

- ensure that all doctors, nurses, and clinical and non-clinical professional staff in their departments are aware of the segregation, sealing and storage procedures, and that all personnel comply with the highest standards;
- liaise regularly with the waste-management officer to monitor working practices for failures or mistakes;
- ensure that key staff members in their departments are trained in waste segregation and disposal procedures;
- encourage medical and nursing staff to be vigilant so as to ensure that hospital attendants and ancillary staff follow correct procedures at all times.

Matron

- The matron (or senior nursing officer) and the hospital manager are responsible for training nursing staff, medical assistants, hospital attendants and ancillary staff in the correct procedures for segregation, sealing, storage, transport and disposal of waste. They should:
- liaise with the waste-management officer and the advisers (infection-control officer, chief pharmacist, lab safety officer and radiation officer) to maintain high standards of infection control;
- participate in staff induction and refresher training in the handling and treatment and disposal of health-care waste;
- liaise with department heads to ensure coordination of training activities, and decide what to do about waste-management issues specific to particular departments.

Infection-control officer

- The infection-control officer should liaise with the waste-management officer on a continual basis, and provide advice about the control of infection, and the standards of the waste treatment and disposal system. The infection-control officer's duties that relate to health-care waste include:
- identifying training requirements according to staff grade and occupation
- organizing and supervising staff training courses on the infection risks from poor waste management
- liaising with the department heads, the matron and the hospital manager to coordinate training.

Chief pharmacist

The chief pharmacist is responsible for the safe management of pharmaceutical stores and for minimizing pharmaceutical waste**. Duties include**:

- liaising with department heads, the waste-management officer, the matron and the hospital manager, and giving advice, in accordance with the national policy and guidelines, on the appropriate procedures for pharmaceutical waste treatment and disposal;
- coordinating continual monitoring of procedures for the treatment and disposal of pharmaceutical waste;
- ensuring that personnel involved in pharmaceutical waste handling, treatment and disposal receive adequate training;
- remaining up to date with the proper treatment and safe disposal of expired, damaged and unusable pharmaceuticals, pharmaceutical packaging and equipment.
- The chief pharmacist also has the special responsibility of ensuring that genotoxic products are used safely, and that genotoxic waste is managed safely.

Radiation officer and Lab. safety officer

The duties and responsibilities of the radiation officer and Lab. safety officer are the same as those of the pharmaceutical officer but relate to radioactive and Lab. waste. There may also be additional regulations regarding the storage, disposal and safeguarding of radioactive and Lab. wastes. These regulations need to be followed strictly for the safety of those handling the wastes.

Supply officer

The supply officer should liaise with the waste-management officer to ensure a continuous supply of the items required for waste management (containers of the right quality, spare parts for onsite health-care waste-treatment equipment). These items should be ordered in good time to ensure that they are always available, but accumulation of excessive stores supplies should be avoided. The supply officer should also investigate the possibility of purchasing environmentally friendly products (e.g. polyvinyl chloride–free plastic items).

Hospital engineer

- The hospital engineer is responsible for installing and maintaining waste-storage facilities and handling equipment that comply with the specifications of the national guidelines.
- The engineer is also accountable for the adequate operation and maintenance of any onsite waste-treatment equipment, and is responsible for the staff involved in waste treatment, ensuring that:
- staff receive training in the principles of waste disposal and are aware of their responsibilities under the hospital waste-management plan;
- staff operating onsite waste-treatment facilities are trained in their operation and maintenance.