# Greening Health Infrastructure

## Rapid Assessment of Policies and Practices on Health Care Waste Management in Ethiopia and Kenya

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Greening Health Infrastructure – Rapid Assessment of Policies and Practices on Health Care Waste Management in Ethiopia and Kenya



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# Contents

# Abbreviations

| | |
|---|---|
| **CCET** | IGES Centre Collaborating with UNEP on Environmental Technologies |
| **CME** | Continuing Medical Education |
| **COVID-19** | Coronavirus disease 2019 |
| **HCFs** | Health Care Facilities |
| **HCW** | Health Care Waste |
| **HCWM** | Health Care Waste Management |
| **IPC** | Infection Prevention Control |
| **KIPPRA** | Kenya Institute for Public Policy Research and Analysis |
| **KSh** | Kenyan Shilling |
| **MOH** | Ministry of Health |
| **NEMA** | National Environment Management Authority of Kenya |
| **NMS** | Nairobi Metropolitan Services |
| **OSH** | Occupational Safety and Health |
| **PHC** | Primary Health Care |
| **PPD** | Public-Private Dialogue |
| **PPE** | Personal Protective Equipment |
| **PPP** | Public Private Partnership |
| **SACCO** | Saving and Credit Cooperative Organization |
| **SDGs** | Sustainable Development Goals |
| **SME** | Small and Medium-sized Enterprise |
| **SOP** | Standard Operating Procedure |
| **3R** | Reduce, Reuse and Recycle |
| **UNEP** | United Nations Environment Programme |

# Executive Summary

The sound management of Health Care Waste (HCW) has been receiving increasing global attention, now even more so given the urgency of the COVID-19 pandemic. The spread of COVID-19 throughout Africa has significantly influenced the already overburdened Health Care Waste Management (HCWM) systems in many countries. A lack of infrastructure, inadequate budgets and capacity gaps make it difficult to achieve environmentally sound HCWM, which underscores the urgency of realising sustainable and inclusive HCWM systems and infrastructure in African countries, in order to improve resilience to health emergencies such as COVID-19 and mitigate impacts on development, the environment and society.

This rapid assessment of HCWM in Ethiopia and Kenya, thus aims to identify gaps and propose strategic recommendations for a holistic approach to improving the sustainability of HCWM systems as the focus. It examines other policies and practices such as green procurement (environmentally preferable purchasing), green buildings (energy saving & renewable energy supply), green facility management (environmental management system) in the broader context of green health infrastructure in Africa. The scope of this report is thus focused on Health Care Waste (HCW) generated from Health Care Facilities (HCFs) and sustainable HCWM systems using the waste-management hierarchy, which is largely based on the concept of the 3Rs, namely reduce, reuse and recycle, and broadly relates to the sustainable use of resources. The report also considers broader sustainable infrastructure, and the use of locally acceptable best available technologies (BAT) and best environment practices (BEP), which in turn are expected to help minimize exposure to health risk and thus help promote public health and well-being and improve the ecosystem. Through undertaking this rapid assessment, consisting of (i) secondary data collection (literature review) and (ii) semi-structured interviews based on a questionnaire, the following strategic directions and recommendations were identified to improve HCWM in Ethiopia and Kenya, with connections to the wider region.

## 1. Policy Measures

Greening heath infrastructure and sustainable HCWM systems can begin in pioneering local HCFs. However, ensuring a wider impact across a country requires active government intervention and enabling policy measures, including a national plan and budget. The following policy measures provide a blueprint that drives decision making at the political level and mobilises government efforts and resources to create the enabling conditions to make changes in HCFs.

### Review and revise HCWM policies, guidelines, and standards

Both Kenyan and Ethiopian governments have introduced numerous policies and legislative measures at the national level. However, challenges remain in their implementation, proper enforcement, monitoring and reporting at county levels due to lack of budget, lack of awareness, lack of institutional and personal capacities. Thus, review and revise HCWM policies, guidelines, and standards, strengthening implementation mechanisms and budget allocations at local levels are important. The policy and regulatory structures and mechanisms should also be strengthened to monitor and enforce the HCWM standards in the essential service standards for HCFs. The proper system also needs to be in place to disseminate existing policies, regulations, tools and strategic plan on HCWM and update legal frameworks for the implementation of HCWM at national and county levels.

### Strengthen the governance of HCWM activities across national and county levels

Key stakeholders in both countries identified the importance of having a vertical and horizontal

coordination and governance structures at each administrative level and among different agencies and actors. At national level, Ministry of Health (MOH) should formulate an effective coordination structure to work with other relevant ministries, departments and authorities, such as Ministry of Environment for setting environmental standards, Ministry of Finance and National Planning for budget allocation, and Ministry of Education and Training for awareness raising and capacity building etc. Similar coordination structure should also strengthen at county level to continuously monitor, coordinate, and evaluate HCWM implementation. Priority should also be given to strengthening partnerships between various stakeholders including formal and informal private sector who are involved in HCWM. A team of multidisciplinary experts including from pertinent universities with the medical schools and research institutions have to be involved for science-based data analysis and strengthening leadership skills for HCWM at all levels of the waste-management systems. In addition, relevant tools to assist HCWM planning and management need to be developed and disseminated at HCFs.

### Strengthen monitoring and evaluation system for HCWM

Monitoring and evaluation (M&E) is a vital component of good governance, though both countries do not give much attention both at administrative and operation levels. It is hardly found established mechanisms and proper indicators are available in both countries for M&E. Thus, it is important for setting up the National Steering Committee for HCWM to develop M&E plans and tools that can be integrated into existing M&E systems. Indicators expressing the level of achievement and tools for auditing also need developing. Stakeholder participation in the analysis and interpretation of findings, from process evaluation, including the formulation of conclusions and linkages with future-plans, is critical to ensuring results become accepted and put into practice.

### Improve facilities, commodities, and equipment supply for HCWM

In both countries, there is urgency in improving the HCWM at HCFs. This covers improvement, standardisation and enhancing access to new technologies for facilities, commodities and equipment supply in HCWM system at all levels. MOH in partnership with other relevant agencies need to develop standards and provide technical guidance to HCFs on implementation of them. Additionally, partnerships between various levels of HCFs for waste pooling need to be established and enhanced. The practice of having larger hospitals treat waste from nearby small HCFs is an alternative means of providing proper HCWM. Increase access of emerging HCWM technologies and create financing support schemes for researchers and practitioners to identify and apply new technologies that reduce impact on the environment. International experiences on HCWM and technology application can be used but it should be adapted and applied to local context of Ethiopia and Kenya.

### Establish sustainable sources of funding and adequate resources

Lack of adequate funds for HCWM is one of the critical challenges in increasing the efficiency of the sector in both Ethiopia and Kenya. Both national governments and HCFs in Kenya and Ethiopia have failed to reflect the serious profile that HCWM deserves in their budget planning and allocation. Thus, HCWM budgets should be adequately considered in annual budget plans at all levels, including national, county and facility levels. Public-Private Partnership (PPP) needs to be used as a vehicle to invest in the HCWM system and both countries need to develop appropriate policies to encourage the PPP engagement. These policies need to consider in integrating the informal sector who are actively involved in providing HCWM services in both countries. A compressive study on the environmental and socioeconomic impacts of the HCWM will be done involving multi-disciplinary experts that could attract the attention of policy and decision makers in order to address problems associated with budget allocation for HCFs.

### Increase capacity building, training, and awareness of HCWM

In both countries, capacity building on HCWM at various levels is essential and should be recurrent in each HCF. Training of waste handlers about HCWM and the different risks is critically important. Environmental

health professionals need to engage in the management of HCWM in all HCFs. The MOH need to work together with other relevant agencies in developing and providing capacity building strategies and programmes for all health care workers, develop curricula for HCWM including in-service and refresher training for all HCWs in line with emerging issues; review, develop, and integrate HCWM training in all levels of trainings, and create a pool of trainers of trainers on HCWM in every county. The MOH also can engage with national and local media to awareness creation and advocacy.

### Establish support systems to integrate the informal sector

The informal sector plays a vital contribution in managing HCW in both countries though its role is still not well acknowledged and recognised in formal systems. To improve the situation, it is recommended to create support mechanisms such as adequate prices for waste collection and recycling, preventing the exploitation exerted by buyers, securing hospital insurance, provision of more opportunities for training on recycling, and allocation of equipment such as wheelbarrows and carts for transport.

### Regional strategies and coordination among African countries

Given the various states of development of national HCWM systems in the African region, regional coordination and knowledge sharing provides an opportunity to learn among others. For this, a regional knowledge platform could be established to share experiences on the practical management of HCW, technology development and to update each other on lessons learnt regularly. It is also recommended to establish and operate a regional database on HCWM in Africa compiling available data, policy documents and good practices. To ease implementation and coordination of national policies, standardization of the legal and administrative framework by creating regional templates for the development of policies, strategies and guidelines should take place. To standardize and harmonize training systems, it is recommended to develop regional curricula and training materials for HCWM. International and development partners can also initiate regional projects and support programmes to improve the HCWM infrastructure in Africa.

## 2. HCWM Measures

The appropriate handling, treatment, and disposal of HCW can reduce costs and greatly helps in protecting public health and the environment. HCWM plans, specifications and standardization relating to HCWM systems are not found to be developed by each HCF, nor updated regularly in Kenya and Ethiopia. Capacity should therefore be strengthened in the two examined countries to manage HCW based on the waste hierarchy, including waste minimization, waste segregation, labelling of waste receptacles or containers, waste containment collection, internal transport, internal storage, special storage areas and waste treatment, as summarised below.

### Adequate knowledge and information about HCW

Planning of HCWM requires knowledge of waste generation and the characteristics, though there is no data readily available at either HCFs or national levels in Ethiopia and Kenya. Proper methodologies for measurement of waste need to be regulated and common measurement metrics should be introduced, along with adequate training and capacity building opportunities for managers and planners at HCFs. A simple ongoing monitoring system is essential, in addition to any more detailed short-term surveys of waste audits. As a minimum approach, the types of waste targeted can be categorised into three: infectious waste or hazardous waste, sharps waste and the non-infectious waste or general waste.

### Introduce waste minimization, reuse and recycling

HCW minimization should be considered as a first step in managing HCW; however, most HCFs in both countries do not adequately practice waste minimization. Thus, it is important to investigate options for waste minimization/ reduction, reuse, recycling, and practice them at HCFs. The relevant heads of departments, including procurement, waste management and others should be involved in identifying these options and procedures.

### Apply waste segregation, packaging, colour coding and labelling

Though both countries set minimum standards based on WHO guidelines, most HCFs do not effectively practice such in daily operations. HCFs should ensure that waste is strictly segregated at the point of generation, that colour coding and labelling are properly practiced, and that segregation methods are clearly set out in their waste-management plans. Waste separation at source can also increase recycling of food wastes by applying compost or biogas, where regulations allow, or sterilize it and use it for animal feed. It is also important to conduct periodic education and training programmes and display posters depicting segregation for medical and waste workers, to improve their knowledge on segregation practices.

### Improve onsite collection and transport of HCW

In Ethiopia and Kenya, most hospitals use wheelbarrows for the collection and transport of HCW within the compound. This practice leads to spillage of waste during collection. HCF should adopt practices and procedures to remove properly packaged and labelled wastes using designated trolleys or carts. Clinical staff and waste operators should ensure that infectious waste bags are tightly closed when they are about three-quarters full. A routine for collection should be established as part of the HCWM plans.

### Proper operation of storage areas

Only a few HCFs in both countries were found to have proper HCW storage areas or rooms. A large number of HCFs lacked properly maintained storage areas with adequate fencing or restricted entry. In some hospitals, disused rooms, some with leaking roofs, were used to store HCW. Storage locations for health care waste should be designated inside HCFs. Hazardous waste segregated from general waste should be maintained in storage. Further, temporary storage areas and containers should be periodically cleaned and disinfected.

### Improve off-site transport of HCW

In Ethiopia and Kenya, most HCFs hire private service providers for off-site transport, in which the service provider uses its own vehicles. However, it was also found that most of these service providers failed to meet the required standards and that logistics staff lacked the appropriate training on handling of hazardous waste. Service providers should follow at least minimum requirements in transporting HCW to minimize the risks, such as use of suitable vehicles, appropriate training to drivers and workers, and following legal requirements including transport documentation, commonly called a consignment note, waste tracking note or manifest. Using advanced radio frequency identification (RFID) tracking for HCW can also prevent waste being diverted from the approved disposal site.

### Improve HCW treatment and final disposal

In both Ethiopia and Kenya, most HCFs operate small-scale waste incineration facilities installed on-site to treat HCW. However, most of such incinerators do not meet the required technical requirements, process capacity, performance requirements, or operational capacities. Because of these and other concerns, together with the high costs associated with modern incineration to meet the highest technical standards, the WHO recommends that such small-scale incineration be viewed only as a transitional means for treating HCW. To help green the HCWM infrastructure in Africa in the long term, other non-burn technologies, such as autoclaves and microwave treatment should be trialled and promoted in the context of the waste-management hierarchy and measures should first be followed to minimize, treat, recycle, and reuse HCW to the extent possible. At the end of the waste management flow, operation of controlled landfill for final disposal of HCW is recommended rather than practicing open burning or dumping.

### Ensure occupational health & safety

Most waste operators in Kenya and Ethiopia do not possess PPE. The provision of respirators or facemasks, overalls, helmets, and plastic goggles for eye protection was also poor. This highlights the importance of providing adequate PPE for waste operators, education on occupational health and safety measures, ensuring workers are properly trained on the aspects of their job and informed on how to avoid infection transmission, as well as provision of an effective occupational health programme that includes immunization, post-exposure prophylaxis treatment, and medical surveillance.

# 1. Introduction

## 1.1 Background

The spread of COVID-19 infections throughout continental Africa stood at 5.5 million people as of August 2021, adding a sudden additional burden to the already overstressed health systems in many African states. Challenges such as a lack of health infrastructure, shortages in medical personnel and equipment, supply chain disruptions, and capacity gaps in the environmentally sound management of medical waste require systematic solutions. African countries have adopted several measures to contain the spread of the virus and mitigate its socio-economic impacts, and green health infrastructure stands at the core of recovery plans. Countries at the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow committed to cut the carbon footprint of their health infrastructural systems. Implementing sustainable, inclusive health infrastructural systems in each country could improve the resilience to health crises such as the COVID-19 pandemic and mitigate the impacts on development, the environment and society, as well as ensure responses to the pandemic are aligned with the Sustainable Development Goals (SDGs), the Paris Agreement, and the Africa Agenda 2063.

In this regard, UNEP has been supporting the greening of health infrastructure systems in Africa through drawing on its expertise and experience in work on the environment and health, pollution, sustainable infrastructure, inclusive green economy, green industrial policy, clean technologies, resource efficiency, as well as its work and partnerships in Africa, with the aim of realising a coherent response to COVID-19 and future crises. Within this context, this rapid assessment of green health infrastructure in Ethiopia and Kenya explores holistic waste management systems and policies specifically, including innovative and green technologies in health care waste management (HCWM), capacity building for health care practitioners on best HCWM practices, compliance with international conventions and support for health regulatory authorities in developing and implementing a data management scheme with monitoring systems. The findings of the rapid assessment will form the basis for developing funding proposals to mobilize funding to implement sound HCWM in the region. Based on the primary and secondary data collections to assess and identify the key challenges in HCWM, this report consists of the background, the methodology adopted, results of the survey, discussions and some policy recommendations to improve HCWM in Ethiopia and Kenya and the region more broadly.

## 1.2 Objective

The overall objective is to identify gaps and potential solutions to be achieved by conducting a rapid assessment of health care waste management in Ethiopia and Kenya. The study assesses the types and amounts of health care waste (HCW) generated in the respective countries, current management practices, gaps in the management practices from the point of view of environmental and social safeguards and identifies a suitable solution package to effectively manage the HCW generated in a wide spectrum of HCFs from national to county levels, governed by both the public sector and private sector. The assessment also reviews the current legal framework, identifies the gaps with current systems as well as impacts on public health and environment due to inadequate HCWM and provides recommendations for policy improvement in order to implement the developed strategy in line with national and multilateral conventions for greening HCWM systems.

## 1.3 Scope, Concepts and Methodology

### 1.3.1 Scope and key concepts

Some of the key concepts and definitions that are widely used in this report are summarised here.

Health Care Waste: According to WHO guideline reports (WHO, 2014; WHO, 2017), HCW includes all waste generated within HCFs, research centres and laboratories related to medical procedures. It also includes HCW generated at homes (e.g., home dialysis, self-administration of insulin, recuperative care). While the scope of this report covers HCWM in Ethiopia and Kenya, and targets the waste generated from HCFs related to medical procedures (excluding medical and infectious waste generated from households), the approach used for data collection and analysis was designed from the broader perspective of sustainable infrastructure and greening of health infrastructure. The WHO classifies health care waste into eight major categories, based on their hazardous or non-hazardous components, as shown in Table 1 (WHO, 2014; UNEP, 2020).

Table 1: Major categories of HCW

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

Source: Adapted from WHO, 2014; UNEP, 2020

***Health Care Waste Management based on Waste Hierarchy:*** This report covers all steps of the HCWM system based on the waste hierarchy, i.e., prevention, reduction, separation, storage, collection, transport, recycling, recovery, treatment and disposal (Figure 1). The waste management hierarchy, which is based on the concept of the 3Rs (Reduce, Reuse and Recycle) helps protect public health and prevent negative environmental impacts from HCWM. It also promotes green operations and sustainable use of resources and informs on best practices for waste management, aiming to avoid and recover as much as possible from waste rather than disposing of it by burning or burial (UNEP, 2020). It is most preferable to manage waste at its source rather than adopting end-of-pipe solutions.


Figure 1: Waste management hierarchy. Source: WHO, 2014

***Greening Health Infrastructure:*** The International Good Practice Principles for Sustainable Infrastructure (UNEP, 2021) defines sustainable or green infrastructure as that which is planned, designed, constructed, operated and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience), and institutional sustainability over entire infrastructure lifecycles. The concepts of inclusiveness, health and well-being, quality, service delivery, resilience and value for money are also implicit in the term. The International Finance Corporation – Excellence in Design for Greater Efficiencies (IFC-EDGE) initiative (Green hospitals) enables health care facilities to target those areas where technologies can significantly reduce energy bills and help facility managers stay within tight budgets. Also, WHO (2020) defines climate-resilient and environmentally sustainable health care facilities as those which can anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stresses, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, so as to enable ongoing and sustained health care to their target population and protect the health and well-being of future generations.

Therefore, the term 'greening health infrastructure' broadly covers the above-mentioned definitions and encourages all stakeholders, including but not limited to health care institutions, government authorities, private companies, and individuals, to work together to reduce the negative impacts of the health care sector on the environment, ecosystems and climate change and ensure that health care benefits the people, society and the planet, and does not cause more pollution and waste or health problems.

There are encouraging examples of greening health infrastructure to be found worldwide. For example, in the Netherlands, more than 200 parties, including health care providers and a range of profit and non-profit organizations, have signed the Green Deal on sustainable health care in the country, which contributes to achieving the four targets shown in Box 1.

### Box 1: Key targets in the Green Deal on sustainable health care in the Netherlands

(i) 49% reduction in carbon emissions by 2030 (as compared with 1990), and reaching carbon neutrality by 2050 – in line with the goals set out in the National Climate Agreement, through striving for energy-efficient buildings, transport and procurement, use of renewable energy, as well as reducing the amount of energy used by hospitals and other care institutions.

(ii) Circular health care – using less raw materials and minimizing waste; examples are pilots for recycling medical materials (such as single use plastics, incontinence materials), reducing food wastage, and developing sustainable procurement guidelines.

(iii) Less pharmaceutical residues in surface water – includes a wide range of initiatives aimed at good use of pharmaceuticals and reducing wastage; examples are efforts aimed at proper disposal of unused medicines or pilot actions such as the use of urine collection bags for patients treated with diagnostic contrast agents.

(iv) A healthy environment for health workers and patients – this means providing a good living and working environment in care homes and hospitals, which improves the health and wellbeing of patients and workers. Initiatives are aimed at gathering knowledge and creating collaborative networks; examples are building a repository of best practices and effective interventions of partners, and creating a network to mobilize leadership towards sustainable nutrition in health care facilities.

Source: Adapted from WHO (2020)

## 1.3.2 Methodology

The provision of sustainable HCWM and greening of health infrastructure to provide a more inclusive green economy is one of the leading issues faced by all countries in Africa, the world's second largest continent and highest population growth rate (Chisholm et al., 2021). This rapid assessment thus reviews the current HCWM policies and practices in order to better understand how to holistically achieve sustainable HCWM systems in Africa by applying both (i) secondary data collection (desk review) and (ii) primary data collection (semi-structured interviews based on a questionnaire) in Ethiopia and Kenya.

***Secondary data collection***

As the first step, a desk review for (i) Baseline information, (ii) Legal and regulatory arrangements (including level of compliance), (iii) Institutional arrangements (mandate and responsibility), and (iv) Financial arrangements for HCWM were conducted from reliable existing knowledge sources, covering both national policy documents and scientific/academic papers in Ethiopia and Kenya.

***Semi-structured interviews based on a questionnaire***

A semi-structured interview based on a pre-prepared questionnaire was conducted to supplement the desk review. As shown in Figure 2, there were eight key target groups of stakeholders identified throughout the HCWM flow to conduct primary interviews in both countries, across: (i) Central Government, (ii) provincial/ local governments, (iii) HCFs, (iv) HCE transporters, (v) HCW treatment and disposal operators, (vi) recyclers, (vii) informal sector/waste pickers, and (viii) citizens (nearby communities). These stakeholders were identified based on their importance and key roles played in HCWM, and in order to extract holistic information on current practices and technical, financial and institutional challenges facing HCWM. At the beginning, the national experts planned to cover all levels of hospitals both in urban and rural areas as well as public and private hospitals, in both countries. However, due to domestic travel restrictions and issues in obtaining official approval for visits and interviews under the COVID-19 pandemic situation, the study needed to limit the sample survey to Nairobi city, Kenya.

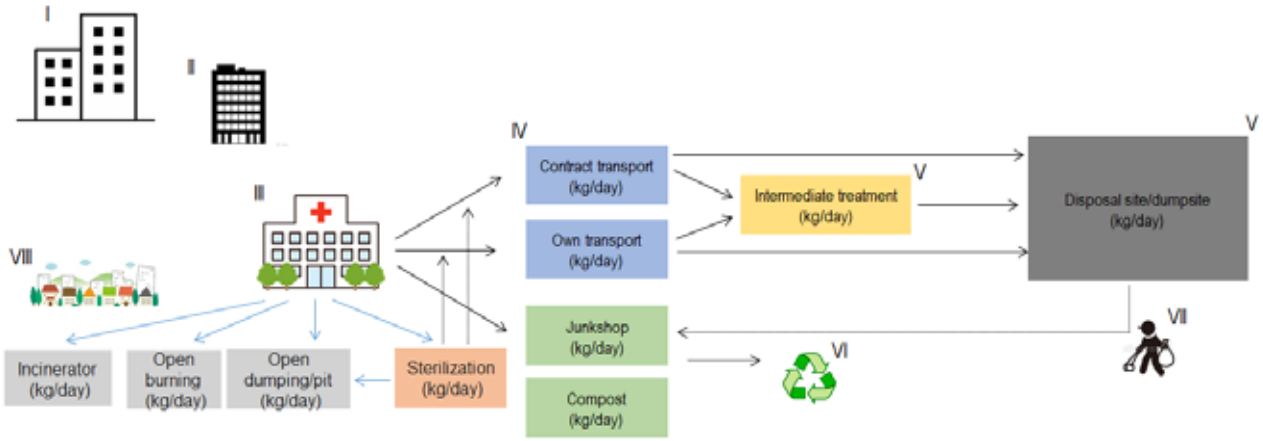



Figure 2: Overview of target stakeholders within the overall HCWM system. Source: Compiled by the authors, 2021

Due to the COVID-19 pandemic situation, the sample survey was carried out based on mail, whereby the questionnaire form and an official request letter were distributed to the target stakeholders from UNEP via national authorities. This had limited results, particularly in Ethiopia, as shown in Table 2. Nevertheless, a variety of perspectives was still captured to inform the overall assessment.

Table 2: Target stakeholders for questionnaire interviews in Ethiopia and Kenya

| No. | Stakeholders | Ethiopia | Kenya |
|---|---|---|---|
| | | No. of Respondents | No. of Respondents |
| 1 | Central Government | 1 | 2 |
| 2 | Provincial/Local Governments | 1 | 1 |
| 3 | Health care Facility (HCF) | | |
| | - Manager or Administrator | 2 | 34 |
| | - Waste Management Administrator | 2 | 28 |
| | - Waste Management Operator | 2 | 26 |
| 4 | Health care Waste Transporter | N.A. | 13 |
| 5 | Health care Waste Treatment and Disposal Operator | N.A. | 4 |
| 6 | Recyclers | N.A. | 1 |
| 7 | Waste Pickers | N.A. | 29 |
| 8 | Nearby communities | N.A. | 34 |

Source: Compiled by the authors, 2021

Identification of the target groups and development of the questionnaire survey were carried out through cooperation between UNEP experts, CCET and national experts in Ethiopia and Kenya (Annex-2). The outline of the questionnaire is shown in Figure 3. For regulators such as national and local governments the questionnaire mainly aimed to inquire about the current situation regarding laws, regulations, and institutional and financial arrangements for HCWM, whereas for the implementors, such as HCFs and the private sector, the questionnaire covered the actual operations from the technical and managerial perspectives. The questionnaire form was also developed to include communities and waste pickers who may be directly or indirectly affected by aspects of HCWM.

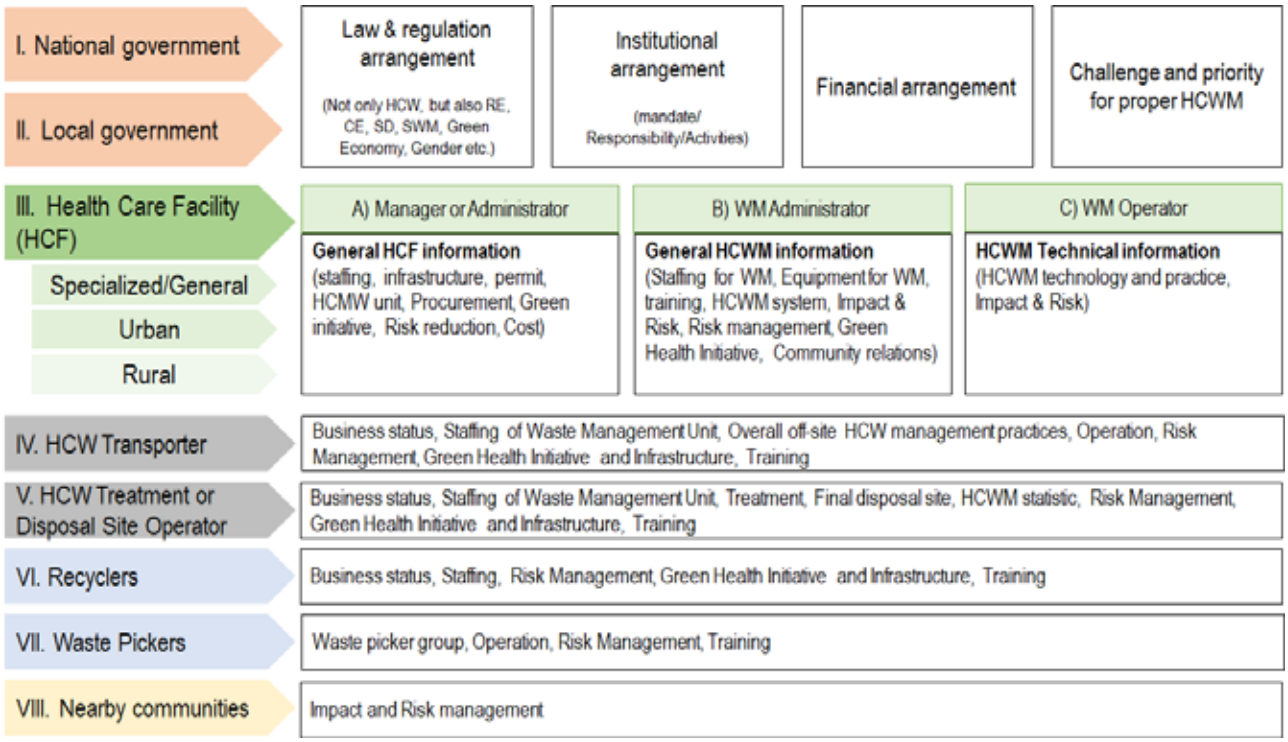



Figure 3: Outline of the questionnaire for each target stakeholder. Source: Compiled by the authors, 2021

## 1.4 Outline of this report

This report includes the following seven sections and annex overall:

- Section 1 comprises the introduction, background and methodologies of the study.
- Section 2 includes a review of governance aspects of HCWM that includes national policies, regulations, institutional arrangements, financing and budgeting, and training and capacity needs assessments.
- Section 3 explains the current situation of HCWM in Ethiopia and Kenya based on the data analysis, which are summarized and divided into two parts: 1) HCW generation and characterization, and 2) practices of HCWM (health care waste management flow) in greater detail under four sub-headings: waste minimization, segregation, storage, and transportation, treatment and disposal methods of health care waste.
- Section 4 covers environmental risks, occupational safety and health relevant to waste operators, the informal sector and the public (communities).
- Section 5 identifies the challenges with current HCWM systems and policies.
- Section 6 provides a conclusion and offers some recommendations for the wider region.

# 2. Health Care Waste Management Systems, Policies and Institutional Arrangements

## 2.1 Overview of Health Care Systems

According to WHO (2017a and 2017b), both Ethiopia and Kenya have made some progress in key health indicators over recent years (Table 3). For example, in Ethiopia, the life expectancy has been rising and now stands at 64 years at birth. A major health issue in the country is maternal and child health. The maternal mortality rate stood at 353 per 100,000 live births and in 2015 the country's infant mortality rate was 59 per 1,000 live births. On the other hand, in the same year, 86.4% of children were immunized, including with pneumococcal and rotavirus vaccines. Ethiopia allocated the equivalent of 1.6 billion USD to health care in 2015. Of its total health expenditure, 14.69% is used to finance Primary Health Care (PHC). Households contribute to over one-third of the country's health care budget.

The government of Kenya's health goal is attainment of universal health care coverage for key services, including maternal, neonatal and child health services. These priorities were reflected in the country's budget for 2016/2017. Public primary health facilities have been reported to be pro-poor, particularly in rural locations. Neonatal mortality rates are higher among women aged under 20 years (20 per 1,000 live births) than those above 20 years. The risk of losing a child during birth is lower among educated women (11 per 1,000 live births, compared to 15 per 1,000 for women with no education). The rate for delivery by a skilled attendant is lower in rural areas (94%, compared to 98% in urban areas). Immunization coverage stands at over 70%, with higher coverage among urban residents (78%, compared to 73% for rural locations).

Table 3: Summary of Country Health Profiles of Ethiopia and Kenya

| Indicators | Ethiopia | Kenya |
|---|---|---|
| **Life expectancy at birth** | 64 years | 62 years |
| **Infant mortality rate** | 59/1,000 | 52/1,000 |
| **Maternal mortality rate** | 353/100,000 live births | 362/100,000 live births |
| **Immunization coverage (including pneumococcal and rotavirus vaccine)** | 86.4% | 74.9% |
| **Total health expenditure as proportion of gross domestic product (GDP)** | 2.66% | 5.7% |
| **% total public sector expenditure on PHC** | 26.73% | 3.5% |
| **Per capita public sector expenditure on PHC** | 11.57 Ethiopian Birr (0.24 USD) | 20 Kenya Shillings (0.18 USD) |
| **Out-of-pocket payments as proportion of total expenditure on health** | 36% | 26.1% |

Source: Adapted from WHO (2017a and 2017b)

Ethiopia's health service is structured into a three-tier system: primary, secondary and tertiary levels of care (Figure 4). The primary level of care includes primary hospitals, health centres (HCs) and health posts (HPs). The primary health care unit (PHCU) comprises five satellite HPs (the lowest-level health system facility, at village level) and a referral HC. This is the point where PHC is administered and primary services are facilitated under the health service delivery structure. A primary hospital provides inpatient and ambulatory services to an average population of 100,000. A primary hospital provides emergency surgical services, and is a referral centre for the HCs and a practical training centre for nurses and other paramedical health professionals. A general hospital serves as a referral centre for primary hospitals and as a training centre for health officers, nurses and emergency surgeons. Similarly, a specialized hospital acts as a referral centre for general hospitals.

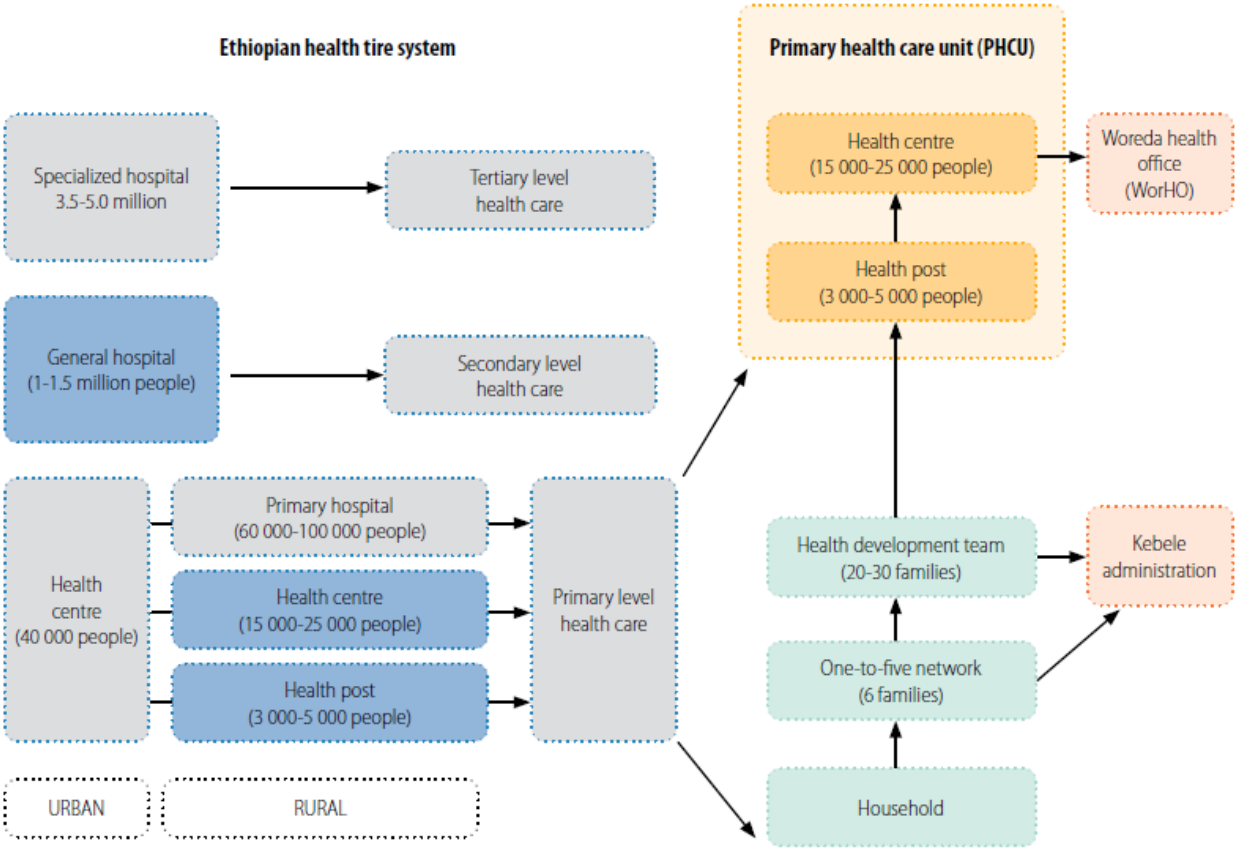



Figure 4: Ethiopian Health System structure. Source: WHO, 2017a

On the other hand, the Kenyan health system comprises a six-level hierarchy: level 1, community services; level 2, dispensaries and clinics; level 3, health centres and maternity and nursing homes; level 4, sub-county hospitals and medium-sized private hospitals; level 5, county referral hospitals and large private hospitals; and level 6, national referral hospitals and large private teaching hospitals. PHC services are primarily provided at levels 1 to 3 (Figure 5). Public PHC facilities are governed by health facility committees, which include the facility in-charge and community representatives. For private PHC facilities, government oversight is provided through regulations, and implemented through eight regulatory agencies.

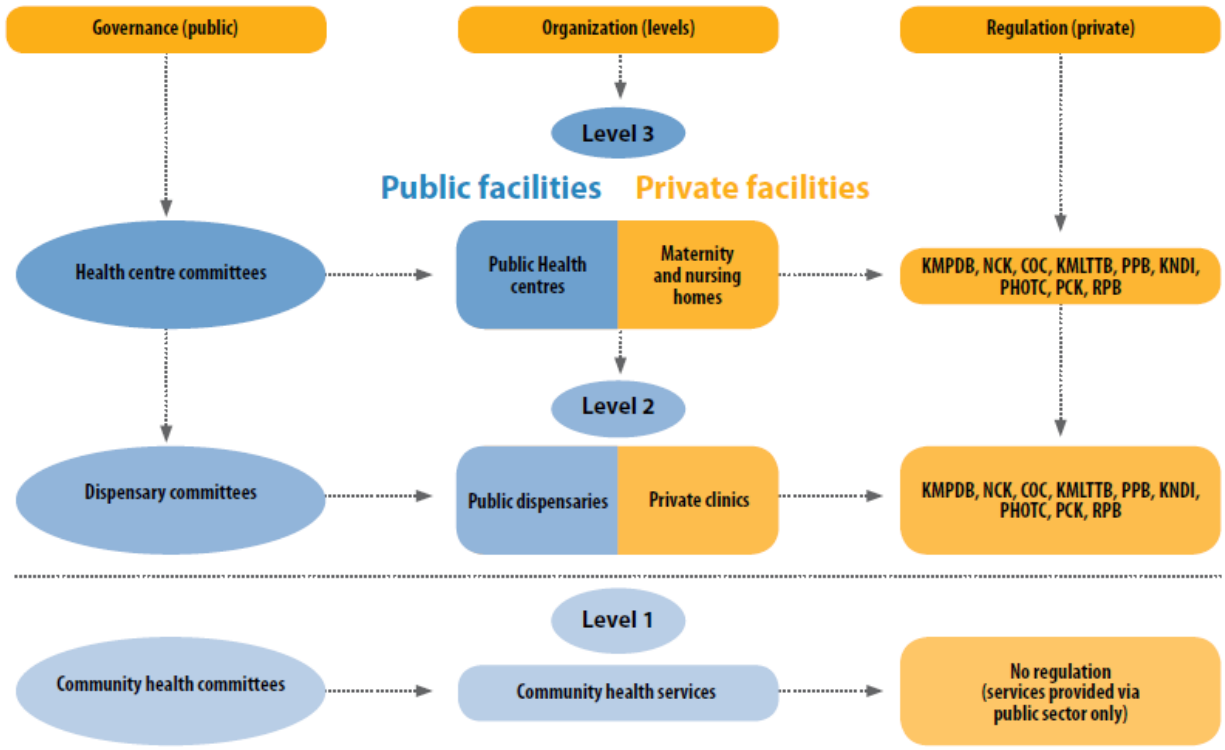



Figure 5: Structure of PHC facilities and community units in Kenya. Source: WHO, 2017b

## 2.2 Policies and Regulatory Guidelines

Both Ethiopia and Kenya have ratified international treaties seeking to strengthen sound management of HCW, including the Stockholm Convention, Basel Convention, and Bamako Convention. In addition, a substantial number of regulations on HCWM are in force in both countries, as summarised in Table 4.

Table 4: Key policies, plans and regulations related to HCWM in Ethiopia and Kenya

| National Policies and plans in Ethiopia | National policies and plans in Kenya |
|---|---|
| • The right of Ethiopian people to a clean and healthy environment is enshrined in the constitution, particularly under articles 43, 44, and 92.<br>• The Environmental Policy of Ethiopia, which was approved by the Council of Ministers in 1997, comprised 10 sectors and 10 cross-sector components, one of which addresses Human Settlements, Urban Environment and Environmental Health.<br>• Guideline for Environmental Management Plan (draft), May 2004 outlines measures for preparation of Environmental Management Plans for proposed developments in Ethiopia and institutional arrangements for implementation of Environmental Management Plans. | • Kenya Vision 2030 (Government of Kenya, 2007)<br>• Medium Term Plan III for Vision 2030 (Government of Kenya, 2018)<br>• Environmental Management and Coordination Act (Amendment) of 2015<br>• Climate Change Act of 2016<br>• National Environmental Health and Sanitation Bill 2020<br>• Environmental Management and Coordination (Waste Management) Regulations of 2006<br>• Kenya Health Policy 2014–2030 (MOH, 2014)<br>• National Environmental Policy, 2013 |

- The Waste Handling and Disposal Guideline, 1997 has been used by health facilities since 1997. The Guideline is aimed at helping industry and local authorities handle medical waste at the local level.
- National Health Care Waste Management (HCWM) Strategic Action Plan 2015/16–2019/20
- Health Sector Transformational Plan II (HSTP II) 2020/21-2024/25, MoH, Feb. 2021
- National Infection Prevention and Control Policy for Health Care Services
- National Hygiene and Sanitation Strategic Action Plan 2015/16–2019/20
- National IPC Strategic Plan 2020/21–2024/25
- National IPC Guidelines for Health Care Services in Ethiopia
- Water, Sanitation and Hygiene (WASH) in Health care Facilities, May 2021, Addis Ababa, Ethiopia
- Ethiopian Hospital Service Transformation Guidelines (EHSTG),
- Ethiopian National Quality Strategy (ENQS),
- Saving Life through Safe Surgery (SaLTs)
- Health Service Transformation in Quality (HSTQ)
- Hospital Performance Monitoring Improvement (HPMI)
- Health-care Waste Management Manual for Ethiopia, MoH, April 2021
- Ethiopia Health System Transformation Plan (HSTP), MoH, 2015–2020
- Health Policy of Ethiopia, 1993
- Infection Control and Waste Management Plan Ethiopia, 2019
- Proclamation No. 661/2009 a Proclamation to Provide for Food, Medicine and Health Care Administration and Control
- Proclamation No. 30012002 Environmental Pollution Control Proclamation
- Proclamation No.1090-2018 Hazardous Waste Management and Disposal Control Proclamation
- Kenya Environmental Sanitation and Hygiene Policy, 2016
- Menstrual Hygiene Policy (MOH, 2020b) and Strategy (MOH, 2020c)
- National Policy on Injection Safety and Medical Waste Management (MOH, 2007)
- Kenya-Community-Health-Strategy-2020-25 (MOH, 2020)
- Kenya-Health-Sector-Strategic-Plan-2018-23 (MOH, 2018)
- Health Products and Technologies Supply Chain Strategy - 2020–2025 (MOH, 2020a)
- Green Economy Strategy and Implementation Plan 2016–2030
- National Climate Change Action Plan 2018–2022 (Ministry of Environment and Forestry, 2018)
- Injection Safety and Medical Waste Disposal communication strategy 2010
- National Solid Waste Management Strategy (NEMA, 2014)
- Health Care Waste management Strategic Plan 2015–2020 (MOH, 2015)
- HCWM (Health Care Waste Management) Implementation Plan 2016–2020
- The National Occupational Safety and Health Policy, 2012
- National Guidelines for the Management of COVID-19 Wastes, 2020 (NEMA, 2020)
- Kenyatta National Hospitals' Policy Guidelines on Antiseptic, Disinfection, Sterilization and Waste Disposal (2006)
- National Infection Prevention and Control Guidelines for Health Care Services, 2010
- Policy Guideline on Blood Transfusion, 2001
- Kenya's State of Environment Report 2016–2018

Source: Adapted from WHO (2017a and 2017b)

As shown in Table 5, the common challenge facing both countries is effective enforcement of the above national policies, rules and regulations. For example, the Ministry of Health (MOH), Ethiopia prepared the Health Care Waste Management Guidelines in 2007 for the safe handling and disposal of health care wastes, promotion of occupational health and protection of the environment from health care waste. However, the application of standard operating procedures, as well as any applicable local or regional guidelines regarding health care waste management, was hardly observed at HCFs. In addition, most HCFs lack safety committees to monitor the disposal of HCW. It was also commonly reported that no guidelines specifically dealt with hazardous waste and waste from health care activities at the micro level, despite the presence of such at the federal level, i.e., the Environmental Policy of Ethiopia, the Public Health Proclamation No.200/2000 Federal Democratic Republic of Ethiopia and the Environmental Pollution Proclamation No.300/2002.

Table 5: Challenges in implementing national policies, tools and regulations at HCFs

| Thematic Policy Area | Observations in Ethiopia and Kenya |
|---|---|
| **Legal and regulatory framework** | • HCWM policy not reviewed<br>• Poor enforcement of laws in health care settings |
| **Standardization of HCWM practices** | • Standards for HCWM commodities and PPE not disseminated<br>• M&E tools not disseminated<br>• No linkages with industry created for PPP on waste management<br>• No research on new technologies carried out |
| **HCWM funding** | • National costing of waste management activities not done<br>• No budget line for waste management at the national level to guide county government in allocating financial resources<br>• No framework for development of PPPs on HCWM |
| **Capacity-building** | • Waste handlers not recruited in MOH as essential staff |
| **Reduction of pollution associated with HCWM** | • Periodic evaluation of efficiency and emissions of HCWM incinerators not done |
| **Monitoring and evaluation** | • Integration of HCWM indicators into HMIS<br>• Baseline assessment on HCWM indicators not done<br>• Support for supervising plans at all levels to ensure accountability at all levels not done<br>• Dissemination of HCWM tools not done<br>• Biannual assessment to measure improvement not done |

Source: Adapted from sample survey in 2021 and HCWM strategic plan in Kenya, 2015–2020

The existence of gaps in implementation of national policies and guidelines at HCFs is also due to the lower attention afforded to HCWM by responsible authorities such as sub-city health offices responsible for wastes management. At the city and federal levels, issues include lack of supervision by the responsible monitoring bodies at City Health Bureaus and lack of health care waste management committee at the Federal Ministry of Health (Tadesse and Kumie, 2014). In addition, the lack of training, awareness, staff resistance, poor managerial

commitment, lack of adequate resources, negligence, and unfavourable attitude of health care staff were the main challenges identified. The experience summarised in Box 2 shares the lessons from Japanese case in creating a successful enforcement system to improve the application of HCWM policies at local levels.

### Box 2: Law Enforcement on Illegal Dumping and Illegal Treatment of Medical Waste in Japan

Between 1990s and early 2000s, large scale illegal dumping and improper treatment of medical waste often took place in Japan. This became a serious social issue due to the possibility of such waste being infectious or containing sharps or chemical/toxic substances, representing environmental pollution as well as public health risks. However, such cases have continued to decrease since 2000, in parallel with changes in law enforcement. Of the cities and countries currently in their development stage, and which have elaborated sophisticated polices, strategies, and guidelines to promote better medical waste management, many of such fail to enforce the regulations introduced or monitor the performance of medical waste management operators. Below summarises the actions and measures that were put in place in Japan:

- Repeated amendments of the Law along with tighter penalties and stronger inspections via sufficient funding and equipment such as security cameras has made it difficult for waste generators and waste management operators to commit illegal waste management activities.
- Two agencies (Japan Industrial Waste Management Foundation (WMF) and Japan Industrial Waste Information Centre (JW Centre)), designated by the national government, play a significant role to connect legislation with practice, which has contributed to law enforcement. In other words, these agencies translate the Waste Disposal and Public Cleansing Law and the Manual for handling infectious waste in such a way that the waste generators and waste management operators can easily put into practice. They share the legal information and provide technical training and financial assistance for the concerned operators.
- The recovery of damaged environments due to illegal dumping and treatment is the responsibility of the waste generator, in principle. However, a fund was established to help cover the costs where waste generators are unable to fulfil their responsibility or no polluter is identified. The fund is supported by national government, the industrial sector, with medical associations acting as voluntary contributors.
- In addition, the media has led the population to be more conscious of environmental pollution caused by illegal dumping and improper treatment, which has enabled the population to act as public inspectors. This has been facilitated by setting up illegal dumping hotlines by local governments for citizens to call.
- Above all, introduction and promotion of e-manifest, which is a system that ensures transparency and traceability of waste handling by tracking the flow of industrial waste from generation point to disposal point, has greatly contributed to reducing cases of illegal dumping and treatment.
- The data in the e-manifest has helped provide an overview of the current waste management situation in a timely and transparent manner, and helps identify potential problems and areas for improvement. The accumulated data can be utilized not only for further law enforcement but also for promotion of the circular economy, as the related data contains information on types and amounts of waste that could be turned into resources, once removed of hazards.

Source: compiled by authors based on case study on Law Enforcement on Illegal Dumping and Illegal Treatment of Medical Waste in Japan, 2021.

## 2.3 Institutional arrangements

The functions of HCWM are split between national and local governments in both countries. The national functions include providing policy, technical and financial support, training and capacity building as well as decision making, while local or county-level governments and institutions are responsible for implementing sustainable HCWM in partnership with private and other health services. Table 6 shows some of the responsible agencies with their roles in HCWM both in Ethiopia and Kenya.

Table 6: Key responsible agencies in Ethiopia and Kenya

| Country | Administrative level | |
|---|---|---|
| | National | County and local |
| **Ethiopia** | • The Federal Ministry of Health - policy development and decision making. | • Regional Health Bureau - Management, coordination, and distribution of technical support.<br>• Woreda District Health Offices - Management, coordination, and distribution of technical support. |
| **Kenya** | • National Environment Management Authority (NEMA) - Supervise and coordinate all matters relating to the environment and to be principal instrument of government in the implementation of policies relating to the environment.<br>• KEMRI - State corporation established as the national body responsible for carrying out health research in Kenya.<br>• Ministry of Health - Primary role of the Ministry to monitor and measure the progress of implementation of the social and environmental safeguards.<br>• The National Construction Authority (NCA) - Responsible for issuing permits to construction sites and advising the government of Kenya on construction. | • County Governments - County Governments have powers to control or prohibit all businesses, factories and other activities including proposed projects which by reason of smoke, fumes, gases, dust, noise or other cause, may be or may become a source of danger, discomfort or annoyance to the neighbourhood and to prescribe conditions to which such activities are subject.<br>• Directorate of occupational safety and health services (DOSHS) - Mandated to ensure compliance with the provisions of the Occupational Safety and Health Act 2007 and promote work safety and health. |

Source: Compiled by the authors, 2021

According to the stakeholder analysis, the roles and responsibilities of the key stakeholders involved in HCWM can be summarised as in Table 7.

Table 7: Roles and Responsibilities of key stakeholders

| Stakeholder | Roles and responsibilities |
|---|---|
| **1. National ministries (Ministry of Health, Ministry of Environment, other relevant ministries and regulatory agencies, etc.)** | Development of relevant policies, regulations and guidelines; Training and capacity-building; Coordination and resource mobilization; Oversight role on safety of the general environment, pollution and health risks; Maintenance of the standards and Enforcement and monitoring compliance |
| **2. County governments** | Policy and guideline implementation; Training and capacity-building; Coordination at the county level; Resource mobilization; and Supervision of operation of HCFs |
| **3. Private sector (private hospitals, waste management service providers, suppliers and technology manufactures, etc.)** | Compliance with waste-management guidelines; Allocation of resources; Oversight of HCWM at facility level; Provision of waste-management services at commercial rates; and Provision of waste-management commodities/equipment at commercial rates |
| **4. Professional, training and research institutions** | Advocacy, training and research; HCWM practices; and Compliance and adherence |
| **5. Civil societies (NGOs, CSO, community, etc.)** | Advocacy; Raising awareness on HCWM and environmental pollution; Organising informal sector; and Training and capacity building |
| **6. Development partners** | Provide technical assistance for national and local policy and guideline development; Training and capacity building; Monitoring and verification of standards; and Financial support for improving health systems and infrastructure |

Source: Compiled by the authors based on the Kenya HCWM Strategic Plan (2015–2020)

## 2.4 Financing

All HCFs need to cost their HCWM systems – both direct/capital costs and operational costs by outlining guiding principles for budgeting of HCW, including staff costs, bin and bin liner supply, PPE and waste trolley supply, legal and regulatory licenses and audits (WHO, 2014). However, in practice, the lack of budgetary allocation is identified as one of the serious challenges in HCWM at both national and local levels. For example, Figure 6 shows the average monthly budgets allocated to HCWM of five selected HCFs in Kenya. Most of the budgets are allocated to purchasing bin liners and fuel for incinerators, and fail to include human resource costs, purchase of PPE for waste handlers and environmental protection costs, spill kits, disposal costs or the purchase of colour-coded bins. In addition, no HCF had a mechanism for sustained financing of HCWM activities over the long term.

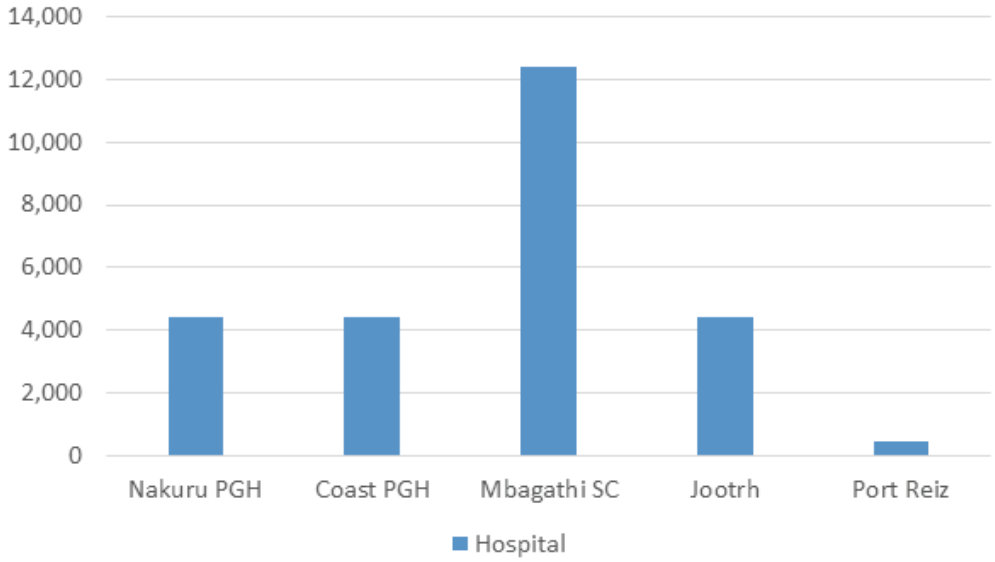



Figure 6: Average budget allocated to HCWM of five HCFs in Kenya. Source: Ministry of Environment and Natural Resources, Kenya, 2017

A sample survey carried out in Kenya under the current study also identified that most health managers are not aware of the costs involved in managing HCW in their hospitals (Table 8). In many cases, the separation of costs for managing waste is not well understood or defined since the related costs are currently lumped in with other operational costs. Financial resources to purchase bins, bin liners, and funds for personnel deployment and maintenance of treatment equipment have been difficult to obtain for all facilities. The assessment also identified that financial support and budgetary allocation for HCW treatment and final disposal are inadequate, which calls for allocating sufficient budgets with a well-designed HCWM system that targets minimum levels of waste for final treatment.

Table 8: Average cost estimation for selected HCFs in Kenya

| Category | Average budget |
|---|---|
| **Average annual budget for HCWM** | 3,203 USD |
| **HCWM budget/Total budget** | 14% |
| **Monthly operating cost** | 627 USD |
| **Monthly service fee (contract)** | 13 - 620 USD |
| **Bins** | 257 USD |
| **Bag holders** | 70 USD |
| **Waste carts, roll-off containers or skips** | 35 USD |

Source: Compiled by the authors based on the sample survey in 2021

## 2.5 Assessment of training needs and capacity building

Best practices in HCWM require that all health care staff receive induction and repeated training on HCWM (Table 9). However, the main observation in Ethiopia and Kenya was that there is an overwhelming and widespread need, throughout all cadres and occupations of health care work, for the provision of training. There is a chronic absence and severe backlog of routine in-service training. Without exception, health workers in both countries expressed an urgent need for training, mainly because most of them had received no specific training on sound chemical management or waste and were not aware of global multilateral environmental agreements.

Table 9: Summary of competence gaps in different occupations in Kenya

| Occupation | Competence gaps |
|---|---|
| **1. Managerial/administrative staff** | |
| **Managerial/administrative** | • HCWM concepts, principles, legal framework<br>• HCWM planning for Health Care Facilities<br>• HCWM Organizational structures, roles & responsibilities & running a HCWM Committee |
| **2. Health care workers (clinical staff)** | |
| **Doctors, pharmacists, laboratory staff, clinical staff, nurses, dentists/COHO** | • Awareness of multilateral environmental agreements (Stockholm convention, Minamata and SAICM)<br>• National legal and policy framework on chemicals and wastes<br>• HCW classification & segregation<br>• Environmental Health Risks & Impacts of HCW<br>• Chemical management |
| **3. Special health service staff** | |
| **Health education environmental health/ occupational health** | • Awareness of multilateral environmental agreements (Stockholm convention, Minamata and SAICM)<br>• HCWM concepts, principles, legal framework<br>• HCW classification & segregation<br>• Environmental health risks & impacts of HCW<br>• HCW storage, transport, treatment and disposal<br>• HCWM planning for Health Care Facilities<br>• HCWM compliance monitoring, evaluation, enforcement<br>• Organizational structures, HCWM roles & responsibilities & running an HCWM Committee<br>• HCW emergency response procedures<br>• HCWM education and training<br>• HCWM awareness promotion |

| 4. Non-technical support staff | |
|---|---|
| **General support staff, housekeeping (cleaners), mortuary attendants** | • HCW classification & segregation<br>• Environmental health risks & impacts of HCW<br>• HCW storage, transport, treatment and disposal<br>• HCW Emergency response procedures |
| **5. Waste treatment equipment operators** | |
| **Incinerator operators/ autoclave and shredder operators; microwave and shredder operators** | • HCW classification & segregation<br>• Environmental health risks & impacts of HCW<br>• HCW storage, transport, treatment and disposal<br>• HCW emergency response procedures<br>• Standard operating procedures of equipment operation<br>• Daily/weekly maintenance activities<br>• Common malfunctions and solving them<br>• Record keeping, including maintenance schedule |

Source: Adapted from Ministry of Environment and Natural Resources, Kenya, 2017

The national government holds the responsibility for providing training and capacity building in the counties, and should roll out the training at HCFs and provide oversight. In Kenya, the staff from the National Environment Management Authority (NEMA), Ministry of Health (MOH) and Nairobi Metropolitan Services (NMS) identified that monitoring systems and budgetary allocation are the most urgent and high priority challenges facing national agencies (Figure 7). NEMA also pointed out that vertical and horizontal coordination among stakeholders is an urgent and key issue requiring improvement. Allocating staff to pursue these mandates was also suggested as an urgent need for MOH and NMS.

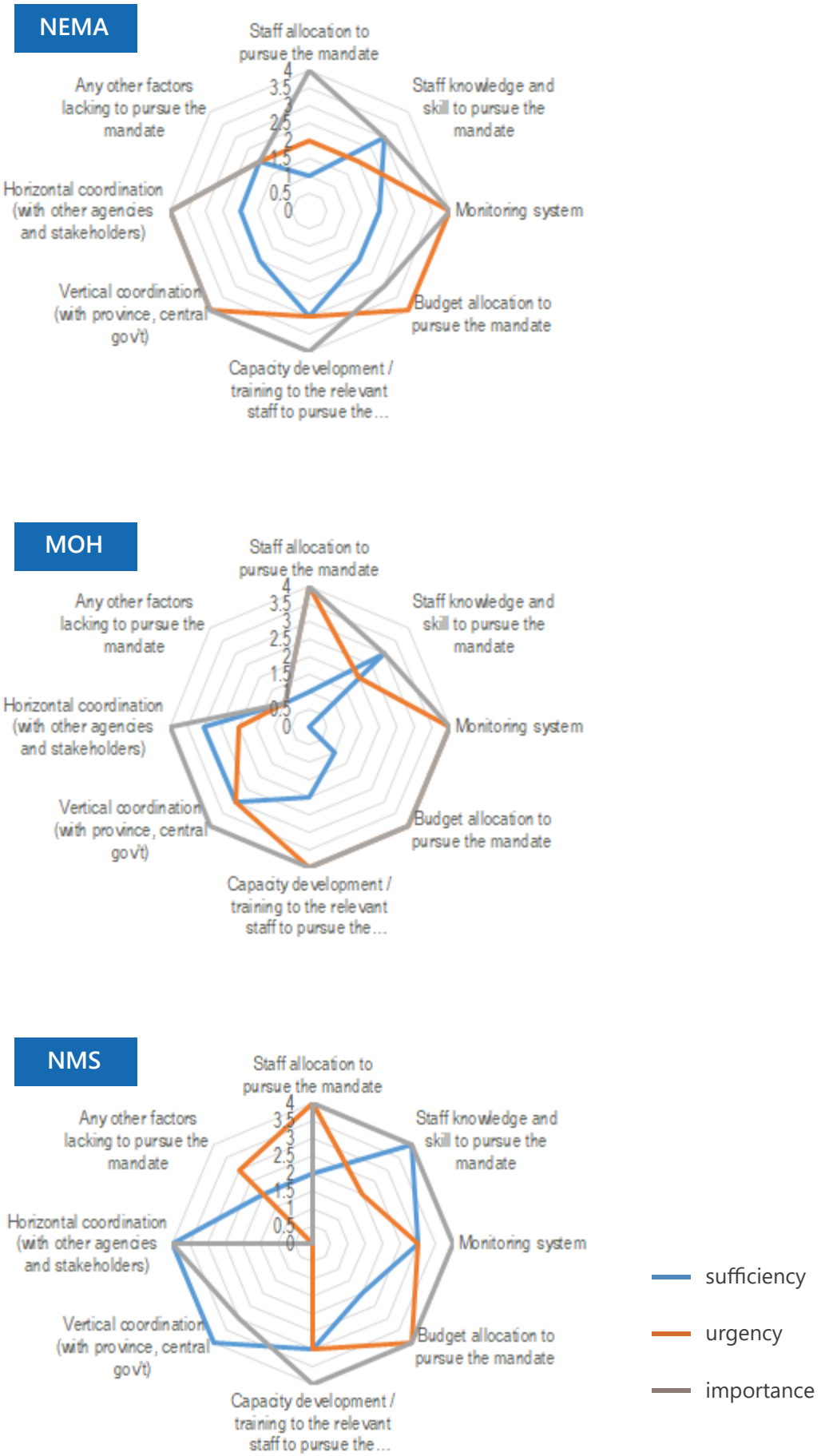



Figure 7: Capacity building needs at national level. Source: Compiled by the authors based on sample survey in Kenya in 2021

# 3. Current Status of Health Care Waste Management

## 3.1 Health care waste generation and characteristics

Primary data on HCW generation and its characteristics are essential to the planning of effective HCWM systems, and include estimating the required capacities of containers, storage areas, transportation vehicles and treatment technologies. These data also help mangers to make decisions on setting procurement specifications, make waste management plans, allocate budget, calculate revenues from recycling, optimize HCWM systems, and conduct environmental impact assessments.

As shown in Table 10, African countries report the lowest HCW generation rates compared to other countries worldwide. However, actual HCW generation rates can vary due to many reasons, such as the type or level of HCFs, differences between rural and urban HCFs, differences in services provided, scale, organizational complexity, and availability of human and financial resources. In addition, existing regulations and policies on waste classification and the quality of waste segregation practices can affect waste generation rates. Dissimilarities between low-, middle- and high-income countries may be partly due to differences in resources, service provision, and available waste management systems. Thus, comparing HCW data from economically diverse countries should be approached with caution.

Table 10: HCW generation rates of selected countries worldwide

| Region | Country | HCW Generation Rate (kg/bed/day) |
|---|---|---|
| **Africa** | Algeria | 0.96 |
| | Cameroon | 0.55 |
| | Egypt | 1.03 |
| | Mauritius | 0.44 |
| | Morocco | 0.53 |
| | Sudan | 0.87 |
| | Tanzania | 0.75 |

| Region | Country | HCW Generation Rate (kg/bed/day) |
|---|---|---|
| **Asia** | Bangladesh | 1.24 |
| | China | 4.03 |
| | India | 1.55 |
| | Indonesia | 0.75 |
| | Iran | 3.04 |
| | Japan | 2.15 |
| | Jordan | 2.69 |
| | Korea | 2.4 |
| | Laos | 0.51 |

| Region | Country | HCW Generation Rate (kg/bed/day) |
|---|---|---|
| America | Argentina | 3 |
| | Brazil | 2.94 |
| | Canada | 8.2 |
| | Ecuador | 2.09 |
| | El Salvador | 1.85 |
| | USA | 8.4 |
| Europe | Bulgaria | 2 |
| | Italy | 4 |
| | France | 3.3 |
| | Germany | 3.6 |
| | Greece | 3.6 |

Source: Adapted from Minoglou et al., 2012

Due to the lack of national data readily available, Table 11 presents HCW generation rates in Ethiopia and Kenya based on the data collected from the sample surveys carried out to assess the present rates of generation and management of HCW in both countries. According to these results, the average waste generation rate is calculated using three different parameters: (i) kilograms per occupied bed per day (kg/bed/day), (ii) kg per patient per day (kg/patient/day), and (iii) kg per unit per day (kg/unit/day) to compare the situation and operations of different HCFs with different levels of activities. The data reveals a difference in waste generation rates even within countries, according to the types of HCF.

Table 11: Average HCW generation rates in Ethiopia and Kenya

| Country | HCF | Health care waste generation rate | | | Reference |
|---|---|---|---|---|---|
| | | (kg/unit/day) | (kg/patient/day) | (kg/bed/day) | |
| Ethiopia | Mizan-Tepi University Teaching Hospital, South-west | 6.63 | 0.08 | 0.306 | Mekonnen et al., 2020; |
| | Government health centres of Addis Ababa | 9.61 | 0.06 | | Tadesse and Kumie, 2014 |
| | Menellik II Referral Hospital, Addis Ababa | | 0.49 | 1.94 | Atnafu and Kumie, 2017 |
| | Health centres in West Gojjam Zone, Amhara Region, | 1.25-2.33 | 0.03-0.04 | | Azage and Kumie, 2010 |
| Kenya | Average values obtained from 23 hospitals | | 0.52 | | The National Health Care Waste Management Plan 2008-2012 |
| | Kenyatta National Hospital | | | 0.61 | International Journal of Environment and Waste Management 14(2):199-209, 2014 |
| | Moi Teaching Hospital | | | 1.03 | |

Source: Compiled by the authors from various literature, 2021

Based on the type of HCF and its functions, average HCW generation rates can be seen to vary, with the highest generation of HCW observed in maternity centres and hospitals, as shown in Table 12.

Table12: Average HCW generation rates by type of HCF

| Facility | Total HCW Generation Rate | Infectious HCW Generation Rate |
|---|---|---|
| **Hospital** | 2 kg/bed/day | 0.5 kg/bed/day |
| **Clinic** | 0.02 kg/patient/day | 0.007 kg/patient/day |
| **Maternity Centre** | 5 kg/patient/day | 3 kg/patient/day |
| **Clinical Laboratory** | 0.06 kg/test/day | 0.02 kg/test/day |
| **Basic Health Unit** | 0.04 kg/patient/day | 0.01 kg/patient/day |

Source: UNEP-IETC (2012)

The sample data collected from Mizan-Tepi University Hospital, southwest Ethiopia, indicates that large amounts of waste are generated from the delivery ward, at 6.7 kg/day (18%), while the paediatrics ward contributed the lowest portion of total HCW, at 4.28 kg/day (12%) within the hospital (Figure 8).

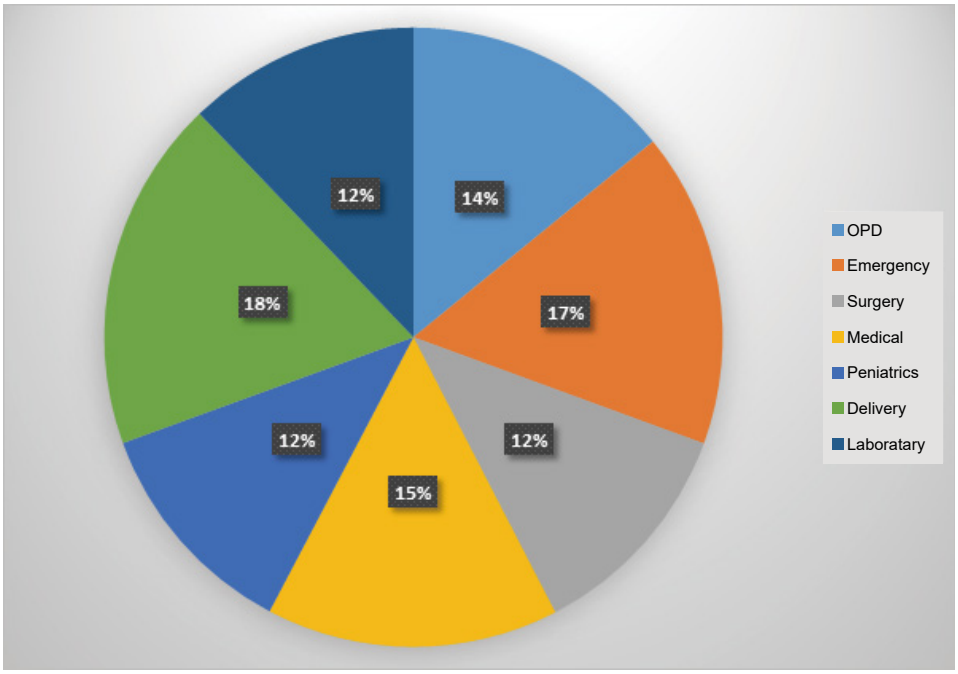



Figure 8: Quantity of Health care waste generated per day by type in study unit of Mizan-Tepi University Teaching Hospital, southwest Ethiopia 2019. Source: Compiled by the authors based on Mekonnen et al., 2020

A similar result was also observed from a micro study conducted on HCFs in Addis Ababa City Admin Area, Ethiopia (Figure 9). A large amount of HCW was generated by delivery wards, at 36.60–40.60 kg/day (40.79%), while a lower amount of 1.885–0.055 kg/day (0.97%) of HCW was generated at IMNCI. These data also show that most HCW is generated from delivery or maternity wards compared to other wards.

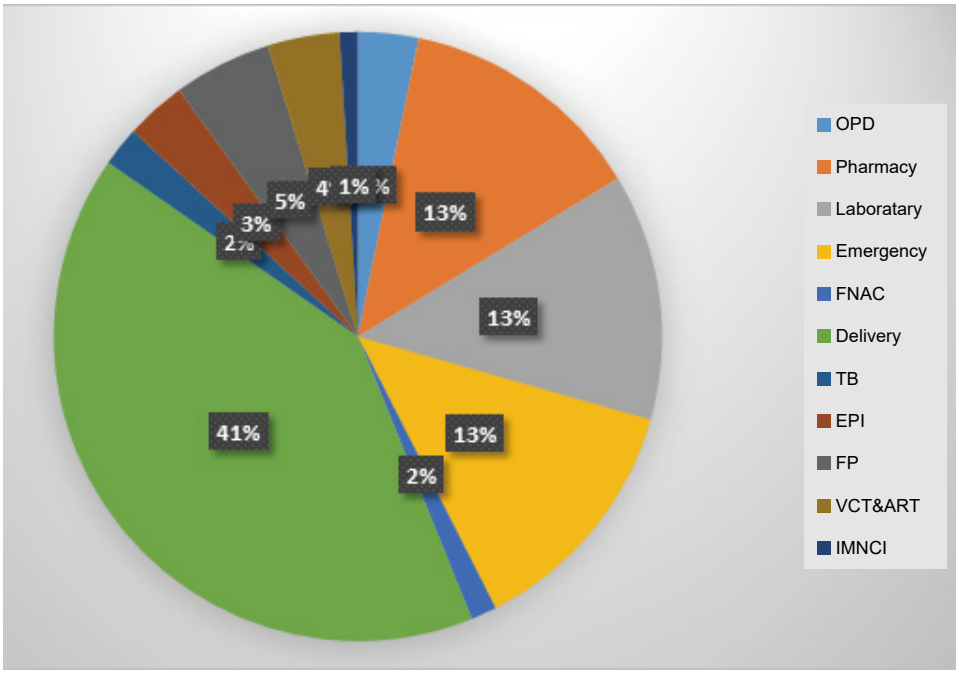



Figure 9: Distribution and daily amount of HCW generation rate by point source in Health centres, Addis Ababa City Admin., January 2011. Source: Compiled by the authors based on Tadesse and Kumie, 2014

As a reference, globally, HCW generated from HCFs is reportedly around 85% non-hazardous and mostly comes from the administrative, kitchen and housekeeping functions, packaging and waste generated during maintenance of HCFs. The remaining 15% is regarded as hazardous and may pose a variety of environmental and health risks. Of this, about 10% is infectious (hence, biologically hazardous), and the remaining 5% is comprised of toxic chemicals, pharmaceuticals and radioactive wastes, as shown in Figure 10 (WHO, 2014).

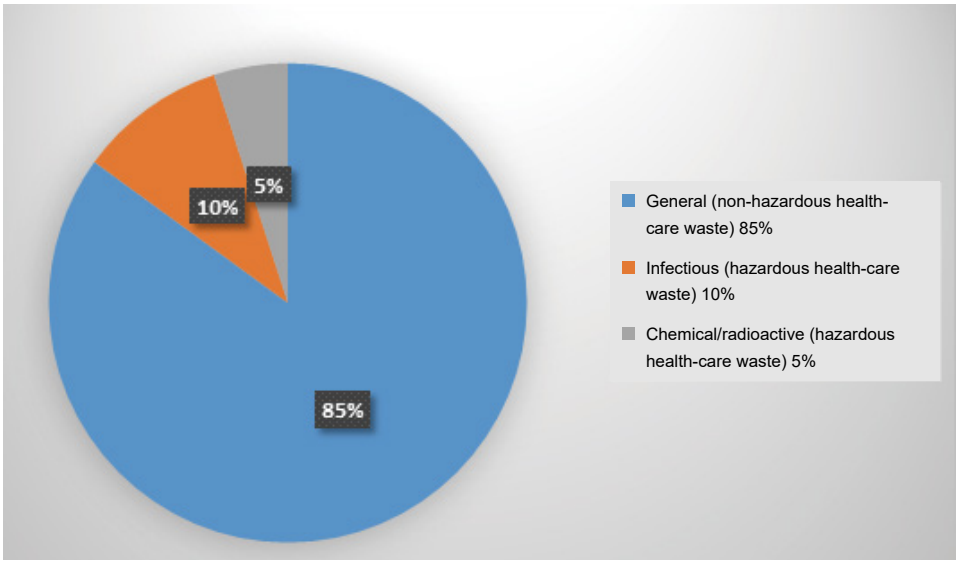



Figure 10: Typical waste composition of health care facilities. Source: Adapted from WHO, 2014

However, global data indicates that percentages of infectious waste or hazardous waste and non-hazardous or general waste vary from country to country, as shown in Table 13.

Table 13: Composition of hazardous and non-hazardous waste in selected countries

| Country | Composition of health care waste (%) | | Reference |
|---|---|---|---|
| | Hazardous | Non-hazardous | |
| **Ethiopia** | 40-60 | 60-40 | Alvim Ferraz and Afonso (2003); Tesfahun, E (2015) |
| **Kenya** | 40-50 | 60-50 | NHCWMP, 2008-2012; HCWSP, 2015-2020 |
| **Libya** | 28 | 72 | Mugambe et. al., (2011) |
| **South Africa** | 39.3 | 60.7 | Mostafa et al., (2009) |
| **Nigeria** | 41 | 59 | Ogbonna (2013) |
| **Sudan** | 20 | 80 | Ahmed and Gasmelseed (2014) |
| **Nepal** | 27 | 73 | UNEP (2020) |
| **Malaysia** | 20 | 80 | UNEP (2020) |
| **India** | 10-25 | 90-75 | UNEP (2020) |
| **Pakistan** | 25 | 75 | UNEP (2020) |

Source: Compiled by the authors based on various studies, 2021

Based on the data in Table 13, it was found that African countries reported a high rate of hazardous waste in their HCW compared to countries in Asia. It is also noted that within Africa, Ethiopia and Kenya reported the highest rates of hazardous (infectious) waste, at over 50%. These data are also confirmed by the micro data collected from specific HCFs in both countries, as summarized in Table 14.

Table 14: Composition of hazardous and non-hazardous waste in selected HCFs in Ethiopia and Kenya

| Country | Hospital | Total HCW (kg/day) | Infectious Waste (kg/day) | Percentage (%) | General waste (kg/day) | Percentage (%) | Reference |
|---|---|---|---|---|---|---|---|
| **Ethiopia** | Health centres, Addis Ababa City Admin | 96.08 | 59.69 | 62 | 36.39 | 38 | Tadesse and Kumie, 2014 |
| | Mizan-Tepi University Teaching Hospital, Southwest | 36.43 | 20.77 | 57 | 15.66 | 43 | Mekonnen et al., 2020 |
| **Kenya** | Nakuru PGH | 350 | 120 | 34 | 230 | 66 | Ministry of Environment and Natural Resources, 2017 |
| | Jootrh | 300 | 120 | 40 | 180 | 60 | |
| | Mbagathi | 94 | 64 | 68 | 30 | 32 | |
| | Coast PGH | 350 | 200 | 57 | 150 | 43 | |
| | Port Reitz | 200 | 120 | 60 | 80 | 40 | |

Source: Compiled by the authors, 2021

## 3.2 Health care waste management

### 3.2.1 Waste minimization

According to the waste hierarchy, the preferred management solution in the first place is not to produce waste and prevent wasteful HCW operations. To ensure waste reduction occurs, the focus should be on working with medical staff to change clinical practices so that they use fewer materials. Although waste minimisation is commonly practiced at the point of its generation, health care managers can also take measures to reduce the production of waste through modifying their purchasing and stock control strategies. However, most HCFs in Ethiopia and Kenya still find it difficult to practice it, or show little proactive efforts geared towards it. As shown in Figure 11, less than half of the HCFs surveyed in Kenya responded that they practice the 3Rs or other practices that avoid or minimize waste in a holistic way such as green procurement (environmentally preferable purchasing), green facility management (environmental management system) or resource efficiency (safe reuse, recovery and recycling) measures in their operations.

Besides waste minimization, these measures could also bring other environmental, social and economic benefits, e.g. spurring local green businesses and creating green jobs. In particular, energy saving measures in the context of green buildings in HCFs have a large potential in reducing GHGs and mitigating climate change. However, currently the overall uptake of these measures, as part of the integrated approaches for greening the health infrastructure, is still low.

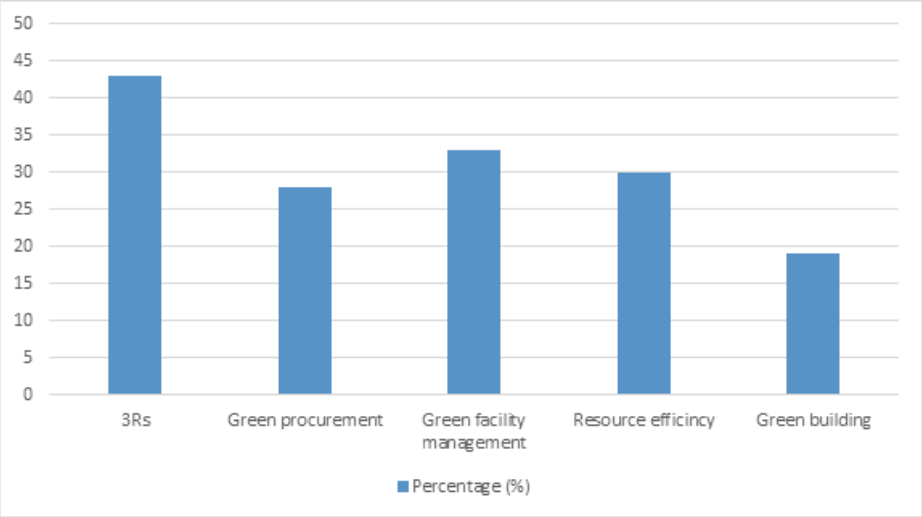



Figure 11: Practice of measures greening health infrastructure at selected HCF in Kenya. Source: Compiled by the authors based on the sample survey in 2021

### 3.2.2 Segregation, storage and transportation of HCW

A correctly functioning HCWM system, from the point of HCW generation to its final treatment or disposal, needs to follow the general principles of waste segregation, storage and transportation.

#### HCW Segregation

Source segregation helps in reducing the quantity of waste requiring treatment before final disposal and ultimately reduces the cost of HCW management and final disposal. Segregation involves placing different types of wastes into separate and appropriate temporary storage colour-coded containers or bags, as recommended by national guidelines or WHO guidelines. However, in practice, most HCFs in Ethiopia and Kenya exhibit no or limited success in performing waste separation.

In Ethiopia, segregation of HCW into separate and appropriate temporary storage colour-coded containers or bags appears as a clear recommendation in the Health Care Waste Management National Guidelines (2008), as summarised in Table 15.

Table 15: Recommended use of colour coded for HCFs in Ethiopia

| Waste category | Colour of container and markings | Type of container | Collection frequency |
|---|---|---|---|
| **Infectious waste** | Yellow with biohazard symbol (highly infectious waste should be additionally marked as HIGHLY INFECTIOUS). | Strong, leak-proof plastic bag placed in a container (bags for highly infectious waste can be autoclaved). | When three-quarters full or at least once a day. |
| **Sharps waste** | Yellow, marked SHARPS with biohazard symbol | Puncture-proof container. | When filled to the line or three-quarters full. |
| **Pathological waste** | Yellow with biohazard symbol | Strong, leak-proof plastic bag placed in a container. | When three-quarters full, or at least once a day. |
| **Chemical waste** | Brown, labelled with appropriate hazard symbol. | Plastic bag or rigid container. | As needed. |
| **Non-hazardous Waste** | Black | Plastic bag inside a container or container which is disinfected after use | When three-quarters full or at least once a day. |

Source: Adapted from Federal Democratic Republic of Ethiopia, 2019

However, most of the HCFs in the country lack proper waste separation systems in practice. For example, a sample survey carried out on governmental health care facilities in Addis Ababa identified that over two-thirds (68.5%) of HCFs do not segregate HCW appropriately, while hospitals performing better on this compared with to health centres. There is also a significant difference in HCW segregation practices between different health care delivery sections (Binyam et al., 2018). Due to poor waste segregation practices, all the nearby municipal garbage collection points contained mixed waste. This facility is often overfilled with refuse commonly found in the surroundings due to delays in services for off-site transportation to the municipal disposal area. Even HCFs that practise waste segregation follow minimum levels of practice involving the three-bin system, i.e., general waste (black container), hazardous waste (yellow container) and sharp materials (safety box).

Similar results were also confirmed by other studies in Ethiopia. For example, Atnafu and Kumie (2017) found that there was no adequate segregation of HCW into waste categories for proper disposal into colour-coded waste containers at the point of generation, except in Menellik II Hospital, which used a puncture-proof safety box for sharps waste. Here too, at the time of investigation, the nearby municipal garbage tank contained mixed waste and was overfilled, and refuse was dumped in the surroundings owing to delays in the off-site transportation service to the municipal disposal area. Yazie et al., (2019) also identified a lack of use of proper colour-coded bins for waste segregation in HCFs in Ethiopia. The authors found all general and infectious wastes were mixed and plastic buckets were used to store HCW temporarily. Disinfection of waste storage as well as transporting utilities was uncommon.

Figure 12: A HCF worker shows best-practice of waste separation is done at a facility in Kenya

A further study, by Sahiledengle (2019), on hospitals in southeast Ethiopia identified that only half (53.8%) of the HCFs demonstrated adequate HCW segregation practices and facilities, such as placing general, infectious, and sharp wastes into different waste collection containers. It further identified factors such as the gender of health care workers, age, experience, number of years in service, use of standard precautions, and presence of on-site waste segregation containers as the most important variables that correlate with self-reported health care waste segregation practices. Findings from this study indicate that a significant number of health care workers had poor HCW segregation practices, as was found in other studies conducted elsewhere in Ethiopia (Mululen et. al., 2014).

Poor practice of segregation is also common among HCFs in Kenya, despite the presence of the Kenya National Guidelines on Safe Management of Health care Waste, which requires waste to be segregated properly according its hazard level and to make use of the six-bin segregation system for handling waste generated in facilities, as shown in Figure 12.

| 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 |  BIOHAZARD |
| Highly infectious or anatomical/ pathological | Laboratory specimens and containers with biological agents anatomical waste, pathological waste | Red-pedal act |  BIOHAZARD |
| Chemical | Formaldehyde, batteries, photographic chemicals, solvents, organic chemicals, inorganic chemicals | Brown | Marking will very with classification of the chemical |
| Radioactive | Any solid, liquid, or pathological waste contaminated with radioactive isotopes of any kind | Yellow |  Radioactive symbol |
| Genotoxic/Cytotoxic | All drug administrative equipment (e.g. needles, syringes, drip sets), gowns and bodily fluid/ waste from patients undergoing cytotoxic drug therapy | Purple |  BIOHAZARD |
| Sharps Box (Safety Box) | Needles, Syringes, broken vials | White/yellow safety boxes (WHO Approved) |  BIOHAZARD |

Figure 13: National guideline on waste separation in HCFs in Kenya. Source: Adapted from Ministry of Environment and Natural resources, Kenya, 2017

As was found in Ethiopia, HCW segregation practices in Kenya were also found to be limited to the three-bin segregation system, comprising red for highly infectious pathological waste, yellow for infectious waste and black for non-infectious or general waste. According to reports from health workers, waste segregation was identified as one of the key challenges in HCFs, as can be seen from Table 16. Only 48% of HCFs practised separation of HCW at source.

Table 15: Recommended use of colour coded for HCFs in Ethiopia

| Category | Rate |
|---|---|
| **Separation practice** | 48% |
| **Use of labelling and symbols** | 78% |
| **Availability of temporary waste storage bins** | 78% |
| **Well designed temporary waste storage bins** | 69% |
| **Use of disposable temporary waste storage bins** | 42% |

Source: Compiled by the authors based on the sample survey in 2021

These data are similar to those of a previous study conducted by the MOH (2008–2012), which also identified the importance of segregation of HCW in Kenya. According to MOH, at the time of the study, only 55% of HCFs in the country practised segregation at source. In addition, the data from the Ministry of Environment and Natural Resources (2017) indicates that most HCFs experience challenges with waste segregation; observations showed mixing of general and infectious waste in some areas, including the inadequacy of bins with matching liners. It also shows that the HCFs that act as training institutions have a high turnover of staff and hence experience diminishing consistency of practices. With the devolution of health services, training is required to ensure segregation is carried out at all levels, together with the introduction of segregation of other types of waste, i.e., pharmaceutical, chemical and radioactive waste, which is currently not being practised in health care facilities (Figure 13).

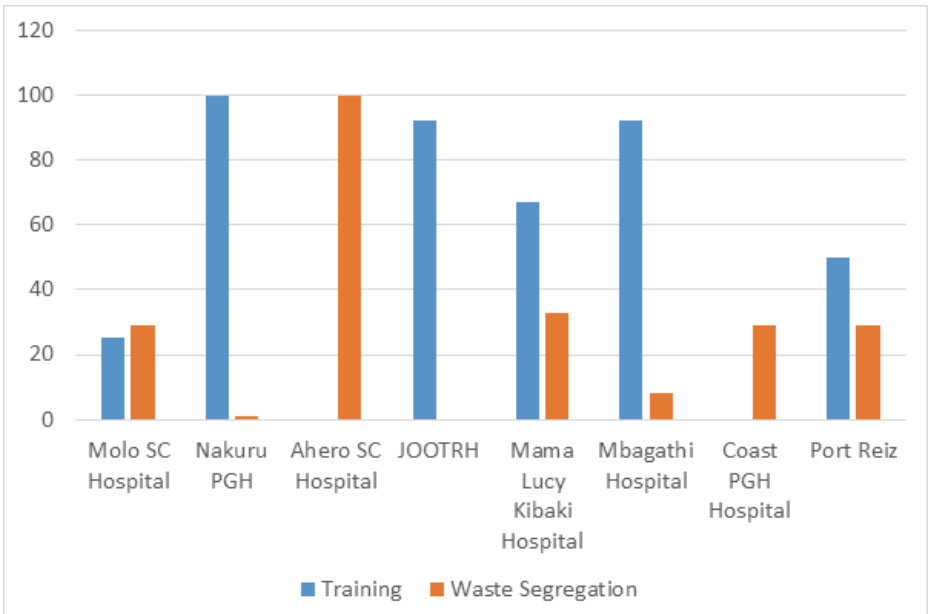



Figure 14: Analysis of progress in source segregation in selected HCFs in Kenya. Source: Adapted from Ministry of Environment and Natural resources, Kenya, 2017

The National Guidelines on HCW require the display of posters and signage, i.e., waste segregation charts, at segregation points, which act as a reminder for health workers on the placement of HCW generated. The WHO (2014) research also specifies the use of segregation posters for medical and waste workers, to help to raise awareness of segregation practices and improve the quality of separated waste components. Most of the HCFs surveyed in both Ethiopia and Kenya, however, did not post such segregation charts near designated waste receptacles in health care facilities, in contravention of the national standards aimed at aiding proper waste segregation. The experience summarised in Box 3 shows how HCFs can achieve sustainable HCWM and circular economy through promoting source separation.

### Box 3: HCWM towards the circular economy in Tribhuvan University Teaching Hospital (TUTH), Nepal

Before TUTH started developing a HCWM plan, no data on HCW was available, and the majority of waste was directed for municipal disposal, while the remainder was incinerated on-site. The incinerator was a diesel-fuelled single chamber unit without air pollution control, located in close proximity to the paediatric department, birthing centre and respiratory ward. The smoke from the incinerator affected all staff, patients and visitors in the vicinity.

The project activities to change the waste management system started with conducting a quick study to provide an overview on HCW generation and characteristics. The results showed that the hospital generated 968 kg of waste per day under an 87% bed occupancy. If the waste were correctly separated, it would result in about 45% being classified as recyclable, 21% as biodegradable, and 29% as infectious (without sharps and syringes). However, the reality in 2014 was that 92% was classified as risk waste due to the lack of separation practice. Once infectious waste contacts other waste, all waste becomes potentially infectious. Under such circumstances, separating healthcare waste at source is considered a fundamental principle in the HCWM plan to reducing risk as well as environmental pollution.

HECAF 360, a local NGO in the field of HCWM in Nepal, and Healthcare Waste without Harm (HCWH), an international NGO, supported TUTH in improving its HCWM activities. They established a waste management committee, which is responsible for handling higher-level issues including planning approval and troubleshooting, and a working committee to implement the project at TUTH. All members received training from HECAF 360 and they learned through daily experience using newly installed machines, such as a bio-digester to treat organic waste and autoclaves to treat infectious waste. Since the installation of these facilities, levels of hygiene have risen and risk of exposure to infectious disease and injuries associated with waste handling have been reduced along with the reduction of waste that goes to the landfill site. In addition, the risk of emission of air pollutants and greenhouse gases (GHG) caused by the use of uncontrolled conventional incinerators has also been minimized through non-burning treatment technology. The hospital gains in revenue as well by selling recyclables from the treated healthcare waste.

This case study highlights that to improve HCWM, HCFs must have an HCWM plan based on 3Rs with allocation of sufficient budget and human resources for implementation. The units for HCWM have to be established with clear identification of responsibilities, and the members need to be fully trained – at minimum through on-the-job training. For tasks outsourced, contracts should include conditions ensuring appropriate handling and treatment of waste generated at HCFs based on the HCWM plan. Expenses associated with

waste management, hygiene conditions at HCFs and working environments for staff should also be carefully monitored for further improvements. Above all, determined leadership from top management is vital towards implementation of the waste management plan.

To achieve or maintain the standards and targets set under the policy and strategy, national and regional governments should allocate sufficient budgets and personnel to implement projects, as well as perform monitoring and evaluation using data collection and analysis. They also need to disseminate information on laws and regulations, provide training and develop curricula to enable ongoing improvements in the skills and knowledge of the dedicated individuals in the field of HCWM.
turned into resources, once removed of hazards.

Source: compiled by authors based on the case study on Health Care Waste Management towards the Circular Economy – Tribhuvan University Teaching Hospital in Nepal, 2021

### Waste Storage

According to the WHO (2014), hazardous waste generated in HCFs should be temporarily stored in designated rooms to keep it away from patients before removal, then collected conveniently and transported to a central storage facility. If temporary storage rooms are not available, waste can be stored at other designated locations near to medical areas but away from patients and public access, such as in closed containers. If storage containers are used for infectious waste, they should be clearly labelled and preferably lockable. However, in practice, HCFs in both Ethiopia and Kenya do not follow these requirements to a satisfactory level.

One study identified that all public and private hospitals in the Amhara National Regional State in Ethiopia temporarily store all waste in open, substandard dustbins for about 12 hours. Pathological and sharp wastes were found to be stored in closed plastic containers and collected in less than an hour. Public hospitals use standard safety boxes to store sharp wastes, while private hospitals use non-standard storage, such as carton boxes that can be easily damaged (Tesfahun, 2015). Similar storage practices were observed during the assessment of HCWM in the Mizan-Tepi University Teaching Hospital in Ethiopia. Here, HCW is temporarily stored in open, substandard dustbins for about 12 hours. Pathological waste is stored in closed plastic containers and collected in less than 30 minutes. For sharp waste, the HCF used non-standard storage, such as carton boxes (Mekonnen et al., 2020). In addition, Tadesse and Kumie (2014) identified that the majority of HCFs in Addis Ababa city administration had interim waste storage, which was easy for the staff to access, but 60% of containers had no lid and storage times exceeded 48 hours.

Figure 15: Poor storage of medical waste at a HCF in Kenya

In Kenya, IPC Guidelines 2010 highlight the importance of having a specific storage area in each HCF for storing HCW, which should be available for use before treating or moving HCW out of the facility, should have restricted access, and should be marked with a biohazard symbol. As summarized in Table 17, a sample survey carried out in Kenya identified that 73% of HCFs have onsite waste storage sites of sufficient size on-site, but only 4% of them have a more secure area to store pathological waste. Most HCFs (72%) do not post warning signs around waste storage sites. Further, half of the HCFs do not close or lock the door of the waste storage room, making it easy for animals to gain access. It was found that about 46% of storage areas did not provide proper protection from the sun, 35% of HCFs had temperature-ontrolled waste storage areas, and a more limited

number of HCFs (28%) kept PPEs close to storage areas for use. In addition, infectious waste (excluding sharps) was stored in storage areas for nearly two weeks (about 11 days).

These findings were also confirmed by the data presented in the National Health Care Waste Management Plan (2008–2012). About 47% of hospitals were found to have refuse storage areas or rooms. However, at the time of investigation, some of these storage rooms were not well covered and properly maintained. Leaking roofs were common feature and only 61% were fenced or had restricted entry.

Table 17: On-site waste storage areas (transfer point) in selected HCFs in Kenya

| Category | Available |
|---|---|
| **Location** | 59% |
| **Dedicated and well-designed storage room** | 64% |
| **Large enough** | 73% |
| **With warning sign** | 38% |
| **Impermeable & hard-standing floor** | 71% |
| **Good drainage system** | 64% |
| **Access to water for cleaning purposes** | 77% |
| **Easily accessible to staff** | 77% |
| **Normally closed and locked** | 50% |
| **Easily accessible to waste-collection vehicles** | 77% |
| **Protected from the sun** | 54% |
| **Temperature controlled** | 35% |
| **Inaccessible to animals, insects, birds, and rats** | 43% |
| **Good lighting and ventilation** | 65% |
| **How far is the storage area from food preparation areas or stores selling fresh food (meters)** | 111 |
| **How far is the storage area from the patient area (meters)** | 90 |
| **Supply of cleaning equipment (in case of spill)** | 61% |
| **PPE close to the storage area** | 28% |
| **What is the maximum duration that infectious waste (excluding sharps) is stored in the storage area (days)?** | 11 |
| **Special storage area for pathological waste** | 4% |

Source: Compiled by the authors based on the sample survey 2021

## Transportation

According to the national guidelines on HCWM in both Ethiopia and Kenya, all HCFs should conduct reviews to optimize the waste collection process, reduce handling and transportation, and promote safe work practices, as well as use colour-coded trolleys to maintain segregation during waste transportation. These guidelines highlight the importance of proper internal collection and transportation of HCW to avoid waste spilling from collection containers. They state that collection must be done promptly and routinely or as often as required, in order to reduce the probability of the public coming into contact with contaminated wastes. In addition, only approved and trained personnel fully equipped with appropriate PPE and means of conveyance such as trollies or carts should handle waste collection according to the national guidelines. They must ensure containers/bags (bins/boxes and collection receptacles) are less than three-quarters full and collection containers are appropriately labelled before sealing them at the point of waste generation.

According to global good practice, HCW collection and transportation are usually separated into on- and off-site transport. On-site transport involves conveying wastes from the various points of generation within an HCF to a temporary storage location also within the same area, while off-site transport involves sending HCW from the HCF for treatment and disposal at sites located outside of the HCF.

In Ethiopia, there is no structured system for collection and transportation of general and hazardous waste in private or public hospitals (Tesfahun, 2015). In two-thirds of public hospitals surveyed in this study (67%), open plastic bins (25 litre capacity) were used to collect and transport mixed wastes, while one public hospital used closed plastic containers (50 litre capacity) and the remaining hospitals used both open containers and carton boxes. In all hospitals, only sharps and pathological wastes were collected and transported separately. All HCFs transport their collected HCW to incineration facilities located on-site using wheeled trolleys (stainless steel, leak-proof) twice a day, in the morning (before 8:00 am) and in the evening (after 6:00 pm) by cleaning personnel. The waste from delivery, operating and intensive care units was collected within two hours.

Mizan-Tepi University Teaching Hospital, in southwest Ethiopia, also used wheeled trolleys for HCW collection and transportation within the HCF. Not all waste handlers were found to be fortified with suitable Personal Protective Equipment (PPE) such as heavy-duty gloves, thick-soled boots and leg protectors during waste transportation. The hospital uses both open and closed trolleys for general waste and hazardous waste for transportation to on-site collection and carton boxes for contaminated sharp material collection (Mekonnen et al., 2020).

This situation is similar to that in Menellik Referral Hospital, where HCW is collected daily in the morning except for the major operating rooms and EOPD, where collection takes place within eight hours on average. Most of the means for on-site transportation of HCW comprised closed bins with wheels. Waste is usually stored in the municipal garbage tank (all of it infectious) for at least one to three weeks before being transported by an outsourced private company to the city municipal disposal site, which is an unsanitary landfill site using open dumping. HCW bins that are placed in walkways and pedestrian areas are also not emptied or cleaned on a regular basis (Atnafu and Kumie, 2017).

As was found in Ethiopia, most public and private hospitals in Kenya make use of wheelbarrows for the transportation of waste within compounds, while only a few used trolleys. It was also observed that more than half of the hospitals had noticeable waste spillage, due to ineffective waste collection practices. The recommended practice for waste transportation within hospitals is dedicated trolleys, with separate ones for infectious waste. The frequency of collection of waste in most hospitals was reported as once per day, except for a few hospitals with high waste generation rates, for which two or three collections per day took place (Table 18). In addition, mismanagement and insufficient space for storage areas, a lack of transport carts and difficult access for transport vehicles to storage areas are key challenges in HCFs in Kenya.

Table 18: On-site collection and transport in selected HCFs in Kenya

| Category | Average |
|---|---|
| **How often and when is the waste transported from source to the storage area? (times/day)** | 1.03 |
| **Well designed waste transportation system** | 60% |
| **Waste bins removed and replaced immediately when they are no more than three-quarters full** | 80% |
| **Frequency of waste transport cart cleaning** | Immediately, Daily, Weekly, Bi-weekly |
| **Waste collectors and transporters using PPEs** | 100%<br>100%<br>100% |
| **Presence of concerns about collection and transport of waste on-site** | Construction of well dedicated waste collection area; Proper storage area; Transport carts to be made available; Expansion of storage area |

Source: Compiled by the authors based on the sample survey 2021

For the off-site transport of HCW, most HCFs in Kenya contract this out to private waste transportation services (92%), in which private service providers provide vehicles. The lack of use of the manifest system, mixing of HCW with municipal waste and lack of compliance such as with international symbols or signs and WHO recommended standards are the main challenges for transportation and treatment of HCW in Kenya (Table 19).

Table 19: Off-site transportation system in Kenya

| Category | Private Transport |
|---|---|
| **Is the off-site collection service public or private?** | Private contractors: 92%; and 8% (Referral from county, recommended by Ministry of Health) |
| **Where and at what time does the transport vehicle collect the waste?** | Morning – 83%, Afternoon – 13%, and Evening/night – 4% |
| **How often does the transport vehicle pick up the waste? (times/week)** | 1.37 |
| **What type of waste is collected from the facility?** | All types: highly infectious, infectious, sharp waste, etc. |
| **Is there a waste tracking or manifest system?** | 8% |
| **Who owns the transport vehicle?** | Private: Contractor and Public Government (Ministry of Health) |

| | |
|---|---|
| **Does the transport vehicle carry infectious and general municipal waste together?** | 54% |
| **Closed transport vehicle** | 84% |
| **Well-designed (refrigerated, has internal rounded/ angled corners) waste transportation vehicles for off-site solid waste disposal?** | 4% |
| **Transport vehicles display international hazard symbol or sign stating it is carrying infectious waste and an emergency telephone number?** | 24% |
| **Does the transport vehicle meet the WHO recommended standards*? (Based on observation)** | 20% |
| **Does the transport vehicle meet the WHO recommended standards*? (Based on observation)** | 20% |

Source: Compiled by the authors based on the sample survey in 2021

Table 20 summarises the opinions expressed by four selected transport service providers in Kenya in handling off-site HCW transportation and treatment. All four companies remarked that they followed operational standards, manuals and the manifest system in their waste collection operations. However, observations uncovered that even though all companies possessed such guiding documents, there was a very large gap in their actual implementation. Capacity building to ensure standards are put into practice and strictly observed, training for waste handling staff, and low rates paid for operational costs were identified as the top-three priority challenges faced by these transportation companies.

Table 20. HCW transportation practice by four selected private service providers in Kenya

| Description | Company A | Company B | Company C | Company D |
|---|---|---|---|---|
| **Operation flow on HCWM** | Yes | Yes | Yes | Yes |
| **Operation manual** | Yes | Yes | Yes | Yes |
| **Manifest system** | Yes | Yes | Yes | Yes |
| **Amount of total waste accepted in total (t/month)** | 100 | 300 | 200 | 100 |
| **t/d (20 day operation/month)** | 5 | 15 | 10 | 5 |
| **Amount of HCW accepted in total (t/ month)** | 20 | 50 | 180 | 70 |
| **%** | 20% | 17% | 90% | 70% |
| **Type of HCW accepted** | All | All | All | All |

| | | | | |
|---|---|---|---|---|
| **COVID-19 waste management policy or plan?** | Yes | Yes | Yes | Yes |
| **Any specific businesses currently implemented for COVID-19 waste management** | Segregation then incineration | Incineration | Incineration | Microwaving |
| **Rules, manual, standards covering pollution control and monitoring method, if any (air, water, soil, noise, other pollution)** | N.A. | N.A. | Ash thrown in plastic covered pits to prevent soil contamination | |
| **Top-3 priority challenges in your business** | Operational costs | No | Strict standards before certification; continuous training for shifting staff; costs of operation | |
| **Top-3 priority opportunities in your business** | Increased waste generation | No | Deals in small quantity waste niche, unlike other companies | |

Source: Compiled by the authors based on the sample survey, 2021

## Waste treatment and disposal

Application of sound treatment and disposal technologies as part of the waste management hierarchy is a key component in reducing the potential hazards posed by HCW, while endeavouring to protect public health and the environment. The choice of treatment methods and technologies involves many factors, including waste characteristics, technological capabilities and requirements, environment and safety, and costs – many of which depend on local conditions. According to WHO guidelines (2014), there are five basic means for treating hazardous components in HCW: thermal, chemical, irradiation, biological and mechanical.

Figure 16: Officer-In-Charge of Mutuini Hospital explains how the new incinerator works. This was donated through UNIDO/JICA sponsorship in Kenya

In practice, incineration, open-pit burning, small burial, and placenta pits are the major technologies used by HCFs in Ethiopia and Kenya for both on-site and off-site waste treatment (Box 4). In Ethiopia, small incinerators made of local bricks are commonly used to burn sharps waste within HCFs. Nevertheless, the incinerators used for the treatment of HCW did not follow adequate design or construction rules. None of them can ensure waste is completely burnt, thus were not significantly reducing

waste volumes, and also produced high smoke and GHG emissions. This results in only partly burnt health care waste being disposed of in open pits. In addition to brick incinerators, some HCFs had open, hand-dug pits in their backyards that were used for the direct dumping and open burning of HCW. Some public and private hospitals had a placenta pit for disposal of pathological waste generated from delivery and operating rooms (Tesfahun, 2015).

### Box 4: Construction and operation of small-scale incinerators in Ethiopia

Almost all HCFs in Ethiopia are assumed to own single chamber brick incinerators on their premises for treating infectious wastes. The average construction cost for small capacity single chamber incinerators with an ash pit built by health centres in 2013 was about ETB 150,000 (8,000 USD). Such incinerators are used to burn about 1,500 kg of infectious waste per month, generated in emergency treatment and examination rooms as well as at patient beds. About 200 kg/month of infectious waste is generated from patient beds, which gives a waste generation rate of 0.83 kg/day/bed. The photos below show a single chamber incinerator, ash outlet and earthen ash pit in Addis Rai'Y Health Center in Addis Ababa. It is reported that the smoke and odour are only tolerable due to the small quantities of waste burnt, which occurs every six hours after collection.

A larger incinerator, built through the support of CDC in Zewditu Memorial General Hospital in Addis Ababa with a capital outlay of about 1.5 million ETB (80,000 USD) in 2013, was found to be overloaded. In effect, it only functions as an open burning fireplace, and is a nuisance to neighbouring residents, hospital staff and adjacent public park. (See photo below)

Source: Compiled by the authors in 2021

Similar practices were observed in the HCFs in Kenya (Figure 14). According to the National Health Care Waste Management Plan (2008–2012), most hospitals treated their waste on-site, the most common method being incineration at 62% using functional incinerators. Of those transporting their waste off-site, it was found that most facilities kept no records of such waste contracted out for off-site disposal. For the incinerators observed in hospitals, the majority were in a functional state while a quarter were dysfunctional and either under repair or not working. Other waste treatment facilities available in these hospitals included compost pits for non-hazardous biodegradable waste, and shredders, which were found in only Kenyatta National Hospital, Mater Mission Hospital and Nairobi Hospital. Most hospitals had no alternative waste treatment options other than incineration.

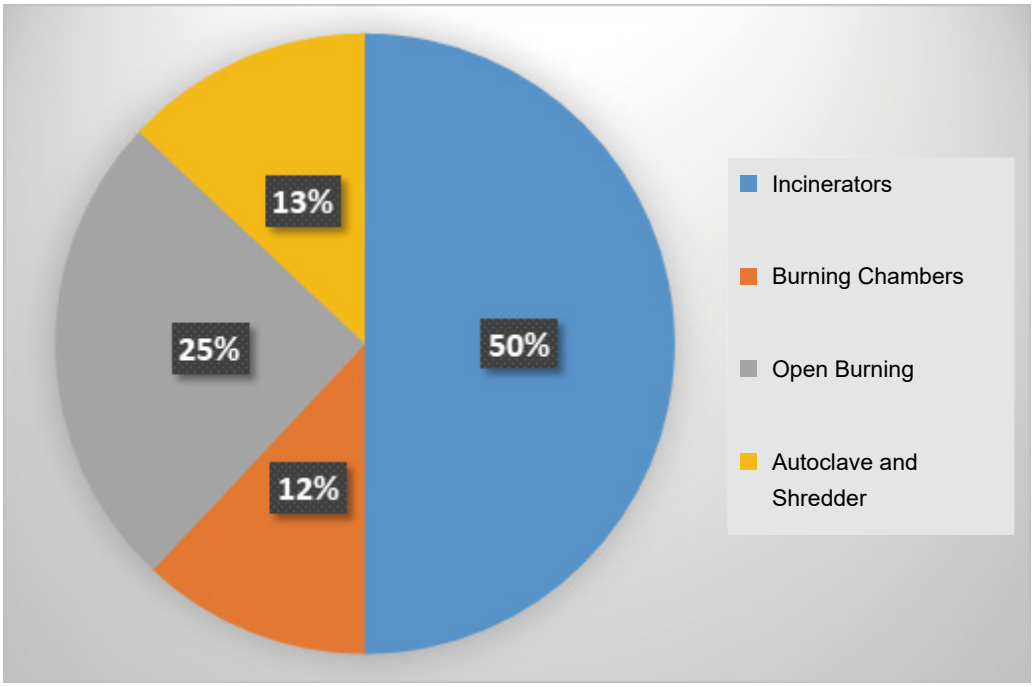



Figure 17 : Waste treatment methods in HCFs in Kenya. Source: Adapted from National Health care Waste Management Plan (2008–2012), Kenya

# 4. Environmental risk, occupational health and safety

## 4.1 HCWM staff and operators

Improper management of HCW can result in both environmental and public health issues. It is apparent that infectious waste generated in both Ethiopia and Kenya is usually contaminated or suspected of being contaminated due to poor handling of HCW. As shown in Figure 15, this results in occupational health and safety risks for health care providers and support staff. The HCWM staff agreed that HCW poses many risks to their waste collectors, handlers and health care workers.

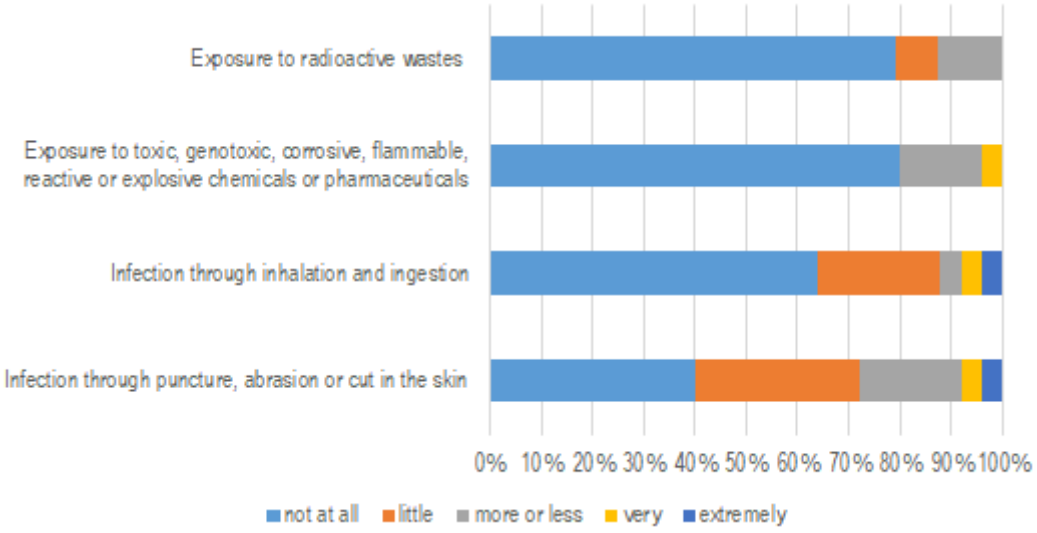



Figure 18: Health impacts on HCWM in selected HCFs in Kenya. Source: Compiled by the authors through field data, 2021

In terms of vulnerability, the most vulnerable group is the health care workers who handle the waste (janitors, cleaners), followed by the support staff in HCFs and then the medical doctors and nurses. The HCWM administrators and officers were also aware that waste handlers had encountered needle-stick injuries over the past 12 months during work hours and that the types of injuries sustained included deep injuries, superficial skin injuries, and splashing, according to the answers given by the health centre managers. However, many HCFs did not keep logs for any injuries or HCW contamination suffered by their staffs, and the majority of HCFs did not provide health insurance for their waste management officers.

In addition, improper HCWM can lead to water and soil contamination, air pollution from aerosol-generated activities, incineration and volatile chemicals, and environmental pollution and community health risks due to improper waste disposal and specimen handling and transportation (Figure 16). The assessment revealed that good segregation practices were limited and that most hospital departments mixed their waste. The lack of segregation practices coupled with lack of colour-coded bags, poor labelling practices and inadequate provision of bins for waste containment encouraged the mixing of waste. The use of substandard transport facilities (mainly wheelbarrows) also encouraged the spillage of waste, which only exacerbated the situation, as spilled waste creates the potential for injury and infection. During the assessment, it was clear that most waste disposal and storage areas were not secured to prevent unauthorized entry.

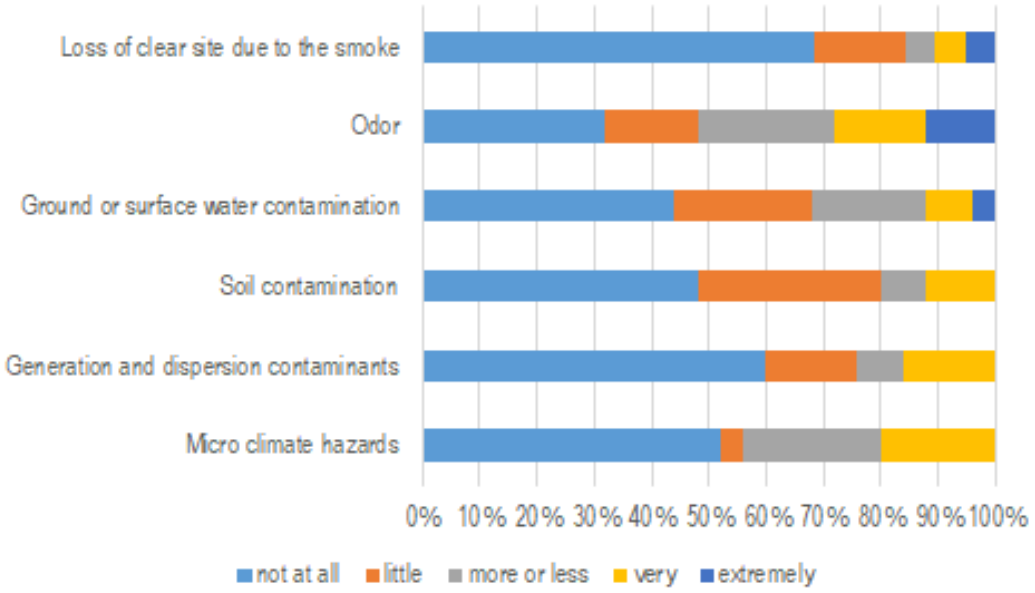



Figure 19: Environmental impacts on HCWM in selected HCFs in Kenya. Source: Compiled by the authors through field data, 2021

It is apparent therefore that health and safety at the workplace and environmental awareness are crucial responsibilities that must be borne by all, in the interests of all (Table 21). Although most HCFs in Ethiopia and Kenya do not provide regular training programmes on proper HCWM for their staff, awareness of the danger of disease transmission from infectious waste among health workers led to increased demands for the provision of personal protective equipment (PPEs) for waste handlers; in particular, use of gumboots for foot protection and heavy-duty gloves for hand protection was common. However, the provision of respirators or facemasks, overalls, helmets, and plastic goggles for eye protection was poor. Further, the need to use PPE has failed to be internalized among the expected users – in most waste treatment sites where respirators or goggles were available to waste handlers, most of the waste handlers did not use them, or only used them upon noticing visitors.

Table 21: Risk management and Occupational Safety and Health in selected HCFs in Kenya

| Description | Average |
|---|---|
| **Are infectious waste spills reported?** | 37% |
| **Is there a written infectious waste spill response procedure or plan?** | 22% |
| **Is there a standard clean-up kit available for infectious waste spills?** | 41% |
| **Is there an inventory or report for the chemical equipment (waste) such as mercury containing medical devices, and how do you manage such waste?** | 8% |
| **What measures are taken to mitigate health risks and medical accidents of the workers who handle waste?** | Training, PPEs, Vaccination |
| **List the types, condition, and quantity of Personal Protective Equipment (PPE) available.** | Overalls, helmets/caps, masks, gumboots, gloves, and aprons/lab coats during transportation and disposal of waste |

| | |
|---|---|
| **Mixing of other wastes with sharps** | 9% |
| **Does the facility have a dedicated and well-designed primary storage place?** | 68% |
| **Have you been exposed to puncture from disposed sharps?** | 18% |
| **Do you know a person exposed to puncture from disposed sharps?** | 14% |
| **Fulfil standardized use of safety wear for cleaning staff (heavy duty gloves, aprons, boots, etc.)** | 74% |
| **Does your health-care centre cover your health costs?** | 48% |
| **Does your health-care center cover the health costs of your family?** | 35% |
| **Have you noticed smoke during waste incineration?** | 25% |
| **Where is the ash from incineration disposed of in your health-care centre?** | Dumping |
| **Do you remember any time you were sick due to poor solid waste management?** | 5% |
| **Do you work shifts?** | 29% |
| **Is regular training provided for the staff dealing with waste?** | 70% |
| **Who is responsible for training?** | Doctor, facility waste manager officer, manager, supervisor, Ministry of Health at sub-county level |
| **What training did you receive? List topics, frequency of training, duration of training, target audiences.** | Themes: waste management; infection prevention; safety during handling waste |

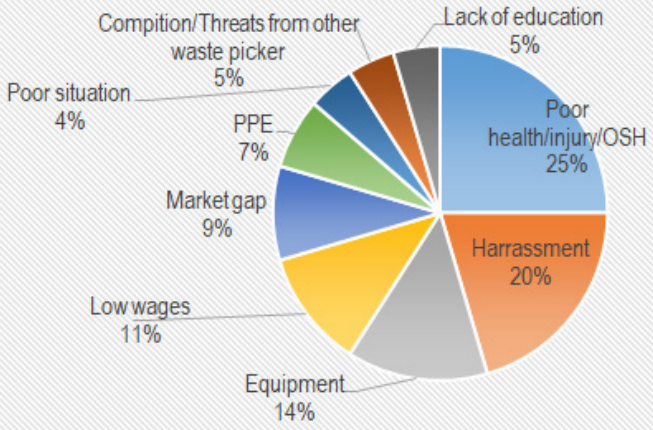
Source: Compiled by the authors based on the sample survey in 2021

## 4.2 Health risks among other stakeholders

### 4.2.1 Informal sector (Waste pickers)

As shown in Table 22, many health risks and concerns were reported by the informal sector, which were related to improper HCWM. From the survey responses, it was found that most waste pickers are concerned about the health and environmental risks caused by mismanaged HCW, such as being cut by sharps, poor working environments (poor OSH), and open dumping of HCW, which means that activities such as salvaging items for resale or even retrieving food waste for consumption put this group at the most risk. A lack of equipment (tools for waste collection) and PPE as well as harassment, low income, low market rates for recyclables, competition, and lack of education were reported as the priority challenges for waste pickers. Waste pickers noted the need to promote higher prices for recyclables, to cease exploitation on the part of the buyers, to secure hospital insurance, to provide recycling training, to procure wheelbarrows and carts for transport of collected recyclables and to develop an accessible loan, such as through the Saving and Credit Cooperative Organization (SACCO) for loans in Kenya. The communities highlighted the importance of awareness raising activities and programmes on HCWM such as through government signposts, TV advertising, and print and electronic media messaging aimed against use of single use of plastics, etc.

Table 22: Risks and concerns on HCWM for waste pickers in Kenya

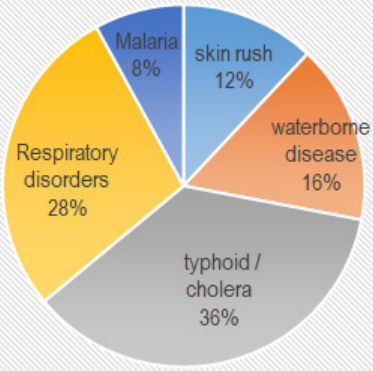
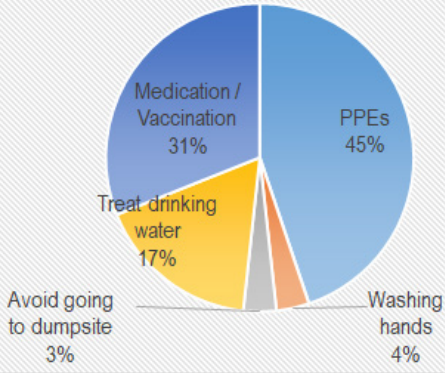
| Description | Response |
|---|---|
| **Presence of health concern** | 86% |
| | COVID-19; cholera; injuries causing breathing issues; risk of tetanus; upset stomach; sharps cut injuries; need for frequent vaccinations; infection from pricks and cuts |
| **Presence of risk (incidents, accidents, etc.) during waste collection** | 100% |
| | Cut by sharps (metal, glass, etc.); municipal police; tearing of PPE; encounter with city askari |
| **Presence of impacts, concerns & risks on HCWM from economic aspect** | 38% |
| | HCW dumped at dumpsites; missed work due to sickness; water contamination from waste; open dumping; drug abuse caused by availability of needles in streets |
| **Presence of concerns on environmental pollution** | 50% |
| | Cholera; dumping of HCW at dumpsites; dumping of infectious waste; odour and smoke; haphazard waste item dumping |
| **Measurements to mitigate health risks and medical accidents of workers** | Proper training and vaccinations; PPE; exercising extra caution |
| **Top-3 priority challenges in the business** |  |
| **Priority opportunities in the business** | Better prices for recyclables; ending of exploitation by buyers; hospital insurance; recycling training; wheelbarrows and carts for transport; formation of Saving and Credit Cooperative Organization (SACCO) for loans |
| **Training** | • Current trainer: Waste collector or leader of waste pickers<br>• Existing training: First aid; proper waste handling; proper sorting; procedures in case of accidents or incidents<br>• Expected training: Waste separation methods; First Aid; infection prevention; waste handling methods; waste disposal |

Source: Compiled by the authors based on the sample survey in 2021

## 4.2.2 Public (Nearby Communities)

Members of communities living close to HCFs also reported the existence of economic impacts, concerns and risks such as income loss, sickness preventing work, adverse health of children, high cost of HCF, damage to farms, and loss of conducive living environment, etc., as summarised in Table 23.

Table 23: Risks and concerns on HCWM of nearby communities interviewed in Kenya

| Description | Response |
|---|---|
| **Any environmental change in the last 10 years (air, water, soil, etc.)** | 94% |
| **Any concerns about environmental pollution** | 94% |
| **Any health issues caused by pollution** |  |
| **Any economic impacts, concerns & risks** | 35% (Income loss; inability to work due to sickness; poor child health; high cost of HCF; damage to farms; recycling centre built (positive aspect); loss of conducive living environment |
| **Any messages regarding pollution caused by the government or operator?** | 21% (government signposting; TV adverts; print and electronic media messaging against use of polythene bags) |
| **Any protests against the government and SWM in the city? When and what for?** | 3% (Protest to improve sanitation in the area) |
| **If so, any reaction from the government or operator?** | 6% (Clean up done by city council though not with sufficient regularity) |
| **Mitigation measures against health risks** |  |

Source: Compiled by the authors based on the sample survey in 2021

## 4.3 COVID-19 pandemic and handling emergencies

As with other developing countries, both Ethiopia and Kenya have faced significant challenges in managing HCW under COVID-19 due to limited capacities, knowledge gaps, deficient infrastructure, and lack of resources. Amid COVID-19, while there is little reliable and accurate data on HCWM available in either country, a few studies have indicated increased rates of waste generation. An average daily HCW generation rate of 1.88 kg/bed/day was reported for Tepi General Hospital in Ethiopia in July 2020, which is higher than the rates revealed by the studies conducted on Mizan-Tepi University Teaching Hospital and Adama Referral Hospital, Ethiopia, which were 0.164 kg/bed/day and 1.23 kg/bed/day, respectively (Hayleeyesus and Cherinete, 2016; Meleko and Adane, 2018). The higher waste generation rate found through the current study could be attributed to the COVID-19 pandemic. As the unprecedented increase in HCW volumes continues to exert pressure on waste collection, transport, treatment and disposal systems, both countries have exerted efforts, including the introduction of new policies, regulations and tools (Box 5).

### Box 5: COVID-19-specific policies and tools in Ethiopia and Kenya

**1. Ethiopia**

- Following the first case of COVID-19, the Government issued an Emergency Proclamation for Response to the COVID-19 Pandemic. The Council of Ministers then issued a Regulation that enforced implementation of the Proclamation and the MoH established and strengthened the Public Health Emergency Operations Center (PHEOC). Several teams were formed, such as related to risk communication and community engagement, case management, surveillance and rapid response, as well as infection prevention control, and the WASH team. Case identification, contact tracing, isolation and quarantine are the actions being taken to contain the spread of the disease. Case management has been put in place to mitigate the damage caused by the pandemic, in addition to the preventive measures which mainly promote social distancing, infection prevention and control, including proper hand washing measures and mandatory use of facemasks by the public.
- The Federal Ministry of Health prepared a national guideline and the National Comprehensive Covid19 Management Handbook in April 2020 to standardize the response in accordance with protocols recommended by WHO and the African CDC. Several publications and standard operating procedures were issued by the MoH. Cognizant that COVID 19 is a novel virus with disease pathogenesis and treatment options changing periodically, the MoH revised the first edition of the COVID 19 Clinical Management Handbook in September 2020 to incorporate updated and new recommendations.
- The Ministry of Health had issued a total of 30 updated directives (as of the time of report compilation), available on the Ministry's website, including Standard Operating Procedures for Preparation of Commonly used Disinfectants and Fumigants against Coronavirus (SARS-CoV-2), COVID-19 Clinical Management Pocket Book, Infection Prevention and Control Interim Protocol for COVID-19 In Health Care Settings in Ethiopia, National capacities review tool for the novel coronavirus (nCoV), Ethiopian health care facility COVID-19 preparedness and response protocol, Protocol for transporting COVID-19 patients, COVID-19 Prevention and Control Quarantine, Laboratory testing and Border Control Implementation Guide, COVID-19 Prevention and Control Quarantine and Border Control Protocol, among others.
- Regarding Health care waste management, SOP and guidelines were developed and training was

provided for responsible human resources in charge of health care waste management. Resources were mobilized from government and non-government organizations, including the private sector. Guidelines and SOP were distributed to quarantine, isolation and treatment centres. Dialogs were held with related organizations and agencies in charge of waste management. A technical working group was established drawing on universities, MoH and the Ethiopian public health Institute, and a series of consultations were conducted. Training and PPE were provided for waste handlers. Wastes were properly segregated and buried in temporary pits ready for treatment. Incineration of wastes was done in treatment centres. COVID-19 wastes were treated as infectious and separately managed.

**2. Kenya**

- Following the outbreak of COVID-19, National Environment Management Authority (NEMA) developed guidelines (NEMA, 2020) for the sustainable management of waste, focusing on biomedical waste. The provisions of the guidelines relate to segregation of biomedical waste, and securing, packaging, storage and disposal of all generated medical waste within the country, to ensure a clean and healthy environment for all. Most of the items targeted were single-use types, such as face masks, surgical gloves, sanitizer bottles, soap bottles and other related medical waste, which could pose both cross-infection and environmental risks.
- The Ministry of Health also reacted swiftly by sustaining the development of COVID-19 protocols and guidelines in response to the emerging pandemic. The first policy intervention was to issue National 2019 Novel Coronavirus Contingency Readiness and Early Response Plan February–April 2020. This was followed by over 80 others, which are available on the Ministry's website, such as the Guidance on Rational Use of PPE, 2020, Guidance for infection prevention and control for COVID-19 in homes and residential communities 2020, the Infection Control and Waste Management Plan, 2020, Interim guidelines for human resources for health during COVID-19, Interim Guidelines on Human Resources for Health during Covid-19, 2020, Interim guidelines for health and safety in the workplace, Guidance on use of face masks and gloves for the general public and the Protocol for management of restaurants and eateries.

Source: Compiled by the authors, 2021

# 5. Challenges and opportunities for greening of health infrastructure

## 5.1 National and local authorities

Both Ethiopia and Kenya have developed policies, strategies, plans and guidelines to promote proper HCWM. The most urgent issues for national and local authorities as regulators are how to enforce such regulations and monitor the compliance of operators such as HCFs and private HCWM companies, as well as how to monitor communities that may be affected by inadequate HCWM practices. Strengthening the enforcement and monitoring system, as well as adequate budget allocation, are also reported to be the main challenges faced by national authorities. On the other hand, national authorities have exerted efforts into securing additional budgets in collaboration with international partners and private sector involvement through Public Private Partnerships (PPPs) and Public-Private Dialogue (PPD).

Since the questionnaire survey for authorities found that there are limited activities and initiatives aimed at promoting green health infrastructure with respect to HCWM, relevant programmes should be developed to fill this gap. Despite the presence of several national strategies and plans addressing HCWM in Kenya, there is a lack of comprehensive, overall HCWM strategy or plan in Ethiopia. Such overarching strategy or plan needs to be developed in accordance with the volume of HCW generated, the level of urbanization, location of hospitals, stakeholder mapping to manage HCW regionally and locally, and the funding opportunities mentioned above.

These strategies should also include promotion of centralized or decentralized HCWM systems, strict control of taxes and penalties, involvement of the private sector where appropriate, and comprehensive HCWM in collaboration with vertical and horizontal stakeholders to promote sustainable HCWM systems in the context of green health infrastructure in both countries. In addition, the HCWM manifest system needs to be enhanced through instruction from national and local authorities. This should include development of guidance or guidelines with due enforcement aimed at HCW generators and HCWM companies.

## 5.2 Health care facilities

Proper source separation in HCFs is one of the key principles of sustainable HCWM. The lack of segregation results in environmental and health risks for various stakeholders, including health care staff, janitors, and waste management officers within HCFs as well as outside of HCFs, such as workers in HCWM companies, nearby communities and waste pickers. Most HCFs use colour bins in compliance with the recommended protocol formulated by national authorities, but many HCFs that mix sharps with other waste were observed. Limitations were also noted in relation to the temporary HCW storage, collection and transportation systems investigated.

Despite the presence of guidelines in both countries that outline identifying storage areas for waste prior to treating or moving it, storing waste in specified areas with restricted access, and use of signage for storage areas using the biohazard symbol, most HCFs do not comply with these guidelines and areas are easily accessible for anyone, even animals. In addition, some HCFs identified that temporary storage areas are insufficient for the storage of all HCW generated in HCF, thus stored HCW causes overflows and remains for extended periods of time, which has a big impact on public health. Furthermore, some HCFs reported that accessibility to storage areas for vehicles to load HCW for transportation to treatment and disposal sites is low due to the poor access road conditions as well as location.

The lack of adequate equipment for waste collection such as a transport carts is another issue to be addressed.

In addition, only half of HCFs had established waste management committees with a member of facility management, medical staff or waste management. Establishment of waste management committees at HCFs should be encouraged, and proper planning of HCWM should be discussed among all stakeholders in HCFs through such committees. In addition, consideration of green health infrastructure including 3R, climate change, resource efficiency, circular economy, green building, PPP/SME, green procurement, and green facilities is neglected in most HCFs, thus raising of awareness on such topics at HCFs is needed through sharing of good practices conducted domestically or from other countries. Most HCFs identified challenges in off-site transportation services and highlighted the importance of the manifest system. Most HCFs used incinerators for waste treatment, but none of them function adequately. A comprehensive strategy to discuss centralized or decentralized HCWM systems, private sector involvement and criteria on selection of green technologies according to the amounts of HCW generated, as well as technical and financial capacities of HCFs is therefore needed.

Many HCFs have confirmed that relevant manuals or procedures to manage the spillage of liquid waste do not exist and that such incidents are reported regularly. A regular training programme dealing with HCWM for both management and operations-level staff is therefore required, and such should include waste segregation, packaging, labelling, transportation, handling of infectious waste, IPC during waste management, disaster management, and proper usage of PPE. Such trainings can be implemented via training of trainers (ToT), including managers, administrators, IPC Team, infection prevention officers, doctors-in-charge, CME chairpersons, and/or waste administrators, all of whom are staffs within HCFs. These training programmes must include current policies and regulations, best practices on HCWM systems implemented in other HCFs in addition to the training topics, and vice versa; this can also contribute to enforcement of regulations by the authorities. As for the gender balance, women were significantly dominant in the categories of nurse, administration staff, and janitor.

## 5.3 HCWM companies

HCWM companies provide waste management services that include collection, transportation, and treatment of HCW based on agreed fees. According to the questionnaire survey, the top priorities of these service providers are poor waste segregation at source, and high operational costs (transport fuel and license fees) in the handling of HCW. In addition, the poor road conditions for treatment and disposal facilities, traffic jams, and inaccessibility of HCW storage areas in HCFs are also identified as their challenges. The service providers also identified the issues of municipal council harassment related to licensing or certificate matters, and difficulties in complying with regulations and standards.

Any future policies and programmes on HCWM need to consider such challenges in order to strengthen private sector involvement for proper HCWM. Most companies are concerned about the environment, health, social and economic impacts caused by mismanaged HCW. However, as with other stakeholders, most HCWM companies have taken no initiatives or activities in green health infrastructure, except for small-scale recycling activities and promotion of solar power.

## 5.4 Informal sector (Waste Pickers) / Public (Community)

Most waste pickers and nearby communities are concerned about the health and environmental risks caused by mismanaged HCW, such as being cut by sharps, poor working environments (poor OSH), and open dumping. Harassment and threats from other waste pickers and officials, the lack of equipment for waste picking (PPE and carts for transportation), and low wages were identified as the key challenges faced by waste pickers. To improve the situation, they recommend support mechanisms such as higher prices for waste collection and recycling, preventing the exploitation exerted by buyers, securing hospital insurance, provision of more opportunities for training on recycling, and allocation of equipment such as wheelbarrows and carts

for transport. Policies and activities on safeguarding the more vulnerable groups such as waste pickers are necessary, as they could play an important role in promoting proper HCWM.

The nearby communities reported that there are economic impacts, concerns and risks such as income loss, ill health preventing work, poor child health, high cost of HCF, damage to farms, and loss of conducive living environment due to mismanaged HCW. They highlight the importance of awareness activities and programmes on HCWM such as installation of government signage, TV adverts, and print and electronic media messages aimed at preventing pollution caused by mismanaged HCW and heavy use of single use plastics, etc. Conversely, some useful programmes aimed at waste pickers and communities have been introduced, namely micro finance programmes (Saving and Credit Cooperative Organization (SACCO) in Kenya) and training programmes for waste pickers coordinated by authorities with use of resources of private companies (HCWM companies, etc.). Such initiatives are beneficial, thus stakeholder involvement activities and collaborations need to be expanded and duplicated across the country.

Table 25 summarizes key challenges from the environmental, health, social, economic, technical and financial aspects.

Table 23: Risks and concerns on HCWM of nearby communities interviewed in Kenya

| Aspect | Challenges |
|---|---|
| **Environment** | **(On site, HCF)**<br>• Vulnerable storage area (small, no warning sign, not locked, accessible to animals, etc.)<br>• Poor risk management (no manual for infectious spills, no clean-up kits for infectious spills, no detailed information on chemical equipment)<br>• Smell and odour generated from waste remaining in storage area for too long<br>• Pollution from open burning and spillage of liquid waste<br>• Surface water contamination, loss of aesthetic appeal<br>• Low activities in 3R, climate change, renewable energy, circular economy, green building, green procurement, green facilities and gender. |
| | **(HCWM company)**<br>• Poor waste segregation and 3R activities<br>• Certain practices, in which waste collected from HCFs is transported to dumpsites<br>• Lack of system for waste spill response procedures and standard clean-up kits<br>• Lack of manifest system<br>• Little action related to climate change and renewable energy, circular economy<br>• No policies or activities on green procurement, green buildings, and green facilities/infrastructure policy |

| | |
|---|---|
| | **(Community, waste picker)**<br>• Lack of training on recycling<br>• Open dumping of HCW at dumpsites<br>• Odour and smoke<br>• Water contamination from waste<br>• Haphazard item dumping (94% of community residents are concerned about environmental pollution) |
| **Health** | **(On-site, HCF)**<br>• Infection through puncture and inhalation<br>• Injury during waste collection<br>• Exposure to toxic vapours (smoke released from the combustion chamber, presence of toxic gases during combustion, acid rain produced by the gasses)<br>• Noise from disposal facility<br>• High water contamination<br>• Low health insurance coverage by HCF<br>• Insufficient training provided for waste management staff |
| | **(HCWM company)**<br>• Providing training on HCWM for staff |
| | **(Community, waste pickers)**<br>• Poor health and OSH<br>• Injuries and risk of diseases (cholera, tetanus, COVID-19, HIV, breathing issues)<br>• Lack of PPE, stomach upsets, sharps injuries, etc.<br>• Lack of hospital insurance<br>• Dumping of HCW at dumpsites<br>• Community concerns related to HCW: typhoid/cholera (36%), respiratory disorders (28%), waterborne diseases (16%), skin rashes (12%), malaria (8%) |
| **Social** | **(On-site, HCF)**<br>• Smoke from the hospital generated during waste treatment<br>• Dogs feeding on human tissue<br>• Bad odour when waste remains uncollected (complaint from neighbouring community to HCF)<br>• Little action regarding gender balance<br>• Open burning practised near the school |
| | **(HCWM company)**<br>• No gender-related activities<br>• Concerned about municipal council harassment |

| | |
|---|---|
| | **(Community, waste pickers)**<br>• Harassment, poor situation, threats from other waste pickers, municipal police, encounters with city askari<br>• Lack of education<br>• Tearing of PPE<br>• Availability of needles in the streets which has caused drug abuse |
| **Economic** | **(On-site, HCF)**<br>• No relevant policies or activities aimed at green facility/infrastructure (e.g., transportation data (fuel use), potential for energy saving in the facility, green spaces for patients, membership in green health hospitals, etc.)<br>• Health issues caused by pollution impeding income generation ability of individuals |
| | **(HCWM company)**<br>• Expensive fuel, traffic jams, high license fees |
| | **(Community, waste pickers)**<br>• Market gap for recyclables<br>• Becoming sick and unable to work (income loss, too sick to work, children's ill heath, high cost of health care)<br>• Damage to farms<br>• Loss of conducive living environment |
| **Technical** | **(On-site, HCF)**<br>• Improper on-site incineration (air pollution)<br>• Open collection points with hazardous waste<br>• Waste remaining too long and not collected on time |
| | **(HCWM company)**<br>• Extra care needed in handling |
| | **(Community, waste pickers)**<br>• Lack of equipment (wheelbarrows, carts for transport, etc.) |
| **Financial** | **(On-site, HCF)**<br>• Health costs not factored in by waste administrator<br>• Securing budgets to contract with HCWM companies |
| | **(Community, waste pickers)**<br>• Low wages/higher prices for recyclables (average salary: 6,308 KSh), Exploitation by buyers |

Source: Compiled by the authors based on the sample survey in Kenya in 2021

# 6. Conclusions

As a result of carrying out the present study, it was found that neither Ethiopia nor Kenya had comprehensive, systematic green health infrastructure strategies, including HCWM strategies. HCWM strategies therefore should be developed in accordance with the volumes of HCW generated and the level of urbanization, location of the hospitals, stakeholder mapping to manage HCW regionally and locally, and any existing funding opportunities. The strategies should include promotion of centralized or decentralized systems, strict control of taxes and penalties, involvement of the private sector, and comprehensive HCWM based on the concept of green health infrastructure in collaboration with vertical and horizontal stakeholders to promote sustainable HCWM systems in Ethiopia and Kenya, as well as other African countries.

## Environmental and Health aspects

Source separation in consideration of green procurement should be enhanced, such as through use of the 3R concept, in particular in reducing plastic pollution, and use of organic waste composting for HCF gardens to promote natural spaces in HCFs. Improvement of storage areas for HCW in HCFs should be a top priority, such as through strict management by authorized staff and designating areas that are easy and safe to access for transportation vehicles, which contributes to shorter durations of waste storage in storage areas and more efficient transportation of HCW. SOP with the necessary kits (standard set of PPE and first aid kit) and reporting system on accidents or incidents associated with HCWM for all officers in charge within HCFs should be developed or improved. HCWM should be integrated into the disaster management and emergency plans at HCFs and national levels.

## Technical aspects

Due to the lack of technical options and capacities for HCWM regarding incinerators, applicable HCWM technologies in Ethiopia and Kenya should be reviewed, including conducting feasibility studies towards a sustainable HCWM system. In addition, capacity mapping on HCWM at district and municipal levels should be conducted to identify gaps such as in HCW treatment capacities (by major hospitals equipped with HCW treatment facilities on-site, or licenced HCWM companies) in each district or municipality for further evaluation of the necessary HCWM technologies and systems. The criteria used for such evaluations could include the possibility of centralized or decentralized systems, based on regional or local HCWM capacities, as well as the existence of licensed HCWM companies regionally or locally. In addition, incorporation of alternative energy use and the option to reduce energy use with energy recovery to promote sustainable HCWM systems in line with green health infrastructure can be considered. From this aspect, incentives aimed at HCWM companies to promote proper and environmentally friendly HCWM should be also discussed by authorities, such as through the establishment of award systems for excellent companies, reduction of license fees, and tax exemptions.

## Economic and Social aspects

The procurement of local goods based on the green procurement policy could be recommended and at the same time, involvement of communities and waste pickers to promote recycling and improve their living and working environments can be considered. Some HCFs reported that they prioritize involvement and collaboration with nearby communities, such as in employment, organizing community events to raise awareness of HCMW and other topics such as HIV and family planning to promote social cohesion. HCWM awareness and training should be regularly provided to all stakeholders, such as waste management officers in HCFs and the private sector as well as communities

and informal sectors including waste pickers. Therefore, a comprehensive and strategic awareness and training programme including a trainer's training programme should be developed and promoted by authorities locally, regionally and nationally. The authorities can also consider the involvement and participation of the private sector to use its facilities to train waste pickers. According to the questionnaire, the topics of training and awareness programmes such as vaccination, PPEs, biohazard symbols, disposing waste, first aid, proper waste handling, proper sorting, and how to handle waste with infection prevention, are recommended. As the green health infrastructure concept and initiative are not well known in most HCFs, training or awareness programmes to promote the concept and initiative (e.g., transportation data (fuel use), potentials for energy saving in the facility, green spaces for patients, any membership on green health hospitals) should be provided. Those activities can be enhanced through leadership by national and local authorities strategically and comprehensively to raise awareness on waste management, recycling and plastic pollution issues as well as green health infrastructure, through a variety of channels such as government signposts, television and radio advertisements, SMS, and print and electronic media messages.

## Financial aspects

Each HCF, according to the 'polluter pays' principle, should be financially liable for the safe management of HCW. HCWM budgets should be integrated into the annual operational plan budget at all levels, including national, county and facility levels. A national framework to promote PPPs in providing HCWM should be introduced, which would also support the creation of new business models for HCWM in partnership with private and informal sectors. Activities in one organization known as SACCO in Kenya were introduced in the questionnaire survey. This organisation brings people together as members to arrange funds for individuals to borrow and provides guarantee to each other. This type of financial model can be highlighted and introduced to the informal sector, including waste pickers, to accelerate formalization of their activities as well as provide a means of possible business development towards contributing to sustainable HCWM.

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