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MINISTRY OF HEALTH-ETHIOPIA
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HEALTHIER CITIZENS FOR PROSPEROUS NATION!

HEALTHCARE FACILITIES WASH GUIDELINE

MAY 2021
ADDIS ABABA, ETHIOPIA

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ACRONYMS AND ABBREVIATIONS

HCAI	Health Care Acquired Infections
HCFs	Health Care Facilities
HCWs	Health Care Workers
IDP	Inpatient Department
JMP	Joint Monitoring Programme
MHM	Menstrual Hygiene Management
MoH	Ministry of Health
NTU	Nephelometric Turbidity Unit
OPD	Outpatient Department
PHCU	Primary Health Care Unit
PPE	Personal Protective Equipment
RWH	Rainwater Harvesting
SDG	Sustainable Development Goal
SOP	Standard Operating Procedures
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit Latrine
WHO	World Health Organization
WASH	Water, Sanitation, Hygiene, Health Care Waste Management, & Environmental Cleaning

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FOREWORD

Universal health coverage that includes access to WASH services has a new emphasis on sustainable development goals, or SDGs. SDGs echo a form of thinking that recognizes the importance of quality care and the integration of a people-centered approach that enhances the experience of care, which cannot be achieved without WASH services in health care facilities.

Health care facilities (HCF) are required to have a standardized approach that guides the provision of WASH services. This ensures quality and safe care and minimizes the risk of healthcare-associated infections for staff, patients, caregivers, and visitors. It also tackles anti-microbial resistance and ultimately improves the health outcomes of patients. This requires leadership and political commitment from the government, the health system, and non-government organizations devoted to better health service provision.

As such, WASH in HCFs includes provision of basic water supply, basic sanitation, hygiene, health care waste management, and environmental cleaning; each of which are critically important for infection prevention and quality of care.

The Ministry of Health acknowledges the importance of WASH in healthcare facilities and shows its commitments for its provision in all such facilities. The ministry believes the National WASH in Healthcare Facilities Guidelines will play a fundamental role in addressing WASH services in order to augment the quality of health care in Ethiopia. Consequently, the ministry requests all Regional Health Bureaus and other stakeholders ensure implementation of these guidelines in all health care facilities, monitor their progress regularly, and allocate resources for implementation.

Finally, I would like to extend my sincere gratitude to all individuals and organizations who have contributed to the development of the WASH in Healthcare Facilities Guidelines.

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1. INTRODUCTION

1.1. BACKGROUND

WASH in healthcare facilities refers to the provision of water, sanitation, health care waste management, infrastructure for hygiene and environmental cleaning, and services across all parts of a facility. Healthcare facilities discussed in this guide include primary health care units (health posts, health centers, and primary hospitals), general hospitals, comprehensive and specialized hospitals, and temporary emergency-related structures (e.g., cholera treatment centers and COVID-19 treatment centers).

The primary objective of healthcare facilities is to provide clients and workers, caregivers, and all visitors with reliable and secure care. It is understood that in order to seek medical or health care, people go to a healthcare facility. However, due to the lack of sufficient water, sanitation, and hygiene (WASH) facilities, the quality of the provided health services is significantly compromised. Lack of or poor WASH facilities in HCFs also compromises patient safety and dignity, exacerbates the spread of antimicrobial-resistant infections, and undermines efforts to improve health care practices, including child and maternal health.

Adequate hand hygiene, such as handwashing with soap, is a cost-effective practice for preventing infection in health care settings. However, several hundred million patients acquire infections arising from poor handwashing practices annually. This is due in part to the lack of available handwashing materials and facilities. Compliance with handwashing standards among healthcare providers is often low, and healthcare providers often transmit infection. Because of these deficiencies, HCFs serve as foci for infection and patients seeking treatment fall ill (and potentially die) because of the lack of basic elements needed for a safe and clean environment.

Globally, 26% of healthcare facilities lack basic water services, and 21% lack sanitation services. About 1.8 billion people use healthcare facilities without basic water and 800 million use facilities with no toilets. Billions of people are affected by a lack of WASH services in HCFs, which implies that many more people are likely to be served by healthcare facilities that lack any sort of hand hygiene and healthcare waste management facilities. This problem is very severe in rural and lower-level healthcare facilities. The level of WASH services provided vary considerably between regions. For example, more than 1 in 2 healthcare facilities in sub-Saharan Africa lack basic water service[1].

[1] *World Health Organization and the United Nations Children's Fund. WASH in healthcare facilities: Global Baseline Report. 2019. License: CC BY-NC-SA 3.0 IGO.*

It is reported that endemic healthcare-acquired infections (HCAIs) are responsible for up to 56% of all neonatal deaths among babies born in the hospitals of developing countries globally, with 75% of these deaths occurring in Southeast Asia and sub-Saharan Africa.

Sanitation, water, and hygiene in HCFs are recognized in the SDG goals, particularly in SDG 6. SDG 6 calls for the "availability and sustainable management of water and sanitation for all." Furthermore, SDG 3.8 calls for "access to quality essential healthcare services" for all (*United Nations General Assembly, 2015. Draft Resolution A/69/L.85: Transforming Our World: The 2030 Agenda for Sustainable Development*). Hence, the global community will not reach the goal of universal access to essential services nor will it achieve its sustainable development goals (SDGs) without WASH services in HCFs.

In HCFs, there are many reasons to motivate the improvement of WASH services. Some of these reasons are to provide a higher quality of care, reduce infections associated with healthcare, improve health services, and boost the morale of health care workers. Improving these services will require health sector leadership and political commitment by governmental and non-governmental partners alike to improve health for all.[2]

Therefore, as centers for promoting health and wellbeing, HCFs are required to operate within acceptable standards of personal and environmental cleanliness, which are essentially predetermined by the availability and accessibility of improved WASH services. Improved WASH services in HCFs are critical for creating a more comprehensive health service and improving health outcomes. A lack of national policies, consolidated guidelines, and standards on implementation of WASH in HCFs coupled with limited financial and human resources for effective and efficient implementation, as well as a lack of a clear approach toward standardizing and strengthening monitoring mechanisms for WASH interventions in HCFs are significant detriments.

1.2. HEALTHCARE FACILITIES WASH OVERVIEW IN ETHIOPIA

In Ethiopia, about 34% of health facilities have an improved water source on the facility premises. Furthermore, two-thirds (61%) of facilities have access to an improved sanitation facility on the premises, and 52% of health facilities utilized safe disposal of infectious wastes according to service availability and readiness assessments[3] [4].

In 2014, about 26% of HCFs in Ethiopia did not have a functioning latrine intended for patient use. In Ethiopian Health Sector Transformation Plan II, a goal was set to increase the amount of basic toilets in healthcare facilities from 61% to 80% by 2025. Another goal was set to increase the amount of health facilities with basic healthcare waste management services

[2] *World Health Organization and UNICEF. Joint monitoring tools for WASH in Healthcare Facilities. 2019.*
[3] *Government of Ethiopia Ministry of Health. Health Sector Transformation Plan II. 2021*
[4] *Ethiopian Public Health Institute. Service Availability and Readiness. 2018.*

from 16% to 80%, and health facilities fulfilling climate resilience criteria from baseline to 25%, both by 2025. Implementing WASH in more healthcare facilities is one of the priorities of the sector, in order to ensure safety and quality care for the community.

The prevalence of healthcare-acquired infection (HCAI) was estimated to be 17% in Ethiopia. The possible reasons for this high a prevalence is very poor hand hygiene practice, low adherence to infection prevention practice, low levels of job satisfaction, distressed nurses, resource constraints, poor implementation of nursing processes, and less attention given to healthcare-associated infections[5].

WASH in healthcare facilities has been implemented in fragmented ways by the Ethiopian health system. Different WASH-related strategies, guidelines, manuals, and initiatives have been developed and implemented in said system. For instance, there have been design and construction manuals for WASH facilities in healthcare facilities, healthcare waste management guidelines, infection prevention and control guidelines, Clean and Safe Health facility initiatives, and a national WASH program supporting healthcare facilities. In the aforementioned documents, WASH in healthcare facilities in Ethiopia was not addressed in a consolidated manner. There is also a shortage of financial and human resources for WASH in healthcare facilities. Due to these fragmented documents and programs, the monitoring and evaluation system was very weak and the support provided for healthcare facilities by program managers at various levels was also low. This demands attention by both the government and stakeholders. Therefore, these guidelines support policymakers, implementers, and other stakeholders in the provision of WASH in healthcare facilities.

1.3. THE BENEFITS OF WASH IN HEALTHCARE FACILITIES

In order to improve public health, ensuring better WASH facilities in the HCFs of Ethiopia is of utmost importance. This will in turn have economic benefits and other developmental benefits as well. WASH in the HCFs will result in:

- Improved prevention, preparedness, and response to health emergencies (e.g., COVID-19, Cholera, Ebola, etc.)
- Improved health and safety: reduced healthcare-acquired infections, reduced antimicrobial resistance, and improved occupational health and safety
- Improved patient satisfaction and improved quality of service
- Decreased healthcare costs: more efficient services and disease/deaths averted
- Reduced antimicrobial resistance and spread of antimicrobial-resistant entities into the environment

[5] *The burden of healthcare-associated infection in Ethiopia: a systematic review and meta-analysis; Alemu et al. Tropical Medicine and Health (2020) 48:77.*

- Promotion of people-centered care: increased uptake of services; e.g. facility births, vaccinations
- Enhanced staff morale and performance: improved satisfaction and ability to provide safe care
- Improved community WASH practice: healthcare workers can be role models for the community; improved hygiene practice at home
- Climate change and disaster resilience: facilities will be better prepared to continue to provide WASH in disasters and/or climate related events

1.4. RATIONALE

There are many ongoing initiatives nationwide by various stakeholders to support the improvement of WASH services in HCFs. However, there are no well-organized national guidelines to guide the provision of such services, making it difficult for the MoH to follow up and ensure quality control. The absence of WASH service guidelines in the provision of HCFs leads to a lack of uniformity, especially concerning planning and budgeting, technical designing and construction, and related interventions. These guidelines allow all stakeholders to follow the same set of rules when providing WASH services in HCFs. Therefore, it is helpful to harmonize and standardize WASH in healthcare facilities.

1.5. OBJECTIVES OF THE GUIDELINE

The main objective of these guidelines is to put in place a uniform and harmonized approach regarding the provision of WASH services in healthcare facilities all over the country. These guidelines offer practical guidance for the effective and efficient provision of WASH services in HCFs to ultimately contribute to the prevention and control of healthcare-acquired infections as well as the improvement of health care service quality in Ethiopia.

Specifically, the guidelines intend to:

- Provide technical guidance on the planning and implementation of WASH services in HCFs.
- Provide basic information on technical designs, operation, and maintenance of WASH services for sustainable service delivery.
- Establish systems for monitoring and evaluating WASH services in HCFs for continuous quality improvement.

1.6. SCOPE OF THE GUIDELINES

These guidelines guide the provision of WASH services in the country. Specifically, the guidelines focus on promoting WASH services in HCFs, which include hospitals, health centers, and health posts.

These guidelines largely focus on the following key issues:

- Water supply for healthcare facilities
- Sanitation in healthcare facilities
- Healthcare waste management drainage
- Hygiene
- Environmental cleaning and laundry
- WASH services in healthcare facilities during an emergency
- Design, operation, and maintenance for WASH facilities
- Planning of and resource allocation for WASH services
- Implementing, monitoring, reviewing, and revising WASH services

1.7. USERS OF THE GUIDELINES

These guidelines are developed for use by national-level policymakers, regional health bureaus, zonal health departments, Woreda health offices, and all healthcare facilities (both public and private) in Ethiopia, as well as hygiene and environmental officers at different levels, development partners, public and private health care workers, health promoters, and other stakeholders.

2. WATER SUPPLY

To provide quality care, healthcare facilities need to have a safe and adequate water supply readily available onsite[6],[7]. HCFs are ranked among institutions with high water demand and hence, require access to an adequate supply of water at all times in order to maintain a standard of daily patient care services and other operations. Adequacy of water can be characterized in terms of quantity, quality, reliability, and accessibility[8].

2.1. WATER SOURCES

The term "water source" refers to water (rainwater, groundwater, and surface water) that provide water for drinking purposes and other activities in healthcare facilities. HCFs can access water for different purposes from the following sources:

MUNICIPAL WATER: Municipal water is potable water that is provided to the health facilities through pipes. The treatment and distribution of the water is operated by the municipality. The HCFs will pay the water bill based on the amount of consumption.

GROUNDWATER SOURCES: Groundwater can be developed by the HCFs. Groundwater might be used in combination with the municipal water system, or, in rural healthcare facilities, it can be used as the major water source. Depending on the depth of the water table and method of drilling, different types of water sources can be developed from groundwater. The quality and safety of the water also depends on the types of sources.

Figure 1: Groundwater sources

[6] *WASH in Healthcare Facilities, Centers for Disease Control and Prevention. https://www.cdc.gov/healthywater/global/healthcare-facilities/overview.html.*

[7] *World Health Organization and UNICEF. Water, Sanitation, and Hygiene in Health Care Facilities: Practical Steps to Achieve Universal Access to Quality Care. 2019.*

[8] *World Health Organization, Essential Environmental Health Standards in Health Care. Geneva. 2008. www.who.int/water_sanitation_health/publications/ehs_hc/en.*

SURFACE WATER SOURCES: If municipal water and groundwater sources are not available in some health care facilities, surface water can be considered as alternative source of water. The water can be transported by donkey, human, or cart. Since surface water is highly polluted, the water should be adequately treated using appropriate treatment options before use.

RAINWATER HARVESTING (RWH) SYSTEM: This is an alternative source that can ensure the availability of water in HCFs, especially in areas with water scarcity or an intermittent water supply. The capacity of an RWH depends on the quality of the collecting surface (roof), storage capacity, and the rainfall season(s) in a respective area (once or twice per year). The main advantage of rainwater is that it usually is clean and natural, especially if collected from buildings roofed with non-rusted corrugated iron sheets/tiles and clean gutters and is then stored in clean closed tanks.

RECYCLED WATER: Recycled water is a water source obtained by further processing after treatment in sewage treatment plants, which was originally sent there from the HCFs. Recycled water can be considered as alternative water source if the HCFs have their own wastewater treatment plant that sufficiently treats the wastewater contaminants. From an ethical point of view, such water sources may not be used for direct drinking but could be used to flush a toilet, cleaning, gardening, unrestricted agriculture, etc. In such circumstances, careful attention needs to be paid to the quality of the recycled water. In this regard, recycled water from wastewater could be used as a water source option for WASH facilities in the HCFs.

2.1.1. BASIC CONSIDERATIONS FOR SELECTING APPROPRIATE WATER SOURCES FOR HCFS

In selecting any of the water sources mentioned above, HCFs should consider the following criteria:

WATER QUANTITY: Sufficient water should be available at all times for drinking, food preparation, personal hygiene, medical activities, cleaning, and laundry; considering both the current and future demands of the HCFs.

WATER QUALITY: Water for drinking, cooking, personal hygiene, medical activities, cleaning, and laundry should be safe for the intended purposes. The water quality should be in line with the national standards for the specified purpose of the water.

FEASIBILITY: The selected source should be amenable to exploitation using appropriate technology and within a reasonable cost, considering both capital and operation/maintenance costs such as various forms of simple and reliable treatment and transmission technology.

ACCESSIBILITY: The availability of a water source (with adequate yield) that is found within or around the health care facility is important. Water should be available at all points of care (in all outpatient and inpatient treatment locations).

AFFORDABILITY: This refers to the amount paid by the HCFs to the municipality, or the cost incurred by HCFs for maintenance, operation, treatment and distribution, if the water sources are developed by the facility itself.

CONTINUITY: The water must be available whenever it is required for different activities in the HCFs in all seasons. Water should be available throughout the year (i.e. not affected by seasons, power outages, etc.)

2.1.2. RECOMMENDED WATER SOURCES FOR EACH FACILITY LEVEL

In principle, in planning and designing WASH facilities, HCFs should adhere to the global WHO standards for environmental health services in healthcare facilities, along with WHO guidelines on drinking water quality, sanitation, and healthcare waste. In parallel, the WHO/UNICEF Joint Monitoring Programme (JMP) has developed global indicators and questions to support the monitoring of WASH services in health care facilities. An improved drinking water source includes sources that, by nature of their construction or through active intervention, are protected from outside contamination, particularly fecal matter.

The most feasible options available to HCFs include forging connection to existing water supply networks, drilling or digging their own wells, tapping water from protected springs, and/or installing rainwater harvesting systems.

2.1.3. CONNECTION TO EXISTING WATER SUPPLY SYSTEMS

Most of the HCFs located in regional cities or in small towns are either already connected to water supply distribution networks operated by water supply and sewage authorities or have the potential of doing so. Climate change can impact the function of the water supply system. Whenever there is interruption in the distribution of water from the existing pipe schemes, it is strongly recommended that a backup should be available to ensure that the supply for the HCF is reliable. In this case, storage facilities such as reservoir tanks or deep wells (that can provide emergency water for three days) should be installed within the HCF's premises. While urban water supply authorities will normally provide an extension of pipes to the premises, HCFs will be tasked with contracting out the services regarding the improvement of the in-house distribution network and the installation of storage facilities to local water technicians/plumbers.

2.1.4. DEVELOPMENT OF PRIVATE WATER SOURCES

HCFs located in areas where there are no pipe schemes (owned or operated by neither water supply and sewage authorities nor community-owned water supply systems) will have to develop their own water sources. The most likely options would be drilled boreholes (medium or deep wells), protected shallow wells, springs, and rainwater harvesting. However, mechanized drilling is relatively costly and therefore, HCFs that choose this option should consider the financial feasibility.

2.2. OPERATION AND MAINTENANCE OF WATER SUPPLY SYSTEMS

The provision of safe water as per designed quality and quantity with adequate pressure at a convenient location that is also accessible on a sustainable basis is the main objective of an efficient operation and maintenance management of an HCF water supply.

Operation and maintenance (O&M) include routine maintenance, minor repairs, and corrective maintenance, which includes training:

ROUTINE MAINTENANCE: Refers to any planned maintenance task performed on an ongoing basis to identify and prevent problems before they result in equipment failure.

MINOR REPAIR: Refers to the renewal or replacement of any existing part.

CORRECTIVE MAINTENANCE: Refers to maintenance tasks that are performed in order to rectify and repair faulty systems and equipment (for further information please see Annex 1).

A responsible person should be assigned by the facility for operation and maintenance activities.

2.3. CLEANING AND DISINFECTION OF WATER STORAGE TANKS

An HCF's water storage capacity should be sufficient to meet the needs of the facility for 3 days. Storage tanks/reservoirs should be kept clean and have a tight lid. Acceptable storage methods include clean, covered, and well-maintained containers which are free from any cracks, leaks, etc. Such containers should also allow for the extraction of water without using hands or other potentially contaminated surfaces (i.e. through use of a tap).

It is of practical importance for HCFs to clean and disinfect water storage tank(s) at least once every three months or more frequently if necessary, due to flooding, heavy rains, reported contamination of water, and so on. Cleaning and disinfecting water storage tanks aims to remove algae (plant growth which produces bad tastes and odors), silt, and bacteria, all of which may be harmful.

The steps below should be followed when cleaning and disinfecting water storage tanks:

- Empty the tank
- Scrub or pressure wash the interior walls to remove dirt and grime with detergents
- Rinse out the tank
- Scrub or pressure wash the interior walls of the tank with a 0.2% chlorine solution and leave for two hours
- After two hours, thoroughly rinse the tank with clean water
- Refill the tank with water

2.4. WATER SOURCE PROTECTION

In every health care facility, a water safety plan should be implemented to improve the quality of water, rather than relying on water treatment alone. A water safety plan is a plan to ensure the safety of drinking water through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply, from catchment to consumer (please see additional info in Annex 2).

2.5. MINIMUM WATER REQUIREMENTS FOR HEALTHCARE FACILITIES

Adequate water should be available for drinking, personal hygiene (including hand washing and bathing), cleaning personal utensils, cooking, laundry, cleaning, and medical activities.

Water demand in HCFs refers to the total amount of water to be used by the HCWs, patients, and any other people in need at any specific time and for various health and/or health-related activities.

The water demand may vary from one HCF to another depending on the average number of people being served in a particular time, the number and type of tasks carried out in different units and the level of the health facility. Water demand can be expressed in terms of liters per person or bed per day. The water consumption per day of a health post will be lower compared to health centers and district, regional, and national/referral hospitals. Thus, the higher the level of the facility, the more water is required, because of the number of users and variety of uses.

2.5.1. MINIMUM WATER REQUIREMENTS FOR HEALTHCARE CENTERS[8,9]

DEPARTMENT TYPE	REQUIREMENTS
Outpatient	5 liters/consultation
Inpatient	40-60 liters/patient
Operating theatre or maternity unit	100 liters/intervention
Dry or supplementary feeding center	0.5-5 liters/consultation *(depending on waiting time)*
Wet supplementary feeding center	15 liters/consultation
Inpatient therapeutic feeding center	30 liters/patient/day
Cholera treatment center	60 liters/patient/day
Severe acute respiratory disease isolation center	100 liters/patient/day
Viral hemorrhagic fever isolation center	300-400 liters/patient/day

Table 1: Minimum water requirement in healthcare facilities

[9] *National guidelines for water, sanitation and hygiene in health care facilities in Tanzania. 2017.*

2.6. MINIMUM WATER STORAGE REQUIREMENTS FOR HCFS

The water storage requirement for HCFs is determined by the water demand of each facility's level of service and time required to carry out its activities during a potential interruption of water from the main source. Water should be stored in HCFs for the following reasons:

- To guarantee a consistent water supply during intermittent/rational situations
- To increase the volume and pressure during a potential scarcity of water, as long as the tanks are correctly installed and work with adequate plumbing.

Sufficient water has to be available at all times for drinking, food preparation, personal hygiene, medical activities, cleaning, and laundry. Moreover, the following also need to be considered when designing water storage systems:

- Does the water supply fulfill the capacity required?
- Is there a suitable alternative supply in case of need?
- Is sufficient water available at all times for all needs?
- Is the water supply operated and maintained to prevent waste?

2.7. WATER QUALITY STANDARDS FOR HEALTHCARE FACILITIES

Water supplied in HCFs should maintain a standard quality to ensure that there is a total absence of risk from microbiological, chemical, and physical contaminants.

2.8. DISINFECTION

In health care facilities, water supplies frequently do not achieve adequate water safety once delivered due to problems at the water treatment works and contamination in the distribution system. Stored water may also need supplementary chlorination before use. Efforts should be made to ensure that water is not contaminated in the healthcare setting during storage, distribution, and handling.

Even though there are many water disinfectants, disinfection with chlorine is the most widely accepted and appropriate way of providing microbial safety in most low-cost settings. Bleaching powder, liquid bleach, chlorine tablets, and other sources of chlorine may be used, depending on local availability.

To ensure adequate disinfection, a contact time of at least 30 minutes is necessary as well as a free chlorine residual (the free form of chlorine remaining in the water) post contact time should be between 0.5 and 1.0 milligrams per liter (WHO, 2006). The concentration of chlorine in the water supplied to consumers should always be <5mg/l. If the turbidity exceeds

5 NTU then the water should be treated to remove the suspended matter before disinfection by sedimentation (with or without coagulation and flocculation) and/or filtration[10].

2.8.1. CALCULATING CHLORINE CONCENTRATION

The following terms are essential to calculate the chlorine solution and, in general, to understand disinfection in practice:

CHLORINE DEMAND: Chlorine demand is when chlorine is added to water. Chlorine reacts with any organic and inorganic material (chlorine reactive substances) ⇒ during these reactions, chlorine is consumed, and this is referred to as the 'chlorine demand.'

Once the chlorine demand has been satisfied and the disinfection reactions are complete, the remaining chlorine is referred to as the total chlorine. Total chlorine consists of:

COMBINED CHLORINE: This is the chlorine that has reacted with the organic material and nitrogen compounds (such as ammonia) to form weak disinfectants; and

RESIDUAL CHLORINE: The free chlorine remaining and available for disinfection that protects the water from recontamination by microorganisms.

Where routine monitoring is not practical, you should be aware of the impact of changing raw water quality (i.e. changing chlorine demand) on the required chlorine dose (E.g. poorer water quality ⇒ higher chlorine demand ⇒ higher chlorine dose required)

Chlorine Demand (mg/L) = Actual Chlorine Dose (mg/L) - Total Residual Chlorine (mg/L)

EXAMPLE: ⇒ If the actual chlorine dose is 3 mg/L ⇒ The total residual chlorine is 1 mg/L (after 30 minutes contact time), then using Eq. 1: Chlorine Demand (mg/L) = 3 mg/L - 1 mg/L = 2 mg/L.

CHLORINE DECAY: This refers to the decrease (or reduction) in the concentration of chlorine in drinking water as it passes from the water treatment plant, through the distribution system, to the point of consumer delivery. Due to chlorine decay, the concentration of chlorine at the end of the distribution system will usually be less than the concentration at the water treatment plant.

Understanding the chlorine demand and chlorine decay of your water supply system is important, as it helps you determine the correct chlorine dose at the water treatment plant. Remember, you must use enough chlorine at the water treatment plant to ensure you have ≥ 0.2 mg/L at the point of consumer delivery.

[10] *Center for Disease Control and Prevention. Rationale and Considerations for Chlorine Use in Infection Control for Non-U.S. General Healthcare Settings. 2019. https://www.cdc.gov/vhf/ebola/clinicians/non-us-healthcaresettings/chlorine-use.html, accessed March 18, 2020.*

You may need to maintain a higher residual chlorine concentration in some parts of the distribution system to ensure a minimum residual chlorine concentration of 0.2 mg/L is achieved throughout the entire system[11].

Required Chlorine Dose (mg/L) = Chlorine Demand (mg/L) + Desired Residual Chlorine (mg/L)

EXAMPLE: ⇒ The chlorine demand is known to be 2 mg/L ⇒ the desired residual chlorine is 1 mg/L, then: required chlorine dose (mg/L) = 2 mg/L + 1 mg/L = 3 mg/L

EXAMPLE: A water treatment plant requires 500 L of a 2% chlorine liquid solution using bleaching powder with an active chlorine concentration of 35%. To determine the weight of chlorine powder required: Weight required (g) = 1 000 x 500 L x 2% divided by 35% = 28 571 g (or 28.6 kg) per 500 L of water

2.9. WATER ACCESS AND DISTRIBUTION

HCFs are ranked among institutions that have a relatively high water use intensity (WUI) and hence, require access to an adequate supply of water at all times in order to maintain daily patient care services and other operations. Adequacy of water should be met in terms of quantity, quality, reliability, and accessibility. The purpose of this is to ensure that sufficient water collection points and water use facilities are available in the HCF to allow convenient access to water for medical purposes, drinking, personal hygiene, food preparation, laundry, and cleaning. As a guiding principle, water should be available within all wards and in waiting areas.

Most importantly, making sure adaptations for the disabled or seriously ill patients are incorporated into the design of WASH facilities is a significant consideration. Planners and technical designers need to note that not all the potential users of the WASH facilities will have normal physical abilities as they will include those with physical disabilities or chronically and/or seriously ill individuals.

2.9.1. MAJOR CONSIDERATIONS IN THE DISTRIBUTION OF WATER IN HEALTHCARE FACILITIES

Water points/taps in HCFs should be installed, taking into account the following aspects:

- A reliable drinking-water point should be accessible for staff, patients, and caregivers at all times. To be considered accessible, the following criteria should be met:
  - Pathway to drinking water area: width is minimum 120 cm, is flat, even, dry, and clear of obstacles.
  - Signs for drinking water station has words, pictures, and braille, and is displayed on the wall at 140 cm -160 cm from the ground.

[11] *World Health Organization. Principles and practices of drinking water chlorination: a guide to strengthening chlorination practices in small to medium-sized water supplies. 2017.*

    - The drinking water station tap is 75cm from the floor, and a cup is available to patients. For COVID-19 patients, cups should be disposable, and ideally not made from single-use plastic.
- In case of a rapid increase in care seekers (e.g. due to climate-related events), staff fill stations more regularly, more water is procured, or other options (such as in-line treatment for piped water) must be employed.
- A reliable water point (with soap or a suitable antiseptic or sanitizers for hand washing) should be available at all critical points within the HCF including operating theatres, wards, consulting rooms, dressing rooms, and in service areas such as sterilization, laboratory, kitchen, laundry, showers, toilets, waste zone, and mortuary.
- At least two hand washing basins should be provided in wards with more than 20 beds.
- At least one shower should be available for every 40 users in inpatient settings (users include patients, HCWs, and careers).
- Laundry facilities with soap or detergent, hot water, and a disinfectant (such as chlorine solution) should be available for inpatient settings[12].

[12] *World Health Organization. Drinking water Guidelines. 2017.*

3. SANITATION IN HEALTHCARE FACILITIES

Sanitation is defined as access to and safe management of facilities and services for the safe disposal of human urine and feces. A **safe sanitation system** is a system designed and used to separate human excreta from human contact at all steps of the sanitation service chain, from toilet capture and containment through emptying, transport, treatment (on or off-site), to final disposal or end use.

Safe sanitation is essential for health, from preventing infection to breaking the disease transmission cycle and maintaining mental and social well-being. Sanitation facilities within healthcare facilities are essential to improve the privacy and dignity of patients, staff, women, girls, and people with physical disabilities to improve their health outcomes

3.1. SERVICE LEVEL CRITERIA FOR SANITATION FACILITIES WITHIN HEALTHCARE FACILITIES

Generally, sanitation services in HCFs should be satisfactory and adequate if the following minimum requirements are met.

3.1.1. USER CONVENIENCE

There should be **separate** provisions of toilets for female and male users for HCWs, visitors, patients, and people with special needs such as the differently abled, pregnant women, elderly, seriously ill persons, and young children. **Supportive facilities** should be provided for people with special needs, such as wheelchair users and the blind.

A toilet can be considered to meet the needs of people with reduced mobility if it meets the following conditions: it can be accessed without stairs or steps, handrails for support are attached either to the floor or sidewalls, the door is at least 80 cm wide, the toilet has a raised seat (between 40–48 cm from the floor), a backrest is present, and the cubicle has space for circulation/ maneuvering (150 x 150 cm). The sink, tap, and water should also be accessible. The top of the sink can be maximum 75 cm from the floor (with knee clearance). Switches for lights, where relevant, should also be at an accessible height (max 120 cm)[13].

Handwashing stations at the toilet should also be accessible according to the following criteria: taps should have lever-type handles, the sink has grab rails on both sides, and soap (or alcohol-based hand rub) and tissues are easy to reach. The height of the sink is 75 cm for knee clearance.

[13] *ISO 21542: Building construction – Accessibility and usability of the built environment. 2011.*

Sign posts indicating toilets for male and female users should be provided to help them find the toilets easily. Also, toilets should be designed and equipped to respond to social and cultural norms regarding provision of water for anal cleansing, lockable doors for privacy, and gender separation.

3.1.2. ACCESSIBILITY

Toilets should be conveniently located; preferably not more than 30 meters from all users. They should have a ramp access, e.g not steps, and the path should be a clear and smooth terrain (not bumpy rocks that make walking difficult). Toilets must be open for use when needed: doors are unlocked, or a key is available at all times.

3.1.3. RELIABILITY

Toilets should be in a good state of repair and functional at all times. The toilet must not be broken, the hole must not blocked, and water is available for flush/pour-flush toilets. Toilets should be checked by facility staff and cleaned on a regular basis – at least once a day minimum but more if there is a high patient volume.

3.1.4. SAFETY

The latrine should be designed and constructed in a way that human excreta do not contaminate the environment, transmit disease, or harbor vector or vermin. Measures to control fly and mosquito breeding should be in place. Sanitation facilities should be structurally sound without presenting the risk of collapsing, falling, or otherwise causing injuries to users.

In order to minimize the risk of violence, including sexual violence, toilets should be properly located, with lockable doors and windows as well as access to proper lighting and ventilation, and natural light if used in the day or electrical lighting if the facility is open at night (WHO, 2008).

3.2. DESIGN AND CONSTRUCTION OF SANITATION FACILITIES

Providing adequate sanitation infrastructure and services requires careful planning and selection of the appropriate designs for a facility. Designing sanitation facilities should be part of the initial HCF planning. However, where sanitation infrastructure and services are inadequate, it is equally important to plan for construction of new ones or upgrading the existing facilities.

The following factors need to be considered during selection of sanitation facility design:

- Facility size and catchment population (with future projections)
- Type of services being offered at a facility
- Availability of reliable water supply
- Level of water table

- Type of weather condition
- Soil permeability
- Presence of supporting sanitation infrastructure such as a public sewer
- Sociocultural norms of users
- Cost of sanitation infrastructure
- Availability of construction materials
- Any other environmental, technical, and social considerations that might apply

Design and construction minimum standards:

- For each health institution, ensure one sanitary latrine for every 50 users, with a minimum of 3 squatting slabs; one for women, one for men, and a separate one for the staff.
- A minimum space with a width of 1.50m and length of 1.50m should be provided for every squatting space.
- Pits can be rectangular or circular, based on the soil type: Circular pits in loose soil formations and rectangular pits in hard and stable formations.
- Pits should be located at a minimum distance of 30 to 50 meters away from drinking water sources (tube wells and hand dug wells) depending on the soil condition. The distance will depend on hydrogeological conditions such as texture of the soil and groundwater depth and flow.
- When groundwater levels are high or when the soil is too hard to dig, the pit may have to be raised above ground level.
- Handwashing facilities with water and soap must be provided beside each latrine/ sanitation facility (within 5 metres) in every healthcare facility.

3.3. RECOMMENDED SANITATION FACILITIES FOR HCFS

Due to public health concerns in HCFs, wet sanitation systems are preferable. However, in places where water is scarce, dry sanitation systems can be used. The following sanitation systems are recommended for HCFs:

WATER CARRIAGE SANITATION SYSTEM

- Flush/pour flush toilets connected to pipe sewer systems
- Flush/pour flush toilets connected to septic tanks or pits

NON-WATER CARRIAGE SANITATION SYSTEM

- Ventilated improved pit latrines
- Composting latrine

3.4. DESCRIPTION OF EACH TYPE OF TOILET RECOMMENDED FOR HCFS

3.4.1. FLUSH TOILETS

A **flush toilet** or water closet (WC) is a **toilet** that disposes of human excreta by using water to **flush** it through a drainpipe to another location for disposal, thus maintaining a separation between humans and their waste. Flush toilets can be designed for sitting (for differently abled groups and squatting (for non-differently abled groups). A flush toilet consists of two parts: a tank (cistern) and a bowl into which the excreta are deposited. It also needs a connection to constant running water and a discharge pipe to take the wastewater away to a sewer or septic tank.

Flush toilets are suitable for areas where a water supply is available.

Figure 2: Squatting and siting types of flush toilets

3.4.2. POUR-FLUSH TOILETS

A pour-flush toilet is like a cistern flush toilet except that instead of water coming in from the cistern above, it is poured in by the user. Water is simply poured into the bowl manually from a bucket or a jug to flush the excreta; approximately 2–3 liters of water is usually sufficient.

Pour-flush toilets are suitable for areas where water supply is available.

3.4.3. MAINTENANCE AND HYGIENE OF FLUSH/POUR-FLUSH TOILETS

The appropriate technical human figure should be available for maintenance and operation of sanitation facilities in health care settings. Flush toilets are not typically designed to handle waste onsite. Instead, their drain pipes are connected to waste transport and treatment systems. In normal circumstances, when a toilet is flushed, the wastewater flows into an inspection chamber, septic tank, then to a sewerage system or a soak-away pit.

For maintenance and hygiene purposes the following practices are recommended:

- Users of flush toilets should be reminded through a visibly displayed poster that they must flush and leave the toilet clean after use.
- The cleaners should regularly clean the flush toilet with a toilet brush and detergents.
- There should be a cleaning schedule that shows the cleaning time and a supervisor's verification column that is signed to indicate monitoring for cleanliness.
- Periodic checks for effective functioning of the flush toilets in the HCF should be carried out to identify any mechanical faults, especially the blockage of wastewater flow due to a faulty cistern mechanism.
- Since flush toilets are located within buildings in many cases, rectification of such faults should be done immediately, otherwise flies could be easily attracted to the premises of the HCFs. Rectification is also important to avoid a bad smell from blocked toilets.
- Bedpans should be immediately emptied, cleaned, and disinfected after being used.

3.4.4. VENTILATED IMPROVED PIT LATRINE

A ventilated improved pit latrine or VIP latrine is a modification to the basic pit latrine. It is a latrine with a concrete slab and pit lining having a tall vertical (gradually tapered towards the pit) vent pipe with a fly-screen fitted outside the superstructure to trap flies and reduce odor nuisance. Therefore, it is a more sanitary and safe latrine. The VIP latrine has design features that control both odors and flies.

It is important that the vent pipe be at least 100mm in diameter to permit sufficient airflow. The top of the vent pipe must also extend at least 0.5 meters above the top of the superstructure. These are suitable for areas in which water is scarce, as there is no need for water except for occasional cleaning of the squat plate. It is also suitable for communities using dry cleansing materials as well as a less densely populated area where space is available for relocating the latrine when it is full. Footrests should be installed near the squat hole.

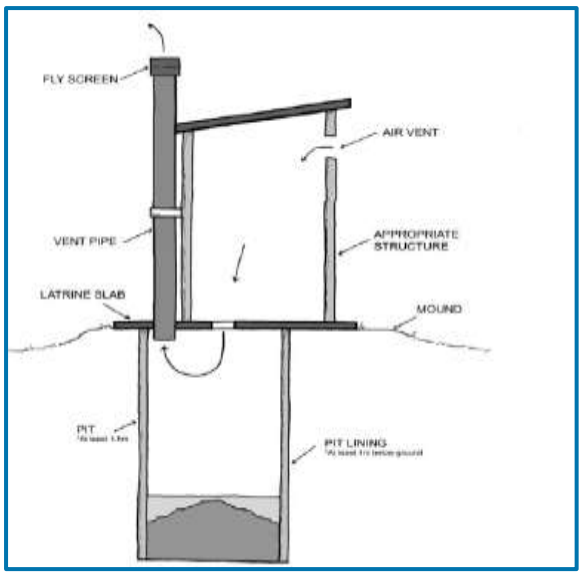


Figure 3: Ventilated Improved Pit Latrine

OPERATION AND MAINTENANCE OF A VIP LATRINE

To keep the VIP free of flies and odors, regular cleaning and maintenance is required. This will also prevent the spread of pathogens. Dead flies, spider webs, dust, and other debris should be removed from the ventilation screen to ensure good airflow. When the pit is full, it can either be emptied to treat and use the sludge as fertilizer, or the superstructure and squatting plate can be moved to a new pit. In the latter case, the old pit is covered and decommissioned, which is only advisable if plenty of land area is available. If the superstructure can be moved to a new pit, after several years, the decomposed sludge in the former pit will not cause any health problems and can be dug out without any offensive smells.

VOLUME OF THE PIT

Pits can be rectangular or circular. The volume of the pit may be calculated by the following equation:

- V = A + B
- V = 0.3CPN + 0.75 x w x l x h - for a rectangular pit
- V = 0.3CPN + n x 0.75 x h x Π x d2 /4 - for a series of circular pits

Where:

- A is the volume of accumulated sludge and is equal to 0.3 CPN in m^3.
- B is the volume of free space above the sludge and is equal to (0.75 x w x l x h) for A rectangular pit or (n x 0.75x hxΠxd2/ 4) for a circular pit in m3
- C is the sludge accumulation rate or effective capacity per capita per year in m^3/c/y. This figure varies from 0.04 to 0.093 and 0.045 to 0.0504 taken as 0.06m^3/c/y even though there are no available researched data for this.
- P is the number of visitors using the latrine.
- N is the number of years the pit is to be used before emptying.
- h is the topmost depth of the pit, which is 1m in this case
- w is the width of the pit in m
- l is the length of the pit in m
- d is the diameter of a single pit in m

The factor 0.3 has been introduced, taking into consideration that such latrines are not going to be used during certain hours of the day, and a factor 0.75 has been introduced as the pit is to be emptied or filled with earth when the level of the waste in the pit has a free space of one quarter of a meter from the squatting level.

3.4.5. COMPOSTING TOILETS

A **composting toilet** is a type of dry toilet that treats human waste through a biological process called composting. This process leads to the decomposition of organic matter and turns human waste into compost-like material. Composting is carried out by microorganisms (mainly bacteria and fungi) under controlled aerobic conditions.

COMPONENTS AND USE

A composting toilet consists of two elements: a place to sit or squat and a collection/ composting unit. The composting unit consists of four main parts:

- storage or composting chamber
- a ventilation unit to vent odorous gases and to ensure that the degradation process in the toilet is predominantly aerobic
- a leachate collection system
- an access door for extracting the compost

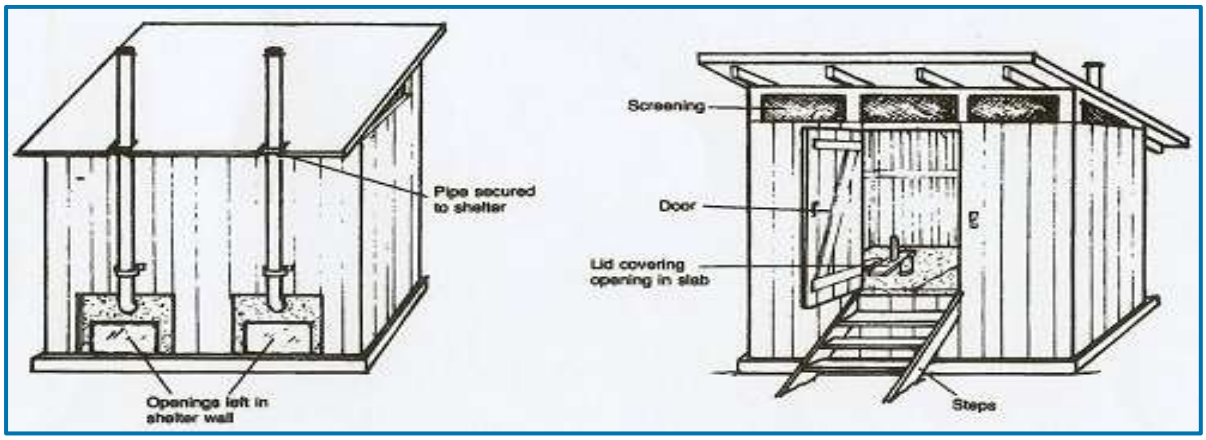


Figure 4: Components of latrine

OPERATION AND MAINTENANCE OF COMPOSTING TOILET

Maintenance is critical to ensure proper operation, including odor prevention. Maintenance tasks include: cleaning, servicing technical components (such as fans), and the removal of compost. Compost must be removed from the unit once composting is complete. How often this occurs depends on the container size, usage, and composting conditions, such as temperature. Active, hot composting may span months while passive, cold composting may require years.

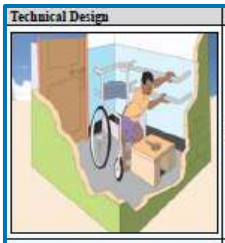
3.5. SANITATION FACILITIES FOR PEOPLE WITH SPECIAL NEEDS

Sanitation facilities can present accessibility challenges for people with special needs, such as differently abled persons, pregnant women, and even young children. HCFs are therefore required to have accessible toilets which are specifically designed to accommodate these groups of people according to their disability or special needs. There are various technical options of sanitation facilities from which HCFs can select the one most appropriate for their situation.

The design of sanitation facilities should take into account the following categories of disabilities:

- Blind people and people with poor vision need to have special grips and guiding systems (ramps) as well as proper lighting for the poor-sighted people.
- For people in wheelchairs or with crutches, the design of a toilet should include wider doors, ramps, hand rails, and special grips or foldable seats.

Technical Design	Functional purpose
	To help the blind to access toilets by means of ramps
	A VIP toilet with a washable seat that provides comfort to people with physical disability especially those who cannot squat.

Technical Design	Functional purpose
	Another design of a VIP toilet with a fixed wooden chair and bars to help disabled clients feel ease in accessing and using the toilet.
	A pedestal flush toilet for disabled and children who cannot use the squat toilets. Note also, that the hand washing facility is within reach of a user.

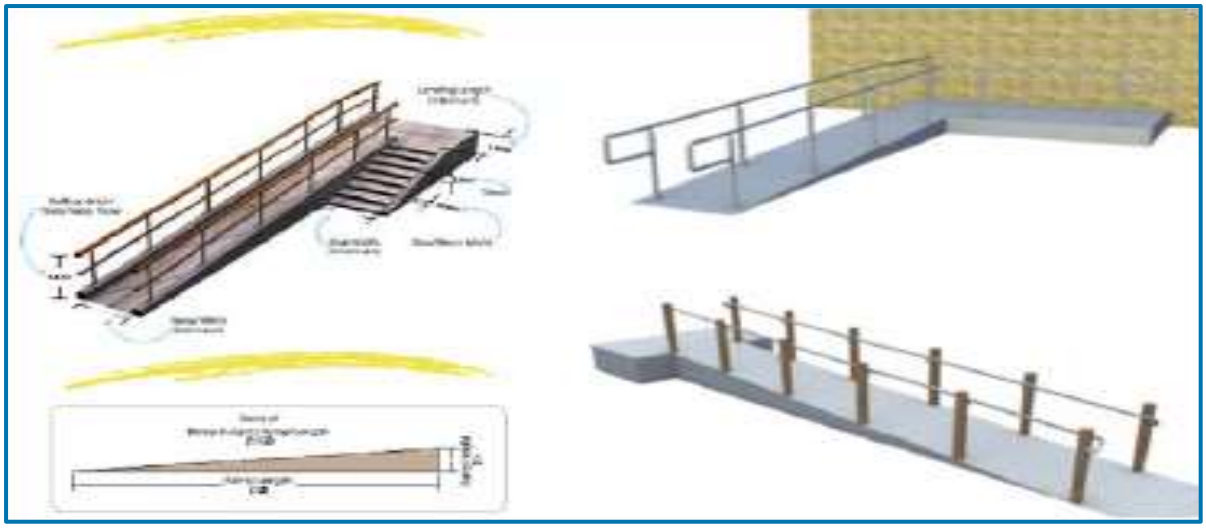


Figure 5: Latrine options for people with disabilities

3.5.1. URINALS

A urinal is a sanitary plumbing fixture for urination by men. It can take the form of a container or just a wall with drainage systems and automatic or manual flushing. Urinals are seen as part of the package for sanitation facilities in HCFs. The main types of urinals recommended in HCFs are presented below:

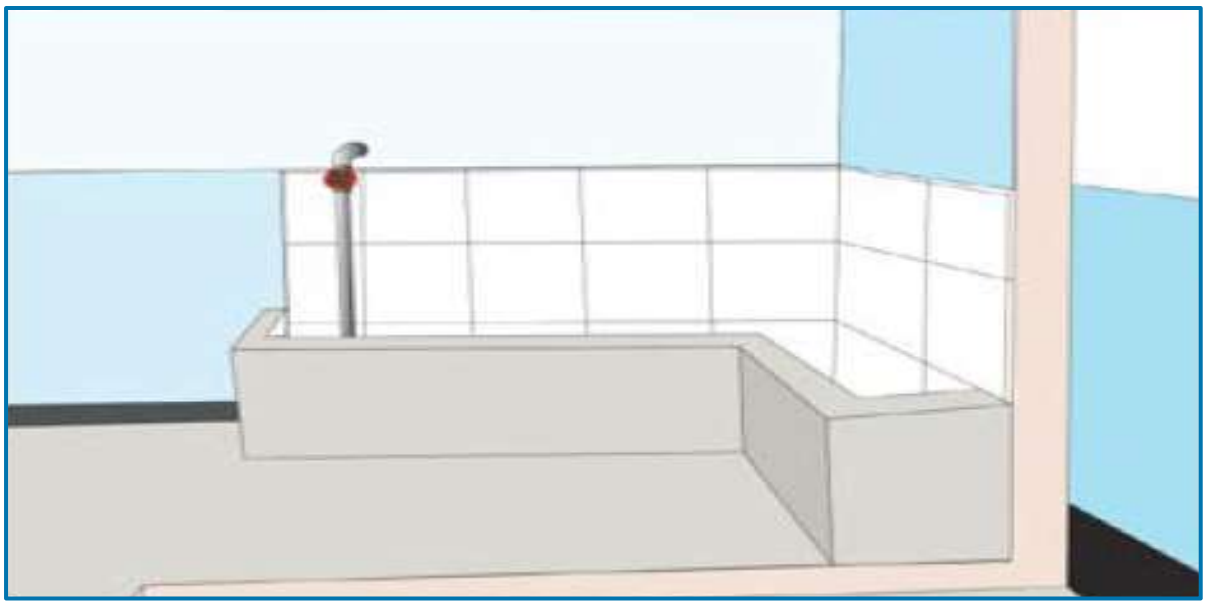


Figure 6: Urinal options

3.6. SPECIFIC SANITATION FACILITY REQUIREMENTS FOR DIFFERENT LEVELS OF HEALTHCARE FACILITIES

3.6.1. HEALTH POSTS

- VIP latrines and composting toilets are recommended
- There should be separate latrines for HCWs and clients
- The latrine should be gender friendly
- The latrine should be convenient for people with special needs

3.6.2. HEALTH CENTERS

- There should be separate toilets for staff and clients
- There should be gender-separated toilets with menstrual hygiene facilities to ensure gender friendliness
- At least one seat for 24 users
- Urinals should be provided in all male toilet blocks
- Flush toilets should be provided in all health centers with adequate water supply
- There must be flush toilets with water seal and bathing facilities at the delivery unit
- Health centers must be provided with conventional sewage system onsite or offsite for effective liquid waste transportation and disposal
- The final disposal of wastewater should be wastewater treatment ponds or any other recommended treatment methods, like septic tanks
- The sewage systems must be properly maintained and monitored

- In all-female toilets there should be a foot-operated lined receptacle bin fit with a plastic bag for disposal of sanitary pads
- Separate toilet for differently abled individuals
- Separate and convenient toilet for differently abled individuals with special needs.

3.6.3. PRIMARY HOSPITALS

- There should be separate toilets for staff and clients in both OPD and IPD
- At least one toilet seat should be available for 20 users in an inpatient department and one for every 24 users in an OPD
- In an OPD, there should be separate seats for female and male clients and separate seats for differently abled male and female clients
- Urinals should be provided in all male toilet blocks
- There should be separate seats for male and female toilets for HCWs in office blocks
- At least one toilet and bathroom for each ward and service unit. Separate male and female toilets for HWCs in office blocks and reception areas should be provided
- Excreta disposal facilities (including urinals) for hospitals must be water-based with flushing systems and must adhere to high quality standards
- Bedpans should be provided as per hospital requirements and should be separated between infectious and non-infectious wards
- Excreta disposal facilities for hospitals must be provided with sufficient water for regular operations and maintenance at all times
- Sufficient sewage systems onsite or offsite (connected to public sewers) should be provided to support excreta disposal systems in accordance with the particular type of sanitation infrastructure
- Excreta disposal and bathing facilities should be provided specifically for delivery clients. Toilets at the delivery unit must be flush toilets with a water seal
- In all-female toilets there should be a foot-operated lined receptacle bin fit with a plastic bag for disposal of sanitary pads

3.6.4. GENERAL HOSPITAL

- There should be separate toilets for staff and clients
- Two staff toilets (separate for males and females) per department. At least one seat should be available for every 20 users in an inpatient department (IPD) and one for every 24 users in an outpatient department (OPD)
- In an OPD, there should be separate seats for female and male clients and separate seats for differently abled male and female clients
- Adequate number of toilets and urinals should be designed based on the number of clients attending

- At least one toilet and bathroom for each ward and service unit. Separate seats for male and female toilets for staff in office blocks and reception areas should be provided
- Bedpans should be provided as per hospital requirements and should be separated between infectious and non-infectious wards
- Adequate number of mobile receptacles (wheelchairs with receptacles) and bedpans should be allocated in each ward as needed
- Facilities for excreta disposal, wastewater and solid waste management, and environmental cleanness for regional referral hospitals should adhere the minimum requirements as provided for a hospital level
- Excreta disposal and bathing facilities should be provided specifically for a delivery unit. Toilets at the delivery unit must be flush toilets with a water seal

3.6.5. COMPREHENSIVE AND SPECIALIZED HOSPITALS

- There should be separate toilets for staff and clients in both OPD and IPD
- Two staff toilets (separate for males and females) per department
- At least one seat should be available for every 20 users in an IPD and one for every 24 users in an OPD
- In an OPD, there should be separate seats for female and male clients and separate seats for differently abled male and female clients
- At least one toilet and bathroom for each ward and service unit. Separate seats for male and female toilets for staff and clients in office blocks and client reception areas should be provided
- Bedpans provided as per the hospital's needs and should be separated between infectious and non-infectious wards
- Adequate number of mobile receptacles (wheelchairs with receptacles) and bedpans should be allocated in each ward as per the hospital's requirement
- Excreta disposal and bathing facilities should be provided specifically for the delivery unit
- Toilets at the delivery unit must be flush toilets with a water seal.
- In all-female toilets there should be a foot-operated lined receptacle bin fit with a plastic bag for disposal of sanitary pads
- All OPD toilets must be open for visitors/relatives
- Toilets should also be provided in waiting areas

4. HYGIENE IN HEALTHCARE FACILITIES

Good hygiene is critical to ensure that healthcare staff provide quality care, reduce the spread of infections, and protect the health of communities. Good hygiene practices such as hand hygiene, bathing, kitchen, laundry, and morgue hygiene, plus the use of personal protective equipment are very important in preventing the spread of infectious microorganisms among healthcare staff, patients, and any visitors.

Hygiene is defined as the practice of keeping oneself and their surroundings clean, especially in order to prevent illness or the spread of illness.

Basic hand hygiene facilities are defined by the WHO/UNICEF Joint Monitoring Programme as "hand hygiene materials, either a basin with water and soap or alcohol hand rub available at points of care and toilets." Good hand hygiene requires the presence of functional and well-maintained handwashing stations located in or near sanitation facilities, at main entrances and exits of the healthcare facility, and in all treatment and recovery wards. The World Health Organization (WHO) recommends a 1:10 sink to bed ratio in healthcare facilities and handwashing stations within 5 meters of toilets. Sinks (with water and soap) or hand hygiene stations (alcohol-based hand rub) should be designed to make hand hygiene user-friendly for all staff, patients, and visitors.

4.1. HAND HYGIENE PRACTICES

Effective hand hygiene in healthcare facilities has been the cornerstone of infection prevention and control and is considered the primary measure for preventing healthcare-associated infections and the spread of antimicrobial resistance[14].

4.1.1. STEPS FOR ROUTINE HANDWASHING

Adapted from WHO Guidelines on Hand Hygiene in Health Care, 2009:

1. Wet hands with water
2. Apply enough soap to cover all surfaces of the hands
3. Rub hands palm to palm
4. Right palm over left dorsum with interlaced fingers and vice versa
5. Palm to palm with fingers interlaced
6. Backs of fingers to opposing palms with fingers interlocked
7. Rotational rubbing of left thumb clasped in right palm and vice versa
8. Rotational rubbing backwards and forwards with clasped fingers of right hand in left palm and vice versa
9. Rinse hands with water
10. Dry thoroughly with a single use towel
11. Use towel to turn off faucet

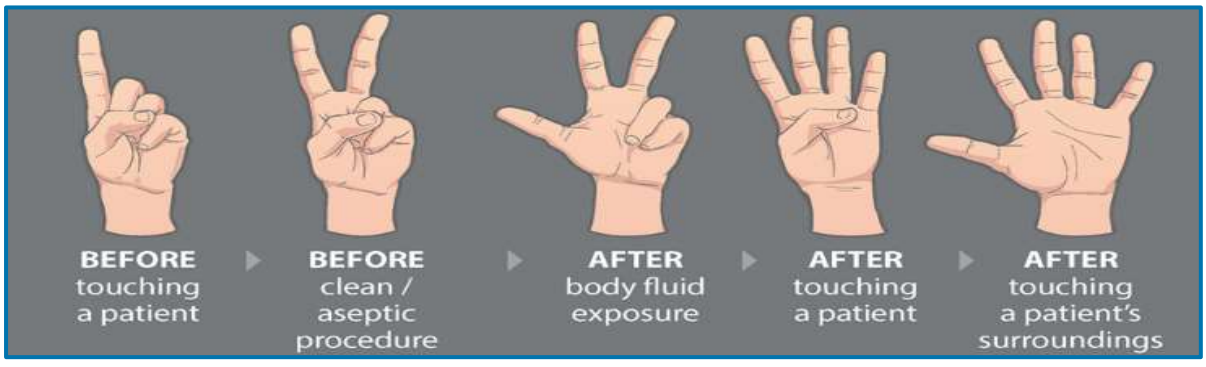
[14] *World Health Organization. Guidelines on Hand Hygiene in Health Care: A Summary. 2009.*

Figure 7: Steps for proper handwashing practice (This diagram was published by the World Health Organization in WHO Guidelines on Hand Hygiene in Health Care: a Summary, 2009)

4.1.2. CRITICAL MOMENTS OF HAND HYGIENE IN HEALTHCARE FACILITIES

Care has to be taken before, during, and after handling or touching a patient. Critical moments of hand hygiene for health care workers in HCFs are illustrated in the figure below.

YOUR FIVE MOMENTS FOR HAND HYGIENE:



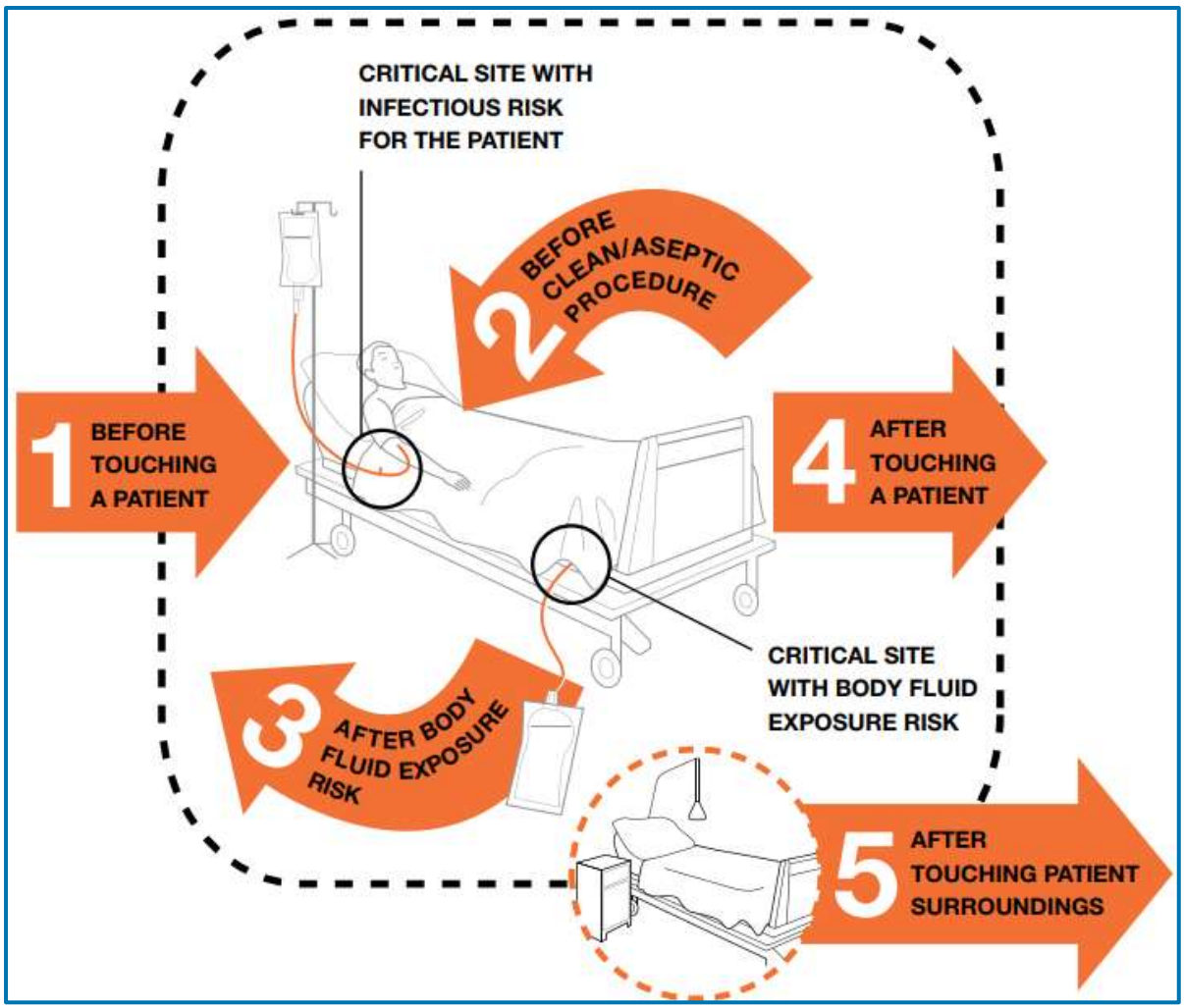


Figure 8: Critical moments of hand hygiene in healthcare facilities

Apart from moments when handling patients, proper handwashing in healthcare facilities should be done:

- When hands are visibly dirty or soiled with blood or other bodily fluids.
- After visiting the toilet
- Before preparing food
- Before eating or serving food
- Before preparing food
- Before entering and leaving inpatient wards or any working area of the health facility setting
- After contact with inanimate surfaces and objects (including medical equipment) in the immediate vicinity of the patient
- After blowing nose or covering a sneeze
- Before putting on gloves and after removing them

4.1.3. ANTISEPTIC HAND RUBBING

All HCFs should make alcohol based hand rub (Alcohols: Isopropyl 60–70% Ethanol 70–90%; includes methylated spirit 70%) available at the point of care and the formula should conform to the national specifications for alcohol-based hand hygiene products. It should be applied when hands are not visibly soiled in order to decontaminate hands and should follow the steps illustrated in the figure below.

RUB HANDS FOR HAND HYGIENE PROCEDURE:

Figure 9: Hand rubbing techniques (This diagram was published by the World Health Organization in WHO Guidelines on Hand Hygiene in Health Care: a Summary, 2009)

4.1.4. ANTISEPTIC HAND WASHING

Hand antiseptic removes or destroys transient micro-organisms and confers a prolonged effect. They are similar to the substances used for regular handwashing, but instead of plain soap, antiseptic or antimicrobial soap is used. The steps to be followed while performing antiseptic handwashing are similar to those outlined in the above figure.

4.1.5. SURGICAL HAND PREPARATION PROCEDURES

In performing surgical hand preparation, the surgical team should use either an antimicrobial soap or an alcohol-based hand rub with persistent antimicrobial activity, or a surgical hand rub before putting on sterile gloves.

4.1.6. HANDWASHING FACILITIES AND SPECIFICATIONS FOR HEALTHCARE FACILITIES

Handwashing facilities and materials are important for promotion of hand hygiene practices. Each HCF should have access to hand hygiene facilities and materials with acceptable WHO or national specifications. Functional hand hygiene facilities (with water and soap and/or alcohol-based hand rub) should be available at all points of care and within five metres of toilets. Wastewater discharged from hand washing facilities should be properly managed as per the standard criteria. There should be user-friendly handwashing facilities that take into consideration the needs of differently abled groups, pregnant women, and children.

Figure 10: Handwashing at Tagel Health Center in North Mecha

Specifications for handwashing sites in healthcare facilities:

- Handwashing basins should be made of non-porous material, with a round shape inside with dimensions of 25cm by 35cm depth and without overflow
- Should be equipped with elbow, foot, or automatically operating taps
- Soap/detergent dispenser should be available (manual or automatic)
- Hand drying equipment/materials should be a centered-feed hand towel dispenser
- Hand drying material should be a disposable paper towel
- Water supply, both hot and cold, should be provided as applicable
- Sanitizer should be used when hands are visibly clean
- Waste bins should be a round black/blue pedal bin of 12 liters
- Handwashing basin for special needs people
- Wheelchair accessibility

4.1.7. SURGEON SCRUB SINKS

Surgical scrub sinks are only used in an operating theatre and are designed in a way that promote proper handwashing practices and reduce any possible contamination, since all operating tools are sterilized. The sinks are provided with hot and cold water supplies, both of which are activated by a knee action valve or by wrist or foot control. For maintaining the required hygiene practices, the surgeon scrub sink should have the following characteristics:

- Made of stainless steel, or a material which is durable and impervious
- Adequate size and designed to permit the scrubbing of both hands and arms without having to come in contact with any surface
- Shaped and sized to prevent splashing the user
- A non-swivel faucet that provides adequate flow for quick rinsing
- Hand-free operation (electric, eye, or knee/foot operation) to prevent contamination of the hands when water is activated
- Equipped with a seam-free backsplash integrated with the sink that extends at least 60 cm above sink level
- Provide backsplashes covering the areas under the paper towel dispenser and soap dispenser

4.1.8. HAND HYGIENE FACILITY USAGE AND MAINTENANCE

The following precautions should be taken in order to ensure proper use of hand hygiene facilities and maintenance:

- Hand hygiene facilities should not be used for any other purpose
- Handwashing facilities should be regularly inspected and cleaned to ensure they remain in good working condition
- Paper towels and liquid soap should be provided at each handwashing sink.
- A handwashing guide should be posted at each sink in order promote proper handwashing practice.

4.2. MENSTRUAL HYGIENE MANAGEMENT (MHM)

MENSTRUAL HYGIENE MANAGEMENT: refers to management of hygiene associated with the menstrual process. WHO and UNICEF Joint Monitoring Programme (JMP) for drinking water, sanitation, and hygiene have used the following definition to monitor MHM: "Women and adolescent girls are using a clean menstrual management material to absorb or collect menstrual blood, that can be changed in privacy as often as necessary for the duration of a menstrual period, using soap and water for washing the body as required, and having access to safe and convenient facilities to dispose of used menstrual management materials. They understand the basic facts linked to the menstrual cycle and how to manage it with dignity and without discomfort or fear."

Globally, many women and girls face challenges when managing their menstruation. Failure to address the menstrual hygiene needs of women and girls can have far-reaching consequences for basic hygiene, sanitation, and reproductive health. Menstrual hygiene management (MHM) refers to the practice of using clean materials to absorb menstrual blood that can be changed privately, safely, hygienically, and as often as needed for the duration of the menstrual cycle.

MENSTRUAL HYGIENE MATERIALS: are the products used to catch menstrual flow, such as pads, cloths, tampons, or sanitary napkins.

MENSTRUAL HYGIENE IS IMPORTANT: because it prevents infection, prevents body odor, enables women to remain healthy, and allows women to feel comfortable, confident and stay fresh all day.

EVERY HEALTHCARE FACILITY SHOULD:

- Provide safe space (MHM room) privately for changing materials and for washing the body with soap and water. In order to handle solid waste, sanitation facilities should incorporate environmentally friendly and cost-effective mechanisms, such as a tightly closing waste bin for collection in every chamber in the toilet and an incinerator for final disposal of used menstrual materials.
- Have adequate water supply systems with sufficient number of faucets for drinking water as well as access to water and soap within a place for hand washing and for washing stains from clothes/reusable menstrual materials.
- A soak-away pit for liquid waste management can also be provided.

4.3. BATHROOM HYGIENE

To improve hygiene practices within HCFs it is necessary to have adequate numbers of bathrooms which correspond to the level of bed capacities and staffing levels with the ratio of patient per bathroom of 1:20

A proper bathroom within the HCF should have the following minimum qualities:

- A minimum surface area of 3.25m2
- Well-drained non-slippery floor
- Impervious walls
- Mixture of taps for both cold and hot water
- Adequate lighting and ventilation for safe use
- Furnished with wall-mounted seats, functional emergency alarm call system, and room for wheelchair maneuvering
- Bathrooms should be separated for HCWs and patients, and clearly labeled to identify the type and sex of users.

4.4. LAUNDRY HYGIENE

In HCFs, soiled linen harbors pathogenic microorganisms, and hence actual disease transmission is inevitable. Proper handling of linens will help reduce possible risks of transmitting disease-causing microorganisms from contaminated patient linens to HCF workers and also reduce hospital-acquired infections from linens to patients.

4.4.1. SAFE HANDLING OF LAUNDRY

HCF laundries should be well-designed with a good drainage system that is easy to clean. To meet these requirements, laundries in HCFs must have the following minimum qualities:

- The laundry should not be located in a site directly accessible to the kitchen
- The design of the laundry should facilitate the separation of dirty and clean areas to prevent cross contamination
- A separate hand hygiene sink for staff with wall mounted dispensers for soap and paper towels should be provided
- All workers at the laundry should be vaccinated against Hepatitis B virus and Tetanus Toxoid
- Appropriate PPE (boots, aprons, etc.) should be worn by laundry staff as required
- There should be a changing room for staff
- Washable smooth walls, edges, corners, and projections with glazed ceramic tiles should be fixed up to 8 inches high
- The laundry room should have a smooth ceiling with a washable surface and enough height to allow installation and repair
- Laundry containers/skips should be cleaned on a regular basis

4.4.2. BASIC PRINCIPLES IN HANDLING LINEN

HCFs should comply with the following principles for linen used by all patients regardless of their infectiousness:

- All used linen should be considered contaminated thus requiring cautious handling

- Appropriate PPE must be worn during the handling of soiled linen to prevent skin and mucus membrane exposure to blood and bodily fluids
- All linen should be disposed into an appropriate container at the point of care
- Linen contaminated with blood and/or other bodily fluids which could leak should be contained within a leak-proof bag and secured prior to transport
- Hand hygiene must be performed following the handling of all used linen or clothing soiled with blood or bodily fluids. These linens should be placed in an alginate or water-soluble bag at the point of care
- Linen or clothes soiled with blood or bodily fluids should be machine washed using soap/detergent at or above 60°C. A biological washing powder is highly recommended
- Always hold used linen and clothing away from oneself to avoid contaminating staff clothing
- As a precautionary measure, laundry service providers should avoid filling the alginate bags more than 2/3
- Rinsing or spraying clothes soiled with blood or body fluids by hand or carrying out manual sluicing should be discouraged
- Sharp objects and other items such as incontinence wear should not be inadvertently discarded into laundry bags
- Clean and soiled linen should be stored separately
- Clean soiled mattresses by wiping with 0.5% chlorine solution and letting them dry before putting clean linen on them
- Proper collection and transport of linen should be maintained

4.4.3. OPERATION AND MAINTENANCE OF A LAUNDRY FACILITY

The operation and maintenance should be undertaken as prescribed by the manufacturer of the laundry machines.

4.5. KITCHEN HYGIENE

- HCF kitchens should be well-designed with good drainage systems
- Must be well-ventilated, easy to clean, and should conform to standards and procedures for running food premises
- The food should be stored appropriately to avoid cross contamination and to maintain its safety
- The food should be stored at an appropriate temperature
- The kitchen should have separate toilets for males and females with adequate handwashing facilities and proper waste collection
- The food handlers should have proper personal hygiene
- Every three months, a medical checkup is recommended for food handlers
- The kitchen environment should be rodent and insect proof
- Pre-employment and periodic training should be available for food handlers

4.6. MORGUE HYGIENE

A general description of the hygiene maintenance procedure for a morgue area.

CLEANING: This consists of the application of water to remove physical particles and residues present in the surfaces, equipment, implements, and used materials.

WASHING: This is the application of soaps or detergents to thoroughly clean any particles or residues that have been left over.

RINSE: Rinsing consists of removing the remains of soapy substances or detergents used with plenty of water. In this case, it is advisable to use distilled water.

SANITIZATION: The objective of sanitization is to minimize the bacteria and microorganisms present on the surfaces, through application of a sanitizing substance. Sanitizers have antimicrobial properties to prevent the proliferation of germs, bacteria, and microbes.

DISINFECTION: Unlike sanitization, the products used for this process pursue the total elimination of microorganisms in a wider range than sanitizers. Disinfectants have germicidal and antibacterial properties.

4.6.1. DESIGN OF THE MORGUE AREA

The morgue unit shall be designed to control infection utilizing the following:

- layout designed to minimize cross contamination in work areas
- provision of a small wash-down/disposal/booting area
- provision of an adequate number of handwashing facilities
- provision of appropriate cleaning, waste storage, and waste disposal systems

4.6.2. GENERAL CLEANING PROCEDURE OF THE MORGUE AREA

The general cleaning procedures should be as follows:

- The utmost effort should be exerted to increase the accessibility of hygiene facilities in HCFs in order to work effectively
- Cleaning is carried out every day in the morning and after every service
- All parts of equipment and furniture that were used to provide mortuary services should be cleaned by using appropriate disinfectants
- Linens and waterproof coats (makintosh) after post-mortem examination should be changed
- Single-use gloves should be worn when handling contaminated reusable linen and placed in a laundry bag for routine laundering
- Cleaning equipment such as mops and brushes should be cleaned after use. If they are solid, they have to soak in a chlorine solution of 0.5% for 10 minutes and then dry

4.6.3. CLEANING AND DISINFECTION OF ESSENTIAL POST-MORTEM AND AUTOPSY EQUIPMENT

When cleaning and disinfecting essential equipment for post-mortem and autopsies, the following aspects should be considered:

- Cleaning of instruments must be done in a dedicated sink and not the handwashing sink
- Personal protective equipment, preferably heavy utility gloves, should be worn while cleaning
- Instruments used on skin should be cleaned and stored in a dry place, but instruments that penetrate the skin must undergo cleaning and sterilization
- Used items should be removed from their transport containers and sorted out according to the appropriate cleaning method
- If cleaning cannot be performed immediately, then instruments should be covered in warm water to prevent soils from becoming fixed, which would make cleaning difficult
- Instruments should not soak for longer than one hour. Instruments that cannot be immersed should be cleaned immediately
- Disinfectant solutions should be labeled appropriately (with name, date, and dilution strength)
- Chemical disinfection should be used only for items for which sterilization and thermal disinfection are not suitable. For example, items unable to be immersed in water (thermal) or ones unable to withstand high-pressure gradients (sterilization)
- Sufficient and appropriate disinfectants should be 0.1% hypochlorite solution for routine mortuary work, embalming, and post-mortems
- Soaking should be done in 0.1% hypochlorite solution in a plastic container for 10 minutes. Then the tools must be removed and rinsed with distilled water before being dried and stored
- Chemical disinfectant solutions should be discarded immediately after use
- Containers should have close-fitting lids

4.6.4. SAFETY PRECAUTIONS IN THE MORGUE AREA

Since the morgue is a hazardous area, appropriate safety precautions should be adhered to. The following safety measures are recommended:

- Mortuary staff and relatives should wear PPE (gloves, plastic aprons, gowns, protective eyewear, face masks covering the mouth and nose, boots) when handling dead bodies
- Personal protective equipment should be removed after handling the dead body. Wash hands with liquid soap and water immediately
- Placement for boots and procedures for discarding or washing clothing must be clearly designated
- Single-use PPE must be disposed of as infectious wastes

- Instrument processing
- All items must follow instrument processing as laid down by national guidelines and procedures (decontamination, cleaning, high-level disinfection, and sterilization, body storage)
- Bodies should be stored in a functioning refrigerator and must be maintained at a temperature between 2 to 6°C
- If long-term storage is required, the body should be maintained at approximately -20°C
- A body suspected of harboring infectious diseases, decomposition, trauma, or suspicious death should be contained within a body bag; one that is durable and impermeable to body fluids and/or embalming chemicals
- There should be an embalming chemical present (formalin) to temporarily prevent decomposition and restore the natural appearance of the body
- The chemicals used in morgue area should be properly stored and handled

4.7. PROMOTION OF HYGIENE PRACTICES IN HEALTHCARE FACILITIES

Good hygiene practices are closely linked to hygiene behavior changes as an essential part of achieving infection prevention and control in healthcare facilities. There are many approaches for promoting proper hygiene practices in healthcare facilities both among HCWs, clients, and visitors. However, the degree of adaptability depends on a number of factors, which include level of education of the patients or visitors, customs, traditions, and the level of commitment on the part of respective HCF management and staff. The following approaches are recommended to be applied by HCFs so as to ensure that all HCWs, patients, and other visitors progressively adopt proper hygiene practices in order to minimize the transmission of diseases:

- Make WASH one of the tools for health care quality improvement
- Increase funding allocation for hygiene activities
- Orientation to the HCF management on hygiene practices
- Conduct continuing hygiene education to all departments in the HCF
- Provide behavioral change communication, self-explanatory posters including SOPs on hygiene behaviors in ward walls, notice boards, and offices
- Provide adequate WASH supplies
- Ensure that proper hygiene practices are also components of emergency response programs
- Develop strategies and tools to encourage handwashing by community health and outreach workers.

4.7.1. SUSTAINING HYGIENE PRACTICES IN AN HCF

Each HCF should have an operation and maintenance (O&M) strategy so that proper hygiene practices are maintained by staff, caregivers, and patients that is regularly monitored.

To sustain hygienic practices, the following are recommended:

- Conduct regular supportive supervision on matters related to hygiene
- Prepare a working schedule which will show who is responsible for cleanliness as well as when and how it will be conducted
- Each HCF should, according to its working environment, adopt a behavior change and communication model which will be used by HCWs to educate clients on behavior changes to improve people's practices regarding personal hygiene

5. HEALTH CARE WASTE MANAGEMENT

5.1. DEFINITION OF HEALTHCARE WASTE MANAGEMENT

Healthcare waste includes all the waste generated by medical activities from diagnosis as well as preventive, curative, and palliative treatments in the fields of both human and veterinary medicine. In other words, all the wastes produced by a medical institution (public or private), a medical research facility or a laboratory are considered healthcare waste[15].

5.2. HEALTHCARE WASTE CLASSIFICATION

Healthcare wastes are classified as follows:

HAZARDOUS WASTES: *(hazardous waste is summarized below in Table 2)*

NO	WASTE CATEGORY	DESCRIPTION
1	Sharp Wastes	Used or unused sharps (e.g. hypodermic, intravenous or other needles, auto- disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass)
2	Infectious Wastes	Material suspected to contain pathogens (bacteria, viruses, parasites or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts, which includes (waste contaminated with blood or other body fluids) • cultures and stocks of infectious agents from laboratory work • waste from infected patients in isolation wards
3	Pathological Wastes	Human tissue, organs, fluids; body parts; fetuses; unused blood products
4	Pharmaceutical Waste, Cytotoxic Waste	Pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals. Cytotoxic waste-containing substances with genotoxic properties (e.g. waste containing cytostatic drugs - often used in cancer therapy; genotoxic chemicals).
5	Chemical Wastes	Waste-containing chemical substances (e.g. laboratory reagents; film developers; disinfectants that are expired or no longer needed; solvents; waste with high content of heavy metals, e.g. batteries; broken thermometers and blood-pressure gauges).
6	Radioactive Wastes	Waste containing radioactive substances (e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources)

Table 2: Hazardous waste in healthcare facilities.

NON-HAZARDOUS WASTE:

[15] *Microsoft Word - Guidance Manual.doc (who.int)*

- Food waste
- Infectious waste that has been effectively treated (sterilization, etc.)
- Pads, nappies, diapers, bandages, etc. that cannot be classified as infectious waste
- Paper, plastic, metals, packaging materials
- Waste from cleaning activities
- Waste generated from food preparation areas (such as kitchens and mass catering centers)
- Waste from gardening activities

5.3. HEALTHCARE WASTE MINIMIZATION, COLLECTION, TRANSPORT, TREATMENT AND DISPOSAL

5.3.1. WASTE MINIMIZATION

WHO considers the minimization of waste in healthcare facilities as the most effective way in practicing waste management. Although waste minimization is most commonly applied at the point of its generation by source reduction, healthcare managers can also take measures to reduce the production of waste through adapting their purchasing and stock control strategies.

5.3.2. SEGREGATION

The correct segregation of healthcare waste is the responsibility of the healthcare workers who produce each waste item, no matter their position in the organization. The healthcare facility management is responsible for making sure there is proper segregation, as well as a transport and storage system, and that all staff adhere to the correct procedures. Color coding can assist with segregation, which makes it easier for medical staff and hospital workers to put waste items into the correct containers and to maintain segregation of the waste during transport, storage, treatment, and disposal.

5.3.3. COLLECTION

Waste collection is among the most important steps in waste management. Collection times should be fixed and appropriate to the quantity of waste produced in each area of the healthcare facility. The critical points needing consideration for waste collection are: provision of collection bins, avoiding spills when ¾ of bin is full, cleaning bins used for waste collection, appropriate labeling of collection bags, replacing bins immediately, and provision of PPE for waste collectors. Additionally, packaging of hazardous and infectious waste need special handling procedures to avoid any form of direct access.

NO	WASTE CATEGORY	CONTAINER TYPE	COLOR AND LABELING
1	Non-Hazardous	Plastic bag	Color: Black Labeling: No labeling
2	Infectious Waste (Sterilization)	Container (hospital box) with an inserted double plastic bag (strong, leak-proof, puncture-proof)	Color: Yellow Labeling: Hazardous Medical Waste, biohazard sign, date, and source of waste generation
3	Infectious and Toxic Waste (Incineration)	Container (hospital box) with an inserted double plastic bag (strong, leak-proof, puncture-proof)	Color: Red Labeling: Hazardous Medical Waste, biohazard sign, date, and source of waste generation
4	Toxic Waste (Incineration)	Container (hospital box) with an inserted double plastic bag (strong, leak-proof, puncture-proof)	Color: Red Labeling: Hazardous Medical Waste, biohazard sign, date, and source of waste generation
5	Sharps	Puncture-proof container with lid	Color: Yellow Labeling: Hazardous Medical Waste, biohazard sign, date, and source of waste generation

Table 3: Principles of segregation regarding healthcare waste collection

5.3.4. HEALTHCARE WASTE TRANSPORT

Transportation is one of many critical steps in healthcare waste management, which can be classified as onsite and offsite.

ONSITE TRANSPORT OF HEALTHCARE WASTES

Onsite healthcare waste transportation is the handling of waste within the healthcare facility. It should be done in accordance with the following provisions:

- The healthcare facility shall have an onsite waste transportation route based on the setting of the facility.
- Bags or bins shall be transported from the service point to storage, treatment, and disposal areas using a disinfected and clean trolley or wheelbarrow. The safety of employees shall be ensured by providing protective clothing or equipment and training. Plastic bags shall be placed in bins to facilitate easy waste handling and onsite transportation. Hazardous and non-hazardous healthcare waste shall be collected on separate trolleys that shall be painted or marked with the corresponding colors. Containers shall be covered with lids, rendering them puncture-proof and leak-proof during transport.
- If transportation and disposal cannot be immediately ensured, anatomical waste shall be stored in the mortuary.

OFFSITE TRANSPORT OF HEALTHCARE WASTES

Offsite transportation is the conveying of healthcare wastes outside the vicinity of facility to a disposal, treatment, or processing site. This shall be done in accordance with the following provisions:

- Waste shall be placed in rigid or semi-rigid leak-proof containers before being loaded onto trucks. Vehicles used for the carriage of yellow bags shall be disinfected prior to use for the next service
- Treated infectious wastes and other general waste shall be transported in closed, leak-proof, rigid containers using trucks.

5.3.5. HEALTHCARE WASTE STORAGE

Waste storage is one of the functional elements of healthcare waste management. Healthcare waste needs to be stored based on their category. Hazardous wastes like infectious waste, chemical waste, pharmaceutical waste, radioactive waste, pathological waste, and sharps all should be stored according to healthcare waste management guidelines. Generally, the storage area also needs to:

- Have an impermeable, hard-standing floor with good drainage (away from watercourses); the floor should be easy to clean and disinfect
- Ability to keep general waste separated from infectious and other hazardous waste
- Have a water supply for cleaning purposes
- Have easy access for staff in charge of handling the waste
- Be lockable to prevent access by unauthorized persons
- Have easy access for waste collection vehicles
- Have protection from the sun
- Be inaccessible to animals, insects, and birds
- Have good lighting and passive ventilation at the very least
- Not be situated in the proximity of fresh food storage and food preparation areas
- Have a supply of cleaning equipment, protective clothing, and waste bags or containers located conveniently near the storage area
- Have a washing basin with running tap water and soap that is readily available for the staff
- Be cleaned regularly (at least once per week)
- Have spillage containment equipment
- Be appropriate to the volumes of waste generated by each healthcare facility

5.3.6. HEALTHCARE WASTE TREATMENT

GENERAL

Every day around the world, healthcare providers treat the sick and save their lives, but they also generate a large amount of potentially infectious or hazardous waste that can remain toxic for generations upon generations if left untreated. Infectious healthcare wastes are defined as all “discarded materials from healthcare activities which have the potential of transmitting

infectious agents to humans. These include discarded materials or equipment from the diagnosis, treatment, and prevention of disease, assessment of health status or identification purposes that have been in contact with blood and its derivatives, tissues, tissue fluids or excreta, or wastes from infection isolation wards. Such wastes shall include, but are not limited to, cultures and stocks, tissues, dressings, swabs or other items soaked with blood, syringe needles, scalpels, diapers, and blood bags. Sharps (syringe needles, scalpels, infusion sets, knives, blades, broken glass), whether contaminated or not, should be considered as subgroup of infectious health-care waste."

As such, healthcare wastes are considered huge reservoirs of potentially harmful micro-organisms which can affect patients, healthcare workers or anyone in different ways and in different areas. Despite this, medical wastes are often poorly managed and thrown into open dumps or burned in old or badly maintained incinerators. Dumping of infectious medical waste can lead to subsequent contamination and trauma risks, psycho-emotional disorders, and toxicity or pollution of the environment. Moreover, the side effects associated with burning systems (incineration) shall be observed and alternative non-burning solutions shall also be considered.

NO	WASTE CATEGORY	DESCRIPTION	DISPOSAL METHOD
1	General Waste (85%)	Kitchen waste, paper, packaging,	Sanitary land filling; Onsite pit disposal; Open burning
2	Pathological & Infectious Waste	Lab culture, waste from isolation wards, tissues, removed organs, placenta, amputated body parts, blood, and other bodily fluids.	Incineration or autoclave and then disposal in landfill Burning & burial Placenta pit
3	Sharps	Needles, blades, scalpels, broken glassware, infusion sets, etc	Incineration at sufficient temperature (>1000 degrees Celsius) or autoclave Sharp pits
4	Pharmaceutical Wastes	Toxic pharmaceutical, Cytotoxic pharmaceutical	National central collection points to ensure they are properly neutralized and disposed of. Cytotoxic waste must be collected separately from pharmaceutical waste and disposed of in a hazardous waste incineration plant.
5	Radioactive Wastes	Radioactive waste includes solid, liquid, and gaseous waste contaminated with radionuclides generated from in-vitro analysis of body tissue and fluid, in-vivo body organ imaging and tumor localization, and investigative and therapeutic procedures.	Non-infectious radioactive waste, decayed to background level, should follow the non-risk HCW stream. Infectious radioactive waste, decayed to background level, should follow the infectious HCW stream. Liquid radioactive waste should be discharged into the sewage system or a septic tank only after it has decayed to background level in buffer tanks.

Table 4: Recommended treatment methods for health care waste products.

SOLID WASTE TREATMENT

Out of the total amount of waste generated by health-care activities about 85% is general, non-hazardous waste. The remaining 15% (10% infectious & 5% chemical and radioactive) is considered hazardous material that may be infectious, toxic, or radioactive.

INCINERATOR

Incineration is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter. This results in a significant reduction of waste volume and weight. High heat thermal processes take place at temperatures from about 200 °C to over 1000 °C. They involve the chemical and physical breakdown of organic material through the processes of combustion, pyrolysis, or gasification. A disadvantage of these technologies is the release of combustion byproducts into the atmosphere and the generation of residual ash. The combustion of healthcare waste produces mainly gaseous emissions, including steam, carbon dioxide, nitrogen oxides, a range of volatile substances (e.g. metals, halogenic acids, products of incomplete combustion), and particulate matter, plus solid residues in the form of ashes.

Incineration of waste is affordable and feasible only if the “heating” (or “calorific”) value of the waste reaches at least 2000 kcal/kg (8370 kJ/kg). While the value for hospital wastes containing high levels of plastics can exceed 4000 kcal/kg (16 740 kJ/kg), some healthcare waste may contain a high proportion of wet waste and have much lower calorific values.

Figure 11: Waste Zone

TYPES OF WASTES TO INCINERATE

Every health facility should have at least the minimum standard of incinerator. Proper incinerator selection for each health facility depends on the characteristics of the waste produced from said health facility.

According to the WHO, the basic characteristics necessary for incineration include:

- Heating value above 2000 kcal/kg (8370 kj/kg
- Calorific values within the regulatory and design requirements (e.g. The desired residence time, system operating temperature, and excess air levels)
- Content of combustible matter above 60%
- Content of non-combustible solids below 5%
- Content of non-combustible fines below 20%
- Moisture content below 30%

The following wastes types should not be incinerated:

- Pressurized gas containers
- Large amounts of reactive chemical waste
- Silver salts and photographic or radiographic wastes
- Halogenated materials such as polyvinyl chloride (pvc)
- Plastics (waste and/or packaging of waste should not contain pvc material)
- Waste containing mercury, cadmium, and other heavy metals, such as broken thermometers, used batteries and lead-lined wooden panels
- Sealed ampoules or vials that may implode during the combustion process
- Radioactive materials
- Pharmaceuticals thermally stable in conditions below 1200 °c (e.g. 5-fluorouracil)

TYPES OF INCINERATORS FOR HEALTH-CARE WASTES

Incinerators range from extremely sophisticated, high-temperature operating plants to very basic combustion units. All types of incinerators, if operated properly, should eliminate pathogens from waste and reduce waste to a small volume of ash. Incineration equipment should be chosen on the basis of the available resources and the local situation, balancing the public health benefits of pathogen elimination against the technical requirements needed to avoid the health impacts of air or groundwater pollution from the byproducts of waste combustion.

Three generic kinds of incineration technology are commonly used for treating healthcare waste:

- Dual-chamber starved-air incinerators, which operate in starved-air mode (below stochiometric conditions) in the primary chamber and are designed to burn infectious healthcare waste;
- Multiple chamber incinerators, including in-line incinerators and retort incinerators used for pathological waste, which operate in excess-air mode (above stochiometric conditions);
- Rotary kilns, normally capable of reaching temperatures that break down genotoxic substances and heat-resistant chemicals

ASHPIT

All HCWM sites using incineration should be equipped with an ash pit that has sufficient capacity to store ash for a period of at least five years. Essential features of a pit are:

- The pit is positioned above any shallow aquifer
- The pit is positioned to prevent the risk of flooding
- The pit is constructed of concrete, concrete blocks, or brick, with a water-resistant floor to ensure the pit will not collapse
- The pit has provision to deposit ash or other authorized wastes (i.e., needle containers) without risk to the waste handler
- There is provisional access to the pit for the purposes of leveling or removal of accumulated waste and subsequent transfer to a municipal landfill
- The pit is protected from being accessed by unauthorized persons
- The pit is in the immediate vicinity of the incinerator to ensure convenient transfer of ash

5.3.7. STERILWAVE

Several countries choose the Sterilwave for onsite treatment of infectious waste. These ultra-compact, innovative systems with proven efficiency in terms of viral inactivation make it possible to treat biomedical waste [that has even potentially been contaminated by the coronavirus (2019-nCoV) directly onsite and consequently eliminate all risk of contamination outside the hospital.

Figure 12: Sterilwave machine

In order to help combat the spread of contagious pathogens like coronavirus (2019-nCoV) in the nation, Sterilwave technologies can play a great role in treating biomedical waste directly in hospitals, though the treatment capacity may range from 75-250 kg/hour.

In the Sterilwave, the waste is ground down and heated in the same container to over 100°C for 20 minutes. When the waste exits the machine, it is dry, inert, and completely unrecognizable, with a volume reduction of 85% and a weight reduction of 25%. After the Sterilwave process, all the treated waste can be managed as regular municipal waste without biological risk and any hazard to public health. Hence, healthcare facilities that can generate infectious wastes shall have Sterilwave as an onsite treatment option.

5.3.8. AUTOCLAVE

An autoclave consists of a metal vessel designed to withstand high pressures, with a sealable door and an arrangement of pipes and valves through which steam is introduced into and removed from the vessel. Because air is an effective insulator and a key factor in determining the efficiency of steam treatment, removal of air from the autoclave is essential to ensure penetration of heat into the waste. Waste treatment autoclaves must also treat the air removed at the start of the process to prevent pathogenic aerosols from being released. This is usually done by treating the air with steam or passing it through a specific filter (e.g. High Efficiency Particulate Air (HEPA) filter or microbiological filter) before being released. The resulting condensate must also be decontaminated before being released to the wastewater system.

5.3.9. PLACENTA PIT

Placenta pits allow pathological waste to degrade naturally. Around 90% of the waste is liquid, which will soak away into the ground. The rest will degrade though a complex and variable mixture of biological and chemical processes. These are primarily anaerobic processes, though some aerobic decomposition will take place in the upper layers. The waste should not be treated with chemical disinfectants like chlorine before being disposed of because these chemicals destroy the microorganisms that are important for biological decomposition.

At least the top 50cm of the pit should be reinforced with concrete to prevent surface water infiltration, and its base should also be made of concrete to stabilize the structure and to slow the downward movement of liquid towards the water table. The top slab should be above ground level and made of water-tight concrete to prevent surface water infiltration.

The top should be closed by a lockable hatch and a vent pipe installed to ensure that the generated gases can escape, and air can get in. Where soil is particularly sandy, extra precautions may need to be taken to protect the water table and to prevent the pit from collapsing, i.e. the sides may be reinforced with bricks, laid with gaps between them so that the liquids can still escape. The pit should be closed off with a concrete slab to reduce the

risk of attracting vectors such as flies, mosquitoes, and rodents. The organic waste must be covered with the lid immediately after disposal to avoid attracting insects and rodents.

Figure 13: Placenta pit

SELECT THE LOCATION FOR THE PITS:

- As far away as possible from publicly accessible areas and from hygienically critical areas (e.g., water wells, kitchen, etc.).
- Far enough from other buildings and public areas to avoid problems caused by odors.
- A secure location that non-authorized people and animals (e.g., feral dogs) cannot get into. This may be part of a waste disposal zone or a dedicated area.

CONSIDER THE LOCAL SOIL TYPE:

- If soil is mainly sandy it may require extra reinforcement to prevent the pit from collapsing.
- If the subsoil is very rocky and/or has a lot of cracks, the pit may need to be partially dug in a very well-compacted earth mound. In this case, the aboveground part should be completely lined with bricks or stones and should be watertight.

ENSURE THE PIT WILL NOT AFFECT THE GROUNDWATER:

- Placenta pits are not recommended in sites where the water table is near the surface or in areas prone to flooding.
- At least 1.5m from the bottom of the pit to the groundwater level is recommended.
- If the groundwater is too close to the bottom of the test pit, consider other options:
  - Changing the design of the pit to make it wider but shallower.
  - Digging several shallower pits.
  - Digging a pit that is partially in a mound of very well-compacted soil. In this case, the above ground part should be completely lined with bricks or stones and should be watertight.

5.3.10. WASTEWATER TREATMENT

Healthcare wastewater is any water that has been adversely affected in quality during the provision of healthcare services. It is mainly liquid waste, containing some solids produced by humans (staff and patients) or during health-care-related processes, including cooking, cleaning, and laundry.

HEALTHCARE WASTEWATER CATEGORIES

BLACK WATER (SEWAGE): heavily polluted water containing high concentrations of fecal matter and urine.

GREY WATER (SULLAGE): Contains more dilute residues from washing, bathing, laboratory processes, laundry, and technical processes, such as cooling water or the rinsing of X-ray film.

STORMWATER: Technically not wastewater itself, but represents rainfall collected on healthcare facility roof, grounds, yards, paved surfaces. This may be lost to drains and watercourses and as groundwater recharge, or used for irrigating HCF grounds, toilet flushing, and other general washing purposes.

WASTEWATER COLLECTION SYSTEM RECOMMENDED SETUP

- Construction of two separate collection systems
  - Sewage system for wastewater (separate system for hazardous and non-hazardous waste)
  - Stormwater system for rainwater, which can be used for gardens, toilet flushing, or washing of paved areas
- Manholes to allow access for maintenance every 50 meters or less
- Watertight sewage pipes and manholes
- Pre-treatment to reduce or eliminate contaminants in non-domestic wastewater, or in altering its nature before discharging it into the sewer

WASTEWATER TREATMENT

To protect public health and the environment, wastewater generated at HCFs should be treated onsite before it is discharged.

TREATMENT TECHNIQUE

Any method, technique, or process designed to change the physical, chemical, or biological composition of liquid waste to protect human health and the environment.

PRE-TREATMENT OF HAZARDOUS LIQUID

Service delivery in some health facility departments may result in the generation of wastes containing a high composition of heavy metals or other constituents that can impair the efficiency of the management system. Liquid waste from these departments should, therefore, be pretreated before being discharging into the waste treatment systems.

Some of the required pre-treatments include:

- Pre-treatment for the medical laboratory (recommended) includes acid-base neutralization, filtration, and sedimentation, or autoclaving
- Pre-treatment for feces or vomit during an outbreak such as cholera involves decontamination with lime milk (hydrated calcium oxide or calcium hydroxide) – ratio of 1:2 for stool and vomit with lime for 6 hours minimum; the ratio of 1:1 for urine with lime for 2 hours minimum

- Blood can be discharged in the sewer (using PPE to protect from blood splatter) if a risk assessment shows that the organic loading does not require pre-treatment. Otherwise, blood can be pre-treated by a thermal method or disposed directly into a septic tank if safety measures are used

  NOTE: 5% hypochlorite is not effective for high organic loads like blood.
- Pre-treatment for the dental department entails installing amalgam separators in sinks, especially at the patient treatment chairs. The separated mercury waste must be safely stored until disposal
- Pre-treatment of waste containing radioactive materials from the radiotherapy department is important (waste includes urine of patients receiving thyroid treatment). The separated radioactive waste must be stored in a secure basin until background concentrations have decreased. After the compulsory storage time, the wastewater can be disposed of in the sewer system
- Pre-treatment for kitchens entails a grease trap to remove grease, oil, and other floating materials

TYPES OF TREATMENT SYSTEMS

CENTRAL SYSTEM: A centralized system uses a series of sewer pipes, tunnels, and pumps to collect wastewater from different sources & locations to transport them to a central treatment plant. The sewer lines can be combined or separate. The treatment plant is designed to serve all blocks of the health facility and the localities.

DECENTRALIZED SYSTEMS: A decentralized system is the preferred option in areas with no central treatment system and a dispersed settlement. It's also a low-cost option compared to the central system.

SEPTIC TANK SYSTEM: The septic tank system is the recommended treatment method for onsite and decentralized wastewater treatment systems. The primary treatment method for wastewater in HCFs should be a septic tank with a watertight tank for the separation of solid and liquid parts of the wastewater and degradation of the organic matter in an anaerobic condition. A constructed septic tank consists of two or more compartments. It can be divided horizontally: inflow, settlement, clarifying zone; and vertically: scum, detention, sludge zone.

CONSTRUCTION OF THE SEPTIC TANK

The septic tank capacity should be equal to a cumulative flow of 2-4 days of wastewater. The first chamber should be two-thirds of the total capacity if a two-chamber system is used. In every chamber, access holes, inspection ports, and ventilation should be mounted. The wastewater reaches the septic tank through an inlet drain. Fat and other lighter matter (scum) floats to the surface; the heavier solid matter (sludge) sinks to the bottom. The retention time inside the tank, which should be no less than 24 hours, directly depends on the efficient settling and floating of solids. This solid matter partially breaks down anaerobic bacteria. It should be

noted that excessive sludge and scum buildup decreases the detention zone's capacity, resulting in the discharge to the effluent disposal system of suspended solids. When the chambers are half-filled with sludge, solid matter (sludge, scum) from septic tanks must be removed.

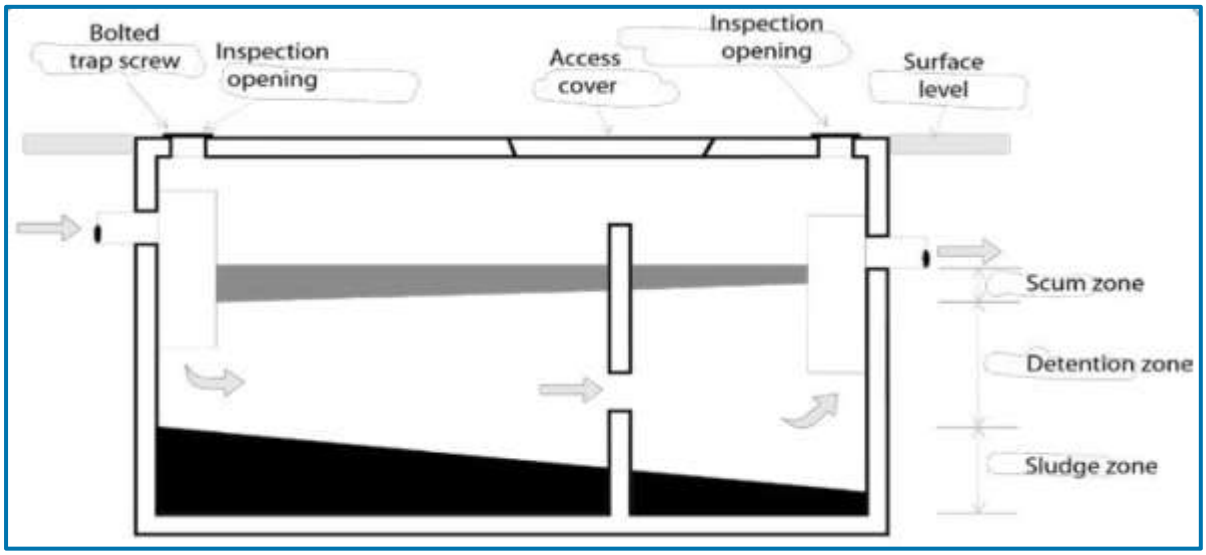


Figure 14: A cross-section of a septic tank

NOTE: Based on land availability and construction costs, it is recommended to have a conventional sewage treatment plant for better accommodation, treatment, and disposal of wastewater released from healthcare facilities.

CONVENTIONAL SEWERAGE TREATMENT PLANTS

A traditional treatment facility is classified into three groups, namely primary, secondary, and tertiary (or advanced therapy). Selecting the appropriate type of wastewater treatment system would depends on the size and location of the health facility as well as the level of healthcare services. The key benefits of a traditional sewage treatment plant are rapid treatment, efficiency of huge sewage volumes, and the comparatively limited land demand compared to the wastewater stabilization pond. One of the key drawbacks of this facility apart from cost of construction or installation of the plant is that the sewage still contains a large number of pathogens as it leaves the treatment plant. Compact wastewater treatment plants for comprehensive specialized hospitals are recommended.

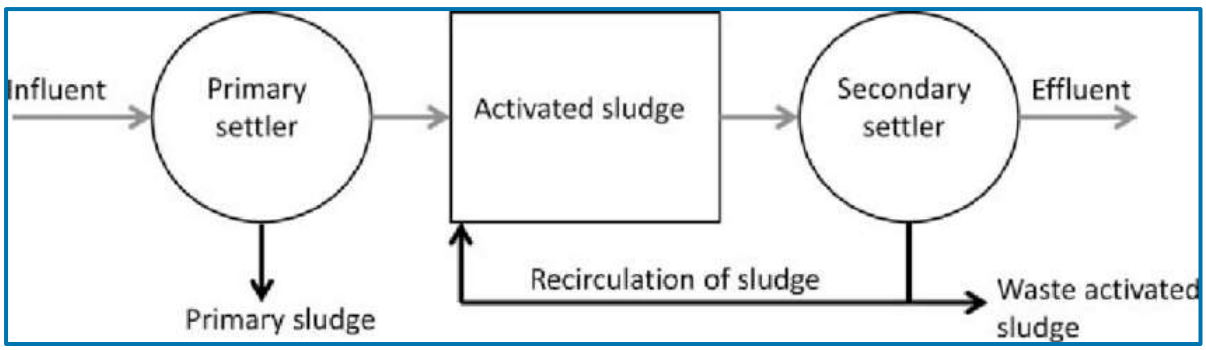


Figure 15: Schematic presentation of conventional wastewater treatment

WASTEWATER STABILIZATION PONDS

Wastewater stabilization ponds (WSPs) are large, shallow basins in which natural processes involving both algae and bacteria handle raw sewage in their entirety. In simple terms, ponds for waste stabilization are impoundments into which, after a given retention time, wastewater flows in and out. Treatment relies entirely on the natural biological purification processes that will exist in everybody of natural water. For its operation, the WSP only uses solar energy and treatment is optimized by choosing suitable organic loads, retention times, and depths of the ponds to facilitate the optimum organic growth beneficial to the chosen treatment process. This means that in tropical climates, WSP functions more efficiently in wastewater treatment than it does in temperate climates. There are usually three different forms of WSP; anaerobic, optional and maturation, each of which has different functions and procedures for design. WSP is known to be the most affordable and reliable way to handle wastewater. In a series of large ponds, the wastewater flows to allow the solid portion of the waste to settle and break down. The liquid portion of the waste flows into other ponds where many of the harmful germs in the wastewater are destroyed by air and sunlight, making it less harmful to living organisms. This implies that in the removal of fecal coliform bacteria, waste stabilization ponds are very successful.

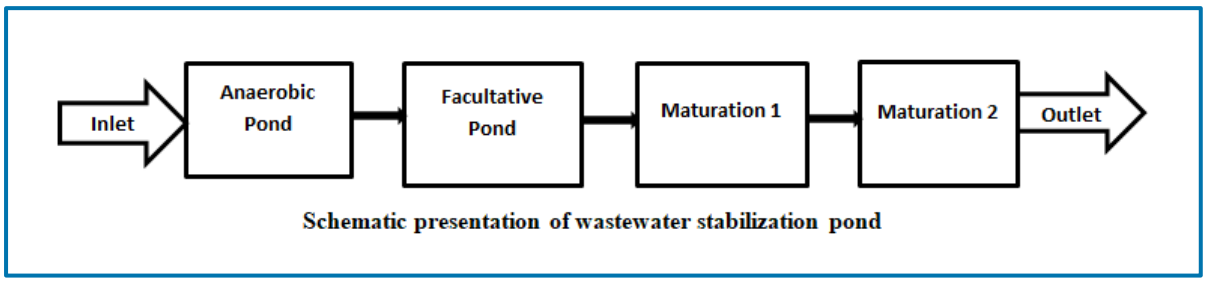


Figure 16: Wastewater stabilization pond

5.4. MANAGEMENT OF FECAL SLUDGE

Onsite sanitation results in the accumulation of fecal sludge that would need emptying and further treatment to minimize the harmful load of microbes to humans and the environment. Depending on toilet use, inflow and infiltration, collection methods and the environment, the physical, chemical, and bacteriological characteristics of fecal sludge differ. Accordingly, the design and installation of fecal sludge treatment methods should consider the characteristics of successful desludging and treatment prior to being designed.

5.4.1. TECHNOLOGY FOR TREATMENT OF FECAL SLUDGE

Established fecal sludge treatment technologies include co-composting, co-treatment in ponds for waste stabilization, or deep well entrenchment. Other creative ways of treatment can be implemented by HCFs, depending on the treatment objective, especially when the goal is to recover resources. Examples of methods of treatment for resource recovery include vermicomposting, black soldier flies, ammonia treatment, thermal drying and pelletizing, and solar drying.

5.4.2. SELECTION CRITERIA FOR TREATMENT TECHNOLOGY

NO	TREATMENT TECHNOLOGY	ADVANTAGES	DISADVANTAGES
1	Co-composting of fecal sludge with municipal waste	The output of co-composting is a good soil conditioner which provides potential for income generation	Operating a composting plant and generating a safe product with value requires technical and managerial skills
2	Co-treatment in waste stabilization ponds	Waste stabilization ponds are simple to build Require relatively little operation and maintenance Appropriate for tropical climates Achieve high pathogenic removal	Land availability High rate of solid accumulation if preliminary solid separation is not performed Potential inhibition due to high salt and ammonia concentration Removal of accumulating sludge in the anaerobic ponds may require heavy mechanical equipment
3	Deep row entrenchment	No need for expensive infrastructure or pumps Growing trees has numerous benefits such as CO2 absorption and erosion protection	Sufficient land has to be available in an area with a low ground water table Legislative control is required in order to be instituted
4	Anaerobic digestion	Produces biogas while stabilizing fecal sludge Reduces sludge volume and odor	Operation and maintenance require relatively high-skilled operators Restriction measures for detergents and heavy metals should be instituted Need for pilot scale prior to full scale implementation to learn more about safety and sustainability
5	Imhoff tank	Small land requirement There is the possibility of operating only one tank Physical separation between the settled sludge and the liquid fraction	Increased operation complexity as compared to other methods Comparatively high cost Requires skilled operators
6	Sludge incineration	The sludge volume is substantially reduced, and all pathogens are removed	Potential emission of pollutants Need for highly skilled operating and maintenance staff High capital and O&M costs Residual ashes

Table 5: Sludge treatment options in healthcare facilities

The choice of treatment methods is influenced among others by the type of onsite sanitation system being used, the sludge quantity and characteristics, rain patterns (quantity, distribution over time), and the institutional setup. Designers and planners should therefore regard fecal sludge management methods as a combination of systems that facilitate efficient desludging, transportation, treatment, and the intended end use.

The selection process for the management method for fecal sludge is a participatory process and should therefore include different stakeholders, including land use managers, water engineers, environmental engineers, and the private sector, among others. In the implementation of the selected suitable technology for the treatment of accumulated fecal sludge in HCFs, the management should use environmental health officers (EHOs). The figure below is a selection scheme for prototype technologies.

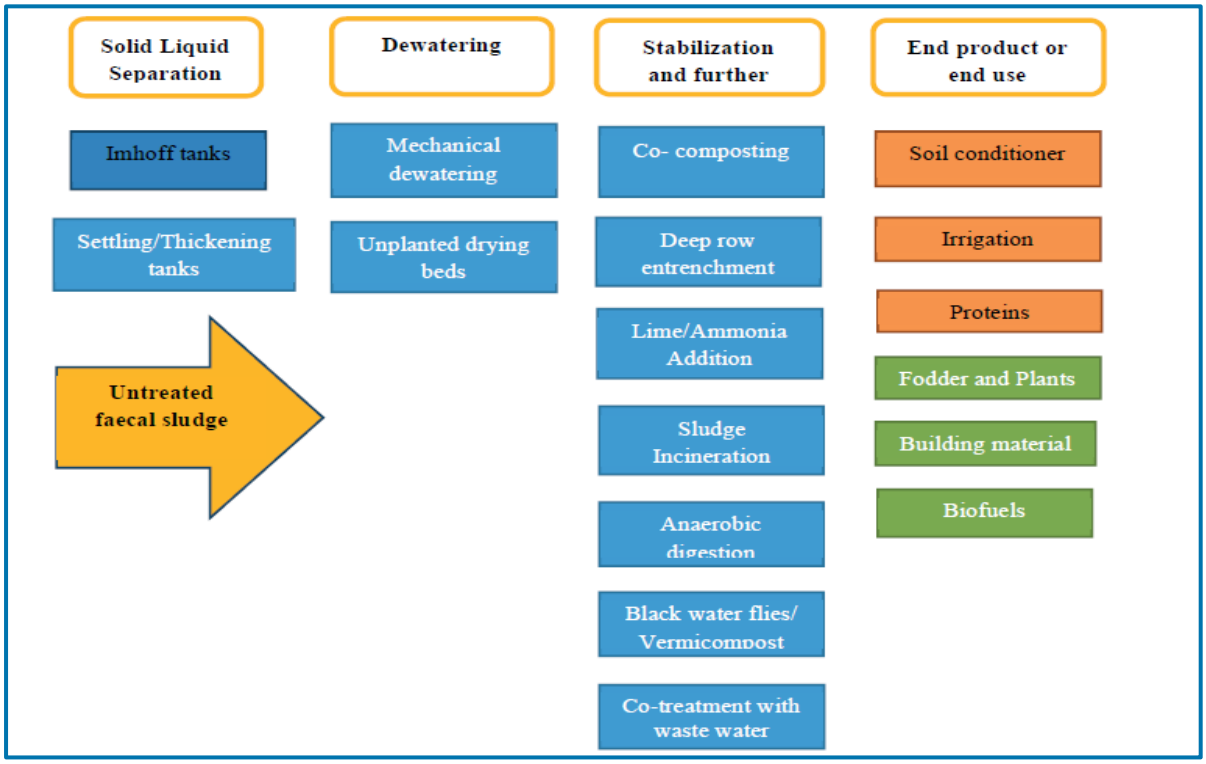


Figure 17: Prototype technology selection scheme (Strande et al., 2014)

5.5. STORM WATER MANAGEMENT

Storm water management consists of collecting, retaining (infiltrating) and/or detaining runoff before it is released to a natural drainage course. The runoff can be managed onsite by infiltration or dispersion if the runoff is minimal in quantity. Otherwise, the runoff will be managed by proper collection, conveyance by pipes, and final treatment or disposal. In some circumstances, excessive runoff might be retained in a detention pond to protect the downstream water course.

5.5.1. STORM WATER MANAGEMENT FOR SMALL HEALTHCARE FACILITIES

- Infiltration trenches or shallow dry wells work well for HCFs with an area less than or equal to 8,000 m^2 in which the site is free from flood risk.
- Alternative methods for capturing runoff are splash blocks and shallow rocked trenches.

5.5.2. STORM WATER MANAGEMENT FOR LARGE HEALTHCARE FACILITIES

For higher level HCFs, such as a specialized hospital, regional referral hospitals, and district hospitals, the installation of a pipe storm drain network to collect, convey, and manage runoff in a safe and effective manner is required. Major considerations during design are:

- Complete drainage analysis to properly size drainage collection, conveyance, storage, and treatment systems. The drainage analysis should be completed by a qualified engineer with experience in drainage engineering.
- Detention ponds can be constructed for temporarily detaining runoff to reduce the rate at which storm water flows off the facility and controls erosion or flash flooding down a slope.

5.6. OPERATIONS AND MAINTENANCE OF SANITATION FACILITIES

During the design and development phases, it is most important to take into account the cleaning, maintenance, repair, and eventual replacement of sanitation facilities. For each health facility, maintenance, renovation, and reconstruction of equipment should be scheduled and budgeted to keep the facilities working. User orientation, preparation, and training are essential parts of the programs that need to be incorporated. In order to assist refugees, frequent guests, and employees, orientation resources, personnel, and time should be devoted.

It is important to develop an operation and maintenance plan to cover the operation and repair of sanitation facilities and services. Daily or incidental repairs and planned maintenance tasks should include this.

5.6.1. INCINERATOR OR AUTOCLAVE OPERATION

The following operator-related measures should be adopted to ensure good incineration performance:

- Only a trained, qualified, and equipped operator should operate the incinerator or autoclave.
- The operator must be onsite while the incinerator is functioning.
- The operator must follow “Best Practices.”
- Operators must be permanent hires.

5.6.2. PLACENTA PIT OPERATION

The following operator-related measures should be adopted to ensure good incineration performance:

- Don’t close placenta pits with a key, as they have to be accessible.
- Throw only placentas inside the pit.
- Place a big sticker in the placenta pit saying, “Beware, this is a placenta pit. Please only dispose of placentas and nothing else, especially plastic bags.”
- Fence the pit to protect against any unauthorized access.

5.6.3. SEPTIC TANK

A properly constructed sewage disposal system, consisting of a septic tank and absorption field or a soak-away pit, can provide several years of service with proper care and maintenance. The following data will help you boost the performance of the device and prolong its useful life.

SURFACE WATER: Do not allow roof drains to discharge to the septic tank or surface water to drain towards the area of the disposal field.

WATER USAGE: It is important to prevent excessive and wasteful water use. Make sure full loads are washed each time if automatic washers and dishwashers are used. Excessive use of water may flush solids from the tank to the disposal area, such as doing multiple washings in one day.

GARBAGE DISPOSAL: Waste units from waste disposal in the septic tank are not easily digested by bacteria and just contribute to the amount of solids that must be collected by pumping the tank. The use of garbage disposal units is, therefore, not recommended.

OPERATION: Moderate usage of household drain solvents, cleaners, disinfectants, etc. does not interfere with the activity of the sewage disposal system but can cause problems when used excessively. Substitutes for toilet paper, paper towels, newspaper, and/or sanitary napkins, etc. should not be washed into the septic tank as they will not decompose quickly.

STARTERS AND CLEANERS: For the septic tank or disposal area, there is no need to use commercial "starters," "bacterial feeds," or "cleaners." By allowing solids to be transported into the absorption system, inevitably resulting in soil clogging, some additives may actually cause problems.

INSPECTION AND CLEANING: The septic tank should be tested at least once a year. When it is 3⁄4 full (or when appropriate), the tank should be drained out. The tank should be washed every two years at the very least. Failure to pump out a septic tank can lead to sludge or scum being carried over to the disposal field, resulting in soil clogging and complete system failure. The tank should not be cleaned or disinfected after pumping. The cleaning should be performed by professionals who are familiar with proper procedures and have adequate equipment.

TRAFFIC OVER ABSORPTION SYSTEM: The area above and near a soil absorption system should never be used as a traffic area for vehicles, pedestrians, or animals.

VEGETATION: The area over a disposal field should have a good vegetation cover. However, shrubs or trees should not be planted over the area in order to expose the ground to sunlight/heat.

INCREASED WASTE LOADS: Field failure will occur if the waste loads and volumes of sewage entering the soil absorption system are greater than that for which the system was built. In terms of enlargement, repair, load reduction, and/or replacement options, contact the Environmental Health Officer.

AS-BUILT PLANS: For future reference, a comprehensive diagram showing the exact position of the septic tank and disposal area, along with the application, permit, final approval, and installation photos, should be held in the health office. This will help service/repair system locations and provide support for sales and financing.

6. ENVIRONMENTAL CLEANING

CLEANING: The physical removal of visible dirty (e.g., dust, soil) and organic material (e.g., blood, secretions, excretions, microorganisms). Cleaning physically removes rather than kills microorganisms. It is accomplished with water, detergents, and mechanical action. Cleaning is required before high-level disinfection or sterilization because tissue, blood, bodily fluids, dirt, and debris reduce the effectiveness of these processes.

DISINFECTION: Thermal or chemical process for inactivating microorganisms on inanimate objects.

ENVIRONMENTAL CLEANING: In healthcare facilities, environmental cleaning refers to the general cleaning of surfaces (e.g., bed rails, mattresses, call buttons, chairs, floor) and equipment (e.g., IV poles, stethoscopes) to reduce the number of microorganisms present in order to provide a clean and pleasant atmosphere.

6.1. INTRODUCTION

Healthcare-associated infections (HAI) are a significant burden globally, with millions of patients affected each year. It is well documented that environmental contamination in healthcare settings plays a role in the transmission of HAIs. Therefore, environmental cleaning is a fundamental intervention for infection prevention and control (MoH IPC manual I).

To be effective, environmental cleaning activities must be implemented within the framework of the facility IPC program, and not as a standalone intervention. It is also essential that IPC programs advocate for and work with facility administration and government officials to budget, operate, and maintain adequate water, sanitation, and hygiene (WASH) infrastructure to ensure that environmental cleaning can be performed according to best practices.

6.2. THE GENERAL PRINCIPLES FOR CLEANING

- Scrubbing (frictional cleaning) is the best way to physically remove dirt, debris and microorganisms
- Cleaning is required before any disinfection process because dirt, debris and other materials can decrease the effectiveness of many chemical disinfectants.
- Cleaning products should be selected based on their intended use, efficacy, safety, and cost.
- Cleaning should always progress from the least soiled areas to the most soiled areas (and from high to low areas) so that the dirtiest areas as well as debris falling on the floor will be cleaned up last.
- Dry sweeping, mopping, and dusting should be avoided to prevent dust, debris, and micro-organisms from getting into the air and landing on clean surfaces. Airborne fungal spores are especially important as they can cause fatal infections in immune-suppressed patients [5].

- Instructions for mixing (dilution) should strictly be followed when using disinfectants. Too much or too little water may reduce the effectiveness of disinfectants.
- Cleaning methods and written cleaning schedules should be based on the type of the surface, the amount and the extent of the soil present and the purpose of the area.
- Routine cleaning is necessary to maintain the standard of cleanliness. Also, schedules and procedures should be consistent and posted publicly.

6.3. CLEANING PROGRAM

Environmental cleaning programs in healthcare facilities involve resources and engagement from multiple stakeholders and departments, such as administration, IPC, WASH, and facilities management. They require a standardized and multi-modal approach, as well as strong management and oversight in order to be implemented effectively.

The scope of the environmental cleaning program and its implementation can vary (e.g., in-house management versus external contract) based on the size of the facility and level of services provided. Comprehensive environmental cleaning programs are most important at acute healthcare facilities and higher tiers of healthcare, where the burden caused by HAIs is highest. Regardless of the facility type, the key elements for effective environmental cleaning programs include:

- organization/administration
- staffing and training
- equipment and supplies
- protocol and procedures
- monitoring, feedback, and audit

6.4. TRAINING FOR STAFF WITH CLEANING RESPONSIBILITIES

Training for cleaning staff should be based on national or facility environmental cleaning guidelines and policies. It should be mandatory, structured, targeted, and delivered in the right way (e.g., participatory) and conducted before staff can work independently within the healthcare facility.

Training content should include, at a minimum:

- a general introduction to the principles of IPC, including transmission of pathogens
  - the key role cleaning staff play in keeping patients, staff, and visitors safe
  - how cleaning staff can protect themselves from pathogens
- A detailed review of the specific environmental cleaning tasks for which they are responsible, including review of SOPs, checklists, and other job aids
- When and how to safely prepare and use different detergents, disinfectants and cleaning solutions

- How to prepare, use, reprocess, and store cleaning supplies and equipment (including PPE)
- Participatory training methods, the hands-on component with demonstration and practice
- Easy-to-use visual reminders that show the cleaning procedures (i.e., without the need for a lot of reading)
- Orientation to the facility layout and key areas for the cleaning program (e.g., environmental cleaning services areas)
- Other health and safety aspects, as appropriate
- Develop the training program according to the intended audience, in terms of education and literacy level.
- Develop training content specifically for cleaning staff who could be responsible for cleaning procedures in specialized patient areas—particularly high-risk areas, such as intensive care units, operating rooms, and maternity units.
- Maintain training records, including dates, training content, and names of trainers/trainees.
- Select appropriate, qualified trainers at a facility or district level—generally, staff with IPC training. They could be members of existing IPC or hygiene committees.
- Conduct periodic competency assessments and refresh training as needed (e.g., at least annually, before the introduction of new environmental cleaning supplies or equipment).
    - Focus refresh training on gaps identified during competency assessments and routine monitoring activities.

6.5. CLEANING SUPPLIES AND EQUIPMENT

Essential supplies and equipment for environmental cleaning include cleaning cloths, wipes, mops, buckets, brushes, and cleaning materials like detergents and disinfectants as well as personal protective equipment for the cleaning staff, such as reusable rubber gloves, gowns, plastic aprons, face masks with either goggles or a face shield, and safety shoes. Also, fundamentally, environmental cleaning requires access to sufficient quantities of clean water. Different products and materials should be used for different types of cleaning, including routine cleaning conducted regularly, terminal cleaning conducted after patient discharge, and responsive cleaning following specific events, such as spills of blood or bodily fluids.

- A consistent supply of cleaning materials, including detergent and disinfectant, is needed for routine cleaning.
- The selection of and appropriate use of supplies and equipment are critical for effective environmental cleaning.
- Separate cleaning equipment should be available.

SURFACE CLEANING SUPPLIES: Portable containers (e.g., bottles, small buckets) for storing environmental cleaning products (or solutions) and surface cleaning cloths.

FLOOR CLEANING SUPPLIES: Mops or squeegees with floor cloths, buckets, and wet floor/ caution signs.

In general, all the essential environmental cleaning supplies and equipment are reusable, but facilities can also choose to use disposable supplies (e.g., cloths) for certain cleaning tasks or where and when resources allow.

Cleaning equipment should be:

- fit for the intended purpose
- cleaned and stored dry between uses
- properly used
- well maintained.

HOW TO PREPARE A DISINFECTANT CLEANING SOLUTION

Disinfectant cleaning solutions contain both disinfectants for decontamination and detergents (soap) for cleaning. When we use a chlorine solution, we should be very cautious. Although chlorine-containing solutions (sodium hypochlorite) are excellent and inexpensive disinfectants, they should not be mixed with cleaning solutions containing an acid (e.g. phosphoric acid) like ammonia or ammonium chloride (NH4Cl). Doing so will release chlorine gas and other byproducts that can result in temporary illness (nausea, tearing up, headache, or shortness of breath) in the staff who inhaled fumes in a poorly ventilated area (CDC, 1991). To find out if a cleaning solution contains ammonia, first check the label. If it is not mentioned among the ingredients, you may still be able to detect ammonia when opening the product by its pungent and burning smell. If one is exposed to chlorine gas or ammonium chloride or other unpleasant (noxious) gases with strong odors, the subject should immediately leave the room or the area until it becomes completely ventilated.

STEPS:

Prepare a 0.5% chlorine solution from liquid concentrates (See Equation a) for directions) or from chlorine powder compounds (See Equation b). Alternative disinfectants that can be used include 1 to 2% phenols or 5% carbolic acid.

FORMULA FOR MAKING A DILUTION FROM A CONCENTRATED SOLUTION:

$$Total\ parts(TP)\ of\ water = \left[\frac{\%Concentrate}{\%Dilute}\right] - 1$$

FORMULA FOR MAKING A DILUTE SOLUTION FROM A DRY POWDER:

$$\frac{gm}{L}\ solution = \left[\frac{\%Dilute}{\%Concentrate}\right] * 1000$$

Add enough detergent to the 0.5% chlorine solution or another disinfectant to make a mild and soapy cleaning solution.

6.6. CLEANING FREQUENCY

Global guidelines recommend that all highly touched surfaces in health care facilities are cleaned at least daily plus whenever they are dirty. Wet mopping with hot water and detergent is advised. While few countries have data on the frequency and methods of cleaning at healthcare facilities, routine cleaning may be much less frequent than once per day at some facilities and even fewer facilities clean daily with hot water and detergent.

6.7. ENVIRONMENTAL CLEANING PROCEDURE

The procedures have to be implemented on a regular basis in the areas listed below:

- General outpatient area (adult and children)
- General inpatient area (adult and children)
- Patient area toilets
- Patient area floors
- Spills of blood or bodily fluids

7. BUDGET AND HUMAN RESOURCE FOR WASH IN HEALTHCARE FACILITIES

Resource distribution in health care facilities is critically necessary for WASH. The government should take the lead in allocating money to WASH facilities for building, service, and maintenance. The allocation of additional resources can come from the private sector and from other partners. Since WASH plays a key role in the provision of quality care in health care facilities, the HCF's programs and services should be harmonized and aligned. Hardware and software tasks such as infection prevention and management, capacity building, monitoring, assessment, analysis, and evidence all require a dedicated budget.

Skilled practitioners are very important to ensure the sustainable provision of secure WASH services in healthcare facilities. In order to guarantee WASH is implemented in healthcare facilities, including infection prevention and control, a curriculum for healthcare personnel preservation training should be included. For healthcare providers involved in WASH services, continuous training should be offered.

7.1. MANDATORY HUMAN RESOURCES FOR PROPER EXECUTION OF WASH IN HEALTHCARE FACILITIES

Proper performance of the healthcare facility is decided by the healthcare personnel assigned to each section or department. Pertaining to WASH, facility-qualified hygiene, and environmental health practitioners should be allocated in health centers and hospitals to manage WASH in these facilities. Need-based assessments, continuous updating, and work training should be provided. The availability of appropriate workers for cleaning, laundry, and waste management in health care facilities should be considered in the human resource development strategy. The number of WASH personnel required in the respective healthcare facilities is indicated in table 6.

7.2. BUDGET ALLOCATION OF WASH FACILITIES

Sufficient budget allocation and resource mobilization is critically essential for the proper functioning of WASH facilities and to minimize hospital infections. For proper budget determination, the situational analysis needs to be conducted at all levels of the healthcare facility. It is reported (UNICEF, 2019) that the WASH budget allocation in Ethiopia is very limited. The situational analysis would help to fix the insufficient budget allocation.

EXPLICIT BUDGET ALLOCATION SHOULD BE FOR:

- WASH facility construction or expansion
- WASH facility operation and maintenance
- For incinerators and autoclaves, as well as their construction, purchase and maintenance
- Skill building such as training and experience sharing
- Cleaning materials
- Equipment for monitoring and evaluation purposes

NO	TYPE OF HCF	NUMBER/TYPE OF PROFESSIONALS FOR WASH	COMMENTS
1	Health Post	One environmental health professional, two health extension workers and one cleaner	Extensive training about WASH and proper utilization of WASH facilities is mandatory
2	Health Center / PHCU	One environmental health professional and 10 cleaners Two sanitary maintenance worker and electricians	The number of janitors needs to be determined using the human resource requirement
3	Primary Hospital (including private hospitals)	Minimum of two environmental health workers Minimum of 40 cleaners Sanitary maintenance worker and electricians; 3 each Minimum of 3 morgue attendants	It can be customized based on the service load
4	Comprehensive specialized hospital	Minimum of three environmental health professionals Minimum of 100 cleaners Sanitary maintenance worker and electrician; 4 each Minimum of 6 morgue attendants	It has to be customized based on the number of wards and patient flow
5	Teaching Hospitals	Minimum of three environmental health professionals Minimum of 400 cleaners Minimum of 6 morgue attendants	The number of students, beds, wards, and size of patient flow needs to be assessed. There is a trend of outsourcing the cleaning work

Table 6: Human resource requirements for WASH at different healthcare facilities (Federal Ministry of Health)

8. ENERGY

A reliable power source is critical in a healthcare facility to ensure proper functioning. The availability of green energy sources for each healthcare facility is highly preferable for climate resilience. HCFs starting from health centers need to have a continuous power source.

Figure 18: Solar Powered Water Supply system

9. MINIMUM STANDARDS AND INDICATORS FOR WASH IN HEALTHCARE FACILITIES

9.1. MINIMUM STANDARDS FOR WATER QUALITY

Microbial quality is crucial for infection prevention and control in healthcare settings. Drinking water should be acceptable to patients and staff. Particular care is needed to ensure that safe drinking water is supplied to immuno-compromised patients because of their high susceptibility to infection. Water for drinking, cooking, personal hygiene, medical activities, cleaning, and laundry needs to be safe for the purpose intended. Ideally, all healthcare facilities, especially hospitals, should have a continuous supply of piped water. Whether piped or non-piped, water supplies can be contaminated. Water available in healthcare facilities should meet appropriate national standards or WHO Guideline Values (WHO 2006).

9.1.1. INDICATORS FOR WATER QUALITY

- Drinking water meets the WHO guidelines for drinking-water quality (2011) or national standards concerning chemical guidelines and radiological parameters.
- Escherichia coli or thermotolerant coliform bacteria are not detectable in any 100-milliliter sample of drinking water. A water safety plan aimed at assessing and managing water systems and ensuring effective operational monitoring should be designed, developed, and implemented to prevent microbial contamination in water and promote its ongoing safety.
- Chemical constituents should not be in excess of national standards and WHO guideline levels in water supplies.
- There are no tastes, odors, or colors that would discourage consumption or use of the drinking water.
- All drinking water is treated with a residual disinfectant to ensure microbial safety up to the point of consumption or use.
- Water that is below drinking water quality is used only for cleaning, laundry, and sanitation and is labeled as such at every outlet.
- Facilities should adopt a risk management approach to ensure water safety.

ITEM	RECOMMENDED STANDARD	EXPLANATION
Water Quantity	5–400 liters/person/day	Outpatient services require less water, while operating theatres and delivery rooms require more water. The upper limit is for viral hemorrhagic fever and/or isolation centers.
Water Access	Onsite supplies	Water should be available within all treatment wards and in waiting areas.
Water Quality	Less than 1 Escherichia coli/100 ml. sample of water Presence of residual disinfectant for water treatment. Water safety plan in place	Drinking water should comply with WHO guidelines for microbial, chemical, and physical aspects. Facilities should adopt a risk management approach to ensure water safety
Sanitation Quantity	1 toilet for every 20 users in an inpatient setting At least 4 toilets per outpatient setting Separate toilets for patients and staff	A sufficient number of toilets should be available for patients, staff, and visitors
Sanitation Access	Onsite facilities	Sanitation facilities should be within the facility grounds and accessible to all types of users (females, males, those with limited mobility).
Sanitation Quality	Appropriate for local technical, cultural, and financial conditions Safe, clean, and accessible to all users including those with limited mobility	Toilets should be built according to technical specifications to ensure excreta are safely managed
Hygiene	A reliable water point with soap or alcohol-based hand rubs available in all treatment areas, waiting rooms, and near latrines for patients and staff	Water and soap (or alcohol-based hand rubs) should be available in all key areas of the facility for ensuring safe hand hygiene practices.
Waste Management	Healthcare waste is segregated at the point of generation according to its type, using at least three bins Each category of waste is treated and disposed of according to the safest feasible method available	Health care waste should be segregated, collected, treated and disposed properly to prevent infection and environmental pollution
Environmental Cleaning	Availability of protocols (SOP) for cleaning All staff received training Regular cleaning of surfaces and fittings Availability of cleaning supplies	Protocols, training, and regular cleaning should be established Cleaning supplies at the point of care and near sanitation and hygiene facilities should be present

Table 7: Summary of environmental health standards in healthcare facilities

9.1.2. MINIMUM REQUIREMENTS FOR WATER QUANTITY

Sufficient water is available at all times for drinking, food preparation, personal hygiene, medical activities, cleaning, and laundry.

Sufficient water collection points and water use facilities are available in the healthcare setting to allow convenient access to, and use of, water for medical activities, drinking, personal hygiene, food preparation, laundry, and cleaning.

9.1.3. INDICATORS FOR WATER ACCESSIBILITY

- A reliable drinking water point is accessible to staff, patients, and attendants at all times.
- A reliable water point, with soap or a suitable alternative, is available at all critical points within the healthcare setting (operating theatres, wards, consulting rooms, dressing stations, etc.) and in-service areas (sterilization, laboratory, kitchen, laundry, showers, toilets, waste zone, and mortuary).
- At least two handwashing basins should be provided in wards with more than 20 beds.
- At least one shower is available for every 40 users in inpatient settings (users include patients, staff, and attendants staying in the healthcare setting).
- Laundry facilities with soap or detergent, hot water, and a disinfectant (such as chlorine solution) are available for inpatient settings.

9.1.4. MINIMUM REQUIREMENTS FOR SANITATION

Adequate, accessible, and appropriate toilets are provided for patients, staff, and attendants. The time and effort required to reach the toilets need to be taken into account. In multi-story buildings, there should be toilets available on all floors. The routes used to reach the toilets should be smooth and flat, for easy access for people in wheelchairs.

9.1.5. INDICATOR FOR SANITATION FACILITIES

- There are sufficient toilets available: one per 20 users for inpatient settings; at least four toilets per outpatient setting (one for staff, and patients: one for females, one for males, and one toilet accessible for people with limited mobility)
- Toilets are appropriate for menstrual hygiene management
- Toilets are designed to respond to local cultural and social conditions and all age and user groups.
- Toilets are safe to use
- Toilets are easily accessible (that is, no more than 30 meters from all users).
- There is a cleaning and maintenance routine in operation that ensures that clean and functioning toilets are available at all times.

9.1.6. MINIMUM REQUIREMENTS FOR HYGIENE

- Functional hand hygiene facilities (with water and soap and/or alcohol-based hand rub) are available at the point of care
- Functional hand hygiene facilities (with water and soap and/or alcohol-based hand rub) are available within five meters of the toilet

9.1.7. WASTE MANAGEMENT SERVICES IN HEALTHCARE FACILITIES

- Healthcare waste is segregated at the point of generation according to its type, using at least three bins.
- Three color-coded waste containers or containers bearing clearly understood signs and symbols are provided at convenient locations. They are collected from all healthcare services and stored safely before treatment and/or disposal.
- Each category of waste is treated and disposed of according to the safest feasible method available.

9.1.8. ENVIRONMENTAL CLEANING SERVICES IN HEALTHCARE FACILITIES

- Availability of protocols (SOP) for cleaning
- Staff with cleaning responsibilities have all received training
- Regular cleaning of surfaces and fittings is carried out to ensure that the healthcare environment is visibly clean (floors, walls, and ceilings) and free from dust and soil.
- Availability of cleaning supplies at different points of care
- Availability of cleaning supplies at different sanitation and hygiene facilities

10. MONITORING AND EVALUATION OF WASH IN HEALTHCARE FACILITIES

10.1. IMPORTANCE OF MONITORING AND EVALUATION OF WASH SERVICES IN HEALTH CARE FACILITIES

The primary aim of monitoring WASH services in the HCFs is to measure the implementation of guidelines (i.e., minimum WaSH standards) as well as ensure the available WASH facilities are providing the expected services to the clients and HCF workers. Besides, monitoring will help to identify potential areas for remedial actions. Evaluation of the WASH and service coverage in HCFs is critically essential for informed policy decisions, budget allocations, and making related actions to maintain an improved WASH.

10.2. WHAT TO MONITOR?

Monitoring and evaluation of the WASH facilities and services of HCFs are both critically essential. Monitoring and evaluation should focus on:

WATER SUPPLY

- Availability of adequate and continuously functional water at each premise
- Accessibility of water at each premise
- Presence of quality water at each premise
- The presence of equitable (by space and user) water supply in the premise

SANITATION

- Absence of open defecation in the compound of an HCF
- The presence of a sufficient number (1 latrine/24 users) of an improved latrine for men, women, and the disabled in the healthcare facility
- Cultural appropriateness of the latrines

HYGIENE

- Availability of functional hand hygiene stations (water and soap OR alcohol-based hand rub) at points of care
- Availability of functional handwashing stations (water and soap) at latrines
- Availability of shower facilities for each ward
- Availability of hand rubs/sanitizer with dispenser at the wall of the exit of each ward
- Presence and proper utilization of PPE (including for waste handlers)

VECTORS CONTROL

- Vector control measures, including those against the common house fly
- Absence of cockroaches, CHF, rodents, bats, and other biological / mechanical vector management
- Presence of color-coded healthcare waste bins for segregation at all points of care
- Timely collection of waste
- Presence of general healthcare waste collection and disposal mechanisms
- Presence of hazardous healthcare waste (infectious waste, sharps waste, pathological waste, pharmaceutical waste, chemical waste, radioactive waste) treatment and disposal methods
- Presence of wastewater proper management system in an HCF
    - Separate and closed drainage system/sewer line
    - Treatment and disposal system in the absence of a municipal treatment system

WASTEWATER

- No liquid waste discharge from the HCF, creating a possible source of infection
- Waste not discharged to the public/to the environment untreated
- Must have a pretreatment facility
- Have proper inspection and maintenance holes

CLEANING SYSTEM

- Presence of cleaning stations
- Availability of standard operating protocol
- Presence of cleaning supplies

LAUNDRY

- Presence of functional laundry machines
- Presence of separate transportation/trolley equipment
- Presence and functionality of an ironing facility
- Presence of proper wastewater discharge
- Presence of dedicated personnel

10.3. WHO MONITORS?

Institutionally, monitoring and evaluations have to be performed in all health sectors at all levels following the implementation of WASH services. However, to ensure ownership of the process, a bottom-up participatory approach will be adopted in accessing the data, starting from HCFs themselves and moving upward to the district, regional, and eventually through the national level. To ensure quality care, top-down monitoring also needs to be implemented

regularly. The two reports (bottom-up and top-down monitoring reports) need to be evaluated to provide practical feedback.

WASH monitoring will be undertaken at five levels, namely, HCF, woreda, zonal, regional, and central (or national) level.

In this way, monitoring evaluation teams will be structured in a cascading manner from the HCF to the national level. Professionals involved in these tasks need to take training on monitoring and evaluation before the job begins.

Professionals involved in the monitoring and evaluation are:

- Environmental health professionals
- WASH experts
- Health officers, nurses, and other health professionals who have taken up-to-date training on WASH

10.4. WHEN TO MONITOR?

Regular monitoring and evaluation of the WASH facilities in the HCFs by the responsible employee are mandatory. However, monitoring and evaluation of the HCFs by an external body is also highly recommended, which should be performed using the flowing schedule.

NO	TYPE OF HCF	FREQUENCY OF MONITORING	RESPONSIBLE BODY
1	Health Post	Monthly supervision	Health Center/PHCU
2	Health Center/PHCU, Clinics (for privates)	Quarterly	Woreda Health Office
3	Primary hospital	Biannual and yearly evaluation	Woreda Health office/Zone/ Regional Health Bureau
4	General Hospitals, including private hospitals	Biannual and yearly evaluation	Zone/Regional Health Bureau
5	Comprehensive and Specialized Hospitals	Biannual	MoH and Regional Health Bureau
6	Teaching Hospitals	Biannual	MoH

Table 8: Frequency and responsibility for monitoring and evaluation of the different healthcare facilities (Federal Ministry of Health)

10.5. REPORTING AND FEEDBACK

Following the monitoring and evaluation process and program, or at any critical time of supervision, reports have to be organized about the WASH practices and facility conditions of

the healthcare sector. Reports need to be communicated to the higher organizational level of the healthcare system.

The authorities or experts of a higher-level who receive WASH reports need to provide timely feedback to the respective healthcare facility.

ITEM	BASIC SERVICE	LIMITED SERVICE	NO SERVICE
Water	Water is available from an improved source on the premises	An improved water source is within 500 meters of the premises, but not all requirements for basic service are met	Water is taken from unprotected dug wells or springs, or surface water sources; or an improved source that is more than 500m from the premises; or there is no water source
Sanitation	Improved sanitation facilities are usable, with at least one toilet dedicated for staff, at least one sex-separated toilet with menstrual hygiene facilities, and at least one toilet accessible for people with limited mobility.	At least one improved sanitation facility is available, but not all requirements for basic service are met	Toilet facilities are unimproved (e.g. pit latrines without a slab or platform, hanging latrines, bucket latrines) or there are no toilets.
Hygiene	Functional hand hygiene facilities (with water and soap and/ or alcohol-based hand rub) are available at points of care, and within five metres of toilets.	Functional hand hygiene facilities are available either at points of care or toilets but not both.	No functional hand hygiene facilities are available either at points of care or toilets.
Waste Management	Waste is safely segregated into at least three bins, and sharps and infectious waste are treated and disposed of safely.	There is limited separation and/or treatment and disposal of sharps and infectious waste, but not all basic services are met	There are no separate bins for sharps or infectious waste, and sharps and/or infectious waste are not treated/disposed of safely.
Environmental Cleaning	Basic protocols for cleaning are available, and staff with cleaning responsibilities has all received training.	There are cleaning protocols and/or at least some staff have received training on cleaning.	There are cleaning protocols and/or at least some staff have received training on cleaning.

Table 9: Level of WASH services in healthcare facilities

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12. ANNEXES

12.1. ANNEX 1: OPERATION AND MAINTENANCE OF WATER SOURCES

12.1.1. OPERATION AND MAINTENANCE OF A DRILLED WELL

A drilled well consists of a hole bored (a borehole) into the ground, with the upper part or the entire depth of the well lined with casing. The expected service life of a well depends on its design, construction, development, operation, and proper maintenance. With regards to O&M of drilled wells, HCFs should consider the following actions:

- Keep proper records of power consumption, well discharge and operating hours
- Carry out periodic chemical and bacteriological analysis of water and treatment when necessary
- Check the well cap and the area to see if they are secured annually to avoid source contamination
- Make the site free from hazardous waste, healthcare waste and other waste that can alter water quality
- Undertake periodic cleaning of screens by adding hydrochlorics, polyphosphates, specific proprietary chemicals or chlorine followed by agitation of the water in the well.

In addition to the aforementioned actions, preventive and routine maintenance should be done for protected shallow wells. On one hand, preventive maintenance should focus on cleaning of the surroundings and regular check-up of a hand pump/ well at fixed time intervals e.g. weekly or monthly so as to change some parts before they are fully damaged. On the other hand, routine maintenance should involve replacing fast-wearing parts such as rings, I-seals, bobbins, and bearings

12.1.2. OPERATION AND MAINTENANCE OF SPRINGS

Sometimes, HCFs may choose to use water from nearby protected springs. A land spring is a simple outcropping of water that has percolated into permeable sub-soil and followed the first impermeable stratum to a point at which it reaches the surface.

Construction of a spring depends on the spring type, size, location, drainage system, and storage chambers. The main parts of a spring are as listed below and should be observed during construction. Spring capping requires minimum intervention in both operation and maintenance. Thus, generally the main O&M activities while spring water collection include:

- Permitting water to flow out freely from the chamber at all times so that it will not find another way out through the aquifer in a different direction

- Opening or closing the valves to divert water to reservoir or a drain
- Maintaining cleanliness of the spring and its surroundings

Moreover, contamination and deterioration of water should be avoided by checking the following anticipated issues at regular intervals:

- Check surface drains
- Fence the spring and regularly check and repair animal-proof fences and gates
- Protect the vegetation cover growth within the spring and the surrounding area
- Frequently check the water flow from the spring box in order to detect water turbidity or increased flow after rainstorm. In case of surface rain-off, protection of the spring should be improved. Whereas, if the system is clogged, old gravel should be replaced by new ones.
- Take regular water samples as recommended by guidelines to check for evidence of fecal contamination
- Open the washout annually to remove the accumulated silt
- Check screens regularly. If they are found damaged or blocked, they should be cleaned or replaced with non-rusting materials.
- After cleaning, make sure the washout valve is fully closed and the manhole cover sealed
- Disinfect the spring box each time a person enters to clean or repair or when there is bacteriological contamination
- Repair any leaks in the protective seal, undermining of the head wall, or damage caused by erosion or settlement of soil must be repaired

12.1.3. OPERATION AND MAINTENANCE (O&M) OF ROOFTOP RAINWATER HARVESTING SYSTEM

In rooftop harvesting, the roof becomes the catchment, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to an artificial recharge system. Rooftop rainwater harvesting system requires minimal attention with respect to their operation. The major concern of installing rooftop rainwater harvesting system is to prevent the entry of contaminants into the tank while it is being refilled during a rainstorm.

The following maintenance procedures should be considered in the operation of rooftop rainwater harvesting systems:

- Flush the rainwater to waste and away from the tank to avoid the entry of debris from the catchment area into the tank.
- Check and clean the storage tank periodically.
- Cover and ventilate the tank to avoid mosquito breeding, prevent insects and rodents from entering the tank, and minimize the growth of algae.
- Chlorinate water in storage tanks.

- Maintain gutters and down pipes. A good time to inspect gutters and down pipes is while it is raining, so that leaks can easily be detected. Regular cleaning is necessary to avoid contamination.
- If a filter is provided, it should be cleaned every month and/or and when it is required, filter sand should be washed at least every six months.
- Leaks have to be repaired throughout the year, especially leaking tanks and taps, as they present health risks.
- In some cases, where the water is pumped, periodic preventive maintenance is required on the small pumps that lift water to selected areas of house or building, or provide public supply from underground storage tanks.

12.2. ANNEX 2: WATER SOURCE PROTECTION

12.2.1. PROTECTION OF WELLS

GROUND WATER (WELL) CASING: the inside wall of the well should be made waterproof by cementing from the top of the well down to a minimum depth of 3 meters. The deeper it is extended, the better. The casing of the well should also be extended for a minimum of 60cm above the surrounding ground level.

COVER: A concrete cover should be fitted over the casing to prevent dust, insects, small animals, etc. from falling in to the well and also to prevent leakage of flushed water.

FENCING: The immediate area of the well should preferably be fenced to keep animals away.

DIVERSION DITCH: The area surrounding the well should be graded off in order to prevent the flow of storm water into the well.

CLEANLINESS: The area surrounding the source should be maintained clean

12.2.2. PROTECTION OF A SPRING

Spring protection is a widely used technique in developing countries to provide a safe water supply. Above and to the sides of the gravel layer, a further impervious clay layer is used to keep surface seepage water out. A perimeter drain is also dug to channel storm water away from the spring area.

12.2.3. PROTECTION OF RAINWATER HARVESTING (RWH)

- Rainwater harvesting (RWH) flushes the rainwater to waste away from the tank to avoid entry debris from the catchment area into the tank.
- Check and clean the storage tank periodically
- Cover and ventilate the tank to avoid mosquito breeding, prevent insects and rodents from entering the tank, and minimize the growth of algae
- Provide a filter to the tank and clean monthly

12.3. ANNEX 3: WATER QUALITY STANDARDS

12.3.1. REQUIREMENTS AND TEST METHODS

PHYSICAL REQUIREMENTS

The physical characteristic of drinking water should confirm to the level specified in Table 1.

CHARACTERISTIC	MAXIMUM PERMISSIBLE LEVEL	TEST METHOD
Odor*	Unobjectionable	ES 605
Taste	Unobjectionable	
Turbidity, NTU	5	ES ISO 7027
Color, TCU	15	ES ISO 7887

Table 10: Physical characteristics of drinking water

CHEMICAL REQUIREMENTS

12.3.2. PALATABILITY PROPERTIES

Characteristics that affect the palatability of water shall conform to the level specified in Table 2:

SUBSTANCE / CHARACTERISTIC	MAXIMUM PERMISSIBLE LEVEL	TEST METHOD
Total hardness (as CaCO3)	300	ES 607
Total dissolved solids mg/l, Max	1000	ES 609
Total Iron (as Fe) mg/l, Max	0.3	ES ISO 6332
Manganese (as Mn) mg/l, Max	0.5	ES ISO 6333
Ammonia (NH3+NH+4)* mg/l, Max	1.5	ES ISO 7150-2
Residual, free chlorine mg/l, max	0.5	ES ISO 7393
Anionic surfactant, as maçç concentration of MBAS mg/l, Max	1.0	ES ISO 7875-1
Magneçium (as Mg) mg/l, Max	50	ES ISO 7980
Calcium (as Ca), mg/l, Max	75	ES ISO 7980
Copper (as Cu) mg/l, Max	2	ES ISO 8288
Zinc (as Zn) mg/l, Max	5	ES ISO 8288
Sulfate (as SO4) mg/l, max.	250	ES ISO 9280
Chloride (as Cl), mg/l, Max	250	ES ISO 9297
Total alkalinity (as CaCO3) mg/l, Max	200	ES ISO 9963-1
Sodium (as Na), mg/l, Max	200	ES ISO 9964-1
Potassium (as K), mg/l, max	1.5	ES ISO 9964-2
pH value, unit	6.5 to 8.5	ES ISO 10523
Aluminum (as Al) mg/l, Max	0.2	ES ISO 12020

Table 11: Characteristics that affect the palatability of drinking water

CONTENT OF TOXIC AND/OR DISEASE-CAUSING SUBSTANCES

When tested, the characteristics that affect the safety of drinking water shall conform to the level specified in Table 3.

SUBSTANCE / CHARACTERISTIC	MAXIMUM PERMISSIBLE LEVEL	TEST METHOD
Barium (as Ba) mg/l, Max	0.7	ES 606
Total mercury (as Hg) mg/l, Max	0.001	ES ISO 5666-3
Cadmium (as Cd) mg/l, Max	0.003	ES ISO 5961
Arsenic (as As) mg/l, Max	0.01	ES ISO 6595
Cyanide(as CN) mg/l, Max	0.07	ES ISO 6703-1
Nitrite (as NO2) Mg/l, Max	3	ES ISO 6777
Nitrate as NO3 Mg/l, Max	50	ES ISO 7890-3
Phenolic compound as phenol mg/l, Max	0.002	ES ISO 8165-1
Lead (as Pb) mg/l, Max	0.01	ES ISO 8288
Boron (as B) mg/l, Max	0.3	ES ISO 9390
Selenium (as Se) mg/l, Max	0.01	ES ISO 9965
Fluoride (as F) Max	1.5	ES ISO 10359-1
Chromium (as Cr) mg/l, Max	0.05	ES ISO 11083
Pesticide and Organic constituent, Mg/l, Max		
a) DDT	2	ES ISO 6468
b) Heptachlor and heptachlor epoxide	0.03	
c) Hexchchlorobenzene	1	
d) Lindane (Gamma – BHC)	2	
e) Methoxychlor	20	
f) Aldrin/Dildine	0.03	
g) 1,2 Dichloride ethane	30	ES ISO 10301
h) 1,1,1- Tricolor ethane	2001	
i) Trichloro ethane	70	
j) Trichlorobenzeneç (total)	20	
k) Hexachlorobutadiene	0.6	

Table 12: Content of toxic and/or disease-causing substances of drinking water

If nitrates (expressed as N) are present in concentration in excess of 10 mg/l, the water may be unsuitable for use by infant under one year of age, and an alternative source of supply must be found for such infant use or the water from the same source should be corrected in care of lack of other sources.

**The term ammonia includes the non-ionized (NH3) and ionized (NH+4) species.*

NOTE 1: Several of the inorganic elements for which a maximum permissible level has been settled are recognized to be essential element in human nutrition. No attempt has been made here to define a minimum desirable concentration of such substance in drinking water.

NOTE 2: Because of the possibility of simultaneous occurrence of nitrite and in drinking water, the sum of the ratio of the concentration of each to its standard value should not exceed 1, i.e. C nitrite + C nitrate □ 1, SV nitrite SV nitrate

Where, C is concentration and SV is standard value.

NOTE 3: The limit value for fluoride should consider climatic conditions, volume of water consumed, and intake from other sources provided the limit specified in the above table is satisfied.

OTHER CONSTITUENTS

Radioactivity, if present, shall not exceed the following level, when determined according to ES ISO 9696 and ES ISO 9697 respectively:

- gross alpha activity 0.1 Be/l max.
- gross beta activity 1Bq/l max.

NOTE 4: If a screening value is exceeded, more detailed radionuclide analytic is necessary. Higher values do not necessarily imply that the water is unsuitable for human consumption.

BACTERIOLOGICAL REQUIREMENTS

When tested with the corresponding test method, the bacteriological requirement of treated drinking water shall not exceed the level shown in Table 4.

ORGANISM	MAXIMUM PERMISSIBLE LEVEL	TEST METHOD
Total viable organisms, colonies per ml	must not be detectable	ES ISO 4833
Faucal streptococci per 100ml	must not be detectable	ES ISO 7899-1 ES ISO 7899-2
Coliform organisms, number per 100ml	must not be detectable	ES ISO 9308-1
E. Coli, number per 100 ml	must not be detectable	ES ISO 9308-1 ES ISO 9308-2

Table 13: Bacteriological levels

If any coliform organisms are found in a sample, a second sample shall be taken immediately after the tests on the first sample have been completed and must be free from coliform organisms.

No more than 2 percent of the total number of water samples from any one distribution system tested per year may contain coliform organisms.

Any treated water shall not contain fecal and coliform organisms when tested with the corresponding test method.

Any treated water shall not contain any fecal streptococci when tested according to ES ISO 7899-1 or ES ISO 7899-2.

SOURCE: Ethiopian Standard has been prepared under the direction of the Technical Committee for Water Quality (TC 78) and published by the Ethiopian Standards Agency (ESA). WTO-TBT Agreement. Implementation of this standard shall be effective as of 01 October 2013.

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MINISTRY OF HEALTH-ETHIOPIA

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