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NATIONAL GUIDELINES FOR SAFE MANAGEMENT OF HEALTH CARE WASTE

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National Guidelines for Safe Management of Health Care Waste

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LIST OF ABBREVIATIONS

CDC	Centers For Disease Control and Prevention
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act (1999)
GEF	Global Environment Facility
HBV	Hepatitis B Virus
HCF	Health Care Facility
HCWM	Health Care Waste Management
HFMT	Health Facility Management Team, Also Known as Health Management Team
IPC	Infection Prevention and Control
IRAT	Individualized Rapid Assessment Tool
KMTC	Kenya Medical Training College
MGB	Mobile Garbage Bin
MOH	Ministry Of Health
MTaPS	Medicines, Technologies, and Pharmaceutical Services
NEMA	National Environment Management Authority
OSH	Occupational Safety and Health
PEP	Post-Exposure Prophylaxis
PHO	Public Health Officer
POP	Persistent Organic Pollutant
PPE	Personal Protective Equipment
PPP	Public-Private Partnership
PVC	Polyvinyl Chloride
SAICM	Strategic Approach To International Chemicals Management
SOP	Standard Operating Procedure
TB	Tuberculosis
TWG	Technical Working Group
UNDP	United Nations Developmental Programme
UPOPs	Unintentional Persistent Organic Pollutants
USAID	Us Agency For International Development
WDU	Waste Disposal Unit
WHO	World Health Organization
WMT	Waste Management Team

Definition of Terms

Term	Definition
Approved design	Architectural drawing approved by the local authority, including an architect, quantity surveyor, and the public health section.
Ash pit	An impervious pit constructed to match the approved design.
Best available techniques	Technology or technique approved by legislators or regulators for achieving output standards for a particular process, such as pollution abatement or prevention.
Best environmental practices	Application of the most appropriate combination of environmental control measures and strategies, including putting in place and implementing a system for managing health care waste together with basic elements within the system.
Biochemical transformation	The breakdown of compounds by enzymes.
Biodegradable substance	A substance that can be degraded by microorganisms.
Biomedical waste	Any waste generated during the diagnosis, treatment, or immunization of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biological products.
Chemical transformation	Change of substance through chemical reactions.
Clinical waste	Any waste arising from the provision of health care or biomedical research.
Cytotoxic waste	Waste with the ability to cause damage to cells/DNA, such as waste generated during the management of cancer.
Disposal site	Any area of land on which waste disposal facilities are physically located or final discharge point without the intention of retrieval but does not mean a reuse or recycling plant or site.
Domestic waste	Waste generated from residences.
Environment	Surroundings, including water, air, soil, and their interrelationships, as well as all relationships between them and any living organisms.
Environmentally sound management of waste	Taking all practical steps to ensure that waste is managed in a manner that will protect human health and the environment against the adverse effects that may result from improper disposal of the waste.
Exporter	Any person who causes transboundary movement of waste out of the country.
General waste	Waste that contains no products or potential properties that are known to have either a reactive or toxic effect either on humans or the environment. It is generated during the administrative and housekeeping functions of the healthcare facility and includes food preparation, cleaning and sweeping, repair and replacement, clerical and office services, packaging, cardboard, damaged containers, discarded flowers, bags, tins, wrappings and plastics.
Generator	Any person whose activities produce health care waste or is in possession and/or control of those wastes.
Genotoxic	Waste with the ability to cause damage to genes/DNA, such as waste generated during the management of cancer.
Hazard	A substance, mixture or substances, process or situation that has the potential to cause harm to human health or adverse effect to the environment.
Hazardous waste	A waste that is considered to be of special risk to human health or the environment and therefore needs special management.
Health care waste	Waste that is generated during the diagnosis, treatment, or immunization of human beings or animals, in biomedical research, and in the production or testing of biological products.
Importer	Any person who causes transboundary movement of waste into the country.

Term	Definition
Incineration	The controlled burning of solids, liquids, and gaseous combustible waste to produce gases and residues containing little or no combustible materials.
Infectious waste	All kinds of waste that may transmit viral, bacterial, fungal, or parasitic diseases to human beings and animals.
Kenya Nuclear Regulatory Authority	The Kenya Nuclear Regulatory Authority was established under the Radiation Protection Act, Chapter 243, Laws of Kenya, to protect persons, property, and the environment against the harmful effects of ionizing and non-ionizing radiation through the establishment of a system of regulatory control.
Label	The written, printed, or graphic matter on or attached to the container or wrapper of packaged waste.
Mixed material waste	Waste from products containing a mixture of substances, at least one being xenobiotic, or waste from manufacturing, such products where simple sorting may not separate the substances.
Municipal solid waste	Waste from household, commerce, administration, and service companies that are disposed of through the public waste management system.
Packaging	The container and the protective wrapping used to carry waste during storage and transportation.
Poison	A substance that can cause disturbance of structure or function, leading to injury or death when absorbed in relatively small amounts by humans, plants, and animals.
Prior informed consent	The international operation procedure for exchanging, receiving, and handling notification information by the competent authority on waste.
Protective clothing	Any clothes, materials, or devices that are designed to protect the user when handling hazardous material.
Radioactive waste	Any radioactive material that has been, or will be, discarded as of being of no further use.
Recycling of waste	The processing of waste material into a new product of similar chemical composition.
Reprocessing	The processing of waste into a new product of different chemical composition.
Reuse	Waste reused with or without cleaning and/or repairing.
Segregation	Any activity that separates waste materials for processing.
Storage	Temporary placement of waste in a suitable location or facility where isolation, environmental and health protection, and human control are provided in order to ensure that waste is subsequently retrieved for treatment and conditioning and/or disposal.
Thermo-transformation	Change of a substance through the application of high temperature with or without pressure.
Toxic chemical	Any substance that on entry into an organism through ingestion, inhalation, and dermal contact, is injurious, causes physiological or biochemical disturbances, or otherwise causes deterioration of the organism's functions in any way.
Treatment	When used in waste management, it means any method, technique, or process designed to change the biological character or composition of health care waste to reduce or eliminate its potential for causing harm.
Waste disposal unit	It consists of a De Montfort Mark 9 incinerator fitted with a temperature gauge, an ashpit for resultant ash, a modified De Monfort Mark 8A (optional) for incinerating sharps boxes, and an ashpit beneath it.
Waste generator	Any person whose activities or activities under his or her direction produce waste or, if that person is not known, the person who is in possession or control of that waste.
Waste management	The activities (administrative and operational) that are used in handling, packaging, treatment, conditioning, reducing, recycling, reusing, storage, and disposal of waste.
Wastewater	Liquid waste arising from the use of raw water in kitchens, wash hand basins, sinks, and washrooms.

Foreword

There is growing global concern over the multiplicity of hazardous substances used and/or generated by the health sector during service delivery. The COVID-19 pandemic magnified this concern. Hazards range from infections; volatile, irritating, flammable, and explosive chemicals; pressurized containers; heavy metals; ionizing radiation; sharps; expired pharmaceuticals; persistent organic pollutants, such as furans and dioxins; and cytotoxic substances. Exposure to these substances poses significant health and environmental risks.

The World Health Organization recommends that countries put in place systems for the safe management of health care waste and calls upon all those concerned with supporting health programs to make provisions within their assistance to cover costs for sound waste management. The Government of Kenya developed the *Injection Safety and Medical Waste Management Policy* in 2007, setting limits within which waste will be managed. Accompanying guidelines were also developed in 2011 to operationalize the policy. A review done in 2017 under the auspices of the United Nations Developmental Program (UNDP) revealed gaps in levels of protection, especially against persistent organic pollutants, mercury, and a range of chemicals commonly used in the health sector. In this context, despite the desruptions caused by the C0VID-19 pandemic, the Ministry of Health embarked on updating the guidelines and also in the process to develop a health care waste management policy to address the gaps identified, while ensuring that all provided guidance is rational and based on current evidence and best practices.

The Ministry of Health expects that all health managers at national, county, sub-county, and facility levels; and manufacturers, law enforcement officers, administrators, training institutions, and researchers will use the guidelines and provide feedback, as necessary. All stakeholders are called upon to support the implementation of the guidelines.

The Ministry ,continues to commit itself to putting in place systems that protect health workers, patients, communities, the public, and the environment. Technical support will be provided to ensure consistent implementation, compliance, and monitoring uptake of the guidelines.

Dr. Patrick Amoth EBS

Ag. Director General for Health

Ministry of Health

Preface

It is the strong desire of the Ministry of Health (MOH) in Kenya to establish a practice where health workers, patients, communities, the public, and the environment are better protected from risks associated with unsafe production, handling, storage, treatment, and disposal of health care waste as a duty of care.

High levels of protection are achieved when sound systems are put in place for managing waste. Critical here is the appropriateness of the technology to be deployed, the need to inform all those concerned about the risks involved and the methods used for waste treatment and disposal achieve recommended emission and air quality levels. In addition, sound systems, also require that basic processes for managing waste are standardized and based on evidence and best practices. Furthermore, it is paramount that all stakeholders are trained on their roles and responsibilities and that the public is fully aware of what is going on and when a multisectoral approach is needed to be deployed to sustain .

This second edition presents an update to the current management of hazards and risks associated with health care waste handling it incorporates the management of obsolete chemcials and exposure to mercury and persistent organic pollutants. The guidelines are intended to assist national entities, county managers, individual health training institutions, and practitioners in public and private sectors to improve health care waste management practices. Different cadres of health workers will be expected to participate according to the prescribed roles and responsibilities.

The guidelines provide summaries of applicable laws, regulations, and policies. It classifies waste according to the category of risk and type of material; explains critical steps in safe waste management; and provides illustrations of important symbols when labelling waste. It further provides tools needed when executing selected activities; discusses planning for health care waste management, what it takes, and aspects to include in the plan; and describes roles and responsibilities of different cadres and people at all levels of service delivery. In addition, it guides how to select, procure, operate, and maintain waste treatment technologies; and gives guidance on the best ways to dispose of health care waste. Training requirements are communicated by a cadre of staff and according to assigned roles and responsibilities.

Every stakeholder is encouraged to fully support the implementation of the guidelines. The proposed approaches will go a long way in establishing a safe working culture while protecting human health and the environment.

Everyone has a role. Let each one of us play it expeditiously.

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Acknowledgments

The Ministry of Health (MOH) appreciates the contributions of all institutions, individuals, and teams that participated in reviewing and updating the *National Guidelines for Safe Management of Health Care Waste 2011* into this second edition. The review involved benchmarking global and regional guidance on safe and appropriate management of health care waste, notably the World Health Organization's (WHO) Blue Book and other international conventions and guidance related to management of health care waste and chemical (obsolete). Consultative meetings were held with subject matter experts, and health facility surveys were conducted to get practitioners' perspectives, views, experiences, and real needs. A stakeholder validation workshop was held to update the content.

The MOH would like to extend its appreciation to colleagues in the Ministry of Environment and Forestry; MOH staff at national, county, and health facility levels; the National Environment Management Authority (NEMA); United Nations Development Program (UNDP); and Medicines, Technologies, and Pharmaceutical Services (MTaPS), a program funded by the United States Agency for International Development, for the dedication exercised when guiding the process. Special recognition goes to Ms. Julia Saino (Ministry of Environment and Forestry)/Unintentional Persistent Organic Pollutants (UPOPs) Project, Mr. Francis Kihumba (Ministry of Environment and Forestry)/ UPOPs Project, Mr. Anthony Wainaina (MOH), Mr. Gamaliel Omondi (MOH), Mr. Bosco Lolem Lokolile (MOH), Mr. Michael Mwania (MOH), Ms. Pauline Ngari (MOH), Ms. Rose Mokaya (MOH), Mr. Muitungu Mwai (NEMA), Mr. Francis Chwanya (NEMA), Mr. Washington Ayiemba (UNDP), and Mr. Eric Kitangala (USAID MTaPS). Appreciation goes to all those who contributed to the development of this document. (The complete list of contributors is provided in annex 17.)

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CHAPTER 1: INTRODUCTION

Health care activities are a means of protecting health, curing patients, and saving lives; however, they also generate waste, 15% to 25% of which entail risks of infection, trauma, or chemical or radiation exposure. Therefore, poor health care waste management (HCWM) can jeopardize the safety of health workers, waste handlers, patients and their families, and the neighboring population. In addition, the inappropriate treatment or disposal of that waste can lead to environmental contamination or pollution (1, 2).

There has been a concerted global effort to find lasting solutions to HCWM risks, with the global community coming up with the World Health Organization (WHO) Blue Book for Safe Management of Wastes from Health Care Activities. The Blue Book brings together the best recommendations that protect humans and the environment from hazards and risks associated with health care waste. The recommendations are also reflected in several global conventions and treaties, such as the Stockholm, Basel, Montreal, and Minamata conventions, and the Strategic Approach to International Chemicals Management (SAICM) Strategy (3, 4).

Many developing countries have developed regulatory frameworks, national guidelines and plans, and innovative approaches to address issues in HCWM. However, implementation of these guidelines has been a challenge due to inadequate funding and capacity building.

HCWM is an integral part of the Kenya health care system, aimed at ensuring the safety of health workers, communities, and the environment. It has been the responsibility of the Ministry of Health (MOH) at the national and county levels, and at all levels of health care institutions and health industries to safely manage all waste they generate in their institutions.

Therefore, these guidelines are an integral part of maintaining the safety of health workers, the communities, and the environment. It was developed under the stewardship of the Department of Environmental Health at the MOH through an extensive consultative process with stakeholders. The stakeholders' inputs were incorporated in the final draft during joint sessions between the technical working group and various health and non-health actors. The resultant consensus guidelines document was then presented for validation to the county leadership.

The guidelines will be implemented in line with the mandate of the MOH as per the provisions of the constitution and the national laws on public health and the environment.

1.1 Background

1.1.1 Generation of Health Care Waste in Kenya

WHO estimates that for every inpatient seen per day, 0.031 kg of sharps waste, 0.175 kg of infectious waste, 0.135 kg of non-infectious waste, and 0.184 kg of food waste are generated by category. This gives a total of 0.525 kg of health care waste per patient daily (5).

In situations of complex public health concerns, such as during the COVID-19 pandemic, it is estimated that an infected individual under treatment produces 3 to 4 kg of infectious waste each day, which translates to a six-to-seven-fold increase from the normal. This presents a complex situation to health managers on how much waste could safely be managed without risking the sick, or endangering staff, or compromising the quality of the environment. Unsafe waste disposal contributes to significant health concerns (5).

Health care facilities (HCFs) in Kenya generate significant amounts of health care waste. In the past five years, renal, intensive care unit, and oncology services have been established in many public and private hospitals, increasing the waste generated. Of most concern is the cytotoxic waste that needs special handling and disposal.

1.1.2 Risk of Transmission of Infections

Globally, it is estimated that 11 million people die of pollution-related diseases annually, half of whom live in Africa. Studies done by WHO in the year 2000 showed that if health facilities do not adhere to best practices in infection prevention and control, 40% of new cases of hepatitis C, 30% of new cases of hepatitis B, and 5% of new cases of HIV can be transmitted by the health sector annually (6, 7).

1.2 About the Guidelines

In 2011, the then Ministry of Public Health and Sanitation and the Ministry of Medical Services developed the first edition of the *National Guidelines for Safe Management of Health Care Waste*.

These guidelines (2nd edition, 2024) include the new updates on HCWM, providing a minimum standard of best practice for the safe management of all health care waste. The Stockholm Convention has informed the Guidelines on Persistent Organic Pollutants (POPs), the WHO Bluebook, the WHO/United Nations Environment Programme Compendium of Technologies for the Treatment and Destruction of Health Care Waste, and the Individualized Rapid Assessment Tool (IRAT), and national statutes, as well as consultations and collaborations among environmentalists, health practitioners, and county governments.

1.2.1 Objectives

General Objective

To strengthen the management of health care waste and obsolete chemicals in Kenya.

Specific Objectives

1. To provide guidance for managing health care waste based on the relevant legal, regulatory, and policy frameworks as well as in line with the best global best environemntal practices (BEP) and best available techncologies (BAT).
2. To standardize waste management practices.
3. To define the roles and responsibilities of stakeholders in HCWM.
4. To provide tools that can be used in executing HCWM activities.
5. To provide the basis for capacity building.
6. To provide a basis for conducting monitoring and evaluation of HCWM practices.

1.2.2 Scope

The guidelines provides guidance based on the relevant legal, regulatory, and policy framework within which HCWM activities should be implemented and decisions are taken. The document provides key guiding principles, waste classification, the rationale for proposed critical steps in HCWM, and sets standards for segregation, storage, transportation, treatment, and disposal of health care waste. It states the procedures for selecting, specifying, procuring, and operating waste treatment technologies, and gives guidance on minimal training requirements, occupational health and safety considerations, and means of handling special types of waste.

1.2.3 Target Audience

These guidelines are intended for use by managers at national, county, sub-county, and health facility levels; all health workers in public and private settings; vendors and contractors engaged in HCWM; administrative officers, procurement teams, staff involved in law enforcement and compliance activities; and members of the public. Community-based health workers, biomedical research institutions, medical schools, and other interested stakeholders in the broader health care industry will be expected to adhere to these guidelines.

1.2.4 How to Implement the Guidelines

The Department of Environmental Health will upload the guidelines into the MOH portal for accessibility to all. It will also review the HCWM training modules in line with the guidelines. Moreover, standard operating procedures (SOPs) will be developed for common practices recommended in these guidelines and be accessed by HCFs through the existing county structures. Countrywide sensitization meetings will be held targeting the county management to lobby for the establishment of recommended structures and for financing the implementation of the guidelines.

1.2.5 Call for Commitment

Adopting these guidelines should be accompanied by the commitment of each HCF through the establishment of a HCWM Team and the development of an HCWM plan that will assist the HCF in managing its waste. The operations of these guidelines should be incorporated in the health facility's annual operational plan.

CHAPTER 2: SITUATION ANALYSIS

Like all other developing countries, Kenya has a rapidly growing population demanding quality health services amidst emerging and re-emerging infectious disease outbreaks. Health facilities respond by using single-use devices and chemicals to interrupt further transmission and, as a result, generate ever-increasing volumes of health care waste, imposing a considerable burden on the health system. Very few health facilities in Kenya have acceptable methods of health care waste disposal (with open burning widely practiced). Larger facilities have incinerators to reduce the volume of waste, but the majority do not achieve recommended temperature and smoke emission requirements per the Stockholm convention. Unsafe disposal continues to pose a serious potential risk to the people and the environment (7).

The MOH has made progress in establishing sound systems for managing health care waste. Since 2007, the MOH has developed policies, guidelines, and communication strategies on the National Injection Safety and Safe Disposal of Medical Waste (2010), *National Guidelines for Safe Management of Health Care Waste* (2011), and strategic plans on HCWM, all to a large extent in line with global standards. Where there are gaps, SOPs have been developed to provide more detailed guidance on what needs to be done. The MOH has also introduced the HCWM commodities into the list of essential medicines and health supplies. HCFs can now procure quality commodities from the Kenya Essential Medical Supplies Agency (8, 9).

Structures of HCWM are well established at national, county, and health facility levels. Public health facilities, at all levels, have a public health officer (PHO) who supervises HCWM.

The MOH has gradually introduced non-burn technology by installing microwaves or autoclaves in national and county hospitals. Previously, the country has benefited from buy-in from such stakeholders such as the United States Agency for International Development (USAID), WHO, World Bank, UNDP, the Global Fund to Fight AIDS, Malaria and Tuberculosis, and county governments, among others. Counties, sub-counties, and health facilities are encouraged to include waste management aspects in their annual budgets.

A major setback to adapting these guidelines is the lack of enforcement for HCFs to comply with the regulations on HCWM. Public HCFs can openly burn their waste without any consequences. Health facilities are also not obliged to adopt the new technology.

The MOH policy on scaling up HIV, tuberculosis (TB), and malaria interventions as well as expanded scope of vaccination program and blood transfusion services, among other expanded health delivery services contribute to large volumes of health care waste. Procedures in HIV counselling and testing, elimination of mother-to-child transmission, TB directly observed therapy/ short course, rapid diagnostic testing, routine laboratory monitoring for antiretroviral therapy, indoor residual spraying, routine and mass vaccination campaigns, blood donation exercises and safe male circumcision all contribute to the increasing volume of waste. Partners are introducing new services that involve blood drawing at community and household levels where there are usually no established systems for appropriate HCWM. The private sector also participates in service delivery but lacks plans and budgets for managing resulting health care waste.

The challenge for most HCFs has been a lack of adequate resources for HCWM, poor maintenance of waste treatment equipment, non-availability of written guidelines, fragmented training programs, poor staff attitudes, and lack of information, education, and communications materials.

2.1 Current HCWM Practices, Capacity Building Efforts, and Administrative Arrangements

Current capacities in the health sector fall short of protecting the public, health workers, and the environment from the undesirable effects of pollution, chemicals, expired pharmaceuticals, and heavy metals, as elaborated below.

A study under the auspices of the UNDP-funded Global Environment Facility (GEF) Project in 2017 revealed that the health sector lacked proper structures, ideal technologies, and human and financial resources to achieve best practices in HCWM.

2.1.1 Management of Health Care Waste

Over time the health sector has made some progress in managing health care waste. Almost all HCFs have safety boxes for sharps disposal. However, there is a wide variation in the quality of HCWM supplies among HCFs, with those better resourced demonstrating higher quality.

A study in 2017 *"Efficacy Tests for Burn and Non-burn health Care Waste Technology Equipment in Selected Facilities in Kenya* showed that only 40% of the health facilities had a permanent committee dealing with health care waste, with a similar proportion of the health workers in the surveyed facilities not being clear about their roles and responsibilities in HCWM. Most (80%) of the health facilities did not have copies of HCWM policies, and 70% had no written plans, manuals, and procedures consistent with national HCWM laws and regulations. About 70% of the facilities lacked plans for recycling and waste minimization, and none were mercury (10).

2.1.2 Training of Health Workers

The Kenya Medical Training College (KMTC) has a fully-fledged training course at a higher national diploma level on waste management for PHOs with a component on HCWM. Public universities have a training component on waste management in their diploma and master's degree programs in public health. In 2015, the KMTC incorporated training on HCWM in the curriculum for clinical officers, nurses, and others. There is still a large knowledge gap, with many health workers graduating from different medical institutions not having incorporated waste management in the curriculum (11).

In 2015, the country developed a training guide for training of trainers and an on-the-job training guide informed by the *National Guidelines for Safe Management of Health Care Waste* to aid in-service training for health workers, waste handlers, and incinerator operators at the in-service level. These training programs were rolled out with support from PATH, jhpiego, and the Centers for Disease Control and Prevention (CDC). However, the training guides do not include chemical waste management content in line with Stockholm and Minamata Conventions and SAICM (12).

Other health courses with a core module on HCWM include injection safety, infection prevention and control (IPC), laboratory biosafety, and biosecurity.

A training needs assessment facilitated by the Sound Chemical Management Mainstreaming and Unintentional Persistent Organic Pollutants (UPOPs) reduction in Kenya project, in close collaboration with the Ministry of Health and Ministry of Environment and Natural Resources, in 2017 showed that 39% of health care workers, 37.5% of waste handlers, and 87.5% of incinerator operators had received training on HCWM. Since then, many more health care workers have been trained in waste management through the IPC course. Most health facilities (53%) did not have a training program in HCWM and were not orienting new staff on this subject. None of the facilities had provided their health workers with refresher training in the year preceding the survey (13).

Levels of training among staff varied from facility to facility, with some facilities having their staff trained more regularly than others, but training was generally organized in such a way that all health facilities were taking their new staff through induction courses in IPC, with a focus on HCWM. Intern doctors and clinical officers were given special consideration during training due to their vulnerability. However, waste handlers were not being adequately trained.

2.1.3 Occupational Safety and Health

The MOH developed the *Occupational Safety and Health Policy for the Health Sector in Kenya* in 2014, but the guidelines have not been disseminated to HCFs.

However, some components of occupational safety and health (OSH) have been implemented in the context of health workers' vaccination, injection safety, HCWM, and IPC. The MOH Division of Patient and Health Worker Safety is currently piloting a tool for reporting health worker incidents. The HCFs will report health worker incidents to the Kenya Health Information System, and this will help the department monitor the magnitude of harm to health workers from exposure to health care waste.

Health care waste (15%-25%) is considered hazardous; therefore, maximum precaution must be taken in its handling. The *National Guidelines on the Safe Management of Health Care* Waste require all health workers, waste handlers, and incinerator operators to be sensitized on their occupational exposure when handling waste, provided with occupational vaccination, and made to understand the standard precaution procedures.

The study, *Efficacy Tests for Burn and Non-Burn Health Care Waste Technology Equipment in Selected Facilities in Kenya,* showed that 37.5% of incinerator operators and 31.2 % of waste handlers had personal protective equipment (PPE) for performing their respective duties, although most were worn out and required replacement. Mortuary attendants in all sites did not have the required PPE for handling formaldehyde, and their hands and eyes showed symptoms of chemical exposure.

Ninety percent of the respondents were not vaccinated against the hepatitis B virus (HBV). Of those vaccinated, 60% had two doses and, therefore, incomplete vaccination. None of the waste handlers or incinerator operators had been vaccinated. Thirty-one percent of waste handlers and 25% of incinerator operators reported having had a needle stick injury while performing their duties. Thirty percent understood the recommended immediate action of washing in running water without squeezing and reporting to their supervisor as stated in the national IPC guidelines (10, 14).

2.1.4 Budgeting and Financing

Although most HCFs may not have a specific budget for HCWM, they will allocate some funds to procure basic HCWM supplies. A study showed that 54% of HCFs allocated a budget to HCWM activities. Although this finding is in a positive direction, the funds allocated were insufficient to meet the HCWM needs. None of the facilities had long-term financing plans to cover costs for sustainable HCWM. It was noted that facilities that had tracked expenditure had used 10% on waste management but they could not meet the required needs (15).

2.2 Waste Management Practices

2.2.1 Segregation and Handling

The MOH has provided job aids for waste segregation and widely disseminated them to HCFs, yet health care waste segregation continues to be a challenge in most HCFs in Kenya. Knowledge had not been translated into practice and innovative ways are required to ensure adherence to good practice. A study showed that only 69% of the facilities were making any effort to segregate waste at the source according to different categories. Even where segregation was practiced, not all waste was being segregated. The sharps were well segregated, but some mixed up non-infectious waste with the infectious waste in the yellow-coded bin. The challenge is common in hospitals with training institutions with a high staff turnover; hence, they experience diminishing consistency of good practice (15).

There was a general lack of knowledge among health workers on handling chemical, pharmaceutical, and radioactive waste. This can be attributed to the gap in HCWM training. This is a gap to be addressed in these guidelines.

2.2.2 Storage and Transportation

Infectious waste should be collected daily from the waste generation point, or at least two times in a busy area or when complete, as per the *National Guidelines for Safe Management of Health Care Waste*. Health care waste should also be transported in a covered wheeled cart. In Kenya, it is common practice in most HCFs to use wheelbarrows with no segregation maintained for waste transportation in the HCFs and its compounds (8).

The study conducted in 2017 on *Efficacy Tests for Burn and Non-Burn Health Care Waste Technology Equipment in Selected Facilities in Kenya* showed that all facilities had their waste collected daily, except for safety boxes, which were collected when three-fours full or after one week, and none transported waste in wheeled covered carts (10). Another study showed that only 38% of the health facilities had storage areas that met the standard requirements, only 69% were found to have kept the storage area clean and removed waste before the maximum allowable storage time was exceeded, and 46% cleaned their transportation wheelbarrows at least once a day (15).

2.2.3 Waste Treatment and Disposal

Most HCFs in Kenya treat their waste on-site. The common practice in level 2 and level 3 HCFs is burning, either in the open or in a burning chamber. Only 62% of hospitals properly treat their waste before disposal (15). The common waste treatment method in hospitals is incineration, yet very few reach the recommended temperatures. A few hospitals with nonburn technology, such as microwaves and autoclaves, have had a challenge in the maintenance of the equipment. Most equipment is nonfunctional, and the hospitals have reverted to incineration, open burning, or offsite treatment.

The non-infectious waste is either composted in the hospital dump site or taken to the county dumping site. However, in many hospitals, non-infectious waste is incinerated together with infectious waste due to poor segregation practices. This overloads the treatment equipment causing regular breakdowns.

2.2.4 Pollution Control

Most health care waste in Kenya is treated either in open or controlled burning, releasing poisonous environmental emissions. Although burning chambers or the De Montfort incinerators are aesthetically acceptable, they too pollute the environment and should gradually be phased out.

A study has shown that incinerators in use in most hospitals do not have air pollution control devices; therefore, they are unable to meet smoke emission requirements. Reasonable effort was being made to ensure that waste treatment equipment was serviced, but schedules were irregular. Some incinerators were not functional at the time of the assessment (15).

The MOH has recommended using non-burn technology to treat infectious waste. Microwaves/ autoclaves will be installed in all hospitals to phase out the routine use of incinerators gradually (8).

CHAPTER 3: LEGAL, REGULATORY, AND POLICY FRAMEWORKS, INTERNATIONAL CONVENTIONS, AND TREATIES

3.1 International Treaties/Legal and Regulatory Frameworks

3.1.1 Stockholm Convention Guidelines on Open Burning

Low-temperature burning generates persistent organic pollutants (prohibited under the Stockholm convention) and has therefore been banned. Open burning should be minimized and/or eliminated as soon as possible. These guidelines recommend that non-combustible materials, loads containing high chlorine and bromide content, and catalytic metals, such as copper, iron, chromium, aluminum, and wet materials should not be burned. Where burning is unavoidable, sufficient air should be provided. It is also recommended that steady burning is maintained and smoldering is minimized (6).

3.1.2 Stockholm Convention Guidelines on Incineration

Kenya ratified the Stockholm convention on persistent organic pollutants in 2014 (16). Under Article 5 of the convention, the country has taken measures to further reduce the release of dioxins and furans with the goal of their continuing minimization and ultimate elimination. Annex C of the convention recognizes medical waste incinerators as a major source with "the potential for the comparatively high formation and release" of dioxins and furans.

3.1.3 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

This is the main global instrument for guiding the environmentally sound management of hazardous electronic waste (e-waste); hence its provisions need to be fully respected. Illegal trafficking in e-waste is a serious concern that requires urgent action. The Basel Convention encourages national, regional, and comprehensive global actions for the environmentally sound management of e-waste and end-of-life equipment through shared responsibilities and commitments from all concerned stakeholders (17).

3.1.4 Rio Declaration

States shall widely apply the precautionary approach according to their capabilities to protect the environment. Where there are threats of serious or irreversible damage, a lack of full scientific certainty shall not be used to postpone cost-effective measures to prevent environmental degradation.

3.1.5 SAICM Strategy and Sessional Paper No. 6 of 1999 on Environment and Development (UN)

The Government of Kenya recognizes the Johannesburg Plan of Implementation as adopted at the World Summit on Sustainable Development in 2002 and set the goal to ensure the sound management of chemicals worldwide by 2020. During the first International Conference on Chemicals Management held in February 2006, the world community adopted the SAICM tool to achieve this goal. Kenya has adopted SAICM as the standard tool for addressing chemical risks. SAICM also augments the Sessional Paper No. 6 of 1999 on Environment and Development (18).

3.1.6 WHO Core Principles for Managing Health Care Waste

WHO's core principles for managing health care waste require that donors and development

partners make provisions in their assistance programs to support the safe management and disposal of waste generated from their program activities; governments provide budgets for sound systems for managing health care waste; all stakeholders concerned with the provision of health services provide budgets for managing health care waste and build health worker capacities while protecting communities and the environment; the private sector reduce the toxicity of waste generated from their production activities and services; nongovernmental organizations advocate for HCWM; and all concerned advocate for the incorporation of waste management requirements in the plans and budgets (19).

3.2 National Legal and Regulatory Frameworks

The legal basis for the formulation and implementation of the *National Guidelines for Safe Management of Health Care Waste* is provided for by the Constitution of Kenya, 2010, the Public Health Act Cap. 242, the Environmental Management and Coordination Act (EMCA) 1999, and the Occupational Safety and Health Act 2007 of the Laws of Kenya. These guidelines will also operationalize the *Injection Safety and Medical Waste Management Policy, 2007.*

3.2.1 Legal Notice No. 101: Environmental (Impact Assessment and Audit) Regulations, 2003

It identifies and manages waste likely to be produced from proposed projects, including HCFs. It also makes provision for monitoring and evaluating waste management through environmental audits.

3.2.2 Legal Notice No. 121: Waste Management Regulations, 2006

These regulations focus on managing solid waste, industrial waste, hazardous waste, pesticides and toxic substances, and biomedical and radioactive substances. They provide details on the responsibility of the waste generator, adoption of cleaner production principles, waste handling and transportation, and waste treatment and disposal. These regulations may apply to asbestos and e-waste where electronics can be classified as hazardous.

3.2.3 Environmental Management and Coordination (Controlled Substances) Regulations, 2020

These regulations aim to regulate the production, trade, and use of controlled substances and products; provide for a system of data collection to facilitate compliance with relevant reporting requirements under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol); promote the use of ozone-friendly substances, products, equipment, and technology; and ensure the elimination of substances and products that deplete the ozone layer. Ozone-depleting substances are chemicals that destroy the atmosphere's stratospheric ozone layer by increasing the sun's ultraviolet rays to the earth's surface.

3.2.4 Legal Notice No. 120: Water Quality Regulations, 2006

The regulations address the pollution of water resources as well as their conservation. Any development likely to affect water resources (both the surface and groundwater) through pollution or use is required by law to comply with these regulations. They provide effluent discharge control standards for both surface and underground water.

3.2.5 Occupational Safety and Health Act, 2007

This Act applies to all workplaces where any person is either temporarily or permanently and lawfully at work. It stipulates the provisions for securing persons' health, safety, and welfare at

work. The Act also protects other people not at work against risks to safety and health arising out of or in connection with activities of the persons at work.

The Act deals with issues that include general duties of the occupier (persons in actual occupation of a workplace), machinery safety, general health provisions, general safety provisions, chemical safety, and general welfare provisions, among others.

3.2.6 Food, Drugs and Chemical Substances Act, Cap. 254, Laws of Kenya

It is an Act of Parliament that makes provision for the prevention of adulteration of food, drugs, and chemical substances and matters incidental thereto and connected therewith. This Act prohibits the disposal of chemical substances in a manner likely to cause contamination of food or water for human consumption or in a manner liable to be injurious or dangerous to the health of any person.

3.2.7 Agenda 21 on Environmental Conservation

Environmentally sound waste management must go beyond the mere safe disposal or recovery of waste generated and seek to address the root cause of the problem by attempting to change unsustainable production and consumption patterns. Accordingly, the framework for requisite action should be founded on a hierarchy of objectives and focused on the four major waste-related program areas: minimizing wastes; maximizing environmentally sound waste reuse and recycling; promoting environmentally sound waste disposal and treatment; and extending waste service coverage. Kenya is a signatory to Agenda 21.

3.2.8 Nairobi Declaration on Environmentally Sound Management of Electrical and Electronic Waste of 2007

This declaration addresses promotion and awareness at all levels on the issue of e-waste challenges and solutions; encourages and promotes the exchange of information and the transfer of best available technologies for the environmentally sound management of e-waste from developed countries to developing countries and countries with economies in transition; and promotes clean technology and green design for e-products, including the phase-out of hazardous substances used in the production of the products. In addition, the declaration promotes the phase-out of hazardous components within parts of electronic and electrical devices and further promotes product stewardship and extended producer responsibilities in the life-cycle management of electrical and electronic products (20).

3.2.9 Guidelines for e-Waste Management in Kenya, December 2010

These guidelines provide vital information in ensuring the development of a management framework needed to enable proper collection and recycling and to set the standards therein. The guidelines seek to ensure that the health and safety aspects of the people involved in the operations are protected, along with issues of emissions and waste emerging from such operations. The existing e-waste management systems from different stakeholders in the private sector should be streamlined to attract recyclers who will make the recycling process safe and efficient (21).

3.2.10 National Environment Management Authority (NEMA) Solid Waste Strategy

This strategy focuses on the formulation and enforcement of policies, laws, legislation, and economic instruments; addressing behaviors among members of the public through sensitization and awareness creation and educating the public; intensifying waste segregation efforts, including through partnerships; promoting resource recovery, including through the use of modern technology; and promoting waste for wealth creation and through promoting waste to energy generation projects (22).

3.2.11 Air Quality Regulations, 2014

The air quality regulations 2014 prohibit immediate or subsequent air pollution, emission of liquid, solid, or gaseous substances, or deposits of such substances in levels beyond what is permissible and prohibit the emission of priority air pollutants and particulate emissions into the atmosphere. The regulations prohibit any person from acting in a way that directly or indirectly causes or is likely to cause immediate or subsequent air pollution or emitting any liquid, solid, or gaseous substance, or depositing any such substance in levels exceeding those set out in the First Schedule. Owners of premises have an important role in ensuring compliance (23).

3.2.12 Plastic Waste Regulations

In 2017, the Government of Kenya banned the manufacture and use of plastic bags and imposed severe penalties against offenders. This ban has been 80% successful. The regulation allows the health sector to use specific gauge plastic bags to contain health care waste.

3.2.13 National e-Waste Management Strategy

The national e-Waste Management Strategy is a five-year plan covering 2019/20 to 2023/24. The strategy has five thematic areas aimed at resource mobilization for proper e-waste management, raising awareness, strengthening Kenya's e-waste coordination structures at national and county levels, putting in place a monitoring and evaluation mechanism, and promoting research and innovation in legal and regulatory frameworks for e-waste management in Kenya (24).

3.2.14 Environmental Management and Coordination (Toxic and Hazardous Chemicals and Materials Management) Regulations, 2019

The regulations are aimed at ensuring the protection of human health and the environment from adverse effects of toxic and hazardous industrial chemicals and materials, reducing risks posed by chemicals, providing for sound management of chemicals, and domesticating relevant provisions of international treaties, agreements, and conventions. The regulations apply to the production, manufacture, exportation, importation, transportation, distribution, storage, handling, and disposal of toxic and hazardous industrial chemicals and materials. These are newly developed regulations that need to be implemented at all levels.

3.2.15 National Policy on Injection Safety and Medical Waste Management, 2007

The overall objective of the policy is to ensure safe injection practices and proper coordination of the various sectoral initiatives in the field of environment. It provides a framework for ensuring that environmental considerations are successfully integrated in the country's overall economic and social development.

3.2.16 Constitution of Kenya, 2010

The Constitution of Kenya 2010, under articles 42 and 43, guarantees every person a right to a clean and healthy environment and the highest attainable standard of health. Further, Schedule 4 part 2 (g) of the Constitution assigns the County Governments the repsonsibility to manage refuse, dumps and solid waste disposal.

3.2.17 Public Health Act, Chapter 242, Laws of Kenya

The Public Health Act makes provisions for securing and maintaining health in Kenya by making it an offence for any landowner or occupier to engage in or allow engagement in activities that are likely to cause nuisance or are injurious or dangerous to health to be undertaken in their land.

3.2.18 Health Act No 21 of 2017

The Act, in its Part VIII, Sec. 68, provides that the national health system shall ensure that measures for managing environmental risk factors to curtail the occurrence and distribution of diseases are put in place and implemented. In particular, such measures shall target: the reduction of disease burden arising from poor environmental hygiene, sanitation, occupational exposure, and environmental pollution; the reduction of morbidity and mortality of waterborne, foodborne, and vector-transmitted diseases; and mitigation of the health effects of climate change.

3.2.19 Environmental Management and Coordination Act, 1999 (Amended 2015)

This Act aims to improve the legal and administrative management of medical waste to safeguard the patient, health care provider, community, and the environment. This will be achieved through training, behavior change communication, provision of adequate supplies for injection equipment, and proper waste management practices. All stakeholders will be expected to provide the necessary support in ensuring the achievement of injection safety and waste management objectives.

3.2.20 National IPC Policy 2021

It is designed to prevent harm caused by infection to patients, health workers, and the community. It is grounded in infectious disease, epidemiology, social science, and health system strengthening. IPC occupies a unique position in patient safety and quality universal health coverage (UHC) because it is relevant to health workers and patients at every health care encounter (25).

3.2.21 Kenya Environmental Sanitation and Hygiene Policy 2016-2030

The Kenya Environmental Sanitation and Hygiene Policy 2016–2030 provides broad guidelines to state and non-state actors at all levels to achieve universal access to improved sanitation, leading to improved quality of life for the people. Primarily, the policy aims to increase the proportion of the population with access to improved sanitation to 100% by 2030 and ensure a clean and healthy environment for all in Kenya.

The Government of Kenya recognizes the range of environmental effects that result from different types of sanitation systems and will seek to minimize their adverse impacts while maximizing their positive effects. One of the key objectives of this policy is to protect the environment from pollution and its negative impact on human health. The national and county governments shall therefore ensure that sanitation systems are environmentally sound and that the technologies used to uphold the right of present and future generations to a clean, healthy, and pollution-free environment. The National Government, through the National Environmental Sanitation Coordinating and Regulatory Authority, in collaboration with NEMA and the Water Services Regulatory Board shall provide guidelines for solid and liquid waste management. Monitoring and surveillance will be increased and undertaken systematically to help prevent environmental pollution from liquid and solid wastes. In cases where inappropriate waste management systems have negative environmental impacts, the particular choice of technology will be weighed against the unimproved or less elaborate waste management practices.

3.2.22 Sustainable Solid Waste Management Policy

The sustainable solid waste management policy aims at reducing pollution, improving public health, and creating jobs. This will be achieved by creating a favorable regulatory environment, establishing systems for systematic waste segregation, collection, reuse, recycling, composting waste materials, and ensuring transformation of waste into useful sources of new products or energy. The policy also supports the creation of planning, financing, technical and governance capacities that county governments need to deliver on their waste management mandate to reduce pollution, improve public health, and create jobs.

3.2.23 Sustainable Waste Management Act 2022

Requires the MOH to reduce generated waste, increase reuse, promote recycling and recovery,

ensure that waste is treated before disposal, eliminate use of toxic materials, reduce toxic emissions, and monitor product life cycle. The Cabinet Secretary is required to set standards for waste pickers, put in place quality certification standards for organic compost, operating standards for dumpsites, set standards for classifying engineered sanitary landfills, promote the formation of waste collection, material recovery and recycling cooperative organizations, and facilitate waste to energy and manure projects. Counties are required to implement a devolved waste management function in accordance with national laws, policies, and regulations and to ensure that waste is disposed of within their borders. The law encourages county governments to form clusters and pool resources for effective waste management, provide well-managed collection centers, and improve infrastructure to promote segregation, collection, reuse, and material recovery. In addition, counties are expected to establish county waste management funds and create investment opportunities.

3.3 General HCWM Guiding Principles and Strategies

3.3.1 Guiding Principles for HCWM

Given the challenge posed by health care waste and its management, the health sector activities are guided by the following guiding principles:

i. Every person has a right to a clean and healthy environment as enshrined in the Constitution of Kenya 2010.

ii. Preventing the health risks associated with exposure to health care waste for both health workers and the public by promoting environmentally sound management policies for health care waste.

iii. Compliance with the Waste Management Regulation of 2006 (EMCA, 1999) and other relevant laws.

iv. Supporting global efforts to reduce the amount of noxious emissions released into the atmosphere to reduce disease and defer the onset of global change.

3.3.2 Basic Principles of Integrated Waste Management

This refers to a waste management system in the context of social and ecological dynamics of material flow, which employs all suitable techniques that are compatible with proper environmental and health safeguards. It is based on seven basic principles of integrated waste management, which include:

i. **Duty of care principle:** Any organization that generates waste has a duty to dispose of the waste safely.

ii. **Sustainable development:** Basic resources should be used by man in a way that they are not irreversibly depleted.

iii. **Precautionary approach:** One must always assume that waste is hazardous until shown to be safe.

iv. **Rational utilization of resources:** Resources should be allocated to those activities that result in the greatest improvement in relation to the input.

v. **Responsibility for waste generator:** The waste generator should be responsible for the proper management of the waste.

vi. **Polluter-pays principle:** Waste producers are legally and financially responsible for the safe handling and environmentally sound disposal of the waste they produce.

vii. **Proximity principle:** Treatment and disposal of hazardous waste occur at the closest possible location to its source.

CHAPTER 4: CHARACTERIZATION AND EFFECTS OF HEALTH CARE WASTE

Health care waste includes all waste generated from HCFs, laboratories, and research centers. In addition, it contains such waste originating from "minor" and/or "scattered" sources.

4.1 Categories of Health Care Waste

Health care wastes are categorized as infectious, pathological, sharps, pharmaceutical, radioactive, genotoxic/cytotoxic, non-infectious, pressurized containers, chemical waste, and waste with high content of heavy metals (26).

4.1.1 Infectious Waste

This category of waste is suspected of containing pathogenic microorganisms. It includes:

i. Cultures and stocks of infectious agents from laboratory work.

ii. Waste from surgery and autopsies on patients with infectious diseases, (e.g., tissues and materials or equipment that have been in contact with blood or other body fluids).

iii. Waste from patients in isolation wards (e.g., excreta, dressings from infected or surgical wounds, clothes soiled with human blood or other body fluids).

iv. Waste that has been in contact with patients undergoing hemodialysis (e.g., dialysis equipment, such as tubing and filters, disposable towels, gowns, aprons, gloves, and laboratory coats, among others).

v. Any other instruments or materials used at home, such as needles and syringes (for treatment of diabetes and intravenous drug use).

4.1.2 Pathological Waste/Anatomical Wastes

Any identifiable body parts, including specimens, biopsy specimens, and tissues taken during surgery or autopsy and/or resulting from investigations or treatment of a patient, and consists of tissues, organs, body parts, human fetuses, and animal carcasses; blood and blood products; dead infected animals from laboratories; and body fluids. This category should be considered a subcategory of infectious waste, even though it may include anatomical parts.

4.1.3 Sharps

Sharps are items that could cause cuts or puncture skin and may include needles, hypodermic needles, scalpels and other blades, knives, infusion sets, saws, broken glass and nails, among others (27). Whether or not they are infected, such items should be considered as highly hazardous health care waste.

4.1.4 Pharmaceutical Waste

Pharmaceutical waste includes cytotoxic, expired, spilt, and contaminated pharmaceutical products. It also includes drugs, vaccines, and sera that are no longer needed. The category also includes discarded items used in handling pharmaceuticals, such as bottles or boxes with residues and drug vials.

4.1.5 Genotoxic Wastes

Genotoxic waste is highly hazardous and may have carcinogenic properties. It raises serious safety problems inside hospitals and after disposal and should be given special attention. Genotoxic waste may include certain cytotoxic drugs often used in cancer therapy, vomit, urine, or feces from patients treated with cytotoxic drugs, chemicals, and radioactive material.

4.1.6 Radioactive Waste

Radioactive waste includes solid, liquid, and gaseous materials contaminated with radionuclide. It is produced as a result of procedures, such as in-vitro analysis of body tissue and fluid, in-vivo organ imaging and tumor localization, and various investigative and therapeutic practices. In addition, the waste is produced from health care and research activities involving radionuclide and related activities, such as equipment maintenance and storage.

4.1.7 Chemical Waste

Chemical waste consists of discarded solid, liquid, and gaseous chemicals, such as diagnostic and experimental work and cleaning, housekeeping, and disinfecting procedures. Chemical waste from health care may be hazardous or non-hazardous. In protecting health, it is considered hazardous if it is toxic, corrosive, flammable, reactive, and/or genotoxic. The non-hazardous chemical waste consists of compounds with none of the above properties. These are chemicals commonly used in the maintenance of hygiene at health facilities, (e.g., disinfectants, detergents, insecticides, and engine oils for machinery and equipment).

4.1.8 Waste with Heavy Metal Content

This category includes waste containing mercury, cadmium, lead, and drugs containing arsenic, among others. Drugs containing arsenic should be treated as pharmaceutical waste. Mercury wastes are typically generated by spillage from broken clinical equipment (their volume decreases with the substitution of solid-state electronic sensing instruments, [i.e., thermometers, blood pressure gauges, etc.]), residues from dentistry procedures, and fluorescent tubes.

Whenever possible, spilt drops of mercury should be recovered. Cadmium waste comes mainly from discarded batteries. It should be noted that certain "reinforced wood panels" used in radiation proofing of X-ray and diagnostic departments may contain lead.

4.1.9 Non-Infectious Waste/General Waste

It consists of recyclable, compostable, and non-recyclable waste, including waste generated from offices, kitchens, packaging material, and stores. It is similar to domestic waste.

4.2 Sources of Health Care Waste

There is a wide variety of sources of health care waste, such as hospitals, clinics, other health care institutions, biomedical research facilities, home-based care, blood banks, veterinary clinics, medical schools, ambulatory services, vaccine program etc. At the facility level, the waste composition is often characteristic of the source type. Other sources of health care wastes include emergency health care services, blood transfusion centers, outreach health services, funeral homes and mortuaries, laboratories, and voluntary counseling and testing centers.

4.2.1 Sources of Health Care Waste Within an HCF

The sources include the following areas: medical wards, surgical wards, operating theatre, maternity unit, recovery and intensive care, isolation wards, dialysis units, oncology unit, outpatient clinic, emergency room, dressing and injection room, radiology, medical laboratories, research, nuclear medicine, blood bank, pharmacy and central sterile supply department. The list of sources of health care waste outlined above varies according to the facility type.

CHAPTER 5: HEALTH CARE WASTE MANAGEMENT PLANNING

5.1 Preliminary Planning for HCWM

Planning for HCWM involves (4):

i. Setting the management objectives.

ii. Defining a strategy that will facilitate careful implementation of the necessary measures and the appropriate allocation of resources according to the identified priorities. An appropriate, safe, cost-effective strategy will be concerned principally with segregation, transport, recycling, treatment, and disposal options.

iii. Conducting surveys on waste generation shall provide baseline information on the quantities and classes of waste generated. A national survey of health care waste will provide the relevant agency with a basis for identifying actions on a community, sub-county, county, and national levels, considering conditions, needs, and possibilities.

iv. Setting the targets for waste minimization, reuse, recycling, and cost reduction. A sample sheet for the assessment of waste generation is provided in annex 1.

v. Proper management of health care waste depends largely on good administration and organization.

vi. Adequate legislation and financing are required.

vii. Active participation by trained and informed staff is necessary.

5.2 Steps for Developing a Waste Management Plan

Based on waste generation surveys and recommendations, the waste management focal person should estimate the amount and type of waste generated by the Waste Management Team (WMT).

Existing practices should then be evaluated in light of these national guidelines, and recommendations should be made to the waste management focal person on how the guidelines can be implemented in each department.

The following issues should be addressed:

5.2.1 Location and Organization of Collection and Storage Facilities

i. Drawings of the establishment showing designated waste holding sites for every ward and department in the hospital.

ii. Each bag site shall be appropriately designated for health care waste or other waste.

iii. The drawings should show the paths that should be used during waste transportation, among other inclusions.

5.2.2 Design Specifications

This should show the type of bag holder, type of trolley or wheeled container, and sharps containers, with their specifications.

5.2.3 Required Financial, Material, and Human Resources

It is a best practice that donors, development partners, governments, and all relevant stakeholders make provisions for their assistance and/or other programs to support the safe management and disposal of waste generated from their program activities. Nongovernmental organizations and all other concerned agencies should advocate for incorporating HCWM requirements in the plans and budgets.

Allocating insufficient financial resources to the HCWM program has costs in terms of morbidity and mortality as well as the environmental damage that will, in the end, negatively impact people's

health. The reasons to invest in HCWM are ethical, legal, and financial; therefore, multi-year HCWM plans should be developed, and costs and resources mobilized to support implementation (annex 10).

5.2.4 Procedures and Practices

i. A flow chart showing procedures for waste minimization, segregation, storage, transportation, and disposal should be drawn.

ii. The flowchart should include an outline of monitoring procedures for different waste.

iii. Emergency procedures should be clearly drawn.

5.3 Implementation of the Waste Management Plan

The overall responsibility of implementation lies with the head of the facility. It involves the following steps:

i. Interim measures should be introduced as a precursor to the complete implementation of the new waste management system. They should be developed by the waste management focal person in collaboration with the WMT and be appended to the plan.

ii. A Gantt chart should be developed showing dates of implementation of each part of the new system.

iii. Provision for future expansion of the hospital or of waste storage facilities should be made.

Note: The head of the facility should deploy personnel to the posts with responsibility for waste management. The PHO, in liaison with the IPC focal person, shall organize and supervise training programs for all staff on HCWM. The WMT should review the waste management plan annually and initiate changes necessary to upgrade the system. The team should also design and implement monitoring and evaluation mechanisms for the plan. The head of the facility should prepare an annual report.

5.4 Stakeholder Roles and Responsibilities

5.4.1 Roles and Responsibilities of the National-Level HCWM Team

According to the Public Health Act, Cap 242, Laws of Kenya, the responsibility of managing health care waste lies with the person who generates the waste. HCWM is, however, a cross-cutting issue, with many stakeholder departments having critical roles to play. Due to its cross-cutting nature, the MOH will strengthen the HCWM Technical Working Group (TWG), chaired by the department responsible for environmental health, and all other relevant departments, agencies, faith-based and private health organizations will have representation on the TWG. The TWG will have its terms of reference. The same arrangements shall be replicated in all devolved units.

The MOH will have the responsibility of:

i. Formulating policies and guidelines governing HCWM at different levels of care in the health sector.

ii. Mobilizing resources to ensure that health care waste is properly managed.

iii. Establishing and operationalizing structures through which health care waste will be managed.

iv. Putting in place a monitoring and evaluation framework for HCWM, including generating necessary tools for use.

v. Conducting comprehensive HCWM needs assessment.

vi. Developing in-service training curriculum for staff tailored to required core competencies.

vii. Conducting training of health workers in HCWM.

viii. Providing technical assistance to devolved units.

ix. Strengthening compliance to HCWM standards and best practices.

x. Selecting waste treatment technology for different levels of care in consultation with frontline health workers and including the technology on lists of essential equipment.

xi. Developing multi-year strategic plans and evaluating their performance.

xii. Developing technical specifications for HCWM commodities for use in the health sector and including the items on lists of essential medical supplies.

5.4.2 Roles and Responsibilities of the County-Level HCWM Team

i. Setting up waste treatment plants at the county and sub-county levels, including through public-private partnerships.

ii. Providing continuing professional development among health workers in the county, including those in the private sector.

iii. Conducting supportive technical supervision at sub-county and facility levels.

iv. Supporting facilities to achieve recommended standards and accreditation status.

v. Conducting county and sub-county performance reviews and making recommendations on how the situation can be improved.

vi. Developing multi-year HCWM strategic plans and evaluating their performance.

vii. Ensuring adequate budgetary allocation towards HCWM across the county.

viii. Mobilizing resources towards proper management of health care waste through health development partners' support.

ix. Specifying HCWM commodities for use in the health sector and including the items on lists of essential health supplies.

x. Conducting county-based research in HCWM to inform policy.

xi. Inspecting health facilities to identify and mitigate risks associated with health care waste.

xii. Generating risk mitigation plans and follow-up as necessary to ensure that action has been taken.

xiii. Conducting periodic audits to identify system gaps and take corrective action.

xiv. Conducting health education for the public on HCWM.

xv. Building capacity of the sub-county health leadership and staff to take up HCWM responsibilities, such as periodic HCWM audits, application of the IRAT, selection of health care waste treatment technologies, etc.

5.4.3 Roles and Responsibilities of Sub-County-Level HCWM Team

i. Inspecting health facilities to identify and mitigate risks associated with health care waste.

ii. Conducting periodic audits to identify system gaps and take corrective action.

iii. Conducting health education to the public on HCWM.

iv. Conducting supportive technical supervision.

v. Supporting facilities to achieve recommended standards and accreditation status.

vi. Building capacity of the health facility staff to take up HCWM responsibilities, such as periodic HCWM audits, application of IRAT, selection of health care waste treatment technologies, etc.

5.4.4 Roles and Responsibilities for Heads of Institutions

The heads of health care establishments are responsible for the safe disposal of health care waste generated in their establishments.

They should therefore take all reasonable measures to:

i. Prevent health care waste from causing environmental pollution or adverse effects on human health.

ii. Ensure that health care waste is adequately segregated and safely packed, especially in the case of sharps, which should be packed in puncture-proof containers.

iii. Ensure that bags or containers of health care waste are handled only by those officially licensed to transport and/or dispose of such waste.

iv. Ensure that a transfer note describing the waste is handed to the recipient when the waste is transferred.

v. Check for proof that the driver of the collection vehicle is aware of the procedures governing the transport of hazardous goods. Such proof shall include but not be limited to an authorization letter or a certificate indicating a form of training in the transportation of health care waste.

vi. Where on-site treatment is impossible or uneconomical, cold storage facilities should be provided, and there should be a regular collection of the health care waste by a contractor who has access to licensed incineration facilities.

vii. When an injection is carried out at a patient's home, the practitioner is responsible for disposing of syringes, needles, and other items, including incontinence pads and swabs.

viii. The patient or the caregiver shall be responsible for the safe disposal of health care waste in the case of home-based treatment, for example, in the case of diabetics.

ix. Ensure that ambulances are equipped with puncture-proof containers of appropriate size, mainly for infectious waste and sharps.

x. Ensure that staff are trained in the safe handling of health care waste.

xi. Ensure that any contractual arrangement for research by workers outside the establishment should include adequate provisions for the safe handling and disposal of waste.

5.4.5 Roles and Responsibilities for the Facility Management Team

The facility management team's roles and responsibilities are summarized in table 5.1.

Table 5.1. Roles and responsibilities of facility-based health managers by cadre

S. No	Officeholder	Roles and responsibilities
1	Hospital Medical Superintendent	Forming a waste management team. Allocating adequate financial and human resources. Capacity building of staff on HCWM.
2	Heads of Hospital Departments	Liaising with the waste management focal person. Monitoring waste management practices. Ensuring the availability of HCWM commodities.
3	Infection Prevention and Control Officer	Identifying training needs of health workers on HCWM. Organizing and supervising staff training courses on safe waste management. Ensuring adherence to post-exposure prophylaxis (PEP) protocols.
4	Head of Pharmacy	Controlling pharmaceutical waste generation through appropriate stock management.
5	Radiation Officer	Controlling radioactive waste. Liaising with the Radiation Protection Board for guidelines on procurement and disposal. Undertaking on-the-job training for staff in handling radioactive waste.

S. No	Officeholder	Roles and responsibilities
6	Nursing Officer in Charge	Participating in the continuous training of staff in the management of health care waste. Providing supportive supervision for staff in the control of health care waste.
7	Public Health Officer (Waste Management Focal Person)	Undertaking a baseline survey on the amount and type of waste generated by facilities using the IRAT. Drawing up waste management plans. Directly supervising the collection, segregation, storage, transportation, treatment, and disposal of health care waste. Liaising with all departments to raise the profile of HCWM. Facilitating the drafting of emergency procedures and dissemination to staff. Record keeping

5.5 Management of Health Care Waste from Scattered Small Sources

The scope of application in the management of health care waste from scattered small sources shall include but not be limited to private medical or dental practitioners, research facilities, nursing homes, home treatment, ambulance services, and veterinary centers.

The options for the safe collection, transportation, treatment, and disposal of health care waste from small sources that do not treat their waste include the following:

i. The concerned authority or licensed private contractor should collect the waste for treatment and take it to a local hospital incinerator or other treatment facility.

ii. An authorized private contractor collects and treats the waste at the contractor's treatment facility.

5.5.1 Marking of Waste

i. All waste should be clearly marked with self-adhesive or tie-on labels indicating source and type.

ii. Infectious, pathological, and sharps waste should also be marked with international biohazard symbols. Chemicals should also be marked with the appropriate international chemical hazard symbol. Radioactive waste must be labelled with the appropriate warning symbol as provided in annexes 3a and 3b.

iii. Any contract for the collection by a private registered health care waste carrier/handler should identify the disposal or treatment facility to be used.

5.5.2 Dedicated Vehicles

i. Vessels carrying health care waste should be closed, leakproof, and clearly labelled with a symbol for hazardous waste (transportation vessel specifications) and written words in English and Kiswahili (22).

ii. The service provider shall use dedicated vessels approved by the unit responsible for HCWM in that local health authority and licensed by NEMA for collecting and transporting infectious/hazardous waste.

iii. The vessels for the collection, transportation, and conveyance of waste shall follow the time schedules and routes approved by NEMA from the point of collection to the treatment sites and disposal or any other plant handling health care waste.

iv. The collection and transportation of such waste should be conducted in such a manner that will not cause scattering, escaping, and/or flowing out of the waste.

v. The vessels and equipment for the transportation of waste are in such a state that shall not cause the scattering of, escaping of, or flowing out of the waste, or emitting of noxious smells from the waste.

vi. The service provider or their agent(s) shall always possess, during transportation of the waste, a duly filled tracking document as set out in Form III of the First Schedule to the Waste Management Regulations, 2006, and shall produce the same on demand to any law enforcement officer.

vii. Any person licensed to transport waste shall collect waste from the designated area of operations or storage areas and shall deliver such waste to the designated storage site, treatment, or disposal sites.

viii. Any storage of waste before treatment or collection for off-site disposal should be in a secure location designated for the purpose.

5.6 Contingency and Emergency Planning

5.6.1 Considerations in Contingency Planning

All health facilities should develop a contingency plan with consideration being given to the following:

i. Adequate financial and human resources should be available for easy mobilization in time of need.

ii. The HCWM plan should also include a contingency plan for emergencies.

iii. The plan should include, but not be limited to, operational procedures to be followed when situations such as the following arise:

- Spill of liquid infectious waste – clean-up procedures, protection of personnel, and disposal of spill residue.
- Rupture of plastic bags (or other loss of containment) – clean up procedures, protection of personnel, and repackaging of waste.
- Equipment failure - alternative arrangements for waste storage and treatment (e.g., off-site treatment).
- Natural disasters, such as fire, floods, and earthquakes.
- Biohazard risks.
- Accidental exposure management and post-exposure decontamination.
- Emergency medical treatment of exposed and injured persons.
- Medical surveillance of exposed persons.
- Clinical management of exposed persons.
- Epidemiological investigations.
- Identification of high-risk organisms.
- Insurance issues.

5.6.2 Contingency Planning Process

i. Draw up a management plan for each class of incidents (SOP).

ii. The Health Facility Management Team (HFMT) shall ensure the existence of:

- Safety measures (e.g., PPE)
- Emergency response (e.g., in case of spills or occupational injuries)

iii. The HFMT should make available and display information on safety practices, evacuation plans, and emergency response in case of incidents or accidents associated with HCWM (e.g., occupational

iv. injuries, spillage of hazardous waste, and exposure to cytotoxic chemicals and drugs). vi. In case of disease outbreaks (e.g., cholera) or during close-down for planned maintenance (e.g., safe procedures for handling laboratory wastes in case of breakdown of the autoclave), the facility shall plan for alternative measures,

v. The HFMT shall maintain an accident/occurrence logbook.

vi. The HFMT should ensure that health surveillance and control are conducted (e.g., immunization against HBV, typhoid, and tetanus) and provision of information on rapid access to PEP (28).

vii. The HFMT should ensure the periodic review of the contingency and emergency plans.

- » In case of a breakdown of health care waste treatment units, or
- » During close-down for planned maintenance (e.g., safe procedures for handling laboratory waste in case of breakdown of the autoclave).

5.6.3 Planning for Emergency Situations

Emergency situations to be planned for include:

i. Identification of at-risk personnel and populations.

ii. Mapping of high-risk areas, (e.g., laboratories, storage areas).

iii. Identification of responsible personnel and their duties, (e.g., bio-safety officers, local health authority, clinicians, police, and fire officers).

iv. List of clinical treatment and isolation facilities that can receive infected and exposed persons.

v. List of sources of immune serum, vaccines, drugs, and special equipment and supplies.

vi. Provision of emergency equipment, (e.g., decontamination equipment).

5.6.4 Emergency Equipment

The following emergency equipment should be made available in every facility:

i. First aid kit, including universal and special antidotes.

ii. Full protective clothing (one-piece coveralls, gloves, and head covering for highly infectious micro-organisms).

iii. Full-face respirators with appropriate chemical and particulate filter canisters.

iv. Room disinfection apparatus, (e.g., sprays and formaldehyde vaporizers).

v. Tools (e.g., hammers, axes, spanners, ladders, and ropes).

vi. Hazardous area demarcation equipment and notices.

5.6.5 Reporting Accidents and Incidents

i. All waste management staff should be trained in emergency response and made aware of the correct procedure for prompt reporting.

ii. Accidents or incidents, including near-misses, spillages, damaged containers, inappropriate segregation, and any incidents involving sharps should be reported to the Waste Management Officer (if waste is involved) or to another designated person.

iii. The report should include details of:

- » The nature and cause of the accident or incident
- » The place and time of the accident or incident
- » The staff who were directly involved

- Any other relevant circumstances
- Action to prevent a recurrence
- Accident documentation.

5.7 Role of Public-Private Partnership in HCWM

The rationale for the public-private partnership (PPP) initiative is to establish a long-term contract between a private party and a government entity. The contract is meant to provide a public service in which the private party bears significant risk and management responsibility and remuneration is linked to its performance.

Kenya's commitment to advancing from burn to non-burn technologies in HCWM requires support from the private sector to ensure its success. Bringing private-sector participation to developing public infrastructure will bring greater efficiencies and improved service delivery. Such an initiative will help bridge the financial gaps experienced by the government in addressing issues related to HCWM.

It is worth noting that the HCWM PPP opportunities in Kenya are not fully exploited, yet this is a virgin market considering that most health facilities lack adequate capacity to manage the entire health care waste on their own. In the recent past, the country has witnessed private stakeholders investing heavily in managing health care waste; however, this has not been able to explore the entire HCWM PPP market.

The probable PPP models to be implemented would include:

- **"Service contract outsourcing,"** whose internal control can be either public or private.
- **"Management contract"** funded and owned by the public sector but managed by the private sector.
- **"Leasing contract,"** which is similar to a management contract.
- **"Concession of existing network,"** which is managed and funded by the private sector but still publicly owned.
- **"Build, Operate. and Transfer,"** which is owned by both the public and private sectors.
- "**Divestiture privatization,"** which is fully owned, funded, and managed by the private sector.

When establishing the PPP initiative, consideration should be given to various factors, including value-for-money, affordability, commercial viability, manageability, and acceptability. The Public-Private Partnerships Act 2013 should guide any HCWM PPP initiative.

CHAPTER 6: WASTE MINIMIZATION, SEGREGATION, RECYCLING, AND REUSE

In HCWM, minimization and segregation are important issues that require attention due to the risk of needle-stick injuries and potential acquisition of HBV, hepatitis C virus, HIV, and other bloodborne diseases associated with inappropriate sharps management; associated increased costs of waste management; and community concern about environmental issues (2, 7, 29, 30).

The strategies include:

- **Waste minimization:** The quantities of health care waste generated need to be reduced and the hazardous elements minimized or eliminated.
- **Waste segregation:** The process of separating different categories of waste into color-coded bags/bins.
- **Recycling:** Reprocessing these materials to make new products as an alternative to disposal.
- **Resource recovery:** Waste can be described as a lost resource potentially awaiting recovery. Recovery schemes should be put in place to salvage items, such as paper, glass, and metal.

6.1 Minimization of Waste

Significant reduction of the waste generated in health care establishments and research facilities can be encouraged by the implementation of certain policies and practices, including the following:

6.1.1 Source Reduction

i. Avoid the generation of sharps waste by promoting the use of oral and other alternative formulations.
ii. Take off all specimens at the same sitting to minimize quantities of used PPEs.
iii. Minimize purchases especially through green procurement. Ensure selection/specification of good quality supplies, and less hazardous.
iv. Use of physical rather than chemical cleaning methods (e.g., steam disinfection instead of chemical disinfection).
v. Segregate all waste at the source to avoid contamination.
vi. Prevent wastage of products during use, (e.g., in nursing and cleaning activities).

6.1.2 Recyclable and Reuse of Products

i. The facility should give preference to reusable products.
ii. Use of materials that may be recycled, either on-site or off-site.
iii. Encourage extended producer responsibility.

6.1.3 Minimization and Control of the Use of Chemicals

i. Purchasing of hazardous chemicals should be centralized.
ii. Monitoring of chemical flows at the health facility from receipt as raw materials to disposal as hazardous wastes is essential.
iii. Product substitution - substitute products with much waste-producing characteristics with one that produces less waste.
iv. Product changes - use better, safer, more efficient products.

v. Procedural changes – change to procedures that produce less waste.

6.1.4 Segregation of Chemical Waste

Careful segregation (separation) of waste matter into different categories helps minimize hazardous waste quantities.

6.1.5 Avoiding Expiries through Good Stock Management of Chemical and Pharmaceutical Products

i. Stock management of chemical and pharmaceutical products, especially for the unstable products.
ii. Use the oldest batch of a product first (first in, first out - FIFO).
iii. Use of the product that will expire first (first to expire, first out - FEFO)
iv. Use all the contents of each container.
v. Check the manufacture and expiry date of all products at the time of delivery.

6.2 Safe Reuse and Recycling

6.2.1 Reuse


Plastic Food Containers


Reusable Water Bottles


Plastic Medicine Containers


Water Bottles


Carton Boxes

Figure 6.1: Samples of reusable bottles

6.2.2 Recycling

6.2.2.1 What can be recycled?

The items that can be recycled include boxes and cartons, paper, newspapers and magazines, old phone directories, ink cartridges, plastic bottles, in vitro fertilization bottles, assorted plastics, used kitchen oil, food waste, glass bottles, car batteries, assorted metals, tin cans and scrap wood, among others that are not contaminated with blood or body fluids. Items suitable for composting and bio-digestion include food remains (food waste) 31).

6.2.2.2 Setting up Recycling Facilities

i. Identify channels for recycling waste and map vendors dealing in different types of recyclable materials as part of the process.

ii. Establish a system for segregating recyclables; adopt international color codes and symbols for recyclables as much as possible.

iii. Assign staff responsibility for recycling.

iv. Provide the necessary items for waste collection according to color codes and symbols.

v. Segregate what is recyclable.

vi. Where appropriate, compress the recyclables to allow more waste to be collected using the same transport (i.e., compact your waste).

vii. Establish a system for recording recyclable waste.

viii. Make it convenient.

ix. Track waste disposal savings and income from the waste sale.

x. Set progressive targets.

xi. Publicize /reward success.

xii. Regularly review progress.

Figure 6.2: Receptacles for recyclable plastics

6.2.2.3 Further Guidance on Recycling

Recycling is the process of converting waste materials into new materials and objects. The recovery of energy from waste materials is often included in this concept. The recyclability of a material depends on its ability to reacquire the properties it had in its original state. It is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions. It can also prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, reducing energy use, air pollution (from incineration), and water pollution (from landfilling).

For successful recycling:

i. Segregate at the source.

ii. Site bins carefully, with bins for hazardous/infectious waste being placed where only medical staff can reach them.

iii. Well-segregated waste sells for a higher price.

iv. A simpler system may be more successful.

v. Publicize the financial benefits of recycling.

vi. Buy recycled products wherever possible.

vii. Motivate staff through:

- » Competition and recognition for achievement.
- » Economic incentives (especially for housekeeping staff).
- » Label bins with the value of waste/cost of disposal.

viii. Use arts and crafts as patient therapy, especially in rehabilitating burn patients

ix. Regularly review recycling options (annex 11).

6.2.2.4 Symbols for recyclable plastics

Figure 6.3: Symbol for paper recycling

6.3 Waste Segregation

x. Waste segregation is separating different categories of waste into color-coded bags/bins. Waste segregation should always be the responsibility of the waste producer and should occur as close as possible to where the waste is generated. The segregation should be maintained in storage areas during transportation, treatment, and disposal (14).

6.3.1 Importance of Waste Segregation

i. Minimizes the amount of waste that has the potential to cause disease.

ii. For economic reasons, unsegregated waste is unnecessarily expensive because more complex treatment methods are used because all waste is then assumed to be hazardous.

iii. Waste that can be recycled is easy to recognize and hand over to the right vendors.

iv. Different categories of waste require different methods of treatment. The most cost-effective method is applied to a specific category of waste, thus saving on costs.

v. Reduces accidents and injuries, such as injuries from sharps.

6.3.2 How to Start Waste Segregation at a Health Facility

Starting waste segregation calls for an understanding of what needs to be done. To do this:

i. The PHO should coordinate HCWM activities and programs.

ii. There should be sensitization of health care workers and other facility staff on waste segregation.

iii. The different categories of waste that need to be segregated should be identified according to the type of risk.

iv. There should be agreement on the methods to be used to segregate waste, such as color codes and symbols, types of waste bins and liners that will be used, and the full range of waste management items required, in conformity with national guidelines and SOPs.

v. A walk through should be done at the health facility to identify all service delivery areas that generate waste, types of waste generated at each service point, and sizes and colors of waste bins and liners that will be required.

vi. A staff training needs assessment should be conducted.

vii. The identification of vendors interested in recyclables and where it makes business sense should be done, followed by signing memoranda of understanding for handing over segregated waste.

viii. Staff should be trained in waste segregation and other aspects of waste management.

ix. Job aids reminding staff where to place different items once they are declared waste should be developed and made available at waste-generating points.

x. Additional/extra storage bins for storing segregated waste whenever bins are full should be obtained, with color codes being maintained.

xi. A waste segregation exercise should be started.

6.3.3 Segregation of Waste According to Color Codes

6.3.3.1 Color-Coded Bags/Containers

The most appropriate way of identifying the categories of health care waste is by separating the waste into color-coded plastic bags or containers. The recommended color-coding scheme is provided in annex 2.

- Food waste - White
- General waste - Black
- Sharps waste - Yellow/white safety boxes
- Infectious waste - Yellow
- Pathological waste - Red
- Pharmaceutical waste - Brown
- Recyclable Waste - Clear bags

Note: Recyclable waste should be separated from general waste.

Figure 6.4: Waste segregation chart

6.3.3.2 Other Segregation Requirements

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

i. General (non-infectious) health care waste can join the stream of domestic refuse for disposal if none can be salvaged for reuse or recycling..

ii. All sharps should be collected together, regardless of whether they are contaminated.

6.3.3.3 Special Considerations for Waste Segregation

a) Pathological waste

Pathological waste, (e.g., culture plates, blood samples, tissues, organs, and sputum) should, whenever possible:

i. Be packaged in bags that are compatible with the proposed treatment process. Bags suitable for autoclaving are recommended.

ii. Be immediately autoclaved.

iii. The autoclaved waste should be destined to the appropriate facility waste treatment technique.

b) Waste bags destined for incineration

Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.

c) Collection of cytotoxic waste

Cytotoxic waste, most of which is produced at major hospitals or research facilities, should be collected in strong, leak-proof containers clearly labelled "Cytotoxic Wastes."

d) Small amounts of chemical or pharmaceutical waste

Before treatment, pharmaceutical waste should be labelled and sorted using proper PPE. Pharmaceutical waste should be separated according to the form (solids, semi-solids, powders, liquids, or aerosols) or by active ingredient, depending on the treatment options available. Special consideration is needed for controlled substances (e.g., narcotics), anti-infective drugs, antineoplastic and cytotoxic drugs, and disinfectants.

Several options exist for small quantities of pharmaceutical waste:

» Return of expired pharmaceuticals to the donor or manufacturer.

» Encapsulation and burial in a sanitary landfill.

» Chemical decomposition in accordance with manufacturers' recommendations if chemical expertise materials are available.

» Dilution in large amounts of water and discharge into a sewer for moderate quantities of relatively mild liquid or semi-liquid pharmaceuticals, such as solutions containing vitamins, cough syrups, intravenous solutions, and eye drops.

Antibiotics or cytotoxic drugs should not be discharged into municipal sewers or water courses. For large quantities of pharmaceutical waste, the options available include:

» Encapsulation and burial in sanitary landfills.

» Incineration in kilns equipped with pollution control devices designed for industrial waste and that operate at high temperatures.

» Dilution and sewer discharge for relatively harmless liquids, such as intravenous fluids (salts, amino acids, and glucose).

Some emerging technologies include large-scale ozonation and decomposition using iron-tetra-amido macrocyclic ligand (Fe-TAML) peroxide catalysis. These technologies should be evaluated carefully because many do not have an established record for treated health care-related pharmaceutical wastes.

CHAPTER 7: ORGANIZATION, CONTAINMENT, COLLECTION, LABELING, HANDLING, TRANSPORT, AND STORAGE

This section explains the importance of streamlining the waste collection, handling, and transport process to ensure compliance with OSH and environmental control requirements.

7.1 Organization

i. Each HCF must form a core team of waste handlers.

ii. Waste handlers must be trained and equipped to undertake the handling, internal transportation, spill management, blood and body fluid exposure management and storage requirements of the health care waste.

7.2 Collection, Labelling, and Handling

i. Waste should not be allowed to accumulate at the point of production. For this reason, a routine program for its collection should be established as part of the HCWM plan.

ii. General waste (non-hazardous waste) should be contained in a well-labelled black bag.

iii. There should be a waste collection schedule. All highly infectious waste should be placed in a well-labelled red bag and collected immediately after the procedure. Infectious waste should be placed in a yellow bag and be collected when the waste bag is three-quarters full or at the end of the day, whichever comes first.

iv. Sharps must always be placed in safety boxes and never be placed in waste bags.

v. Sharps boxes should be collected when three-quarters full.

vi. Nursing and other clinical staff should ensure that waste bags are tightly closed or sealed when they are about three-quarters full.

vii. All waste liner bags should be well-labelled plastic bags and waste containers should be color-coded (annex 2), inscribed with hazard marks or stickers, and identified in accordance with international waste labelling symbols as provided in annexes 3a and 3b.

viii. The volume of a waste bag should not exceed 55 liters.

ix. Excess air should be expelled without compaction before closure using a bag tie/tying the mouth of the bag at the point of waste generation.

x. Light-gauge bags can be closed by tying the neck, but heavier-gauge bags require a plastic sealing tag of the self-locking type.

xi. Bags should not be closed by stapling.

xii. Sealed sharps containers should be placed in a labelled, yellow infectious health care waste bag before removal from the hospital ward or department.

xiii. All bags should be held away from the body by the closed top of the bag and placed directly into a mobile garbage bin or trolley.

Waste Receptacles

Figure 7.1: Waste receptacle

7.3 Storage

Figure 7.2: Signage for the waste storage area

7.3.1 Storage of Waste

i. Where sealed waste bags are stored pending collection, they should be in a secure place with restricted access.

ii. A storage location for health care waste should be designated inside the health care establishment or research facility.

iii. The location should be free from adverse conditions (rain, direct sunlight, vermin and rodents, scavengers)

iv. Unless a refrigerated storage room is available, storage times for health care waste (i.e., the delay between production and treatment) should not exceed the following:

- 48 hours during the cool season
- 24 hours during the hot season

v. Cytotoxic waste should be stored separately from other health care waste in a designated secure location.

vi. Radioactive waste should be stored in containers that prevent dispersion behind lead shielding. Waste that is to be stored during radioactive decay should be labelled with the type of radionuclide, the date, and details of required storage conditions.

7.3.2 Storage Area Recommendations

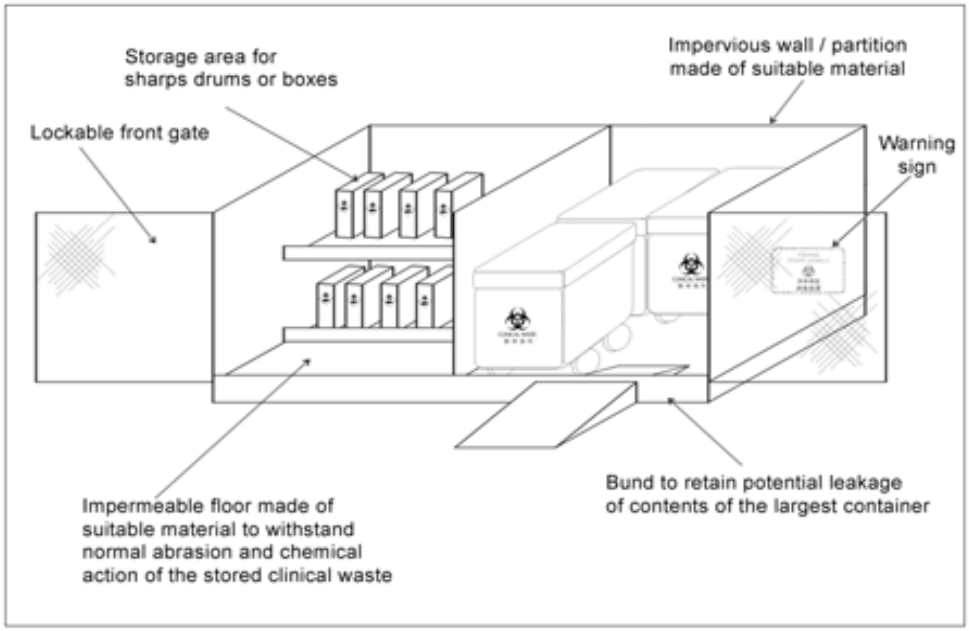


Figure 7.3: Storage area for sharps waste

The following are recommendations for the transfer station/storage area and its equipment:

i. There should be a water supply for cleaning purposes.
ii. The area should be demarcated and warning signs provided for trespassers.
iii. The storage area should have an impermeable, hard-standing floor with good drainage; it should be easy to clean and disinfect.
iv. The storage area should afford easy access for staff handling the waste.
v. It should be possible to lock the store to prevent access by unauthorized persons.
vi. Easy access to waste collection vehicles is essential.
vii. There should be protection from the sun.
viii. The storage area should be inaccessible to animals, insects, and birds.
ix. There should be good lighting and at least passive ventilation.
x. The storage area should not be situated in the proximity of fresh food stores or food preparation areas.
xi. A supply of cleaning equipment, protective clothing, and waste bags or containers should be located conveniently close to the storage area.
xii. Clean-up facilities, spill kits, appropriate drainage, and banding should be provided. Where waste is stored in bins, the bin must be locked.

7.3.3 Storage of Chemical Waste

When planning for hazardous chemical waste storage places, the characteristics of the different chemicals to be stored and disposed of must be considered (inflammable, corrosive, explosive). The storage place should be enclosed and separate from other waste storage areas. The storage area should be equipped with a liquid- and chemical-proof sump pump when storing liquid chemicals. If no sump pump is present, catch containers should be placed under the storage containers to collect leaked liquids. 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 waste, 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 chemical waste should be stored separately, and the original packaging material should be taken for storage where possible. The packaging used to store and transport chemical waste off-site 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.

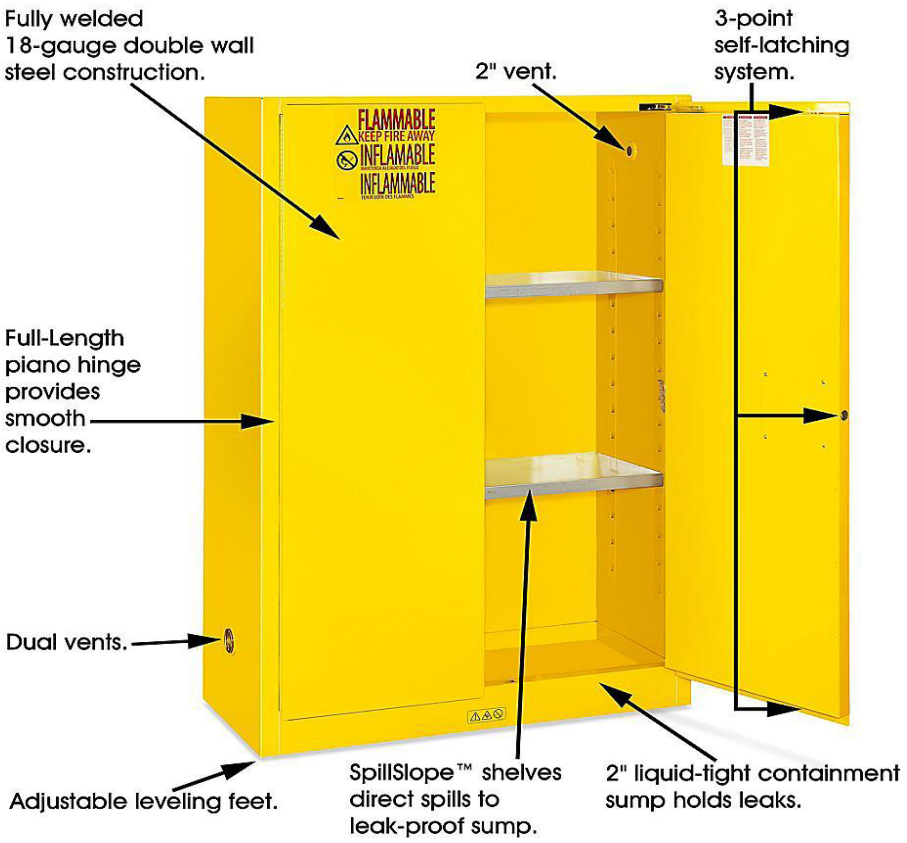


Figure 7.4: Safety cabinet for flammable substances

Figure 7.5: Liquid chemicals in a chemical-resistant plastic container

Area for re-usable photochemical waste		Shelf for toxic water polluting waste		Shelf for reactive waste e.g. acids		
						Fire Extinguisher
Safety cabinet for flammable chemicals		Shelf for corrosive bases		Shelf for PPE, spill kits, supply equipment etc		

Figure 7.6: A sample sketch of a chemical storage area

Used with permission from the GEF/UPOPs Project Management

Figure 7.7: Labelling on exterior of storage rooms and facilities for chemicals

7.3.4 Storage of Radioactive Waste

Radioactive waste should be stored in containers that prevent radiation dispersion and lead shielding. Waste that is to be stored during radioactive decay should be labelled with the type of radionuclide, date, time period 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. The recommended practice for radioisotopes with a half-life of less than 90 days is that the waste is stored for a minimum period of storage time, equivalent to 10 half-lives of the isotope. For example, if the half-life of an isotope is 20 days, the waste should be stored for 200 days (20 days [one half-life] × 10 [10 half-lives] = 200 days) before disposal. Infectious, radioactive waste should be decontaminated before disposal. Sharp objects, such as needles, Pasteur pipettes, and broken glass should be placed in 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.

7.4 Transportation

7.4.1 General Considerations

i. All HCFs should conduct a review to optimize the waste collection process, reduce handling and transportation, and promote safe work practices.

ii. Transportation routes should avoid where there is possible food preparation and heavily used areas.

7.4.2 On-Site Transport for Collection Purposes

i. Mobile garbage bins (MGBs) and trolleys should be used when transporting waste to decrease spills, minimize collector contact with waste, and minimize manual handling.

ii. Loads contained in MGBs and trolleys should be less than 55kg.

iii. All bins must be color coded and marked, as specified in annex 2.

iv. Health care waste should be transported in the hospital or other facility by means of wheeled waste trolleys or containers that are not used for any other purpose and meet the following specifications:

a) Easy to load and unload.
b) No sharp edges that could damage waste bags or containers during loading and unloading.
c) Easy to clean.

v. Trolleys and MGBs must be dedicated to collecting waste and must be made of rigid material, lidded, lockable (if used for storage), leakproof, and washable.

vi. These MGBs and trolleys should be labelled according to the type of waste contained, cleaned regularly, and must never be overfilled.

vii. Waste collection rounds should be performed as often as necessary to minimize housekeeping hazards.

viii. When cleaning trolleys and MGBs:

» Rinse with cold water, then wash with warm water and a neutral detergent.

» Trolleys and MGBs should then be drained into the sewer and left to dry.

» Clean trolleys and bins should be stored separately from soiled containers.

» Appropriate PPE should be worn when cleaning MGBs.

» Wastewater may only be diverted to the sewer.

ix. The vehicles should be cleaned and disinfected daily with an appropriate disinfectant (glutaraldehyde or peracetic acid).

x. All waste bag seals should be in place and intact at the end of transportation.

xi. Wheelbarrows are not recommended for transportation, especially for HCFs at levels 4–6.

xii. 7.4.3 Off-Site Transportation of Waste

xiii. 7.4.3.1 Regulation and Control System

xiv. The health care waste producer is responsible for safe packaging and adequate labelling of waste to be transported off-site and for authorization of its destination.

xv. The tracking form (annex 4a) must be signed at the point of destination and shall be kept as records by the health facility as proof of proper waste disposal.

xvi. The signed tracking form will be submitted as part of the records in the annual environmental audit reports.

xvii. Packaging and labelling of waste should comply with the Environmental Management and Coordination Waste Management regulations (2006) governing the transportation of hazardous waste and with international agreements (such as the Basel Convention) if waste is shipped abroad for treatment and disposal.

xviii. The control strategy for health care waste should have the following components:

» A consignment note (annex 4b) should accompany the waste from its place of production to the final disposal site. On completion of the journey, the transporter should complete the part of the consignment note especially reserved for him and return it to the waste producer. The transporting organization should be registered

with or known to the waste regulation authority.

» Handling and disposal facilities should hold a permit issued by NEMA, allowing the facilities to handle and dispose of health care waste.

7.4.3.2 Transportation of Health Care Waste by Licensed Transporters

(Photo credit to Jed Kirschbaun, Baltimore Sun)

Figure 7.8: A designated vehicle for waste transportation

Figure 7.9: Closed vehicle for transporting waste

i. All transporters of biomedical waste must be licensed by NEMA.

ii. The specification for transportation vessels must meet the minimum requirements as provided for by MOH guidelines and approved by the Ministry responsible for transport (4, 8, 31).

iii. The transport shall collect waste from the designated area of operations or storage areas and shall deliver such waste to the designated storage site, disposal site, or plant.

iv. The owner of the facility (can be government or private entity) shall ensure that:

» The collection and transportation of such waste is conducted in such a manner that will not cause scattering, escaping, and/or flowing out of the waste.

- » The vehicles for transportation and other means of conveyance of waste shall follow the scheduled routes approved by NEMA from the point of collection to the disposal site or plant.
- » The generator or his agent(s) should always possess during transportation of the waste a duly filled tracking document as set out in Form III of the First Schedule to the Environmental Management and Coordination (Waste Management) Regulations, 2006, and shall produce the same on demand to any law enforcement officer.

i. Biomedical waste shall be:

- » Transported in a specially designed vehicle or other means of conveyance to prevent scattering, escaping, flowing, spillage, or leakage of the waste.
- » The vehicle is recommended to be closely lockable, covered, labelled, leakproof, and corrosion-proof, preferably internally lined with aluminum or stainless steel.
- » Any vehicle used for the transportation of waste or any other means of conveyance shall be appropriately labelled.
- » 7.4.4 Routing

ii. Health care waste should be transported by the quickest possible route, which should be planned before the journey begins.

iii. After departure from the waste production point, every effort should be made to avoid further handling.

iv. If handling cannot be avoided, it should be prearranged and take place in adequately designed and authorized premises by the waste management focal person/PHO.

v. Handling requirements can be specified in the contract established between the waste producer and the carrier.

7.4.5 Transboundary Movement and Transfer of Waste

i. Currently, there are no situations where health care waste is either exported from or imported into the country for destruction.

ii. Health care waste, being hazardous in nature, is regulated and subject to the Basel Convention on the transboundary movement of hazardous waste. Waste falls in the category of the convention if it has such characteristics as being explosive, flammable, toxic, or corrosive, and if it is defined as or considered to be hazardous waste under the laws of either the exporting country, the importing country, or any of the countries of transit. Electrical and e-waste are examples of waste regulated under the Basel Convention.

The Basel Convention Guidelines recommend the disposal of hazardous waste within boundaries and as close to the source of the waste as possible. Where transportation of waste is unavoidable, the guidelines have stringent requirements for notice, consent, and tracking for the movement of waste across national boundaries. A sample tag for shipment of such waste is provided in annex 9. The convention prohibits the exportation of hazardous waste from developed to developing countries (32).

7.5 Health Care Waste Tracking

i. Tracking of health care waste is necessary to enable both the regulatory bodies and all other stakeholders to follow the movement of waste from generation to safe final disposal. As much as possible, tracking of waste will be done according to Environmental Management and Coordination (Waste Management) Regulations, 2006. The regulations require that waste is disposed of only in designated areas (article 1). Waste generators are required to segregate waste at the source, collect, transport, and dispose of or hand over waste to a licensed service provider (article 38). Article 46 of the regulations requires operators of bio-medical waste management plants to submit environmental audit reports and, thereafter, annual audit reports to the NEMA.

ii. Tracking may be as simple as a cardboard luggage label attached by string or sticky labels or as

sophisticated as a self-adhesive barcode. Tracking assists in rapidly identifying the source of waste, facilitate segregation, provides feedback, provides data for education purposes and decision making, facilitates auditing, and may be used to allocate resources for HCWM.

iii. The use of tracking forms is therefore necessary and will enable the regulatory bodies and all concerned to follow the movement of waste from generation to the safe final disposal. Samples of waste tracking forms are provided in annexes 4a and 4b.

iv. All liner bags and waste receptacles must be clearly marked to identify the HCF, unit (e.g., Ward 20B), and collection date.

v. The illegal dumping of health care waste by unscrupulous waste collectors/generators poses a great risk to public health. Tracking the movement of waste from the points of generation through transportation to the final disposal point will guard against the malpractice of illegal dumping (annex 4a).

7.6 Managing Health Care Waste Generated Within the Community

Community health programs offer services based on community health outreach or at external locations, such as patients' homes and school dental clinics.

7.6.1 Clinical Waste Generated at Community Health Outreach

i. All health facility management committees should ensure that clinical waste is returned to the HCF for appropriate disposal (in circumstances where applicable).

ii. Waste must be transported in a designated vehicle supplied with a spill kit.

7.6.2 Sharps Containers

i. Safety boxes should be supplied at all sites that generate sharps.

Figure 7.10: Examples of safety boxes

7.6.3 Waste Transportation

The following points should be observed in relation to the transportation of waste:

i. Lids shall be securely fitted to the containers to ensure that the waste is prevented from spilling.

ii. Containers should be thoroughly cleaned and disinfected before reuse.

iii. Containers used for the transportation of clinical waste shall be clearly marked.

iv. During transportation, containers holding the waste shall be securely held inside the vehicle to prevent movement of the containers and spillage of the waste.

v. The transporter shall ensure that vehicles being used for the transportation of clinical waste shall be securely locked when left unattended.

7.7 Spill Management

i. Accidental spillage of materials can be a serious hazard to health according to the circumstances

and nature of the substances involved.

ii. Spillage can be chemical or biological. An example of the general procedure of dealing with spillages is provided in annex 6.

7.7.1 General Spill Management

HCFs should manage waste spills as they occur at the facility (14, 33).

i. In the case of gross spills, containment is the principal action

ii. Procedures must specify the spill management process and the conditions when emergency services, such as when the local city/town fire brigade section becomes involved.

iii. It is essential that personnel involved in spill management receive education and training in emergency procedures and handling requirements.

iv. Spill kits should be readily available throughout the HCF with their location known by all staff.

v. Spill kits that have been used should be disposed of with the type of waste that has been cleaned up, (e.g., used cytotoxic spill kits should be disposed of with cytotoxic waste).

vi. All spills should be documented per department and per facility. This will assist in, among others, designing training protocols.

7.7.2 Biological Spillage

All biological specimens/body fluids should be considered potentially infectious. The main aim should be to safely contain, neutralize, and dispose of the material.

7.7.2.1 Agents Used to Neutralize Spillages

i. Sodium hypochlorite

- Rapidly effective against a wide range of microorganisms, including bloodborne viruses, mycobacterium, and bacterial spores.
- Used at a high concentration - 3.5% (apply 1 in 6 parts for 5 minutes of available chlorine). It can be used at a lower concentration of available chlorine if the spill is removed and the surface cleaned first.
- Corrosive to metal surfaces and can damage rubber and other materials.
- Inactivated by organic material and so needs to be at high concentrations.
- Diluting the agent with hot water or mixing it with urine may result in the rapid release of chlorine, which can irritate the eyes and respiratory mucosa.

ii. Clear soluble phenolic compounds

- Many phenolic compounds contain a detergent base that allows them to clean and disinfect.
- Used in concentrations of 0.6% to 2%.
- Highly effective against mycobacterium and non-spore-forming bacteria but poor against viruses.
- An irritant that taints food and damages plastic surfaces.
- Not generally recommended for blood spills.

iii. Peroxygen and quaternary ammonia compounds and iodophors

Peroxygen is ready-to-use 6% hydrogen peroxide. Quaternary ammonium compounds (commonly known as quats or QACs) are cationic surfactants (surface active agents) that combine bactericidal and virucidal (generally only enveloped viruses) activity with good detergency and, therefore,

cleaning ability. Iodophor is a complex of iodine and a surface-active agent that releases iodine gradually and serves as a disinfectant. Iodine compounds or iodophors are fast-acting and effective against all bacteria. They are relatively non-toxic, non-irritating to the skin, and stable. Iodophors are widely used in hand sanitizing solutions.

- » Application of peroxygen and quaternary ammonia compounds and iodophors
- » These agents are used where chlorine-releasing agents are not practical.
- » They are good cleaning agents and more user- and environment-friendly than sodium hypochlorite or clear soluble phenolic compounds.
- » Their activity against mycobacterium, spores, and non-enveloped viruses is less effective.
- » Staff members dealing with spillages should consult the organization's policies and procedures and/or seek advice from the local health authority (Department of Environmental Health and Sanitation).
- » Inexperienced staff and staff with fresh or open cuts or active dermatitis of the hand and arms should be discouraged from cleaning up biological spillages.

7.7.2.2 Procedure for Dealing with Biological Spillage

i. Seal off the immediate area to avoid others becoming involved or contaminated by the spillage.
ii. If hypochlorite is used in a confined area, ensure good ventilation.
iii. Put on a plastic apron, gloves, face protection/ mask, if required, and overshoes/boots. (Solutions used to neutralize the spillage will depend on the nature of the substance and local advice should be sought).
iv. Limit the spread of fluid by absorbent disposable toweling. Discard the towels carefully into yellow plastic bags for incineration.
v. Take care to avoid injury if broken glass is present.
vi. Dispose of sharp items into a sharps container.
vii. After the necessary disinfectant contact period, collect the absorbed spillage and discard it in a yellow plastic bag or sharps box (if there is sharp debris).
viii. Remove and discard disposable protective clothing and other contaminated non-sharp disposable materials. Wash and dry hands.
ix. Notify the PHO in charge. Kindly use CDC guidelines on the management of spills.

7.7.3 Infectious Waste Spill Kit

The infectious waste spill kit should contain at least:

i. A broom, a pan and scraper, and a mop and mop bucket.
ii. A large (10 liter) reusable plastic container or bucket with a fitted lid containing two infectious waste bags for the disposal of clinical waste.
iii. Disinfectant containing 1% 10,000 ppm available chlorine or equivalent.
iv. Rubber gloves suitable for cleaning.
v. Detergent, sponges/disposable cloths.
vi. PPE, including eye protection, an apron or long-sleeved impervious gown, a face mask, and heavy-duty gloves.
vii. Incident report form.
viii. Waste spill sign.

7.7.4 Cytotoxic Spill Kit

The cytotoxic spill kit should contain at least:

i. A mop and mop bucket, and a pan and scraper.
ii. A large (10 liter) reusable plastic container or bucket with a fitted lid containing two cytotoxic waste bags for the disposal of cytotoxic waste.
iii. Two hooded overalls, shoe covers, long heavy-duty gloves, latex gloves, a face mask, and eye protection.
iv. Absorbent toweling/absorbent spill mat.
v. Incident report form.
vi. Waste spill sign.

7.7.5 Mercury Spill Kit

The mercury spill kit should contain at least the following:

i. Two unbreakable lidded containers
ii. Spill sign
iii. Pasteur pipette, eye dropper
iv. Sodium thiosulphate
v. Face mask
vi. Dustpan and brush
vii. Sulfur powder.

7.7.6 Chemical Spillage

7.7.6.1 Storage of Chemicals

i. The bulk stock should be kept in specially designated rooms or buildings with concrete floors with sills at the doorways to retain spills.
ii. Flammable substances should be stored separately in buildings some distance from others.
iii. To avoid ignition of flammable and explosive vapors by sparking of electrical contacts:
    - » Light switches for stores should be on the outside of the building.
    - » Lights (bulbs, tubes) should be in bulkheads.
iv. Chemicals should not be stored in alphabetical order; otherwise, incompatible chemicals may be in close proximity, and some hazardous chemicals may be on high shelves.
v. All large bottles and all bottles containing strong acids and alkalis:
    - » It should be at floor level
    - » In drip trays.
vi. Bottle carriers and siphoning devices for filling bottles from bulk containers should be provided.
vii. A stepladder should be provided where there are high shelves.

7.7.6.2 Neutralizing Spillage

i. Soda ash or sodium bicarbonate sand should be used to neutralize acids and corrosive chemicals.
ii. Dry sand should be used to cover alkalis.

7.7.6.3 Dealing with Spillage of a Dangerous Chemical

i. Secure the affected area.

ii. Take appropriate precautions (your safety first).

iii. Notify the waste management officer/PHO in charge or any other designated officer responsible for safety.

iv. Evacuate non-essential personnel from the area.

v. Attend to persons who may have been contaminated (see emergency response).

vi. If the spilt material is flammable:

- » Extinguish all naked flames
- » Turn off the gas in the room and adjacent areas
- » Switch off all electrical equipment.

vii. Activate the exhaust ventilation system if it is safe to do so.

viii. Secure the necessary items to clean up the spillage.

7.7.6.4 Clean-Up Equipment and Materials

i. Protective clothing, (e.g., heavy-duty rubber gloves, safety boots, or rubber boots).

ii. Scoops and dustpans (recommended to be part of the kit).

iii. Forceps for picking up broken glass.

iv. Mops, clothes, and paper towels.

v. Buckets.

vi. Non-flammable detergent.

CHAPTER 8 : Treatment & Disposal of Health Care Waste

HCFs should consider the following factors when selecting a treatment and final disposal option:

- Regulatory acceptance
- Throughput capacity
- Types of waste treated
- Microbial inactivation efficacy
- Environmental emissions and waste residues
- Space requirements
- Utility and other installation requirements
- Waste reduction
- Occupational safety and health
- Noise
- Odor
- Automation
- Reliability
- Level of commercialization
- Background of the technology manufacturer or vendor
- Cost
- Community and staff acceptance

8.1 Treatment Options

- Incineration
- Autoclaving and shredding
- Microwaving and shredding
- Steam sterilization
- Chemical treatment

i. Health care waste should be treated before final disposal to ensure protection from potential hazards posed by these wastes.

ii. To be effective, treatment must reduce or eliminate the risk present in the waste so that it no longer poses a hazard to persons who may be exposed to it.

iii. The common treatment methods are incineration, steam sterilization, chemical disinfection, autoclaving/shredding, and microwave irradiation. The order depends on the choice of whether it is burn or non-burn technology. Selecting non-burn technology is the preferred option (to protect the environment). Open and crude burning are highly dangerous to both human health and the environment and, therefore, the best treatment facility for remote and hard-to-reach facilities is the waste disposal unit (WDU) (see figure 8.7, annex 12, and annex 16).

iv. Certain types of health care waste, such as anatomical waste, will still have an offensive visual impact after disinfection, which is culturally unacceptable in many countries, including Kenya. Such waste should therefore be made unrecognizable before disposal, for example, by incineration.

v. Other methods that can be used include encapsulation and inertization, shredding, maceration, and grinding.

vi. Treatment methods should, however, be chosen according to the national and local situation.

vii. For infectious and sharp wastes, all treatment methods are applicable, except inertization.

This section describes the appropriate guidance when treating the waste by incineration, autoclaving, and shredding (5).

8.1.1 Incineration

i. Incineration is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter, and significantly reduces waste volume and weight.

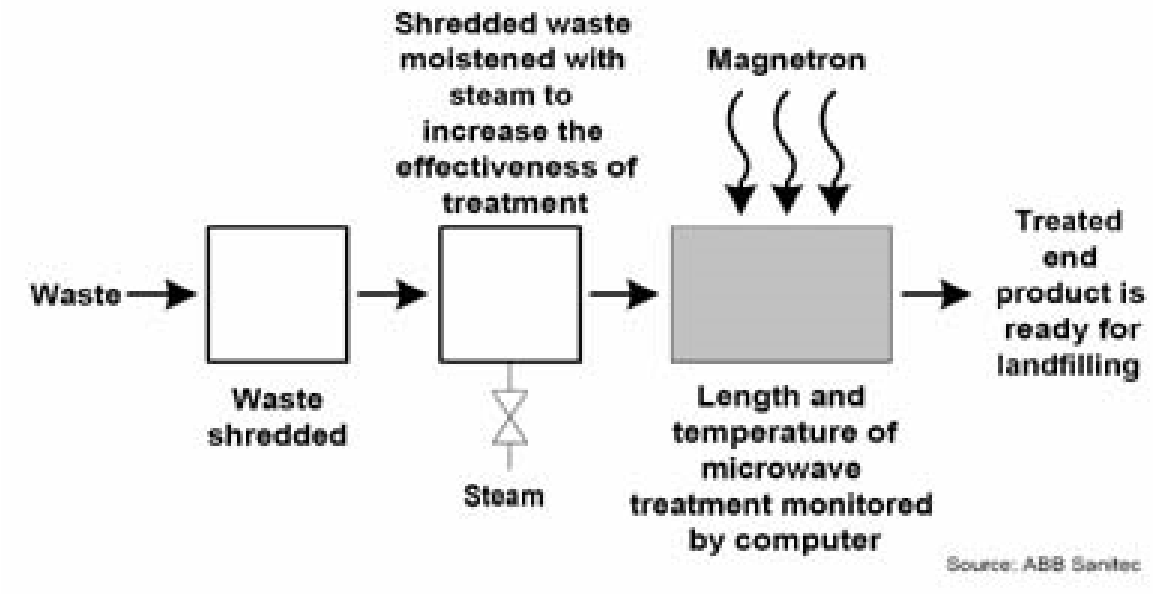
ii. This process is usually selected to treat waste that cannot be recycled, reused, or disposed of in a sanitary landfill.

iii. The local PHO shall approve the incinerator housing design. The treatment process flow shall safe-guard the operator's health from risks of exposure to the handling of the health care waste. (See annex 13 for a typical incinerator housing design and annex 14 for a MOH incinerator housing plan.)

8.1.2 Microwave Waste Treatment

Biohazardous waste is shredded, injected with steam, and finally heated by microwave (2,450 MHz) at 95 °C for 30 minutes. This heating destroys any microorganisms present in the waste. The decontaminated waste can be disposed of in a sanitary landfill. A similar large-scale system uses radio frequency radiation (also called microwaves) to disinfect waste at regional waste treatment facilities.

Selection criteria: Microwave provides reliable on-site waste treatment without air or liquid emissions. Microwave is best suited for large (over 500 beds) hospitals desiring an on-site alternative to incineration.



(Picture courtesy of ABB Santec.) (34)

Figure 8.1: Flow diagram of microwave waste treatment process

Typical energy usage: 270 kWh/ton of waste treated, usually around 75 kW total

(Photo courtesy of AMB Group)

Figure 8.2: A sample medical waste microwave

The model in figure 8.2, known as the AMB Ecosteryl Serial 75, is alternative technology in hospital waste disposal. It has a 20 kW four-shaft shredder designed to process sharps, prickly syringes, needles, and waste drums that hold up to 60 liters. It comes with a built-in motorized wheelie bin lifting and dumping system. Larger capacity AMB Ecostyrel serial 250 have been installed in level 5 and national teaching and referral hospitals and are ideal for centralized treatment due to their capacity to treat large volumes.

The technology is designed to handle a large variety of regulated medical wastes, including hospital and laboratory waste, solid and liquid medical waste, human and animal pathological waste, sharp containers and prickly hospital waste, cultures and stocks, as well as any other waste listed in state and federal regulations as medical waste.

8.1.3. Medical Waste Autoclave/Shredder

Autoclaving processes use thermal energy to destroy microorganisms at temperatures between 100 °C and 180 °C. They are designed specifically for hybrid waste treatment and have been used for more than a century to sterilize medical instruments, and in the last several decades, they have been adapted for the treatment of health care waste. The autoclave is one of the non-burn technology equipment used in the treatment of health care waste. Because it operates based on the principle of steam under pressure, it consists of a metal vessel designed to withstand high pressures, with a sealed door, and an arrangement of pipes and valves through which steam is brought in and removed. It can treat a wide range of health care waste.

There are various types of autoclaves: gravity, pre-vacuum, and vacuum; however, for the treatment of health care waste, a vacuum is recommended and preferred because air is sucked out before steam is injected; there is therefore better steam penetration and disinfection (5, 36). A photo of the autoclave and shredder at the National Public Health Laboratories Services and Coast General Hospital, Mombasa is attached in annex 15.

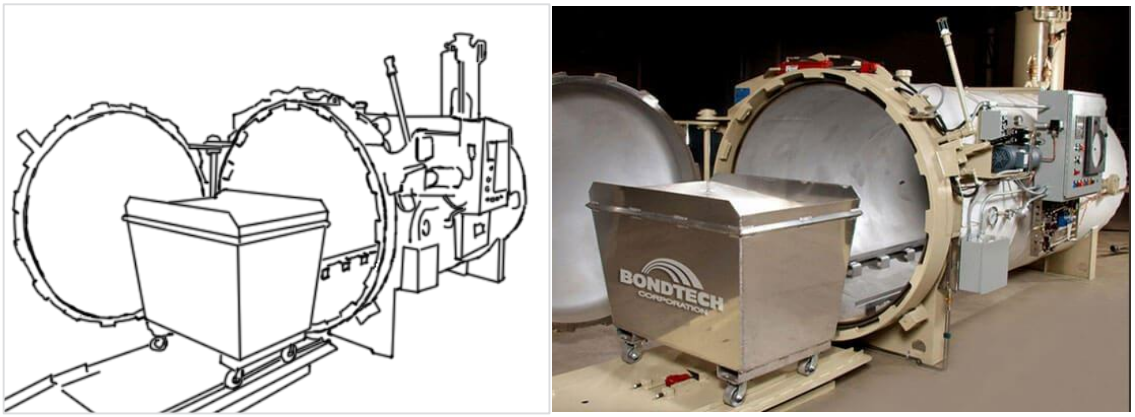


Figure 8.3: Diagram of an autoclave

8.2 Waste Disposal

8.2.1 Sanitary Landfill

Waste that has undergone treatment through microwaving or autoclaving can be considered for disposal in sanitary landfills. Ash from incineration plants has heavy metal pollutants and is therefore not recommended for landfilling.

i. Properly constructed and operated landfill sites offer a relatively safe disposal route for municipal solid waste, including health care waste.

ii. The priority is the protection of the water aquifers. Each day's waste is compacted and covered with soil to maintain sanitary conditions.

iii. Treated health care waste can be safely disposed of in a sanitary landfill site without any problems.

iv. At no time should there be open burning unless directed by the PHO, following requisite guidelines.

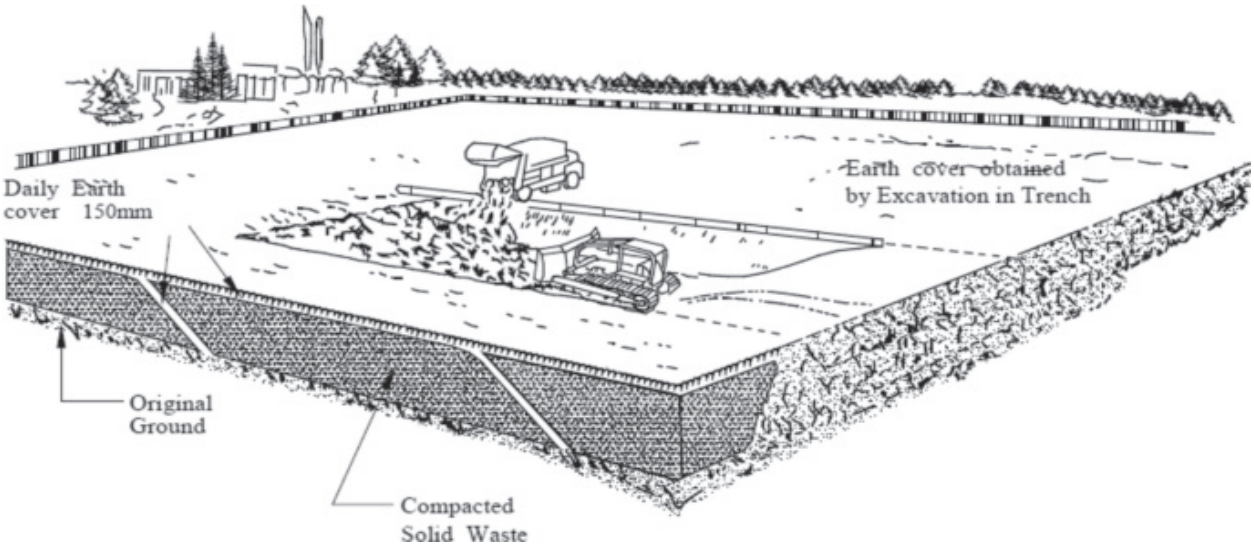


Figure 8.4: Illustration of a landfill

8.2.2 Inertization

i. The process of "inertization" involves mixing waste with cement and other substances before disposal to minimize the risk of toxic waste contaminating surface water or groundwater.

ii. It is especially suitable for pharmaceuticals and for incinerating ashes with a high-metal content (in this case, the process is also called "stabilization").

iii. For the inertization of pharmaceutical waste, the packaging should be removed, the pharmaceuticals ground, and a mixture of water, lime, and cement added.

iv. A homogeneous mass is formed, and cubes or pellets are produced on-site and then can be transported to a suitable storage site.

v. Alternatively, the homogeneous mixture can be transported in a liquid state to a landfill and poured into municipal waste.

vi. The following are typical proportions for the mixture: 65% pharmaceutical waste, 15% lime, 15% cement, and 5% water.

vii. The process is reasonably inexpensive and can be performed using relatively unsophisticated equipment.

viii. Other than personnel, the main requirements are a grinder or road roller to crush the pharmaceuticals, a concrete mixer, and supplies of cement, lime, and water.

ix. The main way to achieve this is to sort the health care waste into various categories to minimize the need for expensive or complicated disposal methods.

8.2.3. Ash Pit

It is used to dispose bottom-ash and fly-ash from the incineration of medical waste, unreusable glass, vials, and ampoules. After the waste has burned down, it is given sufficient time to completely cool down to allow the "fixed carbon" in the waste bed to burn, reducing toxic emissions, and ensuring that all the waste is destroyed.

The pit should be covered and be deep enough with access trap doors to allow the pile of ash to be redistributed from time to time. It should also be as close to the incinerator as possible and should be fenced to prevent access to unauthorized people.

8.2.4. Pit for Disposal of Placentas Where They Decompose Naturally

It should be as far away as possible from publicly accessible areas and hygienically critical areas (e.g., water wells, kitchens). It should be far enough from other buildings and public areas to avoid odor problems and in a secure location that nonauthorized people and animals (e.g., feral dogs) cannot get into. It should be impervious and 1.5 meters above the water level.

Any spillages around the placenta pit should be decontaminated with 0.5% chlorine (26).

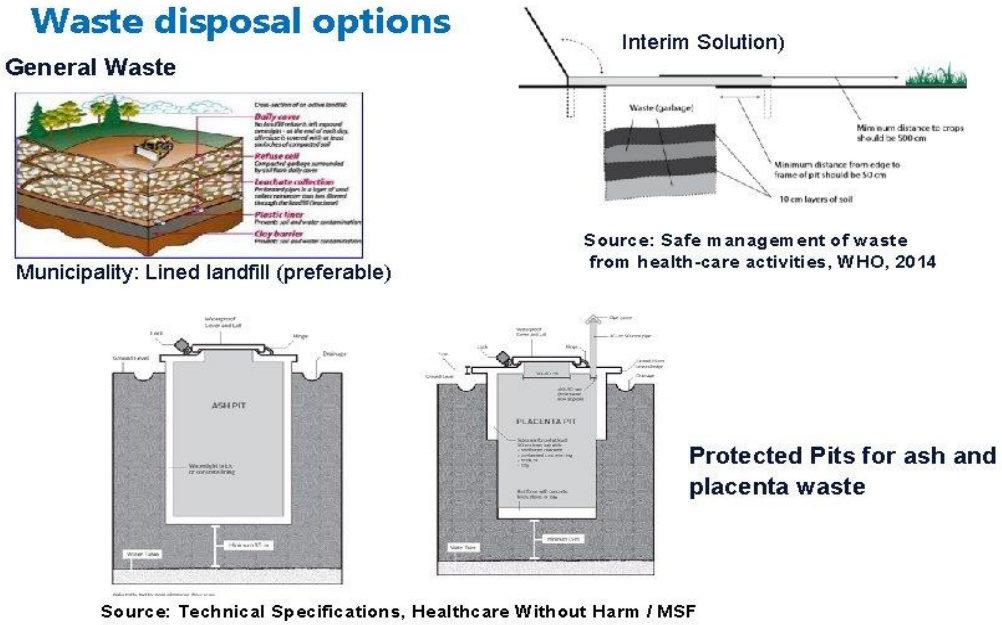


Figure 8.6: Various waste disposal options

8.2.5. Macerator

A hygienic treatment and disposal equipment for medical waste through maceration. For use in Level 4 and above health facilities (annex 7).

8.2.6. Encapsulation

This is used for medical waste, which can cause pricks. Materials are put in puncture-proof containers. Immobilizing containers used should be sealed when three-quarters full. The encapsulated waste should be placed at the base of a landfill and covered with waste, or buried, or stored as blocks.

8.2.7 Waste Disposal Unit

Used in remote and hard-to-reach health facilities. The WDU is used for both the treatment and disposal of health care waste. It consists of the De Montfort Mark Incinerator and an underlying ash pit, a side modified De Montfort Mark 8A incinerator for handling sharps boxes, and its underlying underneath ash pit in a fenced-off area.

(See annex 16 for a HCWM WDU plan from the MOH.)

8.3 Chemical and Pharmaceutical Waste

Chemical and pharmaceutical waste, especially in large quantities, can threaten the environment and human health. Because hazardous chemical waste may be toxic, corrosive, flammable, reactive, and/or explosive, it can harm people who touch, inhale, or are near it. If burned, it may explode or produce toxic fumes. Some pharmaceuticals are also toxic. The leachate may contaminate ground and surface water when chemical and pharmaceutical waste are disposed of in unlined landfills or pits. Such contamination may threaten people using the water for drinking, bathing, and cooking, and damage local plants and animals.

Burning or incinerating health care waste, although often a better option than disposal in an unlined pit, may create additional problems. Burning or incinerating health care waste may produce toxic air pollutants, such as acid gases, nitrogen oxides, particulates, dioxins, and heavy metals, and distribute them over a wide area. Dioxins and heavy metals are of particular concern. Dioxins, believed to be potent cancer-causing agents, do not biodegrade, and accumulate in progressively higher concentrations as they move up the food chain. Heavy metals, such as mercury and cadmium, are toxic and can concentrate in the food chain and/or cause birth defects, even in small quantities.

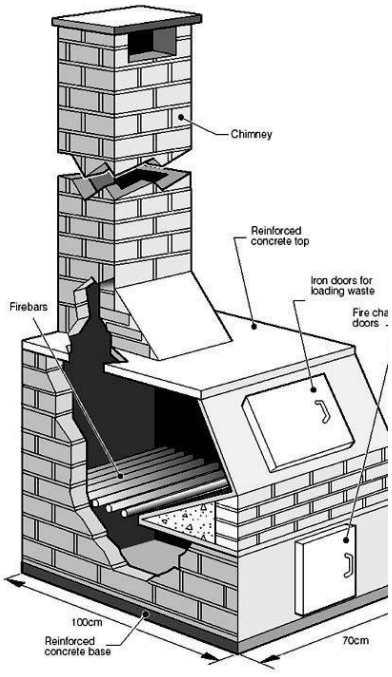


Figure 8.7: A waste disposal unit

Disposable pressurized containers pose another hazard for incineration because they can explode if burned. Table 8.1 outlines effective treatment and disposal methods for chemical and pharmaceutical waste.

Table 8.1. Effective treatment and disposal methods for chemical and pharmaceutical waste

Type of Waste	Management Options	Comments
Pharmaceutical waste, small quantities	Water-soluble, mild liquid-form pharmaceuticals, such as vitamin solutions, cough syrups; intravenous solutions of salts, amino acids, lipids, glucose; eye drops, etc., may be diluted with large amounts of water and discharged to fast-flowing watercourses ONLY. Neither antineoplastic (cytotoxic/anti-cancer) drugs nor antibiotics should be discharged to water courses. • Most small health facilities will not use antineoplastic drugs. However, in view of the special handling they require, they are noted here for completeness. • Equivalent materials in solid or semi-solid form (e.g., vitamins) can be removed from packaging and buried safely on site or disposed to the latrine or seepage pits. • Where fast-flowing water is not available and for other pharmaceuticals, incinerate. Small quantities of pharmaceutical waste can be collected and incinerated together with solid infectious waste. • Important notes: • Double-chambered incinerators operating in excess of 800 °C are strongly preferred, though the reality is that many facilities will have only single-chamber incinerators available. • Open (pit) burning of pharmaceuticals is not acceptable. • Do not incinerate ampoules because these can explode. Either encapsulate or crush and bury. • Do not incinerate polyvinyl chloride (PVC) packaging. • Antineoplastic (cytotoxic/anti-cancer) drugs cannot be incinerated safely except at very high temperatures (at least 1200 °C). • Encapsulate: Pharmaceuticals and sharps can be encapsulated together. • If incineration or encapsulation is not feasible, remove the outer (but not inner) packaging and dispose of via safe burial on-site. However, this is NOT acceptable for antineoplastic (cytotoxic/anti-cancer) drugs or narcotics. See WHO's Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies, page 24.	For more information, see: Guidelines for safe disposal of pharmaceutical wastes. WHO. 1999. Chapter 4. https://apps.who.int/iris/bitstream/handle/10665/42238/WHO_EDM_PAR_99.2.pdf Safe Management of Wastes from Healthcare Activities. WHO. 2014 https://www.who.int/publications/i/item/9789241548564

Type of Waste	Management Options	Comments
Pharmaceutical waste, large quantities	• Water-soluble, mild liquid-form pharmaceuticals, such as vitamin solutions, cough syrups, intravenous solutions, eye drops, etc.., can be diluted with large amounts of water and discharged to fast-flowing watercourses ONLY. *This is NOT acceptable for antibiotics or antineoplastic (anti-cancer) drugs.* • Equivalent materials in solid or semi-solid form (e.g., vitamins) can be removed from packaging and landfilled if scavenging can be prevented. • Where fast-flowing water is not available and for other pharmaceuticals, in order of preference: • Return to the supplier. • Arrange for very high-temperature incineration (>1200 °C). (A cement kiln can also be used for this purpose, at not more than 5% of total fuel volume.) • Note that destruction of antineoplastics requires incineration temperatures of at least 1200 °C; cement kilns usually satisfy this condition. • Other options are available for some classes of pharmaceuticals. If no other option is available, waste can be encapsulated. Note that special procedures apply for encapsulating antineoplastics.	Acceptable options are neither cheap nor easy. and are not likely readily available to small-scale facilities, (i.e., there is no safe way to dispose of these materials). It is, therefore, critical to minimize the amount of pharmaceutical waste generated.
Chemical waste, small quantities	• In general, bury. • If collected with infectious waste, small quantities of chemical waste can be treated as infectious waste (i.e., follow the same procedures of incineration/ burning and safe burial).	
Chemical waste, large quantities	• Return to the supplier. • Subcontract for incineration in a double-chamber incinerator that operates at >900 °C, if available. • Export to a location with adequate facilities for safe disposal. • Other options are available for some subcategories.	Acceptable options are neither cheap nor easy and are not likely readily available to small-scale facilities, (i.e., there is no safe way to dispose of these materials). It is, therefore, critical to minimize the amount of chemical waste generated.
PVC plastic and other halogenated materials	• Bury	DO NOT BURN. Doing so will create highly toxic pollutants and spread them over a wide area.
Materials containing heavy metals (e.g., broken thermometers, manometers, rechargeable batteries)	• Capture mercury and reuse or recycle via the local cottage industry, if available. Batteries can also be locally recyclable via the cottage industry.	DO NOT BURN. Doing so will spread highly toxic pollutants over a wide area.

Type of Waste	Management Options	Comments
Pressurized containers	• Return undamaged containers to the supplier. • Empty damaged containers and recycle them via local cottage industries. • Small cans can be buried with ash, residues, and other waste on site.	Do not burn/incinerate because of the high risk of explosion.
Incinerator ash/ residues from burning	• Bury in a pit on site.	

8.3.1 Options for Health Care Waste Treatment and Disposal as per the Level of Care

Table 8.2. Options for health care waste treatment and disposal as per the level of care

Type of waste	Level				
	1 and 2	3	4	5	6
Sharps	Incineration and/or burial in a deep pit	Incineration and burial in a deep pit	Incineration	Autoclave; microwave; incineration	Autoclave; microwave; incineration
Infectious	Deep burial	Incineration and deep burial	Incineration and disposal of residue in municipal landfill	Incineration and disposal of residue in municipal landfill	Incineration and disposal of residue in municipal landfill
Highly Infectious	Deep burial	Deep burial/ incineration	Deep burial/ incineration	Grind and discharge to sewer; incineration and residue to landfill	Pulverize and discharge to sewer; incineration and disposal of residue in landfill
Pharmaceutical	Return to County Medical Supplies Stores	Return to County Medical Supplies Stores	Incinerate, inertization, encapsulation, return to source or manufacturer	Incinerate, inertization, encapsulation, return to source or manufacturer	Incinerate, inertization, encapsulation, return to source or manufacturer
Glass	Recycle, crush, and bury	Recycle, crush, and bury	Recycle, crush, and bury	Recycle, crush, and bury	Recycle, crush, and bury
Cytotoxic	Not applicable	Not applicable	Incinerate; waste inertization; encapsulation	Incinerate; waste inertization; encapsulation	High temperature incinerate; inertization; encapsulation
Chemical	Deep burial	Deep burial	Encapsulation and landfilling	Encapsulation and landfilling	Encapsulation and landfilling

Type of waste	Level				
	1 and 2	3	4	5	6
Radioactive	Not applicable	Not applicable	Not applicable	Consult Kenya Nuclear Regulatory Authority, store in lead-lined containers (short half-life), re-export to source/ manufacturer	Consult Kenya Nuclear Regulatory Authority, store in lead-lined containers (short half-life), re-export to source/ manufacturer

8.4 Emission Limits

Emission standards are the legal requirements governing **air pollutants** released into the **atmosphere**. Emission standards set quantitative limits on the permissible amount of specific **air pollutants** that may be released from specific sources over specific timeframes. They are generally designed to achieve air quality standards and to protect human life. Different regions and countries have different standards for vehicle emissions. In Kenya, emission limits standards are set in Legal Notice No.34 of the Environmental Management and Co-Ordination Act (No. 8 of 1999) and the Environmental Management and Co-Ordination (Air Quality) Regulations, 2014.

8.5 Safe and Dignified Burial of Highly Infectious Bodies

All deaths, including community deaths and deaths occurring at health facilities, should be notified to the authorities. Deaths during outbreaks due to infectious diseases should be categorized according to case definition by a qualified doctor before the body is removed. A case investigation will be conducted before the removal of the body, and additional tests can be requested when in doubt. The tests should only be taken by a well-trained health worker.

8.5.1 Scope

This guide illustrates how people who have died of highly infectious diseases should be buried. They apply to burial teams and all personnel involved in the disposal of bodies at treatment units for highly infectious diseases/outbreaks and in the community.

8.5.2 Purpose

To provide operational guidance on the classification of deaths, the proper burial of corpses, and the disposal of potentially contaminated materials.

8.5.3 Stakeholder Responsibilities

Burial team coordinators, logisticians, and burial team members: Shall adhere to the provisions of these guidelines when conducting burials during disease outbreaks.

Government officials in the MOH: Shall ensure that burials of victims of disease outbreaks are undertaken according to the SOP.

8.5.4 Procedure

i. Engagement with the family.

ii. Upon arrival at the location of the body, the burial team supervisor should introduce him/herself and other team members.

iii. A community leader or counsellor should be included in discussion with the family.

iv. Express condolences for the family's loss.

v. Counsel the family about why special steps need to be taken to protect the family and community from illness. If the body is prepared without giving information and support to the family and the community, they may not want to bring other family members to the health facility in future. They may think that in future if a patient dies, the body will not be returned to them to take home.

vi. Help them understand the reason for the need for a safe medical burial so that the family and community members can pray for the deceased while the body is being removed, from a safe distance.

vii. If they wish, allow the family to give any items in which the body will be buried, such as clothes, and personal objects, as culturally acceptable.

viii. Inform the family of exactly where the body will be taken and, if they are planning on viewing the burial, what time the burial team will be arriving at the cemetery.

ix. Always treat the body with respect during the removal and burial process.

8.5.5 Precautions

i. The burial team will have two vehicles. One vehicle will transport the burial team and supplies, and the other will transport the body but will have a separate front cab where the burial team and driver will not be exposed to the body.

ii. All bodies collected by the burial team will be buried in sacks made of polyethene materials (body bags).

iii. The burial team will not touch suspects' bodies or confirmed cases without PPE, such as gloves, goggles, face shields, masks, gowns, rubber boots, or shoe covers.

iv. All materials, such as mattresses, beddings, blankets, and bed nets used by the person before death should be burnt at a safe distance away from the house. The MOH will replace all destroyed items.

v. The burial team should be aware of the family's cultural practices and religious beliefs and help the family understand why some practices cannot be done because they place the family or others at risk of exposure.

CHAPTER 9: COLLECTION AND DISPOSAL OF WASTE WATER FROM HEALTH CARE ESTABLISHMENTS

9.1 Characteristics and Hazards of Wastewater from Health Care Establishments

i. Wastewater from health care establishments is similar to urban wastewater but may also contain various potentially hazardous components.

ii. The principal concern is wastewater with a high content of enteric pathogens, including bacteria, viruses, and helminths, which are easily transmitted through water.

iii. Contaminated wastewater is produced by departments treating patients with enteric diseases and is a particular problem during outbreaks of diarrheal disease.

iv. It may also contain various potentially hazardous components, such as microbiological pathogens, hazardous chemicals, pharmaceuticals, and radioactive materials, which are discussed below:

- Small amounts of chemicals from cleaning and disinfection operations are regularly discharged into sewers.
- Small quantities of pharmaceuticals are usually discharged into sewers from hospital pharmacies and from the various departments.
- Radioactive isotopes should be discharged into holding tanks by oncology departments.
- The toxic effects of any chemical pollutants in wastewater on the active bacteria of the sewage purification process may give rise to additional hazards.

9.2 Wastewater Management

i. The basic principle underlying effective wastewater management is a strict limit on discharging hazardous liquids into sewers.

ii. Only in an outbreak of acute diarrheal diseases should excreta from patients be collected separately and disinfected.

iii. Where water use is commonly high, sewage is usually diluted.

iv. No significant health risks should be expected for effluents treated in treatment plants, even without further specific treatment of these effluents.

9.3 Connection to a Municipal Sewage Treatment Plant

It is acceptable to discharge the sewage of health care establishments to sewers without pretreatment, provided that the following requirements are met:

i. The municipal sewers are connected to efficiently operated sewage treatment plants that ensure at least 95% removal of bacteria.

ii. The sludge resulting from sewage treatment is subjected to anaerobic digestion, leaving no more than one helminth egg per liter in the digested sludge.

iii. The waste management system of the health care establishment maintains high standards, ensuring the absence of significant quantities of toxic chemicals, pharmaceuticals, radionuclides, cytotoxic drugs, and antibiotics in the discharged sewage.

iv. Excreta from patients treated with cytotoxic drugs may be collected separately and adequately treated (as for other cytotoxic waste).

v. In normal circumstances, the usual secondary bacteriological treatment of sewage, properly applied and complemented by anaerobic digestion of sludge, can be considered sufficient.

vi. During outbreaks of communicable diseases, effluent disinfection by chlorine dioxide (chlorine powder) or by any other efficient process is recommended.

vii. If the final effluent is discharged into coastal waters close to shellfish habitats, disinfection of the effluent will be required throughout the year (33).

9.4 On-Site Treatment or Pretreatment of Wastewater

i. Health care establishments, especially those that are not connected to any municipal treatment plant, should have their own sewage treatment plants, (e.g., septic tanks).

ii. Efficient on-site treatment of sewage should include the following operations:

iii. Primary treatment is the removal of large, suspended solids and organic matter.

iv. Secondary biological purification: Most helminths will settle in the sludge resulting from secondary purification, with 90-95% of bacteria and a significant percentage of viruses. The secondary effluent will thus be almost free of helminths but will still include infective concentrations of bacteria and viruses.

v. Tertiary treatment: The secondary effluent will probably contain at least 20mg/liter of suspended organic matter, which is too high for efficient chlorine disinfection. It should therefore be subjected to a tertiary treatment, such as lagoons. If no space exists for creating a lagoon, rapid sand filtration may be substituted to produce a tertiary effluent with a much-reduced suspended organic matter (<10mg/liter).

vi. Chlorine disinfection: The tertiary effluent will be subjected to chlorine disinfection to the break-point to achieve pathogen concentrations comparable with those found in natural waters. This may be done with chlorine dioxide (the most efficient), sodium hypochlorite, chlorine gas, or chlorine powder.

vii. Another option is ultraviolet light disinfection.

viii. Disinfection of the effluents is particularly important if they are discharged into coastal waters close to shellfish habitats, especially if local people are in the habit of eating raw shellfish.

CHAPTER 10: MANAGEMENT OF SPECIAL WASTE

This section refers to the management of waste, including e-waste, pressurized containers, genotoxic and cytotoxic, obsolete chemical waste, glass, and plastic waste.

10.1 Glass and Plastic Waste

Table 10.1 Glass and plastic waste

Minimi-zation	Segregation and packaging	Temporary storage	On-site transportation	Off-site transportation	Pre-treatment	On-site disposal	Off-site disposal
• Reduce unnecessary use of injections • Promote the use of alternative medicine • Procure good quality injection devices • Rational use of injectable drugs • Use of needle cutter	• Put in an injection safety box or approved sharps container with a biohazard mark • Sharps container to be up to 3/4 full • Seal-filled sharps containers • Use needle cutters (remover); put syringes into the sharps container • Use needle destroyers/ • cutters	• Store sharps containers in a secure dry place	• Develop a collection schedule • Use designated trolleys to remove to the transfer station • Use designated routes • Tracking of waste movement	• Develop transportation schedule • Follow transportation schedule • Contract between the facility and licensed contractor • Tracking document to be fully signed and in triplicate • Maintain segregation at all stages	Incinerate	Dispose into an ash pit	Sanitary landfill

10.2 Chemical Waste

Table 10.2 Chemical waste

Minimization	Segregation and packaging	Temporary storage	On-site transportation	Off-site transportation	Pre-treatment	On-site disposal	Off-site disposal
• Establish chemical use parameters before placing an order • Purchase chemicals in small quantities • Older chemicals to be used first • Avoid stockpiling common chemicals and whenever possible, substitute less-hazardous chemicals for hazardous ones	• Put in standard brown color-coded bins and liners • Segregate chemical products according to type, physical properties, and chemical composition • Refer to safety data sheets/ material safety data sheets	• a. Store in a restricted designated sheltered area/carriage • Loose chemicals are repackaged and labelled • Store in a designated area under lock and key • Keep a record of expired drugs	• Follow material safety data sheets guidelines	• Use designated/ approved means of transport • Use holding containers not exceeding 20kgs in capacity • Follow material safety data sheets guidelines • Use licensed vehicles • Follow the designated route/waste transporter to declare the route they use • Waste transporter is to always carry the tracking documents duly filled in triplicate • Emergency procedures in case of an accident	• Incineration • Follow material safety data sheets guidelines • Neutralization • Detoxification	• Follow material safety data sheets guidelines • Dilution for expired disinfectants and disposal to sewer /septic tank	Follow WHO guidelines for reshipping back to the supplier Encapsulation

10.3 Radioactive Waste

Table 10.3 Radioactive waste

Minimization	Segregation & packaging	Temporary storage	On-site transportation	Off-site transportation	Pretreatment	On-site disposal	Off-site disposal
Refer to Kenya Nuclear Regulatory Authority (formerly the Radiation Protection Board)							

10.4 Genotoxic /Cytotoxic Waste

Table 10.4. Genotoxic/cytotoxic wastes

Minimization	Segregation & packaging	Temporary storage	Transportation		Pretreatment	Disposal	
			On-site	Off-site		On-site	Off-site
• Adhere to procurement procedures • Follow strict commodity management guidelines • Do not accept donations with a short shelf life as determined by the facility • Do not accept donations you do not need • Do not accept more quantities than you need	Segregate and put into appropriate color-coded waste containers	• Loose medicines are repackaged and labelled. • Store in a designated area under lock and key	Follow pharmaceutical and poison guidelines		• Follow pharmaceutical and poison guidelines • Incineration	Follow pharmaceutical and poison guidelines	

10.5 Pressurized Containers

Table 10.5. Pressurized containers

Minimization	Segregation and packaging	Temporary storage	On-site transportation	Off-site transportation	Pre-treatment	On-site disposal	Off-site disposal
• Do not procure what you do not need at the time • Reuse what can be reused/ refilled	Spray cans that are completely empty may be placed in black bags if the bags are not intended for incineration.	Should be stored in a secure place free from the rain	Both full and empty gas cylinders must be secured to prevent falling.	Use a designated means of transport	They must not be incinerated.	Any aerosol spray cans which the supplier does not take back must be completely emptied and disposed of along with household refuse.	Any aerosol spray cans which the supplier does not take back must be completely emptied and disposed of along with household refuse.

10.6 Electronic and Electrical Waste

Table 10.6. Electronic and electrical waste

Minimization	Segregation & packaging	Temporary storage	On-site transportation	Off-site transportation	Pretreatment	On-site disposal	Off-site disposal
Do not procure what you do not need. Procure the latest version of the desired electronic or electrical equipment	Put in a clearly labelled waste leak-proof container	Store in a restricted room/ area	Use a designated means of transport	Use a designated means of transport	Follow e-waste guidelines		

10.6.1 Hazardous Elements Found in Electrical and e-Waste

Almost all electronics contain lead and tin (as solder), copper as wire, and printed circuit board tracks. The following elements in table 10.7 are harmful to the environment and human health:

Table 10.7. Harmful elements and examples of electrical and electronic equipment of concern

Element	Examples of electrical and electronic equipment of concern
Americium	Smoke alarms (radioactive source)
Mercury	Fluorescent tubes (numerous applications); tilt switches (pinball games, mechanical doorbells, and thermostats)
Sulfur	Lead-acid batteries
PCBs	Prior to the ban, they were found in almost all 1930s–1970s equipment, including capacitors, transformers, wiring insulation, paints, inks, and flexible sealants
Cadmium	Light-sensitive resistors, corrosive-resistant alloys for marine and aviation environments, and nickel-cadmium batteries
Lead	Old solder, cathode-ray tube monitor glass, lead acid batteries, and formulations of PVC
Beryllium	Filler in some thermal interface materials, such as thermal grease used on heat sinks of oxide, CPUs, and power transistors, magnetrons, X-ray transparent ceramic windows, heat transfer fins in vacuum tubes, and glass lasers
PVC	PVC contains additional chemicals to change the chemical consistency of the product. Some of these additives can leach out if vinyl products, such as plasticizers, are added to make PVC flexible.
Non-hazardous elements	Non-hazardous elements in electrical and electronic equipment include tin, copper, aluminum, iron, germanium, silicon, nickel, lithium, zinc, and gold.

10.6.2 Guidelines for the Importation of New and Used Products

The following guidelines apply when making decisions to import used or new electrical and electronic products:

i. Specify standards for products on the expected remaining lifespan of the equipment and electrical appliances.

ii. Secure clearance from NEMA to transport e-waste through Kenya or use licensed transporters.

iii. For pre-owned products, state the number of years computer equipment has been used before being donated to the country.

iv. Ensure that used electrical and electronic goods reach intended beneficiaries, including documenting receipt of the goods. This is for the purpose of facilitating collection.

v. Indicate the envisaged lifespan of used items when importing used equipment and bear responsibility for this by ensuring that take-back mechanisms are in place.

vi. Do not import hazardous e-waste.

10.6.3 Guidelines for Government Organizations Enforcing Management of e-waste

i. Prepare a framework with appropriate legislation to support e-waste management.

ii. Monitor the processes of e-waste handling regularly.

iii. Create a management plan with responsibilities for different target groups.

iv. National and county governments should provide incentives to entrepreneurs to set up e-waste collection and treatment facilities.

v. Approve innovative e-waste management technologies that are environmentally sound.

vi. Form multi-stakeholder monitoring committees to oversee the implementation of the e-Waste Management Guidelines.

vii. Create awareness among all stakeholders through the legislative framework of e-waste management.

viii. Enforce standards to prevent the importation and donation of useless or harmful e-waste.

ix. Make strategic plans for transitioning from harmful to less harmful technologies. Decisions made should be guided by environmental impact assessments.

10.6.4 Special Considerations for Learning Institutions in the Health Sector

Learning institutions tend to receive large quantities of electrical and e-waste**.** There is, therefore, a need to do the following when planning to receive donated electrical and electronic products:

i. Develop a memorandum of understanding with the donating agency or its supplier/representative to take back the waste once the products expire.

ii. Develop mechanisms to ensure that the inspection certificate clearly specifies the end-of-life date and who bears responsibility thereafter.

iii. Develop and mainstream e-waste education curricula.

10.6.5 Guidelines for Establishing Collection and Storage Facilities for e-waste

i. e-Waste will be managed separately from other categories of waste, and collection and storage areas should provide room for proper waste segregation.

ii. The collection and storage facilities should be set up in areas easily accessed by the population.

iii. Handling, collection, and transportation should preserve the items for possible reuse and recycling of whole components of whole appliances.

iv. Floors of storage facilities should be impermeable with provision for easy cleaning of spillages.

v. Weatherproof covering should be used as appropriate.

10.6.6 General Guidance on e-Waste Collection

i. Collection mechanism for e-waste in terms of packaging, labelling, and transportation shall be as per the existing Waste Management Regulations 2006.

ii. Collection centers shall be established by NEMA-licensed producers/dealers, manufacturers, importers, and distributors.

iii. Collection centers shall store the e-waste after sorting it into various access points by downstream users as well as facilitate record keeping on the quantities of various categories of waste.

iv. Producers/dealers, manufacturers, importers, and distributors should enroll in an e-waste collection scheme by virtue of the fact that they introduce electrical and electronic equipment into the environment.

v. Producers/dealers, manufacturers, importers, and distributors should have the extended producer/manufacturer responsibility to ensure that the equipment's end-of-life span and disposal is managed responsibly.

vi. NEMA, with other regulatory authorities, will regulate the collection, recycling, refurbishing, and disposal of e-waste.

vii. Manufacturers, local authorities, importers, and distributors will create awareness of waste collection systems.

10.7 Managing Asbestos Waste

10.7.1 Environmental Impact Assessment

i. Removing asbestos for disposal calls for an environmental impact assessment (EIA) before the exercise. The EIA must go through proper procedures as recommended by NEMA and will be done by experts/consultants registered by NEMA.

ii. The exercise of removal and disposal should be according to the recommendations of the EIA.

iii. Asbestos removal, handling, and disposal should not commence until an EIA license is issued.

10.7.2 Notification

i. When planning to remove asbestos from a site, parties concerned shall be notified about the time and nature of work to be done and the risk of exposure that needs to be mitigated against.

ii. Notice should be given at least seven days ahead of the actual handling and removal.

CHAPTER 11: OCCUPATIONAL SAFETY AND HEALTH

11.1. Background

i. OSH is an area concerned with protecting the safety, health, and welfare of people engaged in work or employment. The goals of OSH programs include fostering a safe and healthy work environment. It is a multi-disciplinary activity targeting four basic aspects, namely:

ii. (1) The protection and promotion of worker's health by preventing and controlling occupational diseases and accidents.

iii. (2) The development and promotion of healthy and safe work, work environments, and work organizations.

iv. (3) Enhancement of physical, mental, and social well-being of workers.

v. (4) Enabling workers to conduct socially and economically productive lives and to contribute positively to sustainable development (36).

vi. Inspection of workplaces will foster compliance with safety and health law; measurement of workplace pollutants for the purposes of their control; investigation of occupational accidents and diseases and aiming to prevent recurrence; examination and testing of steam boilers, steam and air receivers, lifts, gas cylinders, crane chains, among other lifting equipment; training on OSH, first aid, and fire safety; approving of architectural plans of buildings intended to serve as workplaces; medical examinations of workers; and dissemination of information on OSH to employers, workers, other key stakeholders, and the general public.

11.2. Employers

The Occupational Safety and Health Act provides for the health, safety, and welfare of persons employed and all persons lawfully present at workplaces and related matters.

According to the Act, an "occupier" means the person or persons in actual occupation of a workplace, whether as the owner or not, and includes an employer.

An employer must provide and maintain plant, systems, and work procedures that are safe and without risk to workers' health. The employer must ensure safety and absence of risks to health in connection with the use, handling, storage, and transport of articles and substances. Providing such information, instruction, training, and supervision of workers is crucial to maintaining a safe and healthy workplace.

A safe workplace and work environment, without health risks, and adequate facilities and arrangements for the workers' welfare at work should be maintained. Workers should be well informed of any hazards and imminent dangers related to new technologies, and they should participate in the application and review of safety and health measures.

The occupier must also ensure proper cleanliness, ventilation, lighting, drainage of the floor, sanitary convenience, avoid overcrowding, and control air pollution, noise, and vibration at the workplace. Every occupier is required to establish a safety and health committee at the workplace in accordance with regulations prescribed under the law.

Preventive and protective measures should be taken after proper risk assessment (at least once a year) to ensure that all chemicals, machinery, equipment, tools, and processes are safe and without risk to health, and comply with the requirements of safety and health provisions in this Act.

An occupier who fails to comply with a duty imposed on him commits an offence, and he/she is liable to a fine not exceeding 500,000 shillings or to imprisonment up to six months or to both.

All the above provisions are applicable also to the mine workers, as enunciated under the Mines Act 2016.

11.3. Free Protection

In accordance with the Occupational Safety and Health Act 2007, the employer must provide free protective equipment, including clothing and appliances, and where necessary, suitable gloves, footwear, goggles, and head coverings to the workers involved in hazardous work. The type of PPE needed varies depending on the work's nature. The right use of PPE reduces the risk of accidents and illness and helps in the creation of a safer working environment. The employer should also provide the relevant vaccines against infections with pathogens, (e.g., HBV).

A safety consultant, registered by the Director, assesses the suitability and effectiveness of protective clothes and appliances. (37)

11.4. Training

In accordance with the Occupational Safety and Health Act 2007, it is the responsibility of an employer to provide instruction, training, and supervision as is necessary to ensure the health and safety at work of the workers.

Employment of a worker at any machine or in any process that may cause ill health or bodily injury is prohibited unless the worker has been fully instructed about the hazards involved and precautions that must be observed. A worker should be properly trained or required to work under the supervision of experienced people.

Training is carried out on recruitment, transfer, or change of job; introduction of new work equipment or materials or change in equipment or materials; and introduction of new technology. The training must be arranged regularly at the workplace during working hours and adapted accordingly with the new and changed risks.

The employer must ensure that all persons involved in work receive appropriate instructions regarding safety and health risks, including emergency procedures during their activities at the workplace and actions to be taken in case of an emergency.

If a person fails to comply with these provisions, he/she commits an offence and is liable to a fine up to 200,000 shillings or to imprisonment up to six months or to both.

11.5. Labor Inspection System

The Occupational Safety, Health, and Injury Benefits Authority is responsible for the implementation of occupational health and safety; for improving and ensuring health, safety, security, and good working conditions at the enterprises; for inspecting enterprises; and for ensuring the law enforcement.

The national legislation provides inspectors the power to enter, inspect, and examine the work premises at any time during day or night with or without prior notice; take measurements, photographs, and samples and make recordings for the purpose of examination and investigation; ask for registers, documents, certificates, and notices to inspect, examine, and copy them; interview any one; if the inspector is a medical practitioner he/she may carry out medical examinations; and may take a police officer along with him/her, if necessary.

If an occupier or his representatives do not facilitate the inspector and obstruct the execution of his duties, he/she commits an offense and is liable to a fine up to 100,000 shillings or to imprisonment up to six months or to both.

Labor inspectors are authorized to conduct proceedings arising under this Act; to obtain samples of any substance used or intended to be used at workplace; to deal with the cause of imminent danger by seizing it or causing it to be rendered harmless; and issue notices (improvement or prohibition). The inspector must not disclose any information obtained during his/her duty, otherwise he/she is liable to a fine up to 100,000 shillings (37).

11.6. Law Provision

There are also other laws and regulations touching on OSH that are issued and enforced by other ministries and state departments. Such laws and regulations include: the Mining Act, Cap. 306, No. 2, 2009; the Biosafety Act; the Food, Drugs and Chemical Substances Act, Cap. 254; the Environmental Management and Coordination Act, No. 8, 1999; the Public Health Act, Cap. 242; the Employment Act, No. 11, 2007; the Energy Act, No. 12, 2006; the Radiation and Protection Act, Cap. 243; the Standards Act, Cap. 496; the Pest Control and Product Act, Cap. 346; and the Petroleum (Exploration and Production) Act, Cap. 308.

In addition, the National Occupation Safety and Health Policy (2012) established national OSH systems and programs designed to improve the workplace environment.

The Directorate of Occupational Safety and Health Services outlines that occupational accidents should be reported by an employer to the Director of Occupational Health and Safety Services on a prescribed form within seven days following receipt of an accident notice or on learning that an employee has been injured at work. In case of fatal accidents, the accident should be reported within 24 hours by the fastest means possible and thereafter in writing to the Directorate of Occupational Safety and Health Services within seven days.

CHAPTER 12: TRAINING

12.1 Technical Training and Deployment

12.1.1 Staff Deployment

Trained personnel shall be deployed in HCWM (11, 25, 30, 31). Management should facilitate education and training in the following levels:

i. Training of HCF managers
ii. Operational training
iii. Waste handlers' training (generators, handlers, collectors, transporters)
iv. Public awareness and behavior change communication

Note: The MOH should develop training manuals to facilitate this process.

12.1.2 Continuing Education

i. Continuous medical education and continuing professional development should be organized to address the performance gaps (by use of tools [e.g., supervisory checklist]).
ii. The HFMT shall facilitate refresher training on a critical review of existing waste management practices, (i.e., segregation, storage, collection, transport, treatment, and disposal).
iii. The HFMT should also develop/adopt and disseminate guidelines or SOPs to the health care workers, waste handlers, and the community.

12.1.3 Proposed Training Packages for Different Cadres of Staff

Table 12.1. Recommended training programs for different cadres of staff

Cadre	Capacity needs	Course duration
National-level managers	• Policy and guidelines formulation • Designing HCWM programs • Advocacy for resource mobilization • National-level stakeholder coordination and alignment • Conducting HCWM assessments and audits • Research • Generating strategic HCWM plans and accompanying budgets • Specification of HCWM equipment and supplies and ensuring full supply • Creating awareness among communities on risks associated with health care waste and its management • Adopting global and regional best practices, policies, and protocols • Training of health care workers in waste management • Awareness of the multilateral environmental agreements (Stockholm Minamata, Basel, Montreal conventions and SAICM strategy, WHO Chemicals Health Strategy) • Conducting technical supportive supervision • HCWM concepts, principles, legal framework	4 days

Cadre	Capacity needs	Course duration
Management staff at county and sub-county levels (nursing officers, PHOs, IPC coordinators, procurement officers, health administrative staff, laboratory officers, pharmacists, biomedical engineering staff, etc.)	• Develop template for health facility roadmap • Occupational and environmental standards and practices • Awareness of the multilateral environmental agreements (Stockholm Minamata, Basel, Montreal conventions and SAICM strategy) • HCWM concepts, principles, legal framework • Health care waste classification and segregation • Environmental health risks and impacts of health care waste • Health care waste storage, transport, treatment, and disposal • Planning for HCWM at HCFs • HCWM compliance monitoring, IRAT application, and monitoring and evaluation framework • Selecting health care waste treatment technologies, setting up treatment plants, choosing disposal options, and undertaking Environmental Social Impact Assessment • Resource mobilization	4 days
Facility-level managers (medical superintendents, nursing officers, PHOs, IPC officers, procurement and administrative officers, laboratory managers, pharmacists, and biomedical engineering officers)	• Essential HCWM commodities • Best available techniques and best environmental practices • Principles of HCWM, legal framework • Planning for HCWM at HCFs • Drafting and managing HCWM contracts • Organizational structures, roles, and responsibilities in HCWM • Establishment of a facility HCWM Committee • Selecting, operating, and maintaining waste treatment technologies • Using IRAT to assess for risks associated with HCWM • Establishing systems for exposure management • Emission limits for environmental pollutants	4 days
Health care providers (medical officers, clinical officers, nursing officers, laboratory technologists, PHOs, nutritionists, radiographers, physiotherapists); merge with sanitation officers	• Awareness of the multilateral environmental agreements (Stockholm convention, Minamata, and SAICM) • MOH policies and guidelines for managing health care waste • National legal and policy frameworks on different categories of waste • Classification, segregation, handling, storage, treatment, and disposal of different categories of health care waste • Environmental health risks and impacts of health care waste • Heavy metals and chemicals waste management • Common environmental pollutants and their emission limits	3 days

Cadre	Capacity needs	Course duration
Waste handlers (casuals and support staff)	• Health care waste classification and segregation using color codes • Environmental health risks and impact of health care waste • Health care waste storage, transport, treatment, and disposal • Health care waste emergency response procedure • Donning and doffing of PPE • Exposure management • Weighing, recording, and reporting • Managing spillages • Ensuring a clean environment at the health facility	2 days
Treatment equipment operators (incinerator/ microwave/autoclave operators)	• Health care waste classification and segregation • Environmental health risks and impact of health care waste • Health care waste storage, transport, treatment, and disposal • Health care waste emergency response procedure • SOPs for equipment operation • Daily/weekly maintenance activities • Common malfunction errors and solving them • Monitoring and timely reporting on fuel use and supply status • Use of PPE when handling waste • Record keeping, including maintenance schedule • Risks posed by using different waste treatment technologies, such as incinerators, autoclaves, and microwaves, and prohibited items	2 days

CHAPTER 13: ENVIRONMENTAL AUDIT PROCESS FOR HEALTH CARE FACILITIES AND MONITORING

13.1 Environmental Auditing

i. Environmental auditing is a management tool consisting of a systematic, periodic, and objective evaluation of how effective environmental management is performing in safeguarding the environment.

ii. The audit is undertaken as guided by the EMCA.

iii. All new or proposed facilities will have to carry out an EIA at the planning level and propose adequate mitigation measures for the facility. In this case, an initial environmental audit will be carried out at the end of the first year of operation.

iv. The audit assesses actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures, and the functioning of monitoring mechanisms.

v. The Environmental Impact Assessment/Environmental Audit Regulation requires all HCFs to carry out an initial audit once operations commence and thereafter annual self-audits.

vi. NEMA will periodically carry out control audits of these facilities to ascertain the information contained in the annual audit reports.

vii. It is notable that HCFs are classified as high risk due to the hazardous nature of the waste generated.

13.1.1 Objectives of an Audit

Environmental auditing is used to:

i. Facilitate management and control of environmental practices.

ii. Assess compliance with relevant statutory and regulatory requirements.

iii. Raise awareness of and commitment to environmental policy by project staff, the community, and other concerned parties.

iv. Maintain environmental health and safety standards while continuously exploring opportunities for improvement.

13.1.2 Audit Process

i. Environmental auditing is based on baseline information generated during the EIA process.

ii. Existing projects that have not been subjected to EIA are to be audited based on information to be generated over a period of time.

iii. The Environmental Audit process entails the steps outlined below:

- Examining the effectiveness of EIA as a decision-making tool.
- Ensuring that conditions set in the environmental management plan have been complied with.
- Examining the performance of agencies concerned with the management of projects.
- Examining environmental impacts arising from project implementation.
- Examining the accuracy of predictions by comparing actual against predicted environmental impacts.

13.1.3 Stakeholder Roles in Environmental Auditing

13.1.3.1 Role of the MOH in Environmental Auditing

The responsibilities and activities of the proponent include:

i. Informing the employees about the objectives and scope of the audit.
ii. Provision of facilities needed by the audit team to ensure an efficient and effective audit process.
iii. Conducting self-audit.
iv. Implementing recommendations in audit reports and instructions and orders by the NEMA.

13.1.3.2 Role of Environmental Auditors

i. Self-audits will be carried out by both internal and external auditors commissioned by the MOH.
ii. The auditors must have been registered by the NEMA.
iii. At HCFs, PHOs in charge of sanitation will carry out annual audits of the facilities.

13.1.3.3 Role of NEMA

13.1.3.3.1 Introduction

The NEMA is responsible for:

i. Determining the need for and time of audit.
ii. Defining the objectives of the audit.
iii. Approving the environmental audit criteria.
iv. Approving the audit plan and scope.
v. Receiving and reviewing the audit reports.
vi. Ensuring follow-up actions on recommendations of the audit reports.
vii. Where necessary, overseeing the requirement that a lead agency undertakes the audit.

13.1.4 Conducting the Environmental Audit

13.1.4.1 Preparing for an Environmental Audit

The environmental audit will be conducted in accordance with audit plans prepared by proponents in consultation with the authority. An audit plan should include the following:

» The audit objectives and scope
» The audit criteria
» Identification of proponent's organizational and functional units to be audited
» Identification of the functions and/or individuals in the proponent's organization and their responsibilities
» Time frame for audit activities
» Report content and format.

13.1.4.2 Environmental Audit Methodology

The audit methodology should include the following:

» Establishing an audit protocol and tools.
» Reviewing existing baseline information.

» Assembling and assigning responsibilities to the audit team carrying out audit activities.

13.1.4.3 Content of the Environmental Audit Report

The audit report should contain all audit findings and a summary, including the following:

i. The proponent's name and address
ii. Project title
iii. Objective, scope, and criteria of the audit
iv. The audit team members
v. An executive summary of the audit process including any problems encountered during the process
vi. Project site
vii. Project description
viii. Review of all relevant environmental law and regulatory frameworks on health, safety, environmental standards, and sustainable use of natural resources
ix. Verification of the level of compliance by the proponent with the conditions of the environmental management plan
x. Evaluation of the proponent's knowledge and awareness of and responsibility for the application of relevant legislation
xi. Review of all project documentation related to infrastructural facilities and designs
xii. Examination of monitoring programs, parameters, and procedures for control and corrective actions in case of emergencies
xiii. Examination of records of incidents and accidents and the likelihood of future occurrence of the incidents and accidents; amounts of waste generated and disposed; and records of maintenance of equipment
xiv. Inspection of all buildings, premises, and yards in which collection and storage, testing, transportation takes place within and without the project area, as well as areas where shortage and disposal of goods is carried out, and give a record of all significant environmental risks associated with such activities
xv. Examination of public views on health and safety issues, especially from potentially affected communities as well as occupational health and safety issues for project employees
xvi. List of health and environmental concerns of past and ongoing activities.

13.1.4.5 Audit Report Format

The format of the audit report should include:

i. An executive summary
ii. Introduction and background to audit
iii. Description of audit approach and methodology
iv. Audit findings
v. Conclusion and recommendations

13.1.5 Development of Audit Action Plan

In formulating an audit action plan for effective performance and environmental improvement, it is important to provide clear guidelines specifying the following:

i. What should be done – activities?
ii. Who must do it – responsibilities?

iii. Time frame
iv. Budget
v. Implementation program
vi. Reporting
vii. Monitoring.

13.2 Monitoring

13.2.1 About Monitoring

i. Monitoring is an activity undertaken to provide specific information on the characteristics and functioning of environmental and social variables in space and time.

ii. Environmental monitoring compares impacts predicted in an EIA with those that actually occur during and after implementation to assess whether the impact prediction process performs during and after implementation.

iii. Environmental monitoring is essential for:

- » Ensuring that impacts do not exceed legal standards.
- » Checking the implementation of mitigation measures in the manner described in the EIA report.
- » Providing early warning of potential environmental damage.

iv. The frequency of monitoring will vary from project to project, depending on the nature of the project and the severity of the environmental impacts.

13.2.2 Principles of Monitoring

The EIA monitoring process is intended to generate meaningful information and improve implementation of mitigation measures.

Monitoring must accomplish the following:

i. Carefully determine the indicators to be used in monitoring activities.
ii. Collect meaningful and relevant information.
iii. Apply measurable criteria in relation to chosen indicators.
iv. Pass objective judgments on the information collected.
v. Draw tangible conclusions based on the processing of information and objective judgments.
vi. Facilitate rational decision making based on the conclusions drawn.

13.2.3 Objectives of Monitoring

Monitoring is put in place to achieve the following:

vii. Verify impact predictions
viii. Check success of mitigation measures (progress of actions undertaken)
ix. Adherence to approved plan of action
x. Compliance with conditions of approval
xi. Success of management plan to meet environmental health and safety needs and standards
xii. Enable corrective action to be taken promptly if there is a major unpredicted environmental impact.

13.2.4 Types of Monitoring

Monitoring activities include the following types:

1. Baseline monitoring: A survey should be conducted of basic environmental parameters in the area surrounding the proposed project before operation begins, so that subsequent monitoring can assess changes in those parameters over time against the baseline.
2. Impact monitoring: The ecological, health, and socioeconomic parameters in the project area must be measured during the project construction and operational phases to detect environmental changes that may have occurred as a result of project implementation.
3. Compliance monitoring: Employs a periodic sampling method or continuous recording of specific environmental quality indicators or pollution levels to ensure project compliance with recommended environmental protection standards.

13.2.5 Monitoring and Supervision of HCWM Program

i. A monitoring system shall be set up to track hazardous health care waste and sharps along the waste stream up to final disposal.
ii. Monitoring should include incident and accident reporting and recording.
iii. Monitoring data shall be analyzed and reviewed at regular intervals and compared with the country regulatory limits so that any necessary corrective actions can be taken.
iv. Records of monitoring results should be kept in an acceptable and easily retrievable format.
v. Periodic surveys shall be performed in waste generating, storage and transportation, treatment, and disposal facilities.
vi. All responsible bodies should submit annual HCWM performance monitoring reports to their respective regulatory and supervisory bodies.
vii. The annual reports shall contain quantitative data on the performance of the facility illustrating compliance with national guidelines and regulations.

13.2.6 Preparing for Monitoring, Supervision, and Evaluation

In preparation for monthly, quarterly, semi-annual, and annual monitoring and supervision exercises, teams will hold pre-field meetings to agree on mission objectives and schedules, priority sites to be visited, tools to be used, and expected outcomes. Arrangements should be made to hold post monitoring meetings to generate action points based on recommendations of the field teams.

13.2.7 Monitoring at the Health-Facility Level

» **Public health officer**

The PHO in charge of the facility will make weekly plans for monitoring HCWM activities. All service delivery areas in the health facility will be mapped and assessed for risks. The service delivery areas will be prioritized based on some criteria; for example, the facilities can be categorized into low, medium, and high-risk areas. The HCWM focal person will design a weekly plan for supporting the service delivery areas to improve their practices, prioritizing high risk areas for more frequent monitoring.

» **Monitoring by HCWM and IPC committees**

HCWM will, on monthly basis, be tabled for discussion by the facility HCWM and IPC committees. The topic will be put on the agenda for each/every monthly performance review meeting. All exposures occurring at the different service delivery areas will be reported to the committee. Risk factors for each exposure will be investigated, mitigation measures against each identified risk agreed on, costed, and implemented.

Monthly meetings will be preceded by health facility walk through sessions by members of senior management and the HCWM and IPC committees. The purpose of the supportive supervision will be to observe any potential risks to patients and health workers as well as to get feedback from operational-level workers, especially at high and medium risk service delivery points. Reports on

findings registered during the supervision will be shared at the subsequent scheduled monthly meeting.

» **Monitoring by the sub-county team**

Quarterly technical supportive supervision visits will be conducted by the Sub-County Health Management Teams. As part of this supervision, the IRAT will be administered to assess progress being made by the health facility in achieving best standards in HCWM. Health facilities will be assessed according to prevailing risks and categorized into low, medium, and high risk. High and medium risk facilities can be visited more often to help them improve their situations. Action plans will be generated based on jointly agreed recommendations for implementation by the HCWM facility staff.

» **Monitoring by the county team**

The County Health Management Team will conduct biannual county technical supportive supervision and audits using standardized tools for assessing HCWM. Data collected will be analyzed and used to inform reprogramming. Inasmuch as possible, collected sub-county data and lessons learned by sub-county teams will be shared at the county and sub-county meetings to enrich the understanding of the county context and how it relates to HCWM. Regional scientific HCWM meetings will be organized to enhance information gathering.

Independent monitoring/auditing will be carried out by contracted independent consultants hired by the county to identify health system strengthening issues that need attention.

13.3 HCWM Monitoring and Evaluation Framework

The MOH shall develop a comprehensive Monitoring and Evaluation Framework for HCWM that may be customized by the Department of Health services in the counties. Appropriate indicators for monitoring HCWM activities throughout the country will be selected. Recommended reporting tools necessary for the operationalization of the monitoring process will be developed and administered, as necessary, at all levels, including through cross-sectional health facility surveys to generate annual HCWM status reports, and during quarterly, monthly, weekly, and daily monitoring exercises.

13.3.1 Selection of Impact Indicators

i. Impact monitoring should not be limited to a few program components.
ii. Appropriate environmental indicators need to be selected so that monitoring covers all program components.
iii. Emphasis should be given to monitoring potentially significant indicators for components in causing adverse environmental impacts.

13.3.2 Monitoring Report Content and Format

The MOH shall make a monitoring report for all facilities and will include the following:

i. Name and address of facility indicating owner/operator
ii. Project title
iii. Date of implementation
iv. Date of the last report with a summary of findings, actions undertaken, and results of these actions
v. Details of environmental parameters to be monitored
vi. Result of the actual monitoring exercise

13.4 Monitoring Waste Handling, Storage, and Transportation (Execution of Legal Notice No. 121; Waste Management Regulations, 2006)

Monitoring of waste management will be done by the lead agency to ensure that such waste is treated in a manner that will not adversely affect public health and the environment.

Table 13.1. Areas for HCWM auditing and parameters to assess

No.	Area for auditing	Parameters to assess
1	Waste segregation and containment	a) Waste must be physically separated and put in the recommended color-coded waste bins. b) Number of bins used must be counted and recorded.
2	Double bagging	a) Waste must be bagged twice to ensure that it is secure, and that spillage is avoided. b) Number of bags must be counted and recorded.
3	Weighing	a) The waste bins must be weighed when empty to ascertain net weight (in kg) for each and recorded for future reference. The weight of the empty waste bin is then captured in the system. b) To get the actual weight of collected waste, the weight of the empty bin is subtracted from the registered weight of the filled bin.
4	Loading on trucks	The weight of the transporting trucks must be recorded before loading and then recorded after loading to ascertain the net weight of the waste bins and recorded in the system.
5	Transportation	Transportation must be done using specialized trucks (licensed, closed, labeled "hazardous waste," and leak proof) to avoid spillage.
6	Off loading	The number of bins loaded must be reconciled with the off-loaded ones.
7	Treating waste, including disinfecting waste bins	All waste bins must be treated/disinfected, and the number should be reconciled with the number of loaded bins.
8	Disposal	All bins should be disposed of, and the number of bins disposed of should be reconciled with the ones treated.
9	Data compilation	This should include all details for deliveries and must tally with all other records (loading and off-loading).
10	Invoicing	Will be as per the transportation and disposal agreement/contract. All other records must be checked before invoice is approved for payment (loading, off-loading, treatment, and disposal)
11	Receiving payment	All payments should be done through issuing a receipt by the cashier or authorized person and a copy retained in the receipt book for reference.
12	Procurement of waste handling materials/fuel of vehicles	Must be done as per the laid down procurement procedures of the organization.
13	Distributing waste handling materials to the health facilities	Distribution should be as per the health facilities approved requirements and procedures.
14	Incinerator	All disposals are taken to the incinerator for burning.
15	Safety	All staff must have protective gear

Note: All monitoring and evaluation activities on HCWM should be guided by the National Health Care Waste Management Monitoring and Evaluation Framework.

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ANNEXES

Annex 1. Sample Sheets for Assessment of Waste Generation

Name of the Health Care Facility: Week.....Date..... Month.....

Waste collection point department /location	Waste category (specify)	Quantity of waste generated per day (weight and volume)													
		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
		Kg	Litre	Kg	Litre	Kg	Litre	Kg	Litre	Kg	Litre	Kg	Litre	Kg	Litre

Annex 2. Color Code for Biomedical Waste

No.	TYPE OF WASTE	COLOR OF CONTAINER	TYPE OF CONTAINER
1	Infectious	Yellow with biohazard sign	Strong leak proof plastic bag with biohazard symbol
2	Pathological/ Anatomical	Red with Biohazard Sign	Strong leak proof plastic bag with biohazard symbol
3	Sharps	Yellow, marked sharps	Puncture proof
4	Chemicals	Brown, marked chemicals	Plastic bag or container
5	Pharmaceutical	Brown	Plastic bag or container
6	General waste/ Non-infectious / Non-hazardous (Non-clinical)	Black	Plastic bag or container
7	Radioactive waste	Symbol for radioactive waste	Lead box labelled with radioactive symbol
8	Genotoxic waste		
9	e-Waste	Refer to e-waste guidelines	

Annex 3a. International Waste Labeling Symbols

 Potentially explosive	 Radioactive	 Potentially corrosive waste
 Label for infectious waste	 Waste containing flammable materials	 Label for waste containing oxidizing chemicals
 Waste containing toxic materials	 Highly infectious/sharps waste	

Annex 3b. Waste Segregation categories

CATEGORY	EXAMPLES OF WASTES	COLOR OF BIN AND LINER	MARKING
General or non- infectious	Paper, packaging materials, plastic bottles, food, cartons	Black	No recommended marking
Infectious	Gloves, dressings, blood, body fluids, used specimen containers	Yellow– pedal action	
Highly infectious or anatomical/ pathological	Laboratory specimens and containers with biological agents, anatomical waste, pathological waste	Red-pedal action	
Chemical	Formaldehyde, batteries, photographic chemicals, solvents, organic chemicals, inorganic chemicals	Brown	Marking will vary with classification of the chemical
Radioactive	Any solid, liquid, or pathological waste contaminated with radioactive isotopes of any kind	Yellow	
Genotoxic/ Cytotoxic	All drug administrative equipment (e.g., needles, syringes, drip sets), gowns and bodily fluid/ waste from patients undergoing cytotoxic drug therapy	Purple	
Sharps Box (Safety Box)	Needles, Syringes, broken vials	White/yellow safety boxes (WHO Approved)	

Annex 4. Waste Tracking Form Sample

(Can also be modified to fit use at a HCF)

Name, address, and telephone number of waste regulatory agency	Serial no.
	Originator's reference
CONSIGNMENT NOTE FOR THE CARRIAGE AND DISPOSAL OF HAZARDOUS WASTE	
A. Producer's certificate	The material described in B below is to be collected from (location)….….....and taken to (location): Name……Signed…… On behalf of …… Designation…… Address ……Tel. no…… Date ……Time of collection……
B: Description of the waste	General description and physical nature of the waste..... Relevant chemical and biological components and maximum concentrations..... Quantity of waste and size, type, and number of containers..... Process (es) from which waste originated.....
C. Carrier's collection certificate	I certify that I collected the consignment of waste and the information given in A (1) and B (1) is correct, subject to any amendment listed in this space I collected this consignment on…….. at…….. Time Signed …….. Name …….. Date …… On behalf of …… Vehicle reg. no. .. ……. Address ……Tel. no. ……...……..
D. Producer's collection certificate	I certify that the information given in B and C is correct and the carrier was advised of appropriate precautionary measures. Signed ……Name …… Date……Tel. no. ……..
E. Disposer's certificate	I certify that Waste Disposal License No……., issued by ……. [name of issuing body], authorizes the treatment/disposal at this facility of the waste described in B (and as amended where necessary at C) Name and address of facility……... This waste was delivered in vehicle ……[Reg. No.] at …… Time …….. [date] and the carrier gave his name as …….. on behalf of …… Proper instructions were given that the waste should be taken to …… Signed …….. Name …… Position …….. Date ……on behalf of ……

Annex 5. Waste Treatment Methods

Waste category	Treatment method
Infectious waste	
Cultures and stock	Steam sterilization/microwave
Contaminated bedding/patient care waste	Steam sterilization or incineration
Contaminated small equipment	Steam sterilization or incineration
Contaminated large equipment	Formaldehyde decontamination
Biological waste	Steam sterilization or incineration/ microwave
Contaminated laboratory waste	Steam sterilization/microwave
Dialysis unit waste	Steam sterilization
Pathological waste	
Anatomical waste	Steam sterilization or incineration/grinding
Surgery waste	Steam sterilization or incineration
Human blood and blood products	Steam sterilization or incineration
Contaminated animal carcasses	Incineration
Autopsy waste	Incineration
Sharps	
Contaminated and unused sharps	Steam sterilization and incineration/ grinding
Pharmaceutical waste	
Pharmaceutical waste	See separate pharmaceutical waste guidelines. Microwave
Anti-neoplastic drug waste	Incineration
Low-level radioactive waste	Consult the Kenya Nuclear Regulatory Authority

Annex 6. Management of Spillage

Example of General Procedure for Dealing with Spillage

i. Evacuate the contaminated area.

ii. Decontaminate the eyes and skin of exposed personnel immediately.

iii. Inform the designated person (usually the Waste Management Officer), who should coordinate the necessary actions.

iv. Determine the nature of the spill.

v. Evacuate all people not involved in cleaning up if the spillage involves a particularly hazardous substance.

vi. Provide first aid and medical care to injured individuals.

vii. Secure the area to prevent exposure of additional individuals.

viii. Provide adequate protective clothing to personnel involved in cleaning up.

ix. Limit the spread of the spill.

x. Neutralize or disinfect the spilled or contaminated material if indicated.

xi. Collect all spilled and contaminated material. Sharps should never be picked up by hand brushes. Pans or other suitable tools should be used.

xii. Spilled material and disposable contaminated items used for cleaning should be placed in the appropriate waste bags or containers.

xiii. Decontaminate or disinfect the area, wiping up with absorbent cloth. The cloth (or other absorbent material) should never be turned during this process because this will spread the contamination. The decontamination should be carried out by working from the least to the most contaminated parts, with a change of cloth at each stage. Dry cloths should be used in the case of liquid spillage; for spillages of solids, cloth impregnated with water (acidic, basic, or neutral, as appropriate) should be used.

xiv. Rinse the area and wipe dry with absorbent cloth.

xv. Decontaminate or disinfect any tools that were used.

xvi. Remove protective clothing and decontaminate or disinfect it, if necessary.

xvii. Seek medical attention if exposure to hazardous material has occurred during the operation.

Annex 7. Macerator Specifications

Description: A hygienic treatment and disposal equipment for medical waste through maceration.

Scope: For use in Level 4 and above health facilities

Features:

- Be vertical type and top loading
- Infection control properties: curved angles and edges, non-staining hopper
- Upright motor and pulverizer
- Disposal of up to 4 waste units per cycle
- Closed lid manual – with an indicator
- Process indicators fitted
- Antimicrobial cleaner provided
- Internal hopper and impeller self-clean per cycle
- Manual override capacity
- Be made of non-corrosive material
- Embossed biohazard universal symbol on the equipment for safety measures

Technical specification:

- Installation: Inlet 12.5mm-15mm mains cold water inlet
- Machine supplied with ¾ inch reinforced flex tube at least 700mm long
- P-trap and overflow switch fitted internally
- Minimum outlet: 50mm, preferably no bends
- Cycle run time: 1.6–2 minutes adjustable
- Programmable cycles
- Internal water cistern minimum capacity 5 liters
- Noise level minimum 60 DB @ 3M

Utilities

- Electrical: a) 220–240V /1-Phase/415V, 50HZ
- MCB to be supplied; single phase 220–240V
- External water back-up storage at least 200 liters with gravity flow when mains fail

Installation

- Surge protectors
- Power cable

Other Requirements

- Operation and service manual in English language
- One (1) year warranty on parts and service after acceptance and commissioning
- On-site training of operators, biomedical staff, and PHOs
- Guaranteed local availability of spares during life span

Approval: Director, Public Health, Kenya

Annex 8. Recycling Index

Category	Action	Outcome
Uncontaminated Paper and Cardboard		
Cardboard	Flatten and bundle	Recycled cartons
Confidential documents	Shred	Recycled paper
Office paper	Separate and bundle	Recycled paper
Metals		
Aluminum	Contact a scrap merchant	Reprocessed cans
Dental amalgam	Contact a silver recovery contractor	Recovered silver
Mercury	Contact a recovery contractor	Reprocessed mercury
Scrap steel	Contact a scrap merchant	Reprocessed steel
Silver X-ray films and processors	Contact a silver recovery contractor	Recovered silver
Glass		
Bottles and jars, clear, brown and green	Separate, reuse and contact a recycler	Reused item or reprocessed glass
Broken glass	Separate, store in rigid containers and contact a recycler	Reprocessed glass
Oils		
Waste oil	Separate and contact a recycler	Refined or used as fuels
Food remains/leftovers and green waste		
Food remains/leftovers	Separate from other types of waste into appropriate color-coded bins	Garden compost Pig swill
Grass cuttings, tree/shrub pruning, dead leaves	Mulching firewood	Garden compost
Plastics		
High- and low-density polyethylene	Return to supplier	Reprocessed
PET (polythene terephthalate) soft drink bottles	Separate and arrange collection	Recycled bottles
PP (polypropylene) car battery casings	Separate and arrange collection	Reprocessed
PPVC (plasticized polyvinyl chloride) plastic tubing	Separate and arrange collection	Reprocessed
PS (polystyrene) foam cups and packaging	Separate and arrange collection	Reprocessed or reused
UPVC (unplasticized polyvinyl chloride)	Separate and arrange collection	Reprocessed

Annex 9. A Sample Tag for Shipment

HEALTH CARE WASTE

Date of shipment 00/00/0000

GENERATOR

Name:	**GENERAL HOSPITAL**
Physical address:	**First Aid Avenue, Generation House, Plot:0000**
Postal address:	**Box 000, Any town Tel:0000000**

TRANSPORTER

Name:	**WE-HAUL HEALTH CARE WASTE**
Physical address:	**123 Haula Way**
	Towtown, Any Province.
Postal address:	**Box 000, Any Town.**
	Tel:000000

HEALTH CARE WASTE

Annex 10. Facility HCWM Plan

Name of Facility:	Date:

Define Staff Roles

Who is responsible overall for supervising HCWM at your facility? Attach the supervision structure organogram of your facility.
Who is responsible for performing waste disposal for each area of your facility?
Attach job descriptions for all cadres of staff at your facility.

Outline Current HCWM Status at Facility

Define type and amounts of waste generated:

Type	Amount (per week)
Non-infectious waste	
Infectious waste	
Highly infectious waste	
Sharps waste	

List number of staff and their designations at your facility

Designation	Number

Outline HCWM practices used currently.

Concept	Current Practice
Is waste classified and segregated into different colored waste bins? Describe how.	
How are sharps (needles) disposed? How are safety boxes used?	
Are full safety boxes recorded? Where are they stored? How are they transported to their final disposal location?	
Where are different categories of waste disposed? Describe the disposal process.	

Outline Ideal Practices: Establishing Standards

Concept	Standard
Segregating waste (different types, corresponding colors of waste liners)	
Prioritizing sharps (use of safety boxes or needle removers, if applicable)	
Recording, handling, and transport of safety boxes	
Final waste disposal for each category of waste (including sharps barrel, if applicable)	
Hepatitis B and tetanus toxoid immunization for all cadres of staff	

List of Improvements Needed

What capital improvements are needed at your facility?

Item	Date for Introduction	Total Cost	Responsible Party

What supplies are needed for the next 6 months? (protective clothing, cleaning supplies, waste bin, liners, safety boxes)

Supplies	Quantity	Total Cost

What training is needed at your facility for each cadre of staff?

Cadre of Staff	Training Topics	Date for Completion

Outline Monitoring Schedule

List the person responsible to perform the monitoring for each cadre of staff and the frequency with which they will be monitored.

Cadre of Staff	Supervisor	Frequency to be monitored

List the person responsible to perform the monitoring for each cadre of staff and the frequency with which they will be monitored.

Form	Frequency to be monitored

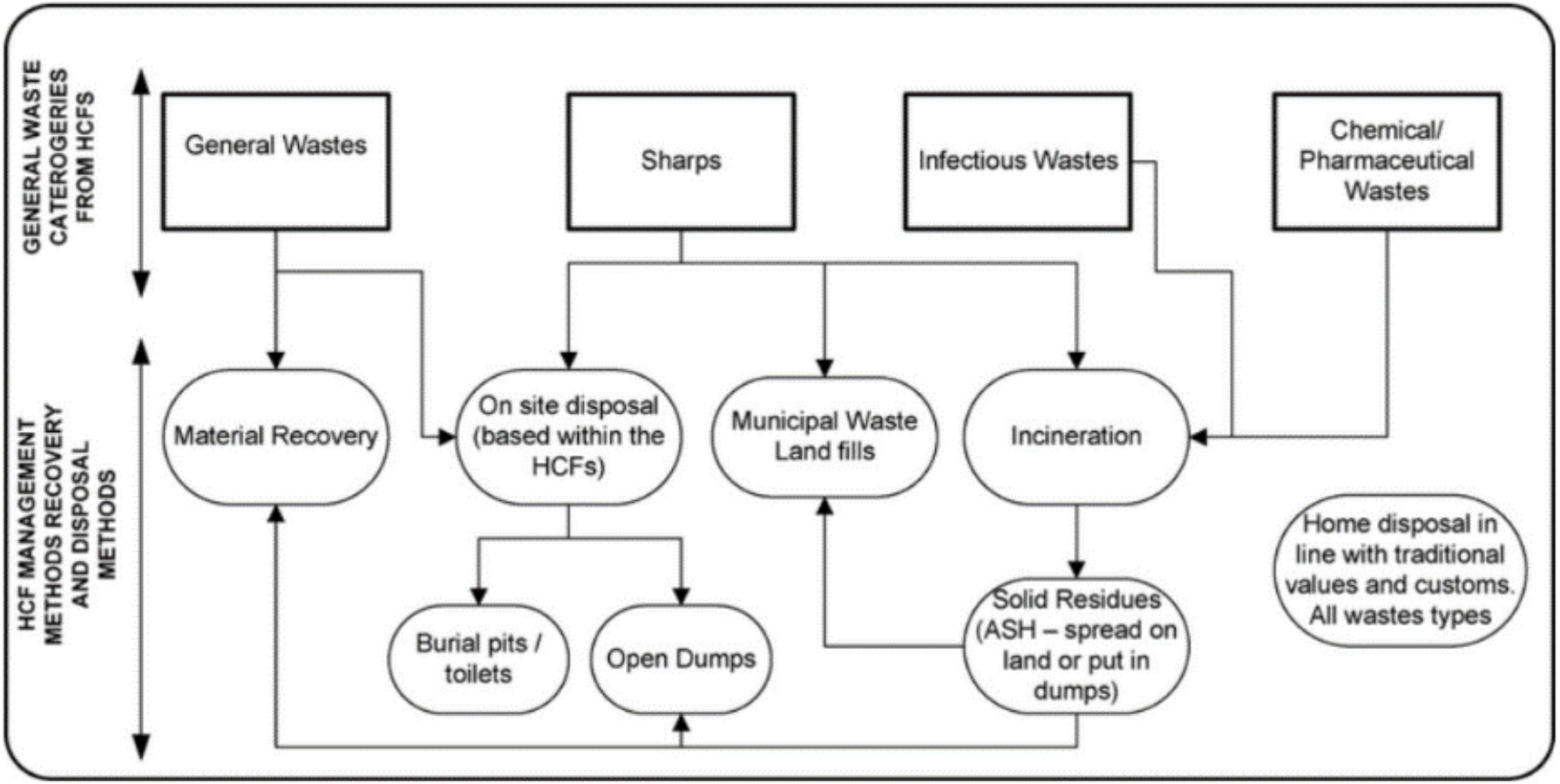
Date for introduction of this plan:

Source: JSI/MMIS Final Waste Management Manual (2010) (38)

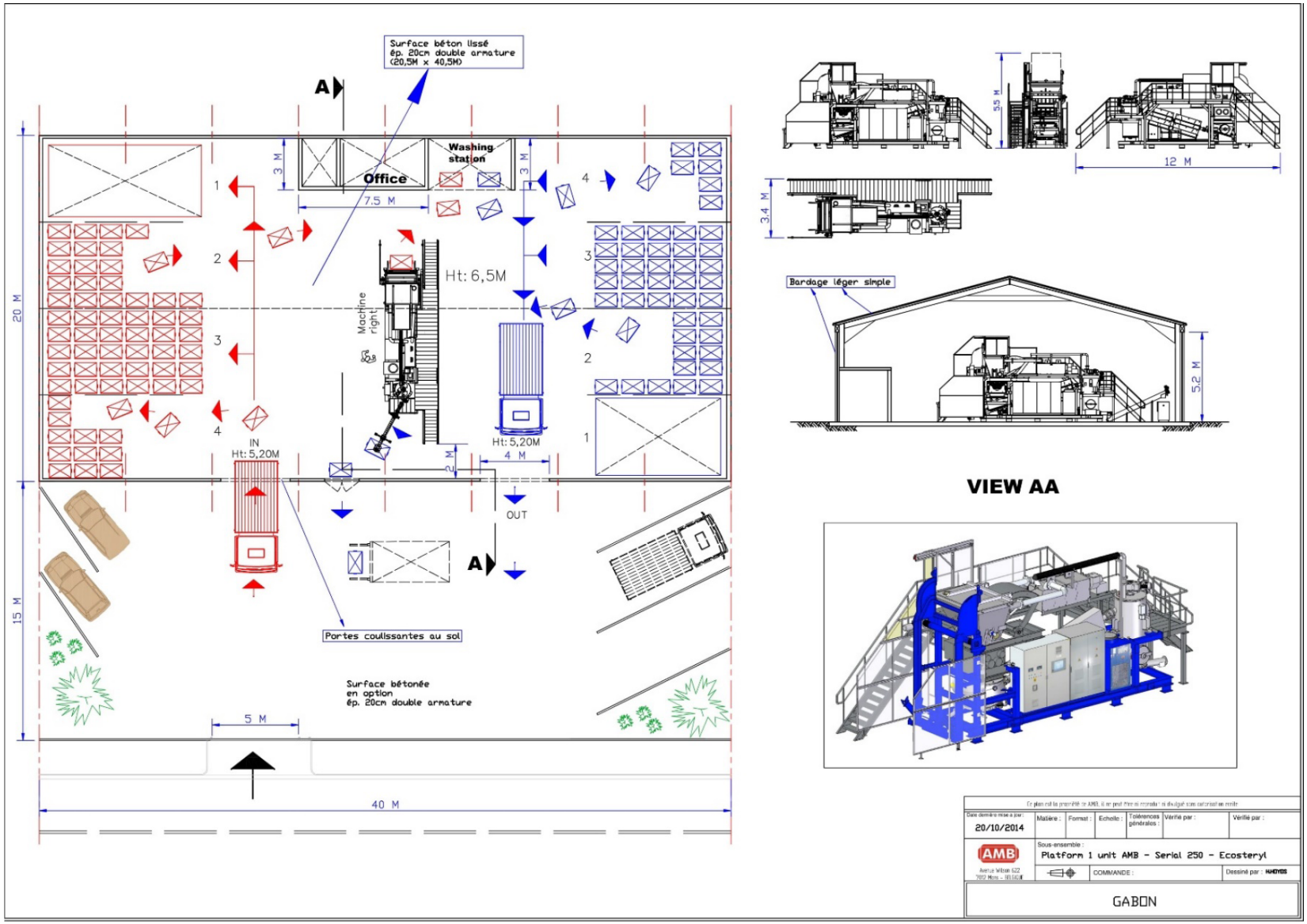
Annex 11. Symbols for Different Types of Recyclable and Non-Recyclable Plastics

Symbol	Example	Polymer type	Recyclable
	Bottles of cooking oil, squashes, water, mineral water and juice bottles, X-ray films	Polyethylene terephthalate	Yes
	Mil bottles, used medicine containers and caps, films and packaging, juice bottles	High-density polyethylene	Yes
	Cables, pipes, blood bags IV tubes, etc.	Polyvinyl chloride	No
	Carrier bags, bin liners, drip bottles	Low-density polyethene	Yes
	Margarine tabs, microwave trays, syringes	Polypropylene	Yes
	Yoghurt pots, disposable cups	Polystyrene	Yes
	Any other plastics		No

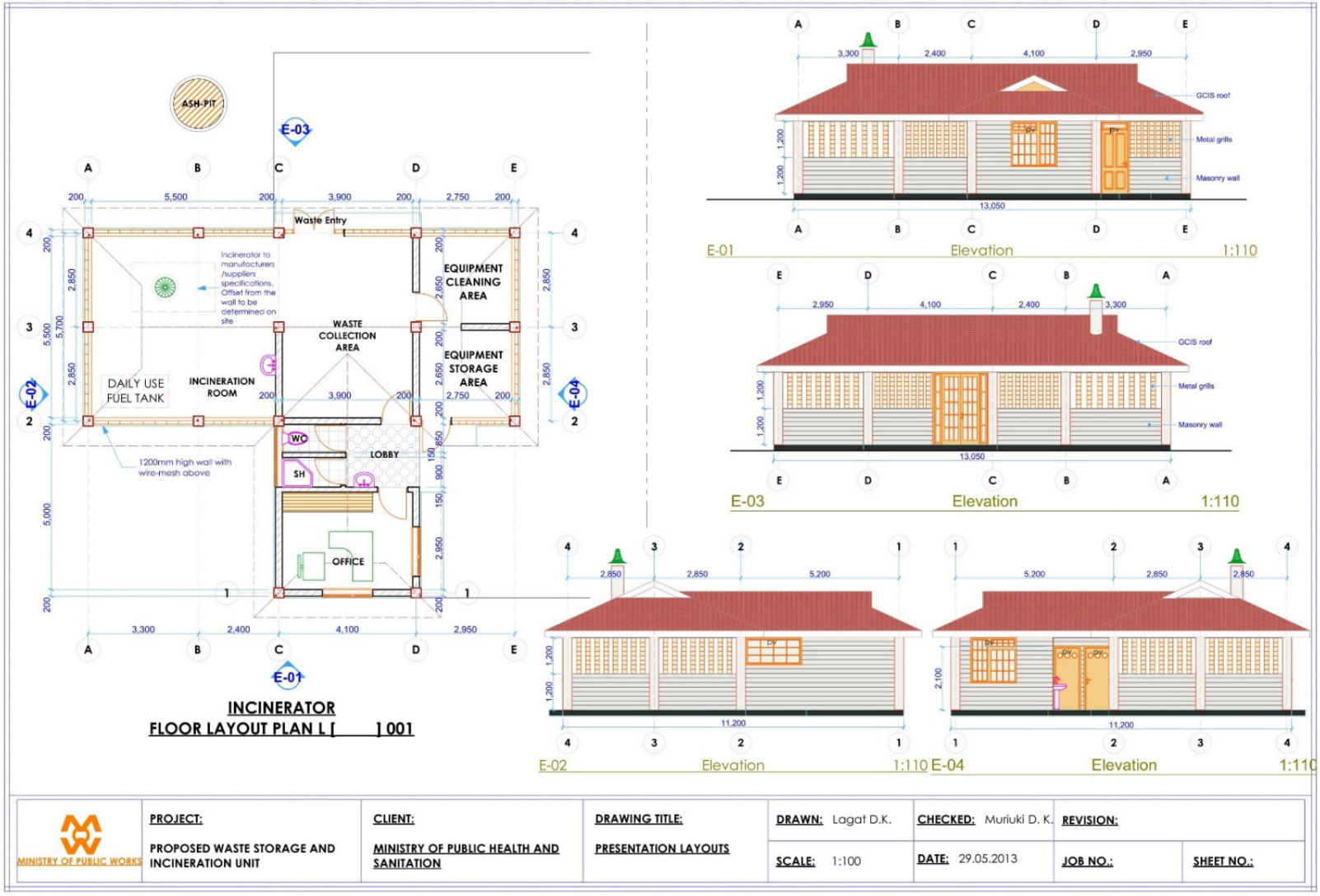
Annex 12. Waste Disposal Unit



Annex 13. Incinerator Housing (Typical Design)

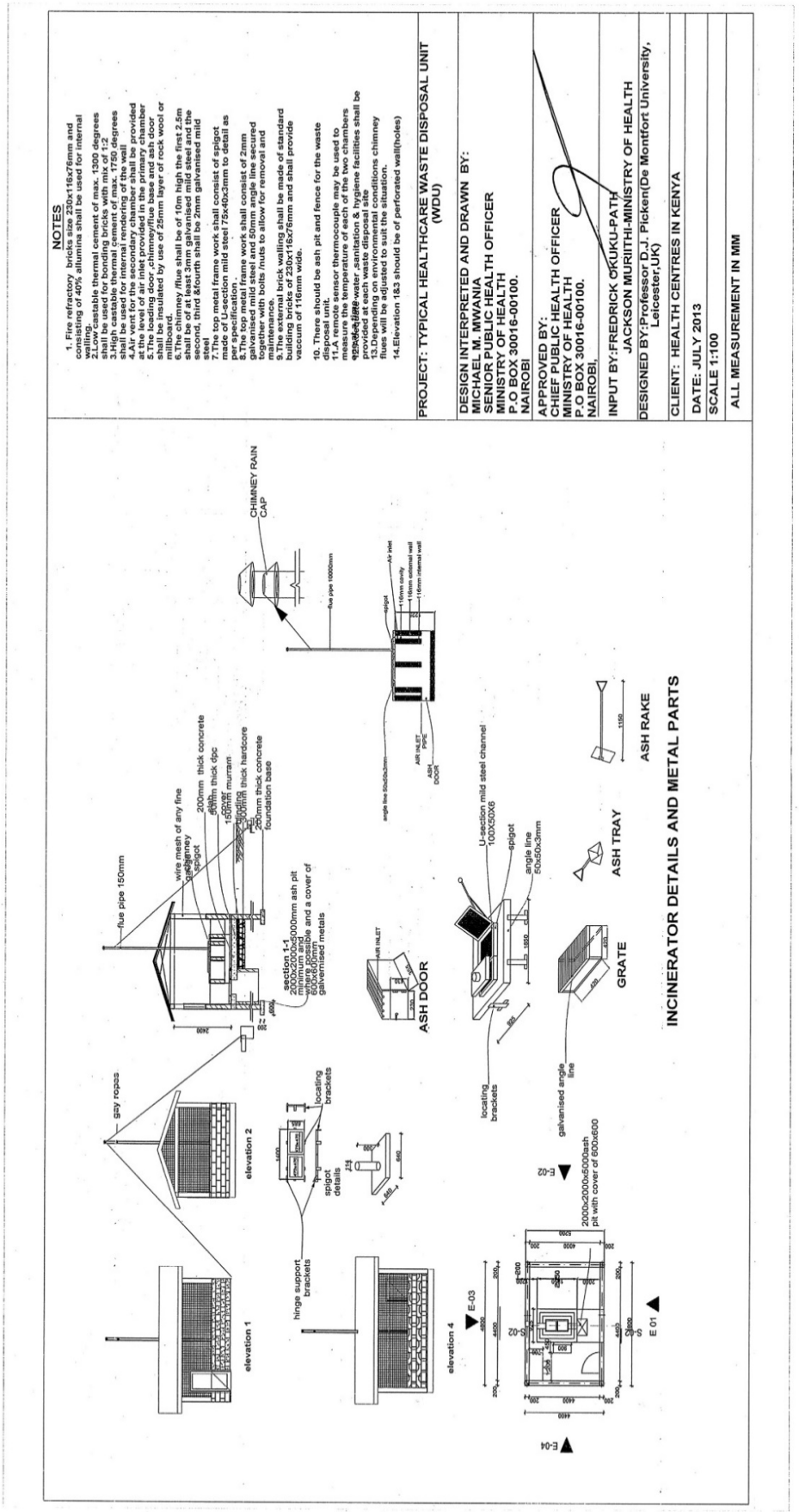


Annex 14. MOH Incinerator Housing Plan



Annex 15. Autoclave/Shredder at the National Public Health Laboratories Services or Coast General Hospital, Mombasa

Annex 16. HCWM WDU Plan by the MOH



Annex 17. List of Contributors

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