KASHISH DAS SHRESTHA FOR USAID

SECTOR ENVIRONMENTAL GUIDELINES
HEALTHCARE WASTE

Full Technical Update, 2019

DISCLAIMER: This report is made possible by the support of the American People through the United States Agency for International Development (USAID). Kestrel Tellevate, The Cloudburst Group, and ICF prepared this report under USAID's Environmental Compliance Support (ECOS) Contract, Contract Number GS00Q14OADU119, Order No. 7200AA18N00001. ECOS is implemented by ICF and its subcontractors. The contents of this report are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

On the Cover: *Nepal 2015.* A hospital nurse and her team of nurses responded quickly to the medical needs of injured citizens after the magnitude 7.8 earthquake in April 2015. Doctors and nurses at the hospital treated approximately 700 patients and performed 300 surgeries within the first 24 hours of the natural disaster.

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ABOUT THIS DOCUMENT AND THE SECTOR ENVIRONMENTAL GUIDELINES

This document presents one sector within the Sector Environmental Guidelines (SEGs) prepared for USAID under the Agency's Global Environmental Management Support (GEMS and GEMS-II) Program and Environmental Compliance Support (ECOS) Contract. All SEGs are accessible at:
USAID. 2019. *Sector Environmental Guidelines & Resources.*
https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.

Purpose. The purpose of the SEGs is to support environmentally sound design and management of common USAID sectoral development activities by providing concise, plain-language information regarding:

- The typical, potential adverse impacts of activities in these sectors;
- How to prevent or otherwise mitigate these impacts, both in the form of general activity design guidance and specific design, construction, and operating measures;
- How to minimize the vulnerability of sector activities to climate change; and
- More detailed resources for further exploration of these issues.

Environmental Procedures. USAID's mandatory environmental procedures, as described in Automated Directives System (ADS) 204, require that the potential adverse impacts of USAID-funded and managed activities be assessed prior to implementation via the Environmental Impact Assessment (EIA) process defined by Title 22, Code of Federal Regulations, Part 216 (22 CFR 216 or Reg. 216). They also require that the environmental management/mitigation measures identified by this process be written into award documents, implemented over the life of projects, and monitored for compliance and sufficiency.

The procedures are USAID's principal mechanism to ensure environmentally sound design and management of USAID-funded activities and, thus, to protect environmental resources, biodiversity, ecosystems, ecosystem services, and the health and livelihoods of beneficiaries and other affected groups. These procedures strengthen and sustain development outcomes and help safeguard the good name and reputation of USAID.

The SEGs directly support environmental compliance by providing information essential to assessing the potential impacts of activities and helping identify and design appropriate mitigation and monitoring measures, as necessary and appropriate based on capabilities. However, they are not specific to USAID's environmental procedures. They are generally written and are intended to support the EIA of these activities by all actors, regardless of the specific environmental requirements, regulations, or processes that may apply.

This document serves as an introductory tool to Agency staff and Implementing Partners dealing with healthcare waste within projects, programs, and activities. This document is not intended to act as a complete compendium of all potential impacts, as contextual information is critical to determining those impacts. Further, SEGs are not a substitute for detailed sources of technical information or design manuals. Users are expected to refer to the accompanying list of resources and references for additional information, as well as other resources not included in this document. Related cross-cutting guidelines and resources may also be found in the following SEGs: *Construction*, *Small Healthcare Facilities*, *Solid Waste*, *Water Supply and Sanitation*, and *Livestock*.

USAID Guidelines Superseded. This Healthcare Waste SEG (2019) replaces the Healthcare Waste SEG (2015).

Comments and corrections. Each SEG is a work in progress. Comments, corrections, and suggested additions are welcome. Email: environmentalcompliancesupport@usaid.gov.

Advisory. The SEGs are advisory only. They are not official USAID regulatory guidance or policy. Following the practices and approaches outlined in the SEGs does not necessarily ensure compliance with USAID environmental procedures or host country environmental requirements.

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ACRONYM LIST

ADS	Automated Directives System
AOR	Agreement Officer's Representative
BEO	Bureau Environmental Officer
CDC	Centers for Disease Control and Prevention
CEMS	Continuous Emission Monitoring System
CFR	Code of Federal Regulations (e.g., 22 CFR 216)
COR	Contracting Officer's Representative
ECOS	Environmental Compliance Support Contract
EIA	Environmental Impact Assessment
EMMP	Environmental Mitigation and Monitoring Plan
FAA	Foreign Assistance Act
FEFO	First-Expired-First-Out
FP/RH	Family Planning/Reproductive Health
GEMS	Global Environmental Management Support Program
GHG	Greenhouse Gas
GHS	Globally Harmonized System
GHSA	Global Health Security Agenda
HEPA	High-Efficiency Particulate Air
HCV	Hepatitis C Virus
HCW	Healthcare Waste
IEE	Initial Environmental Examination
IETC	International Environmental Technology Centre
IP	Implementing Partner
IPC	Infection Prevention Control

ACRONYM LIST – CONTINUED

ISWA International Solid Waste Association

IWMP Integrated Waste Management Plan

MSDS Material Safety Data Sheet

MCH Maternal and Child Health

MEO Mission Environmental Officer

MDR TB Multi-Drug Resistant TB

NEPA National Environmental Policy Act

NGO Non-Governmental Organization

NTD Neglected Tropical Diseases

OECD Organization for Economic Cooperation and Development

PAD Project Appraisal Document

PDCA Plan-Do-Check-Act

PEPFAR U.S. President's Emergency Plan for AIDS Relief

PET Polyethylene Terephthalate

PMI President's Malaria Initiative

POP Persistent Organic Pollutant

PPE Personal Protective Equipment

REA Regional Environmental Advisor

RTK Rapid Test Kit

TB Tuberculosis

SDS Safety Data Sheet

SBCC Social and Behavior Change Communication

SEG Sector Environmental Guideline

SOP Standard Operating Procedure

ACRONYM LIST – CONTINUED

USAID	United States Agency for International Development
VMMC	Voluntary Medical Male Circumcision
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WMP	Waste Management Plan
XDR	Extensively Drug Resistant TB

1. USING THESE GUIDELINES

The primary intended audience for this Guideline is USAID Project Design Teams, Agreement Officer's Representatives/Contracting Officer's Representatives (AORs/CORs) and Implementing Partners (IPs). The secondary intended audience consists of other USAID staff with design, monitoring and evaluation, and environmental compliance responsibilities; and other actors involved in the design, implementation, and monitoring of development activities in the healthcare sector. Brief recommendations on the use of the guidelines for these user groups are provided below.

AGENCY TECHNICAL OR PROGRAM OFFICE STAFF who are designing or providing technical expertise to colleagues and missions on health projects and activities may find Sections 2–6 most useful. These sections establish the framework for healthcare waste (HCW) management for USAID actions, including typical types of wastes, potential negative environmental impacts, and climate change considerations. Staff may also benefit from using the Annexes when supporting or evaluating health interventions.

PROJECT DESIGN TEAMS, AORS/CORS, AND ACTIVITY MANAGERS must work together with their IPs to address HCW management throughout the project lifecycle, from project planning and procurement through disposal and closeout. They can use all sections of this SEG to help guide them through these processes and to ensure HCW management systems are developed and implemented to suit the size, scope, and complexity of their programs. In particular, the discussion of the Integrated Waste Management Plan (IWMP) template in Section 6 can help guide these stakeholders in determining if their IPs have adequately considered and prepared for HCW issues.

IN-COUNTRY AND REGIONAL MISSION STAFF, such as in-country Activity Managers, Mission Environmental Officers (MEOs), and Environmental Compliance Officers, will find Sections 2–6 useful for project and activity design, including key elements to address in Initial Environmental Examinations (IEEs). Section 7 and Annex 4 will be most useful for oversight of IPs in planning, monitoring, and reporting on environmental mitigation measures during project implementation. These users may likely benefit from the IWMP template guidance in Section 6 in their oversight capacity as well.

IPs will benefit from the project and activity guidance design provided throughout the SEG, especially the mitigation and monitoring elements of Section 7, as well as the tools provided in the Annexes. This guidance may be useful at various stages, including the development of work plans, activity planning, and/or development of Environmental Mitigation and Monitoring Plans (EMMPs) and IWMPs. The Resources and References section may also be useful for this group of users, as they search for more assistance with specific issues or locations.

1.1 USER NOTES FOR DEVELOPERS OF ENVIRONMENTAL DOCUMENTS

This SEG is intended to describe the basic elements of sound HCW management to assist with the design and implementation of global health programs, while also providing a list of technical resources and references for further assistance. Developers of environmental documents, such as IEEs, for USAID projects or activities will benefit from referring to this SEG throughout the project lifecycle to improve compliance with applicable environmental requirements. However, document developers should also consult with host country authorities to understand local laws, regulations, and capabilities related to HCW management.

During project planning and design, potential waste streams should be identified and evaluated to adequately consider treatment and disposal requirements and feasibility before conducting any activities, including procurement. Such considerations may effect a change in project design early on to help mitigate environmental impacts before they occur, including minimizing the amount of waste generated and, ultimately, encouraging more sustainable health interventions around the world. Examples of project and activity design elements related to healthcare programs, as well as how to safely and effectively mitigate potential impacts, are discussed in further detail in Section 6, Section 7, and Annex 4.

2. THE POLICY CONTEXT AND USAID PROGRAMMING IN HEALTHCARE

USAID invests in projects to improve healthcare in developing countries around the world. Such projects are controlled by international, domestic, and Agency-specific agreements, guidelines, regulations, and policies in order to ensure environmental impacts are minimized and projects are sustainable. Key examples are referenced below. Additional resources are available in the Resources and References section.

2.1 INTERNATIONAL CONVENTIONS AND AGREEMENTS

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal – This International Convention is aimed at protecting human health and the environment against the adverse effects of hazardous wastes by controlling the movement of wastes across national borders. Its scope covers a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and characteristics, as well as two types of wastes defined as "other wastes" (household waste and incinerator ash). Parties to the Convention may not import waste from, or export waste to, non-parties, except where a separate agreement exists to govern that transboundary movement. While the U.S. is not yet party to the Basel Convention, it does participate in another legally binding agreement on the transboundary movement of wastes termed the Organization for Economic Cooperation and Development (OECD) Council Decision on the Control of Transboundary Movements of Wastes Destined for Recovery Operations, which is discussed below.

OECD Council Decision on the Control of Transboundary Movements of Wastes – The Council Decision established the OECD Control System, which aims to facilitate the environmentally sound and economically efficient trade of recyclables by establishing two types of control procedures using a risk-based approach. The Green Control Procedure does not establish any controls other than those normally applied in commercial transactions for wastes representing low risk for human health and the environment. The Amber Control Procedure establishes controls for wastes presenting sufficient risk to justify their control. Regardless of whether wastes are on the Green list or Amber list, they will not benefit from simplified control procedures if they are exported outside the OECD area.

Stockholm Convention on Persistent Organic Pollutants – This global treaty is aimed at protecting human health and the environment from chemicals known as Persistent Organic Pollutants (POPs). POPs remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health and the environment. Currently, the Convention controls 22 POPs that fall into three general categories: certain pesticide-related substances, certain industrial chemicals (e.g., polychlorinated biphenyls), and certain unintentionally produced substances (e.g., dioxins and furans). Article 5 of the Convention requires parties to reduce or eliminate release from the unintentional production of POPs, especially dioxins and furans, which are often produced and released into the air as a result of the use of healthcare waste (HCW) incinerators. While the U.S. is not yet party to the Stockholm Convention, which entered into enforcement in 2004, it has signed other POPs-related agreements and supported initiatives for POPs reduction.

Minamata Convention on Mercury – This multilateral environmental agreement is aimed at reducing global mercury pollution over time by controlling specific human activities that contribute to global mercury pollution. Such activities include conducting waste incineration, artisanal and small-scale gold mining, operating coal-fired power plants and coal-fired industrial boilers, manufacturing of mercury-containing products (e.g., batteries, lights, cosmetics, medical devices, and dental amalgams), and other manufacturing operations. The Minamata Convention became legally binding for all its parties on 16 August 2017 after passing the 50-ratification milestone required for it to enter into force. The U.S. accepted the Minamata Convention on 11 June 2013. Of particular relevance to healthcare projects, Article 4 of the convention calls for the phasing out of mercury-containing products and antiseptics, as well as mercury sphygmomanometers and thermometers used in healthcare facilities.

2.2 U.S. GOVERNING FRAMEWORK

Foreign Assistance Act (FAA) of 1961 as amended, Section 117—Environment and Natural Resources – This section requires USAID to utilize an environmental impact assessment (EIA) process to evaluate the potential impact of USAID's activities on the environment prior to implementation, and to "fully take into account" environmental sustainability in designing and carrying out its development programs. It states, "Special efforts shall be made to maintain, and where possible, restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being especially that of the poor."

PEPFAR Strategy for Accelerating HIV/AIDS Epidemic Control (2017–2020) – This Strategy reaffirms the U.S. government's leadership and commitment, through PEPFAR, to support HIV/AIDS efforts in more than 50 countries, ensuring access to services by all populations, including the most vulnerable and at-risk groups.

U.S.G. Global Tuberculosis (TB) Strategy (2015–2019) – This Strategy lays out how the U.S. Government will direct and coordinate its investments in the global fight against TB between 2015 and 2019. Led by USAID and implemented by and involving several agencies, efforts focus on diagnosis, treatment, and control of TB (including multi-drug resistant and extensively drug-resistant TB (MDR/XDR TB)) and on research. The U.S. is also a donor to the Global Drug Facility of the Stop TB Partnership, a global network of public and private entities working to eliminate TB.

President's Malaria Initiative (PMI) Strategy (2015–2020) – The updated PMI Strategy continues efforts begun in 2005 with the goal of malaria eradication. PMI programs, overseen by USAID's U.S. Global Malaria Coordinator and implemented by USAID and Centers for Disease Control and Prevention (CDC), center on expanding coverage of four key high-impact interventions: artemisinin-based combination therapy, intermittent preventive treatment in pregnancy, indoor residual spraying with insecticides, and insecticide-treated mosquito nets.

Global Health Security Agenda (GHSA) – The GHSA was launched in February 2014 and endorsed by the G7 to advance a world safe and secure from infectious disease threats, to bring together nations from all over the world to make new, concrete commitments, and to elevate global health security as a national leaders-level priority. The U.S. contributes to the global effort through USAID, Department of Health and Human Services, CDC, Department of Defense, and others, working with ministries of health, agriculture, environment, and other key stakeholders to detect viruses with pandemic potential, improve laboratory capacity to support surveillance, strengthen national and local capacities to respond in an appropriate and timely manner, and provide education on ways to prevent exposure to dangerous pathogens.

2.3 USAID STRATEGY AND PROGRAMMING

Agency Sustainability Plan – As a part of this Plan, USAID is committed to "pursuing waste management strategies that include reducing, reusing, and recycling." USAID's sustainability program also emphasizes the procurement of "energy efficient and environmentally-preferable electronic products and utilizing sound environmental practices when disposing of those products."

USAID Neglected Tropical Diseases (NTD) Program – The NTD Program began in 2006, primarily focusing on seven diseases—lymphatic filariasis, blinding trachoma, onchocerciasis, schistosomiasis, and three soil transmitted helminths that could be eliminated or controlled through community-wide administration of safe and effective medicines. The donation of pharmaceuticals by companies has enabled USAID to focus its support on distributing these medicines to communities around the world and evaluating progress toward the elimination of these diseases.

USAID Family Planning/Reproductive Health (FP/RH) Program – FP/RH activities encompass a wide range of services with the objective of assisting countries to provide sustainable access to quality voluntary FP/RH services, commodities, and information that enhance efforts to reduce high-risk pregnancies; allow sufficient time between pregnancies; provide information, counseling, and access to condoms to prevent HIV transmission; reduce the number of abortions; support women's rights; and stabilize population growth.

USAID Maternal and Child Health (MCH) Program – MCH activities aim to improve equity of access to and use of services by vulnerable populations; bring to scale a range of high impact interventions that mitigate maternal, newborn, and under-five deaths; prevent and address the indirect causes of such deaths (such as HIV, TB, and malaria); strengthen integration of maternal health services with FP; and strengthen health systems. Additionally, some water, sanitation, and hygiene (WASH) activities are part of the environmental health efforts within the USAID MCH program.

3. OVERVIEW OF THE SECTOR

Small-scale healthcare activities (e.g., rural health posts, immunization posts, reproductive health posts, mobile health clinics, emergency healthcare programs, urban clinics, and small hospitals) provide important and often critical healthcare services to individuals and communities that would otherwise have little or no access to such services. The medical and health services they provide improve family planning, nurture child and adult health, prevent disease, cure debilitating illnesses, and alleviate the suffering of the terminally ill. However, appropriate management of associated wastes from these services and facilities is limited, especially in small-scale facilities in developing countries.

It is common practice in developing countries to dispose of healthcare waste (HCW) along with general solid waste and to bury HCW without prior treatment. Some HCW generators may burn waste in dedicated on-site incinerators but often fail to operate them properly. Others use small-scale incinerators or less effective treatment options, like open burn pits or burn barrels, resulting in toxic air emissions and smoke. Unwanted/expired pharmaceuticals and chemicals may be comingled with general waste or improperly dumped, sometimes into local wastewater systems, including sewage collection systems, septic tanks, or latrines.

Case Study: Spread of Infected Hypodermic Needles in India through Informal Recycling

In 2004, Ramaiah Medical College in Bangalore was considered the best HCW program operating in India. Despite this, it was reported that 9 out of 10 hypodermic needles packaged and sold in Indian drug stores and pharmacies for home use had trace elements of organic materials or chemicals from previous uses, resulting in potential health risks. The high demand for hypodermics at that time created a market for used hypodermics, and informal recyclers (or "waste scavengers") began combing waste dumps for them because they could be sold for a high price. This is one example of how uncontrolled disposal of HCW can create health risks.

(Source: Iyengar, V., and M. R. Islam. 2017. "Biomedical, Sharps and General Waste Disposal in India: Potential for the Spread of Contagious Diseases and Serious Environmental Contamination." *Universal Journal of Public Health*, 5(5): 271-274, 2017 DOI: 10.13189/ujph. 2017.050509. http://www.hrpub.org/journals/article_info.php?aid=6271)

Improper management of HCW poses risks to both the environment and human health. These risks include potential for disease transmission, physical injury, air pollution, soil pollution, water pollution, fish and wildlife impacts, as well social impacts. Lack of resources, infrastructure, and training to properly manage HCW are common in developing countries. It is important for USAID and Implementing Partners (IPs) to take into consideration host country policies, laws, operational norms, and management constraints to integrate feasible waste management practices throughout the project lifecycle.

To understand the nature of the HCW management issues related to USAID projects and activities, it is important to understand the scope of the healthcare interventions conducted by USAID.

These interventions typically include:

- Provision of pharmaceuticals or health commodities (e.g., anti-retroviral medication and/or family planning supplies);
- Direct provision of health services (e.g., vaccinations, medical evaluations, and/or maternal and child healthcare);

- Capacity building for healthcare providers (e.g., nurses and/or doctors) and healthcare education;
- Capacity building for healthcare institutions (e.g., NGOs, clinics, and/or hospitals);
- Capacity building for healthcare delivery and management systems above the facility level, which may engage host-country government institutions and agencies at the district, regional, or national levels, as well as private, NGO, and faith-based healthcare networks; and
- Construction, expansion, rehabilitation, and/or upgrade of new or existing healthcare and healthcare supply chain facilities.

The scale of USAID's healthcare interventions can be grouped into three tiers:

- Tier 1: Small rural, peri-urban, or urban health clinics, family planning facilities, or mobile clinics;
- Tier 2: Larger health clinics or small hospitals (e.g., non-referral hospitals); and
- Tier 3: Large hospitals.

This SEG will generally focus on Tier 1 activities.

Supplementing this SEG

Where appropriate, references and links are provided to the other SEGs that supplement the information covered in this SEG. In particular, the:

- *Solid Waste SEG* provides an overview of the nonhazardous solid waste management sector, including systems for reducing, collecting, treating, and disposing wastes. It provides guidance on planning and implementing such systems.
- *Small Healthcare Facilities SEG* provides more information about waste generated as a result of the construction, rehabilitation, and operation of small-scale health clinics or hospitals.
- *Construction SEG* provides guidance on managing waste generated as a result of the design, siting, building, maintenance, occupation, and use of infrastructure developed as part of USAID's construction portfolio. This includes the management of asbestos and lead wastes.
- *Water Supply and Sanitation SEG* discusses the public health importance of potable water and sanitation projects, including proper management of wastewater.
- *Livestock Sector Environmental* Guideline addresses veterinary or livestock waste issues.

The Resources section of this SEG provides tools for the safe management of wastes associated with vector control activities (e.g., empty pesticide containers from activities to combat the spread of malaria-spreading mosquitos) under the heading, "Vector Control Waste Management."

3.1 TYPES OF HEALTHCARE WASTES

The World Health Organization (WHO) *Safe management of wastes from health-care activities handbook*[1] reports that, regardless of scope or scale, healthcare activities will typically generate waste that consists of approximately 75%–90% "nonhazardous" or general waste (see Figure 1). Nonhazardous waste is waste that has not been in contact with infectious agents, hazardous chemicals, or radioactive substances, and therefore, it is considered safe for disposal with regular municipal solid waste and does not require special handling.

Figure 1. Two Major Categories of Healthcare Waste

Nonhazardous

75–90%

- Packaging, unwanted paper, food, etc.
- Generally harmless
- Needs no special handling

Hazardous

10–25%

- Infectious waste, sharps waste, chemicals, etc.
- Human health and environmental risks
- Requires special handling

The remaining 10%–25% of HCW is considered "hazardous" and consists of wastes that must be specially managed to prevent adverse impacts on human health and the environment. This guideline focuses on hazardous waste generated by healthcare activities and emphasizes a risk minimization approach to address HCW management challenges in developing countries.

Hazardous HCW includes a variety of waste streams, or types. The primary types of hazardous HCW generated by typical USAID health interventions include:

- Sharps
- Rapid Test Kits (RTKs) and other disposables
- Infectious
- Pathological
- Pharmaceutical
- Cytotoxic (antineoplastic)
- Chemical
- Radioactive

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[1] WHO. 2014. *Safe management of wastes from health-care activities, Second edition.* [Chartier, Y., J. Emmanuel, U. Pieper, A. Prüss, P. Rushbrook, R. Stringer, W. Townend, S. Wilburn and R. Zghondi (eds)]. ISBN 978 92 4 154856 4. https://www.who.int/water_sanitation_health/publications/wastemanag/en/

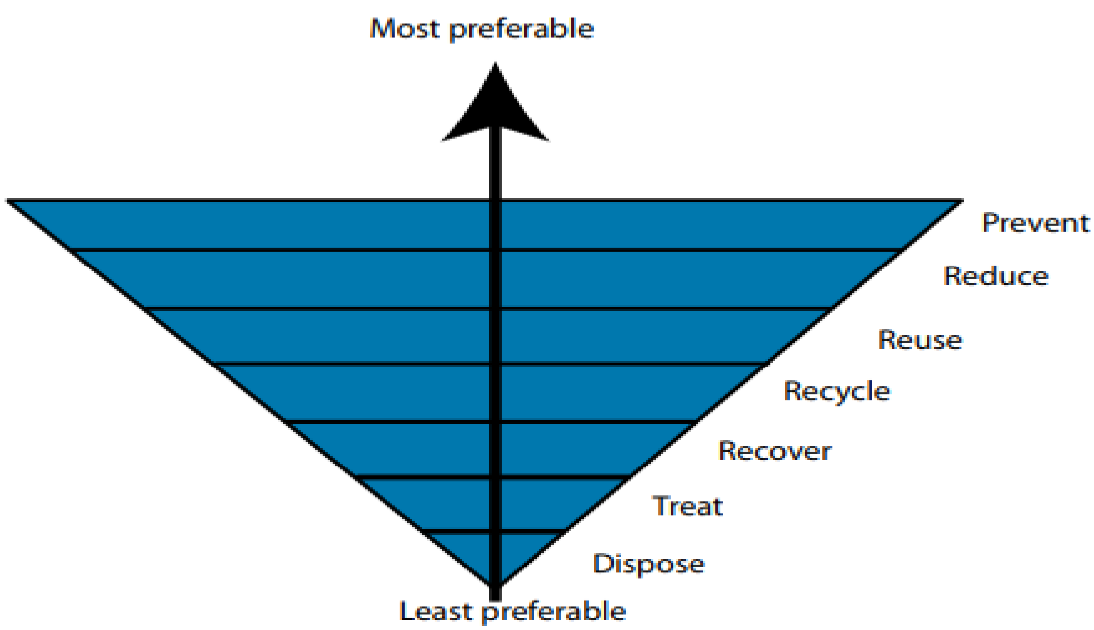
For information regarding each of these types of waste, including examples and suggested management methods, refer to Annex 1.

3.2 WASTE MANAGEMENT HIERARCHY

Health programs can achieve safe and effective management of their waste, both hazardous and nonhazardous, through a variety of methods. Some methods are preferable and are ranked in what is known as the "waste management hierarchy" (see Figure 2). Prevention or reduction of the amount of waste generated (i.e., waste minimization) typically sit at the top of this hierarchy, while treatment and disposal sit on the bottom. The basis for the hierarchy is that e decreasing the amount of waste requiring treatment and disposal helps avoid negative impacts on human health and the environment, such as respiratory illnesses due to air pollution or contamination of ground and surface water.

In the middle of the waste management hierarchy, there are reuse, recycling, and recovery options, which have varying degrees of benefit and feasibility in the development context. Additionally, certain types of waste, such as pathological waste or expired pharmaceuticals, cannot be reused or recycled. Refer to Section 6.5 of the WHO *Safe management of wastes from health-care activities handbook* for further information on these practices. Section 3 of the *Solid Waste Sector Environmental Guideline* provides additional discussion of the waste management hierarchy.

Figure 2. WHO Waste Management Hierarchy



3.2.1 WASTE MINIMIZATION

Waste minimization is the most preferable approach to reducing the negative impacts of HCW. Waste minimization may be performed "at the source" (i.e., where it is generated), but it should also be implemented at the procurement stage, including considering green purchasing and adapting inventory management strategies. Table 1 presents examples of some waste minimization practices.

TABLE 1. WASTE MINIMIZATION PRACTICES

EXAMPLES OF WASTE MINIMIZATION PRACTICES	DESCRIPTION OF PRACTICES
Green Procurement	Integrate "green" requirements into contractual clauses for chemicals, pharmaceuticals, and other supplies (e.g., request suppliers to reduce packaging, replace use of PVC plastics with more easily recyclable plastics like polyethylene terephthalate (PET), and/or provide reusable materials/equipment or energy efficiency devices). Often, such procurement occurs through centrally managed or Washington-based mechanisms for USAID projects.
Hazardous Chemical Use Minimization	Implement management and control measures to promote the minimization of hazardous chemical usage (e.g., centralized purchasing of hazardous chemicals; use of chemical inventories and Safety Data Sheets (SDS)/Globally Harmonized System (GHS) classifications to monitor usage and disposal, and/or switching to less hazardous chemicals or physical cleaning methods).
Inventory Management	Practice sound inventory management to reduce generation of chemical and pharmaceutical waste due to expiration. Good practices include more frequent deliveries of smaller amounts of inventory rather than one-time, large deliveries; application of first-expired-first-out (FEFO) practices to use oldest batches of products first to avoid expired stockpiles; and/or encouragement of beneficiaries to use all contents of medicine containers before discarding.

3.2.2 WASTE TREATMENT AND DISPOSAL

Waste treatment and disposal should be considered after waste minimization, reuse, recycling, and recovery. There are a variety of treatment and disposal methods available for HCW, including mechanical processes (e.g., shredders); steam-based technologies (e.g., autoclaves); chemical, dry heat, or microwave treatments; encapsulation; incineration; and sanitary landfills.

The choice of HCW treatment or disposal technology will depend on local conditions and other considerations, such as:

- Relevant host country regulations and requirements (e.g., a ban on incineration);
- Available resources, including technical expertise (e.g., the operation of some technologies require a high degree of training/education);
- Waste characteristics and volume (e.g., hazardous vs. nonhazardous, or small vs. large quantities);
- Safety and environmental factors (e.g., proximity to sensitive ecosystems); and
- Cost considerations (e.g., shipping fees, customs fees, operating and fuel expenses, transportation fees, and/or decommissioning expenses).

Section 6 further discusses planning for HCW treatment and disposal, and Annex 2 presents analysis of different treatment and disposal methods.

3.3 GENERAL PRINCIPLES FOR SUSTAINABLE HEALTHCARE WASTE MANAGEMENT

Sustainable HCW management interventions should be based on the size and complexity of a project or facility, as well as the resources available for waste management. Adopting just a few key practices can dramatically reduce risk, protect the environment, and improve the health and safety of healthcare workers, patients, and the surrounding community. To successfully implement the waste management hierarchy and ensure the effective long-term management of waste, generators of HCW should strive to follow the guiding principles listed below.

> Minimum Considerations for HCW Management Budgeting
>
> - Sharps containers or safety boxes
> - Bins and/or bags of different colors for hazardous and nonhazardous waste segregation
> - Waste handling, PPE, and cleaning supplies
> - Treatment and disposal processes
> - Repairs and maintenance
> - Healthcare workers (e.g., waste handlers and/or transporters)
> - Program development and training

1. Ensure **waste minimization, recycling, and reuse opportunities** are considered during project planning. Refer to Table 1 above for examples of waste minimization practices.
2. Ensure **funding for waste management** is included in the project or facility's budget.
3. Develop and implement an effective **waste management plan (WMP) or comparable Standard Operating Procedures (SOPs)** that cover waste management aspects, including waste minimization, classification, segregation, recycling, and treatment/disposal.
4. Define and communicate **roles and responsibilities** of affected personnel within the waste management process, including healthcare providers.
5. Provide **training and capacity building for healthcare providers** on topics related to healthcare waste management, including occupational health and safety, such as:
    a. **Personal hygiene**—Ensure that soap/water or hand sanitizer are readily available, and healthcare workers are appropriately trained on best practices.
    b. **Sharps handling**—Ensure sharps boxes (or alternatives) are readily available and healthcare workers are adequately trained to segregate waste and avoid risks associated with needlestick injuries.
    c. **Personal Protective Equipment (PPE)**—Ensure healthcare workers receive and are trained on using the required PPE for their respective jobs, such as thick gloves and aprons for staff handling HCW.
    d. **Vaccinations**—Ensure healthcare workers receive required vaccinations depending on their roles and responsibilities (e.g., Hepatitis B vaccination for all healthcare workers at risk of exposure to blood).
    e. **Accident Response**—Ensure healthcare workers understand accident reporting procedures and post-prophylaxis requirements in the event of accidents, such as needlestick injuries. Develop and implement an accident mitigation procedure.
    f. **Provision of Supplies**—Ensure adequate supplies for waste collection, storage, treatment, and disposal are provided, as appropriate.

g. **Environmental Best Practices**—Promote environmental best practices, such as for waste treatment technologies and sustainable procurement of goods and supplies, where possible.

Refer to Annex 3 for a checklist template to assist with developing a sustainable HCW management program based on the above guiding principles.

In resource-scarce areas, such as remote or disaster-stricken locations, it may not be possible to strictly adhere to these guiding principles. In such cases, WHO recommends employing minimal approaches to HCW management; for example, pharmaceutical and chemical wastes should be safely stored until an appropriate disposal method has been identified. Project teams should consult with their Bureau's or Mission's Environmental Officer (BEO or MEO) for assistance with identifying alternative options for managing wastes. Section 6 of this SEG provides further discussion on adaptive management. Annexes 1 and 2 provide treatment and disposal options for various types of HCW waste.

HCW Management in Emergency or Disaster Scenarios

In emergency or disaster response scenarios, some USAID projects or activities may be exempted from the Initial Environmental Examination (IEE) process. However, these exemptions are typically reserved for exceptional circumstances that meet specific criteria defined under Title 22, Code of Federal Regulations, Part 216 (22 CFR 216 or Reg. 216). Activities that do not meet these criteria must follow the IEE process, including planning for, mitigating, and monitoring adverse impacts from the generation healthcare waste. Resources applicable to emergency or disaster response are provided in the Resources section under "Emergency or Disaster Scenarios."

4. POTENTIAL ADVERSE IMPACTS OF IMPROPER HEALTHCARE WASTE MANAGEMENT

Healthcare waste (HCW) management activities can directly affect the environment, human health, and society in a variety of different ways. The potential adverse impacts of inadequate HCW management include disease transmission, physical injury, air pollution, soil pollution, water pollution, and social impacts. These impacts can result from the improper management and handling of HCW during generation, transportation, storage, treatment, and disposal. More information about these adverse impacts is presented below.

4.1 DISEASE TRANSMISSION

Hazardous HCW, including infectious, pathological, and sharps waste, has the potential to contain infectious agents that can transmit disease to those who encounter it. Infectious agents include bacteria (e.g., cholera and/or E. coli), viruses (e.g., Hepatitis B and/or HIV), and parasites (e.g., giardia and/or lice) that can cause disease transmission in humans or animals. Individuals exposed to these infectious agents can develop serious and even fatal illnesses. Healthcare workers and those handling and managing HCW are at the highest risk of exposure. Infectious agents can enter the body through punctures, breaks in the skin, inhalation, or ingestion. Providing awareness training to affected workers and using appropriate personal protective equipment (PPE) are important first steps to minimize this risk. There are many documented cases of individuals handling HCW without appropriate PPE and then contracting serious illnesses, including Hepatitis B, HIV/AIDS, or heavy metal poisoning (e.g., due to exposure to mercury from broken thermometers).

If HCW is not stored, transported, treated, and disposed of properly, there is an increased risk of disease transmission for healthcare patients, visitors, healthcare workers, and the general public. Unsegregated, improperly stored, and/or improperly disposed of infectious and sharps waste can spread disease through inadvertent contact made by healthcare workers, patients or individuals in the local community (e.g., children playing near or in an unsecured HCW burial pit). Another common occurrence in many developing countries is people scavenging in unsecured landfills/burial pits for contaminated, used syringes in order to re-sell or re-use them. Such people are at high risk for disease transmission. Similarly, foraging animals, both domesticated and feral, are at high risk for disease transmission when not inhibited from entering these sites and becoming exposed to infectious wastes.

Trash, including sharps waste, lays in open landfill near residential area.

PHOTO CREDIT: ADEEL SAEED.

Another example of poor HCW management that can lead to disease transmission is improper incineration. When infectious waste is not incinerated at the proper temperature, or for an appropriate amount of time, this partial combustion may fail to eliminate the infectious agents present in the waste. In some cases, it may be safer to manage such wastes using alternative means, rather than through partial combustion. Waste handlers, or others who come in contact with partially combusted waste, may not know the waste is still infectious and are at risk of contracting diseases.

> Case Study: Spread of Hepatitis C among Egypt's Waste Collectors
>
> Mismanagement of healthcare waste in Egypt has led to increased disease transmission, especially the Hepatitis C virus (HCV), and threatens public health. According to a 2013 report for solid waste management, Egypt produces almost four million tons of medical waste per year, and a lack of adequate incinerators and education/awareness of the importance of proper waste management has contributed to the spread of disease. In particular, Cairo's main informal garbage collection community, known as the Zabaleen, experiences high infection rates, especially HCV. According to WHO, "HCV kills an estimated 40,000 Egyptians a year, and at least 1 in 10 of the population aged 15 to 59 is infected." Local NGOs have launched grass roots initiatives, aiming to segregate waste on-site, direct waste to appropriate facilities, and provide medical help to individuals who have contracted diseases from improper healthcare waste management.
>
> (Source: El Dirini, A. Shorthand Social. 2017. *Medical Waste in Cairo: Impact and Health Problems.* #Cairo BioHazards. https://social.shorthand.com/AlaaDirini/nyRRut9223/medical-waste-in-cairo-impact-and-health-problems)

4.2 PHYSICAL INJURY

Physical injuries can occur when HCW is poorly managed. Individuals exposed to sharps, including needles, scalpels, razors, or broken glass, are at risk of puncture wounds, severe cuts, abrasions, and increased risk of exposure to pathogens. Examples of improper sharps management include overfilling or not using puncture-proof storage containers, not segregating sharps waste from other waste streams, or handling sharps without proper PPE.

Physical injuries can also occur when chemical waste is improperly handled. Depending on the type of chemical (e.g., corrosive, toxic, and/or reactive), exposed individuals can experience chemical burns, headaches, and/or respiratory illness. One example of a common healthcare chemical is formaldehyde. Individuals handling formaldehyde waste without the appropriate PPE can be exposed through inhalation or skin contact. This exposure can cause individuals to experience respiratory irritation, skin irritation, and/or cancer, if exposed for longer periods.

Physical injury may also occur is when HCW is improperly stored, treated, or disposed. If waste containers are overfilled or become too heavy, individuals transporting or treating the waste may experience back or muscle strain. Workers responsible for the operation of treatment equipment, such as incinerators, compactors, or grinders, can experience physical injuries and respiratory complications if such equipment is not properly operated. Workers handling ash disposal from incinerators without appropriate PPE, for example, can be exposed to physical injuries due to exposure to heavy metals and other toxins contained in the ash.

4.3 AIR POLLUTION

Absent appropriate controls, air pollution may occur when hazardous HCW, including chemicals, pharmaceuticals, plastics, or heavy metals, are openly burned or incinerated causing particulates, toxic gases, or other pollutants to be released into the air. The use of a continuous emission monitoring system (CEMS), for example, can be used by incinerator operators (or by regulatory agencies, remotely) to help ensure on-going environmental compliance of air emissions.[2] If HCW is landfilled, decomposing organic components can release greenhouse gases (GHGs) like methane and carbon dioxide, which are primary contributors to climate change. Air pollution, in the form of toxic fumes, can also occur when containers of certain chemical wastes (e.g., solvents, formaldehyde, and/or alcohols) are left open and the contents allowed to evaporate into the air. Lack of awareness or training for waste handlers managing these HCW streams can lead to improper waste segregation and, ultimately, these materials being left in open containers, burned, or incinerated improperly.

Individuals exposed to air pollutants from improper HCW management may have an increased risk of respiratory diseases, cardiovascular diseases, birth defects, and/or cancer. Toxic gases pose a significant health risk to individuals working or living near treatment sites. Air pollution and the associated health risks are greatly increased when incinerators used to treat HCW are poorly maintained or operated or when unsuitable materials, such as PVC plastics, are burned.

Proper PPE is crucial for individuals handling waste and opearting incinerators to reduce associated risks, including physical injury or inhalation of exhaust.

PHOTO CREDIT: SAMANTHA SALCEDO.

4.4 SOIL POLLUTION

Soil pollution may occur when hazardous HCW, including chemicals, pharmaceuticals, incineration ash, or infectious waste, is disposed of in unlined landfills or pits, accidently spilled, or stored on permeable ground surfaces. Soil pollution can also occur when smoke and ash from waste burning or treatment activities are not controlled and settle on surrounding areas. If waste is not properly segregated prior to incineration, incinerators are not operated properly, or waste is only partially combusted prior to final disposal, the risk of soil and water pollution is increased.

HCW can accumulate and contaminate the soil over a period of time, which can then contaminate crops or groundwater and increase the risk of disease transmission, inhibit the growth of plants, or contribute

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[2] U.S. Environmental Protection Agency (U.S. EPA). 2018. *Basic Information about Air Emissions Monitoring.* https://www.epa.gov/air-emissions-monitoring-knowledge-base/basic-information-about-air-emissions-monitoring.

to the degradation of animal habitats. Heavy metals, such as mercury, lead, or cadmium are commonly present in areas where soil has been contaminated from incinerator ash disposal or other HCW, such as medical devices (e.g., thermometers and/or catheters), batteries used in medical devices, and chemical reagents. Heavy metal contamination of soil can pose a risk of disease and neurological effects for individuals, especially children, who come in contact with the soil.

4.5 WATER POLLUTION

Water pollution may occur when untreated water containing hazardous HCW, including infectious waste and heavy metals, enters surface water or groundwater. Untreated or improperly treated hazardous HCW discharged to the sanitary sewer system (e.g., via sinks, toilets, and/or floor drains or directly where no sewer systems exist) can ultimately enter surface water bodies, storm drains, ditches, or other conveyances and impact natural surface water bodies (e.g., streams and/or ponds). Illegal dumping of HCW in or near surface water bodies can also contribute to water pollution. Additionally, the leachate from polluted soil can contaminate groundwater and surface waters.

A waterway is visibly contaminated with waste.

PHOTO CREDIT: USAID.

When HCW is disposed in low-lying areas, there are chances of waste being leached into the soil and nearby water bodies. The risk of infection increases when wastewater treatment systems and drinking water treatment systems are not equipped to adequately neutralize and remove HCW contaminants (e.g., pharmaceuticals, chemicals, and/or infectious agents) from the effluent. Water contaminated by waste chemicals, pharmaceuticals, or heavy metals can inhibit plant growth and degrade the habitats of water fauna. Individuals exposed to polluted water are at an increased risk of disease transmission and epidemic outbreaks.

4.6 SOCIAL IMPACTS

Social impacts are any effect on human health and well-being determinants, such as lifestyle, personal safety, cultural and religious preferences, genetics, social influences, economic conditions, and availability of and access to services and facilities.[3] When HCW is improperly managed, it can lead to adverse social impacts, such as increased occupational hazards for healthcare workers handling hazardous wastes, increased air pollution for neighboring communities due to improper waste burning, or impact on existing waste management infrastructure due to project-induced increased use of health services.

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3 International Association for Impact Assessment (IAIA). 2015. *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects* [Vanclay, F., A. M. Esteves, I. Aucamp, and D. Franks authors]. https://www.iaia.org/uploads/pdf/SIA_Guidance_Document_IAIA.pdf

System-wide solid waste management, as opposed to project-specific HCW management, can have large-scale social impacts, including the exacerbation of land tenure conflicts and the loss of land used for customary practices, such as when siting or constructing a new landfill. This level of social impacts is explored in more detail in the *Solid Waste Sector Environmental Guideline*.

4.7 SUMMARY OF POTENTIAL IMPACTS

Inadequate or poor management of HCW can have short- and long-term adverse environmental, human health, and social impacts. The implementation of a proper waste management program with appropriate mitigation measures and monitoring activities is important for preventing disease transmission, injury, pollution, and other impacts on communities.

Annex 4 provides more detailed information on potential adverse impacts associated with improper HCW management and lists recommended mitigation measures and monitoring indicators for those impacts.

5. CLIMATE CHANGE IMPACTS ON HEALTHCARE WASTE MANAGEMENT

The impacts of climate change have increasingly resulted in new stressors on communities in developing countries, thus creating additional challenges for USAID projects and activities. Per ADS Mandatory References 201mal and 201mat[4], assessing climate risk within USAID programming is mandatory. Further, summary tables of such assessments must be incorporated into environmental documentation, such as the Initial Environmental Examination (IEE).

Projects with healthcare waste (HCW) management activities should include efforts to mitigate climate-related risks and vulnerabilities to improve the likelihood of long-term project success. To facilitate this goal, USAID has developed tools to support climate risk screening and assessment in strategy, project and activity design. Using the USAID Climate Risk Screening and Management tools[5] and the Climate Risk Management Health Annex[6] will guide project designers in assessing and addressing climate risk and improving the effectiveness and sustainability of development interventions.

5.1 ADAPTING TO CLIMATE CHANGE

HCW management activities, per USAID policy, should consider climatic uncertainties and develop a plan for sustainability through climate adaptation, which is defined as adjustment to natural or human systems in response to actual or expected climate change effects. One example of climate adaptation is the proper siting of HCW storage facilities, collection/transfer stations, and treatment/disposal facilities away from flood plains, rivers, and wetlands. Proper siting can mitigate the potential impacts to these facilities from projected sea level rise, flooding following storm events, or coastal storm surges.

Another example of climate adaptation is ensuring adequate capacity to treat HCW more frequently (e.g., within 24 hours of generation) due to higher decomposition rates and pest activity from elevated temperatures in locations where local temperatures are likely to increase. This may require altering waste collection schedules, ensuring transportation, and increasing the use of disposal equipment. These measures may increase the cost of HCW management. However, from a risk management perspective, it is less costly to design for the potential direct and indirect impacts of climate change on HCW management systems than to risk major losses or damage (e.g., damaging sophisticated disposal equipment, such as an autoclave) or for staff, patients, or communities to face risk of exposure to infectious diseases. Table 2 provides additional examples.

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[4] USAID. 2019. *Climate Risk Management Resources and Training.* https://www.climatelinks.org/climate-risk-management/resources-training

[5] USAID. 2019. *Climate Risk Screen and Management Tools.* https://www.climatelinks.org/resources/climate-risk-screening-management-tool

[6] USAID. 2017. *CRM Tool Health Annex.* https://www.climatelinks.org/sites/default/files/2017-06-13%20USAID%20CRM%20Tool%20Health%20Annex.pdf

TABLE 2. EXAMPLES OF CLIMATE CHANGE IMPACTS AND MITIGATION STRATEGIES FOR HEALTHCARE WASTE MANAGEMENT

EXAMPLES OF DIRECT CLIMATE CHANGE IMPACTS	EXAMPLES OF INDIRECT CLIMATE CHANGE IMPACTS	POTENTIAL CLIMATE ADAPTION/MITIGATION STRATEGIES
• Inundation of burial pits, municipal dumps, and/or placenta pits from sea level rise or storm surges • Damage to burial pits, municipal dumps, and/or sanitary landfills (if present) from heatwaves and/or droughts • Increased power outages from weather events and/or increased energy demand, resulting in diminished energy supply for waste operations (e.g., fuel required for operating incinerators, burning chambers, rotary kilns, autoclaves, fuel for waste transportation from remote healthcare facilities to healthcare facilities with appropriate waste disposal capacity)	• Higher operating and maintenance costs and/or shorter lifespan of municipal dumps, burial pits, chemical treatment pits, and sanitary landfills (if present) • Adverse health impacts on community caused by increased burden of disease through shifting disease patterns, pandemics, and emerging diseases • Increased need for HCW collection, storage, and transportation due to higher decomposition rates and pest activity • Loss of transportation system efficiency (e.g., being cut off from waste-collection services by floods when planning waste storage and treatment needs for remote facilities) • Increase in groundwater contamination and spread of disease from flooded subsurface constructions (e.g., sanitary landfills, healthcare facility septic tanks, and/or composting/placenta pits) and HCW storage sites • Increased HCW generation due to increased volume of patient visits causing increased demand for antibiotic, antiparasitic, and antiviral drugs to counter the increased prevalence of vector and water-borne diseases (e.g., epidemic malaria outbreaks) • Increased HCW generation due to use of large quantity of disposables and single use devices • Increased HCW generation due to increased prevalence of power outages and increasing costs of energy sources, leading to spoiled pharmaceuticals, vaccines, and/or stored blood that typically require refrigeration • Increased HCW generation due to unwanted medical supplies and equipment, such as old cold chain equipment and boxes, leading to large quantities of waste	• Develop back-up contingency plans for extreme weather events • Establish natural buffer zones on coasts • Site or relocate waste disposal and treatment sites to less exposed/flood-prone locations • Update design standards for waste treatment sites (e.g., incinerators, chemical treatment pits, and/or placenta pits), waste disposal sites (e.g., on-site burial pits and/or sanitary landfills), and waste storage facilities (including temporary storage containers) by ensuring proper drainage, extra clearance between subsurface constructions and the water table, and/or elevate to prevent inundation from flood waters • Increase financial and technical resources for more frequent maintenance and repairs • Adapt collection schedules to reduce storage time during heatwaves • Install temperature controls in waste storage areas, noting that extreme weather events may result in power failures • Use reusable and/or energy efficient devices and equipment, where feasible

5.2 MINIMIZING GREENHOUSE GAS EMISSIONS

Waste treatment and disposal practices may generate greenhouse gases (GHGs) either directly (e.g., via waste combustion or burning) or indirectly (e.g., via energy consumption or waste transportation). The overall climate impact depends on net GHGs. Properly maintained and operated waste management systems can reduce downstream, indirect GHG emissions through increased recycling and decreased energy and fossil fuel use. Project teams should assess a proposed project's contribution to increasing GHG emissions and select implementation strategies and activities that will minimize these emissions in the most cost-effective way. These implementation strategies and activities should be incorporated into project documents, such as the work plan, IEE, Environmental Mitigation and Monitoring Plan (EMMP), or other, to ensure implementation.

> Case Study: Low-Carbon Waste Management
>
> Nepal Bir Hospital in Kathmandu installed 248 solar panels with the support of the World Bank, providing 60KVA of electricity for critical care units. Bir Hospital also received international recognition for its waste reduction efforts, which are considered as much a humanitarian feat as an environmental one. The hospital cut its medical waste in half and now recycles 55% of all waste, which provides income to the hospital. Bir uses autoclaves to treat its infectious waste, including sharps, reducing emissions from small-scale incinerators. The hospital is experimenting with new methods to reduce waste further, including vermicomposting and a biogas system that turns food waste into biogas, with the potential to generate 1kW of electricity for cooking in the hospital kitchen.
>
> (Source: World Bank and Health Care Without Harm. 2017. *Climate Smart Healthcare Lo-Carbon and Resilience Strategies for the Health Sector.* https://noharm-global.org/issues/global/climate-smart-health-care)

A holistic approach to HCW management may also result in positive consequences for GHG emissions. HCW treatment and disposal methods vary in terms of emissions and related environmental impacts. Some options have higher fuel consumption rates or higher emissions to the air or water than others. These factors are all important to consider during project and activity design and to both mitigate and reduce negative impacts.

Waste segregation and minimization strategies can help reduce GHG emissions of HCW management activities. Encouraging waste minimization, as described in Section 3, can aid Implementing Partners (IPs) in reaching project objectives while reducing GHG emissions by, for example, minimizing commodities purchased and, therefore, reducing transportation and disposal needs. The segregation and recovery of nonhazardous paper and organic wastes from hazardous HCW (e.g., to recycle paper, recover pharmaceutical packaging, and compost organics), as well as the associated reduction in the amount of hazardous HCW to manage and treat, can reduce fossil fuel use and avoid increased air emissions. Additionally, in low-resource or energy-poor settings, powering healthcare with renewable energy sources, such as solar and wind, can enhance access to healthcare services to the community.

6. PROJECT AND ACTIVITY DESIGN—SPECIFIC ENVIRONMENTAL GUIDANCE

Most USAID health projects and activities are designed to improve health outcomes and save lives, while building sustainable and resilient health systems in the poorest regions of the world. Project design teams must begin identifying proposed actions and their potential adverse impacts, as described in Sections 4 and 5, as well as selecting appropriate mitigation measures. Where these impacts can't be avoided, they will be further analyzed as the Initial Environmental Examination (IEE) documentation is developed and, subsequently, in more depth in the Environmental Mitigation and Monitoring Plan (EMMP). Mitigation and monitoring requirements must also be included in procurement documents to ensure issues are addressed during project implementation (see Section 7).

This Section focuses on best management practices and design criteria that can help prevent adverse environmental impacts associated with healthcare waste (HCW) management and support achieving compliance with the requirements of host country laws; Title 22, Code of Federal Regulations, Part 216 (22 CFR 216 or Reg. 216); and Automated Directives System, Chapter 204 (ADS 204).

6.1 BEST PRACTICES FOR HEALTHCARE WASTE MANAGEMENT

The primary objective of HCW management is to properly dispose of waste while protecting the environment and human health and ensuring the sustainability of projects and activities. In order to achieve this objective, projects and activities must be designed and implemented with waste management needs and capabilities in mind. Therefore, proper planning for HCW management during the strategy, project, and activity stages is crucial to the success and sustainability of USAID health programs.

Proper planning typically requires the development of a system to ensure proper management of HCW, as well as a Waste Management Plan (WMP) or comparable Standard Operating Procedure (SOP) to ensure the effective implementation of the HCW management system. In some cases, waste management may be part of a broader set of procedures, such as Infection Prevention Control (IPC) programs. HCW management considerations must also be incorporated into solicitation and award documents in order to ensure they are given due consideration, including budgeting and planning. The following sections discuss the importance of such systems and how to ensure adequate management of HCW.

6.1.1 EVALUATING HEALTHCARE WASTE MANAGEMENT SYSTEMS

Whether developing a new system for managing HCW or strengthening an existing one, a good place to start is evaluating the current situation. This evaluation includes understanding the existing HCW management system or IPC program (if any), the expected waste types and quantities, and the available infrastructure and workforce to manage the HCW. The Waste Management Program checklist and Waste Inventory Sheet templates in Annex 3 can assist project teams with this process.

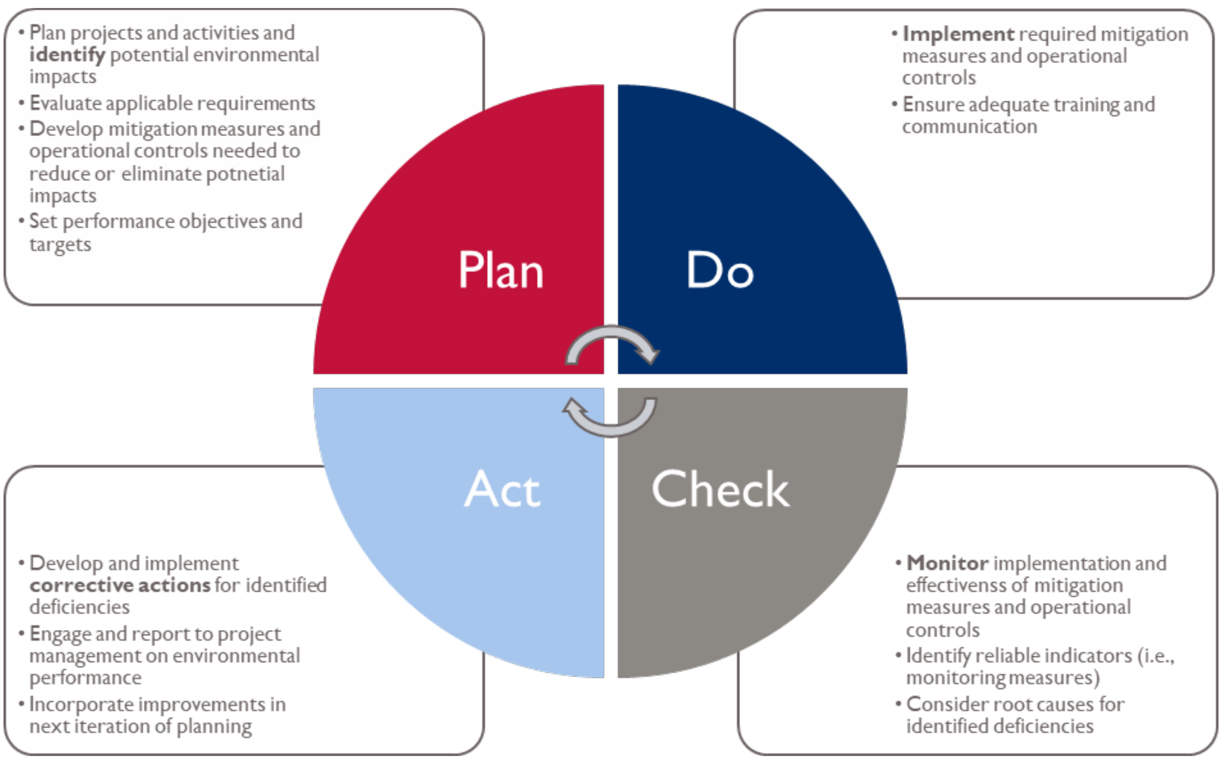
For teams wishing to conduct assessments of HCW management systems on the national level, WHO has developed a detailed rapid assessment tool that may be downloaded in English and French. See: WHO. 2019. *Health-care waste management rapid assessment tool.* https://www.who.int/water_sanitation_health/facilities/waste/hcwmtool/en/https://www.who.int/water_sanitation_health/facilities/waste/hcwmtool/en/.

6.1.2 ADAPTIVE HEALTHCARE WASTE MANAGEMENT

The development of an HCW management system for the safe and effective management of HCW is an important best practice. However, such systems must be adaptive in order to remain successful. ADS 201.6 defines adaptive management as "an intentional approach to making decisions and adjustments in response to new information and changes in context." There are various tools that can help with adaptively managing projects through continuous learning, including the Plan-Do-Check-Act (PDCA) cycle (see Figure 3). PDCA is an iterative process used to achieve continual improvement by helping ensure that:

- Environmental impacts are identified;
- Adequate controls are implemented;
- Monitoring is performed; and
- Corrective actions are taken when needed to improve compliance.

Figure 3. The Plan-Do-Check-Act Cycle.



Once improvements are identified and made through the PDCA cycle, they can be incorporated into the next iteration of planning, thereby improving the HCW management system moving forward.

6.1.3 WASTE MANAGEMENT PLANS

The development and use of a WMP or comparable SOP is the recommended approach for successfully implementing an HCW management system. USAID has developed a recommended WMP template, called an Integrated WMP (IWMP), which can serve as a starting point for project teams preparing for HCW management.

To download the template, with explanatory guidance text, see: USAID. 2019. *Integrated Waste Management Plan (IWMP)*. https://www.usaid.gov/documents/1865/integrated-waste-management-plan-iwmp.

The USAID IWMP template provides the framework for creating a plan that takes a holistic view of the risks and impacts associated with waste generated from a project or activity. It also promotes the use of best practices and formal procedures in addressing those risks and impacts. The IWMP will vary in terms of length, content, and approach depending on the scope, scale, and location of the project or activity.

Key Elements of a WMP

1. Introduction—Purpose, Scope, and Objective of the IWMP
2. Roles and Responsibilities
3. Waste Stream Identification
4. Applicable Laws and Regulations
5. Waste Management Procedures
6. Waste Minimization
7. Health and Safety Practices
8. Implementation Strategy
9. Employee Training Program
10. Performance Monitoring and Reporting
11. Plan Review Cycle

Regardless of its title or format, a WMP or comparable SOP should address the different types of waste the team expects the project or activity to generate, as well as the associated handling, treatment, and disposal. It should also provide for monitoring and oversight, including monitoring operations, maintaining written records, and conducting periodic reviews of the plan itself. Therefore, multiple stakeholders with a variety of areas of expertise should be engaged during the planning stage. For example, the in-country Activity Manager may be an expert on applicable host country laws and regulations and project implementation strategy. However, it is important for the team to also have a HCW specialist, who can develop specific WMP elements regarding waste management procedures and health and safety practices.

By working together, the project team can ensure that HCW management practices are organized, effective, and sustainable. Moreover, increased involvement during the planning stages typically results in stronger ownership and, therefore, increased commitment to ensuring the success of the plan.

The USAID IWMP template encompasses the key elements of a WMP and includes 11 sections:

1. **Introduction**—A clearly defined purpose and scope (i.e., what activities and/or wastes are covered). A clear scope and simple objectives can help avoid confusion.
2. **Roles and Responsibilities**—Typically consists of four layers of responsible parties: those designing it, those affected by it, those implementing it, and those monitoring its implementation. The plan should identify those persons and their designated roles and responsibilities.
3. **Waste Stream Identification**—In order to plan appropriately, a waste management team must understand the sources, types, and quantities of waste generated, or expected to be generated, by a project or activity. Using an inventory, such as the template provided in Annex 3, can assist with this process. Annex 1 provides definitions and examples of the different types of HCW expected for USAID health projects and activities.
4. **Applicable Laws and Regulations**—Once waste types have been identified, it is important to understand the laws or regulations that may apply. Often, generating hazardous wastes will involve special requirements for additional controls. These requirements may include, but are not limited to, international standards and treaties, USAID or other USG policies or procedures, and host country laws and standards.

5. **Waste Management Procedures**—Project teams should develop procedures that address the full lifecycle of waste management, ranging from on-site activities (e.g., waste segregation, containment, and storage) to off-site activities (e.g., transportation, treatment/disposal, and associated documentation and recordkeeping). Annex 1 provides guidance related to storing, handling, and treating/disposing of different types of HCW. Annex 2 provides more detailed guidance on the different types of treatment and disposal methods available for HCW.
6. **Waste Minimization**—As discussed in Section 3, waste minimization is the most preferable approach to reducing the negative impacts of HCW. Therefore, it is important for project teams to consider options and develop performance targets for minimizing waste generation. This section of the IWMP template also calls on project teams to consider and document recycling, reuse, and recovery options.
7. **Health and Safety Practices**—Beyond the potential adverse environmental impacts and health implications for neighboring communities, HCW management must also address potential impacts on the health and safety of affected workers. Addressing these impacts may include practices such as mandatory vaccinations or the provision of personal protective equipment (PPE) for certain jobs involved in handling HCW.
8. **Implementation Strategy**—In addition to developing a waste management system, teams must also plan how it will be implemented. For example, implementation plans should include the estimated cost (including cost of personnel; occupational health and safety; waste collection, storage, treatment, and disposal; and/or training and capacity building), source of funding, and training needs, especially for individuals affected by waste management procedures (e.g., healthcare workers and/or waste handlers).
9. **Employee Training Program**—New employees will require training, and existing employees will require refresher trainings at various intervals. A training plan and schedule should be developed and incorporated into the IWMP in order to ensure safe handling, storage, treatment, and disposal of waste.
10. **Performance Monitoring and Reporting**—An effective waste management system should also delineate procedures for ensuring compliance with the system and applicable requirements, as well as procedures for monitoring and reporting the effectiveness of the system. Performance monitoring and reporting should enable teams to identify problems or issues in order to remedy them via corrective actions. A process for corrective actions should be incorporated into the plan.
11. **Plan Review Cycle**—At regular intervals, the plan should undergo review to ensure it remains current and effective.

6.2 USAID RESPONSIBILITY FOR HEALTHCARE WASTE MANAGEMENT

Understanding that an effective HCW management system is crucial to the success of USAID projects and activities, the question then arises: **Who is responsible for developing and implementing the HCW management system?**

In USAID, this responsibility is often established based upon the IEE process and resulting Threshold Determinations, which reflect the level of expected environmental impacts of activities and the degree to which such impacts can be mitigated, as well as the degree of USAID control over those activities.

Typically, the negative impacts associated with USAID healthcare activities receiving a Negative Determination stem from the increased generation of HCW at discrete locations. Larger scale activities that may have a significant impact on the environment or human health typically receive a Positive Determination and require more thorough assessment of potential impacts. For both Negative and Positive Determinations, potential impacts can be mitigated according to the IEE document's conditions, which provide for appropriate management and monitoring of the waste streams as part of the project or activity. The EMMP required by the IEE document will operationalize these conditions into actions required by the Implementing Partner (IP). Also, activities providing capacity-building and/or technical support for healthcare facilities or supporting broader institutions or systems affecting healthcare operations should generally attempt to develop or strengthen systems for appropriate HCW management.

Most Common Threshold Determinations for USAID Projects/Activities

- **Categorical Exclusion**—Little or no environmental impacts
- **Negative Determination**—Some environmental impacts, which may be reduced or eliminated with mitigation measures and monitoring (i.e., conditions included with the determination)
- **Positive Determination**—Significant, foreseeable environmental impacts requiring further evaluation, design considerations, and mitigation

Where USAID and other donors are directly delivering health services or health training that generates HCW, USAID, through its IPs, generally must take responsibility for managing the resulting waste streams. This responsibility includes the effective development and implementation of an appropriate HCW management system. Where USAID provides partial, or non-controlling, support to an institution, facility, system, or activity that is delivering health services and generating waste, the question becomes more complicated. Careful consideration of the degree of donor responsibility for, and involvement in, the HCW management system is required on a case-by-case basis prior to implementation of the activity.

Table 3 presents various scenarios in which USAID may have different levels of responsibility for HCW management, as well as recommended approaches.

TABLE 3: RECOMMENDED LEVELS OF USAID RESPONSIBILITY AND/OR BEST PRACTICES FOR HEALTHCARE WASTE MANAGEMENT

PROJECT CATEGORY	ILLUSTRATIVE ACTIVITY	RECOMMENDED USAID APPROACH
Direct delivery of health trainings that do not generate waste requiring management	Classroom training on waste management without demonstrations or similar activities that would generate HCW Potential Threshold Determination: Categorical Exclusion	• Avoid indirect impacts
Direct delivery of health services or health trainings that generate waste requiring management	Operating 12 mobile clinics *Potential Threshold Determination:* Negative Determination with Conditions	• Ensure proper management of waste throughout project lifecycle • At a minimum, provide support and guidance to existing facilities and organizations in-country to encourage improvements on the macro-level. Recommended actions may include: – Encouraging public-private partnerships or corporate social responsibility initiatives to build HCW management capabilities, such as sponsoring mobile incinerators or other suitable waste treatment and disposal options – Working with host country environmental and health authorities to ensure proper HCW management guidelines are followed – Coordinating with other donors to share responsibility in disposing of HCW generated – Provision of supplies (e.g., PPE for healthcare staff, color-coded waste bins and liners) – Provision of social and behavior change communication (SBCC) tools (e.g., informational posters in local language or with visual depiction on proper waste disposal)
Distribution of personal use products	Distribution of home test kits, personal repellents, or similar personal products. *Potential Threshold Determination:* Negative Determination with Conditions	• Conduct collection campaigns, if possible • Provide instructions for safe use, handling, and disposal • Conduct SBCC campaigns (e.g., instructions for safe disposal of empty personal repellent containers)

PROJECT CATEGORY	ILLUSTRATIVE ACTIVITY	RECOMMENDED USAID APPROACH
Partial (and often, non-controlling) support to an institution, system, or activity that is delivering health services and generating waste	Supporting health activities at local Ministry of Health facility with no control by USAID IPs over the facility *Potential Threshold Determination:* Negative Determination with Conditions	• At a minimum, provide support and guidance to existing facilities and organizations in-country to encourage improvements on the macro-level. Recommended actions may include: – Encouraging public-private partnerships or corporate social responsibility initiatives to build HCW management capabilities, such as sponsoring mobile incinerators or other suitable waste treatment and disposal options – Working with host country environmental and health authorities to ensure proper HCW management guidelines are followed – Coordinating with other donors to share responsibility in disposing of HCW generated – Provision of supplies (e.g., PPE for healthcare staff and/or color-coded waste bins and liners) – Provision of SBCC tools (e.g., informational posters with local language or visual depictions for safe administration of vaccinations)
On-site/direct management of a health facility or activity	USAID program conducting vaccination program in hundreds of clinics operated by USAID *Potential Threshold Determination:* Negative Determination with Conditions (possibly Positive Determination, depending on circumstances)	• Assess existing host country/local systems capacity (e.g., existing infrastructure, suitable waste treatment and disposal options, and/or applicable laws/regulations) • If host country/local systems capacity is inadequate or does not exist, consider alternative solutions in advance of project implementation (e.g., exportation of waste and/or building waste management capacity as part of project) • Begin following best practices during design and procurement stages (e.g., ensuring procurement of approved commodities, planning for waste minimization, and/or budgeting for sustainable waste management)
Construction or rehabilitation of health facilities	Renovation of a hospital ward *Potential Threshold Determination:* Negative Determination with Conditions (possibly Positive Determination, depending on circumstances)	• See Construction Sector Environmental Guideline and Small Healthcare Facilities Sector Environmental Guideline

It is critically important that roles and responsibilities related to waste management be properly defined in project documents during both the planning and design phase and the implementation phase (i.e., in the Project Appraisal Document (PAD)/Activity Action Memo, IEE, Work Plan, EMMP, WMP, and/or SOP).

7. IMPACT MITIGATION, ENHANCEMENT, AND MONITORING

7.1 MITIGATION AND IMPLEMENTATION HIERARCHY

Where impacts are identified, it is necessary to work through possible mitigation and improvement measures to manage those impacts. Mitigation is the identification and application of measures to avoid, minimize, or remedy impacts. Potential adverse impacts and mitigation measures should be discussed during the planning and design phase, as well as during the development of project documents. The Initial Environmental Examination (IEE) and Environmental Mitigation and Monitoring Plan (EMMP) are project document examples. Mitigation can be implemented at all stages of the project cycle. However, the earlier impacts are identified and considered, the more likely they can be avoided. Mitigation is defined under the US National Environmental Policy Act (NEPA) as any activity that includes the following:

- Avoiding the impact all together by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by conducting preservation and maintenance operations during the life of the action; and
- Compensating for the impact by replacing or providing substitute resources or environments.

Those responsible for designing or implementing projects or activities should prioritize mitigation measures in line with the mitigation hierarchy described above.

7.2 BEST MANAGEMENT PRACTICES IN PLANNING AND DESIGN

As Section 6 illustrates, USAID-funded projects and activities should be planned and designed to maintain or improve environmental, health, or sociopolitical systems, as well as minimize negative impacts. Projects should be designed to meet international industry best practices and should follow the steps outlined in Title 22, Code of Federal Regulations, Part 216 (22 CFR 216 or Reg. 216). Typically, such plans and designs are incorporated into EMMPs, which are required for most USAID-funded projects. EMMPs describe the required mitigation measures to avoid or minimize negative impacts and assign corresponding monitoring activities to ensure mitigation measures are sufficient and appropriate.

7.3 OPERATIONAL STAGE MITIGATION AND MONITORING

It is essential that project managers engage specialists with expertise in the management of environmental and socio-economic impacts to assist in identifying opportunities to avoid or minimize potential impacts. In countries where project infrastructure for supporting good environmental and social management is lacking, it is important that mission leaders, including Mission Front Office and Activity Managers, take a proactive role in determining locally adapted solutions that achieve the best practices set out in the *Sector Environmental Guidelines* and nationally- or internationally-accepted standards.

As noted in previous sections, potential adverse impacts and mitigation measures must be identified, documented, and addressed throughout the project lifecycle, including during procurement and implementation. During implementation, impacts and mitigation measures are typically further analyzed as EMMPs are developed. Once approved, EMMPs set out monitoring requirements to ensure that mitigation measures are sufficient and appropriate. USAID personnel oversee mitigation and monitoring to ensure effective implementation and oversight by the Implementing Partner, as well as appropriate reporting of monitoring, issue identification, and issue resolution. Where serious deviations are noted, USAID personnel may need to intercede. For example, a Contracting Officer's Representative may need to take direct action, and an Agreement Officer may need to issue a stop work order.

The Annex 4 table identifies the potential adverse environmental impacts associated with healthcare waste (HCW) management activities and the mitigation measures that can be implemented to reduce or eliminate these impacts. The table includes activities that may generate HCW (e.g., procurement, storage, distribution/use of commodities), as well as activities directly involving the HCW (e.g., waste storage, transportation, and treatment/disposal). Monitoring indicators described in the table include procedures, plans, or other documentation used to monitor the implementation of mitigation measures and continually improve HCW management practices. However, the Annex 4 information only provides general guidance. Project specific characteristics should be considered before applying such guidance. USAID experts, including Mission Environmental Officers (MEOs), Regional Environmental Advisors (REAs), and Bureau Environmental Officers (BEOs), should be consulted for assistance.

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ANNEX 1: HEALTHCARE WASTE TYPES

Healthcare waste (HCW) includes a variety of separate waste streams, or types, which may require different handling, storage, treatment, and disposal considerations. Proper segregation of these waste streams is important to ensure proper treatment and disposal, as well as aid in potential waste minimization, reuse, and recycling strategies. The Annex 1 table provides detailed information on the types of HCW streams that may be generated by USAID projects and activities. It also contains guidance on the recommended handling, storage, labeling, treatment, and disposal for these waste streams. The treatment and disposal methods presented in this Annex are recommended, though some may not be feasible or available in some locations. Technologies that are not recommended have not been included in this table. However, Annex 2 explores additional information on a range of treatment and disposal options.

A note on color-coding: The primary goal of color-coding waste containers is to allow individuals to be able to easily identify the types of waste contained in them for treatment and disposal. Recommendations provided in this table regarding color-coding of waste containers are based on the World Health Organization (WHO)-recommended segregation scheme in Table 7.1 of the *Safe management of wastes from health-care activities handbook*. However, certain countries may follow different color-coding schemes. Refer to the applicable host country regulations and guidance on healthcare waste management.

TYPE OF WASTE*	DESCRIPTION AND EXAMPLES	SPECIAL HANDLING CONSIDERATIONS	STORAGE AND LABELING CONSIDERATIONS	RECOMMENDED TREATMENT/ DISPOSAL METHODS (MORE DETAILS IN ANNEX 2)
NONHAZARDOUS WASTE				
Nonhazardous/ General Waste	Waste that has not been in contact with infectious waste, hazardous chemicals, or radioactive substances. Waste includes paper, cardboard, plastics, textiles, food, and packaging. This waste type makes up most of the waste generated at healthcare facilities.	• Waste should be segregated from other waste streams. • Waste should be stored in a manner that prevents harboring or infestation of vectors or other pests.	• General waste should be stored in black plastic bags. • Waste bags should be adequately sized to contain all waste and prevent fly-aways or spillage.	• Recycling (e.g., cardboard, glass, and/or metal) • Mechanical processes (e.g., compactors, shredders, or grinders) may be used to reduce waste volume • Composting may be used for food waste and organic materials • Incineration with proper pollution control (for materials not reused, recycled, or composted) • Sanitary landfill

TYPE OF WASTE*	DESCRIPTION AND EXAMPLES	SPECIAL HANDLING CONSIDERATIONS	STORAGE AND LABELING CONSIDERATIONS	RECOMMENDED TREATMENT/DISPOSAL METHODS (MORE DETAILS IN ANNEX 2)
HAZARDOUS WASTE				
Sharps Waste	Items that could cause cuts, punctures, or tears to an individual's skin. Examples of this type of waste include needles, scalpels, razors, glass, saws, and knives.	Sharps waste should be handled in a manner that minimizes healthcare worker contact with the waste to prevent needlestick injuries (e.g., no recapping or manipulation of needles after use).	• Sharps waste should be stored in clearly labeled, hard plastic, metal, or cardboard, leak-proof containers. It is preferable if the containers are single use, self-locking, and tamper-proof. • Sharps disposal containers should not be overfilled. • Sharps containers should be yellow, marked "SHARPS," and marked with a biohazard symbol.	• Advanced autoclave system • Autoclaving • Microwave treatment • Dry heat technology • Incineration with proper pollution control • May include use of mechanical processes (e.g., compactors, shredders, or grinders) to reduce waste volume • Encapsulation and sanitary landfill (after shredding, mixing, incineration, or autoclaving)

TYPE OF WASTE*	DESCRIPTION AND EXAMPLES	SPECIAL HANDLING CONSIDERATIONS	STORAGE AND LABELING CONSIDERATIONS	RECOMMENDED TREATMENT/DISPOSAL METHODS (MORE DETAILS IN ANNEX 2)
Rapid Test Kits (RTKs) and Other Disposables	RTKs and other disposables are self-testing kits, where an individual collects his or her own specimen (e.g., blood or saliva), interprets the results in a private setting (e.g., at home), and disposes of the materials. Sometimes, tests may be administered by a healthcare provider, adding the RTKs to the facility's waste stream. Other disposables may include voluntary medical male circumcision (VMMC) kits, which are used in areas with limited staff or sterilization facilities.	• Oral fluid (or saliva) tests may generate significantly less biohazardous waste than other test types. Blood tests pose a greater risk due to the need for used sharps disposal. • RTKs provided for home testing should be accompanied by disposal instructions. • RTKs administered at a health facility should be segregated and stored according to the facility's WMP.	• Used RTKs and VMMC kits should be handled according to manufacturer's instructions. • For blood tests, see "Sharps Waste" row above.	• Used RTKs should be disposed of according to manufacturer's instructions • Where manufacturer's instructions are not available or feasible, disposal of RTKs should be included with infectious or sharps waste, as appropriate • For blood tests, see "Sharps Waste" row above

TYPE OF WASTE*	DESCRIPTION AND EXAMPLES	SPECIAL HANDLING CONSIDERATIONS	STORAGE AND LABELING CONSIDERATIONS	RECOMMENDED TREATMENT/DISPOSAL METHODS (MORE DETAILS IN ANNEX 2)
Infectious Waste	Waste suspected to contain pathogens (e.g., bacteria, viruses, parasites, or fungi) in sufficient quantity or concentration to cause disease. Examples include items contaminated with blood and/or body fluids, laboratory cultures or stocks, and waste from the treatment of a known infectious patient.	• Infectious waste should be segregated from other wastes and handled in a manner that minimizes healthcare worker contact with the waste. • Highly infectious waste should be collected separately and autoclaved at the point of generation. Once disinfected, it can be stored and transported in an infectious waste container.	• Infectious waste should be stored in leak-proof containers or bags. • Infectious waste containers should be yellow with biohazard symbol.	• Advanced autoclave system • Autoclaving • Microwave treatment • Dry heat technology • Incineration with proper pollution control
Pathological Waste	Pathological waste includes human tissue, organs, placentas, or body parts. Pathological waste could also include blood and body fluids from surgery, autopsy waste, or test tubes containing specimens.	Pathological waste should be segregated from other wastes and handled in a manner that minimizes healthcare worker contact with the waste.	• Pathological waste should be stored in leak-proof containers or bags. • Pathological waste containers should be yellow with biohazard symbol.	• Maceration with chemical disinfection • Incineration with proper pollution control • Placenta burial pits

TYPE OF WASTE*	DESCRIPTION AND EXAMPLES	SPECIAL HANDLING CONSIDERATIONS	STORAGE AND LABELING CONSIDERATIONS	RECOMMENDED TREATMENT/DISPOSAL METHODS (MORE DETAILS IN ANNEX 2)
Pharmaceutical Waste	Pharmaceuticals that are expired, unused, spilt or contaminated. Examples include vaccines, antibiotics, sera, or other prescribed drugs.	Pharmaceutical waste should be segregated from other waste streams.	• Pharmaceutical waste should be stored in plastic bags or rigid containers. • Pharmaceutical waste containers should be brown and labeled with appropriate hazard symbol (e.g., corrosive, highly flammable, or toxic).	• Return to supplier, if possible. Check with suppliers to determine feasibility of and process for returns • Incineration with proper pollution control (requires temperatures of >1200°C for proper disposal) • Encapsulation
Cytotoxic (Antineoplastic) Waste	Cytotoxic waste includes outdated or excess pharmaceuticals used for chemotherapy or cancer treatment. These drugs can cause birth defects, mutations, or cancer. This waste stream also includes contaminated materials from drug preparation and administration or body fluids from treated patients.	• Waste should be segregated from other waste streams. • Due to the toxic nature of this waste, staff should wear chemo-resistant PPE when handling this waste type.	Waste should be stored in leak-proof containers and bags that are clearly labeled as cytotoxic waste, including the appropriate symbol.	• Incineration with proper pollution control (requires temperatures of >1200°C for proper disposal) • Encapsulation

TYPE OF WASTE*	DESCRIPTION AND EXAMPLES	SPECIAL HANDLING CONSIDERATIONS	STORAGE AND LABELING CONSIDERATIONS	RECOMMENDED TREATMENT/DISPOSAL METHODS (MORE DETAILS IN ANNEX 2)
Chemical Waste	Waste includes discarded or expired solid, liquid, or gaseous chemicals. Examples include cleaning and maintenance chemicals or diagnostic laboratory reagents. These chemicals have toxic, corrosive, flammable, oxidative, or reactive properties.	Chemical waste should be segregated according to compatibility (e.g., acids should be stored away from bases) into clearly labeled containers.	• Chemical waste containers should be brown and labeled with appropriate hazard symbol (e.g., corrosive, highly flammable, or toxic). • Containers should be compatible with the contents.	• Chemical treatment/ neutralization (only for certain chemicals) • Encapsulation • Sanitary landfill
Radioactive Waste	Waste materials contaminated with radionuclides. These materials are generated during patient treatment with radionuclides, imaging procedures, or laboratory activities.	Waste should be stored in containers that prevent the dispersion of radiation and stored behind lead shielding.	• Recommended container is a lead box. • Containers should be labeled with radiation symbol.	• Decay in storage • Encapsulation

* The *Construction Sector Environmental Guideline* and the *Small Healthcare Facilities Sector Environmental Guideline* provide information about waste management, including asbestos and lead, for hospitals under construction or rehabilitation. The *Solid Waste Sector Environmental Guideline* provides additional broader level waste management information. For all USAID *Sector Environmental Guidelines*, see USAID. 2019. *Sector Environmental Guidelines & Resources*. https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.

ANNEX 2: TREATMENT AND DISPOSAL OPTIONS FOR WASTES FROM SMALL-SCALE HEALTHCARE ACTIVITIES

A strong waste segregation system (i.e., sorting and separating different waste streams) is extremely important for reducing the volume of waste that requires special treatment and disposal. According to the World Health Organization (WHO), separating infectious from general waste reduces the amount requiring pre-disposal treatment by approximately 75–90%. In addition, separating sharps from other infectious wastes helps reduce the dangers associated with sharps waste, such as needlestick injuries. Other waste streams (e.g., PVC plastics, and/or materials containing heavy metals) can also be segregated for separate treatment and disposal.

The table below provides information regarding various healthcare waste (HCW) treatment and disposal methods (including advantages and disadvantages) and the types of wastes for which they are best-suited. The methods have been categorized as follows:

1. GREEN TIER: Environmentally preferable methods that are typically available and/or feasible in developing countries,
2. YELLOW TIER: Environmentally preferable methods that may not be available and/or feasible in developing countries (e.g., due to cost and/or availability of technology) or that are emerging technologies, and
3. RED TIER: Non-environmentally preferable methods that should only be used if more environmentally preferable options are unavailable.

This table is not intended to be an exhaustive list of options that are available or well-suited for every project or activity, nor an endorsement of one method over another by USAID. The inclusion of a treatment or disposal method in the table does not guarantee its effectiveness or appropriateness for specific cases. The costs and consequences of treatment and disposal methods should be considered when conducting environmental analyses and designing healthcare activities. Technologies should also be carefully evaluated before their selection in order to determine their viability. Beyond treatment and disposal technologies, it is also important to consider waste minimization strategies, as well as recycling and reuse, when and where appropriate.

With regards to incineration, Stockholm Convention guidance states that if HCW is incinerated in conditions that do not constitute best available techniques or best environmental practices, there is potential for the release of polychlorinated dibenzodioxins and polychlorinated dibenzofurans (commonly referred to as "dioxins and furans") in relatively high concentrations. Dioxins and furans are highly toxic air pollutants that are known to cause serious health issues. WHO states that small-scale healthcare incinerators often encounter significant problems and, therefore, concludes that "small-scale incineration is viewed as a transitional means of disposal for healthcare waste." WHO also advises using caution before selecting developing and emerging technologies (e.g., plasma pyrolysis, superheated steam, and/or ozone) for routine use since most do not have a demonstrable track record in HCW applications. See: World Health Organization (WHO). 2014. *Safe management of wastes from health-care activities, Second edition.* [Chartier, Y., J. Emmanuel, U. Pieper, A. Prüss, P. Rushbrook, R. Stringer, W. Townend, S. Wilburn and R. Zghondi (eds)]. ISBN 978 92 4 154856 4. Pages 117 and 126. https://www.who.int/water_sanitation_health/publications/wastemanag/en/.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
GREEN TIER: ENVIRONMENTALLY PREFERABLE TREATMENT/DISPOSAL METHODS THAT ARE TYPICALLY AVAILABLE AND/OR FEASIBLE FOR SMALL-SCALE HEALTHCARE WASTE MANAGEMENT				
Autoclave (Low-Heat Thermal Process)	Steam treatment of waste at high temperature (93–177°C) and pressure for enough time for sterilization. The exact temperate, pressure, and time of exposure needed for disinfection is dependent on the composition of the waste. This method is commonly used for sterilizing reusable medical equipment.	• Efficient at disinfecting. Can be used for infectious and sharps waste. • Pre-vacuum autoclaves are the most efficient type of autoclave. • If properly operated and maintained and if waste is properly segregated, has no significant adverse environmental impacts. • This technology is a widely available with established operating parameters.	• Requires trained/qualified operators. • Waste must be placed into autoclave appropriate (i.e., steam permeable) bags. • Cannot be used on pathological, pharmaceutical, radioactive, or chemical waste. • Waste-treatment autoclaves must include controls to ensure there is no release of pathological aerosols (i.e., HEPA filters) • Treated waste retains its physical appearance and volume. • Insufficient ventilation can lead to odors.	• This technology is widely available. • Capital costs are lower when compared to other waste treatment technologies.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Integrated Autoclave Systems (Advanced Autoclaves)	Functions as an autoclave, but also includes a mechanical process such as internal shredding or compacting, for volume reduction, to make the waste unrecognizable, and to improve heat transfer and distribution.	• Efficient at disinfecting. • Has no significant environmental adverse impacts if properly operated and maintained and if waste is properly segregated. • Highly automated and computer-controlled; reduced reliance on operator. • Reduced disinfection time. • Can be used for pathological waste. • Reduces waste volume by 85–90%.	• Cannot be used on pharmaceutical or chemical waste. • Waste must be placed into autoclave-appropriate (steam permeable) bags.	• This technology is widely available. • Capital costs can vary in price depending on the size and type of mechanical process incorporated into the system. • Higher capital cost than regular autoclaving.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Microwave Treatment (Low-Heat Thermal Process)	Waste is treated by steam generated when water contained in or added to the waste is heated by microwave energy. These systems often have a mechanical process (shredder or compactor) included.	• Efficient at disinfecting. • Has no significant environmental adverse impacts if properly operated and maintained and if waste is properly segregated. • Reduced disinfection time. • Simple to understand and generally requires only a single operator. • Lower operational costs (energy) when compared to autoclaves.	• Requires trained/qualified operators. • Waste must be placed into appropriate, steam permeable bags. • Microwave treatment is most efficient when waste is shredded or in small batches. Treated waste would retain its physical appearance and volume if a mechanical process is not used. • Cannot be used on pathological, pharmaceutical, radioactive, or chemical waste. • System must include controls to ensure there is no release of pathological aerosols (i.e., HEPA filters).	• Capital costs are higher when compared with other technologies.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Dry Heat Technology	Heat is applied to the waste without adding steam or water. Heat is created through conduction, convection, or thermal radiation.	• Has no significant environmental adverse impacts if properly operated and maintained and if waste is properly segregated. • Treatment of infectious, sharps, and pathological waste is feasible with this technology. • Treated waste is dry, and generally unrecognizable. • Generally, an easier installation and simpler operation requirements when compared to other waste treatment technologies.	• Best for small volumes of waste. • Requires higher temperatures and longer exposure times than other methods. • Should not be used for pharmaceutical, radioactive, or chemical waste. • Some organisms may not be destroyed because there is no moisture. • *Bacillus atrophaeus* spores are resistant.	• Capital costs can vary based on size but are generally lower when compared with other technologies. • While there are companies that offer this technology, they are not as widely available as autoclaves.
Encapsulation	The addition of immobilizing material (e.g., sand, clay, or foam) to a waste container and sealing it off prior to burial or storage.	• Used for pharmaceutical waste, chemical, or heavy metal waste. • Allows for safe transportation of hazardous wastes.	• Medical wastes are not sterilized or disinfected. • Increases the volume of waste to dispose. • Long term adverse environmental effects possible.	• Encapsulation costs are generally low. • Encapsulated waste would typically be transported to a sanitary landfill or buried on-site in lined pit.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
In-Country Disposal (Common Waste Treatment and Disposal Facility)	HCW streams are segregated and shipped to a consolidation point with an adequate disposal facility. Final disposal is coordinated at the consolidation point and can include sanitary landfill, incineration, autoclaving, or other appropriate method for each waste stream. The disposal facility is most often an incinerator with appropriate add-on controls for dust and acid removal.	• Various waste types and volumes can be accommodated. • More likely that adequate operational controls, including waste segregation and routine maintenance, are in place. • More likely that qualified operators are used. • More likely that pollutants are adequately controlled.	• Additional responsibility to properly store and transport waste. • Additional cost to properly store and transport waste. • Disposal costs dependent on availability and location of consolidated disposal facility.	• Feasibility dependent on availability of consolidated disposal operations and their willingness to accept HCW. • Requires large, secured storage area on-site until waste can be transported off-site.
Waste Exportation	Transportation of waste to adequate facilities in other countries for final disposal. Waste generator receives receipt of proof of waste disposal in environmentally sound manner in the state of importation (e.g., Certificate of Destruction). Refer to Section 2 of this SEG for information on the Basel Convention.	• No on-site disposal systems needed. • Does not require training disposal operators. • Provides access to treatment and disposal sites when no comparable alternatives are available locally.	• Highly regulated or, in some countries, prohibited. • Requires proper vetting of the transportation contractor to ensure proper qualifications and certifications, including of final disposal site. • Certain wastes are prohibited from import/export.	• Can be extremely costly due to specialized requirements for packing, labeling, shipping, and disposal. • Relatively high risk if handled by unqualified contractor. • Requires large, secured storage area on-site until waste can be transported off-site.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Double-Chamber ("Pyrolytic/ Starved Air") Incineration	A furnace of masonry/concrete, refractory materials and metal. Waste thermally decomposes in the first, oxygen-poor (pyrolytic) chamber, which operates at 800–900°C. In the second chamber, the gases produced in the primary chamber are burned at high temperature (1100–1600°C). If the temperature drops below 1100°C (the minimum requirement specified in the European Union's *Waste incineration directive 2000/76/EC*), additional energy should be provided by a gas or fuel burner.	• Disinfects very effectively. • Fewer toxic emissions, odor and smoke than single-chamber and drum incinerators (but still should not be used to incinerate PVC). • Reduces waste volume by ~95%. • Some mobile and containerized options available, along with varying sizes and options for add-on controls. • Potential for energy recovery through combustion.	• Effective performance requires qualified operators and regular maintenance. • Sharps in ashes will still pose physical hazard. • Without proper maintenance and operation practices, air pollution can occur including emission such as fly ash, acid gases, and some toxins.	Capital costs are higher when compared to other types of incinerators or waste disposal options.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Single-Chamber Incineration	A simple furnace of solid construction (e.g., concrete or brick). Waste is placed on a fixed grate. Burning is maintained by the natural flow of air. Operating temperature reaches <300°C. May need to add kerosene or similar fuel to maintain combustion.	• Disinfects effectively. • Reduces waste volume by ~80%. • Burning efficiency of 90–95%. • Potential for energy recovery through combustion.	• Without proper maintenance and operation practices, air pollution can occur including emission such as fly ash, acid gases, and some toxins. • May produce odors (can be limited by not burning PVC plastics; avoiding PVCs will prevent the worst toxin and odor problems). • Sharps in ashes will still pose physical hazard. • Not appropriate for most pharmaceutical or chemical waste.	Capital costs are lower when compared to other types of incinerators or waste disposal options.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Rotary Kilns	Comprises a rotating oven and a post-combustion chamber, allowing for the incineration of infectious waste (including sharps), pathological waste, chemical and pharmaceutical waste (including cytotoxic waste). Rotating oven is typically inclined 3–5% of slope, rotates 2–5 times a minute and is loaded with waste at the top. Available incineration capacities of rotary kilns range from 0.5 to 3 metric tons per hour.	• Incineration temperature between 1200–1600°C allows decomposition of very persistent chemicals, such as polychlorobiphenyls and genotoxic substances. • May operate continuously and can be adapted to a wide range of loading devices.	• Treatment of radioactive waste does not affect radioactive properties and may disperse radiation. • Likely requires exhaust-gas cleaning and ash treatment equipment if used to incinerate chemical waste, which produces exhaust gases and ashes potentially loaded with toxic chemicals.	• Frequent repair or replacement of kiln refractory lining required due to highly corrosive nature of wastes and incineration by-products. • Requires well-trained operators.
Return to Supplier	Unused and/or expired products are returned to the product supplier or manufacturer for proper disposal or reuse.	• Has no significant environmental impact. • Good method to use for expired or unused pharmaceutical, chemicals, or other medical supplies.	Most efficient when the facility has good inventory control processes.	• Few suppliers have programs that allow facilities to return unused or expired product. • Products must be stored in manner that keeps them in a condition that would allow them to be returned.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Mechanical Processing	Mechanical processing is used to reduce the volume of waste or break it down into smaller pieces. These methods are often combined with autoclaving or chemical disinfection to make the waste treatment/disposal process more efficient. Mechanical processing includes grinding, shredding, compacting, maceration, and needle cutters.	• Reduces bulky waste volume and mass including product packaging and other general solid wastes. • Prepares infectious waste for further treatment, including autoclaving or chemical disinfection. • Has no significant environmental adverse impacts if properly operated and maintained.	• Does not sterilize or disinfect waste. • May require qualified operators and continuous maintenance. • Not for use on infectious or biological waste unless combined with another treatment technology.	These systems are almost always combined with other treatment technologies to reduce waste volume or increase efficiency.
Composting/ Biological Processing	Microorganisms are added to the waste and break down the organic matter.	• Primary use for kitchen and yard waste. • Has no significant environmental impact. • Compost enriches soil with nutrients and can improve plant growth.	• Cannot be used for infectious or medical wastes. • Composting can be a time-consuming process.	This technology is very common and widely available for the treatment of organic waste.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
YELLOW TIER: ENVIRONMENTALLY PREFERABLE TREATMENT/DISPOSAL METHODS THAT ARE NOT TYPICALLY AVAILABLE AND/OR FEASIBLE FOR SMALL-SCALE HEALTHCARE WASTE MANAGEMENT				
Solar Incineration	High-temperature, refractory-lined metal incinerator that includes both primary and secondary chamber, similar in process to double-chamber incineration. Temperature range 800–1320°C.	• Reported by manufacturers. • Less non-renewable energy use and low fuel consumption, thus controlling operating costs and minimizing greenhouse gas (GHG) emissions. • Can disinfect effectively. • Reduces waste volume.	Smaller units, less residence time, less emissions control likely compared to larger incinerators at consolidated disposal facilities.	• Capital costs are higher when compared to other waste disposal options. • Newer technology still unavailable in many markets.
Plasma Pyrolysis (High-Heat Thermal Process)	HCW is exposed to intense heat (1650°C) generated by plasma-arc in an oxygen free environment. Waste is pyrolyzed into CO, H_2, and hydrocarbon gas.	• Reported by manufacturers: • Has no significant environmental impacts if properly operated and maintained. • Reduces the volume and mass of waste. • Chlorinated and other hazardous wastes do not have to be segregated except for mercury waste. • The gasses produced by this process may be used for energy recovery.	• Requires trained/qualified operators. • The potential to emit dioxins with these systems is still possible and should be monitored. • Very high temperature process with temperature reaching upwards of 1500°C. • These systems are generally complex, require high-energy consumption, and have significant installation requirements.	• There is the potential for energy recovery with these systems, however studies have shown that sites would need to treat 300 pounds of waste daily to be cost effective. • These systems are still in the development process for small-scale HCW treatment and have very high capital costs.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Irradiation	Waste is exposed to gamma rays (through a cobalt or other source) to kill bacteria or other pathogens.	• Waste can remain in bags during treatment. • Has no significant environmental adverse impacts if properly operated and maintained. • Reduced disinfection time.	• Irradiation is most efficient when waste is shredded or in small batches. This ensures more adequate exposure to the radiation source. • Treated waste retains its physical appearance and volume, unless mechanical processing is used. • Staff operating this technology should be protected and monitored for radiation exposure. • Should not be used for pharmaceutical, radioactive or chemical waste.	• Capital costs are higher when compared to other waste disposal options. • Many worker protections would need to be in place for operation.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Alkaline Hydrolysis (Chemical Treatment)	A high pH alkali solution is added under high heat and converts body parts and tissue into a decontaminated aqueous solution. This solution can be disposed of in the sanitary sewer.	• Has no significant environmental adverse impacts if properly operated and maintained. • Can be used to treat prion waste. • Can be used for treatment of pathological wastes. • Can be used for some pharmaceutical, cytotoxic, chemical, and radioactive wastes. • Reduces total waste volume.	• Requires trained/qualified operators. • Can take a longer time (4–8 hours) for the digestion to occur. • Best for small quantities of waste.	• Newer technology, with limited availability. • Capital costs are higher when compared to other waste disposal options.
Ozone (Chemical Treatment)	Waste is exposed to ozone in a controlled chamber for a set period. Waste is sterilized and then can be disposed of as regular solid waste.	• Has no significant environmental adverse impacts if properly operated and maintained. • Systems are usually fully enclosed and automated and requires limited waste handling. • Chemical free treatment as ozone can be generated on-site. • Reduced treatment times.	Requires shredding or mixing to be fully effective.	• Newer technology, with limited availability. • Capital costs vary based on the size and scope when compared to other waste treatment technologies.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Sanitary Landfill	HCW is transported off-site to sanitary landfill, where waste is isolated and degraded biologically, chemically, or physically.	• Can be used for many types of solid waste as permitted by the receiving landfill. • Potential for energy recovery through gas recovery.	• If not constructed appropriately (e.g., with liner and/or leachate management), sanitary landfill can cause significant environmental hazards including soil and ground water contamination. • Wastes may need to be disinfected prior to being sent to the sanitary landfill.	• Waste would need appropriate and reliable transportation to the available sanitary landfill. • Costs would be dependent on the availability of sanitary landfills in the area.
RED TIER: NON-ENVIRONMENTALLY PREFERABLE TREATMENT/DISPOSAL METHODS DUE TO POTENTIAL ENVIRONMENTAL AND HEALTH IMPACTS. INCLUDED FOR INFORMATIONAL PURPOSES.				
Open-Air Burning	Waste is burned in an area where smoke and other potentially hazardous emissions do not pass through a chimney or stack.	Readily available and cost effective.	• Releases hazardous air pollutants. • If the burning is not controlled, can lead to a larger, uncontrolled fire. • Poses many physical and health risks for employees tasked with managing the process.	• Burn areas are generally low cost and easy to establish on-site.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Burying	Waste is placed in a pit lined with clay or other impermeable material and covered with soil or lime. Pits should be located away from water sources and have security measures to keep unauthorized individuals away.	Can be used for many types of solid waste, including pathological wastes. Hazardous wastes may be secured in a separate area (e.g., fenced in) from nonhazardous wastes for additional safety.	• Not an effective method for disposing of chemical or other liquid wastes. • Medical wastes are not disinfected or sterilized during the process. • Improperly lined pits could lead to soil and groundwater contamination.	• Cost effective if done on-site. • Requires a larger area of land.
Drum or Brick Incinerator	A simple furnace with less mass and insulating value than a single chamber incinerator. Constructed out of an empty oil drum or a short chimney of bricks placed over a metal grate and covered with a fine screen. Operating temperature <200°C. May need to add kerosene or similar fuel to maintain combustion.	• Disinfects reasonably well, destroying 99% of microorganisms. • 80–90% burning efficiency.	• Emits black smoke, fly ash, acid gases, and some toxins. May produce odors (can be limited by not burning PVC plastics). Avoiding PVCs will prevent the worst toxin and odor problems. • Sharps in ashes will still pose physical hazard. • Not good for most pharmaceutical or chemical waste.	• Cost effective if done on-site. • Requires distance from residential areas.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Gas Sterilization	HCW is placed in an airtight chamber and exposed to a sterilizing gas (ethylene oxide or formaldehyde) to kill pathogens. This technology is generally used for the sterilization of reusable medical equipment.	• Efficient at disinfecting. • Has no significant environmental adverse impacts if properly operated and maintained.	• Requires trained/qualified operators. • Ethylene oxide and formaldehyde are highly toxic to humans. • Cannot be used on pathological, pharmaceutical, radioactive or chemical waste. • Treated waste retains its physical appearance and volume.	• Because of the high toxicity of ethylene oxide and formaldehyde, these treatment technologies are not very feasible due to the increased risk to operators. • These technologies are no longer as available or as frequently used as they have been in the past.

TREATMENT/ DISPOSAL METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	FEASIBILITY OF METHOD*
Chlorine-Based Chemical Treatment	Waste is exposed to chemical agents (e.g., sodium hypochlorite and/or chlorine dioxide) in a controlled environmental and for a set contact time to disinfect.	• Most suitable for liquid wastes, and in many cases the liquids can then be safely disposed of into the sewer system. • No combustion by-products. • Cost effective.	• Requires trained/qualified operators. • Increased chemical risk for staff. • Solid waste disinfection may require shredding or a stronger disinfectant. • Chemically disinfected waste may still require specialized disposal. • Microbial resistance to certain types of chemicals. • Cytotoxic waste, pharmaceuticals, and other hazardous wastes should not be treated with this technology. • Best for small quantities of waste.	• These systems are common and well established. • Capital costs are average when compared to other available waste technologies.

* "Capital costs" are used here in accordance with the WHO definition: "The purchase price for resource items with a life time above one year. Capital costs don't include shipment and customs costs, installation or eventual construction requirements to shelter the equipment." WHO provides methods for calculating the costs associated with setting up a HCWM system. See: WHO. 2019. *Costing estimation/ calculation methods*. https://www.healthcare-waste.org/resources/costing-calculations/. Additional resources for costing information include: 1) WHO. 2005. *Management of Solid Health-Care Waste at Primary Health-Care Centres A Decision-Making Guide.* https://apps.who.int/iris/bitstream/handle/10665/ 43123/ 9241592745.pdf?sequence=1; and 2) WHO, 2019. *Technologies.* https://www.healthcare-waste.org/?id=124.

ANNEX 3: HEALTHCARE WASTE PROGRAM CHECKLIST AND INVENTORY TEMPLATES

Waste Management Program Checklist

Checklist Completion Date: ________________

WASTE MANAGEMENT PROGRAM ELEMENT	IN PLACE? (Y/N)	ACTION PLAN (IF NOT IN PLACE)	ESTIMATED COMPLETION DATE	POINT OF CONTACT
WRITTEN PLANS AND PROCEDURES				
1. Written Waste Management Plan Plan should include information for the handling, storing, treating, and disposing of waste generated at the facility. Training, vaccination, and other requirements for workers, such as personal protective equipment (PPE), should also be included.				
2. Internal Waste Management Procedures Procedures should include step by step processes for internal waste handling, storage, treatment, and disposal. They should clearly assign roles and responsibilities. Procedures may also include waste minimization, reuse, and recycling activities.				
3. Periodic Review Periodic reviews of all plans and procedures are established and followed to determine effectiveness and appropriateness. Plans and procedures that are found to be inadequate or ineffective are revised.				
STAFF TRAINING AND PROTECTION				
4. Waste Management Training Staff should receive routine and periodic training on the proper handing, storage, treatment, and disposal of all waste generated at the facility. Training should include all elements of the facility's Waste Management Plan (WMP), staff responsibilities, and inventory management.				

WASTE MANAGEMENT PROGRAM ELEMENT	IN PLACE? (Y/N)	ACTION PLAN (IF NOT IN PLACE)	ESTIMATED COMPLETION DATE	POINT OF CONTACT
5. Personal Protective Equipment Staff who handle waste have access to the appropriate PPE, such as clothes, masks, gloves, and/or aprons. Staff can demonstrate the proper use of PPE.				
6. Occupational Health and Safety Staff are vaccinated and practice good hygiene (e.g., handwashing with soap and, ideally, warm water), as appropriate for their roles. Waste handlers, for example, should be vaccinated against Hepatitis B and tetanus.				
WASTE MANAGEMENT PRACTICES				
7. Waste Minimization Staff follow good waste minimization practices, per the facility WMP. Waste minimization may include good inventory management (e.g., using oldest batches first), reuse, or recycling practices.				
8. Waste Segregation Staff follow good waste segregation practices, per the facility WMP. Waste segregation includes separating HCW according to the waste type, and ensuring waste is stored in the appropriate containers.				
9. Waste Storage and Labeling Facility has adequate waste containers for collection and designated long-term storage locations on-site. Containers should be appropriately labeled, covered, leak-proof and puncture resistant. Storage location should be an indoor, secured area located away from facility staff, patients, water sources, and food.				
10. Waste Collection Waste is collected daily or at a frequency appropriate for the generation rate, waste type, climate, and/or season.				

WASTE MANAGEMENT PROGRAM ELEMENT	IN PLACE? (Y/N)	ACTION PLAN (IF NOT IN PLACE)	ESTIMATED COMPLETION DATE	POINT OF CONTACT
WASTE TREATMENT AND DISPOSAL				
11. On-Site Treatment/Disposal Waste is treated in accordance with the WMP and the best management practices available at the facility. These waste management treatment options may include autoclaving, microwaving, incineration, or staging for transportation to appropriate off-site treatment facilities.				
12. Off-Site Treatment/Disposal If necessary, waste is safely transported off-site for final treatment and disposal. Off-site transport typically requires appropriately licensed waste transporters, approved vehicles, and certified treatment/disposal facilities. Waste generator should ensure it receives a waste receipt, documenting safe final treatment/disposal of the waste.				

Prepared by: ________________________________

Waste Inventory Sheet (Daily)

Month: ______________________ Waste Inventory Point of Contact: ___________________________________

WASTE TYPES (KG) / DATE	NONHAZARDOUS/ GENERAL WASTE	SHARPS WASTE	RAPID TEST KITS (RTKS)/OTHER DISPOSABLES	INFECTIOUS WASTE	PATHOLOGICAL WASTE	PHARMACEUTICAL WASTE	CYTOTOXIC (ANTINEOPLASTIC) WASTE	CHEMICAL WASTE	RADIOACTIVE WASTE	OTHER WASTE	INITIALS	COMMENTS
Example: 2/1/2019	20 kg			5 kg				2 kg			RF	Waste was placed in main storage area.
Add rows as needed…												
MONTHLY TOTALS (KG)*												

* Waste types should be totaled monthly and added to the Monthly Waste Inventory Sheet.

Waste Inventory Sheet (Monthly)

Review Date: ______________________ Waste Inventory Point of Contact: ___________________________________

ON-SITE INFORMATION							OFF-SITE INFORMATION		COMMENTS
WASTE DESCRIPTION	WASTE TYPE*	HAZARDOUS OR NONHAZARDOUS	MONTHLY QUANTITY	GENERATING ACTIVITY OR AREA	STORAGE LOCATION	SDS**	TRANSPORT	DISPOSAL	
Example: Packaging (cardboard)	General	Nonhazardous	10kg	Storage room, administrative office, misc.	Recycling bin behind administrative office	N/A	Call WeRecycle for pickup when bin is close to full	Paid service with WeRecycle for recycling of materials	Can we ask for less packaging on procured materials?
Add rows as needed…									
Total Monthly Hazardous Waste: _________ Total Monthly Nonhazardous Waste: ________									

* Waste Types: Nonhazardous/General, Sharps, Rapid Test Kits/Other Disposables, Infectious, Pathological, Pharmaceutical, Cytotoxic (Antineoplastic), Chemical, and Radioactive.

** Terminology per the United Nations Globally Harmonized System (GHS). Some countries may still refer to these documents as Material Safety Data Sheets (MSDS).

ANNEX 4: MITIGATION AND MONITORING OF ENVIRONMENTAL AND SOCIAL IMPACTS IN PROJECT AND ACTIVITY IMPLEMENTATION

The Annex 4 table identifies the potential adverse environmental and social impacts associated with healthcare waste (HCW) management activities and the measures that can be implemented to mitigate these impacts. The table includes activities that may generate HCW (e.g., procurement, storage, distribution/use, and treatment/disposal of commodities), as well as activities directly involving the HCW (e.g., waste storage, transportation, and treatment/disposal). The scope of treatment/disposal activities covered by this table is limited to those that would typically be elements of USAID healthcare projects (e.g., incinerators) and does not include discussions of systems for the broader management of wastes (e.g., municipal landfills). For guidance related to those systems, refer to the *Solid Waste Sector Environmental Guideline*: https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.

Monitoring indicators described in the table include procedures, plans, or other records used to monitor the implementation of mitigation measures and continually improve HCW management practices. These indicators, along with the associated mitigation measures, are intended as suggested examples and do not represent an exhaustive list of considerations.

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
PROCUREMENT ACTIVITIES THAT MAY GENERATE HEALTHCARE WASTE		
Disease Transmission • Procurement of syringes without retractable needles (smart syringes) enables unauthorized reuse (or resale by scavengers), thus increasing the risk of disease transmission. • Procurement or inadvertent acceptance of health commodities (e.g., vaccines) that are defective, expired, or counterfeit may render them ineffective and, therefore, allow disease transmission to continue. **Physical Injury** • Procurement of needles that are not single-use smart syringes increases the risk of needle-stick injuries.	• Conduct quantification analysis to determine supply needs and develop a supply plan. • Coordinate forecasting and supply planning activities with quantification team (e.g., host country officials and/or program staff) to meet current needs and minimize the risk of stock-outs or surplus of health commodities. • Procure health commodities that consider ratio of commodities to target population, existing supply of commodities, and supply of commodities from non-USAID sources (e.g., other donors).	• Supply plan • Supply forecast • Inventory control system • Product specifications • Procurement records • Disposal records • Site visits (announced and unannounced) to verify mitigation measures are being implemented correctly and are effective

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
• Procurement or acceptance of health commodities that are defective, expired, or counterfeit may cause illness or physical injury from use of defective items and indirectly generating more HCW. **Air Pollution** • Procuring an oversupply of or defective/expired/counterfeit health commodities increases probability of expiration on the shelf and need for disposal, which increases the potential for air pollution (e.g., due to incineration and/or transportation for disposal). **Soil Pollution** • Procuring an oversupply of or defective/expired/counterfeit health commodities increases probability of expiration on the shelf and need for disposal which increases the potential for soil pollution (e.g., due to increased volume of waste requiring sanitary landfilling and/or lined pit burial). **Water Pollution** • Procuring an oversupply of or defective/expired/counterfeit health commodities increases probability of expiration on the shelf and need for disposal which increases the potential for water pollution (e.g., due to leakage and/or spills). **Social Impacts** • Poor procurement processes can impede delivery of healthcare services, especially at the small-scale clinic level, which may further exacerbate socioeconomic inequities in access to critical health services among vulnerable populations (e.g., poor, elderly, women, and children).	• Manage inventory of stock to minimize potential for diversion in commodity distribution. • Procure health commodities that comply with host country and international regulatory, shipping, and packaging requirements to ensure that only appropriate products enter the supply system. • Negotiate manufacturer take-back clauses and sustainability criteria including minimal, recyclable packaging and environmentally preferred transportation in health commodity procurements, if possible. • Develop and implement an inspection and quality assurance process for assessing and monitoring product quality. • Maintain copies of procurement records (e.g., manufacturing records, chain of custody manifests, Certificate of Analysis, test data, and/or regulatory certificates) and copies of quality documentation on file.	

<table>
<tr><th>POTENTIAL ADVERSE IMPACTS</th><th>MITIGATION MEASURES</th><th>MONITORING INDICATORS</th></tr>
<tr><td colspan="3">CONSTRUCTION OR REHABILITATION ACTIVITIES THAT MAY GENERATE HEALTHCARE WASTE</td></tr>
<tr><td colspan="3">Refer to the Construction Sector Environmental Guideline and the Small Healthcare Facilities Sector Environmental Guideline for information regarding waste management for hospitals or facilities under construction or rehabilitation, including management of wastes containing asbestos, lead, and other hazardous materials. All USAID Sector Environmental Guidelines may be found at: USAID. 2019. Sector Environmental Guidelines & Resources. https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.</td></tr>
<tr><td colspan="3">WATER, SANITATION, AND HYGIENE ACTIVITIES THAT MAY GENERATE WASTEWATER</td></tr>
<tr><td colspan="3">Refer to the Water and Sanitation Sector Environmental Guideline for information regarding waste management related to public health improvement projects conducting potable water, sanitation, and hygiene activities. All USAID Sector Environmental Guidelines may be found at: USAID. 2019. Sector Environmental Guidelines & Resources. https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.</td></tr>
<tr><td colspan="3">STORAGE OF HEALTHCARE WASTE / STORAGE ACTIVITIES THAT MAY GENERATE HEALTHCARE WASTE</td></tr>
<tr><td>Disease Transmission
Improper storage (e.g., not using puncture proof containers, not segregating, overfilling containers, and/or not color-coding bins) of HCW can increase the risk of disease transmission through contamination, exposure to infectious materials, and potential needlestick injuries.
Physical Injury
Improper storage of HCW can increase the risk of physical injury when waste containers are overfilled, unlined, left open, or not labeled.
Air Pollution
Improper storage of health commodities can result in damage to the commodity, increasing the quantity of HCW requiring treatment and/or disposal and the potential for air pollution (e.g., due to incineration and/or HCW transportation for disposal).</td><td>Refer to Annex I for detailed guidance on handling, storing, and labeling various types of HCW.
Develop and implement a Standard Operating Procedure (SOP) for the safe and effective storage of healthcare commodities to reduce damage or early expiration.
Develop and implement a Waste Management Plan (WMP) or comparable SOP for the safe storage of HCW to reduce the potential for disease transmission and physical injury.
Provide training to workers on the WMP/SOP developed for the safe and effective storage of healthcare commodities and HCW.
Conduct site inspections to determine that WMP/SOP and training programs are implemented and effective.</td><td>WMPs/SOPs, including waste collection and storage plans
Training program records
Photographs
Records/ manifests of generation/ transport
Site visits (announced and unannounced) to verify mitigation measures are being implemented correctly and are effective</td></tr>
</table>

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
• Improper storage of health commodities or HCW that contain hazardous chemicals can lead to the release of toxic air pollutants. **Soil Pollution** • Improper storage of health commodities can result in damage to the commodity increasing the need for disposal which increases the potential for soil pollution (e.g., due to increased volume of waste requiring sanitary landfilling and/or lined pit burial). • Improper storage of health commodities or HCW that contain hazardous chemicals can lead to leaks and spills that can ultimately cause soil pollution. **Water Pollution** • Improper storage of health commodities can result in damage to the commodity increasing the quantity of HCW requiring disposal, which increases the potential for water pollution (e.g., due to leakage and/or spills). • Improper storage of health commodities or HCW that contain hazardous chemicals can lead to leaks and spills that can ultimately cause water pollution. **Social Impacts** • Improper storage of health commodities can impede delivery of healthcare services, especially at the small-scale clinic level, which may further exacerbate socioeconomic inequities in access to critical health services among vulnerable populations (e.g., poor, elderly, women, and children). • Workers engaged in HCW-related activities are particularly at risk from poor HCW storage practices, especially if worker welfare provisions are not in place (e.g., mandatory vaccination of certain workers and/or incident response procedures).		

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
COMMODITY DISTRIBUTION AND IMPLEMENTATION ACTIVITIES THAT MAY GENERATE HEALTHCARE WASTE		
Disease Transmission • Improper distribution or use of health commodities may render them ineffective and, therefore, allow disease transmission to continue. **Physical Injury** • Improper distribution and use of needles, razors, scalpels or other sharps increases the risk of needle-stick injuries. **Air Pollution** • Improper distribution and use of health commodities can result in reduction in quality through inadequate temperature or humidity controls, damaged or defective supplies which increases the need for treatment and/or disposal and the potential for air pollution (e.g., due to incineration and/or transportation for disposal). **Soil Pollution** • Improper distribution and implementation of health commodities can result in reduction in quality through inadequate temperature or humidity controls, damaged or defective supplies which increases the need for disposal and increases the potential for soil pollution (e.g., due to increased volume of waste requiring sanitary landfilling and/or lined pit burial). **Water Pollution** • Improper transportation of health commodities can result in reduction in quality through inadequate temperature or humidity controls, damaged or defective supplies which increases the need for disposal and increases the potential for water pollution (e.g., due to leakage and/or spills).	• Develop and implement SOPs, including those in the WMP, for the safe distribution and use of health commodities. • Provide training to workers and drivers on distribution and implementation of health commodities, including inventory and cold chain management during transport. • Include supplies for clean-up in the event of an accident during distribution. • Conduct site visits to verify that workers and drivers are trained and following the WMP/SOPs. • Where possible encourage energy efficient modes for commodity distribution /transportation. • Monitor worker welfare to ensure adequate protections are in place and inequalities are addressed.	• WMPs/SOPs, including commodity distribution plans • Clean-up supplies • Training program records • Photographs • Site visits (announced and unannounced) to verify mitigation measures are being implemented correctly and are effective • Worker welfare monitoring can be carried out via qualitative interviews, anonymous reporting, grievance mechanism, and independent audits

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
Social Impacts • Improper commodity distribution and implementation activities can impede delivery of healthcare services, especially at the small-scale clinic level, which may further exacerbate socioeconomic inequities in access to critical health services among vulnerable populations (e.g., poor, elderly, women, and/or children). • Activities may exacerbate issues with workers' welfare and rights, which may not be prioritized by certain employers and governments or which may not be adequately protected for vulnerable populations (e.g., women and children). This may, in turn, increase their risk of developing health problems or becoming victims of crime or exploitation.		
TREATMENT AND DISPOSAL OF SOLID WASTE (GENERALLY)		
Refer to the *Solid Waste Sector Environmental Guideline* for information regarding planning and implementation of systems for the reduction, collection, treatment, and disposal of wastes. USAID interventions targeting the solid waste management sector help public authorities and communities in the developing world to improve the capacity, systems, and infrastructure needed to manage solid waste (e.g., landfills) through financial and technical assistance and partnerships. This focus differs from that of the *HCW Sector Environmental Guideline*, which aims to guide healthcare project managers, implementers, and workers in properly managing waste generated by their projects. All USAID *Sector Environmental Guidelines* may be found at: USAID. 2019. *Sector Environmental Guidelines & Resources*. https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.		
TREATMENT AND DISPOSAL OF HEALTHCARE WASTE (SPECIFICALLY)		
Disease Transmission • Workers and others handling HCW without using the appropriate personal protective equipment (PPE) may come in direct contact with hazardous HCW including, infectious or sharps waste, which could lead to disease transmission.	• Refer to Annex 1 for detailed guidance on handling, storing, and labeling various types of HCW. • Refer to Annex 2 for detailed guidance on various HCW treatment and disposal methods.	• WMPs/SOPs, including waste treatment and disposal plans • Training program records • Contractor licenses and SOPs • Transportation and disposal documents/records

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
• Unsecured or improperly managed landfills/dump sites/intermediate or satellite storage areas may allow scavengers to collect disposed health commodities and reuse or circulate them in the community, which could result in disease transmission. • Infectious waste that is not treated properly could enter the water supply and increase the potential of disease transmission. • Poor incineration practices (e.g., incineration of unsuitable materials, improper operation, and/or lack of maintenance) can result in the release of pollutants (e.g., particulate matter, heavy metals, dioxins, and furans) into the air or fail to kill infectious agents, which can lead to diseases in people, animals, and plants in surrounding areas. **Physical Injury** • Workers and others handling HCW, such as waste disposal contractors, may come in direct contact with sharps or chemical waste during disposal activities, which could lead to physical injury, such as burns or needle-stick injuries. **Air Pollution** • Improper waste segregation allows materials unsuitable for burning (e.g., chemicals or PVC plastics) to be incinerated, potentially releasing toxic air pollutants. • The use of vehicles to transport wastes (e.g., fuel operation and/or maintenance) can release toxic air pollutants. • Open burning or improper operation and maintenance of incinerators can release toxic air pollutants.	• Develop and implement a WMP/SOP that provides procedures for disposing of HCWs in conformance with international best practices and host country requirements. Management considerations include, but are not limited to waste minimization procedures, proper handling of wastes, storage of wastes (including PPE), containers and labeling, safe treatment and disposal practices and procedures (including fire safety), inspection protocols and frequency, and documentation requirements (including waste manifests). • Provide training to workers on the WMP/SOP developed for properly handling, segregating, storing, and treating/disposing of HCW. • Conduct site visits to document that workers are trained on and following the WMP/SOP. • Ensure waste disposal contractors have SOPs established for properly transporting, treating, and disposing of HCW off-site in conformance with host country requirements and international best practices. • Conduct site visits to verify that waste disposal contractor is following SOPs and that appropriate documents and records are being collected/maintained. • Encourage the use of environmentally preferred technologies, if possible.	• Site visits (announced and unannounced) to verify mitigation measures are being implemented correctly and are effective • Worker welfare monitoring can be carried out via qualitative interviews, anonymous reporting, grievance mechanism, and independent audits • Systematic M&E efforts showing documented improvements relating to human rights protection • Traffic monitoring – via direct observation surveys, GPS tracking, and complaints monitoring – and review of waste collection plan

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
Soil Pollution • Disposal of HCW in unlined landfills/pits/dump sites may lead to leaching of hazardous waste into the soil. • Improper operation and maintenance of incinerator or open burning can release toxic particles, smoke, and ash that can settle and create soil pollution. **Water Pollution** • Disposal of HCW in unlined landfills/pits/dump sites may lead to leaching of hazardous waste into surrounding water sources. • Disposal of HCW (e.g., chemical or pharmaceuticals) into sanitary wastewater systems or into natural waterways can lead to water pollution[7]. **Social Impacts** • Poorly managed HCW treatment/disposal activities may lead to quality of life impacts on neighboring communities (e.g., air quality degradation, increased noise levels, and/or foul odors) and further exacerbate socioeconomic inequities among vulnerable populations (e.g., poor, elderly, women, and children).	• Cover HCW in landfills/pits/dump sites with earthen material (U.S. EPA recommends 6 inches) on a daily basis to control disease transmission, pests, odors, scavengers, or other impacts. • Install access controls (e.g., fences and/or warning signs) to HCW activity locations (e.g., incinerators or landfills/pits) to limit improper access to such areas, especially if contamination exists. • Monitor worker welfare to ensure adequate protections are in place and inequalities are addressed. • Screen visual/odor/noise impacts of HCW treatment/disposal activities through tree plantings, solid fencing/walls, or other screening methods. Incorporate community art and/or architectural features where possible. • Develop and implement a waste collection plan designed to minimize traffic impacts associated with off-site HCW transportation, including appropriate timing of vehicle movements, efficient routing, and appropriate vehicle selection.	

[7] The *Construction Sector Environmental Guideline* provides more information about waste management for hospitals and clinics under construction or rehabilitation. The Small Healthcare Facilities Sector Environmental Guideline provides guidance on operating hospitals and clinics. The Water and Sanitation Sector Environmental Guideline discusses considerations for potable water and sanitation. For all USAID Sector Environmental Guidelines, see USAID. 2019. *Sector Environmental Guidelines & Resources*. https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.

POTENTIAL ADVERSE IMPACTS	MITIGATION MEASURES	MONITORING INDICATORS
• Activities may exacerbate issues with workers' welfare and rights, which may not be prioritized by certain employers and governments or which may not be adequately protected for vulnerable populations (e.g., women and children). This may, in turn, increase their risk of developing health problems or becoming victims of crime or exploitation. • Off-site transportation of HCW for treatment/disposal can increase accidents and traffic flow through certain communities, causing disturbance to community members.		