WORLD BANK GROUP

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Environmental, Health, and Safety Guidelines

HEALTH CARE FACILITIES

2026

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1 INTRODUCTION

1. The Environmental, Health, and Safety Guidelines (EHS Guidelines) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).[1] They are comprised of the General Environmental, Health, and Safety Guidelines (General EHS Guidelines) and Industry-specific Sector Guidelines (Industry Sector EHS Guidelines). The General EHS Guidelines present common environmental, health, and safety (EHS) issues that potentially apply across industry sectors. The Industry Sector EHS Guidelines present EHS issues specific to each industry sector.

2. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as described in their respective policies and standards. The Industry Sector EHS Guidelines are designed to be used together with the General EHS Guidelines. For complex projects, multiple Industry Sector EHS Guidelines may be relevant. A complete list of Industry Sector EHS Guidelines can be found at www.ifc.org/ehsguidelines.

3. The EHS Guidelines specify the performance levels and measures that are generally considered to be GIIP and achievable in new facilities by using existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve establishing site-specific targets, with an appropriate timetable for achieving them.

4. The applicability of EHS Guidelines should be tailored to the hazards and risks identified for each project based on results of an impact assessment that considers site-specific variables, such as host country context, assimilative capacity of the environment, and other project-specific factors. The applicability of specific technical recommendations should follow GIIP and be based on the professional opinion of qualified and experienced professionals. When host country's regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent measures than those in the EHS Guidelines are appropriate due to specific project circumstances, a detailed justification for any proposed alternatives is needed as part of the site-specific assessment and should demonstrate that the alternate performance levels are protective of human health and the environment.

5. The scope of the EHS Guidelines includes environmental, occupational health and safety, and community health and safety aspects. Guidance on social aspects is not included and can be found in relevant Guidance Notes to IFC/MIGA Performance Standards, relevant Guidance Notes to World Bank E&S Standards, and various other World Bank Group good practice publications.

2 APPLICABILITY

6. The EHS Guidelines for Health Care Facilities (HCF) include information relevant to major HCF, such as large district-level or general hospitals with multiple specialties or trauma facilities; minor or specialized HCF, such as primary care centers, specialist

[1] GIIP is defined as the professional skill, diligence, prudence, and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of prevention and control techniques available to a project may include, but are not limited to, varying levels of EHS capabilities and capacities, and financial and technical feasibility.

clinics, outpatient, ancillary and ambulant facilities; and temporary HCF, such as field hospitals, disaster-related temporary facilities, and alternate health care sites. Ancillary facilities may include medical laboratories and research facilities, mortuary centers, and blood banks and collection services. The guidelines do not cover digital clinics or telemedicine services. See Annex A for a description of industry activities.

3 SITING AND DESIGN CONSIDERATIONS

7. This section summarizes key aspects related to project siting and design for this industry sector. Design considerations for buildings and ancillary facilities that are common to various industry sectors are detailed in the General EHS Guidelines.

8. HCF should be planned, designed, constructed, and operated to maintain continuity of essential services and protect the health and safety of workers, patients and communities throughout their operational life. Siting criteria for new facilities should aim to minimize community exposure to pollutants and hazardous materials. This includes assessing waste and effluent management options—such as on-site or off-site disposal and incineration—and considering emission dispersion and other location-specific factors**.** During the planning and design phases, internationally recognized guidelines and standards should be consulted to align with good practices.[2]

9. Design planning should incorporate locally downscaled climate projections and risk assessments to identify potential hazards such as flooding, extreme heat, severe storms, and drought. Where significant climate risks exist, measures to maintain structural integrity and resilience, accessibility, reliable energy and water supply, and operational functionality, should be considered, especially during anticipated extreme events, including emergency response.[3]

10. HCF design should integrate infection prevention and control measures across all phases of planning, construction, maintenance, and renovation, expansion or refurbishments to prevent harm to patients, workers, and visitors.[4] In addition to the hazard identification (HAZID) process described in the General EHS Guidelines, conduct an infection control risk assessment (ICRA) during early planning and update it regularly during construction and/or renovation. The ICRA should help identify infection sources and pathways; identify legacy systems and risks (e.g., HVAC); classify patient vulnerability; define construction activity classes; establish containment and mitigation strategies; and contractor-specific risk management protocols. Operational measures to reduce infectious disease transmission attributable to renovation, demolition and maintenance activities are described in Section 4.2.1.

11. Table 1 presents facility-specific design considerations.

[2] AHIA, *Australasian Health Facilities Guidelines*; FGI, *Design and Construction Hospitals*; IAHSS, *Design Guidelines Healthcare Facilities*; IFC, *EDGE Hospitals*; JCI, *Design Construction Health Facilities; iHFG, Health Facility Design Planning.*
[3] WHO, *Climate Resilient Health Care Facilities*.
[4] US CDC, *HAI Prevention Toolkits*; HSE, *National Guidelines Nosocomial Aspergillosis*; Zilberberg et al., "Epidemiology of Invasive Aspergillosis," 727-735; ASHE, *ASHE ICRA 2.0™ Toolkit*; AHIA, *Australasian Health Facilities Guidelines*.

Table 1. Design considerations for health care facilities

	Type of facility		
	Major HCF	**Minor/Specialized HCF**	**Temporary HCF**
Examples by type of facility	• General-purpose or multifunction hospitals or clinics with high patient capacity (>100 beds)[a], multiple specialists, and a complex waste profile • Research institutes with a complex waste profile	• Single-function hospitals, generic health clinics or centers with small patient capacities (<100 beds)[b] and a simple waste profile • Rural health centers or posts • Radiology clinics • Pregnancy and birth centers • Blood banks • Stand-Alone Medical Laboratories • Hospice homes • Mental health clinics • Ambulant facilities • Alternative medicine clinics (e.g., acupuncture) • Research institutes with a simple waste profile	• Modular or field HCF, commonly referred to as Alternate Care Sites (ACS), including: o Pop-up vaccination facilities o Field hospitals or clinics o Facilities housed in temporary structures, generally with a single function and a simple waste profile
Common HCF design considerations	Siting, structural design safety, life and fire safety, infection control, potable water supply, food safety, energy and resource efficiency, accessibility, hazardous (e.g., pathological, infectious, cytotoxic, radiological, chemical) and non-hazardous (e.g., uncontaminated packaging/solids), waste management and final disposal options		
Examples of specific HCF design considerations	• On-site waste/effluent treatment • Infrastructure and planning to support a diverse range of specialties and general practice • Waiting rooms with high patient capacity, infectious patient segregation • Design standardization for rooms and distance minimization for patient transfers • Design HVAC systems to control airborne infectious disease outbreaks taking into consideration the following factors: room dimensions, building layout, contaminant type, climate, occupancy, and work activities[5] • Emergency/backup electricity generation • Vertical and floor design to increase patient and worker safety • Vertical transportation system • Vehicle traffic and crowd management • The containment of microbiological, chemical, radiological, and physical hazards appropriate to the level of assessed risks in work areas	• On-site or off-site waste/effluent treatment • Specialty-specific EHS considerations (e.g., ionizing radiation, hazardous sharps) • Emergency/backup electricity generation • The containment of microbiological, chemical, radiological, and physical hazards appropriate to the level of assessed risks in work areas • Other case-by-case considerations, in line with Major or Temporary HCF	• Off-site waste/effluent treatment (or temporary on-site treatment e.g., portable systems or storage) • Sustainable/reusable/salvageable materials when such facilities are commissioned/decommissioned • Redesign, adaptation, or conversion of existing facilities (e.g., hotels, stadiums, schools) • Other case-by-case considerations, in line with Major or Minor HCF

[5] ASHRAE, *Health Care Facilities Resources,* including *Standard 170 – Ventilation.*

	Type of facility		
	Major HCF	**Minor/Specialized HCF**	**Temporary HCF**

Notes
a This figure varies by context and jurisdiction and should be considered alongside other major HCF characteristics. A "simple waste profile" includes general non-hazardous waste, while a "complex waste profile" includes multiple types of hazardous waste.
b Minor/specialized HCF may pose higher risk related to the ratio of hazards per patient or facility size; these guidelines should be considered with respect to the overall risks rather than bed count alone.

12. Most HCF are public access buildings, often serving patients unable to self-evacuate during emergencies. Design considerations include:

    - Layouts that support infection control, ergonomics, waste segregation, and efficient patient and worker flow, including during outbreaks or pandemics
    - Adequate storage, maintenance, and safe removal of personal protective equipment (PPE)
    - Durable, non-toxic, slip-resistant, and nonallergenic materials to facilitate cleaning, sterilization, and safety
    - Isolation and redundancy for critical systems (HVAC, plumbing, electrical and waste management) to prevent exposure to hazardous, infectious, or radioactive materials[6]
    - Integrated life and fire safety (LFS) features for partial or full evacuations[7]
    - Emergency power, water, food supplies, and medical gases to sustain essential operations during service interruptions
    - A management of change (MOC) process for new and existing facilities (e.g. expansion/refurbishment) that includes risk assessments for all relevant safety controls of infrastructure and operations

13. Temporary HCFs, or Alternate Care Sites (ACS), are set up during emergencies, including epidemics or pandemics, to expand medical care capacity. These may be repurposed, newly built, or temporarily converted structures not always physically connected to a major/minor HCF, though they may be located nearby. Common ACS examples include hotels, offices, stadiums, tent cities, modular units, and former hospitals. ACS design guidelines vary widely and require site-specific assessments for logistics, accessibility, infection control, waste, life and fire safety, and HVAC concerns, as well as security and patient management.[8]

4 CONSTRUCTION AND OPERATIONAL CONSIDERATIONS

14. This section provides a summary of sector-specific EHS risks typically associated with the operational phase and provides guidance for mitigation and management measures. Where there are unique aspects to the construction, refurbishment, and decommissioning of this industry sector, guidance is also included. Recommendations for EHS issues and management common to the construction, refurbishment, and decommissioning phases of various sectors are provided in the General EHS Guidelines.

[6] ASHRAE, *Ventilation of Health Facilities*. This document includes GIIP ventilation rates in various HCF settings.
[7] NFPA, *Health Care Facilities Code*. This resource includes comprehensive guidance on fire protection design considerations.
[8] ASHRAE, *Alternate Care Site HVAC;* IAHSS, *Alternate Care Sites*; ICC, *Structures for Temporary Healthcare*; IMERT, *Temporary Medical Treatment Stations.*

15. Facilities should maintain an integrated environmental, health, and safety (EHS) management system to continually identify risks, assess potential impacts, and implement mitigation, monitoring and control measures. The facility's management system should be tailored to the type of HCF and its associated risks.[9]

4.1 Environment

16. Key environmental issues for HCF include:

- Waste management
- Air emissions
- Wastewater

4.1.1 Waste Management

17. Health care waste can be classified into:

- Non-hazardous waste -- like domestic waste, from administrative, housekeeping, and maintenance activities
- Hazardous health care waste -- sharps and clinical waste that may be infectious, pathological, pharmaceutical, chemical, cytotoxic, or radioactive[10]

Management options for these waste categories are described in table 2.

18. HCFs should regularly quantify and classify waste to inform planning and minimization and should refer to guidance on waste management in the General EHS Guidelines and other GIIP.[11] HCFs should establish and maintain a Health Care Waste Management System (HWMS) appropriate to its scale, waste streams and volumes, infrastructure and available waste collection and treatment services. All workers involved in waste management should be trained in all HWMS procedures. The HWMS may include the following components depending on the HCF's scale and type.

Waste Minimization, Reuse, and Recycling

19. HCFs should minimize waste generation and maximize reuse and recycling of materials without compromising patient hygiene or safety protocols. In addition to the recommendations in the General EHS Guidelines and more comprehensive guidance from the World Health Organization (WHO), specific HCF considerations include:

- Neutralize or transform active/expired medicines to reduce toxicity.[12]
- Use physical cleaning practices (e.g., microfiber mops) instead of chemicals where hygiene standards allow.
- Sterilize or disinfect reusable equipment (e.g., sharps containers, refillable gas cylinders).

[9] IFC, *Guidance Notes Performance Standard 1*. These resources provide details on management systems. In some cases, companies may decide to establish and maintain specific management systems for different topics, such as an OHS Management System.
[10] Infectious waste can be categorized as waste contaminated with blood and other bodily fluids (e.g., from discarded diagnostic samples), cultures and stocks of infectious agents from laboratory work (e.g., waste from autopsies and infected animals from laboratories), or waste from patients with infections (e.g., swabs, bandages, and disposable medical devices). Pathological waste can be categorized as human tissues, organs or fluids, body parts, or contaminated animal carcasses.
[11] WHO, *Safe Management of Wastes*. UNEP, *Biomedical and Healthcare Waste*. Healthcare, *Healthcare Waste Management Methods.*
[12] Health Care Without Harm, *Waste Minimization and Recycling.*

- Rotate stock rotation and schedule procurement to minimize expired stock (e.g., frequent small orders, using oldest products first).
- Segregate and recycle suitable non-hazardous and sterilized hazardous wastes.

Waste Segregation Strategies

20. Segregate waste at the point of generation.[13]

- Collect non-hazardous paper, cardboard, glass, aluminum, and plastics separately for recycling or disposal per local regulations and viability of recycling facilities.
- Segregate and compost food waste where possible.
- Identify, collect and segregate infectious and/or hazardous waste labeling and coding the packaging. Use internationally recognized symbols and signs for safe waste handling and train workers to recognize them. The WHO recommended color-coding is:[14]
    - Black: Non-infectious/general waste
    - Yellow: Infectious waste, including pathological and sharps
    - Red: Highly infectious waste and anatomical waste
    - Brown: Chemical and pharmaceutical waste
- Avoid mixing general and hazardous health care waste to reduce disposal costs.
- Treat mixed non-hazardous and hazardous waste as hazardous. Workers should not correct segregation errors by removing or combining waste receptacles.
- Collect mercury-containing waste separately and manage with trained workers.[15]
- Separate waste with a high heavy metal content (e.g., cadmium, thallium, arsenic, and lead) to prevent contamination of untreated wastewater discharged offsite.
- Collect infectious waste separately and minimize hazardous waste designated for incineration.
- Collect radioactive waste in labelled, lead-lined, leak-proof containers.
- Collect and move residual chemicals to proper disposal containers to reduce contaminated wastewater and avoid mixing with different hazardous chemicals
- Isolate waste such as urine, feces, blood, vomit from patients treated with genotoxic drugs—this waste is considered hazardous and should be treated according to table 2.[16]
- Separate aerosol cans and gas containers to avoid incineration disposal and related explosion hazards.
- Collect sharps in leak- and puncture-proof single-use containers, not exceeding the fill line.

[13] UNEP, *Biomedical and Healthcare Waste*. These technical guidelines from the Secretariat of the Basel Convention provide information for the proper treatment of waste from health-care establishments (public and private), with a focus on segregation and treatment of hazardous biomedical and health-care waste.
[14] WHO, *Safe Management of Wastes*. This guidance provides a comprehensive guideline on waste segregation in HCF.
[15] WHO, *Mercury in Health Care*.
[16] Genotoxic drugs or substances/waste contaminated with genotoxic drugs may have mutagenic (cause genetic mutation), teratogenic (cause defects in an embryo or fetus), or carcinogenic (cause cancer) properties.

- Segregate polyvinyl chloride (PVC) products, such as gloves, tubing, and fluid-holding/dispensing bags for appropriate disposal, avoiding incineration (see Section 4.1.2).

On-site Handling, Collection, and Storage of Hazardous Wastes

21. Hazardous waste management should follow the HCF's HWMS and include the following:[17]

- Restrict handling of hazardous waste to authorized workers.
- Collect waste at the source in double plastic bags or sharps containers, seal and place in suitable transport containers.
- Seal and replace containers when they are three-quarters full.
- Use leak-proof, puncture-resistant, tightly sealed containers to prevent spills and exposure to harmful materials.
- Label all waste containers per table 2.
- Designate and maintain waste storage areas that are:
    - Located within the facility grounds in areas that minimize exposure risk to patients and communities
    - Appropriately sized for waste volumes generated
    - Secure, lockable and restricted to authorized cleaning personnel and external waste transport vehicles
    - Well ventilated, lit, and with adequate signaling and visible cleaning logs[18]
    - Built with impermeable floors with drainage for frequent disinfection
    - Protected from the sun, animals (e.g., rodents), and separated from food suppliers and preparation areas
    - Stocked with protective clothing and spare bags/containers
- For waste storage without refrigeration, limit the time between waste generation and treatment:
    - Temperate climates: 72 hours (winter), 48 hours (summer)
    - Warm climates: 48 hours (cool season), 24 hours (hot season)
- Store mercury and cytotoxic waste separately in sealed, impermeable containers in a secure location and clearly labeled.
- Store radioactive waste with a half-life of less than 90 days in containers behind lead shields for at least 10 half-life times.
- Decontaminate any infectious radioactive waste before disposal.
- After decay, decant liquids and dispose of them as non-radioactive waste, considering any hazardous chemical classifications.

Off-site Treatment and Transport

22. Off-site treatment of health care waste is appropriate where on-site capacity is lacking, for example in temporary HCF. Waste destined for off-site facilities should be transported according to General EHS Guidelines guidance on hazardous waste/dangerous goods transport.[19]

[17] ICRC, *Medical Waste Management.*
[18] ASHRAE, *Ventilation for Health Facilities*.
[19] Dangerous goods are substances that, when transported, are a risk to health, safety, property, or the environment.

23. Use licensed facilities that meet GIIP for off-site treatment of hazardous health care waste. Transporting hazardous health care waste from HCF should consider the following:

    - Prepare waste for transport with watertight inner layer of metal or plastic with a leak-proof seal.
    - Outer packaging should be of adequate strength and capacity for the type and volume of waste.
    - Place sharps in puncture-proof containers.
    - Label waste substance class, packaging symbol (e.g., infectious waste, radioactive waste), waste category, mass/volume, place of origin within hospital, and destination.
    - Transport waste in dedicated sealed vehicles operated by licensed contractors.
    - Audit transport services and off-site facilities regularly, verifying all permits and licensing to confirm proper handling and disposal of HCF waste.

Treatment and Disposal Technologies

24. When selecting a waste disposal technology, consider potential health and environmental impacts. Avoid open burning or uncontrolled incineration (i.e., without equipment or containment) of health care waste, as it can produce pollutants and hazardous chemicals generated from incomplete combustion (e.g., dioxins and furans), which are harmful to human health and the environment.[20] Facilities handling hazardous health care waste should have all applicable national operational permits and capacity to manage specific waste types. The General EHS Guidelines describe non-hazardous waste treatment and disposal.

25. Treat each waste category according to methods in table 2, considering the HCF's waste profile and site conditions. The main treatment and disposal technologies are described below.[21]

    - **Incineration (dry oxidation).** HCF may operate on-site incinerators or transport waste to an off-site facility.[22] Implement GIIP practices like waste segregation and alternative treatments to minimize unnecessary incineration. Incinerators should have permits to accept hazardous health care waste and be properly operated and maintained.[23] Mercury should not be incinerated due to the release of highly toxic mercury vapor. Incineration is a high-temperature dry oxidation process (850°C – 1100°C) that reduces organic, combustible waste to smaller quantities of inorganic or incombustible matter, or gaseous material that is combusted further (gasification). Specialized methods such as gasification and pyrolysis operate at >1000°C with specialized equipment. For "highly chlorinated wastes," optimal combustion conditions fall between a minimum of 850°C in a primary combustion chamber and a minimum of 1100°C with a two-second residence time in the secondary chamber.[24] Incineration may produce gaseous air emissions, ash residues, and wastewater. Manage incineration residue such as fly ash, bottom ash, and liquid effluents from flue gas cleaning as hazardous waste as they may contain high

[20] Stockholm Convention, *POP Annex C*.
[21] WHO, *Safe Management of Wastes*; US EPA, *Notebook on Health Facilities*; Health Care Without Harm, *Alternative Medical Waste Technologies.* These resources provide further detail on waste management and disposal methods and technologies.
[22] WHO, *Safe Management of Wastes*; EEA, *Emission Inventory Guidebook*.
[23] Health care waste should be disposed of using pyrolytic or rotary kiln incinerators. Single-chamber incinerators should only be used in emergency situations (e.g., acute outbreaks of communicable disease) when other incineration options for infectious waste are not available.
[24] UNEP, *BAT BEP on POP;* UNEP, *Section V Waste Incinerators*.

concentrations of Persistent Organic Pollutants (POPs), including dioxins and furans, as well as toxic metals and phosphate from carcasses.[25] Bottom and fly ash should be disposed of in compliance with national or local regulations and not buried on-site, as doing so can represent a direct route for dioxins and furans into waterways and soil, the food chain, and other human exposure.[26] Dispose of ash in hazardous waste landfills using double-walled containers, solidification or thermal post-treatment.[27] Further guidance on incineration emissions is in Section 4.1.2.

- **Autoclaving (wet thermal treatment).** Autoclaving disinfects shredded waste by using high temperature steam in a tank, potentially emitting wastewater and odors. Often used to sterilize medical equipment, autoclaving can complement or replace incineration, depending on the waste profile.[28] Avoid autoclaving with hypochlorite, ethanol, or formaldehyde due to volatility. Hazardous chemicals like bleach, mercury, or radioactive material should never be autoclaved.
- **Chemical disinfection.** Chemical disinfection uses chemicals to kill pathogens in health care waste. Waste is shredded prior to treatment, which involves using hazardous chemicals and disposing of residues at off-site certified facilities. Manual chemical disinfection is considered unreliable. While chemical disinfection is typically done on-site, commercial, self-contained, and automatic systems are available and may be operated remotely.[29]
- **Dry thermal disinfection.** This process shreds, heats, and compacts waste in a rotating auger, generating air emissions, wastewater, and residues that require disposal.
- **Microwave irradiation.** Microwave irradiation destroys microorganisms by heating water in the waste. The waste is then compacted and sent to municipal disposal streams, potentially generating contaminated wastewater.
- **Inertization.** Inertization mixes waste with substances like cement to minimize toxic leaching into ground or surface water. It is typically suitable for high-leaching wastes like pharmaceutical incineration ash with a high metal content.
- **Landfill disposal.** Dispose of non-hazardous health care waste in sanitary landfills. Classify treated hazardous waste for landfill disposal based on its characteristics. Use properly designed and operated landfills to prevent air and groundwater contamination. Avoid dumping waste at sites without environmental controls. Pretreat waste (including incineration ash and inertization products) prior to landfill disposal, possibly through encapsulation, such as filling containers with waste and immobilizing material and sealing the containers). If pretreatment is not possible at the HCF, use a licensed, engineered, and managed landfill for hazardous waste.
- **Radioactive waste.** Use specialized disposal services for radioactive waste. Before disposal, segregate and store radioactive waste in clearly labelled, lead-lined, leak-proof containers. If specialist disposal services are unavailable, label and store waste in radiation-proof repositories to decay naturally.

[25] Dioxins and furans are formed from the incomplete combustion of chlorinated materials (like PVC plastics) at temperatures between 200°C and 800°C, and rapid cooling (quenching) of flue gases is essential to prevent their reformation.
[26] UNEP, *BAT BEP on POP.* POPs remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms, and are toxic to humans and wildlife. Under Article 5 and Annex C of the Stockholm Convention on POPs, participating governments are required to reduce or eliminate releases from unintentional production of POPs—in particular, polychlorinated dibenzo-p-dioxins (dioxins) and dibenzofurans (furans). The UNEP Guidelines provide incinerator process requirements and emissions guidelines specific to achieving the aims stipulated in Article 5 and Annex C of the Stockholm Convention.
[27] UNEP, *BAT BEP on POP;* EU, *Council Directive 2024/1786;* EU, *1999/31/EC/Annex I;* MMIS, *Incinerator Guidebook;* WHO, *Incineration of Healthcare Waste*.
[28] Health Care Without Harm, *Non-Incineration Project Tanzania*.
[29] Exner et al., "*Chemical Disinfection in Healthcare*."

Table 2. Treatment and disposal methods for categories of HCF waste	
Type of waste	**Summary of treatment and disposal options**
Sharps: Includes needles, scalpels, blades, knives, infusion sets, saws, broken glass, and nails	**Waste segregation strategy:** Yellow or red color code, marked "Sharps." Rigid, impermeable, puncture-proof container (e.g., hard plastic) with cover. Sharps containers should be placed in a sealed, yellow bag labeled "infectious waste." **Treatment:** Chemical disinfection; autoclaving; microwave irradiation; encapsulation; incineration[a] • Following incineration, residues should be landfilled. • Sharps disinfected with chlorinated solutions should not be incinerated due to risk of generating POPs. If sharps are to be disinfected prior to incineration, disinfection methods that do not involve chlorinated disinfectants should be used. • Needles and syringes should undergo mechanical mutilation (e.g., milling or crushing) prior to wet thermal treatment.
Infectious waste: Includes waste suspected to contain pathogens (e.g., bacteria, viruses, parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. Includes pathological and anatomical material (e.g., tissues, organs, body parts, human fetuses, animal carcasses, blood, and other body fluids), clothes, dressings, equipment/instruments, and other items that may have come into contact with infectious materials.	**Waste segregation strategy:** Yellow- or red-colored bag/container, marked "infectious" with international infectious symbol. Strong, leak-proof plastic bag, or container capable of being autoclaved. **Treatment:** Chemical disinfection; autoclaving; microwave irradiation; sanitary landfill; incineration. • Highly infectious waste, such as cultures from lab work, should be sterilized using wet thermal treatment, such as autoclaving. • Anatomical waste should be treated using incineration (rotary kiln or pyrolytic incinerator).
Pharmaceutical waste: Includes expired, unused, spoiled, and contaminated pharmaceutical products, drugs, vaccines, and serums that are no longer needed, including containers and other potentially contaminated materials (e.g., drug bottles, vials, tubing etc.).	**Waste segregation strategy:** Brown bag/container. Leak-proof plastic bag or container. **Treatment:** Sanitary landfill; encapsulation; return expired, spoiled, or recalled drugs to supplier if possible; incineration[b] • Small quantities: Landfill disposal acceptable; however, cytotoxic and narcotic drugs should not be landfilled. Incineration, provided pharmaceuticals do not exceed 1 percent of total waste to avoid hazardous air emissions. Intravenous fluids (e.g., salts, amino acids) should be landfilled. Ampoules should be crushed and disposed of with sharps. Active pharmaceuticals, such as antibiotics and antimicrobials, should be thermally, chemically, or enzymatically deactivated through validated methods or incinerated. • Large quantities: Incineration at temperatures exceeding 1200°C. Encapsulation in metal drums. Landfilling not recommended unless encapsulated in metal drums and groundwater contamination risk is minimal.
Genotoxic/cytotoxic waste: Waste may have mutagenic, teratogenic, or carcinogenic properties and typically arises from the feces, urine, and vomit of patients receiving cytostatic drugs, and from treatment with chemicals and radioactive materials. Cytotoxic drugs are commonly used in oncology and radiology departments as part of cancer treatment.	**Waste segregation strategy:** See above for "infectious waste." Cytotoxic waste should be labeled "Cytotoxic waste." **Treatment**: Return expired, spoiled, or recalled drugs to supplier; chemical degradation; encapsulation;[b] inertization; incineration (double chamber). • Cytotoxic waste should not be landfilled or discharged to sewer systems. • Incineration is the preferred treatment option. Where incineration is not an option, waste should be returned to the supplier. For particular drugs, incineration should be undertaken at specific temperatures and time specifications. Municipal or single-chamber incinerators are not adequate for cytotoxic waste disposal. Open burning of waste is not acceptable.

Table 2. Treatment and disposal methods for categories of HCF waste

Type of waste	Summary of treatment and disposal options
	• Chemical degradation may be used for certain cytotoxic drugs—refer to WHO (2014) Annex 3 for details. • Encapsulation and inertization should be a last resort waste disposal option.
Chemical waste: Waste may be hazardous, depending on the toxic, corrosive, flammable, reactive, and genotoxic properties. Chemical waste may be in solid, liquid, or gaseous form and is generated through use of chemicals during diagnostic/experimental work, cleaning, housekeeping, and disinfection. Chemicals typically include formaldehyde, photographic chemicals, halogenated and nonhalogenated solvents, organic chemicals for cleaning/disinfecting, and various inorganic chemicals (e.g., acids and alkalis).[c]	**Waste segregation strategy:** Brown bag/container. Leak-proof plastic bag or container resistant to chemical corrosion. **Treatment:** Return unused chemicals to supplier; encapsulation; incineration (pyrolytic incinerator); treatment/conversion and temporary safe disposal for remote HCF premises for some chemical waste.[d] • Facilities should have permits for disposal of general chemical waste (e.g., sugars, amino acids, salts) to sewer systems. • Small hazardous quantities: Incineration, encapsulation, or landfilling. • Large hazardous quantities: Transported to appropriate facilities for disposal, or returned to the original supplier using shipping arrangements. Large quantities of chemical waste should not be encapsulated or landfilled. • Formaldehyde: A request for disposal may be submitted to local authorities or private hazardous waste disposal companies. Alternatively, a laboratory may develop a formaldehyde treatment procedure where the lab treats their formaldehyde waste for disposal in the sink. This procedure requires consultation with local authorities.
Radioactive waste: Waste includes solid, liquid, and gaseous materials that have been contaminated with radionuclides. Radioactive waste originates from activities such as organ imaging, tumor localization, radiotherapy, and research/clinical laboratory procedures, among others, and may include glassware, syringes, solutions, and excreta from treated patients.	**Waste segregation strategy:** Lead-lined leak proof box, labeled with the radioactive symbol. **Treatment**: Radioactive waste should be managed according to national requirements and current guidelines from the International Atomic Energy Association (IAEA) 2019. This guidance provides detailed flowcharts for the disposal solid, biological, and disused source (equipment) radioactive wastes. The main common steps in all radioactive waste treatment processes involve waste minimization, segregation, storage in radiation-proof containers, allowing time for sufficient natural decay, and further waste treatment/disposal depending on the residual waste characteristics.
Waste with high content of heavy metals: Waste includes batteries, broken thermometers, blood pressure gauges (e.g., mercury and cadmium content).	**Waste segregation strategy:** Waste containing heavy metals should be collected separately from general health care waste. **Treatment:** Safe storage site designed for final disposal of hazardous waste. • Waste should not be burned, incinerated, or landfilled. Transport to specialized facilities for metal recovery.
Pressurized containers: Includes containers/cartridges/cylinders for nitrous oxide, ethylene oxide, oxygen, nitrogen, carbon dioxide, compressed air, and other gases.	**Waste segregation strategy:** Pressurized containers should be collected separately from general health care waste. **Treatment**: Recycling and reuse, send reusable containers to specialized gas refilling facilities. For disposal, crush the containers followed by landfilling or recycling. • Incineration is not an option due to explosion risks. • Halogenated agents in liquid form should be disposed of as chemical waste, as described above.
General health care waste: Includes food waste and paper, plastics, and cardboard**.**	**Waste segregation strategy**: Black bag/container. Halogenated plastics such as PVC should be separated from general health care facility waste to avoid disposal through incineration and associated hazardous air emissions from exhaust gases (e.g., hydrochloric acid and dioxins). **Treatment:** Disposal as part of domestic waste. Segregate and compost food waste. Segregate and send for recycling component wastes including paper, cardboard, recyclable plastics (PET, PE, PP), and glass.

Table 2. Treatment and disposal methods for categories of HCF waste	
Type of waste	**Summary of treatment and disposal options**

Sources: WHO, *Safe Management of Wastes*; UNEP, *BAT BEP on POP*; IAEA, *Radioactive Material.*

Notes:
a Use starved-air (pyrolytic), multiple chamber, and rotary kiln incinerators. Single-chamber and drum/brick incinerators are not GIIP and may only be considered as a last resort in exceptional circumstances, such as if recommended GIIP methods are overwhelmed or not operational.
b Small quantities only. Burial of hazardous health care waste is not considered GIIP. In emergency infection control situations, the HCF can designate a temporary safe disposal area with adequate technical measures to prevent pollutants from entering soil and groundwater, including exposure to people.
c Formaldehyde is extensively used in pathology laboratories. As a suspected carcinogen and irritant gas, it must be stored, used, and disposed of under strict protocols. Halogenated and nonhalogenated solvents (e.g., chloroform, trichloroethylene (TCE), acetone, methanol) are usually a laboratory-related waste stream for fixation and preservation of specimens in histology/pathology and for extractions in labs.
d Low-level infectious waste only. Low-level liquid waste only.

4.1.2 Air Emissions

26. Air emissions in HCFs arise from HVAC exhaust, medical gas ventilation, fugitive emissions from waste storage, medical technology areas (MTAs), isolation wards, waste incineration, anesthetic gases, metered dose inhalers, and power generation combustion.[30] Prevention and control for power generation combustion emissions are addressed in the General EHS Guidelines.

27. Exhaust air from MTAs, isolation wards, laboratories, and waste facilities may be contaminated with biological agents, pathogens, or toxic materials. Treat contaminated exhaust by directing it to combustion air systems before discharge to render it non-toxic and non-contagious. Classify condensate and blowdown liquids as health care wastewater and treated per Section 4.1.3.

28. Facilities may implement source-specific emission controls such as scavenging systems for anesthetic gases, local exhaust ventilation for fume hoods, catalytic or scrubber systems for ethylene oxide sterilizers, and compliance with applicable emission standards for backup generators.[31] Sufficiently tall stacks should be used to eliminate odor and optimize dispersion. Stack heights for all waste treatment facilities should be determined per the General EHS Guidelines.

Incineration

29. Large general hospitals may operate hospital waste incinerators (HWI), which is a major source of air emissions and wastewater. Minimize the volume of medical waste destined for incineration and evaluate the need for incineration against other waste management technologies.[32] Potential emissions from HWIs include:

- Heavy metals
- Organic compounds in flue gas (vapor phase or condensed or absorbed on fine particulates)
- Pollutants including dioxins, furans (PCDD/Fs), chlorobenzenes, chloroethylenes, and polycyclic aromatic hydrocarbons (PAHs) generally present in hospital waste or generated during combustion and post-combustion
- Hydrogen chloride (HCl), fluorides, and other hydrogen halides (e.g., of bromine and iodine)
- Combustion products, including GHGs (sulfur oxides (SOX); nitrogen oxides (NOX); volatile organic compounds (VOCs), including non-methane VOCs; methane (CH4); carbon monoxide (CO); carbon dioxide (CO2); and nitrous oxide (N2O)33
- Odors

[30] US DOL OSHA, *Anesthetic Gases*. This guidance provides information on suitable controls for fugitive anesthetic gas emissions. Controlled-air incineration (also referred to as pyrolytic, starved-air, two-stage incineration, or modular combustion) is the most widely used hospital waste incinerator (HWI) technology. Single-chamber and drum/brick incinerators should be used only as a last resort or emergency option.
[31] NIOSH, *Waste Anesthetic Gases*.
[32] Health Care Without Harm, *Non-incineration Treatment Technologies*; Healthcare, *"Healthcare Waste Management Methods."* Infectious and pathological waste, selected pharmaceuticals (combustibility to be determined from the manufacturer's specifications) and chemicals, and sharps may be combusted in a pyrolytic incineration facility designed for this purpose. The types of waste incinerated typically include a heterogeneous mix of some, or all, of the following: human- and animal-infected anatomical waste; absorbents; alcohol and other disinfectants; glass; fecal matter; gauze, pads, swabs, garments, paper, and cellulose; plastics, PVC, and syringes; sharps and needles; and fluids and residuals.
[33] UN, *Paris Agreement*. Medical waste incinerators are likely to emit greenhouse gases, of which a national inventory should be maintained by party countries under Article 13 of the Paris Agreement of the United Nations Framework Convention on Climate Change Pollutants.

30. Pollution prevention and control measures that represent GIIP for waste incinerators include:

- Locate incinerators in open areas for maximum dispersion, away from sensitive receptors.[34]
- Segregate waste for incineration; remove halogenated plastics (e.g., PVC), pressurized gas containers, active chemical waste, silver salts, radiographic waste, high heavy metal content items like mercury (e.g., broken thermometers, batteries), and sealed ampoules or ampoules containing heavy metals that should not go in the incinerator.
- Verify that incinerators have valid regulatory agency permits and are operated and maintained by trained workers to maintain proper combustion conditions—sufficient temperature, residence time, and turbulence for waste combustion.[35] Operational controls should include maintaining combustion temperatures above 850°C and monitoring flue gas outlet temperatures, immediately quenching flue gases to avoid formation and reformation of POPs, and using of flue gas cleaning systems that meet international standards.
- For countries that are signatories, comply with the Stockholm Convention on POPs by phasing in best available technologies within four years of signing.[36]
- Install continuous emission monitoring systems (CEMS) on incinerators with >10 tons/day capacity to monitor opacity (particle surrogate), SO_2, CO, O_2, NOx, HCl, Hg and temperature and other parameters (e.g., pressure drop across filters).[37]

31. Air pollution control measures for hospital waste incinerators include:

- Use wet, semi-dry, or dry scrubbers to control acid gas emissions (e.g., HCl, sulfur dioxide (SO_2), and fluoride compounds).
- Control particulate matter with cyclones, fabric or ceramic filters, and/or electrostatic precipitators (ESPs). Efficiencies depend on the particle size distribution of the particulate matter from the combustion chamber, which typically range between 1-10 micrometers (µm) for hospital incinerators.
- Select heavy metal control devices based on operating temperature. Fabric filters and ESPs typically operate at relatively high temperatures and may be less effective than those that operate at lower temperatures. Venturi quenches and venturi scrubbers are also used. The volatile heavy metals usually condense to form a fume (less than 2 µm) that is only partially collected by pollution control equipment.
- Manage incineration residues such as fly ash, bottom ash, and flue gas cleaning liquid effluents as a hazardous waste due to high POPs and metal concentrations (see Section 4.1.1 and refer to the General EHS Guidelines).
- Conduct annual performance tests for fugitive emissions from ash handling.[38]

[34] Sensitive receptors are determined in the impact assessment and may include for example schools, hospitals, elderly homes, places of worship, residences among others.
[35] WHO, *Safe Management of Wastes*; US EPA, *Medical Waste Incinerators;* UNEP, *BAT BEP on POP*. These resources include technical information on the GIIP operation and maintenance of hospital waste incinerators. The UNEP resource provides guidance relevant to Article 5 and Annex C of the Stockholm Convention on POP.
[36] Stockholm Convention on Persistent Organic Pollutants. *UN Treaty Collection: CHAPTER XXVII;* WHO, *Safe Management of Wastes*; UNEP, *BAT BEP on POP*. Only modern incinerators operating at 850–1100°C and fitted with special gas-cleaning equipment can comply with the international emission standards for dioxins and furans.
[37] EU, *Industrial Emissions*; Batterman, "Small-scale incinerators." The EU guidance on incinerator emission levels indicates continuous monitoring for large incinerators (>10 tons/day). Batterman proposes continuous emission monitoring systems in small scale incinerators.
[38] US EPA, *Requirements for Hospital Waste*.

Greenhouse Gas Emission Reduction

32. Strategies to reduce greenhouse gases (GHG) emissions vary by facility characteristics (age, space use, etc.) and should supplement building energy efficiency initiatives. Such strategies include:[39]

- Reduce air changes in unused operating rooms overnight and weekends.
- Minimize air changes per hour (ACH) based on infection prevention protocols.
- Use natural ventilation as an energy saving infection control measure.
- Decommission or avoid central nitrous oxide piping.
- Use portable cylinders where nitrous oxide is essential, and close tanks between uses.
- Recapture and reuse anesthetic gases.

4.1.3 Wastewater

Wastewater from General Operations

33. HCFs generate wastewater from medical wards, operating theaters, laboratories, pharmaceutical and chemical stores, cleaning activities, hemodialysis, dental departments, kitchens, and x-ray facilities, and waste treatment technologies, including autoclaving, microwave irradiation, chemical disinfection, and incineration (e.g., flue gas scrubbers).

34. Poor hazardous waste management can result in hazardous health care wastes to enter wastewater. Such hazardous waste includes microbiological pathogens (e.g., enteric pathogens such as bacteria, viruses, and helminths/parasitic worms), hazardous chemicals, pharmaceuticals (e.g., cytotoxic or antimicrobial), and radioactive isotopes. Pollution prevention measures include:

- Segregate waste to prevent solid waste and hazardous liquids from entering the wastewater stream.
- Separate excreta (e.g., urine, feces, blood, and vomit) from patients on genotoxic drugs.
- Collect large quantities of pharmaceuticals for separate treatment or return to manufacturer (see table 2).
- Connect toilets to a safe containment system (septic tank, sewage, or lined pit) to prevent leakage and groundwater contamination.
- Use sealed tanks or lined pits for on-site containment where sewage is unavailable.
- Treat excreta biologically (e.g., anaerobic digestion) or convey to municipal treatment facilities, with regular cleaning protocols for toilets and containment systems to prevent cross-contamination.
- Provide dedicated sanitation systems with enhanced containment and disinfection measures for isolation wards and infectious disease units.
- Manage sludge from wastewater treatment as hazardous waste if it contains infectious or chemical contaminants.
- Prevent downstream antimicrobial resistance by treating antibiotics, antivirals, antifungals and antiparasitic residues in wastewater streams.

[39] Agency for Healthcare Research and Quality, *Patient Safety and Quality*.

Municipal Wastewater Treatment

35. Before discharging wastewater to municipal sewage systems with a centralized wastewater treatment (WWT) facility, HCFs should:

    - Verify compliance with applicable permits and confirm that the municipal WWT facility can handle the effluent, as discussed in the General EHS Guidelines
    - Install a pretreatment facility, if needed[40]
    - Discharge to WWT without pretreatment should only be done if:
        - The municipal sewer is connected to WWT facilities with primary, secondary, and tertiary treatment.
        - The municipal WWT facility achieves a minimum of 95 percent removal of bacteria.
        - Sewage treatment sludge is further processed (e.g., anaerobic digestion with a maximum one helminth egg per liter).
        - The HWMS minimizes chemical, pharmaceutical, radioactive, and cytotoxic waste discharge as much as practicable.

On-site Wastewater Treatment

36. Major HCFs and those with complex waste profiles may use on-site WWT facilities, while temporary HCFs may deploy portable WWT facilities if needed. Minor or Specialized HCFs should assess their wastewater profile to determine the need for on-site, portable, or off-site WWT. Where adequate municipal treatment is unavailable, three-stage treatment of wastewater streams is recommended:[41]

    - Primary -- Removes or separates solids via sedimentation
    - Secondary – Breaks down dissolved and suspended organic matter resulting from primary treatment using waterborne bacteria that consume the pollutants, and eliminates inorganic matter by sorption to sludge, which is separated from water by sedimentation
    - Tertiary -- Removes remaining suspended solids, phosphates, and other contaminants and may include disinfection (e.g., chlorination)

37. Additional treatment may be needed to remove active ingredients (antibiotics, antimicrobials and miscellaneous pharmaceutical products, among other hazardous constituents) and volatile constituents and aerosols. Techniques include:

    - Segregation and pretreatment to remove or recover specific contaminants (e.g., radioisotopes, mercury)
    - Skimmers or oil-water separators for floatable solids
    - Filtration for separation of filterable solids
    - Flow and load equalization
    - Sedimentation using clarifiers for suspended-solid reduction
    - Aerobic biological treatment to reduce soluble organic matter (biochemical oxygen demand)
    - Biological or chemical nutrient removal to reduce nitrogen and phosphorus

[40] WHO, *Safe Management of Wastes*, 147-164. This source includes additional criteria for disposal to municipal systems.
[41] WHO, *Safe Management of Wastes, Chapter 9*.

- Effluent chlorination for disinfection
- Dewatering and disposal of residuals as hazardous medical waste
- Stabilization, drying, or incineration of hazardous sludges as per table 2

38. Wastewater from wet scrubbers should be treated through chemical neutralization, flocculation, and sludge settling. Manage sludge as hazardous waste and treat off site in a hazardous waste facility or encapsulate in drums with mortar before putting in a landfill. Apply anaerobic digestion or drying before incineration with solid infectious waste.

Other Wastewater Streams and Water Consumption

39. Contaminated streams should be directed to the industrial wastewater treatment system. The General EHS Guidelines provide guidance on managing non-contaminated wastewater, stormwater, and sanitary sewage as well as recommendations for reducing water consumption.

4.2 Occupational Health and Safety

40. This section presents sector-specific considerations for occupational health and safety (OHS) in the HCF sector. OHS hazards common across sectors and related to construction and decommissioning activities are discussed in the General EHS Guidelines.

41. HCF workers may be exposed to major hazards, which should be managed through continuous facility-specific risk assessments and strategies that address worker demographics and gender-specific needs.[42] Key OHS hazards in this sector include: [43]

- Biological: infectious materials, waste, body fluids, specimens, tissue
- Chemical: hazardous materials, cytotoxic and hazardous pharmaceuticals, waste anesthetic gas, surgical smoke
- Physical: extreme temperatures in boiler/freezer rooms, radiation (ionizing and non-ionizing), musculoskeletal disorders[44]
- Psychosocial: stress, burnout, fatigue, occupational violence, harassment (including gender-based violence)

4.2.1 Biological Hazards

42. HCF workers may be exposed to biological hazards, including air-, water- or blood-borne infections from patients, co-workers, or infectious materials during specimen handling, sharps use, patient care, and waste handling.[45] Maintenance, renovation, and

[42] For purposes of these EHS Guidelines, risks and mitigants for HCF workers are also applicable to 'community health workers' and/or volunteers (e.g., social or emotional support, volunteers during emergency response), based on their occupational risk exposure.
[43] WHO, *Occupational Hazards eTool*; WHO and ILO, *OHS Guide*. WHO has an extensive list of information sheets, tools, and guidance regarding the development and implementation of occupational health and safety management systems in HCF.
[44] ICRP, *Dose Quantities Radiological Protection*. This resource provides guidance on assessing radiological doses in healthcare settings for workers and patients.
[45] According to the US OSHA, bloodborne pathogens are pathogenic microorganisms that are present in human blood and can cause disease in humans, including human immunodeficiency virus (HIV), hepatitis B virus (HIB), and hepatitis C virus (HCV). Other potentially infectious materials include: (1) The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; (2) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and (3) HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

demolition activities of HCF may also pose infection risks from waste diversion or HVAC disruption that can spread dust contaminated with bacteria, fungi, or asbestos fibers.

43. Apply the hierarchy of control when implementing measures to reduce the risk of infectious disease transmission.[46] For example:

- Conduct a pre-construction risk assessment (PCRA) together with the ICRA (see Section 3) to establish preventive measures, considering the type of work and proximity to occupied areas.
- Implement engineering controls:
    - Install, maintain, and monitor HVAC systems in patient areas and workspaces to achieve acceptable indoor air quality following local regulations or GIIP, where regulations do not exist or are insufficient. HVAC systems should consider room dimensions, building layout, contaminant type, climate, occupancy, and work activities.[47]
    - Install HEPA filters and real time sensors in higher risk areas.
- Maintain clean and dirty workflow separation.
- Implement strict facility cleaning and housekeeping schedule.
- Establish and implement an Exposure Control Plan (ECP) for air- and blood-borne pathogens with universal precautions, including:[48]
    - Immunize workers against vaccine-preventable infections based on occupational risk (e.g., hepatitis B), per national requirements.[49]
    - Install biosafety hoods in labs to minimize exposure to infectious aerosols.
    - Handle dirty linen, contaminated clothing, and food preparation with proper procedures and facilities.
    - Follow cleaning, disinfection, and waste disposal practices (e.g., waste segregation, safe disposal of contaminated sharps).
    - Provide adequate hand washing and sanitizing facilities.[50]
    - Enforce patient isolation protocols, which should consider segregation and ventilation requirements to prevent the spread of infectious disease.
    - Minimize patient transfers.
    - Implement rigorous cleaning and sterilization for non-disposable equipment and use sterile disposable materials.
    - Provide workers and visitors with clear, accessible information on infection control policies and procedures, hazards and risks using appropriate language and formats (e.g., pictograms, diagrams, and verbal briefings) where necessary.
    - Provide HCF workers with regular and specific infection control training that reflects updated industry standards and regularly audited for improvements.
    - Implement policies to exclude animals unless risk assessments have been developed to protect patient safety.
    - Provide certified PPE for workers with direct patient contact, laboratory tasks and waste management ensuring appropriate fit for different genders and sizes and accommodation of cultural norms (e.g., head coverings). For patient contact, PPE may include masks, visors/face masks, or respirators (fit tested as needed), gowns, and gloves, which

[46] US CDC, *Guideline for Isolation Precautions;* AHIA, *Australasian Health Facilities Guidelines;* OSHA, *Bloodborne Pathogens*.
[47] ASHRAE, *Health Care Facilities Resources,* including *Standard 170 – Ventilation.*
[48] OSHA, *Model Plans Bloodborne Pathogens*. This OSHA resource includes a model ECP.
[49] WHO, *Immunizations for Healthcare Workers*.
[50] US CDC, "Guideline for Hand Hygiene"; WHO, *Guidelines on Hand Hygiene*.

should be changed between patients.[51] For waste management, PPE may include overalls, aprons, leg protectors, boots, heavy duty gloves, helmets, visors/face masks and eye protection (especially for cleaning of hazardous spills), and respirators where required (e.g., spills, highly infectious airborne diseases, or waste involving toxic dust or incinerator residue).[52]

- Use laboratory biological safety cabinets (e.g., Biosafety Cabinet Type II) and other containment devices in labs.[53]
- Provide blood-borne spill kits.

44. The HCF emergency response plan should address public health emergencies, such as infectious disease outbreaks (e.g., Ebola, COVID-19, Zika). Emergency response workers, including medical workers and nurses, face various biological hazards when treating patients. Their protection, training, and equipment should be planned for, including in the deployment of workers to the emergency areas, when establishing temporary HCF or adapting an existing HCF.[54]

4.2.2 Chemical Hazards

45. Health care workers may be exposed to carcinogenic and reproductive toxins, including glutaraldehyde (toxic chemical used to sterilize heat sensitive medical equipment), ethylene oxide gas (a sterilant for medical equipment), formaldehyde, mercury (exposure from broken thermometers), chemotherapy and antineoplastic chemicals, solvents, and photographic chemicals. They may also be exposed to waste anesthetic gases such as nitrous oxide, halothane (fluothane), enflurane (ethrane), and isoflurane (forane).

46. Carry out a chemical hygiene risk assessment and implement a plan to control exposure to hazardous chemicals, particularly in laboratories and patient exposure areas.[55] A chemical hygiene plan should consider the following:

- Include a comprehensive chemical inventory and database of safety data sheets.
- Eliminate unnecessary chemical use (e.g., don't disinfect sharps if they are to be incinerated); Substitute hazardous chemicals for safer alternatives, such as mercury-free substitutes---mercury-containing products, such as dental amalgam, vaccines and pharmaceuticals, or equipment, such as thermometers or sphygmomanometers, should be phased out in alignment with the Minamata Convention.[56]
- Install local exhaust ventilation and scavenging systems for airborne chemical hazards; treat spent charcoal filters as hazardous waste. If no scavenging unit or filter is available, use vacuum lines to disperse and dilute waste anesthetic gases.
- Account for pregnancy risks including risk of miscarriage due to exposure to fugitive anesthetic gases; consider this factor when implementing controls for waste anesthetic gases.

[51] Health care workers may be latex sensitive, resulting in serious allergic reactions. Hypoallergenic gloves, glove liners, powderless gloves, or other similar alternatives should be available to those workers who are allergic.
[52] Health Care Without Harm, *Health Care Worker PPE;* US CDC, *Burn Rate Calculator.* US CDC provides a PPE burn rate calculator relating to COVID-19 PPE for health care workers. The tool may be used to estimate adequate space for emergency PPE stockpiles.
[53] WHO, *Laboratory Biosafety Manual*.
[54] WHO and ILO, *Occupational Safety Manual.*
[55] OSHA, *Hazardous Chemicals in Laboratories.*
[56] UNEP, *Minamata Convention*. WHO, *Mercury in Health Care*.

- Maintain ventilation rates of a minimum of 3 air changes of fresh air per hour in active operating rooms and a minimum of 2 air changes of fresh air per hour in recovery rooms.[57]
- Conduct occupational hygiene monitoring in high-risk airborne exposure work areas, such as in pathology and pharmacy laboratories, surgical and endoscopic suites, and operating rooms; compare data to national industrial hygiene standards or reputable international standards such as the US Occupational Safety and Health Administration (OSHA) permissible exposure limits, whichever is more stringent. In the absence of these, use threshold limit values (TLV) from the American Conference of Governmental Industrial Hygienists (ACGIH) or recommended exposure limits from the US National Institute for Occupational Safety and Health (NIOSH). Further information on health monitoring is provided in Section 5.2.1.
- Implement a hazard communication program that includes safety data sheets for all chemicals; communications should be made available in languages that all workers can understand.
- Prevent exposure to cytotoxic residues, especially for workers trying to conceive or who are pregnant or breastfeeding.[58]
- Use international labelling standards, such as Global Harmonized System (GHS).[59]
- Train workers on hazardous chemicals, including when new chemicals are introduced; on the use and maintenance of PPE; and on using decontamination equipment, such as safety showers and eye-wash stations.
- Install dedicated exhaust ventilation systems to capture and vent hazardous emissions, such as ethylene oxide and other hazardous sterilants avoiding venting plumes that expose populated areas. Adequately aerate sterilized items to allow sterilant to dissipate before handling or use.
- Provide suitable chemical spill measures, including neutralizing agents, spill containment, and absorbents.[60]

47. The HCF emergency response plan should address chemical emergencies (e.g., toxic gas releases, large scale oil spills). The protection of emergency response workers, including medical workers, should be planned for, including in the deployment of health care workers to the emergency area when establishing temporary HCF.

4.2.3 Physical Hazards

48. The main physical hazards in HCF include musculoskeletal risks, slip/trip/fall accidents, physical violence from workers or patients, and hazards from diagnostic/treatment activities (e.g., sharps, ionizing and non-ionizing radiation). Control measures include:

- Provide assistive devices to eliminate manual patient handling (e.g., lifts, sit-to-stand lifts, slide sheets/boards, sling lifts, monkey bars, air transfer mattresses, transfer boards, gait belts).
- Avoid using extension cords and multiple adaptors.
- Train healthcare workers on ergonomic techniques and equipment use; see more in the General EHS Guidelines.
- Design facilities with anti-slip floors and safe layouts to prevent slips, trips, and falls.
- Provide suitable non-slip footwear for workers and clean spills promptly to prevents slips and falls.

[57] NIOSH, *Waste Anesthetic Gases*.
[58] NIOSH, *List of Hazardous Drugs*.
[59] UNECE, *Classification of Chemicals.*
[60] NIOSH, *Managing Hazardous Drug Exposures.* This document provides GIIP on controlling spills in HCF settings.

- Provide adequately labelled, lead-lined, leak-proof containers for radioactive waste and train workers on handling it.
- Evaluate and select needleless devices or sharps with engineered protective systems.
- Use puncture-resistant, leak-proof, and appropriately labeled sharps containers; dispose of contaminated sharps promptly as outlined in table 2.
- Provide adequate security measures to prevent physical violence between workers and patients, and train workers to properly respond to such scenarios.

49. The use of radiation in HCFs for diagnostics and treatment, including handling of radioactive waste, poses significant risk to health care workers.[61] HCFs should implement protocols, procedures, and training to prevent or minimize radiological hazards. A radiation safety program should be designed and implemented in consultation with the affected workforce and should:

- Minimize exposure to radioactive materials, noting additional precautions for vulnerable workers, including pregnant women.
- Provide radiation safety training and incorporate radiation shielding (e.g. lead-lining, concrete) around instruments/rooms containing x-ray sources.
- Maintain records of radionuclide acquisition, use, and disposal.
- Monitor workers' radiation exposure and the environment, radioactive incidents, and emergencies.
- Implement measures for radioactive waste disposal including safety audit records and reports, and a radiation safety audit program.
- Appoint an accredited radiation protection officer (RPO) to manage protocols and program updates, which should be tailored to factor in planned or emergency exposure situations and whether the monitoring relates to routine, special, confirmatory, or task-related activities; keep the program current.

50. The HCF emergency response plan should address public health emergencies, such as radiation emergencies; and natural disasters (e.g., earthquakes, tsunamis). Emergency response workers, including first responders, medical workers and nurses, face various health and safety hazards related to emergencies. Their protection should be planned for, including specialized PPE, training, resources and support, in the deployment of health care workers to emergency areas.

4.2.4 Psychosocial Hazards

51. Health care workers face psychosocial hazards relevant to the sector, characterized by continuous, intense and fast paced workload, long and irregular shifts, caring for high-acuity patients, exposure to suffering and death, emotional intensity, complex team care and workplace violence, including verbal abuse.[62] These characteristics increase the risks of sleep disorders, burnout, fatigue, anxiety, post-traumatic stress, depression, abuse of prescription drug access and use, and workplace violence.[63] These can in turn lead to mental health and stress-related psychological and physical harm. Physical and psychologically healthy workers

[61] IAEA, *Occupational Radiation Protection*; OSHA, *Ionizing Radiation.* These resources, plus WHO publications, contain comprehensive risk control measures.
[62] NIH, *Psychosocial Risks Healthcare*
[63] NIOSH, *Risk Factors for Stress.* This resource provides an extensive range of work stress and mental health tools, including training for health care workers.

are less error-prone, which contributes to better patient and community health outcomes.[64] Management strategies for these hazards may include:[65]

- Optimize shift changes and adequate staffing levels, including a mix of individuals to support safe, quality care, treatment, and services, as well as effective workload assignments and working conditions.[66]
- Implement a worker fatigue risk assessment and management program.[67]
- Educate workers on mental health literacy, psychosocial interventions such as mindfulness or cognitive behavioral approaches, healthy nutrition, sleep, exercise and healthy lifestyle.
- Train workers on respectful workplace and patient interactions, including child safeguarding, and incident response, supported by supervision and monitoring mechanisms.[68]
- Establish worker committees to prevent workplace and gender-based violence (GBV), establish a zero-tolerance policy for violence/ harassment and implement a grievance redress mechanism.
- Establish formal post-incident debriefing and provide confidential access to mental health professionals, support and tools to mitigate long-term effects of a psychosocial incident or burnout.
- Provide clean and safe sleeping quarters, changerooms, showers, telecommunications and recreational facilities, as applicable.
- Implement ergonomic requirements.[69]
- Implement management programs to prevent drug and substance abuse.

4.3 Community Health and Safety

52. This section presents sector-specific considerations for community health and safety (CHS) risks in this industry sector. CHS risks and hazards common across industries are described in the General EHS Guidelines.

53. As public access buildings, HCF pose health and safety risks to patients, visitors, and local communities. The major CHS risks include:

- Life and fire safety
- Exposure to disease
- Sexual exploitation, abuse and harassment and child safeguarding

[64] WHO, *Patient Safety Action Plan*.
[65] WHO, Occupational Hazards e-Tool. This e-tool provides guidance on occupational health and safety for health workers, including on psychosocial risks.
[66] WHO, *Workload Indicators.* This resource can help determine appropriate staffing levels.
[67] SafeWork Australia, *Risk of Fatigue.*
[68] WHO and ILO, *Addressing Workplace Violence*. EBRD, *Gender-Based Violence*. IFC, *Child Safeguarding.*
[69] AHIA, *Australasian Healthcare Facility Guidelines*. Reference should be made to the regularly updated sets of guidelines from the Australasian Healthcare Facility Guidelines, referred to as Parts.

4.3.1 Life and Fire Safety

54. HCFs face considerable fire hazards from flammable gases/liquids, oxygen bottles and conveyancing networks, bed linen, and other combustibles. Consequences of fire and explosions in HCF can be severe given that many patients cannot self-evacuate.

55. Recommendations applicable to buildings accessible to the public, including HCF, are presented in the General EHS Guidelines. The following summarizes additional, HCF-specific recommendations for life and fire safety: [70]

- Develop a fire safety program covering prevention, detection, suppression, containment, and evacuation plans for workers, visitors, and patients, including those with limited mobility or who may need additional support.
- Segregate high-risk areas and/or protect them with dedicated fire suppression systems.
- Maintain fire safety systems, including self-closing doors on escape routes and fire dampers in ventilation ducts.
- Provide and maintain fire safety devices (e.g., extinguishers, sprinklers, alarms) and train workers for their use, especially in smaller or temporary facilities with limited systems.
- Train workers on evacuation procedures, including defend-in-place strategies, patient and visitor assistance, and full hospital evacuation.
- Display safety and evacuation information prominently in relevant languages.
- Maintain registers of patients, visitors, and workers to account for them during an evacuation.
- Restrict smoking to designated non-patient care areas.
- Provide sufficient emergency and standby power for life safety systems and other critical patient care functions.
- Deploy security personnel based on risk assessments; provide adequate lighting and video surveillance, including parking areas, with remote back ups.
- Apply special fire-containment and evacuation measures for high-rise HCF towers, including lift-well smoke control and safe exit routes for vulnerable patients.
- Implement a Management of Change (MOC) plan for renovations or expansions that impact life and fire safety, including an infection control risk assessment, temporary safety measures, and training workers in new fire procedures.

4.3.2 Exposure to Disease

56. The interaction and impact of HCF on the community are crucial for disease prevention, especially when HCFs are near local communities that interact with patients, workers, and visitors. The General EHS Guidelines provide guidance on the prevention of community disease transmission. Below are some unique considerations to minimize community exposure to disease from HCFs.

- Spatial and structural architecture: Site and design emission sources, especially from incinerators and laboratories, away from residential areas and other sensitive receptors to reduce exposure to toxins and pathogens (see Section 3)
- Biocontainment hygiene and biosecurity controls: Implement measures to prevent spread of communicable diseases within the community, including families of health care workers and hospital visitors (see Section 4.2.1)

[70] IFC, *Life Fire Safety Hospitals*; AHIA, *Australasian Health Facilities Guidelines*; NFPA *101 Life Safety Code; NFPA 99 Healthcare Facilities Safety Code.*

- Waste management practices: Implement proper siting, storage, segregation, and disposal of health care waste, including controlled outsourcing of collection and infection control during transportation and disposal (see Section 4.1.3)
- Antimicrobial stewardship. Promote appropriate use of antimicrobials (including antibiotics, antivirals, antifungals and antiparasitic) to reduce microbial resistance and the spread of multidrug-resistant infections[71]

4.3.3 Sexual Exploitation and Abuse, Sexual Harassment and Child Safeguarding

57. HCF settings can present heightened sexual exploitation and abuse, sexual harassment (SEA/SH) and child safeguarding risks due to situations where patients, including children, are separated from caregivers, dependent on healthcare staff, or present in environments where facility design, reporting pathways, or supervision systems are not conducive to their protection.[72] These risks also stem from systemic factors such as unequal power dynamics between providers and patients, reliance on intimate or physical care procedures, or insufficient oversight during certain interactions. Cultural and procedural barriers to reporting can also limit detection and response.

58. In addition to the mitigation measures presented in the General EHS Guidelines, the following should be implemented in HCF[73]:

- Implement policies with zero-tolerance for SEA/SH and establish behavioral standards or code of conduct and clearly communicate them to workers and contractors.
- Provide targeted training to staff, particularly those caring for children and persons with disabilities.
- Embed protection measures into institutional and operational systems, such as chaperone protocols and consent for procedures.
- Conduct vetting and reference checks for staff and contractors.
- Staff facilities with gender-sensitive health workers, recognizing that in some context patients report higher comfort and safety with a given gender.
- Establish safe and confidential reporting channels (i.e., grievance mechanism) with survivor centered protocols and referrals to GBV services, supporting safe and accountable care following GIIP.
- Develop procedures to handle SEA/SH allegations in a safe, timely, and ethical manner and to determine and implement disciplinary actions.
- Develop sensitization and information activities and materials, particularly targeting women, children and other at-risk groups, that include information about prohibited behavior, how to report allegations of SEA/SH, and how to access GBV services.

5 PERFORMANCE INDICATORS AND INDUSTRY BENCHMARKS

59. This section describes relevant EHS performance indicators and industry benchmarks of GIIP for this industry sector. Indicators that are applicable across industries are available in the General EHS Guidelines.

[71] WHO. *Antimicrobial Stewardship Programmes*.
[72] IFC, *Child Safeguarding*.
[73] EBRD and IFC, *Gender-Based Violence;* World Bank, *SEA/SH Good Practice Note; IFC, Child Safeguarding.*

5.1 Environmental Performance

60. Environmental monitoring programs should address significant impacts during normal operations and upset conditions, based on direct and indirect indicators applicable to the project with monitoring frequency sufficient to produce representative data. Select monitoring locations, methods, and durations that meet GIIP and include data verification processes. Monitoring should be conducted by trained specialists, use calibrated and maintained monitoring equipment, and follow GIIP methods to collect, verify and analyze data. Results should be compared to applicable standards, and corrective actions should be implemented for any exceedances, identifying root causes and updating management plans to prevent recurrence. Refer to the General EHS Guidelines for more information.

5.1.1 Emissions Guidelines

61. Emission guidelines for this sector are provided in table 3, reflecting GIIP and standards from countries with recognized regulatory frameworks. These guidelines are achievable in new HCF incinerators, under normal operating conditions in appropriately designed and operated facilities using pollution prevention and control measures outlined in these guidelines. For existing facilities, site-specific targets may be established (see Section 1).

62. Incinerator emissions reflect the Stockholm Convention on Persistent Organic Pollutants, followed by signatory countries. Emissions guidelines for combustion sources up to 50 megawatts thermal (MWth) are in the General EHS Guidelines. Ambient considerations based on total emissions are also in the General EHS Guidelines.

Table 3. Air emission levels for hospital new waste incineration facilities

Pollutants	Units	Standard conditions	Guideline values for a 3-run average (1-hour minimum sample time per run) based on incinerator capacity[a]				Guideline values as daily average (>10 Tn/day)[d]
			Small rural incinerator (<2000 lb/wk)	Small capacity incinerator (<200 lb/hr)	Medium capacity incinerator (200-500 lb/hr)	Large capacity incinerator (>500 lb/hr)	
Total particulate matter (PM)	mg/Nm^3	20^{o}C, 101.3 kPa, 7% O_2 dry	87	66	22	18	10[h]
Total organic carbon (TOC)	mg/Nm^3	273^{o}K, 101.3 kPa, 11% O_2 dry	-	-	-	-	10
Hydrogen chloride (HCl)	mg/Nm^3	273^{o}K, 101.3 kPa, 11% O_2 dry	-	-	-	-	10
	ppm(v)	20^{o}C, 101.3 kPa, 7% O_2 dry	810	15	7.7	5.1	-
Hydrogen fluoride (HF)	mg/Nm^3	273^{o}K, 101.3 kPa, 11% O_2 dry	-	-	-	-	1

Table 3. Air emission levels for hospital new waste incineration facilities

Pollutants	Units	Standard conditions	Guideline values for a 3-run average (1-hour minimum sample time per run) based on incinerator capacity[a]				Guideline values as daily average (>10 Tn/day)[d]
			Small rural incinerator (<2000 lb/wk)	Small capacity incinerator (<200 lb/hr)	Medium capacity incinerator (200-500 lb/hr)	Large capacity incinerator (>500 lb/hr)	
Sulfur dioxide (SO_2)	mg/Nm^3	273°K, 101.3 kPa, 11% O_2 dry	-	-	-	-	50
	ppm(v)	20°C, 101.3 kPa, 7% O_2 dry	55	1.4	1.4	8.1	-
Carbon monoxide (CO)	mg/Nm^3	273°K, 101.3 kPa, 11% O^2 dry	-	-	-	-	50
	ppm(v)	20°C, 101.3 kPa, 7% O_2 dry	20	20	1.8	11	-
Oxides of nitrogen (NO_X)	mg/Nm^3	273°K, 101.3 kPa, 11% O_2 dry	-	-	-	-	200, 400[e]
	ppm(v)	20°C, 101.3 kPa, 7% O_2 dry	130	67	67	140	-
Mercury (Hg)	mg/Nm^3	20°C, 101.3 kPa, 7% O_2 dry	0.051	0.014	0.0035	0.0013	0.05[f,h]
Cadmium + Thallium (Cd + Tl)	mg/Nm^3	20°C, 101.3 kPa, 7% O_2 dry	0.11[b]	0.017[b]	0.0098[b]	0.00013[b]	0.05[f,h]
Sb, As, Pb, Cr, Co, Cu, Mn, Ni, and V	mg/Nm^3	20°C, 101.3 kPa, 7% O_2 dry	0.50[c]	0.31[c]	0.018[c]	0.00069[c]	0.5[f,h]
Polychlorinated dibenzodioxin and dibenzofuran (PCDD/F) (Dioxins and furans)	ng/Nm^{3}TEQ	20°C, 101.3 kPa, 7% O_2 dry	5.1	0.013	0.014	0.035	0.1[g,h]

Sources: US EPA, *New Stationary Sources*; US EPA, *State Plans Designated Facilities*; EU, *Directive on Industrial Emissions*. In the EU Directive, see Annex VI, Part 3 Air emission limit values for waste incineration plants. In the US EPA, see Table 1B to Subpart Ec of Part 60, Title 40.

Notes:
a According to the US EPA source (*40 CFR Part 60)*, rural small capacity is defined as >50 miles from boundary of nearest standard metropolitan statistical area, burning <2000 lb/wk (approximately 907 kg) of waste (refer to Subpart Ce, Table 2B). Small capacity is defined as <200 lbs/hr (approximately 91 kg). Medium capacity is defined as >200 to 500 lbs/hr. Large capacity is defined as >500 lbs/hr (approximately 227 kg), (refer to Subpart Ec, Table 1B).
b Cadmium only.
c Lead only.

Table 3. Air emission levels for hospital new waste incineration facilities							
Pollutants	**Units**	**Standard conditions**	**Guideline values for a 3-run average (1-hour minimum sample time per run) based on incinerator capacity[a]**				**Guideline values as daily average (>10 Tn/day)[d]**
			Small rural incinerator (<2000 lb/wk)	Small capacity incinerator (<200 lb/hr)	Medium capacity incinerator (200-500 lb/hr)	Large capacity incinerator (>500 lb/hr)	
d The EU Directive (*2010/75/EU)* provides a daily average value for continuous measurement of pollutants, except for heavy metals and dioxins and furans, which shall have two measurements per year or as otherwise specified given the specific project conditions or regulatory requirements. Applicable to hazardous waste incinerators with a capacity exceeding 10 tons per day. e NOx values of 200 mg/Nm3 for incinerators with a nominal capacity exceeding 6 tons per hour and 400 mg/Nm3 for incinerators with a nominal capacity of 6 tons per hour or less. f Average values over a sampling period of 0.5 to 8 hours. These average values cover gaseous and vapor forms of the relevant heavy metal emissions as well as their compounds. g Average values over a sampling period of 6-8 hours. 3-run average (4-hour minimum sample time per run). h Standard conditions for this value are 273°K, 101.3 kPa, 11% O_2 dry.							
Key: °C = Degrees Celsius °K = degrees Kelvin kPa = kilopascals mg/Nm^3 = milligrams per normal cubic meter ng/Nm^3 = nanograms per normal cubic meter O_2 = oxygen molecule PCDD/F = Polychlorinated dibenzodioxin and dibenzofuran TEQ = Toxic Equivalency Factors			As = Arsenic Co = Cobalt Cr = Chromium Cu = Copper Mn = Manganese Ni = Nickel Sb = Antimony Pb = Lead V = Vanadium				

5.1.2 Effluent Guidelines

63. Effluent guidelines apply to direct discharges of treated effluents to surface waters. Site-specific discharge levels may be based on:

- the availability and performance of public sewage collection and treatment systems
- the classification and designated use of the receiving water as described in the General EHS Guidelines

64. Effluent guideline values for common HCF wastewater parameters are provided in table 4, which should be met without dilution at least 95 percent of operating hours annually. These guidelines are achievable under normal operating conditions in appropriately designed and operated facilities using pollution prevention and control measures outlined in these guidelines. Any deviation should be supported by a clear technical justification in the environmental assessment, reflecting local project conditions.

Table 4. Effluent levels for health care facilities		
Pollutants	**Guideline units**	**Guideline value**
pH	S.U.	6–9
Biochemical oxygen demand (BOD_5)	mg/L	50
Chemical oxygen demand (COD)	mg/L	250
Oil and grease	mg/L	10
Total suspended solid (TSS)	mg/L	50
Cadmium (Cd)	mg/L	0.05
Chromium (Cr)	mg/L	0.5
Lead (Pb)	mg/L	0.1

Table 4. Effluent levels for health care facilities		
Pollutants	**Guideline units**	**Guideline value**
Mercury (Hg)	mg/L	0.01
Chlorine, total residual	mg/L	0.2
Phenols	mg/L	0.5
Total coliform bacteria[a]	CFU or MPN/100 mL	400
PCDD/F[b]	ng/L TEQ	0.1
Temperature difference[c]	°C (degrees Celsius)	3

Notes:

a US EPA, *Microbial Methods Water Waste*. Approved methods and comparison for total coliform bacteria are available in table A1.

b Polychlorinated dibenzodioxin and dibenzofuran.

c Temperature change at the edge of a scientifically established mixing zone that considers ambient water quality, receiving water use, potential receptors, and assimilative capacity.

Key:

CFU = coliform forming units

mg/L = milligrams per liter

mL = milliliters

MPN = Most Probable Number

ng/L = nanograms per liter

S.U. = standard units

TEQ = Toxic Equivalency Factors

5.1.3 Resource Consumption, Energy Use, and Waste Generation

65. HCF environmental performance should be assessed using international protocols and benchmarks for resource consumption, energy use, GHG emissions (direct and indirect), and waste generation. Audit operations to identify and address inefficiencies without compromising health care quality and safety.[74]

5.2 Occupational Health and Safety Performance

66. HCF should aim to reduce the risk of occupational incidents and injuries among workers to prevent lost work time, disability, illness, or fatalities. Benchmark facility-level health and safety performance against sector standards (e.g., US Bureau of Labor Statistics, UK Health and Safety Executive, US OSHA Hospitals e-Tool).[75] Measure performance using metrics such as incident counts, workplace inspections, resolved and unresolved findings, and training sessions. Refer to the General EHS Guidelines for more guidance.

5.2.1 Occupational Health and Safety Monitoring

67. The working environment should be monitored to identify occupational hazards relevant to the project. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program, as

[74] US DOE EIA, *Energy Efficiency Healthcare Facilities*; Natural Resource Canada, *Energy Consumption Health Facilities*; Healthcare Environmental Resource Center, *Pollution Prevention Compliance Assistance*.
[75] US BLS, *Injuries, Illnesses, and Fatalities*; UK HSE, *Health and Safety Statistics*; US DOL OSHA, *Hospitals e-Tool*.

provided in the General EHS Guidelines.[76] Facilities should record occupational accidents and incidents and report significant accidents and injuries, including the frequency rates and associated lost time.[77] This data should be benchmarked against internationally published guidelines and standards. A root cause analysis (RCA) should be conducted using structured approaches and analyze lessons to implement corrective measures.[78]

5.2.2 Occupational Health and Hygiene Guidelines

68. Occupational hygiene monitoring should be compared against internationally recognized chemical, biological, or physical hazard standards.[79]

[76] Accredited professionals may include Certified/Chartered or Registered Industrial or Occupational Hygienists, or Certified Safety Professionals or specialists or equivalent.
[77] WHO, *Patient Safety Incident Reporting.* This provides guidance on frameworks for reporting, analyzing, and learning from incidents.
[78] ISO, *Environmental Performance Evaluation*. This resource provides guidance on performance evaluation principles for identifying causes and corrective actions for incidents.
[79] US DOL OSHA, *Permissible Exposure Limits*; US DOL OSHA, *Limits for Air Contaminants*; ACGIH, *TLV/BEI Guidelines*; NIOSH, *Pocket Guide Chemical Hazards*; European Agency for Safety and Health at Work, *Occupational Exposure Limit Values*; ILO, *Chemical Exposure Limits.*

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ANNEX A: GENERAL DESCRIPTION OF INDUSTRY ACTIVITIES

1. The HCF sector includes diverse facilities varying in complexity, size, purpose, and permanence, which influence their environmental, health and safety impacts. These Guidelines categorize HCFs based on these variables to aid discussion, not to prescribe characteristics, as definitions may vary by jurisdiction. Table 1 lists examples of HCF types.[80]

2. HCFs involve close contact between patients, health care providers, and workers; and rely on extensive use of sharps, diagnostic instruments; and pharmaceutical, chemical, radiological, and other agents for diagnosis, treatment, cleaning, and disinfection. Their core objectives are to improve patient health, prevent infection transmission, and manage environment, health, and safety impacts. Key activities include maintaining sanitary conditions, performing effective disinfection and sterilization; providing potable water and clean air, and implementing nosocomial infection control measures.

3. Medical technology areas (MTAs) are central to hospitals and clinics but are generally absent in outpatient, assisted living, or hospice facilities. Patient and services areas (P&SA) are crucial in hospitals and clinics, assisted living, and hospice facilities. Each patient bed typically requires 60-100 square meters (m^2) of dedicated space, plus an equivalent area for parking and facility access. Electricity us is determined by facility design and service needs, with general hospitals consuming nearly twice the energy of other buildings due to MTA energy needs.

4. HCFs generate various waste streams, including air emissions, wastewater, health care waste (e.g., infectious, radioactive, and chemical), and municipal solid waste (e.g., plastic packaging and single-use products). These waste streams can pose risks to the environment and human health. Waste management processes--conducted on- or offsite—are tailored to health care sector hazards. Figure A1 illustrates treatment methods for managing these wastes.

[80] WHO, *Waste Management Assessment Tool*. HCF categories referred to in these guidelines are adapted from those defined in the WHO rapid assessment tool, which is designed to develop performance profiles of participants and encourage good health care waste management practices. In view of the intent of these EHS Guidelines, the adaptations of the definitions from WHO (2011) generally account for requirements related to the variety of services, patient numbers, and scale of an HCF.

Figure A1. Illustration of health care waste treatment methods