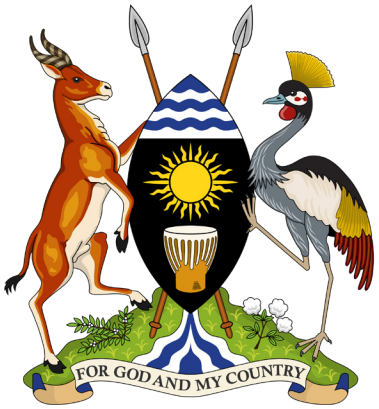


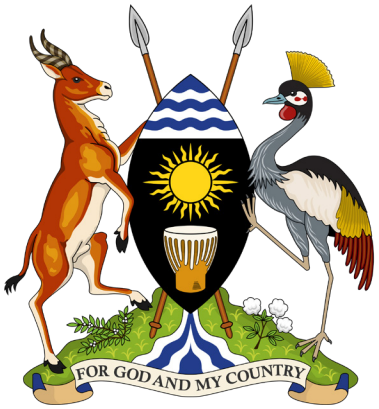
THE REPUBLIC OF UGANDA
MINISTRY OF HEALTH

APPROACHES TO HEALTH CARE WASTE MANAGEMENT

HEALTH WORKERS GUIDE
SECOND EDITION
2013

USAID
FROM THE AMERICAN PEOPLE

UGANDANS AND AMERICANS
IN PARTNERSHIP TO FIGHT HIV/AIDS



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JANUARY 2014
This publication was made possible through the support of the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) through the U.S. Agency for International Development under contract number GHH-I-00-07-00059-00, AIDS Support and Technical Assistance Resources (AIDSTAR-One) Project, Sector I, Task Order 1.

CONTENTS

ACRONYMS

AIDSTAR-One	AIDS Support & Technical Assistance Resources, Sector 1, Task Order 1
DHMT	District Health Management Team
DNA	deoxyribonucleic acid
GLSL	Green Label Services Ltd.
HBV	hepatitis B virus
HC	health centre
HCV	hepatitis C virus
HCW	health care waste
HCWM	health care waste management
HF	health facility
HIV	human immunodeficiency virus
HLD	high-level disinfection
JSI	John Snow, Inc.
MMIS	Making Medical Injections Safer (project)
MOES	Ministry of Education and Sports
MOH	Ministry of Health
NDA	National Drug Authority
NEMA	National Environment Management Authority
PEP	post-exposure prophylaxis
PPE	personal protective equipment
PVC	polyvinyl chlorinated plastic
QIT:	Quality Improvement Teams
SMC	safe male circumcision
SSI	small-scale incinerator
WHO	World Health Organization

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PREFACE

The purpose of these guidelines is to ensure safe and healthy working conditions for health workers and the general public in health facilities. The guidelines will ensure, insofar as practicable, that no workers will suffer diminished health, functional capacity, or life expectancy as a result of their work experience.

This document presents guidelines for reducing the incidence of injury and disease arising from the improper management of health care waste (HCW) among health workers at health facilities and the population at large.

Every effort was made to address all major health hazards that might be encountered in hospitals and other health facilities. The document is intended for use to improve quality of health service provision through improved health care waste management (HCWM).

SECTION 1: Introduction

1.1 Overview of Health Care Facilities Hazards and Infections

Safe management of health care waste (HCW) is a key factor in controlling and reducing nosocomial (hospital acquired) It also promotes protection of the surrounding environment. Health care waste management (HCWM) should be part of the overall health facility management system and reflects the quality of the services provided.

Health services inevitably generate waste that may be hazardous to health as well as to the environment. Some waste, such as sharps and pathological waste, carries a higher potential for infection and injury than other types of waste. Immediate segregation and appropriate disposal of sharps waste should therefore be considered a priority.

Uganda has inadequate HCWM systems in relation to other resource-poor countries both worldwide and specifically within the sub-Saharan African region. A study to identify strategies for improving HCWM, which was conducted in 2003, showed that on average, a hospital generates 0.1kg of waste/bed/day (excluding pathological waste); a health centre (HC) IV generates 1.5kg of waste /day; a HC III generates 0.6kg of waste/day; and a HC II generates 0.5 kg of waste /day [1]. However, there is no robust system in place to manage this waste. Poor segregation practices were reported to be highly prevalent and open sharps containers were being used for collection of used needles and syringes. More recent data collected in districts in eastern Uganda show that on average, a district generates 1,000kg of hazardous waste per month [2].

National surveys on injection and waste management practices conducted in 2003 and 2013 found that health facilities lacked proper trolleys for on-site transportation of waste. The surveys revealed that 44% and 21% of injection providers interviewed had experienced needle-stick injuries in the year prior to the survey in 2003 and 2013, respectively. Incinerators were found in only 2% of the health units. In another assessment to identify the status of the De Montfort incinerators, only 44% were found to be functional.

In 2004, a baseline assessment was done by the Making Medical Injections Safer (MMIS) project, implemented by JSI and funded by the Centers for Disease Control and USAID, in phase two expansion districts. Findings showed that 55% of the health facilities were not segregating waste and 25% had sharps waste littering the facilities. During the same assessment, it was found that none of the programs in the curative sector were procuring safety boxes for sharps' waste disposal. This situation is of concern and continues to occur in districts without HCWM programs. It is largely attributed to a lack of awareness on appropriate HCWM practices among health managers and lack of knowledge and skills to manage HCW among health workers.

According to a Ministry of Health report [3], the country has a total of 152 hospitals, 191 HC IVs, 1,279 HC IIIs, and 3,603 HCIIs. Over 55% of these facilities are publicly-run, 28% are privately run for profit, and 17% are privately run and not for profit. In addition, there are many pharmaceutical retail outlets owned by the government, private owners, and nongovernmental organizations. These service delivery areas generate hazardous waste that may be contributing to some of the infectious and communicable diseases in Uganda. Setting up safe HCWM practices in a country with such a diverse health care provision system requires an integrated approach.

The recommendations contained in this document should be applied in all health facilities in the country. In situations where all recommendations cannot be immediately applied due to financial or institutional constraints, a minimum HCWM package (See Annex 8.5) to ensure basic practices should be implemented.

Projects like MMIS and AIDSTAR-One clearly demonstrated that with proper planning, targeted interventions can greatly improve HCWM practices. The two projects trained health workers and provided waste segregation supplies including bins, bin liners, and safety boxes in targeted districts. The prevalence of needle-stick injuries reduced from 45% in 2003, to 24% in 2012 and 16% in 2013 [4].

1.2 Overview of Health Care Waste Management Programs

Health care waste is both a managerial and technical issue, and its management should become an integral feature of health care services. It is essential that:

- All levels of health service delivery develop and implement realistic HCWM plans.
- Clear individual and group responsibilities for implementing and monitoring HCWM plans are established at each level.
- Awareness and training programmes for medical and auxiliary staff be strengthened in health facilities.
- Specific administrative procedures for ensuring compliance with national and institutional requirements are defined and clearly communicated to all stakeholders (internal and external).
- Adequate resources are allocated at all levels to ensure proper HCWM.
- Appropriate, environmentally-friendly, and affordable technologies are selected for the treatment and disposal of HCW, taking into consideration the resources of each individual health facility.

A national-level hazardous waste policy statement exists. However, specific details that deal with hazardous waste management in general, and HCW in particular, continue to be poorly understood at the service delivery level. The rapid expansion of health-related infrastructure and technology, with the resultant increase in amounts of generated hazardous waste, are major challenges in developing a HCWM strategic plan and implementation guidelines.

Some health facilities (HFs) have already established safety and HCWM committees. Some of these committees have contributed to HCWM by identifying safety and health problems and educating health workers.

1.3 Goal

The goal of these guidelines is to prevent and control possible health risks and hazards due to improper management of HCW in order to create a safe environment for community and health workers.

1.4 Objectives

The objectives of these guidelines are:

- To provide current knowledge on the fundamentals of HCWM and improve understanding of the hazards linked to HCW
- To provide a framework for developing HCWM standards
- To provide a framework for developing HCWM plans
- To direct priority setting of actions in order to tackle the most sensitive problems related to HCWM
- To provide options for appropriate and sustainable technologies to treat and dispose of HCW (low-cost HCWM options are attached)
- To facilitate the analysis of HCWM problems and develop strategies for the safe management of HCW at all levels.

1.5 Target Audience

These guidelines are intended for use by:

- All health workers in both public and private facilities
- Facility in-charges and administrators
- Heads of all hospital departments
- District Health Management Teams
- Regional Quality Improvement Teams (QIT)

- Health training institution instructors
- Waste-handling service providers and their staff
- The general public as need arises
- National policymakers
- International organisations and/or their local implementing organisations.

SECTION 2: Definitions

The definitions and classifications used hereafter are adapted from the international classification provided by WHO.

2.1 Health Care Waste

Health care waste includes all waste, hazardous or not, generated during medical activities. It includes activities of diagnosis as well as preventive, curative, palliative care, and research in the field of human medicine.

2.2 Non-hazardous (Domestic) Health Care Waste

Non-hazardous HCW comprises all waste that has not been infected or contaminated by blood or bodily fluids. It is similar to normal household or municipal waste and can be managed by the municipal waste services. It represents the biggest proportion of the HCW generated by a medical institution. It includes: paper, cardboard, non-contaminated plastic or metal, cans or glass, and leftover food items. All items that have been used for medical care but are visually not contaminated with blood or bodily fluids can also be included in this category of waste. This category excludes domestic waste from an isolation ward.

2.3 Hazardous Health Care Waste

2.3.1 Sharps

Sharps are all objects and materials with puncture or cutting properties such as hypodermic and intravenous needles, syringes with attached needles, scalpels, pipettes, blades, and broken glass—all of which pose a potential risk of injury and infection. For this reason, sharps are considered one of the most hazardous categories of HCW generated during procedures.

2.3.2 Infectious Waste

Infectious waste is comprised of all biomedical and HCW known or clinically assessed by a medical practitioner to have the potential of transmitting infectious agents to humans or animals. Waste of this kind is typically contaminated with blood or bodily fluid, and is generated in health facility service delivery areas like outpatient departments, injection rooms, patient and delivery bedsides, outreach posts, in homes, and sometimes by the road. Infectious agents of concern include: bacteria, viruses, fungi, and parasites.

2.3.3 Highly Infectious Waste

Highly infectious waste includes all waste with viable biological and pathological agents. It also includes agents artificially cultivated in significantly elevated numbers. Cultures and stocks, dishes and devices used to transfer, inoculate, and mix cultures of infectious agents belong to this category of waste. They are generated mainly in diagnostic medical laboratories.

This category of waste can also be generated from the isolation wards of hospitals, pathology departments, operating theatres, laboratories, and other centres caring for patients with infectious pathogens such as hepatitis, Ebola, and Marburg viruses, cholera, and multidrug-resistant TB. Examples include highly contaminated materials with blood or other bodily fluids like free-flowing blood, blood components, and other body fluids. Other examples are dressings, bandages, swabs, gloves, masks, gowns, drapes, and waste that have been in contact with the blood of patients undergoing haemodialysis.

2.3.4 Pathological Waste

Pathological waste is a subcategory of highly infectious waste, but dealt with separately because of the special methods of handling, treatment, and disposal that it needs. This waste includes body organs (including placentas and human foetuses) and tissues, as well as blood and bodily fluids, and its management requires following the precautionary principle stipulated by WHO (i.e. everyone carries an infectious agent until proven otherwise).

2.3.5 Anatomical Waste

Anatomical waste can be considered as a subcategory of pathological waste. Anatomical waste consists of recognizable body parts. It is primarily for ethical reasons that special requirement must be placed on the management of human body parts.

2.3.6 Pharmaceutical Waste

Pharmaceutical waste includes a multitude of active ingredients and types of preparations. This category of waste is comprised of expired pharmaceuticals or pharmaceuticals that are unusable for other reasons such as 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 with care. 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.

2.3.7 Pharmaceutical Waste, Including 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 foetus), or carcinogenic (cancer-causing) properties. The disposal of genotoxic waste raises serious safety concerns, both inside hospitals and after disposal, and should be given special attention. Genotoxic waste may include certain cytostatic drugs in the form of vomit, urine, or faeces from patients treated with cytostatic drugs, chemicals, and radioactive material.

Technically, genotoxic means toxic to the deoxyribonucleic acid (DNA); cytotoxic means toxic to the cell; cytostatic means suppressing the growth and multiplication of the cell; antineoplastic means inhibiting the development of abnormal tissue growth; and chemotherapeutic means the use of chemicals for treatment, including cancer therapy.

Cytotoxic (chemotherapeutic or antineoplastic) drugs; the principal five substances in this category are: alkylating agents, metabolites, antibiotics, plant alkaloids, and others. These substances have the ability to kill or stop the growth of certain living cells and are used in chemotherapy of cancer. They play an important role in the therapy of various neoplastic conditions, but are also finding wider application as immunosuppressive agents in organ transplantation and in treating various diseases with an immunological basis. Cytotoxic drugs are most often used in specialized departments, such as oncology and radiotherapy units, whose main role is cancer treatment. Their use in other hospital departments, and outside the hospital in clinics and elsewhere, is also increasing. The potential health risks for people who handle cytotoxic pharmaceuticals results from the mutagenic, carcinogenic, and teratogenic properties of these substances.

2.3.8 Radioactive Waste

Radioactive waste includes liquids, gases, and solids contaminated with radio nuclides whose ionizing radiations have genotoxic effects. The ionizing radiations of interest in medicine include X-ray and radiotherapy. An important difference between these types of radiations is that X-ray emissions occur when the generating equipment is switched on, unlike in radiotherapy where the emissions occur as long as the patient is on therapy.

2.3.9 Special Hazardous Waste (waste with high heavy metal content)

Special hazardous waste includes gaseous, liquid and solid chemicals, waste with a high content of heavy metals such as batteries, pressurized containers, non-functional thermometers, blood-pressure gauges, photographic fixing, and developing solutions in X-ray departments, halogenated, or non-halogenated solvents. This category of waste is not exclusive to the health sector and it can have toxic, corrosive, flammable, reactive, explosive, shock-sensitive, and genotoxic properties.

Waste with a high heavy metal content should normally be treated by specific recovering industries. Alternatively, it may be encapsulated. Waste with high contents of mercury or cadmium can never be incinerated because of the risk of atmospheric pollution with toxic vapours.

2.3.10 Effluents

Effluents and more particularly, effluents from isolation wards and medical diagnostic laboratories, should be considered as hazardous liquid waste that should receive specific treatment (as outlined in Table 3) before being discharged into the sewerage/drainage system.

2.3.11 Chemical Waste

Chemical waste consists of discarded solid, liquid, and gaseous chemicals; for example from diagnostic, experimental work, 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 (easily catches fire)
- Reactive (explosive, water reactive, and shock sensitive)
- Oxidizing.

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.

SECTION 3: Public Health Importance, Risks, and Management of Health Care Waste

3.1 Public Health Importance

Presently, HCW is generated in large volumes and diverse types that require specific recommended practices of handling and disposal. Hazardous waste must be properly collected, packaged, stored, transported, and disposed in order to protect the handlers and the environment. Waste is considered hazardous due to the presence of any of the following: infectious agents, a genotoxic or cytotoxic chemical composition, toxic or hazardous chemicals or biologically aggressive pharmaceuticals, presence of radioactivity, or the presence of used sharps.

All individuals exposed to hazardous HCW are at a risk of being injured or infected. Some of these individuals include:

- **Medical staff and management personnel:** doctors, nurses, and other para-medical staff and hospital maintenance personnel
- **In-and out-patient individuals** receiving treatment in HFs, as well as their visitors
- **Workers in support services** linked to HFs such as laundries, waste handling, and transportation services
- **Workers transporting waste** to a treatment or disposal facility
- **Persons accessing waste disposal** facilities including human scavengers
- **The general public, and more specifically, children** who play with the items that they find in the waste that are inappropriately disposed of outside the HFs.

3.2 Risks of Health Care Waste

3.2.1 Occupational Risks

Infections

Infectious waste should always be assumed to potentially contain a variety of pathogenic microorganisms. This is because the presence of pathogens cannot be determined at the time a waste item is produced and discarded into a container. Pathogens in infectious waste may enter the human body through several routes, including:

- Through a puncture, abrasion, or cut in the skin
- Through mucous membranes
- By inhalation
- By ingestion.

During handling of waste, medical and ancillary staff as well as sanitary labourers can be injured if HCW has not been managed properly. Sharps are considered one of the most dangerous categories of waste. Many injuries occur because syringes and needles or other sharps have not been collected in safety boxes or because safety boxes have been overfilled. Maintenance workers may also be exposed to pathogens and hazardous HCW that may be found in drainage systems and chemical stores of the health facility environment. At dumpsites, human scavengers may come in contact with infectious waste during their reusing or recycling activities if the waste has not been properly treated or disposed of.

Examples of infections that can be acquired from infectious waste

There is particular concern about infection with human immunodeficiency virus (HIV) and hepatitis B (HBV) and C (HCV), for which there is strong evidence of transmission from injury by syringe needles contaminated by human blood. Although theoretically any needle-stick injury can lead to the transmission of blood borne infections, there is some evidence that hollow needles are associated with a higher risk of transmission than solid

needles, such as suture needles. Sharps represent a double risk. They may not only cause physical injury but also infect these wounds if they are contaminated with pathogens. The principal concern is that infection may be transmitted by subcutaneous introduction of the causative agent (e.g., viral blood infections).

The existence in health facilities of bacteria resistant to antibiotics and chemical disinfectants may also contribute to the hazards created by poorly managed HCW. It has been demonstrated that plasmids from laboratory strains contained in HCW 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.

Survival of pathogenic microorganisms in the environment

The hepatitis B virus can survive for up to one week under optimal conditions and has been detected in discarded needles. It is also resistant to brief exposure to boiling water and remains viable for up to 10 hours at a temperature of 60°C. It can survive exposure to some antiseptics and to 70% ethanol.

HIV is less resistant. It survives for no more than 15 minutes when exposed to 70% ethanol and only three to seven days at ambient temperature. It is inactivated at 56°C. Bacteria are less resistant than viruses. Prions, virus-like agents of degenerative neurological diseases such as Creutzfeldt–Jakob disease and kuru, bind strongly to soil and are very resistant.

Chemicals and pharmaceuticals

Many of the chemicals and pharmaceuticals used in health care can potentially be hazardous. They are commonly present in small quantities in HCW, whereas larger quantities may be found when unwanted or outdated chemicals and pharmaceuticals are sent for disposal. Chemical wastes may cause intoxication, either by acute or chronic exposure, or physical injuries—the most common being chemical burns. Intoxication can result from absorption of a chemical or pharmaceutical through the skin or the mucous membranes, or from inhalation or ingestion. Injuries to the skin, the eyes, the mucous membranes, or the airways can occur by contact with flammable, corrosive, or reactive chemicals (e.g. formaldehyde and other volatile substances).

Laboratory staff are regularly exposed to increasing doses of chemicals during the course of their work. Maintenance workers get exposed to hazardous HCW that may be found in drainage systems and chemical stores of the health facility environment. The hazardous properties most relevant to waste from health care are as follows:

- **Toxic.** Most chemicals are toxic at some level of exposure. Fumes, dusts, and vapours from toxic materials can be especially harmful because they can be inhaled and pass quickly from the lungs into the blood, permitting rapid circulation throughout the body.
- **Corrosive.** Strong acids and alkali bases can corrode completely through other substances, including clothing. If splashed on the skin or eyes, they can cause serious chemical burns and permanent injury. Some of these also break down into poisonous gases, which further increase their hazard.
- **Explosive.** Some materials can explode when exposed to heat or flame, notably flammable liquids when ignited in confined spaces, and the uncontrolled release of compressed gases.
- **Flammable.** Compounds with this property catch fire easily, burn rapidly, spread quickly, and give off intense heat. Many materials used and stored in medical areas, laboratories, and maintenance workshops are flammable, including solvents, fuels, and lubricants.
- **Chemically reactive.** These materials should be used with extreme caution and stored in special containers. Some can burn when exposed to air or water, some when mixed with other substances. It is important to note that reactive materials do not have to be near heat or flames to burn. They may burn spontaneously in the presence of air and also give off vapours that may be harmful if inhaled.

Common Chemical Waste Types

Table 1: Dangers Associated with Common Chemicals

Chemical waste	Danger
Mercury	Mercury is highly toxic, especially in elemental form or as methyl mercury. It may be fatal if inhaled and harmful if absorbed through the skin. Around 80% of the inhaled mercury vapour is absorbed into the blood through the lungs. The nervous, digestive, respiratory, and immune systems, can be harmed, as well as the kidneys and lungs. Adverse health effects from mercury exposure can be tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during foetal development, and attention deficit and developmental delays during childhood.
Silver	Silver is another toxic heavy metal, being used in ever more applications, including as a bactericide and in nanotechnology. Silver, in large doses, can turn a person's skin permanently grey.
Disinfectant	Disinfectants, such as chlorine and quaternary ammonium, are used in large quantities in health facilities, and are corrosive. Poisoning can occur through direct contact with a pesticide formulation, inhalation of vapours, drinking contaminated water, or eating contaminated food.
Pesticides	All pesticides, stored in leaking drums or torn bags, can directly or indirectly affect the health of anyone who comes into contact with them. During heavy rains, leaking pesticides can seep into the ground and contaminate ground waters. Poisoning can occur through direct contact with a pesticide formulation, inhalation of vapours, drinking contaminated water, or eating contaminated food. Other hazards may include the possibility of spontaneous combustion if improperly stored, and contamination as a result of inadequate disposal, such as open burning or indiscriminate burying.
Radioactive agents	Radioactive waste in sufficiently high dose may affect genetic material. Handling highly active sources, such as those used in diagnostic instruments (e.g. gallium sealed sources) may cause much more severe injuries, including tissue destruction, necessitating the amputation of body parts. Moreover, extreme cases can be fatal.

3.2.2 Hazards Associated with Health Care Waste Treatment Methods

In addition to the specific hazards posed by different types of health care waste, there are occupational hazards associated with waste-treatment processes:

- Flue gases from waste incinerators may have an impact on people living or working close to a treatment site. The health risk is most serious where an incinerator is improperly operated or poorly maintained. If poorly controlled, emissions from waste incinerators may cause health concern from particulates (associated with increased cardiovascular and respiratory mortality and morbidity); volatile metals, such as mercury and cadmium (associated with damage to the immune system, neurological system, lungs, and kidneys); and dioxins, furans, and polycyclic aromatic hydrocarbons (which are known carcinogens but may also cause other serious health effects).
- Ash from the incineration of hazardous health care waste may continue to pose a risk. Furthermore, incinerator ash may contain elevated concentrations of heavy metals and other toxic items, and the ash provides ideal conditions for the synthesis of dioxins and furans, because it is often exposed for a long time to a

temperature range of 200–450°C. Also, burnt needles and glass may have been disinfected but can still cause physical injury.

- Autoclave and steam disinfection treatment methods can also pose potential hazards that need to be managed. In particular, good maintenance and operation should be undertaken to avoid physical injuries from high operating temperatures and steam generation. Post-waste treatment water contains organic and inorganic contaminants. The concentrations should be monitored to ensure that discharges to sewerage systems are within regulated limits.
- Health care waste treatment using mechanical equipment, such as shredding devices and waste compactors, can cause physical injury when improperly operated or inadequately maintained.
- Burial of HCW in landfill sites may pose hazards to workers and the public. The risks are often difficult to quantify, and the most likely injury comes from direct physical contact with waste items. Chemical contaminants or pathogens in landfill leachate may be released into surface streams or groundwater. At poorly controlled land-disposal sites, the presence of fires and subsurface burning waste poses the further hazard of airborne smoke. The smoke may contain heavy metals and other chemical contaminants that over time may affect the health of site workers and the general public.

Social-cultural considerations

The general public is sensitive about the visual impact of anatomical waste, particularly recognizable human body parts, including foetuses. There are no normal circumstances where it is acceptable to dispose of anatomical waste inappropriately, such as dumping in a landfill. Most cultural and religious beliefs in Uganda require human body parts to be returned to a patient's family and/or buried in cemeteries.

3.2.3 Risks to the Population

The reuse of syringes is a serious problem in many developing countries. WHO estimates that globally, 21 million infections of HBV, 2 million HCV infections, and 260,000 HIV infections occur yearly from the reuse of discarded syringes and needles [5]. These bloodborne pathogens also contribute to illness among health workers—an estimated 4.4% of HIV infections and 39% of HBV and HCV infections are attributed to occupational injury [6]. Among susceptible health workers who do not receive post-exposure prophylaxis (PEP), the risk of infection after needle-stick injury is 23-62% for HBV and 0-7% for HCV.

The general public is exposed to HCW through dumping waste in open areas. This may have adverse effects to the population either directly through needle-stick injuries or indirectly through environment pollution by release of poisonous and dangerous gases and emissions.

3.3 Health Care Waste Management

Health care waste management is an integral part of hygiene and infection control within HFs, and proper management is essential for the prevention and control of nosocomial infections. Unfortunately, the principles of HCWM are not known to all health workers. Moreover, managerial and financial constraints do not favour setting up of a proper management system to improve current practices of HCW in health facilities.

Health care waste management is not only a prerequisite for national and local regulations, but health facilities should also carefully consider the development of infectious waste management plans to minimize the overall risks of HCW within the facility. The plans should provide for:

1. Description of the waste that should be managed as hazardous or non-hazardous HCW
2. Supplies for segregation of infectious waste from the non-infectious waste
3. Materials and guidelines for packaging of infectious waste to reduce contacts, exposure, and for proper transportation
4. Facilities for storage of HCW

5. Treatment of infectious waste to avoid contaminations
6. Disposal of infectious waste to eliminate risks
7. Measures for emergency situations
8. Staff training on HCWM.

Implementing adequate procedures to minimize the overall risks associated with HCWM remains the major objective of these national guidelines. Waste management and treatment options should aim at primarily protecting the health workers and the general population, and minimizing indirect impacts from environmental exposure to HCW.

The instructions contained in these guidelines for the handling and disposal of sharps, and more specifically, used syringes, are intended to minimize the risks of cuts or needle-stick injuries that may occur during or following injection administration.

Some treatment options—such as low-cost incinerators that emit pollutants—may be used in certain situations (e.g., low-density populated areas) where the overall health benefits from preventing infections are likely to outweigh the risks from exposure to toxic pollutants in the air. Nevertheless, environmentally-friendly practices such as recycling plastics are recommended where practical.

SECTION 4: Principles of Health Care Waste Management

The implementation of safe HCWM guidelines aims to contain infections and reduce public health risks both within and outside the HF. To this effect, the key HCWM principles outlined in Box 1 should be considered.

Box 1: Principles of Health Care Waste Management

- Minimizing waste at purchasing and point-of-service delivery stage
- Segregation of hazardous from non-hazardous HCW
- Adequate packaging, handling, and safe storage of all waste categories
- Safe, appropriate transportation
- Proper treatment of hazardous waste
- Appropriate final disposal.

4.1 Minimization

Waste minimization refers to reduction of 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 managers can also take measures to reduce the production of waste through adapting their purchasing and stock control strategies. Practices found to minimize quantities of waste include:

- Planning of purchase that will lead to reduced volumes of health care waste (e.g., using rapid tests instead of more-involved tests).
- Products with long shelf life and biodegradable packaging materials will be preferred and emphasis should be placed on good storage practices. Avoid the push of bulk materials from donations. This helps to avoid expiries and helps using cheaper methods of waste disposal.
- Proper planning for clinical procedures should be encouraged. For example, all blood draws (for haematology, biochemistry, parasitology, and/or immunology tests) can be done in the same sitting with one pair of gloves and one injection device but multiple specimen containers.

4.2 Segregation of Health Care Waste

Proper segregation must follow standardized procedures to reduce the risks of infecting health workers, clients, and the community. It should also enable use of the most efficient treatment procedures for each waste stream. Segregation must be:

1. Simply designed for implementation by health workers at all levels
2. Able to guarantee the absence of infectious HCW in the domestic waste flow
3. Applied in all HFs
4. Regularly monitored to ensure compliance.

The following guidelines apply to health care waste segregation:

1. Segregation of HCW should consist of separating the different waste streams based on the type of treatment and cost benefits of the method of disposal.

2. Segregation shall take place at the source or site of generation (hospital wards, operation theatre, medical diagnostic laboratories, or any other room or ward in the health facility where the waste is generated).

3. Segregation of HCW requires colour-coded waste bins specifically designated for each category of waste. The colour coding system aims at ensuring immediate identification and segregation of the hazards associated with the type of HCW that is handled or treated. In this respect, the colour-coding system shall remain simple and be applied uniformly throughout the country. In the absence of colour-coded bins, however, labelling can be used as an alternative.

The nine categories of HCW should be segregated and colour-coded, as shown in Table 2.

Table 2: Segregation According to Colour Codes

	Segregation Category	Colour	Container
1	Non-hazardous waste (Household waste)	Black	Biohazard bag or bin with liner
2	Infectious clinical waste	Yellow	Biohazard bag or bin with liner
3	Sharp waste	Yellow	Safety box
4	Radioactive waste	Yellow	Secure container with radioactive symbol
5	Anatomical waste and placenta	Red	Biohazard bag or bin with liner
6	Highly infectious waste	Red	Biohazard bag or bin with liner
7	Wastes with high content of heavy metals	Red	Secure container
8	Effluents	Red	Flask or container
9	Hazardous pharmaceutical and cytotoxic waste	Brown	Biohazard bag or bin with liner

Table 3: Health Care Waste Management Symbols

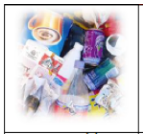
Symbol	Category
	Biohazard
	Radioactive Symbol (old)
	Radiation Symbol (new)

Special Considerations During Segregation

4.2.1 Handling of Safe Male Circumcision Waste Streams

Figure 1 illustrates the procedures to be followed when handling waste generated during safe male circumcision (SMC) procedures.

Figure 1: Handling and Treatment of Safe Male Circumcision Waste

Treatment of SMC Waste Streams					
General Waste	**Sharp Instruments**	**Blunt Instruments**	**Highly Infectious Waste**	**Highly Infectious (Pathological Waste)**	**Pharmaceuticals**
					
Does not need special treatment. Seal the bag when ¾ full.	Seal the sharps box when ¾ full.	Disinfection	Double bag when ¾ full	At static facility dispose of tissue in a placenta pit immediately after completing daily surgery (pour out from bin liner). Dispose of the used bin liner with infectious waste.	Seal and store in a secure temporary storage area.
Store in a secure temporary storage area.	Store in a secure temporary storage area.	Followed by autoclaving. Manage as metal scrap.	Store in a secure temporary storage area.	If at an outreach (non-static); double bag and place in a tightly closing rigid red container. Dispose of in a placenta pit at the nearest static health facility.	Hand over to licensed HCW handling service provider.

4.2.2 Health Care Waste for Recycling and Reusing

Recycling and reuse procedures may complicate the overall segregation scheme by increasing the segregation criteria and multiplying the number of waste streams in the HF. Recycling is totally different from reuse. In recycling, the recyclable material is used as raw material to produce new but similar goods. However, in case of reuse, the material is reused as it is after being subjected to cleaning and disinfection without changing its nature. However, to implement an environmentally- friendly process of HCW disposal, a simple and safe recycling practice should be implemented whenever possible. In recycling and/or reusing materials, the instructions hereafter should be followed.

Recycling of Non-Contaminated Plastic Items

The following guidelines should be included in recycling of non-contaminated plastic items:

All non-contaminated plastic items (e.g. plastic bottles, containers from clinical IV fluids, drug containers, and domestic waste like mineral water bottles, etc.) should be collected and packed in separate boxes. They should be delivered to or picked up by local collectors capable of recycling them with environmentally-friendly techniques.

Laboratory glassware

The following guidelines should be applied for glassware reuse in diagnostic laboratories. Broken glassware shall always follow the stream of sharp waste (class 3) (see Annex 1), while non-broken glass flasks shall be reused only after being disinfected with an appropriate disinfectant solution and carefully washed with a brush and soap, and rinsed.

During the disinfection process, hands shall always be protected with heavy duty gloves. It is further recommended to autoclave the glassware after washing it at a temperature of 1210°C for at least 30 minutes to ensure complete sterility (121 at 15lb per square inch for 15 minutes with a thermal shock test and control).

Used pharmaceutical vials

1. All non-contaminated and non-broken pharmaceutical glassware (vials of injectable penicillin for instance) should be stored separately.

2. They should be put in a disinfectant solution (sodium hypochlorite) for not less than 30 minutes, carefully washed, rinsed, and dried before being reused. Important to note is that the concentration of hypochlorite for decontaminating glass bottles is 5-10% depending on the level of contamination. Five percent is for light contamination, while 10% is for heavy contamination. This is because organic matter inactivates hypochlorite.

3. The disinfected glassware should be reused only for stool specimens.

4. After having been reused once, they shall be considered as contaminated and infectious.

5. Use of personal protective equipment (PPE) while reusing glassware inside the diagnostic laboratories is required. Refer to Annex 8.6 on PPE for HCWM with specifications.

Reuse of non-specific equipment

The following guidelines are for reuse of non-specific equipment:

1. In general, to encourage appropriate reuse, each HF shall collect separately, wash, and sterilize (either thermally or chemically in accordance with approved procedures), surgical equipment and other items designed for reuse. Such reusable items must be resistant to the sterilization or disinfection process, as stipulated in the harmonized Infection Prevention and Control Guidelines [7]. However, not all metallic surgical instruments are reusable; single-use surgical instruments are now widely available, especially for SMC procedures.

2. Pressurized materials such as cylinders shall be returned to suppliers for refilling and reuse.

4.3 Health Care Waste Packaging

Infectious waste should be contained from the point of origin to the point of treatment where it is rendered non-infectious. The packaging should be appropriate for the type of waste involved.

1. **Sharps** (sharp items, or items with sharp corners): Place sharps in impervious rigid, puncture-resistant containers made of glass, metal, rigid plastic, or leak-proof cardboard.

2. **Liquid infectious waste** should be placed in capped or tightly stoppered bottles or flasks and large quantities may be placed in containment tanks.

3. **Solid or semi-solid waste** should be placed in durable, tear-resistant plastic bags.

The following recommendations should be observed:

- Do not load bags beyond their weight or volume capacity
- Keep bags away from contact with sharp objects
- Consider double bagging to ensure tear-resistance.

There should be special packaging characteristics for some treatment techniques:

- Incineration requires combustible containers and steam sterilization requires packaging.
- Materials such as low-density plastics that allow steam penetration and evacuation of air. (See Annex 8.8 on plastic types, symbols, and examples).

4.4 Waste Storage

The following guidelines should be included in waste storage:

1. In each unit where HCW is generated, an adequate place shall be dedicated for storing HCW bags, bins, or containers. This space should be locked and inaccessible to the general public.

2. In all HFs, separate central storage facilities shall be provided for hazardous HCW, except radioactive waste that shall be stored separately. It shall clearly be mentioned that the facility stores hazardous HCW. Health care facilities below level three should store no materials other than yellow bag (infectious) waste.

3. Highly infectious waste and anatomical waste (except heavy metals and effluent waste) should be disposed of immediately (no later than end of shift). No waste shall be stored for more than two days before being treated or disposed of. Properly-treated waste can be stored for a maximum of one week. In cases of outbreaks, additional guidelines for highly infectious waste should be adhered to.

4. The designated central storage facility shall be located within the HF premises close to the treatment unit but away from food storage or food preparation areas.

5. The designated central storage facility should be large enough to contain all the hazardous HCW produced by the hospital during one week, with spare capacity to cope with any maintenance or breakdown of the treatment unit.

6. The designated central storage facility shall be totally enclosed and secured from unauthorized access.

7. The designated central storage facility shall be inaccessible to animals, insects, and birds.

8. The designated central storage facility shall be easy to clean and disinfect and shall have an impermeable hard-standing floor / base, good water supply, drainage and ventilation. The following procedures are recommended:

    - All highly infectious waste (red bags) from isolation wards should be disposed of immediately. Infectious waste should be stored for a minimum of two days if not treated and one week if treated. The waste should be packaged securely enough to ensure containment of the waste and to prevent penetration by rodents and vermin.
    - Limited access to the storage area is recommended.
    - The universal biological hazard symbol should be posted on the storage area door and waste containers. Containers for biohazardous material should be a distinctive red colour.

9. In cases of camp situations where huge numbers of the community need to be served over a limited number of days, usually at temporarily settings such as schools, open fields, market places, and churches, lockable colour-coded waste bins with matching liners should be made available for temporary storage of waste as it accumulates.

Special Storage Considerations for Selected Categories of Waste

Storage of infectious waste

The storage place must be identified as an infectious waste area by using the biohazard sign (Table 3). 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 contained in closed, leak-proof, puncture-proof containers can be stored without special treatment, but other infectious waste should be kept cool or refrigerated at a temperature preferably no higher than 3°C to 8°C as an alternative to waste treatment if stored for more than a week. Unless a refrigerated storage room is available, storage times for infectious waste (i.e., the time gap between generation and treatment/disposal) should not exceed 48 hours during the cool season and 24 hours during the hot season.

Storage of pathological waste

Pathological waste and the growth of pathogens it may contain are considered 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 waste.

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.

Storage of pharmaceutical waste

Pharmaceutical waste should be segregated from other wastes and local regulations should be followed for final disposal. In general, pharmaceutical wastes can be hazardous or non-hazardous, and liquid or solid, and each should be handled differently. The classification should be carried out by a pharmacist or other pharmaceutical expert (Annex 8.2).

The pharmaceutical waste streams that are listed below can be distinguished (WHO, 1999):

Examples of 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), and 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.

Storage of chemical waste

When planning for storage places of 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 and secured 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.

Storage of 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 labelling should be removed on any items to be disposed of (once minimum storage time is complete and the waste is safe for disposal).

4.5 Waste Handling

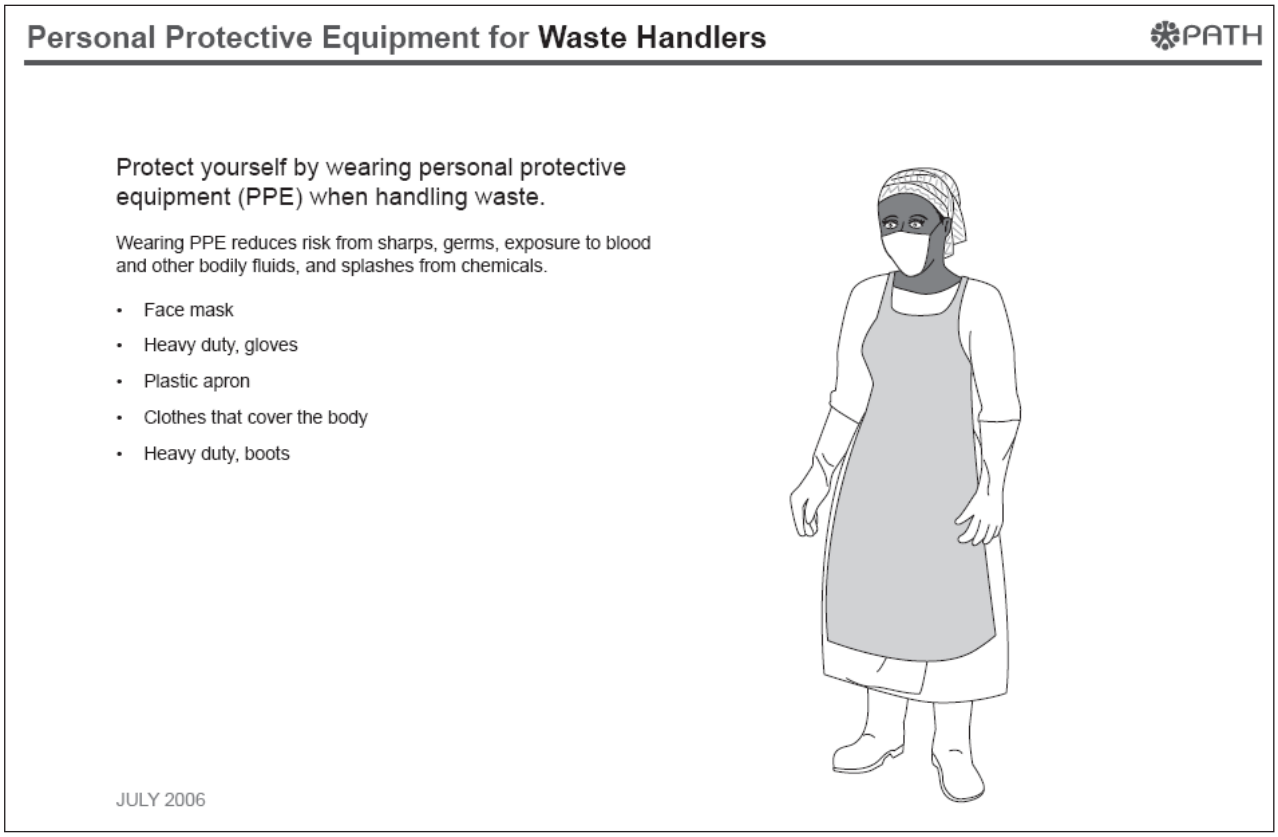
The following guidelines should be included in waste handling:

1. All HCW or disposal of medical equipment shall be disposed of at point of use by the person who used the item. If the used equipment is found improperly disposed of, or handed over to another person for disposal, the health facility personnel who finds it or is given the responsibility of disposal, becomes responsible.

2. All the specific procedures of HCW segregation, packaging, and labelling shall be explained to all health workers and displayed in each department in chart form and job aids should be provided on the walls above the HCW segregation containers.

3. Waste handlers shall wear PPE and clothing including face masks, aprons and boots, heavy duty gloves, and goggles as required when handling waste.

Figure 2. Personal Protective Equipment for Waste Handlers



Source: PATH (2006)

4. Carts and recyclable containers that are used repeatedly for transport should be disinfected after each use. Single-use containers should be destroyed as part of the treatment process.

4.6 Waste Collection and Transportation

4.6.1 Collection within the Facility

Separate routes should be planned and used for collecting hazardous and non-hazardous waste. 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 to 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 (i.e. infectious waste) must be collected at least daily. A routing plan may 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.

4.6.2 Collection to Central Storage within a Facility

1. The waste collection trolley should be easy to load and unload. The trolley shall not be used for any other purpose. It shall be cleaned daily with disinfectant after use and before any maintenance work is performed on it.
2. Yellow bags of hazardous HCW and black bags of non-hazardous HCW shall be collected on separate trolleys that shall be painted and marked with the corresponding colour codes. The trolleys shall be washed daily using a disinfectant and soft brush.
3. The collection route shall be the most direct one from the collection point to the central storage area.
4. The collected waste shall not be left temporarily anywhere along the way to the storage area other than at the designated interim storage locations.
5. Containers should be covered with lids during collection.
6. Carts (wheeled covered waste within the facility).

4.6.3 Transport to Final Disposal Site

When the waste is to be transported to a final disposal site, special handling or packaging is necessary to keep bags intact and to ensure containment of the waste. The following procedures should be followed:

1. Single-bagged waste and containers of sharps and liquids should be placed within a rigid or semi-rigid container such as a bucket, box, or carton lined with plastic bags.
2. Waste containers should be covered with lids during transportation.
3. When transporting plastic bags of infectious waste, care should be taken to prevent tearing the bags.
4. Infectious waste should not be compacted before treatment. This process could damage the packaging and disperse the contents or interfere with the effectiveness of treatment.
5. Infectious waste should be transported in closed, leak-proof dumpsters or trucks when transported offsite.
6. The waste should be placed in rigid or semi-rigid, leak-proof containers before being loaded onto trucks.
7. In case offsite transportation is required to treat hazardous HCW at treatment facilities, the National Environment Management Authority (NEMA), through the local Government, shall approve the offsite transportation plan before any transportation occurs.
8. All yellow (infectious) and red (highly infectious) bags shall be collected and transported at least every second day (except for those carrying placentas and anatomical parts, which should be disposed of daily).
9. The transportation shall be properly documented, and all vehicles shall carry a consignment note from the point of collection to the treatment facility.
10. Vehicles used for the carriage of yellow or red bags shall be disinfected after each trip.
11. The vehicles shall be free of sharp edges, easy to load and unload by hand, easy to disinfect and clean, and fully enclosed to prevent any spillage in the HF premises or on the road during transportation.
12. The vehicles shall carry adequate supply of plastic bags, PPE, cleaning tools, and disinfectants to disinfect and clean in case of any spillage or accident.
13. All staff handling yellow or red bags shall properly utilize PPE.

14. Staff shall be properly trained in the handling, loading and unloading, transportation, and disposal of the yellow and red bags.

15. Staff shall be fully aware of emergency procedures for dealing with accidents and spillage (See Annex 8.7).

16. Standard operating procedures for spillage management shall be conspicuously displayed in/on the vehicle for easy reference.

Note: *Offsite transport of hazardous HCW on public streets/roads should comply with national regulations. International agreements should be observed if wastes are shipped across an international border for treatment [8]. Where there are no national regulations, responsible authorities may refer to recommendations on the transport of dangerous goods published by the United Nations.*

4.7 Waste Treatment and Disposal

The most appropriate technology for treatment and disposal of HCW shall be selected from the available current technologies that should have the following criteria:

1. Most reliable, affordable, and sustainable technology in accordance with the technical, human, and financial resources of each HF.

2. Minimizes the immediate public health risks associated with HCWM and has the

3. lowest impact on the environment.

4. Use any of the following methods for appropriate treatment of infectious waste:

    - Steam sterilization, incineration, thermal inactivation, or gas/vapour sterilization
    - Chemical disinfection and sterilization by irradiation or electromagnetic radiation.

5. Burning and incineration (low, medium, and high temperature incineration) may be considered as the most practical technology for treatment of hazardous waste. In highly densely populated areas, large quantities of hazardous HCW shall not be incinerated at temperatures lower than 8500°C (Box 2 for incinerator specifications).

6. After treatment of waste, the ashes and remains of the waste should be disposed of by burial in sanitary landfills/standard medical waste pits, while liquid waste should be discharged into sewer systems or soak pits.

7. Acceptable treatment methods for waste are listed in Table 3.

Table 3. Recommended Techniques for Treatment of Infectious Wastes

Type of infectious waste	Recommended treatment techniques		
	Steam sterilization	Incineration (above 850^{0}C)	Chemical disinfection
Isolation wastes		√	
Cultures and stocks of infectious agents	√	√	√
Human blood and blood products	√	√	√
Pathological wastes	√	√	
Contaminated sharps	√	√	
Carcasses and parts	√	√	
Bedding		√	

***Note**: Burning and low-temperature incineration methods are no longer recommended.*

For additional waste management options see Annex 8.5

Box 2: Incinerator Operational Specifications

1. Minimum operating temperature: 900°C
2. Maximum operating temperature: 1350°C
3. Have a secondary chamber with a residency time of two seconds (minimum)
4. Have temperature and thermostat control

4.7.1 Sterilization (Autoclaving)

Steam sterilization in an autoclave is one of the most common forms of sterilization. It involves the use of saturated steam within a pressure vessel at temperatures high enough to kill infectious agents in the waste. Sterilization is accomplished primarily by steam penetration. Steam sterilization is most effective with low-density material such as plastics. Contaminated items or wastes are generally sterilized for 30 minutes at 1210°C and 106 kPa pressure. The timing of the process starts when the autoclave reaches the desired temperature and pressure. Before sterilization, the items to be treated should first be decontaminated carefully.

The following are the guidelines for steam sterilization (autoclaving):

1. Autoclaves used to disinfect waste will be used for waste treatment only and should never be used for disinfecting instruments that are used for clinical procedures.
2. Waste autoclaves must be located in a room separate from autoclaves used for clinical disinfection.
3. Containers that should be used for effective steam sterilization are plastic bags, metal pans, bottles, and flasks. High-density polyethylene and polypropylene plastic should not be used in this process because they do not facilitate steam penetration to the waste load.

4. Heat-labile plastic bags allow steam penetration of the waste, but they may crumble and melt. If such bags are used, they should be placed in another heat-stable container that allows steam penetration, such as a strong paper bag. Alternatively, bags should be treated with gas/vapour sterilization.

5. The following precautions should be taken when using steam sterilization:

   a. Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging.

   b. To facilitate steam penetration, bags should be opened and caps and stoppers should be loosened immediately before they are placed in the steam sterilizer.

   c. Care should be taken to separate infectious waste from other hazardous wastes.

   d. Infectious waste that is mixed with other non-infectious hazardous waste should not be steam-sterilized because of the possibility that the equipment operator will be exposed to toxic, radioactive, or other hazardous chemicals.

   e. Waste that contains drugs, toxic chemicals, or chemicals that would be volatilized by steam should not be steam-sterilized.

   f. Persons involved in steam sterilizing should be trained in handling techniques to minimize personal exposure to hazards from infectious wastes. Some of these techniques include:

      - Use of protective equipment
      - Minimization of aerosol formation by using disinfectant chemicals instead of steam sterilization
      - Prevention of waste spillage during autoclave loading and unloading.
      - Prevention of burns from handling hot containers
      - Management of spills following SOPs (Annex 8.7).

   g. The autoclave temperature should be checked with a recording thermometer or sterilization indicator strip to ensure that the proper temperature is being maintained according to the manufacturer's recommendations.

   h. Steam sterilizers should be routinely inspected and serviced, and the process should be routinely monitored to ensure that the equipment is functioning properly.

   i. An alternative treatment method, e.g. incineration, should be used on high-density waste such as large body parts or large quantities of animal bedding or fluids because they inhibit direct steam penetration and require longer sterilization times.

4.7.2 Burning and Incineration

Burning and incineration convert combustible materials into non-combustible residue or ash. Gases are ventilated through the incinerator stacks, and the residue or ash is disposed of in a sanitary landfill, the burning waste in a shallow pit, and the residue into a medical waste pit. If incinerators are properly designed, maintained, and operated, they are effective in killing organisms present in infectious waste.

1. Incineration should be used for aesthetic disposal of pathological wastes such as tissues and body parts.

2. Incineration should be used to render contaminated sharps unusable.

3. The principal factors affecting incineration, including variations in waste composition, the waste feed rate, and the combustion temperature, should be considered to maintain efficiency of incinerating infectious wastes. Proper operating procedures must be followed.

4. Infectious waste containing drugs should be disposed of in an incinerator that provides high

5. The incinerator's effectiveness in disposing/destroying chemical waste should be documented/assessed before use, if applicable.

6. Persons involved in incineration must utilize appropriate PPE and should be trained in handling techniques to minimize personal exposure to hazards from infectious waste. Some of these techniques include:

   - Use of PPE
   - Prevention of waste spillage during incinerators loading.
   - Management of spills following SOPs (Annex 8.7).

7. **Prohibited materials.** The following materials shall not be burned or incinerated due to the toxic emissions they produce:

   a. Polyvinyl chlorinated (PVC) plastic

   b. Photographic and x-ray materials

   c. Mercury containing items such as thermometers, dental materials, or blood pressure machines

   d. Equipment with ozone depleting materials

   e. Batteries and other items containing heavy metals such as lead and cadminium

   f. Aerosol cans or sealed vials.

8. For community safety, all incinerators or burning areas must be:

   - Fenced to prevent access by the community or animals. They should be located away from houses and crops.
   - Inspected and maintained by a qualified person on a regular basis.

4.7.3 Thermal Inactivation

Thermal inactivation involves the treatment of waste with high temperatures to eliminate the presence of infectious agents. This method is usually used for large volumes of infectious waste. Liquid waste is collected in a vessel and heated by heat exchangers or a steam jacket surrounding the vessel. Solid infectious waste should be treated with dry heat in an oven, which is usually electric.

The types of pathogens in the waste determine the temperature and duration of treatment. This method requires higher temperatures and longer treatment cycles than steam sterilization.

The following guidelines should be included in thermal inactivation:

1. After treatment, the contents should be discharged into the sewer or landfills in a manner that complies with government and local requirements.

2. Persons involved in thermal inactivation should be trained in handling techniques to minimize personal exposure to hazards from infectious wastes. Some of these techniques include:

   - Use of protective equipment
   - Prevention of waste spillage during thermal inactivation loading and unloading
   - Prevention of burns from handling hot containers
   - Management of spills.

4.7.4 Gas/Vapour Sterilization

Gas/vapour sterilization uses gaseous or vaporized chemicals as the sterilizing agents. Ethylene oxide is the most commonly used agent. The following guidelines should be followed in gas/vapour sterilization:

1. Gas/vapour sterilization should be used with caution since it is a **potential human carcinogen.** Ethylene oxide may be adsorbed on the surface of treated materials and
2. when not handled safely, the health worker may be exposed to the carcinogen. Persons involved in gas/vapour sterilization should be trained in handling techniques to minimize personal exposure to hazards from infectious wastes and handling of sterilized materials. Some of these techniques include:
    - Use of PPE
    - Prevention of waste spillage during gas/vapour sterilization loading and
    - unloading
    - Prevention of burns from handling hot containers
    - Management of spills.

4.7.5 Chemical Disinfection/High-level Disinfection (HLD)

Chemical disinfection is the preferred treatment for liquid infectious wastes, but it can also be used in treating solid infectious waste.

Warning: Disinfectants are often hazardous and toxic; many are harmful to skin and mucus membranes. Users should therefore utilize PPE, including heavy duty gloves and goggles. Small amounts of disinfectants can be discharged into sewers without pre-treatment, provided there is an adequate sewage treatment process; large amounts of disinfectants should never be discharged into sewers. No disinfectants should be discharged into natural water bodies (WHO).

The guidelines below should be followed in chemical disinfection:

1. The following factors should be considered and labelled on the wastes to be treatedusing chemical disinfection:
    a. Type of microorganism
    b. Type of disinfectant to be used: the chemicals most appropriate for disinfection are chlorine and glutaraldehyde.
    c. Dilution and contact time: different disinfectants have different recommended dilutions and contact time. Even with similar products, different concentrations and contact times are recommended by different manufactures.
    d. Other relevant factors such as temperature, pH, mixing requirements, and the biology of the microorganism should also be considered when using disinfectants.
2. Ultimate disposal of chemically treated waste should be in accordance with national and local requirements. It is not only the treated waste that is of concern but the disposal of the chemicals.

Warning: Messages about chemical disinfectants should be widely disseminated to protect users and the community.

3. Persons involved in chemical disinfection should be trained in handling techniques of chemically treated waste and handling of sterilized materials to minimize personal exposure to hazards. Some of these techniques include:
    - Use of protective equipment

- Prevention of exposure to pathogenic organism
- Prevention of waste spillage during chemical disinfection loading and unloading
- Prevention of burns from handling hot containers
- Management of spills.

Accidents (emergency) and spillage

The guidelines below should be followed in case of accidents and spillage:

All health workers shall be properly trained and prepared for emergency response, including procedures for treatment of injuries, cleanup of the contaminated area, and prompt reporting of all incidents of accidents.

The following actions shall be taken:

- Evacuation of the contaminated area (if required)
- Decontamination or disinfection, rinsing and wiping dry with absorbent cloth by personnel wearing adequate PPE
- Decontamination or disinfection of the PPE/clothing (if necessary)
- Cuts with sharps or needle-stick injuries shall be immediately washed with soap and running water for disinfection.
- Accident shall be immediately reported to the infection control officer/staff.
- All cases shall be registered by the management team of the HF and reported monthly to the district health authorities.
- Blood tests following such an injury are recommended to identify staff that may be infected through the accident and need PEP.

4.8 Final Disposal

The guidelines below should be followed in ultimate disposal:

1. The recommended types of disposal options in accordance with the type of HCW are:
   a. Conventional sewer system for discharge of treated liquids and grounded solids
   b. Landfill disposal of treated solids and incinerator ash.

Note: *NEMA and MOH to issue guidelines and monitor HCWM to ensure that only treated infectious wastes are buried in landfills.*

2. Protected waste pits
   - Burial sites should be fenced off to prevent access by unauthorized persons,
   - the community, or animals.
   - Only hazardous health care waste shall be buried in the protected pits.
   - Burial method should not be used in areas with high water tables. The bottom of the pit should be at least 1.5 meters higher than the groundwater level.
3. Facilities should secure the services of reputable, licensed waste handling firms to ensure, to the possible extent, that ultimate disposal of hazardous wastes is performed according to applicable central and local government regulations.

4.9 Maintenance Workers/Waste Handlers

Maintenance workers and waste handlers should:

1. Use heavy duty gloves and other PPE while working in contaminated areas and handling contaminated materials.
2. Always wash hands thoroughly after removing work gloves.
3. Be aware that other persons may not have followed proper procedures for disposing of needles, knives, surgical blades, and glassware.

4.10 Prevention and Control of Occupational Risks

The following guidelines should be included in HCWM for central store, food, laundry, and other service and office workers:

1. Desks and countertops should be free of sharps.
2. Needles and other sharp instruments should be discarded in designated puncture-resistant containers and not in trash cans or plastic bags.
3. There should be no recapping of needles.
4. Rules for safe disposal and collection of sharp instruments or other hazardous materials should be reviewed regularly.
5. Workers should carefully examine and handle soiled linens and similar items to determine if they contain hazardous items.
6. Workers should receive periodic instruction to keep them aware of the specific hazards of HCW.
7. Workers should follow instructions issued by infection control personnel for reporting accidents and injuries.
8. Workers should take appropriate measures to limit further contamination from HCW by practicing universal precautions of self-protection from exposure to infectious waste.

4.11 Training Needs

All workers who handle infectious waste should receive HCWM training that includes:

1. An introduction to HCW (definition, situation, and impact of unsafe HCWM)
2. An explanation of HCWM giving due emphasis to key principles:
   - Minimization
   - Segregation
   - Safe handling and storage
   - Transport
   - Treatment and disposal
   - Final disposal options
3. An explanation of the facility's HCWM plan
4. The assignment of roles and responsibilities for implementation of the plan. It is important to periodically conduct refresher courses and environmental audits of institutions.

SECTION 5: Specific Guidelines for Management of Each Class of Health Care Waste

Class 1: Non-hazardous Health Care Waste

1. Non-hazardous (domestic) HCW of class 1 (Section 2.2) should be placed in black bins at the point of generation.
2. All non-hazardous (domestic) HCW that is biodegradable should be disposed of in a compost pit. In places where there are municipalities, the waste should be handed over to a licensed provider or disposed of at a municipal skip.
3. Non-biodegradable waste that cannot be recycled should be landfilled.
4. Non-hazardous items that are designated for recycling should be packed in:
   a. Green bins marked "Non-infectious plastic" for plastics
   b. Black bins marked "Non-contaminated glass materials" for glass.
5. Non-hazardous HCW for recycling should be taken for recycling by an approved service provider.
6. The bins for storage of HCW should be placed in all rooms, wards, and in all public areas where such waste is likely to be generated.

Class 2: Infectious Waste

1. All infectious waste should be placed in yellow polyethylene bags (minimum 300 microns gauge) marked "Danger! Hazardous infectious waste" and indicated with the international biohazard symbol (Table 3).
2. The bags/bin liners shall be placed in yellow bins or bag-holders.
3. Bags shall be tied or sealed with appropriate adhesive tape, removed and replaced immediately when they are no more than three-quarters full.
4. As much as possible, infectious HCW shall be incinerated in double chamber incinerators, but where appropriate, chemical treatment and autoclaving can be used as alternative methods for treating infectious waste.
5. In densely populated areas, a centralized pyrolytic incinerator, reaching 8500°C and above is preferable.
6. Yellow bins for infectious waste should be located in all wards and rooms where infectious waste could be produced. Infectious waste containers should **never** be placed in public areas.
7. Infectious waste generated outside health facilities; for example, during SMC outreaches at schools and churches, should be handled appropriately. Put sharps in a safety box and double-bag and seal other infectious waste to ensure safety during transport to a nearby recommended disposal facility.

Class 3: Sharps

1. All sharps should be placed in puncture-resistant and leak-proof cardboard or plastic safety boxes, designed so that items can be dropped in using one hand and no items can be removed.
2. The safety box should be yellow, marked "Danger!" or "Contaminated sharps."
3. Yellow is the conventionally accepted colour and it is advisable to adhere to this convention.

4. The safety box shall be closed and sealed for disposal when it is three-quarters full.
5. In particular, all disposable syringes and needles shall be discarded in the safety box immediately following injection/use.
6. The needle shall never be recapped or removed from the syringe; the whole combination shall be inserted into the safety box.
7. In very rare situations where there is need to re-cap, single hand recapping may be authorised by a senior supervisor; for example, in laboratories when intact needles on syringes are being used to transport blood samples. Two-handed recapping is an unacceptable practice under any circumstance.
8. Under no circumstances are used syringes, needles, or safety boxes to be disposed of in normal garbage or dumped randomly without prior treatment.
9. Sharps are destroyed together with infectious waste. The method of choice for destruction of full safety boxes is incineration, preferably in an appropriate double-chamber (>900°C) incinerator.
10. Safety boxes must be located in all rooms and wards where injections and other sharps may be used.

Class 4: Anatomical Waste, Including Placentas

1. In operating theatres, all anatomical waste, including placentas, should be collected separately and placed in red polyethylene bags of minimum 300 microns gauge, marked "Danger! Hazardous! Highly infectious waste" and indicated with the international biohazard symbol (Table 3).
2. The bags shall be placed in red bins or bag-holders.
3. In Uganda, the cultural preference is to have anatomical waste buried. In such situations, anatomical waste and placentas should be buried at a sufficient depth (>1m) inside the HF compound, preferably placed in a placenta pit.
4. However, when a centralized incinerator is available and culturally acceptable, the anatomical waste can be incinerated. Nevertheless, when low-cost incinerators are used, only small quantities of anatomical waste or placentas should be incinerated at any time. This is because large quantities can be difficult to incinerate and drastically reduce the performance of the system.
5. Where licensed service providers are available, anatomical waste may be handed over for appropriate offsite disposal.
6. If transportation and disposal cannot be immediately ensured, anatomical waste should be stored in the mortuary. Red bins for highly infectious waste should be located in all theatres and rooms where anatomical waste, including placentas, could be produced. Highly infectious waste containers should never be placed in public areas.

Class 5: Hazardous Pharmaceutical and Cytotoxic Waste

1. Hazardous pharmaceutical waste and cytotoxic waste should be sorted according to specific categories: cytotoxic drugs, narcotics; ignitable, corrosive, and/or reactive materials, as well as the waste's nature of formulation (see Annexes 8.2 and 8.3).
2. Brown bins for pharmaceutical waste should be located in all wards and rooms where pharmaceutical and cytotoxic waste could be produced.
3. All expired pharmaceutical and cytotoxic products should be removed from shelves, labelled, and stored in a secure room or segregated area.
4. The products should be boarded off by the Board of Survey following the Public Procurement and

Disposal of Public Assets Act 2003 (a form should be filled in and signed by all members present as evidence).

5. All sorted expired pharmaceutical and cytotoxic waste should be repacked in specific boxes such as cardboard boxes labelled "Danger! Hazardous pharmaceutical or cytotoxic waste."

6. Clearly-labelled pharmaceutical waste from public facilities should be sent to the district medicines store that shall ensure their disposal at the central level. Non-public facilities should make prior arrangements with the National Drug Authority (NDA) to have waste disposed of.
(Contact your regional NDA office for further details on assistance with the disposal of small quantities of expired pharmaceuticals).

7. Stores charged with the responsibility of storage of pharmaceutical and cytotoxic waste should follow the guidelines for storage *(*see Section 4.4: Waste Storage*).*

8. Transportation: Unlike other types of health care waste, transportation of pharmaceutical waste for final disposal should be done in the presence of NDA representatives. If the waste has narcotics, police should be notified.

9. All pharmaceutical and cytotoxic wastes should be disposed of according to recommended best practices (see Annex 8.4).

10. Special precautions should be taken to ensure that expired and/or unusable pharmaceuticals do not pilferage (leak) back to the public.

Class 6: Highly Infectious Waste

1. All highly infectious waste from HFs should be placed in red polyethylene bags of minimum 300 microns gauge marked "Danger! Hazardous highly infectious waste!" and marked with the international biohazard symbol (see Table 3).

2. Highly infectious waste (such as cholera waste) from isolation wards or permanent treatment centres should always be incinerated on-site.

3. Highly infectious waste from the medical diagnostic laboratory of the HF, such as media and culture plates, should be collected in leak-proof red polyethylene waste bags *(*300 microns thick*)* suitable for autoclaving and properly sealed.

4. Media and culture plates should be autoclaved at a temperature of 121°C at one bars for at least 20 minutes at the source (e.g., in the medical diagnostic laboratory).

5. Disinfected waste should be collected and treated with infectious HCW.

6. If a separate autoclave for waste treatment is not available at the medical diagnostic laboratory to ensure a thermal treatment, highly infectious waste should be disinfected in 10% solution of sodium hypochlorite in concentrated form and left overnight.

7. It should then be discarded in a red polyethylene bag, properly sealed and discarded with other infectious HCW.

8. If none of the above steps can be taken, highly infectious waste should at a minimum be sealed in a red polyethylene bag and directly disposed of with infectious HCW.

Class 7: Radioactive Waste

1. All radioactive waste should be stored to allow decay or decomposition to diminish its radioactive nature. Such waste has a minimum storage time of 10 half-life times for radioisotopes in wastes with a half-life of less than 90 days.

2. Radioactive waste should be placed in a large container or drum and labelled with the radiation symbol showing the radionuclide's activity on a given date, the period of storage required, and marked "Caution! Radioactive waste!" Containers or tanks with radioactive waste that has not decayed to background level should be stored in a specific marked area, with concrete walls at least 25 centimeters thick.

3. Non-infectious radioactive waste which has decayed to background level should follow the non-hazardous HCWM procedure (Class 1), while infectious radioactive waste which has decayed to background level should follow the infectious HCW procedure (Class 2).

4. Liquid radioactive waste should be discharged into the sewerage system or into a septic tank only after it has been kept in adequate tanks and allowed to decay to background level.

Class 8: Waste with High Contents of Heavy Metals

1. Waste with high contents of heavy metals should normally be treated in specific recovering industries.

2. Alternatively, the waste should be encapsulated for handling and disposal. Encapsulation is a process where containers are filled three-quarters full with hazardous waste. Then material such as cement mortar, clay, bituminous sand, or plastic foam is used to fill the container. When capping material is dry, the container is buried or landfilled.

3. Wastes with high contents of mercury or cadmium should never be incinerated because of the risk of atmospheric pollution with toxic vapours.

Class 9: Effluents

Improper management, collection, treatment, and disposal of wastewater (effluent) and sludge will result in the pollution of local water sources with pathogens. This can cause numerous water- and vector-borne diseases (e.g., malaria and filariasis) by providing breeding places for the vectors, and favours the spread of parasites (e.g., roundworms or Ascaris lumbricoides). Wastewater discharged in an uncontrolled manner into the environment can lead to several waterborne diseases that are a threat to human life, such as cholera, typhoid fever, campylobacteriosis, hepatitis A and E, and schistosomiasis.

By disposing of untreated wastewater in the environment, nutrients are biologically degraded in groundwater, lakes, and rivers by using oxygen present in fresh water (eutrophication). If the oxygen demand of the wastewater is too high, hypoxia (oxygen depletion) of a watercourse will result in significant environmental degradation though sucking oxygen along the path over which the water is flowing and in the process destroying lives of organisms and plants along the way. Additionally, the nutrients can increase algal production and algal blooms that will favour potentially hazardous bacteria (e.g. cyanobacteria) and might result in hazardous toxins forming that can cause illnesses, such as from exposure to cyanotoxins. Nitrate in the groundwater from untreated wastewater can result in methaemoglobinaemia, particularly in babies.

1. All infectious effluents should be discharged into the sewerage system or soak pits only after being treated according to WHO standards [9].

2. Wastewater from HFs should not be released into the environment without treatment because it may contain various potentially hazardous components such as microbiological pathogens, hazardous chemicals, pharmaceutical waste, and radioactive isotopes.

3. Although proper treatment of wastewater from HFs is very expensive and cannot be currently foreseen in every HF in Uganda, steps 1 and 2 should be applied in order to contribute to the reduction of public health risk associated with liquid waste and wastewater.

SECTION 6: Guidelines for the Development and Implementation of a Health Care Waste Management Plan

Planning for HCWM at national, regional, or local levels should take into consideration the WHO core principles for achieving safe and sustainable management of HCW. The WHO core principles require that all personnel associated with financing and supporting health care activities should provide for the costs of managing HCW. This is the duty of care. Manufacturers also share a responsibility to take waste management into account in the development and sale of their products and services.

The core principles provide guidance on a clear delineation of responsibilities and funding that takes place chiefly at the planning stage.

6.1 Guidelines for National Level Waste Management Planning

Planning at the national level should cover six objectives (WHO, Basel Convention & UNEP, 2005, Stockholm Convention):

1. Develop or consider the legal and regulatory framework for HCWM
2. Rationalize the waste management practices within HFs
3. Develop specific financial investment and operational resources dedicated to waste management
4. Launch capacity building and training measures
5. Set up a monitoring plan
6. Reduce the pollution associated with waste management.

As HCWM is an evolving field, the planning process should allow for periodic updates to policies as improvements in processes and technology advances. The MOH should develop and implement a comprehensive HCWM strategic plan in line with the above objectives.

A national management plan should be based on an assessment of the HCWM options available and then reach consensus on the related actions to be implemented across the country. A national survey of existing health care practices and technologies in use should precede a planning exercise. It provides the data to allow realistic plans to be produced that inform government decision making on the development of new treatment facilities, the regulations and guidance required, and the level of funds necessary to implement a national plan.

6.2 Guidelines for Facility Waste Management Planning and Implementation

Each HCW-generating facility should develop a comprehensive waste management plan as part of the comprehensive HF plan. The HF waste management plan should be guided by the National HCWM Strategic Plan and HCWM Guidelines.

The HCWM plan should:

1. Spell out duties and responsibilities for each management level and different categories of HF staff members. The roles and responsibilities should be accompanied by SOPs.
2. Contain an estimation of the quantities of HCW generated and the annual budgets for the implementation of the HCWM procedures/plan
3. Contain monitoring procedure to track day-to-day activities of the HF and ensure that HCWM rules are adhered to by all staff

4. Contain information on procedures, location of bins, and storage at strategic points
5. Contain budgets for training of all categories of HF staff, including newly recruited health workers
6. Contain budgets for emergency storage and disposal of hazardous HCW in the event of a breakdown of the incinerators or autoclave, and in cases of emergencies as in epidemic outbreaks/epidemics.

6.3 Guidelines for Assigning Duties and Responsibilities

Proper HCWM planning shall involve clarifying the responsibilities of various stakeholders and identifying competencies of each actor involved in HCWM process.

6.3.1 National Level

a. The MOH Directorate of Clinical Services shall take the lead in coordinating implementation of the HCWM plan.

b. The Departments of Clinical Services and Community Health should ensure that DHOs prepare and implement a proper HCWM plan.

c. The Departments of Clinical Services and Community Health should support the DHOs in the definition and implementation of the final HCWM plans by providing technical advice.

d. The MOH (Departments of Clinical Services, Community Health and Human Resource Division), in consultation with the Ministry of Education and Sports (MOES), should set up periodic training program reviews in all training institutions to ensure that adequate training on HCWM is given.

e. New knowledge, skills, and attitudes requirements will be formally communicated to MOES for incorporation into pre-service training curriculum.

f. The Departments of Clinical Services and Community Health (Environmental Health Division) should be responsible for providing supportive supervision on HCWM activities at all levels; and in collaboration with NEMA at local landfills to ensure that treatment and disposal facilities are compliant with guidelines and regulations on HCWM.

g. The MOH and NEMA should coordinate the planning and implementation, and control the means of the collection, transportation, treatment, and final disposal of the waste.

h. The Environmental Health and Health Education Divisions of MOH shall take the lead

i. The Division of Environmental Health and the Office of the Registrars will enforce compliance with national regulations.

j. NEMA shall watch over adherence and observation of environmental norms and procedures, particularly as they are contained in the Environmental Impact Assessment (EIA) guidelines for hazardous waste and health care waste.

k. NEMA shall develop norms and standards for soil, water, and air pollution, mainly as they relate to the use of waste pits, incinerators, and landfill sites for HCW disposal.

l. Norms and standards for landfills should promote safe disposal of HCW.

6.3.2 Local Governments and Urban Authorities

Local Governments and Urban Authorities Should:

a. Construct their landfills according to the norms and standards defined by MOH and NEMA, in order to avoid soil, water, and air pollution as a result of inappropriate HCW disposal

b. Ensure that safe disposal of HCW in designated areas is carried out

c. Enact by-laws that compel waste handling firms to not accept HCW that is mixed with infectious wastes for disposal at local landfills; forbid uncontrolled HCW disposal; and set up strong waste management control systems for managing landfills such as restricting access to areas by unauthorized personnel/public. The by-laws should be enacted in accordance to relevant laws including Local Government Act 1997, NEMA 1994, and KCCA 2010.

The District Health Offices

The DHOs should:

a. Put in place arrangements to make sure that infectious health care waste/hazardous waste is

b. not mixed with general waste destined for public landfills

c. Participate in the formulation for HCWM plan activities proposed for health facilities in their areas of jurisdiction

d. Ensure that coordination, monitoring, and reporting on implementation of the HCWM plan is exercised by the HCWM Committee

e. Support facilities to implement their HCWM plan

f. Set up periodic training programs in all health facilities to ensure that adequate training on HCWM is given to all staff

g. Coordinate and monitor all disposal operations, and for this purpose meet regularly with the concerned representative of the local council.

6.3.3 Health Facility Level

At each facility there should be a designated individual for HCWM, and this officer should be incorporated into existing QIT where applicable. In absence of such teams, a working group responsible for implementation of the HCWM plan should be established.

1. The Officer In-Charge of the health facility should:

a. Be responsible for HCWM plan in his/her HF

b. Ensure that a HCWM plan is prepared and then monitor to ensure that procedures and regulations are adhered to

c. Establish a QIT/working group charged with supervising HCW minimization, segregation, storage, collection, transportation, treatment, and disposal

d. Assign duties and responsibilities to all medical and non-medical staff

e. Allocate sufficient financial and manpower resources for the implementation of the HCWM plan

f. Ensure adequate training and refresher courses for the concerned health facility staff members

g. Coordinate and monitor all disposal operations, and for this purpose meet regularly with the concerned representative of the local council.

2. The QIT and/or HCWM working group or focal persons (depending on the level of operation) should:

a. Identify safety and health risks of HCWM and educate the workforce about safety and health issues

b. Advocate and lobby for support and commitment of the HF administration to have a strong and effec-

tive HCWM system

c. Represent workers and supervisors from all departments in the HF on issues of HCWM.

The composition of the HCWM working group:

The HCWM committee comprises the following members:

i. Officer In-Charge or Deputy, who shall be the chairperson

ii. The Head of Administration

iii. The Nursing Officer In-Charge

iv. The Ward/Unit In-Charges

v. The Infection Control Focal Person

vi. The Pathologist

vii. The Microbiologist

viii. The HCWM Officer/Expert

ix. The Head of Operation and Maintenance

x. The Head of Pharmacy

xi. The Head of Cleaning Contractor/Waste Handler.

Functions of HCWM committee:

The major functions of the committee should include the following:

i. Inspecting workplaces regularly to identify safety and health hazards.

ii. Regularly reviewing exposures (such as needle injury rates), results from prevention activities, and other relevant workplace data.

iii. Preparing information for workers on identified hazards.

iv. Organizing educational classes.

v. Reviewing safety and health aspects when planning new construction or renovating facilities.

vi. Establishing motivational programs (e.g. recognition, awards, and dinners) to motivate health worker participation in HCWM activities.

3. The Environmental Health Officer/focal person shall:

a. Be responsible for the daily implementation and monitoring of the HCWM plan.

b. Ensure internal collection of bags and waste containers and their transport to the central storage area of the HF on a daily basis.

c. Liaise with the medical and supply units to ensure that an adequate supply of waste bags, containers, and protective clothing and collection trolleys are available at all levels.

d. Ensure that cleaners immediately replace used bags/containers with a new bag/container of the same type, and that soiled and contaminated containers are properly decontaminated and cleaned before a new bag is fitted in.

e. Ensure that cleaners do not sort waste and that they only handle waste bags and containers, in the recommended way.

f. Ensure correct use of the central storage facility, where applicable, and that it is kept secured from unauthorised access. S/he should also prevent unsupervised resting of waste bags and waste containers on the facility premises, even for short periods of time

g. Ensure that the correct methods of transportation and disposal of waste are used.

h. Ensure that emergency procedures exist and are taken when necessary. S/he shall investigate records and review all incidents reported regarding HCWM.

i. Ensure that job aids, posters, and charts on proper waste management are available and displayed.

4. The Heads of Administration shall:

a. Ensure that all the logistics and human resources needs are adequately provided to implement the HCWM plan.

b. Ensure a proper budget for implementation of the HCWM plan.

c. Liaise with the Officer In-Charge and the HCWM Officer/focal person to estimate the specific costs to ensure adequate budgeting for HCWM. He/she shall request for the funds for waste storage, treatment and disposal facilities, and services.

5. The Nursing Officer In-Charge shall:

a. Liaise with the Officer In-Charge and HCWM working group.

b. Be responsible for the application of HCWM procedures by the nursing and the cleaning staff.

c. Be responsible for the recording and the reporting of all cuts or puncture wounds associated with sharps and manipulations, such as needle stick injuries of medical and non-medical staff members.

d. Ensure that the staff members know the immediate disinfection measures to be taken during spillage emergencies.

6. The Ward/Units In-Charges shall:

a. Be responsible for the proper management of the HCW generated in their respective units.

b. Ensure that all the medical and ancillary staff working in their unit adhere to the HCWM procedures.

c. Ensure that the HCWM procedures are clearly displayed at strategic locations.

d. Liaise with the HCWM officer/expert for effective monitoring and reporting of incidents and gaps in the implementation of the HCWM plan.

e. Ensure that health workers segregate waste at the point of generation. Ensure proper segregation bins and safety boxes are available at all injection sites.

7. The Head of Maintenance and Head of Waste Handlers shall:

a. Liaise with the head administration and HCWM or Environmental Health Officer/focal person.

b. Be responsible for the application of HCWM procedures by the maintenance (HCWM) staff.

c. Be responsible for recording and reporting of all cuts or puncture wounds associated with sharps and needle stick injuries of maintenance staff.

d. Ensure that the maintenance staff members know the immediate reporting procedures of all exposures, cuts, or puncture wounds associated with sharps and needle-stick injuries.

e. Ensure that the maintenance staff members know the immediate corrective maintenance measures to be taken during spillage emergencies and waste from drainage systems.

f. Be responsible for the installation, maintenance, and safe operation of waste storage facilities, as well as the waste handling and treatment equipment.

g. Ensure that the concerned HF maintenance staff members are properly trained for these purposes.

8. The Pharmacist/Pharmacy Technician shall:

a. Routinely order for adequate quantities of HCWM commodities and other pharmaceuticals; when in excess, redistribute to avoid expiries.

b. Ensure that all logistics and pharmaceutical commodities are stored properly to minimize wastage due to mishandling.

c. Ensure that proper records for logistics and pharmaceutical commodities aremaintained.

d. Ensure the application of first-in first-out dispensing of pharmaceutical commodities. Liaise with the Officer In-Charge and the HCWM Officer/focal person to handle expired pharmaceutical commodities, and to ensure proper handling and disposal methods of pharmaceutical waste.

6.4 Guidelines for Allocation of Resources and Equipment for Health Care Waste Handling

6.4.1 Guidelines for Waste Audits and Needs Assessment

a. A waste management baseline audit and needs assessment should be conducted before developing a waste management plan of the HF.

b. The following information on HCW audit should be collected and assessed in accordance with the guidelines:

i. Types, volume and/or weight, quantities, and composition of waste generated

ii. Incidence and severity of waste handling injuries

iii. Incidence and nature of spills and leakages of hazardous waste

iv. Sources of solid and liquid waste

v. Points of generation, collection, and storage sites

vi. Types and number of waste containers

vii. Loading, transport, and disposal methods

viii. Transportation and disposal records

ix. Costs of waste handling, transport, treatment, and final disposal.

c. The annual requirement for number of safety boxes, yellow, black, brown, and red bags/liners as well as bag-holders/bins, containers, collection trolleys, and protective wear for HCW handling shall be estimated.

d. A contingency margin of stock worth two months shall always be applied for safety boxes, yellow, black, brown, and red bags/liners.

e. The quantities of disinfectants, necessary spare parts for HCW treatment and disposal shall be estimated.

f. The number of staff members required for HCW collection and disposal shall be estimated.

6.4.2 Guidelines for Allocation of Resources and Provision of Equipment

a. Equipment and materials (safety box, bags/liners, disinfectant, PPE) should be supplied regularly and they should not be out of stock at any time.

b. Health facility heads should promote material recovery for recycling under supervision. The facility staff should be motivated to segregate such waste by providing them with special bags/liners or containers for collection.

c. Sufficient annual running costs shall be dedicated in the budget for safe management of the HCW.

6.5 Guidelines for Awareness and Training

Training and awareness efforts with regards to HCWM shall be made at all levels:

1. To raise awareness amongst the public about HCW risks and safe practices.
2. To make sure that medical staff refresher training is given on HCWM.
3. To make sure that new staff members are inducted in HCWM practices of the HF.
4. To ensure that waste management is included in the curricula of health workers in the national training package.
5. To ensure that waste management operators (transporters, treatment plant, and landfill operators) get appropriate training and support.
6. For public education on risks, waste segregation, and waste disposal practices by using the following methods:

    a. Displaying posters at strategic points in HF. Such as waste bin locations and giving instructions on waste segregation. Posters should be explicit, using diagrams and illustrations to convey the message to as broad an audience as possible, including illiterate populations.

    b. Conveying simple messages outside HF through schools, radio, or television programmes and notices in public places, raising awareness about the risks involved in scavenging discarded HCW such as syringes and hypodermic needles.

    c. Applying an attractive manner for all information displayed or communicated to give it maximum effectiveness in holding people's attention.

6.6 Guidelines for Monitoring System and Reporting Procedures for Health Care Waste Management at All Levels

1. A monitoring system shall be set up to track hazardous HCW and sharps along the waste stream up to final disposal.
2. Monitoring should include incident and accident reporting and recording.
3. Monitoring data shall be analysed and reviewed at regular intervals and compared with the country regulatory limits so that any necessary corrective actions can be taken.
4. Records of monitoring results should be kept in an acceptable and easily retrievable format.
5. Periodic survey shall be performed in waste generating, storage and transportation, treatment and dis-

posal facilities.

6. All responsible bodies should submit annual HCWM performance monitoring reports to their respective regulatory and supervisory bodies.

7. The annual reports shall contain quantitative data on the performance of the facility illustrating compliance with national guidelines and regulations.

6.7 Guidelines for Private Sector Involvement

1. All contracts with private contractors for collection, on-site or offsite transportation, treatment or disposal of HCW shall be approved by the necessary authorities (national, district/urban authorities; environment).

2. A private contractor shall be licensed for each of the following services: HCWM transportation, storage, treatment, and disposal by NEMA.

3. Additional operation approval will be sought from local governments and urban authorities.

4. The necessary authority and private contractors shall sign a contract agreement that clearly spells out duties and responsibilities of each party (scope of work, among others).

5. All workers of the private enterprise dealing with HCW shall be trained in HCWM, immunized against HBV; and supplied with adequate protective wear and equipment.

7.0: Bibliography

1. Ministry of Health (MOH) [Uganda], *National assessment of injections practices (unpublished data).* 2003.
2. GLSL, *Health care waste management data base (2013) for Green Label Services Ltd.* 2013.
3. Ministry of Health (MOH) [Uganda], *Health facility Inventory.* 2012.
4. Victoria Masembe, et al., *Follow up Assessment of Health Care Waste Management Practices in Three Districts.* 2013, *Arlington, VA: USAID's AIDS Support and Technical Assistance Resources, AIDSTAR-One, Task Order One.*
5. Prüss-Üstün A, Rapiti E, and Hutin Y., *Sharps injuries: global burden of disease from sharpsinjuries to health-care workers., in WHO Environmental Burden of Disease Series, No. 3* 2003, Geneva, World Health Organization: Geneva.
6. Prüss-Üstün A, Rapiti E, and Hutin Y, *Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers.* American Journal of Industrial Medicine, 2005. 48(6): p. 482-490.
7. Ministry of Health (MOH) [Uganda], *Harmonized infection prevention and Control Guidelines* 2012, Ministry of Health: Kampala.
8. Basel Convention, *The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.* 1992, Switzerland: Basel.
9. A. Prüss, E. Giroult, and P. Rushbrook, *Safe management of wastes from healthcare Activities.* 1999, WHO: Geneva.
10. Board of Public Works HTM Office, City of Los Angeles. *Fact Sheet: Medical Waste Management*, November 1995.
11. California Polytechnic State University. *Medical Waste Management Plan, Risk Management*. June, 1996.
12. D.M. Cardo, K.H. Culver, C. Ciesielski, P.U. Srivastava, R. Marcus, D. Abiteboul et al., *A case-control study of HIV seroconversion in health-care workers after percutaneous exposure*. N Engl J Med 337 (1997), pp. 1485–1490.
13. Fikru Tesfaye. *Assessment of injection safety at health facilities in four pilot Weredas of Oromia Region and SNNPR.* A report submitted to JSI – Injection Safety Project. August 2004, Addis Ababa (unpublished).
14. Garner JS, Favero MS (1985). *Guideline for hand washing and hospital environmental control*, Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Infectious Diseases, Hospital Infections Program.
15. Hauri A, Armstrong G, Hutin Y. The Global burden of diseases from contaminated injections given in health care settings. Presentation October 2001.
16. Ministry of Health (MOH) [Uganda], Infrastructure department. *A study on improvement of health care waste management in Uganda*, Carl bro. 2003 (unpublished).
17. John Snow, Inc. (JSI). Making Medical Injections Safer. *Assessment of Health Care Waste Management Status in Health Facilities of Uganda*. July 2005 (unpublished).
18. John Snow, Inc. (JSI). Making Medical Injections Safer Project. *Assessment of injection practices in Uganda: baseline assessment in phase two expansion districts* (unpublished).
19. John Snow, Inc. (JSI). Making Medical Injections Safer Project. *Assessment of injection practices in Uganda: Follow up assessment at mid-term in phase two expansion districts* (unpublished).

20. Michael Reid, NSWHEALTH, *Waste Management Guidelines for Health Care Facilities.* August 1998. Ministry of Health (MOH) [Uganda]. *National Survey on injection practices in Uganda*. 2003 (unpublished).

21. National Health and Medical Research Council. *National Guidelines for Waste Management in Health Industry*. March 1999.

22. NEMA guidelines for hazardous waste management.

23. Plastic Recycling Industries (U) Limited. *Training Manual for NGO Project Partners And Stakeholders Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC), Guidelines for Environmental Infection Control in Health-Care Facilities*. May 2003. Republic of Malawi Ministry of Health and Population in conjunction with UNICEF, World Bank and WHO. *Health Care Waste Management Plan of Action*. May 2003.

24. Ministry of Health (MOH) [Uganda]. Making Medical Injections Safer, Uganda. *Country strategic plans, 2005-2009, Final draft*.

25. The World Bank. *Final Report - National Health-Care Waste Management Plan of the United Republic of Tanzania*. March 2003.

26. USAID. *Treatment alternatives for medical waste disposal. Programme for Appropriate Technology in Health (PATH)*. October 2005.

27. USNEMA. *Publication on Pollution Prevention for Selected Hospital Waste Streams, Environmental and Social Guidelines for Health Care Facilities*. May, 2003.

28. World Health Organization and Ministry of Health (MOH) [Uganda] National Injection Safety Task Force (UNISTAF). *Assessment of the functional status of the De Montfort incinerators in Uganda*. WHO/UNISTAF 2004.

29. World Health Organization and the World Bank. *Better health care waste management, an integral component of health investment*. WHO/WB, Amman 2005.

30. World Health Organization. *Preparation of national health care waste management plans in Sub-Saharan Countries, Guidance manual*. WHO, UNEP, Geneva 2005.

31. World Health Organization. *Management of Solid Health Care Waste at Primary Health Centers: A Decision Making Guide*. WHO, Geneva, 2005.

32. United Nations Environment Programme. 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. UNEP, Basel 1989.

33. United Nations Environment Programme. Stockholm Convention on Persistent Organic Pollutants (POP). UNEP, Stockholm, 2001.

8.0: Annexes

Annex 8.1: Categories of Health Care Waste

Class 1: *Non-hazardous* comprises the waste generated within the medical institutions as defined in section 2, as well as the non-hazardous pharmaceutical waste.

Class 2: *Clinical waste* comprises pathological waste and infectious waste as defined in section 2. It includes also all items that are visually contaminated with blood or body fluids.

Class 3: *Sharp waste* includes all items that can cause cuts or puncture wounds as defined in section 2. Sharps shall be considered as highly hazardous waste and collected in rigid safety boxes.

Class 4: *Anatomical waste and placenta* comprises recognizable body parts as specified in section 2. Due to similar physical characteristics, anatomical waste and placentas are grouped in the same class.

Class 5: *Hazardous pharmaceutical and cytotoxic wastes* include pharmaceuticals (cytotoxic drugs and toxic chemicals), unidentifiable pharmaceuticals, heavy-metal-containing disinfectants, and cytotoxic waste as defined in section 2. They pose a potential hazard when used improperly by unauthorized persons and owing to their composition, they require special management.

Class 6: *Highly infectious waste* comprises waste as defined in section 2. This category of waste is generated in medical diagnostic laboratories or in isolation wards.

Class 7: *Radioactive waste* includes waste as defined in section 2.

Class 8: *Waste with high contents of heavy metals* include waste as defined in section 2. This category of waste has a high content of heavy metals such as mercury or cadmium.

Class 9: *Effluents* comprises of waste as defined in section 2. This category of waste comprises all infectious liquid waste.

Annex 8.2: Sorting Categories

Category	Examples
Cytotoxic drugs	Chemotherapy or anti-cancer drugs
Narcotics	Opioid pain reliever such as opium and morphine
Ignitable (24% alcohol)	Acetone, acetonitrile, benzene, hexane, methanol, ethanol, isopropanol, toluene, xylene, methyl ethyl ketone, lacquer thinner
Corrosive	Strong acids, strong bases
Reactive	Nitroglycerine
Toxic	Substances containing arsenic, barium, cadmium, selenium, chloroform, lindane, m-cresol, mercury

All other expired pharmaceutical waste not in the categories above will be sorted in the categories outline in Table 2.

Annex 8.3: Sorting Items According to Physical State

Category	Examples
Solids	Tablets, capsules, granules, powders, antibiotics, in vials
Semi-solids	Creams, lotions, gels, suppositories
Liquids	Solutions, suspensions, syrups, ampoules
Aerosol canisters	Propellant driven, sprays, inhalers, anti-histamines sprays
Damaged pressurized cylinders	Cylinders containing anhydrous ammonia, propane, chlorine, nitrous oxide, and carbon

Annex 8.4: Methods of Disposal of Medicines at District Level

Commodity	Disposal Method
Inflammable, corrosive, and reactive waste	Neutralize with appropriate reagents, put in puncture proof storage container and landfill; Where neutralizing is not applicable, enclose in puncture proof containers and landfill
Solid and semi-solid waste (weight below 100 kilograms)	Dispose of in a district landfill
Solid and semi-solid waste (weight above 100 kilograms)	Incinerate above 1200°C

Commodity	Disposal Method
Physiological fluids small quantities (up to 10 litres) e.g. saline, dextrose, and multivitamins	Dilute with water in a ratio 1:50 and dispose of in a sewerage system
Liquid large quantities (more than 10 litres)	Dilute with water and dispose in a lagoon
Liquid anti-effective drugs	Should be diluted in water in a container, left for two weeks, and disposed of in a sewer
Aerosol canisters	Should be disposed of in a district landfill
Cytotoxic medicines and narcotic wastes	Incinerate at temperatures over 1200^{0}C
Heavy metals	*Inertization* - This is a stabilization process used for reduction of hazard potential of the waste by converting the contaminants into their least soluble, least mobile, or least toxic form. *Harvesting* - The item is subjected to a specified chemical reaction and the required component is obtained for reuse.
Solid and semi-solid waste (weighed above 100 kilograms)	Incinerate at 1200^{0}C and above
Damaged pressurized cylinders	Incinerate in military institutions due to potential for explosion

Annex 8.5: Minimum Health Care Waste Management Standards/Options

Table 4: Health Facility: District Hospital (Rural): 250,000 Pop$^{n:}$ 100 beds

Activities	Short Term Solution	Long Term solution
1. Segregation	• Waste labelling • Colour-coded three-bin system • Safety boxes at all injection sites	• Three-bin system
2. Collection	• Health facility based collection system • Protective equipment for waste handlers	• Centralized urban waste collection system • Hospital-based collection system • Protective equipment for waste handlers
3. Storage	• On-site locked storage room • Storage containers	• On-site locked storage room • Centralized storage facilities • Large metal waste container

Activities	Short Term Solution	Long Term solution
4.Transportation On-site Transport Offsite	• Wheel barrow/trolley • Bucket	• Trolley/on-site • Cars/motorcycle
5. Treatment (**For sharps & non-sharp infectious waste**)	• Incinerator • Single chamber (brick) • Double chamber (De Montfort) • Chemical sterilizer • Autoclave/steam sterilizer for highly infectious waste and reusable items • Protective equipment for incinerator operators	• Incinerator • Centralized high temperature • Double chamber • Autoclave/steam sterilizer for reusable items • Protective equipment for waste handlers
6. Disposal (**For all category of wastes**)	• Ash pit • Needle pit (not needed if no needle removers) • Placenta pit	• Sanitary landfill • Placenta pit

Table 5: Health Facility: Referral/Regional/Zonal Hospital (Urban)
500,000 Pop[n:] 100-250 beds for Regional or Zonal Hospital; 251 and above beds for 5 million Pop[n] for Referral Hospital.

Activities	Short Term Solution	Long Term solution
1. Segregation	• Waste labelling • Three-bin system	• Three-bin system
2. Collection	• Health facility based collection system	• Centralizes urban waste collection system • Hospital-based collection system
3. Storage	• On-site storage room • Storage containers	• On-site storage room • Centralized storage facilities • Large metal waste container
4.Transportation On-site Transport Offsite	• Wheel barrow/trolley • Motorcycle with a trailer	• Trolley/on-site • Cars/truck
5. Treatment	• Incinerator • De Montfort • Single chamber • Double chamber • Chemical sterilizer • Autoclave/steam sterilizer for highly infectious waste and reusable items	• Incinerator • Centralized high temperature • Double chamber • Autoclave/steam sterilizer for reusable item

Activities	Short Term Solution	Long Term solution
6. Disposal (**For all category of wastes**)	• Secured water-tight pit • Ash pit • Needle pit • Placenta pit	• Encapsulation • Waste immobilization/centralized • Sanitary landfill • Placenta pit

Table 6: Health Facility: Health Centre (Rural)

Activities	Short Term Solution	Long Term Solution
1. Segregation	• Waste labelling • Three-bin system	• Three-bin system
2. Collection	• Health facility based	• Health facility based
3. Storage	• On-site storage room	• On-site storage room
4.Transportation On-site transport	• Wheel barrow/trolley • Bucket	• Trolley
5. Treatment	• Brick type incinerator/small-scale incinerator (SSI) • HLD • Autoclave/steam for highly infectious waste and reusable items	• De Montfort Incinerator • Brick type incinerator • Double chamber • Autoclave/steam sterilizer for highly infectious waste and reusable items
6. Disposal (**For all category of wastes**)	• Encapsulation • Ash pit • Pit burial • Placenta pit • Needle pit	• Needle pit • Ash pit • Secured pit burial • Placenta pit

Table 7: Health Facility: Health Centre (Urban)

Activities	Short Term Solution	Long Term Solution
1. Segregation	• Waste labelling • Three-bin system	• Three-bin system
2. Collection	• Health facility based	• Centralized urban collection system for non-infectious waste • Health facility based collection system
3. Storage	• On-site storage room • Puncture resistant & leak proof container)	• On-site storage room • Centralized storage facilities • Puncture resistant & leak proof container

Activities	Short Term Solution	Long Term Solution
4.Transportation On-site transport Offsite	• Wheelbarrow/trolley • Motorcycle with a trailer attached	• Wheelbarrow • Trolley • Truck/cars
5. Treatment	• SSI • Drum incinerator • Autoclave/steam sterilizer for reusable items	• De Montfort Incinerator • Transport to centralized high temperature incinerator • Autoclave/steam sterilizer for highly infectious and reusable items
6. Disposal (**For all category of wastes**)	• Encapsulation • Ash pit • Needle pit • Pit burial • Placenta pit	• Needle pit • Ash pit • Sanitary landfill • Placenta pit

Table 8: Health Facility/Health Post (Rural)

Activities	Short Term Solution	Long Term Solution
1. Segregation	• Waste bin labelling	• Three-bin system
2. Collection	• SSI-based collection • Health facility based collection	• Health facility based • SSI-based collection
3. Storage	• Puncture resistant container	• Metallic or plastic receptacle
4.Transportation On-site transport Offsite	• Wheel barrow • Buckets • Motorcycle	• Wheel barrow • Trolley • Car/truck
5. Treatment	• SSI at/nearby HC or hospital • Drum incinerator • Autoclave/steam sterilizer	• SSI at/near HC or hospital • De Montfort Incinerator at/near HC or hospital
6. Disposal (**For all category of wastes**)	• Ash pit • Needle pit • Pit burial • Placenta pit	• Needle pit • Pit burial • Placenta pit

Table 9: Health Facility/Health Post (Urban)

Activities	Short Term Solution	Long Term Solution
1. Segregation	Waste bin labelling	Three-bin system
2. Collection	Health facility based collection	Health facility based SSI-based collection

Activities	Short Term Solution	Long Term Solution
3. Storage	Puncture resistant container	Metallic or plastic receptacle Interim storage room
4.Transportation On-site transport Offsite	Wheel barrow Buckets Motorcycle/car	Wheel barrow Trolley Motorcycle/car
5. Treatment	SSI Drum incinerator Chemical sterilizer	SSI at/near HC or hospital Drum incinerator at/near HC or hospital
6. Disposal (**For all category of wastes**)	Ash pit Needle pit Pit burial Placenta pit	Ash pit Pit burial Placenta pit

N.B: At all levels, people working on the management of HCW are advised to use PPEs when on duty.

Annex 8.6: Personal Protective Equipment and Segregation Supply Specifications

Protective Gloves for Waste Handlers

Managers may use these product specifications to select gloves suitable for cleaning staff to achieve protection against biological hazards present during handling and transport of biomedical waste in the clinic setting.

Purpose

To protect cleaners and other staff who process health care waste from biological hazards that may be present in medical waste. Gloves should be made of materials that are resistant to puncture from contaminated sharps and that are designed to enable staff to safely and effectively perform their duties.

Basic Performance Specifications

Durable, reusable design that is able to withstand periodic disinfection.

- Available in sizes appropriate for all cleaning staff in the health facility.
- Prevent contact with bloodborne pathogens contained in HCW.
- Made from puncture-resistant materials to protect against needlesticks and cuts from other sharps.

Materials

To prevent contact with infective agents and to resist puncture from contaminated sharps, gloves should be made of heavy-weight neoprene, latex, nitrile, or other water-impervious material. Do not use PVC if there is a chance the gloves will be disposed of by burning or incineration.

Table 10: Design Specifications

Glove design	Hand-specific, designed for dexterity and comfort in addition to protection. Texture in palm area should provide grip and tactile sensation to enable safety during janitorial activities.		
Cuff design	Straight cuff for maximum protection from contaminated liquids. Cuff should reach at least 75 mm from the upper arm surface when the elbow is flexed at 90°.		
Thickness Palm	Minimum of 0.5 mm/20 mil.		
Sizes	Small (7)	Medium (8)	Large (9)
Palm width (mm)	90	102	120
Typical length (mm)	350-370	350-370	350-370

Examples of Products

http://www.perfectfitglove.com/products/product_detail.asp?id=34&catID=6&pseriesid=10

http://www.perfectfitglove.com/products/product_detail.asp?id=28&catID=6&pseriesid=10

http://www.ansellpro.com/main/productSearch3.asp?pid=90

http://www.ansellpro.com/main/productSearch3.asp?pid=89

http://www.ansellpro.com/main/productSearch2.asp

http://www.ansellpro.com/main/productSearch3.asp?pid=29

http://www.professionalequipment.com/xq/ASP/ProductID.3059/id.8/subID.360/qx/default.htm

Relevant International Standards

AS/NZS 2161: 1998 Occupational Protective Gloves (Excluding electrical and medical gloves)

AS/NZS 2161.2: Occupational Protective Gloves – General requirements

©AS/NZS 2161.10.1-3: Occupational Protective Gloves – Selection for use with chemicals and microorganisms

Protective Gloves for Incinerator Operators

Managers may use these product specifications to select gloves suitable for incinerator operators to achieve hand protection against intermittent heat and infectious sharps present when handling biomedical waste during incineration.

Purpose

To protect operators of small-scale, medical waste incinerators, gloves must protect against heat and be resistant to punctures from contaminated sharps. Gloves must be designed to enable the incinerator operator to safely and effectively perform their duties, while being made of appropriate protective materials.

Basic Performance Specifications

- Resistant to puncture by used injection equipment
- Provide protection against contact, convective, or radiant heat

- Flame retardant
- Will not interfere with dexterity and tactile sensation required for work duties either by design or poor fit
- Durable, reusable design without compromised performance
- Available in sizes appropriate for all incinerator operators.

Materials

For heat protection, gloves can be made of leather and/or insulated with aramid blends, Terrycord, or cotton blends (www.gloveassociation.org). Newer, specialized knit materials such as KEVLAR® are available that offer heat protections and puncture resistance. A heavy neoprene design can provide needle resistance; however, this glove design will need a specialized liner to protect against radiant heat.

Table 11: Design Specifications

Glove design	Hand-specific, designed for dexterity and comfort in addition to protection.		
Cuff design	Safety cuff design that protects upper wrist but allows for quick glove removal in emergency situations.		
Thickness	Will be material dependant.		
Sizes	Small (7)	Medium (8)	Large (9)
Palm width (mm)	90	102	120
Typical length (mm)	Minimum 127 (5 inches)	Minimum 127 (5 inches)	Minimum 127 (5 inches)

Examples of Products

http://www.ansellpro.com/main/productSearch3.asp?pid=108

http://www.ansellpro.com/main/productSearch3.asp?pid=125

http://www.perfectfitglove.com/products/product_detail.asp?id=47&catID=1&pseriesid=13

http://www.perfectfitglove.com/products/product_detail.asp?id=23&catID=1&pseriesid=6

http://www.perfectfitglove.com/images/downloads/Perfect%20Fit%20Carbtex%20Brochure.pdf

(See Heavyweight Terry Cloth with Leather Palm and Seamless Knit with Leather Palm options)

Relevant International Standards

AS/NZS 2161: 1998 Occupational Protective Gloves (Excluding electrical and medical gloves)

AS/NZS 2161.2: Occupational Protective Gloves – General requirements

AS/NZS 2161.3-9: Occupational Protective Gloves – Selection for use against mechanical risks, thermal risks (fire and heat), cold, hand knives cuts and stabs, ionizing radiation, and radioactive contamination

Protective Eyewear for Incinerator Operators

Managers may use these product specifications to select protective eyewear for incinerator operators to achieve eye protection against uncontained infectious sharps and intermittent heat during handling and incineration of infectious health care waste.

Purpose

Incinerator operators should be provided with protective eyewear to protect them from falling debris, potential bloodborne pathogens contained in medical waste, and heat.

Basic Performance Specifications

- Provide adequate protection against the particular hazards for which they are designed
- Reasonably comfortable when worn under the designated conditions
- Fit snugly do not unduly interfere with the wearer's movements
- Durable
- Capable of being disinfected
- Able to be worn without disturbing the adjustment of any existing prescriptive eyewear.

Table 12: Design Specifications

Design	Glasses with side protection or goggle design
Lens	Impact and heat resistant, moulded, and 2.2 mm thick with anti-fog coating
Heat resistant	Self-extinguishing foam and heat-resistant materials
Ventilation	At minimum, four indirect ventilation slots
Fit	Wide contact between goggle and face
Visibility	Unobstructed peripheral vision
Strap	Adjustable support strap

Examples of Products

http://www.professionalequipment.com/xq/ASP/ProductID.2732/id.8/subID.436/qx/default.htm

http://www.elvex.com/goggles.htm

http://www.hlbouton.com/hlblist.html

Relevant International Standards

CSA Standard CAN/CSA-Z94.3-92: Industrial Eye and Face Protectors ANSI Standard Z87.1-1989: Practice for Occupational and Educational Eye and Face Protection ©AS/NZS 1336: 1997 Recommended Practices for Occupational Eye Protection

AS 1337-l992 Eye Protectors for Industrial Applications

Protective Respirators (Dust Masks) for Incinerator Operators

Managers should use these product specifications to select respiratory protection for incinerator operators to use during the incineration of medical waste.

Purpose

To protect incinerator operators against particulates (dust, fibre, fumes, mist, soot, and smoke) generated during incineration. Paper or cloth surgical masks do not protect from hazards inherent in the incineration of infectious medical waste and should not be substituted for an air-purifying respirator (cartridge or canister).

Respiratory protection is only needed for personnel remaining in the immediate vicinity of the incinerator. Personnel should be properly fitted for an air-purifying respirator, and replacement filter cartridges must be made available approximately every six months depending on frequency of use.

Basic Performance Specifications

- Provide adequate protection against the particular hazards for which they are designed
- Reasonably comfortable when worn under the designated conditions
- Fit snugly and not unduly interfere with the movements of the wearer
- Durable
- Capable of being disinfected regularly
- All dust masks must function as air-purifying respirators and must be able to achieve the National Institute for Occupational Safety and Health P100 or N100 rating, or equivalent European Committee for Standardization certification. P100 respirators will protect against any particulates, including oil-based materials. N-series respirators protect against solid and water-based particulates such as nuisance dust.
- When purchasing an air-purifying respirator, the manager must ensure that the cartridge or canister filters are replaceable and that adequate quantities of spare filters are purchased and provided to incinerator operators. These filters contain a granular or porous material—such as carbon or coconut—which remove specific air particulates in order to protect the health and welfare of the incinerator operator.
- Incinerator operators must be trained on the cleaning and maintenance of dust masks.
- Ideally, each operator should have his or her own dust mask. Any dust mask shared between coworkers must be cleaned and disinfected after each use. The face piece must fit correctly, and all parts must be in good working order.
- A respirator must be inspected for damage before use and whenever it is cleaned.
- Defective respirators must be discarded or repaired by an appropriately trained person. Incinerator operators must store their respirators in a place free from dust, sunlight, extreme temperatures, and moisture so that the face piece and valves are not damaged.
- Materials: Silicone or thermal plastic polymer mask with replaceable absorbent filters in disposable cartridges.

Table 13: Design Specifications

Design	Replaceable dual-cartridge, half-mask respirator
Cartridge/Canister filter	Bayonet or push-in mounted filters in cartridge or canister form; able to remove 99.9% of dusts and non-oil-based mists
Heat resistant	Self-extinguishing, heat-resistant materials
Ventilation	Adequate inhale valves and exhale valve to enable easy breathing
Fit	Wide-sealing flange for a secure seal with special nose bridge
Visibility	Unobstructed peripheral vision
Strap	Elastic straps for a good fit

Examples of Products

http://www.anisafety.com/index.aspx?Command=GroupInfo&GroupID=10580

http://www.moldex.com/pdfs/datasheets/8900_filter.pdf

http://www.msaafrica.co.za/catalog/product502998.html

http://www.gemplers.com/half-mask-respirator

http://www.gemplers.com/product/124374/Premier-Half-mask-Respirator

Example of Instructions for Use and Maintenance:
http://www.moldex.com/pdfs/datasheets/8000seriesinstructionmanual.pdf

Relevant International Standards

BS EN 143: 2000 Respiratory protective devices – Particle filters, requirements, testing, and marketing

NIOSH-42 CFR Part 84: US Standards for Respiratory Protective Devices

Law No. 57 of 1972: Japanese Standard for Dust Mask to Enforce the Industrial Safety and Health Law

Protective Footwear for Waste Handlers

Managers may use these product specifications to select protective footwear for waste handlers and incinerator operators to protect against uncontained infectious sharps and other hazards during handling and incineration of infectious HCW.

Purpose

Waste handlers and incinerator operators should be provided with protective footwear to protect from falling debris, potential bloodborne pathogens contained in medical waste, and occupational heat exposure.

Basic Performance Specifications

- Made from cut-resistant materials.
- Slip-resistant sole
- Puncture-resistant sole
- Protective against minimal impact
- Fit snugly and not unduly interfere with the movements of the wearer.
- Durable
- Capable of being disinfected
- Available in sizes to fit all waste handlers (toes should be about 12.5 mm from the front)
- For incinerator operators, boots should be made from heat-resistant materials when available.

Materials

- Uppers should be made from polyurethane. Soles may be made of polyurethane if a single-mould design is used. A vulcanized nitrile rubber sole will also resist punctures and heat.

Table 14: Design Specifications

Toe impact protection	Toe impact energy up to 90 joules
Sliding	Sole construction
Sole puncture protection	Minimum protection of 1200 Newtons
Slip-resistant sole	Deep tread with coefficient of friction >0.5.

Examples of Products

http://www.idml.com/shop.asp?catid=38&ProdId=279

http://shop.actecs.co.uk/ProductDetails.aspx?productID=709&Categoryid=457

http://www.dickiesstore.co.uk/dickies-workwear/safety-boots-and-footwear/safety-wellington-boots/FW13105/0/

Relevant International Standards

CSA Standard CAN/CSA-Z195-M92: Protective Footwear

ANSI Standard Z41-1991: American National Standard for Personal Protection, Protective Footwear

©AS/NZS 2210.1: Occupational Protective Footwear, Guide to selection, care, and use

British Safety Institution Standard BS EN 345: 1993 Specification for Safety Footwear for Professional Use

British Safety Institution Standard BS EN 346: 1993: Specification for Protective Footwear for Professional Use

Medical Waste Plastic Bin Liners

Managers can use these specifications to select plastic liners appropriate for safe segregation of infectious, non-sharp HCW. Special attention will be required to ensure that the plastic liners are manufactured to quality standards outlined in this specification sheet.

These specifications **do not apply** to plastic autoclave bags.

Purpose

Regulated medical waste must be properly packaged to ensure effective containment throughout the handling, storage, transport, and treatment processes.

General Performance Specifications

- The bin liners must be leak-resistant, impervious to moisture, and tear resistant.
- The bin liners must be either a distinctive red or yellow colour, or clear. If a clear bag is used, then the universal biohazard symbol must be appropriately displayed on the bag.
- A container used to hold regulated medical waste must have either a red or orange plastic bag plainly visible; if a clear container is used, then the universal biohazard symbol must be displayed on the container as well as on the bag.
- Plastic bin liners used for the packaging of medical waste must be managed as regulated medical waste and must not be reused.

Materials

Polyethylene. Product manufactured from Low Density (LD)/Linear Low Density (LLD) resin shall have a density between 0.915 grams/cc to 0.923 grams/cc. Liner material shall be formulated from polyethylene containing metallocene, octane, butane, or hexane-type copolymer resins with a maximum of 15% post-consumer reprocessed polymer. PVC is not recommended since bags may be burned or incinerated.

Dyes used in the coloration of plastic bin liners will be no greater than 100 ppm of sum incidental concentrations of lead, mercury, hexavalent chromium, and cadmium.

(Autoclave bags or liners must be made of a polypropylene plastic that does not melt at the temperatures—116°C to 135°C—achieved during autoclave sterilization!)

Table 15: Design Specifications

Minimum thickness (mandatory)	1.50 mil (should be double-bagged if offsite transport is to be performed)
Material density	Low-density or linear-low-density polyethylene
Bag size	Dimensions will depend on bin size. Must not exceed 44 gallon (38 in x 46 in) to ensure load endurance is not exceeded.
Impact resistance	165 g
Load rating (min.)	35 kg
Tear strength by MD & TD methods	480 g
Colour and markings	Red or yellow with "Biohazard" or "Infectious Waste" printed in black. Marking should include the universal biohazard symbol.
Closure	Twist ties or other restraining devices are required to be either included in each case of liners or otherwise supplied in adequate quantities to cover the amount of liners procured.

Examples of Products

http://www.heritage-bag.com/products/h_red.asp

http://www.allmed.net/catalog/item/134/2241

http://www.sharpssupply.com/mcart/

http://www.mfasco.com/index.php/infection-control/misc-biosafety-products/cPath/20_405?SID

Relevant International Standards

ASTM - D2103-86 standard specification for polyethylene film and sheeting

ASTM - D1709-91 impact resistance of polyethylene film by the free-falling dart method.

©ASTM - D1922-89 propagation tear resistance of plastic film and thin sheeting by pendulum method.

Annex 8.7: Spillages and Exposures Management

Any of the following actions should be carried out as needed:

- Evacuate the contaminated area
- Decontaminate the eyes and skin of exposed personnel immediately
- Inform the designated person who should coordinate the necessary actions
- Determine the nature of the spill and/or exposure
- Evacuate all the people not involved in their cleaning up
- Provide first aid and medical care to injured individuals
- Secure the area to prevent exposure of additional individuals
- Provide adequate PPE (See Annex III) to the personnel involved in the clean-up

- Limit the spread of the spill
- Neutralise or disinfect the spilled or contaminated maternal, if indicated
- Collect all the spilled and contaminated material (sharps should never be picked up by hard (bushes and pans or other suitable tools should be used) spilled material and disposable contaminated items used for cleaning should be placed in the appropriate waste bins and liners.
- Decontaminate or disinfect (using sodium hypochlorite) the area, wiping up with absorbent cloth. The cloth (or other absorbent material) should never be turned during the process; because this will spread the contamination. The decontamination should be carried out by working from the least to the most contaminated part, with a change of cloth at each stage. Dry cloths should be used in the case of liquid spillage, for the spillage of solids, cloth impregnated with water (acidic; basic or neural, as appropriate) should be used.
- Line the area, and wipe dry with absorbent cloth
- Decontaminate or disinfect any tools that were used
- Rework PPE and decontaminate, if necessary
- Seek medical attention if exposure to hazardous material has occurred during operation.

ANNEX 8.8: Plastics

Plastics and Health: Plastics—A Toxic Cocktail

Plastics can have serious detrimental effects to health, depending on:

- The chemical structure of the monomer and other raw materials used to manufacture the plastic.
- The chemicals added to the plastic to modify its properties
- The chemicals evolved during the manufacture of the plastics
- The chemicals that leach out of the plastic once the plastic is disposed of
- The chemicals that result from burning of the plastic
- The chemicals evolved from the plastic during its use.

The following toxic chemicals are associated with the production, use, and disposal or burning of plastics listed.

Polyvinyl chloride (PVC): chlorine, phthalate plasticizers, dioxins, furans, heavy metals

Polyurethane (foam): Toluene diisocyanate, phosgene, brominated flame retardants

Polystyrene (PS): Benzene, styrene, butadiene

Acrylonitrile Butadiene Styrene (ABS): Styrene, butadiene, acrylonitrile

Polycarbonate (PC): Phosgene, methylene chloride, Biphenol A

Polyethylene terephthalate (PET): Acetaldehyde, ethylene glycol.

Dioxins and Furans

"Dioxins" are a group of chlorinated organic chemicals with a similar chemical structure.

Several hundred dioxins are known to exist. Dioxins can be grouped in to three families:

- **CDDs –** Chlorinated dibenzo-p- dioxins
- **CDFs –** Chlorinated dibenzo furans
- **PCBs –** Poly chlorinated bipenyls

The most studied and most toxic of the dioxins is TCCD (2, 3, 7, 8 tetra chlorodibenzo-p-dioxin)

CDD and CDF dioxins are not created intentionally. They result from anthropogenic activities (e.g. combustion of fuels, oils, wastes, etc.).

Dioxins are insoluble in water, but soluble in lipids. 90% of human intake of dioxins is in the form of animal fat. Exposure to dioxins can result in:

- Greatly increased risk of cancer
- Delay in nervous system development in children
- Diabetes
- Liver and heart diseases
- Skin problems (chloracne)
- Conjunctivitis

Dioxins bioaccumulate in food chains, but do not contaminate ground water.

Endocrine Disruptors

Endocrine disruptors are chemicals with hormonal chemical reactions in the body, usually by "mimicking" an existing hormone. Known endocrine disruptors:

- Dioxins, furans, PCBs
- Pesticides e.g. dichlorodiphenyltrichloroethane (DDT), pyrethroids, many others
- Plasticizers e.g. Dibutyl phthalate (DBP), Bis(2-ethylhexyl) phthalate (DEHP)
- Bisphenol A

Health Effects of Endocrine Disruptors

- Birth defects
- Alterations in sexual development
- Structural abnormalities of the uterus, cervix, vagina, and reduced sperm count
- Neurologic disorders
- Learning difficulties; decreased mental capacity
- Diabetes
- Immunologic disorders
- Early puberty in young girls.

Table 16: Summary of Possible Adverse Health Effects of Plastics

Plastic/Additive Type	Known Adverse Health Effects
PVC	Cancer, birth defects, chronic bronchitis, ulcers, skin diseases, vision failure, indigestion, liver dysfunction
Plasticisers (DEHP)	Endocrine disruption, birth defects, infertility, endometriosis, immune system impairment
PS	Eye, nose, throat irritation, dizziness, unconsciousness, lymphatic ulcers
Polyurethane (PU) (Foam)	Bronchitis, coughing, skin/eye problems, lung problems from Toluene diisocyanate induction (TDI)

Plastic/Additive Type	Known Adverse Health Effects
Acrylic Poly(methyl methacrylate) (PMMA)	Breathing problems, vomiting, diarrhoea, nausea, headache, fatigue
Polytetrafluoroethylene (PTFE)	Eye irritation, breathing problems

Table 17: Health Effects of Burning Plastics

Pollutant	Health effects
Particulate matter (PM)	Irritation of respiratory tract, aggravated asthma, contributes to chronic obstructive pulmonary disease.
Volatile organic compounds (VOCs)	Directly toxic including problems ranging from cancer risks to nervous disorders. Causes respiratory irritation/illness, chronic lung disease.
Sulphur oxides	Increase in heart/lung disease, acute/chronic respiratory disease. Healthy people experience shortness of breath, sore throats, breathing difficulties.
Carbon monoxide	Causes dizziness, headaches, and slowed reflexes. Affects mental function, visual acuity, and alertness.
Nitrogen oxides	Causes respiratory illness, fluid collection in the lungs and fibrotic changes.
Poly-nuclear hydrocarbons	May cause cancer
Aldehydes	Cause eye and respiratory tract irritation, headaches. Is an animal carcinogen.
Dioxins and furans	May cause cancer, causes growth defects, affects DNA, immune, and reproductive systems.
Heavy metals	Highly toxic: heavy metals (such as mercury) collect in the human system until lethal dosage is reached. Causes respiratory/intestinal problems.
Hydrochrolic acid	Irritation of the respiratory tract causes respiratory illness; dulls the body's senses.
Hydrogen sulfide (HS)	Toxic, causes respiratory disease. Healthy people experience shortness of breath, sore throats, breathing difficulties, irritated eyes.