CHAPTER 8

Health Hazards of Medical Waste and its Disposal

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8.1 INTRODUCTION

"Health care activities lead to the production of waste that may lead to adverse health effects. Most of this waste is not more dangerous than regular household waste. However, some types of health-care waste represent a higher risk to health. These include infectious waste (15%–25% of total health-care waste), among which are sharps waste (1%), body part waste (1%), chemical or pharmaceutical waste (3%), and radioactive and cytotoxic waste or broken thermometers (less than 1%)."

The purpose of this document is to inform the reader about different technology options for the treatment of infectious medical waste, particularly for developing countries. It describes incerneration, chemical treatment, autoclaving, microwaving, and shredding/compacting. Performance issues, environmental impact, and perspectives from several developing countries are described. In seeking effective solutions for the disposal of medical wastes in developing-world health-care settings, it is necessary to design and build a sustainable system for managing medical waste. All approaches to the management of medical waste must consider the environmental, financial, and technical feasibility of treatment and disposal technologies in the context of the following requirements: (1) Resolve the most critical factors first: Needle-stick injuries and exposure to pathogens. (2) Identify affordable and cost-effective solutions in each specific health-care situation. (3) Consider technical feasibility within the existing health and sanitation infrastructure. (4) Prioritize best environmental practices, considering local infrastructure.

8.2 FUNDAMENTAL PRINCIPLES OF A WASTE MANAGEMENT PROGRAM

The hospital project manager has the overall responsibility of ensuring that the hospital wastes are managed in compliance with national legislation and international conventions.

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8.2.1 Duties of the Hospital Project Manager

- Setting up a working group in charge of drafting the waste management plan.
- Appointing the local waste manager, who will supervise and coordinate the waste management plan on a daily basis.
- Assigning duties; drawing up job descriptions.
- Allocating financial and human resources.
- Implementing the waste disposal plan.
- Conducting audits and continuously updating and improving the waste management system.

8.2.2 Duties of the Water and Habitat Engineer

The water and habitat engineer is responsible for:

Carrying out an initial assessment of the waste situation;

- Proposing a waste management plan to the working group (including the choice of treatment/disposal methods) that is in line with any existing national waste management plan.
- Planning the construction and maintenance of waste storage and disposal facilities.
- Assessing the environmental impact of waste management (monitoring contamination, conducting hydrogeological assessments, etc.).
- Regularly analyzing risks for the personnel.
- Supervising the local waste manager.
- Training.

8.2.3 Duties of the Hospital Administrator

The hospital administrator is responsible for:

- Ensuring that stocks of consumables (bags, receptacles and containers, personal protective equipment, etc.) are permanently available.
- Examining and evaluating costs; drawing up contracts with third parties (carriers, subcontractors).
- Giving advice on purchasing policies with a view to minimize/substitute certain items (mercury-free equipment, PVC-free equipment, etc.).
- Monitoring proper implementation of protective measures.
- Supervising in the absence of the water and habitat engineer.

8.2.4 Duties of the Head Nurse

The head nurse is responsible for:

- Training care staff in waste management (paying special attention to new staff members).

- Monitoring, sorting, collection, storage and transport procedures in the various wards.
- Monitoring protective measures.
- Supervising the hospital hygiene and taking measures to control infection.

8.2.5 Duties of the Chief Pharmacist

The chief pharmacist is responsible for:

- Maintaining medicine stocks and minimizing expired stock.
- Managing waste containing mercury.
- In the absence of the pharmacist, the hospital administrator takes over these responsibilities.

8.2.6 Duties of the Head of Laboratory

The head of laboratory is responsible for:

- Maintaining the stock of chemicals and minimizing chemical wastes.
- Managing chemical wastes.

8.3 CATEGORIES OF HEALTH-CARE WASTE

8.3.1 Major Sources (Hospitals and Medical Centers)

See Tables 8.1 and 8.2.

8.3.2 Methods to Sort Waste

The simplest way to identify the different types of waste and to encourage people to sort them is to collect the various types of waste in separate containers or plastic bags that are color-coded and/or marked with a symbol. The international recommendations are given in Table 8.3.

8.3.3 Types of Waste

Waste and by-products cover a diverse range of materials, as the following list illustrates:

Infectious waste: waste contaminated with blood and other bodily fluids (e.g., from discarded diagnostic samples), cultures and stocks of infectious agents from laboratory work (e.g., waste from autopsies and infected animals from laboratories), or waste from patients in isolation wards and equipment (e.g., swabs, bandages, and disposable medical devices);

Pathological waste: human tissues, organs or fluids, body parts, and contaminated animal carcasses;

Table 8.1 Major sources of medical waster in hospitals and medical centers

Location	Sharps	Infectious and pathological waste	Chemical, pharmaceutical, and cytotoxic waste	Nonhazardous 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, nonbloody diapers, nonbloody intravenous tubing and bags
Operating theater	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	

Table 8.2 Category of waster and its description

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

Sharps: syringes, needles, disposable scalpels and blades, etc.;
Chemicals: for example, solvents used for laboratory preparations, disinfectants, and heavy metals contained in medical devices (e.g., mercury in broken thermometers) and batteries;
Pharmaceuticals: expired, unused, and contaminated drugs and vaccines;
Genotoxicwaste: highly hazardous, mutagenic, teratogenic, or carcinogenic, such as cytotoxic drugs used in cancer treatment and their metabolites;

Table 8.3 Methods to sort waste

S. No	Types of waste	Color-coding symbol	Type of container
1	Household refuse	Black	Plastic bag
2	Sharps	Yellow and 	Sharps container
3A	Waste entailing a risk of contamination	Yellow and 	Plastic bag or container
3B	Anatomical waste	Yellow and 	Plastic bag or container
3C	Infectious waste	Yellow and "highly infectious" and 	Plastic bag or container which can be autoclaved
4	Chemical and pharmaceutical waste	Brown, Marked with suitable symbol. E.g., 	Plastic bag or container

Radioactive waste: such as products contaminated by radionuclides including radioactive diagnostic material or radiotherapeutic materials; and **Nonhazardous or general waste:** waste that does not pose any particular biological, chemical, radioactive, or physical hazard.

High-income countries generate on average up to 0.5 kg of hazardous waste per bed per day; while low-income countries generate on average 0.2 kg. However, health-care waste is often not separated into hazardous or nonhazardous wastes in low-income countries making the real quantity of hazardous waste much higher.

8.3.4 Types of Hazards

Exposure to hazardous health-care waste can result in disease or injury.

The hazardous nature of health-care waste may be due to one or more of the following characteristics:

- It contains infectious agents;
- It is genotoxic;
- It contains toxic or hazardous chemicals or pharmaceuticals;
- It is radioactive;
- It contains sharps.

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 "nonhazardous" 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.

Infectious waste may contain any of a great variety of pathogenic microorganisms. Pathogens in infectious waste may enter the human body by a number of routes: through a puncture, abrasion, or cut in the skin; through the mucous membranes; by inhalation; by ingestion. The body fluids are the usual vehicles of transmission.

There is particular concern about infection with human immunodeficiency virus (HIV) and hepatitis viruses B and C, for which there is strong evidence of transmission via health-care waste. These viruses are generally transmitted through injuries from syringe needles contaminated by human blood.

The existence in health-care establishments of bacteria resistant to antibiotics and chemical disinfectants may also contribute to the hazards created by poorly managed health-care waste. It has been demonstrated, for example, that plasmids from laboratory strains contained in health-care waste were transferred to indigenous bacteria via the waste disposal system. Moreover, antibiotic-resistant *Escherichia coli* have been shown to survive in an activated sludge plant, although there does not seem to be significant transfer of this organism under normal conditions of wastewater disposal and treatment.

8.4 MINIMIZATION, RECYCLING

The reduction of waste generation must be encouraged by the following practices:

- **Reducing the amount of waste at source**
  - Choosing products that generate less waste: less wrapping material, for example.
  - Choosing suppliers who take back empty containers for refilling (cleaning products); returning gas cylinders to the supplier for refilling.

  - Preventing wastage: in the course of care, for example, or of cleaning activities.
  - Choosing equipment that can be reused such as tableware that can be washed rather than disposable tableware.
    - It is prohibited to reuse needles or syringes. The plastic part of syringes is recycled in some regions, but this practice is not recommended in ICRC contexts.
- **Purchasing policy geared to minimizing risks**
  - Purchase of PVC-free equipment (choosing PET, PE, or PP)—see Health-Care Without Harm site.1110.
  - Purchase of mercury-free equipment: mercury-free thermometers (ICRC standards), (mercury-free blood-pressure gauges).
  - If possible, purchase of new safe injection and bloodsampling systems (where the needle is withdrawn automatically).
  - Opting for the least toxic products (cleaning products, for example).
- **Product recycling**
  - Recycling of batteries, paper, glass, metals, and plastic.
  - Composting of plant waste (kitchen and garden wastes).
  - Recycling of the silver used in photographic processing.
  - Recovering energy for water heating for example.
- **Stock management**
  - Centralized purchasing.
  - Chemical and pharmaceutical stock management aiming to avoid a build-up of expired or unused items: "first-in—first out" stock management, expiry date monitoring.
  - Choice of suppliers according to how promptly they deliver small quantities and whether unused goods can be returned.
    - Health-care waste includes a large component of general waste and a smaller proportion of hazardous waste. This chapter addresses the potential hazards of exposure to hazardous (or risk) health-care waste.

8.5 MINIMUM APPROACH TO OVERALL MANAGEMENT OF HEALTH-CARE WASTE

All personnel dealing with health-care waste should be familiar with the main categories of health-care waste as set out in either national or local regulations on waste classification. As a minimum, managers responsible for health-care waste should conduct a walk-through of the facility to identify

the medical areas that produce waste, to obtain an initial estimate of the types and quantities of waste generated, and to understand how the waste is handled and disposed of. A rapid assessment, combining observations with interviews and survey questionnaires, should provide sufficient data to identify problems and begin the process of addressing them (Table 8.4).

Table 8.4 Potential infections caused by exposure to health-care wastes, causative organisms, and transmission vehicles

Type of infection	Examples of causative organisms	Transmission vehicles
Gastroenteric infections	Enterobacteria, e.g., *Salmonella*, *Shigella* spp., *Vibrio cholerae*, *Clostridium difficile*, helminths	Feces and/or vomit
Respiratory infections	*Mycobacterium tuberculosis*, measles virus, *Streptococcus pneumoniae*, severe acute respiratory syndrome (SARS)	Inhaled secretions, saliva
Ocular infection	Herpesvirus	Eye secretions
Genital infections	*Neisseria gonorrhoeae*, herpesvirus	Genital secretions
Skin infections	*Streptococcus* spp.	Pus
Anthrax	*Bacillus anthracis*	Skin secretions
Meningitis	*Neisseria meningitidis*	Cerebrospinal fluid
Acquired immunodeficiency syndrome (AIDS)	Human immunodeficiency virus (HIV)	Blood, sexual secretions, body fluids
Hemorrhagic fevers	Junin, Lassa, Ebola, and Marburg viruses	All bloody products and secretions
Septicemia	*Staphylococcus* spp.	Blood
Bacteremia	Coagulase-negative *Staphylococcus* spp. (including methicillian-resistant *S. aureus*), *Enterobacter*, *Enterococcus*, *Klebsiella,* and *Streptococcus* spp.	Nasal secretion, skin contact
Candidemia	*Candida albicans*	Blood
Viral hepatitis A	Hepatitis A virus	Feces
Viral hepatitis B and C	Hepatitis B and C viruses	Blood and body fluids
Avian influenza	H5N1 virus	Blood, feces

8.5.1 Health Impacts of Health-Care Waste

8.5.1.1 Types of Hazards

Exposure to hazardous health-care waste can result in disease or injury. The hazardous nature of health-care waste may be due to one or more of the following characteristics:

- It contains infectious agents;
- It is genotoxic;
- It contains toxic or hazardous chemicals or pharmaceuticals;
- It is radioactive;
- It contains sharps.

8.5.1.2 Persons at Risk

All individuals exposed to hazardous health-care waste are potentially at risk, including those within health-care establishments that generate hazardous waste, and those outside these sources who either handle such waste or are exposed to it as a consequence of careless management. The main groups at risk are the following: medical doctors, nurses, health-care auxiliaries, and hospital maintenance personnel; patients in health-care establishments or receiving home care; visitors to health-care establishments; workers in support services allied to health-care establishments, such as laundries, waste handling, and transportation; workers in waste disposal facilities (such as incinerators), including scavengers.

The hazards associated with scattered, small sources of health-care waste should not be overlooked; waste from these sources includes that generated by home-based health-care, such as dialysis, and that generated by illicit drug use (usually intravenous).

8.5.2 Key Facts

- Of the total amount of waste generated by health-care activities, about 85% is general, nonhazardous waste.
- The remaining 15% is considered hazardous material that may be infectious, toxic, or radioactive.
- Every year, an estimated 16 billion injections are administered worldwide, but not all of the needles and syringes are properly disposed of afterwards.
- Health-care waste contains potentially harmful microorganisms, which can infect hospital patients, health workers, and the general public.
- Health-care waste in some circumstances is incinerated, and dioxins, furans, and other toxic air pollutants may be produced as emissions.

Health-care activities protect and restore health and save lives. But what about the waste and by-products they generate? Of the total amount of waste generated by health-care activities, about 85% is general, nonhazardous waste comparable to domestic waste. The remaining 15% is considered hazardous material that may be infectious, toxic, or radioactive.

8.5.3 Health Risks

Health-care waste contains potentially harmful microorganisms which can infect hospital patients, health workers, and the general public. Other potential infectious risks may include the spread of drug-resistant microorganisms from health facilities into the environment.

Health risks associated with waste and by-products also include:

- Radiation burns;
- Sharps-inflicted injuries;
- Poisoning and pollution through the release of pharmaceutical products, in particular, antibiotics and cytotoxic drugs; and
- Poisoning and pollution through waste water; and by toxic elements or compounds such as mercury or dioxins that are released during incineration.

8.5.4 Sharps-Related

Worldwide, an estimated 16 billion injections are administered every year. Not all needles and syringes are disposed of safely, creating a risk of injury and infection and opportunities for reuse.

Injections with contaminated needles and syringes in low- and middle-income countries have reduced substantially in recent years, partly due to efforts to reduce reuse of injection devices. Despite this progress, in 2010, unsafe injections were still responsible for as many as 33,800 new HIV infections, 1.7 million hepatitis B infections, and 315,000 hepatitis C infections.

A person who experiences one needle-stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3%, respectively, of becoming infected with HBV, HCV, and HIV.

Additional hazards occur from scavenging at waste disposal sites and during the manual sorting of hazardous waste from health-care facilities. These practices are common in many regions of the world, especially in low- and middle-income countries. The waste handlers are at immediate risk of needle-stick injuries and exposure to toxic or infectious materials.

In 2015, a joint WHO/UNICEF assessment found that just over half (58%) of sampled facilities from 24 countries had adequate systems in place for the safe disposal of health-care waste.

8.5.5 Environmental Impact

Treatment and disposal of health-care waste may pose health risks indirectly through the release of pathogens and toxic pollutants into the environment.

- Landfills can contaminate drinking water if they are not properly constructed. Occupational risks exist at disposal facilities that are not well-designed, run, or maintained.
- Incineration of waste has been widely practised, but inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and of ash residue. Incinerated materials containing chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Incineration of heavy metals or materials with high-metal content (in particular lead, mercury, and cadmium) can lead to the spread of toxic metals in the environment.
- Only modern incinerators operating at 850–1100°C and fitted with special gas-cleaning equipment are able to comply with the international emission standards for dioxins and furans.
- Alternatives to incineration are now available, such as autoclaving, microwaving, steam treatment integrated with internal mixing, and chemical treatment.

8.5.6 Waste Management: Reasons for Failure

Lack of awareness about the health hazards related to health-care waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources, and the low priority given to the topic are the most common problems connected with health-care waste. Many countries either do not have appropriate regulations, or do not enforce them.

8.5.7 Treatment Alternatives for Infectious Medical Waste

1. Thermal destruction (incineration)
2. Chemical treatment
3. Stem-based treatment (autoclaving)
4. Microwave
5. Shredding (during/after treatment), compacting, and landfill

8.5.8 Collection and Storage

Waste must be collected regularly—at least once a day. It must never be allowed to accumulate where it is produced. A daily collection program and collection round must be planned. Each type of waste must be collected and stored separately.

Infectious wastes (categories 1 and 2) must never be stored in places that are open to the public.

The personnel in charge of collecting and transporting wastes must be informed to collect only those yellow bags and sharps containers which the care staff have closed. They must wear gloves.

The bags that have been collected must be replaced immediately with new bags.

- It must be closed, and access must be restricted to authorized persons only;
- It must be separate from any food store;
- It must be covered and sheltered from the sun;
- The flooring must be waterproof with good drainage;
- It must be easy to clean;
- It must be protected from rodents, birds, and other animals;
- There must be easy access for on-site and off-site means of transport;
- It must be well-aired and well-lit;
- It must be compartmented (so that the various types of waste can be sorted);
- It must be near the incinerator, if incineration is the treatment method used;
- There must be wash basins nearby;
- The entrance must be marked with a sign ("No unauthorized access," "Toxic," or "Risk of infection."

8.5.9 Transport

These means of conveyance must meet the following requirements:

- They must be easy to load and unload;
- They must not have any sharp corners or edges that might tear the bags or damage the containers;
- They must be easy to clean; (with a 5% active chlorine solution);
- They must be clearly marked.

Furthermore, off-site means of transport must meet the following requirements:

- They must be closed in order to avoid any spilling on the road;

- They must be equipped with a safe loading system (to prevent any spilling inside or outside the vehicle);
- They must be marked according to the legislation in force if the load exceeds 333 kg.

8.6 THE WAY FORWARD

The management of health-care waste requires increased attention and diligence to avoid the substantial disease burden associated with poor practice, including exposure to infectious agents and toxic substances.

Key elements in improving health-care waste management are:

- Building a comprehensive system, addressing responsibilities, resource allocation, handling, and disposal. This is a long-term process, sustained by gradual improvements;
- Raising awareness of the risks related to health-care waste, and of safe practices; and
- Selecting safe and environmentally friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating, or disposing of waste.
- Government commitment and support is needed for universal, long-term improvement, although immediate action can be taken locally.

8.6.1 WHO's Response

WHO developed the first global and comprehensive guidance document, "Safe management of wastes from health-care activities," now in its second edition. It addresses aspects such as regulatory framework, planning issues, waste minimization and recycling, handling, storage and transportation, treatment and disposal options, and training. The document is aimed at managers of hospitals and other health-care facilities, policy makers, public health professionals, and managers involved in waste management.

In collaboration with other partners, WHO also developed a series of training modules on good practices in health-care waste management covering all aspects of waste management activities from identification and classification of wastes to considerations guiding their safe disposal using both nonincineration or incineration strategies.

WHO guidance documents on health-care waste are also available including:

- a monitoring tool;
- a cost assessment tool;

- a rapid assessment tool;
- a policy paper;
- guidance to develop national plans;
- management of waste from injection activities;
- management of waste at primary health-care centers;
- management of waste from mass immunization activities; and
- management of waste in emergencies.
- In addition, WHO and UNICEF, together with partners in 2015, launched a global initiative to ensure that all health-care facilities have adequate water, sanitation, and hygiene services. This includes addressing health-care waste.

8.7 PARAMETERS TO BE MONITORED BY THE WASTE-MANAGEMENT OFFICER

(a) Waste generated each month, by waste category:
In each department treatment and disposal methods.

(b) 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
Safe disposal methods if on premises of the health-care facility.

8.7.1 Duties and Responsibilities of Various Officials

8.7.1.1 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.

The infection-control officer may also have overall responsibility for chemical disinfection, the safe management of chemical stores, and minimizing chemical waste creation.

8.7.1.2 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.

8.7.1.3 Adiation Officer

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

8.7.1.4 Supply Officer

The supply officer should liaise with the waste-management officer to ensure a continuous supply of the items required for waste management (plastic bags and containers of the right quality, spare parts for on-site 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).

8.7.1.5 Hospital Engineer

The hospital engineer is responsible for installing and maintaining waste-storage facilities and handling equipment that complies with the specifications of the national guidelines. The engineer is also accountable

for the adequate operation and maintenance of any on-site 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 on-site waste-treatment facilities are trained in their operation and maintenance.

8.8 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 (labor and material)
- Costs of operation and maintenance of on-site treatment facilities
- Costs for contractor services.

8.9 NATIONAL PLANS FOR HEALTH-CARE WASTE MANAGEMENT

8.9.1 Purpose of a National Management Plan

A national management plan will permit health-care waste management options to be optimized on a national scale. A national survey of health-care waste will provide the relevant agency with a basis for identifying actions on a district, regional, and national basis, taking into account conditions, needs, and possibilities at each level. An appropriate, safe, and cost-effective strategy will be concerned principally with treatment, recycling, transport, and disposal options.

8.9.2 Treatment Alternatives

Action plan for the development of a national program

Step 1: Establish policy commitment and responsibility for health-care waste management

Step 2: Conduct a national survey of health-care waste practices

Step 3: Develop national guidelines

Step 4: Develop a policy on regional and cooperative methods of health-care waste treatment

Step 5: Legislation: regulations and standards for health-care waste management

Step 6: Institute a national training program

Step 7: Review the national health-care waste management program after implementation

When selecting an appropriate medical waste sterilization or disposal technology, it is important to consider the following issues:

1. Types and quantities of medical waste produced.
2. Capital investment and operational costs associated with each technology.
3. Infrastructure requirements for installation and operation of each technology.
4. Medical waste volume and mass reduction issues that impact final disposal in landfill.
5. Occupational health and safety, including needle-stick prevention.
6. Training and operation requirements.
7. Monitoring requirements for noncombustion technologies to ensure treatment efficacy.
8. Country-specific regulatory requirements.
9. Environmental (air, water, soil) impacts.
10. Locally available treatment and disposal technologies.
11. Community acceptability.

8.9.3 International Recommendations for Waste Management

The United Nations Conference on the Environment and Development (UNCED) in 1992 led to the adoption of Agenda 21, which recommends a set of measures for waste management. The recommendations may be summarized as follows:

(a) Prevent and minimize waste production.
(b) Reuse or recycle the waste to the extent possible.
(c) Treat waste by safe and environmentally sound methods.
(d) Dispose of the final residues by landfall in confined and carefully designed sites.

FURTHER READING

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