National Health Care Waste Management Standards and Operating Procedures - 2020

This document is developed based on the "Health Care Waste Management Guideline 2071 (2014)", "The Public Health Service Act, 2075 (2018), Public Health Service Regulation 2077 (2020) and National Health Policy, 2076 (2019)

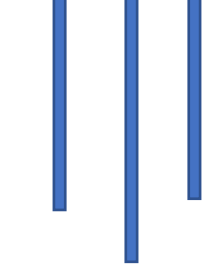
Government of Nepal

Ministry of Health and Population

National Health Care Waste Management

Standards and Operating Procedures

2020



Government of Nepal

Ministry of Health and Population

Department of Health Services

LIST OF ABBREVIATIONS

AD	:	Anaerobic digestion
AIDS	:	Acquired Immune Deficiency Syndrome
BAT	:	Best Available Technology
BEP	:	Best Environmental Practice
CSH	:	Civil Service Hospital
CTF	:	Central Treatment Facility
DDT	:	Dichlorodiphenyltrichloroethane
DoHS	:	Department of Health Services
DHO	:	District Health Office
DPHO	:	District Public Health Office
EDCD	:	Epidemiology and Disease Control Division
EIA	:	Environmental Impact Assessment
ESM	:	Environmentally Sound Management
GEF	:	Global Environment Facility
GTEQ	:	Gram Toxic Equivalent
HBV	:	Hepatitis B Virus
HCB	:	Hexachlorobenzene
HCF	:	Health Care Facility
HCV	:	Hepatitis C Virus
HCW	:	Health Care Waste
HCWM	:	Health Care Waste Management
HCWMC	:	Health Care Waste Management Committee
HCRW	:	Health Care Risk Waste
HIV	:	Human Immunodeficiency Virus
IEC	:	Information, Education and Communication
IEE	:	Initial Environment Examination
IWW	:	Informal Waste Workers
MD	:	Management Division
MoFE	:	Ministry of Forestry and Environment
MoHP	:	Ministry of Health and Population
MoEST	:	Ministry of Education, Science and Technology

MoUD	:	Ministry of Urban Development
NHTC	:	National Health Training Center
NCASC	:	National Center for AIDS and STD Control
NHRC	:	Nepal Health Research Council
NSI	:	Needle Stick Injury
PCBs	:	Polychlorinated Biphenyls
PEP	:	Post Exposure Prophylaxis
PHCORC	:	Primary Health Care Outreach Clinic
PPE		Personal Protective Equipment
PPP	:	Public Private Partnership
PTMI	:	Provisional Tolerable Monthly Intake
POPs	:	Persistent Organic Pollutants
PVC	:	Polyvinyl Chloride
SBC	:	Secretariat of Basel Convention
SDG	:	Sustainable Development Goal
SGNHC	:	Sahid Gangalal National Heart Centre
SOP	:	Standard Operating Procedure
SPHA	:	Senior Public Health Administrator
SWM	:	Solid Waste Management
SWMTSC	:	Solid Waste Management Technical Support Centre
TB	:	Tuberculosis
UNDP	:	United Nations Development Programme
UNEP	:	United Nations Environment Programme
WB	:	World Bank
WEEE	:	Waste electrical and electronic equipment
WHO	:	World Health Organization

DEFINITIONS/GLOSSARY

Anaerobic/ Bio digestion: process in which biodegradable organic matter is further broken down into biogas and biofertilizer in a closed environment in absence of oxygen.

Central Treatment Facilities (CTFs): a facility where healthcare waste, generated from several healthcare units, is collected and jointly treated to reduce adverse effects of hazardous waste.

Circular Economy: An economic system based on a sustainable approach through the continual use of resources. Making, using, and disposing of products in such a way that end-of-life products can be reused, recycled, or reinvented into new useful products.

Disinfection: A process to reduce the number of viable microorganisms to a less harmful level. This process may not inactivate bacterial spores, prions and some viruses

Extended Producer Responsibility: approach in which responsibility for the product is extended to the post-consumption stage, therefore shifting responsibility from the consumer and municipalities to the producer and motivation the producer to account for the environmental costs associated with the product.

Green-House Gases (GHGs): a gas in the planet's atmosphere that absorbs and emit the infrared spectrum of radiant energy, causing the greenhouse effect.

Hazard: Intrinsic potential property or ability of any agent, equipment, material or process to cause harm.

Infection prevention and control: The scientific approaches and practical solutions designed to prevent harm caused by infection to patients and health workers associated with the delivery of health services.

Injection safety: A set of measures taken to perform injections in an optimally safe manner for patients, healthcare personnel, and others.

Nosocomial infection: newly acquired infection, previously not present or incubating in the patient, contracted within a health care facility while the patient was undergoing treatment for another condition.

Personal Protective Equipment: Barriers and filters between the worker and the hazard. Examples eye goggles, gloves, masks and gowns.

Persistent organic pollutants (POPs): Chemicals of global concern characterized by their potential for long-range transport, persistence in the environment, ability to bio-magnify and bio-accumulate in ecosystems, as well as their significant negative effects on human health and the environment.

Polyvinyl Chloride (PVC): Synthetic plastic polymer which is widely used in medical devices- can be harmful (through leachate and gases when burning) to patients, the environment and public health.

Quality of care: Quality of care is the "extent to which health care services provided to individuals and patient populations improve desired health outcomes.

Recycling: Converting waste into reusable materials or returning materials to an earlier stage in a cyclic process.

Segregation: The systematic separation of waste into designated categories

Sharps: Medical equipment/devices or clinical laboratory articles that may cause punctures or cuts.

Zero waste: Set of principles focused on conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health.

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1. BACKGROUND

The Constitution of Nepal states that every citizen has the right to a clean environment (part 3, article 30) and right to free basic health services from the state as well as equal access to health services (part 3, article 35) (NLC 2015). The government of Nepal has focused its efforts in providing good quality of health services to all the people in the country. However, Nepal government is facing different types of challenges associated with communicable and non-communicable disease. One of the major problems is proper management of health care waste (HCW). Poor Health Care Waste Management (HCWM) leads to environmental pollution and carries the risk of infections. Health care waste not only affect the waste generators but also the waste handlers and the general public. One direct effect of poor HCWM is the alarming incidence of nosocomial infections.

As defined by WHO, health-care waste is the by-product of health care that includes sharps, non-sharp blood contaminated items, blood, body parts and tissues, chemicals, pharmaceuticals and radioactive materials (WHO 2019). In addition, it includes the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperative care). Between 75% and 90% of the waste produced by health-care providers is comparable to domestic waste and usually called "non-hazardous" or "general health-care waste". It comes mostly from the administrative, kitchen and housekeeping functions at health-care facilities and may also include packaging waste and waste generated during maintenance of health-care buildings. The remaining 10–25% of health-care waste is regarded as "hazardous" and may pose a variety of environmental and health risks (WHO 2017). Hazardous health-care waste can be categorized as "Infectious waste", "Sharp waste", "Pathological waste", "Pharmaceutical waste", "Cytotoxic waste", "Chemical waste" and "Radioactive waste". Non-hazardous general waste is waste that does not pose any biological, chemical, radioactive or physical hazard (WHO 2014)

According to new global data (WHO/UNICEF 2019) there is no or very limited safe management of health care waste in a large proportion of facilities. The data, representing over 560,000 facilities from 125 countries, indicate that 40% of health care facilities do not segregate waste. In least developed countries, the situation is far worse with only 27% of countries having basic (segregation and safe waste destruction) services.

To select an appropriate technology for HCWM, it is essential to know the predicted quantity of waste that will be generated in a facility. Kilograms per occupied bed per day and kg per outpatient per day are used to compare health care facilities with different levels of activities. If inpatient occupancy rates and the daily number of outpatients are not available, the total number of beds is often used to estimate kg of waste per bed per day. The rate of waste generated in different level of hospitals varies significantly, depending upon the service provided, however WHO has estimated 2-4 kg per bed per day total waste with weight volume ratio of 100-200 kg per cum.

The health care waste generation of Nepal is in a range of 0.99 to 1.73 kg per bed per day, out of this hazardous waste is 0.33 to 0.59 kg per patient per day (MoH 2003, CSH 2011, DoHS 2015, WHO 2016). Considering the sharp waste management and the occurrence of needle stick injuries among health care workers and informal waste workers, a study conducted in Western region of

Nepal reveals that 70% of clinical staff and 63% of non-clinical staff reported of incidents of needle stick injury (NSI) or other sharps injury at some time (DoHS 2013, Paudel, Pun and Gurung 2010).

A study conducted by Médecins du Monde France ((MdM 2018)) on 1278 informal waste workers (IWW) of Kathmandu Valley and Nuwakot districts showed that 38% reported handling medical waste and 66% had been injured at work in the past 12 months. The most common injury were cuts, exposing the IWWs to further risks. Furthermore, most of the IWWs did not know about their infectious disease status (HIV, hepatitis B and C) and 68% admitted to not using any form of personal protective equipment (PPE), exposing the IWWs to greater risks.

Ministry of Health and Population (MoHP) aims to improve the health care waste management system, as stated in Nepal health sector strategy Implementation Plan 2016-2021. Outcome 2 "Improved Quality of care at point of delivery", states improved infection prevention and health care waste management as one of its outputs. The proposed key intervention activities to achieve these outputs are the review and revision of the infection prevention and health care waste management as well as the promotion of public private partnerships (PPPs) models for waste management.

Improper management of HCW in the HCFs is mainly responsible for generating high volume of hazardous wastes. Thus, proper minimization, segregation, storage, transportation, treatment and disposal of hazardous wastes will greatly reduce the risks to public health. The mismanagement of HCW especially burning contributes to air pollution and eventually to global warming through emission of different greenhouse gases. Early recovery of the patient and health of clinical staff directly depends on infection prevention practices used in HCFs. Health care waste management is considered as one of the essential components of good infection prevention practices. Fifteenth five-year plan 2019/20 to 2023/24 has an action plan for provincial and local governments to take responsibility for the management of hospital and other health institution and laboratory waste and pharmaceutical waste.

Based on Public Health Service Act 2075 (2018), Public Health Service Regulation 2077 (2020), Solid Waste Management Act 2068 (2011) with edited version in 2074 Kartik and National Health Policy 2076 (2019), Health Care Waste Management Guideline 2014 has been updated and revised to this form as HCWM Standards and Operating Procedures. This document is further divided into two parts, standards and operating procedures for a safe and efficient HCWM system for HCFs in Nepal. HCFs have the prime responsibility of ensuring that there are no adverse health and environmental consequences during handling, storage, treatment and disposal of HCWs.

1.1. OBJECTIVES OF THIS DOCUMENT

HCFs will be able to implement appropriate waste management systems and approaches that can provide benefits such as:

- Protection of public health by reducing the exposure of employees, patients, visitors and the entire community to hazardous HCWs in the work environment
- Environment protection through waste minimization and promotion of environment friendly technology for safe disposal of HCW
- Facilitate the implementation of a proper health care waste management system by providing guidelines for federal, provincial and local government as well as user friendly manuals for the health care facilities

- Facilitate compliance with applicable legal requirements (e.g. Minimum Service Standard of HCFs, standard for WASH in HCFs and standard for health institution establishment, operation and upgrade etc.)
- Reduce possible risks through better waste handling; improving infection prevention practices within the health care facility and other health facilities outlets like laboratories.
- Facilitate health facilities to select best environmentally friendly treatment and disposal option based on available technologies in the country's context.

1.2. SCOPE OF THE STANDARDS AND OPERATING PROCEDURES

The scope of this standard and operating procedure document is to support federal, provincial and local government as well as all levels of health care facilities for the implementation of a safe health care waste management system, based on the best available technologies and best environmental practice in the country context. This document is developed with the vision for obligatory compliance by the provincial and local level. The target audience of the guideline are national authorities (federal to local) involved with health care waste management, health care practitioners at all levels (including laboratories), waste management service providers; public health professionals, private sector, veterinary, I/NGO, CBO, outreach clinic, pharmacies, Medical/ health camp and other relevant stakeholders and individuals involved in health care waste management.

2. DEFINITIONS, SOURCE AND CATEGORIZATION OF HEALTH CARE WASTE

HCW embraces all waste generated during all medical activities. Medical activities include activities such as diagnosis, preventive, curative and palliative treatments, research pertaining to the above activities and production or testing of biologicals. This also includes the waste generated during required administrative and other activities.

Sources of HCW are:

- Hospitals
- Primary health care centres, health posts, sub-health posts, Expanded Programme on Immunization (EPI) clinics, primary health care outreach clinics (PHC ORC)
- Clinics (medical, primary health care, alternative medicines, dental, maternity homes, dialysis centres, physician offices)
- Laboratories and research centres (medical and biomedical laboratories, medical research centres and institutions, blood banks and blood collection centres, biotechnology laboratories, pathological laboratories, microbiological laboratories)
- Pharmacies and medical stores
- Institutions (medical, nursing home, dental, nursing, paramedics, drug rehabilitation centres, drop-in centre)
- Mortuary and autopsy centres
- Veterinary hospitals and clinics
- Ambulance and emergency care
- Home based care

Solid Waste Management Act 2068 (2011) with edited version in 2074 Kartik, defines health care waste as 'waste generated from hospitals, clinics, pharmacies, blood banks, pathology laboratories, veterinary institutions or health research centres which can be hazardous to human health and

environment'. Based on the various physical and chemical properties and hazards associated with the waste, HCW are broadly categorized into general healthcare waste and hazardous healthcare waste.

2.1 GENERAL WASTE

General HCW, also known as non-hazardous HCW. This waste does not pose any biological, chemical, radioactive or physical hazard and is comparable to domestic waste. It is usually generated from the administrative and house-keeping services of HCFs. Examples of such wastes include general office waste, garden or yard waste, packaging and food waste. These wastes can be composted to make manure, recycled or be managed by the municipal waste services. Researches have shown that general HCW constitutes about 75% to 90% of the total amount of HCW generated by HCFs ((WHO 2014)). General HCWs are classified into the following categories:

2.1.1 Biodegradable

This category of waste consists of the waste that can be composted. Examples are left over food scraps or garden waste.

2.1.2 Non-biodegradable

This category of general waste includes all the health care waste, that does not decompose, but of which a rather large volume can be recycled, and remaining waste can be disposed in a sanitary landfill. There are various sub-categories for other general, recyclable, waste. Examples of common sub-categories are bottles and cans, paper, different plastics and glass.

2.2 HAZARDOUS WASTE

Hazardous waste poses a risk or hazard to human health and/or to the environment. This category of HCW constitutes the waste which needs special attention for handling and management. Researches have shown that hazardous HCWs constitute about 10% to 25% of the total amount of HCWs generated by HCFs. Hazardous wastes are further classified as follows:

2.2.1 Infectious Waste

Infectious wastes are any wastes which suspected to contain pathogens and that poses a risk of disease transmission. This category includes waste contaminated with blood and other body fluids, laboratory cultures and microbiological stocks and waste including excreta and other materials that have been in contact with patients infected with highly infectious diseases (e.g Isolation ward of, Ebola, COVID-19).; or waste from any infected patients in isolation wards

2.2.2 Sharp Waste

Sharps are all objects and materials capable of cutting or penetrating the skin. These wastes pose a potential risk of injury and infection due to their puncturing or cutting properties. For this reason, used or unused sharp wastes (e.g. hypodermic, intravenous or other needles; auto-disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass) whether or not they are infected, such items are usually considered highly hazardous health-care waste and should be treated as if they were potentially infected. . Used sharp waste may be contaminated with blood, body fluid, microbiological materials and toxic or cytotoxic substances and must be managed with utmost care. Sharp waste may be further categorized into glass sharps and metal sharps.

2.2.3 Pathological Waste

Pathological waste consists of human body parts, organs and tissues. Examples of such wastes are tissue waste, removed organs, amputated body parts, placentas, blood, body fluids, human foetus, animal and carcasses obtained through medical procedures.

2.2.4 Pharmaceutical waste

Pharmaceutical waste ranges from normal oxidants to highly specific medicines and includes expired, unused, spilt and contaminated pharmaceutical products, prescribed and proprietary drugs, vaccines and sera that are no longer required, and, due to their chemical or biological nature, need to be disposed of carefully. The category also includes discarded items heavily contaminated during the handling of pharmaceuticals, such as bottles, vials and boxes containing pharmaceutical residues, gloves, masks and connecting tubing

2.2.5 Geno-toxic Cytotoxic waste

Technically, genotoxic means toxic to the deoxyribonucleic acid (DNA); cytotoxic means toxic to the cell; cytostatic means suppressing the growth and multiplication of the cell; antineoplastic means inhibiting the development of abnormal tissue growth; and chemotherapeutic means the use of chemicals for treatment, including cancer therapy. Cytotoxic (chemotherapeutic or antineoplastic) drugs, the principal substances in this category, have the ability to kill or stop the growth of certain living cells and are used in chemotherapy of cancer. They play an important role in the therapy of various neoplastic conditions but are also finding wider application as immunosuppressive agents in organ transplantation and in treating various diseases with an immunological basis. Cytotoxic drugs are most often used in specialized departments, such as oncology and radiotherapy units, whose main role is cancer treatment. Their use in other hospital departments and outside the hospital in clinics and elsewhere is also increasing.

2.2.6 Chemical waste

Chemical waste consists of discarded solid, liquid and gaseous chemicals; for example, from diagnostic and experimental work and from cleaning and disinfecting procedures. Chemical waste from health care is considered to be hazardous if it has at least one of the properties like toxic (harmful), corrosive (e.g. acids of pH <2 and bases of pH >12), flammable , reactive (explosive, water reactive, shock sensitive) or oxidizing. Non-hazardous chemical waste consists of chemicals with none of the above properties; for example, sugars, amino acids and certain organic and inorganic salts, which are widely used in transfusion liquids

2.2.7 Radioactive waste

Radioactive waste in HCFs include materials contaminated with radionuclides, which arise from the medical or research use of radionuclides. Examples includes: radioactive substances (such as unused liquids from radiotherapy or laboratory research), glassware, packages, or absorbent paper contaminated with radioactive substance, urine and excreta from patients treated or tested with radionuclides and sealed sources (containers in which radioactive substances are stored and sealed).

2.2.8 E-waste

In addition to the outlined categories, safe management of electronic waste has been a great challenge in health facilities of Nepal. Electronic waste ranges from small testing devices to larger equipment for various purposes. This equipment contains a multitude of components, some containing toxic substance, which can have adverse impact on human health and environment if not handled

properly. Due to improper recycling and disposal practices often these substances are released. With the increasing use of advanced technologies for medical services, generation of waste electrical and electronic equipment (WEEE) is increasing along with its challenges for proper disposal. Some of the common examples in medical devices are radiotherapy equipment, cardiology, dialysis and pulmonary ventilators, laboratory equipment for in-vitro diagnosis, analysers, freezers, etc.

3. ENVIRONMENTAL AND HEALTH IMPACTS

In Nepal, the health care sector and the provided services are expanding at a rapid rate and this has resulted in the generation of large quantities of HCW. HCWs are either being dumped haphazardly or send to landfill site along with domestic waste without pre-treatment. In many cases HCWs are burned in metal drums or just openly. This results in the emissions of by-products and toxic substances into the environment. Improper disposal of HCW pollutes the environment. This happens either directly through the contamination of soil and water sources, or indirectly by releasing toxic gases like dioxin, furan etc. along with residue of some toxic heavy metals like lead, mercury and cadmium as ash. . All individuals exposed to health care waste; especially people handling infectious and sharp waste are potentially at risk of being injured or infected.

3.1 ENVIRONMENTAL AND PUBLIC HEALTH IMPACT

Besides patients and health care personnel, consideration must be given to the impact of HCW to the environment and thus to the general public. Care must also be paid to the pollution of air, water and soil as well as the aesthetic beauty. The dumping of HCW in uncontrolled areas can have a direct environmental effect by contaminating the surroundings including the water sources.

Obsolete pesticides (especially Dichlorodiphenyltrichloroethane (DDT) used for the control of vectors in HCF), stored in leaking drums or torn bags, can directly or indirectly affect the health of anyone who encounters them. Poisoning can occur through direct contact with the product, inhalation of vapours, drinking of contaminated water, or consumption of contaminated food. Other hazards may include the possibility of fire as a result of inefficient disposal such as burning. Pharmaceutical residues, which may include antibiotics and other drugs, heavy metals such as mercury, phenols and derivatives, and disinfectants and antiseptics may have toxic effects on the natural ecosystems.

Mercury has been used over centuries in HCFs. When mercury is released to the environment, e.g. by broken thermometers, sphygmomanometer, due to accidental spills or emissions from the incineration of HCW, an increased risk of various hazards due to acute and chronic exposures are the result. The most common potential mode of occupational exposure to mercury is via inhalation of metallic liquid mercury vapours. Mercury, due to its potent neurotoxic nature, can affect brain, spinal cord, kidneys and the development of children.

3.2 OCCUPATIONAL HEALTH IMPACT

All individuals, who are exposed to hazardous HCWs are potentially at risk of being injured or infected. They include:

- Medical staff such as doctors, pharmacists, laboratory technologists, nurses, paramedics, sanitary staff and hospital maintenance personnel

- In and outpatients receiving treatment in HCFs, as well as their visitors
- Workers in support services linked to HCFs such as laundry, waste handling and transportation services
- Workers in waste disposal facilities, including scavengers
- The general public, mostly the children playing with the items they can find in the waste outside the HCFs, when it is directly accessible to them.

During the handling of waste (especially infectious and sharps), the medical and auxiliary staff as well as the sanitary staffs, can be infected and injured if the waste has not been packed safely. Many injuries occur because needles or other sharps have not been collected in safety boxes or because these have been over filled. The unsafe disposal of HCW (e.g. contaminated syringes and needles) poses health risks to medical personnel or the public.

Contaminated needles and syringes create a big threat if there is a failure to dispose them safely. WHO estimates that over 20 million infections of hepatitis B, C and HIV occur yearly due to unsafe injection practices (i.e. the reuse of syringes and needles in the absence of sterilization) and are thus transmitted via HCW ((Prüss-Üstün 1999).

Infectious waste may contain a variety of pathogenic microorganisms. Pathogens in infectious waste may enter the human body through a puncture, an abrasion or a cut in the skin; through mucous membranes; inhalation or ingestion and can have major adverse effects to the community.

3.3 AIR POLLUTION AND CLIMATE CHANGE

In the last few years, there has been growing controversy over the incineration of HCWs. Under some circumstances, including when wastes are incinerated at low temperatures than recommended (200-400 degree Celsius) or when plastics that contain polyvinyl chloride (some plastics, blood bags and fluid bags) are incinerated, dioxins, furans and other toxic air pollutants may be produced as emissions, either in bottom ash or in fly ash. Dioxins, furans and co-planar polychlorinated biphenyls (PCBs) are persistent organic substances that do not readily break down in the environment and bio-accumulate in the food chain. Most human exposure to dioxins, furans and co-planar PCBs is through the intake of food. Long-term, low-level exposure of humans to dioxins and furans may lead to the impairment of the immune system, nervous system, endocrine system and reproductive functions. Short-term, high-level exposure may result in skin lesions and altered liver function. The standards set are 0.1 nano gram per Toxic Equivalent per normal cubic meter (ne/TEO/Nm3) (Prüss-Üstün 1999).

Thus, dioxins, furan and mercury emissions from HCFs are major environmental and health challenges. Steps need to be taken to reduce these emissions through waste minimization, and use of environmentally friendly technologies.

4. LEGAL FRAMEWORK, COMMITMENTS AND PRINCIPLES

There are several international and national agreements and guidelines concerning the management of waste. A selection of the most relevant policies, legal Provisions and commitments are summarized in the following.

4.1 INTERNATIONAL AGREEMENTS AND UNDERLYING LEGISLATIVE AND REGULATORY PRINCIPLES

International agreements have been reached on a number of underlying principles, which govern either public health or safe management of hazardous waste. Nepal is signatory on several international conventions. The conventions and guiding principles outlined here should be taken into consideration while making plans for an appropriate HCWM system in Nepal.

4.1.1 Sustainable Development Goals

Sustainable development goals are the goals for implementation aiming at sustainability of the resources by achieving 17 goals. These goals are interconnected with each other and are aimed to be achieved by 2030. Safe health care waste management practices also support a number of sustainable development goals including

SDG 3 Good health and wellbeing: In pursuant with Goal 3 of ensuring healthy lives and promoting well-being for all at all ages and meet the target of reducing deaths and illness from hazardous chemicals, air and water.

SDG 6 Clean water and sanitation: In pursuant to Goal 6 of ensuring availability and sustainable management of water and sanitation for all, the proper management of HCW can help avoid release of toxicants and meet the target of improving ambient water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials.

SDG 7 Affordable and clean energy: In pursuant of Goal 7 ensuring use of appropriate technologies for treatment of health care waste shall aid in assortment of affordable, reliable and sustainable modern energy

SDG 12 Responsible consumption and production: In pursuant of Goal 12 to ensure sustainable consumption and production patterns, environment friendly management of health care waste can further help to promote waste prevention, reduction, recycling and reuse.

SDG 13Climate Action: In pursuant of Goal 13 to take urgent action to combat climate change and its impacts, sustainable healthcare waste management practices can further contribute in minimizing greenhouse gas emission and reducing adverse effects of climate change.

4.1.2 WHA Resolution on water, sanitation and hygiene in health care facilities 2019

Member of world health assembly in 2019 have approved a resolution to work toward universal access to WASH, including safe health care waste management in health care facilities.
This resolution states all member countries to conduct national assessment and analysis, develop roadmaps and set target and implement standards as a part of global effort to improve WASH in health care facilities and safe management of health care waste.

Specifically, efforts are focused on meeting the following targets:

• *Basic services:* By 2022, 60% of all health care facilities globally and in each SDG region will have at least basic WASH services. 80% have basic WASH services by 2025, and 100% by 2030.

• *Higher service levels:* By 2022, higher levels of service are defined and monitored in countries where universal basic WASH services have been achieved already. By 2030, higher levels of WASH services are achieved universally in 80% of those countries.

In addition, efforts to improve waste management and reduce the environmental impact of such practices are being addressed through climate smart and green health care facility initiatives, vaccine waste reduction efforts and patient safety campaigns. (WHO/UNICEF 2019)

4.1.3 Minamata Convention (2013)

The Minamata Convention on Mercury is a global treaty aimed to protect human health and environment from the adverse effects of exposure to mercury. It was adopted on 10th October 2013 in Japan. The convention entered into force on 16th August 2017 with 128 signatories. Mercury is widely used in health care setting especially in medical equipment such as thermometers and sphygmomanometer. According to high level decision of honourable deputy prime minister and minister for health and population, dated 2076/05/04 (21st August 2019), equipment having mercury and dental alugum are prohibited for pregnant and breast-feeding women.

In case of other ages groups, ban in use of mercury dental alugam within 5 years. The school university or academy of dental medicine should revise their curriculum accordingly and use of mercury dental alugum in practical exercises are prohibited.

4.1.4 UN Human Rights Council (2011)

In 2011, the UN Human Rights Council found that improper waste management threatens human rights, including the rights of citizen to a clean environment, the right to a safe working environment and the right to life and health.

4.1.5 The Strategic Approach to international Chemical Management (SAICM) (2006)

SAICM, an international agreement aims to achieve the sound management of chemicals throughout their lifecycle, no matter where it was generated, by 2020. Nepal agreed to SAICM in 2006, with the implementation falling under the former Ministry of Environment, Science and Technology. SAICM ensure that the chemicals are used and produced in ways that minimize significant adverse effect on human health and the environment. It emphasizes the science-based risk assessment of the chemicals in practice and assess the availability of safer substitutes and their efficacy.

4.1.6 The Dhaka Declaration on Waste Management (2004):

Under this declaration, Nepal has pledged for the closure of open-dumping site and for the safe treatment of health care waste, giving priority to non-burn technology.

4.1.7 The Stockholm convention on persistent organic pollutants (2001)

This Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are toxic chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of living organisms. POPs circulate globally and can cause damage wherever they travel. The Stockholm Convention recommends prioritizing alternatives to incineration, which do not produce dioxins and furans. Where incineration cannot be avoided, best available technologies comprising air pollution control devices capable of reducing emissions of dioxins and furans to less than 0.1ng/m3 should be deployed (SSC 2008).

Nepal has signed the Stockholm Convention in 2007 (GoN 2017)and the updated National Implementation Plan (NIP) for the Stockholm Convention in Nepal banned the open burning of waste in municipal areas; it aims to ban the open burning of waste not only in municipalities but throughout all areas of the country (GoN 2017).

4.1.8 Rio Declaration on Environment and Development, 1992

The principles of the Rio Declaration define the right of people to development, and their responsibilities to safeguard the common environment. The Declaration states that the only way to have long term economic progress is by linking it to environmental protection. Principle 16 of the Rio Declaration states that national authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

4.1.9 Basel convention 1989

The Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal was adopted in 1989 and entered into force in 1992. The central goal of the Basel Convention is "environmentally sound management" (ESM), the aim of which is to protect human health and the environment by minimizing hazardous waste production whenever possible. ESM means addressing the issue through an "integrated life-cycle approach", which involves strong controls from the generation of a hazardous waste to its storage, transport, treatment, reuse,

4.1.10 Declaration of the United Nations Conference on the Human Environment (1972)

Principle 6 of the Declaration addresses the discharge of toxic substances and other substances in quantities or concentration that exceeds the capacity of the environment to render them harmless. It states that such discharges and releases need to be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems.

4.1.11 Tort law and principles

Tort law is based on the idea that a party that was harmed as the result of a wrongdoing by another party is entitled to compensation for the harm caused. This wrongdoing covers both intentional as well as unintentional wrongdoing (e.g. by negligence). Applied to the context of health care waste management the following principles can be applied.

Duty of care principle: any organization that generates waste has a duty to dispose the waste safely. Therefore, it is the HCF that has ultimate responsibility for how waste is containerized, handled on-site and off-site and ultimately treated and disposed of.

Precautionary principle: when the magnitude of a particular risk is uncertain, it should be assumed that this risk is significant, and the measures to protect health and safety should be designed accordingly. It must therefore always be assumed that waste is hazardous until it is proved to be safe. This is a key principle governing health and safety protection.

Proximity principle: treatment and disposal of hazardous waste should be conducted at the closest possible location to the source to minimize the risks and financial cost involved in its transport. Similarly, any community should recycle or dispose of the waste it produces inside its own territorial limits.

Polluter pays principle (PPP): all waste producers are legally and financially responsible for the safe handling and environmentally sound disposal of the waste they produce. In case of accidental pollution, the organization is liable for the costs of cleaning it. Therefore, if pollution results from poor management of HCW then the HCF is responsible. However, if the pollution is due to poor standards at the treatment facility then the HCF jointly with the treatment facility is likely to be held accountable for the pollution. Likewise, this could happen with the service provider. The fact that

the polluters should pay for the costs they impose on the environment is seen as an efficient incentive to produce less and segregate well.

4.2 NATIONAL ACTS, RULES AND REGULATIONS

Nepal has endorsed policies, acts, rules and regulations related to HCWM, that hold health care facilities accountable to their responsibilities regarding the management of health care waste. The relevant documents are outlined in the following.

4.2.1 National Health Policy 2076 (2019)

The policy that aims to undertake research, monitoring, controlling, and eliminating communicable diseases, vows to establish a National Disease Control Centre. The policy plans to initiate integrated efforts by bringing all levels together to control infectious diseases and undertake crisis management in the event of a health emergency. The policy states integrated preparedness and response measures shall be adopted to combat communicable diseases, insect-borne and animal-borne diseases, problems related to climate change, other diseases, epidemic, and disasters. Likewise, it further focuses on the following strategies:

- Environment and health-friendly technologies shall be encouraged; state and local levels shall be made responsible for proper management, regulation, and continuous monitoring of waste and medical garbage produced by hospitals, health institutions, and laboratories.
- Coordination and advocacy shall be done to promote domestic and community waste management and environmental cleanliness.

4.2.2 The environmental protection act 2076(2019) and environmental protection regulation 2077 (2020)

Nepal new Environmental Protection Act 2019 prohibits carrying out of any project proposal without getting the environmental studies approved the concerned. All project proposals will have to conduct environmental studies, but the capacity, output or investment of the proposed project determine whether a project requires Environment Impact Assessment (EIA), Initial Environment Examination (IEE), or Concise Environmental Studies (CEA). As part of the efforts to promote stakeholder engagement and information disclosure, the new act makes it mandatory to undertake public hearings at the project site. Moreover, it has a provision to establish an Environmental Protection Fund. The act also allows the government to declare a specific area where harmful materials or waste is stored or disposed of as a 'polluted' area and restrict it to the general public. The Environment Protection regulation, 2020 asks to prepare an IEE for construction of a new hospital of 25-100 beds with teaching facilities and an IEA for a new hospital construction of over 100 beds with teaching facilities.

4.2.3 Fifteenth Periodic Plan 2019/20 to 2023/24

Fifteen periodic r plan has carried the vision of clean, health and greenery environment. This can be achieved by setting goal of pollution control, waste management and plantation of tree to ensure the right to clean and healthy environment. Management of all kind of waste generating from health facility including household, industry has remained under the prime objective of this plan.

4.2.4 Minimum Service Standards for different level of HCF in Nepal 2076 (2019)

In 2076/2019, the Nepali government created five documents outlining the minimum service standards for different levels of healthcare facilities, specifically primary hospitals with general services, primary hospitals with specialized services, secondary hospitals, tertiary hospitals, and health posts. These standards cover a range of issues for health care facilities; "hospital waste management" is clearly addressed in the section "Hospital Support Services," with a checklist for evaluating a hospital's waste management system, including a scoring system for the segregation, collection and transportation, treatment and disposal of waste for the different levels of healthcare facilities.

4.2.5 Public Health Service Act 2075(2018)

Public Health Act 2018 addresses the issues of health care waste management in section 41:

For the minimization of the potential health hazards in humans due to environment pollution and waste management, Nepal government can make required standards according to the relevant federal legislations. Nepal government will develop essential standards for the effective collection, reuse, treatment, disposal and enforcement of the health care waste. Provincial and Local government are responsible to follow the above sub section 1 and 2. Every health care facility is responsible for proper segregation of waste into risk and non-risk and proper disposal of the health care waste generated.

4.2.5.1 Public Health Service Regulation 2077 (2020)

Government of Nepal has endorsed the Public Health Service Rules 2077 (2020) using the legislative authority provisioned by article 63 of Public Health Service Act 2075 (2018). Section 3 of the rules has provision of different level of health facilities (annex 7) including types and standards of the services. According to the Rule 11, Ministry is responsible to set the standards for different operational services as listed in annex 8, that includes, environment, infection and prevention control, health care waste management and water and sanitation in the health facility. Rule 12 says, every health facility needs to be complied the standers for its new license and to renew too. Monitoring and evaluation will be done by public-health inspector, and if the standards are not met, the inspector will either make the health facility to comply the standards or recommend for the associated authority for actions. Similarly Rule 13 Sub rule -3 Renewal of licence to operate Health facility only after complying standards mentioned in annex-8 and Rule number 25: Water Supply , Sanitation and Wate Management, all health facilities have to comply the standards of water supply, sanitation and waste management as mentioned in annex-8: Health Facility Operation Standards – 11.) Healthcare and other waste management standards.

4.2.6 The labour act 2073 (2017)

The Labour Act 2017, administered by the Ministry of Labour is the main regulation governing the working environment by making provision for the rights, interests, safety and insurance of workers and employees working in various enterprises. Section 80 is related to the management of infectious disease transmission in working environment and section 68 states the need of Health and safety regulation and working unit within the working place

4.2.7 Local Government Operation Act (2074 (2016)

The local government operation Act 2074 has clearly defined the roles and responsibilities of all level of government in terms of health care waste management from local level to federal level.

As specified in section 41 the federal government will be responsible to formulate essential rules and regulations to prevent the potential health impacts on public health and environment through environmental pollution and waste management.

Similarly, with regards to local level following responsibilities have been listed:

- Every municipality should have an operational landfill site for the management of the waste generated in the municipality.
- Every rural and urban municipality is responsible for development of operational rules and regulation for providing basic health, sanitation and nutrition in local level.
- Responsible for supply and monitoring of clean water, air and noise pollution level.
- Increasing awareness on sanitation and proper management of health care waste
- Responsible for collection, reuse, treatment and final disposal of health care waste and setting fees for the management.

4.2.8 The industrial enterprises act 2073 (2016)

The industrial enterprises act 2016 highlights the need to conduct Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) before establishment. This Act also states that the responsibility of the safe management of the waste lays with the entity that generates the waste. Furthermore, the act has empowered the concerned authority to punish those who do not comply with the conditions outlined in the license or registration section. The act gives priority and the provision of some benefits to those that use pollution control devices, or enterprises which process the waste into resources (i.e. recycling, upcycling).

4.2.9 Guideline for health institutions establishment, operation and upgrade standard 2071(2014)

This guideline contains the code of conducts required for the operation of health institutions. This guideline deals with the infrastructure and standards required for the operation of health institutions like emergency services, outpatient department and in-patient services, pharmacy, emergency preparedness, waste disposal and management and all other prerequisites.

4.2.10 Solid waste management Act 2068(2011) with edited version of 2074 Kartik (2017)

Solid Waste Management Act 2068 (2011) with edited version of 2074 Kartik, provides legal basis and regulation for HCWM. Chapter 2 section **3** sub-section 1, 2 and 3 states the responsibility of the management of the solid waste will be lies to local government. Whereas chapter 2 section **4** sub-section 1, 2 and 3 states the accountability of the management of the solid waste will be lies to local government. as given below:

1. The accountability to manage or cause to manage solid waste shall rest with the local government.

2. Notwithstanding anything contained in sub-section 1, the responsibility for processing and management of hazardous waste, medical waste, chemical waste or industrial waste under the prescribed standards shall rest with the person or institution that has generated the solid waste.

3. If any industry or medical institution requests for the management of solid waste remained after processing of hazardous waste, medical waste, chemical waste and industrial waste or other solid waste, or for using a sanitary landfill site constructed by the local

government, the local government may manage the solid waste or allow the institution to use the sanitary landfill site by levying fees as determined by the local government.

Similarly in sub-section 5, 6,7,8 ,9 and 10 mentioned about reduction in the production of waste, waste segregation at source, extraction of waste (time, place and methodology), designated waste collection centre, transportation of waste and Reduction, Reuse and Recycle (3R) of waste respectively.

Involvement of private sector and community in waste management is also provisioned in chapter-4 which is a vital step in promotion of public private partnership.

In the chapter-9 section 38 and 39, it is clearly stated about offence and punishment. According to section 39, sub-section 8: A fine from **50,000 to 100,000 rupees** will be charged by local government on anyone who commits offence as mentioned below:

a. If throwing, keeping, discharging or causing to discharge chemical waste, industrial waste, healthcare waste or hazardous waste haphazardly;

b. If throwing, keeping, discharging or causing to discharge hazardous waste produced by any industrial enterprise or health institution haphazardly;

c. If not committing the responsibility while importing chemical pesticide or disposing the expired drugs according to the defined standards as mentioned in section - 44

And if the same offence is committed again, it may also punish with a double fine as was imposed earlier and recommend to the concerned authority for cancellation of the license.

Similarly, if the waste is not segregated at source and mixed or thrown in against section 6, local government will punish the person or institution Rs 500 in each time.

In Chpter-10 section 43, healthcare waste management is mentioned explicitly. In sub-section 1, it is provision that the before providing permission to establish and operate health institution, concerned authorized body should assured that there is proper management of healthcare waste in place or not and give permission only in case of proper healthcare waste management in place. It is also mentioned in Subsection 2, that the conditions and standards for proper healthcare waste management can be fixed for health institutions while providing such kind of permission.

4.2.11 Drugs Act 2035(1978):

Pursuant to Section 12, this Act mandates the return of drugs that are not safe for public consumption (including by virtue of expiration date), that are not efficacious, or that do not meet quality standards. It is the manufacturer or an agent of the manufacturer that must take back such pharmaceuticals from the seller or distributor. (DDA 1978)

5. HEALTH CARE WASTE MANAGEMENT PLANNING

Every HCF must develop its own and individualized HCWM Plan. Ideally, a HCWM plan should be planned and implemented from the initial planning stage of a HCF. In accordance with the legislative requirements, each HCF is responsible for the development of a waste management plan suited for their HCF. Normally, in community health facilities like health-posts and primary health centres it is recommended that HCWM plan can be included in the improvement plan of Water and Sanitation for health facility improvement tool WASHFIT ((WHO/UNICEF, WASHFIT 2017) .

This plan must outline the accountabilities and responsibilities of managers, employees and staff. The HCF shall comply with guidelines, ensure proper HCWM through good practice regarding classification, segregation, collection, transportation, treatment and disposal. Options for the HCWM plan depend on the local context and locally available technology and maintenance are an important consideration while making a HCWM plan. HCF can manage HCW themselves or can contract a private organization for the proper management of HCW. Generally, a concrete implementation plan needs to be drafted, a decision for a treatment concept needs to be made and a process of monitoring and evaluation needs to be set in place to ensure a safe and sustainable HCWM system.

5.1 ROLE OF THE DIFFERENT LEVEL OF GOVERNMENTS

Efficient and appropriate HCWM practices depend on clear objectives and concrete planning at federal, provincial and local level. Each federal, provincial and local level requires political commitment and a functional committee, within their administrative structure, to oversee the HCWM issue. Appropriate government authority needs to be assigned with the responsibility for proper coordination among the stakeholders. Adequate legislative and financial support along with the active participation by trained, skilled and dedicated staff is necessary. Possible functions of the federal, provincial and local level are provided below.

5.1.1 Federal

Possible functions and responsibilities to be taken on by the federal level are listed below.

- Form a steering committee including members from all relevant ministries and organizations. The steering committee may consist of members from the following institutions, with additional members chosen by the federal government to suit the needs and scope of the committee.
    - ✓ Chief Specialist –Ministry of Health and Population (Chair)
    - ✓ Director General – Department of Health Service (Co-Chair)
    - ✓ Director Management Division
    - ✓ Representative - Ministry of Health and Population
    - ✓ Representatives from Curative Division, Department of Health Services (DoHS)
    - ✓ Representatives from Nursing and Social Security Division, DoHS
    - ✓ Representatives from Epidemiology and Disease Control Division, DoHS
    - ✓ Representatives from Family Welfare Division, DoHS
    - ✓ Representatives from National Public Health Lab.
    - ✓ Representative from National Health Training Centre
    - ✓ Representative, Ministry of Forest and Environment
    - ✓ Representative, Ministry of Water Supply
    - ✓ Representative, Ministry of Federal Affairs and General Administration
    - ✓ Municipal Associations of Nepal (MuAN)
    - ✓ National Associations of Rural Municipalities in Nepal (NARMIN)
    - ✓ Representative, Nepal Health professional Council
    - ✓ Representative, Nepal Medical Association
    - ✓ Representative, Nursing Association of Nepal
    - ✓ Representative, Association of Private Health Institutions of Nepal

- ✓ Representative, Nepal Health Clinic Association
- ✓ Representative, Solid Waste Management Association of Nepal
- ✓ Representative from UN agencies
- ✓ Representative from DPs/ Bilateral partners
- ✓ Representative from I/NGOs
- ✓ Representatives from private practitioners on HCWM
- ✓ Member Secretary – Chief, Environmental Health and Health Care Waste Management Section- MD/DOHS

- Assign well-defined roles and responsibilities to the members and organizations of the above-mentioned steering committee,
- Facilitate in the development of a health care waste management policy, directories, guidance, and other necessary documents,
- Facilitate the monitoring as well as study and research regarding health care waste management issues,
- Advocate and facilitate to form a HCWM committee in the health care facilities within their jurisdiction, define the roles and responsibilities of the members of the committee.
- From a Technical Working Group to support and co-ordinate ongoing programme on HCWM including regular capacity building activities on compliance of rules and regulations at federal level

5.1.2 Provincial

The possible functions and responsibilities of the provincial governments are in part very similar to those of the federal level, adjusted to the jurisdiction of the provincial level, with some additional tasks, as listed below.

- A steering committee can be under the leadership of Ministry of Social Development as per their need and scope.
- Assign well-defined roles and responsibilities to the members and organizations of the formed steering committee
- Advocate and facilitate to form a HCWM committee in the health facilities within their jurisdiction and clearly define the roles and responsibilities of the members of the committee.
- Form a Technical Working Group to support and co-ordinate ongoing activities at federal level including regular capacity building activities on compliance of rules and regulations at provincial level
- Facilitate the coordination among municipalities within the province.
- Play a liaison role between federal and local government.
- Facilitate formation of provincial level health care waste management policy, strategic plan, directories, guidance, and other necessary documents as required with compliance with the national standards.

- Establish a monitoring mechanism and capacity development measures to ensure safe health care waste management practices within the province.
- Allocate sufficient budget and human resources for the improvement of health care waste management practices within the province.

5.1.3 Local level

Possible functions and responsibilities to be taken on by the local level government are listed below.

- Develop municipal level health care waste management committee. The committee may consist of the members nominated by the local government as per their needs.
- Facilitate to form a HCWM committee in all the health facilities within their jurisdiction and define the roles and responsibilities of the members of the committee.
- Support health care facilities within their jurisdiction to develop and implement improvement plan based on risk using tools like Water and Sanitation in Health Care Facility Improvement Tool (WASHFIT) in coordination with provincial government / supporting agency
- Incorporate healthcare waste management in municipal policy and strategic plan
- Conduct healthcare waste assessment study to understand situation of municipality and establish HCWM information system
- Develop municipal integrated healthcare waste management strategic plan and allocate a substantial budget.
- Formulate monitoring and evaluation mechanism including regular capacity building activities on compliance of rules and regulations at HF level as well as local level.
- Collection of waste from different health facility and treat them.

5.1.4 Facility Level

The entire organizational structure and service of HCF must be held responsible for the proper management of HCW. However, particular units within the HCF must be identified to play a major role in setting up and maintaining a HCWM system. The functions of the administrations are provided in the paragraph below.

- Form a HCWM committee in the health facility with the support of federal, provincial and local government. Depending on the size of the HCF, and tailored to the individual needs and scope of the HCF regarding additional members, potential members of the committee at facility level could consist of:
    - Larger Facilities (Hospitals)
        - ✓ Chair of the Health Facility Operation and Management Committee (HFOMC)
        - ✓ Chief or Director of the HCF (Chair)
        - ✓ Department Heads

- ✓ Nursing chief
- ✓ Waste Management Officer / Trained Focal Person
- ✓ Head House Keeping
- ✓ Representative from cleaning staff

o Smaller Facilities (Health Post, clinics and others)

- ✓ Chair/ Representative from HFOMC
- ✓ Chief of the HCF
- ✓ Technical staff / Trained focal person
- ✓ Support staff (cleaners and workers)

- Establish HCWM information system with baseline data and develop the HCWM plan. This plan must include training and written guidelines on the whole waste management system, from waste generation over waste treatment to final disposal.
- Implement the HCWM plan and review and update the plans and guidelines on an annual basis.
- Ensure compliance of HCWM related rules and regulations and integrated with Municipal Waste management system only after proper treatment of infectious waste with recommended technology.
- Ensure adequate financial and human resources for the implementation of HCWM plan (to support this, the authorized body can recommend the formulation of strategy to allocate substantial amount of budget for HCWM.

5.2 STEPS FOR IMPLEMENTATION OF MODEL HCWM SYSTEM

A comprehensive plan on how to implement a HCWM system at facility level is essential for the safe, sustainable and efficient waste management in HCFs. Figure 12 shows all the necessary steps for the implementation of a HCWM system as a flowchart.

5.2.1 Health Care Waste Management Committee Formation

A health care waste management committee should be established in every health care facility. A focal person responsible for all the health care waste management issues should be appointed and trained properly. All level of health care facilities can form the committee as recommended in section 7.1.4

5.2.2 Waste Assessment

While developing the waste management plan, the first step is a diagnostic assessment of the waste generation within the facility. The assessment begins by establishing a baseline of how much and what kind of waste is being generated by each department or ward. This involves gathering data regarding the waste streams, processes and operations, types of practices, information on input materials and economic information Data collected for few days provides a snapshot of the waste flow in the HCF. Assessing the waste over a period of seven continuous days provides a clearer picture of waste generation, as the waste generation pattern differs from day to day. Through this data the HCF can establish the flow of waste and generation rates from every unit and department of the HCF. Waste composition data can be used to analyse segregation practice. Data from the waste generation survey should form the basis for the HCWM information system and the development of a HCWM plan as well as strategic plan at local, provincial and federal level. A draft of the assessment data collection format is provided in Annex I

After the intervention of waste management plan, waste audit is utmost to evaluate the results. A waste audit is an important tool for the assessment phase, as it provides data on the source of waste, the composition of the generated waste, the amount of waste as well as the waste flow within the HCF. Data can be collected in-house using self- audit forms and questionnaires.

5.2.3 Planning

In the process of developing a HCWM plan, the following procedures should be taken into consideration.

- Existing policies, laws, regulations and guidelines related to HCWM need to be considered and followed.
- The current waste management stream within the HCF needs to be reviewed and assessed before drafting or revising a new HCWM plan. Special attention should be placed on the following aspects:
    - Where is the waste treatment/ storage area, and how is going to be designed?
    - How and where the waste is collected, stored and transported?
    - What technology is going to be used for treatment of infectious waste and whether it is sustainable and environment friendly or not?
    - How the waste is treated and disposed?
    - The cost effectiveness of the current handling process
    - Personal safety of the waste handlers
    - Infrastructure of health facility
    - Number of beds/services/facilities
    - Types and amount of waste generation
    - Principles adopted for waste management such as 3R.

The existing and future needs of the HCF need to be taken into consideration during the design planning phase. The plan must be capable of handling the current waste stream properly and efficiently, and additionally be equipped to be able to cope with a temporary, extraordinarily high waste generation rate (e.g. after natural disasters or during pandemics). Also the plan should include the plan for capacity building of staff including onsite coaching and refresher trainings and orientations. Likewise, the plan should be regularly reviewed and updated based on the recommendations of the implementation, monitoring and evaluation teams.

5.2.4 Treatment Centre Designing and Construction

Once the treatment technology is finalized, a detailed design of the waste treatment and processing centre with proper waste flow is prepared and constructed. The area should be enough for the treatment of the waste generated in the facility. Separate entry point/door for infectious and general waste should be provided and site selection should be at the appropriate location recommended by experts.

The treatment area must be different from patient management areas.

Dedicated power circuit must be available

Treatment centre should be a completely closed building with controlled ventilation and if needed air filtration system. Treatment centre should have proper electrical and water supply facilities. Drainage system should be provided at appropriate locations inside the facility that could drain

surface cleaning wastewater. Likewise, designated areas for storage of waste during emergency should be allocated during the design.

Space for storage of different types of waste such as metal, needle, bottle, plastic, biodegradable pit, cytotoxic etc

5.2.5 Transportation Route Planning

The transport route to the HCW Collection site needs to be identified and tested. The transportation route should be such that, there is minimum flow of visitors and patients and also the waste volume is not overfilled in the trolleys during transportation. Separate routes or ramp may be needed to be designed in facilities which does not have a separate route/ elevator for waste transportation.

The time for infectious and non-infectious waste transport must be different.

5.2.6 Testing of treatment technology

Environment friendly sustainable waste treatment technology should be selected which is most feasible in local context. Non-burning technology are highly recommended. All treatment technologies should be pretested to ensure its efficiency of treatment of pathogens and other hazards before its operation. The treatment processes should be validated and periodically tested to ensure they function properly using biological indicators (e.g.: spores) or other test assays. The technology/equipment or machine must have PPM and backup plan too.

5.2.7 Capacity building and sensitization

Sensitization, motivation towards waste management, behaviour change and positive attitude are foundation for effective waste management along with capacity building. Capacity building is an important aspect prior to and during the operation of the health care waste management system.

Dedication from all staffs from director to cleaner is paramount for success. The trainings should ensure that staffs at all levels of health care facilities are aware of the health care waste management plan, their own responsibilities and obligations in this regard. Integrated training package of HCWM, Environmental Health and WASH is highly recommended.

5.2.8 Initiation of the System

Finally, once every aspects of operation is completed. Wards and other units should be provided with proper segregation bins and needle cutters along with segregation trollies information leaflet, board etc to initiate the system in the health care facilities. During initiation of the system, it is always suggested to initiate with one unit and then further replicate periodically reviewing the system.

5.2.9 Supportive supervision and continuous monitoring

The detailed step by step plan is demonstrated in the flow chart below(Fig1):

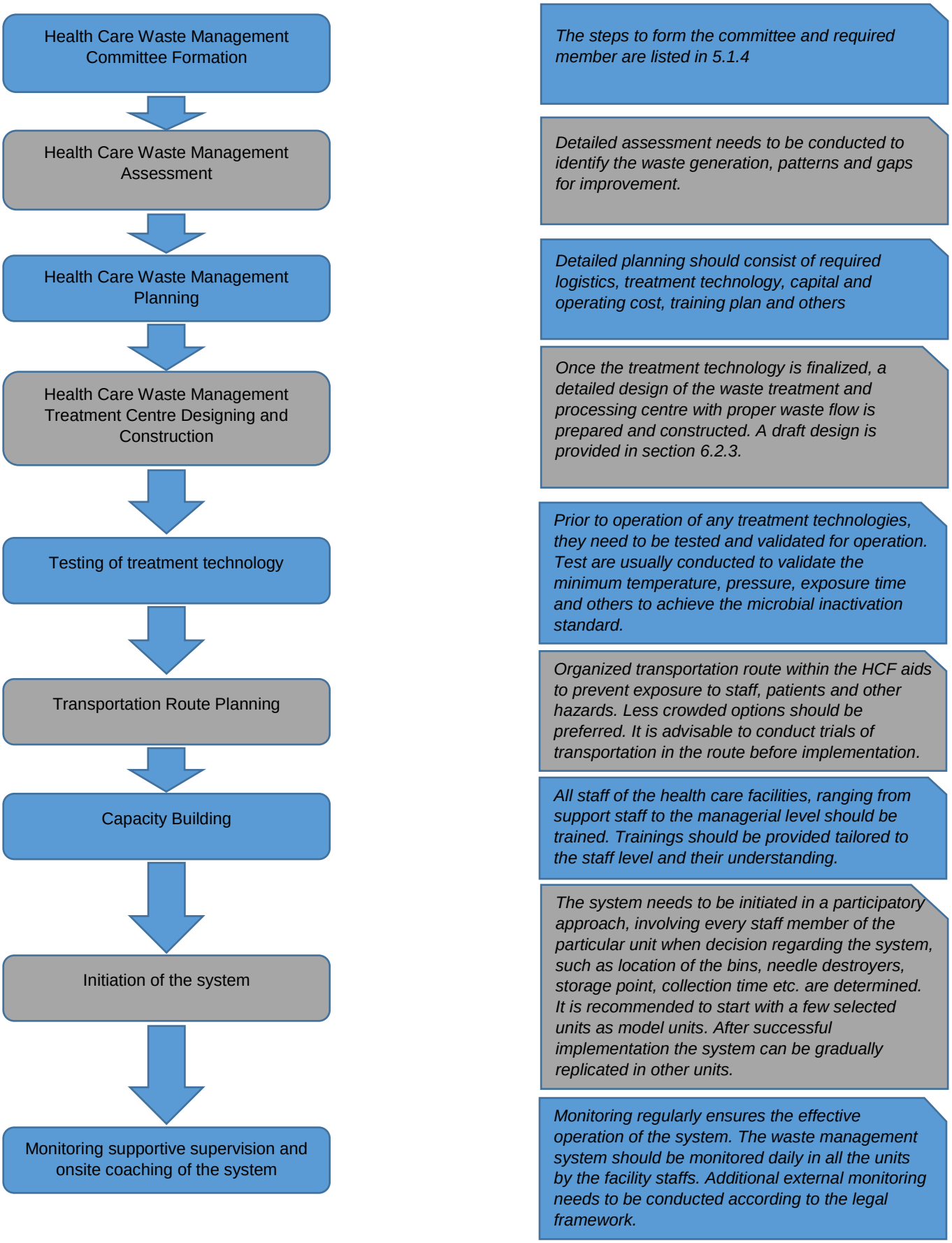

Figure 1: Flowchart of steps of Health care waste management system implementation at facility level

6. 6KEY STEPS TO IMPLEMENT HCWM SYSTEM

The basic steps listed below are considered essential for the proper practice of a health care waste management system and will be elaborated in the following section:

1. Waste minimization
2. Waste segregation at source
3. Waste collection and storage
4. Waste transportation
5. Waste treatment and disposal
6. Monitoring and Evaluation

6.1 WASTE MINIMIZATION

Waste minimization is defined as both the prevention as well as the reduction of waste production. Waste minimization usually benefits the waste producer by reducing the costs for the purchase of goods. It involves specific strategies of changes in management and behaviour. One of the best waste minimization approaches is the adoption of a waste avoidance strategy. To achieve this, work practices need to be changed.

The amount of waste generated is often dictated by processes and behaviours at the workplace. Sustainable behaviours such as choosing reusable equipment over single use, sending e-mails instead of using letters or paper memos, using reusable cups over disposable ones etc. can lead to a minimization of waste. Thus, methods of waste reduction include modification of purchasing procedures, control of inventory and use of less toxic materials. However, no actions should be taken that would impact the quality and limit the access to health care. Waste minimization can be achieved through the reduction of waste generation at source (product substitution, product change, procedural change) and by giving preference to recyclable and reusable items. During infectious pandemic situation (e.g COVID-19) un-necessary visiting isolation area and unnecessary use of PPE generated lots of extra waste, that could be optimized.

6.2 SEGREGATION, STORAGE AND TRANSPORTATION OF HEALTH CARE WASTE

6.2.1 Waste Segregation at source

Waste segregation refers to the process of separation of waste at the point of generation and keeping them apart during handling, collection, interim storage and transportation. Segregation of the waste at source is the most important step for a successful management of HCW. The reason for this is that the amount of potentially hazardous waste is kept at a minimum as contamination of general waste is avoided. It is highly recommended that segregation of HCW occurs on-site at the time the waste is generated, e.g. when an injection is given, needle and syringe are deposited in their respective, different waste containers. Infectious waste must never be mixed with non-infectious waste to keep the volume of infectious waste as low as possible. Segregating risk wastes from non-risk waste additionally greatly reduces the risks of infecting staff and workers handling HCWs. A recommended way of identifying HCW categories is by sorting the waste into color-coded and well-labelled bags or containers.

Segregation should:

- Always take place at the point of waste generation

- Be simple and uniform throughout the facility
- Be well understood and well known by the medical and ancillary staff of the HCFs
- Be regularly monitored to ensure strict adherence to the procedures

6.2.2 Colour code for segregation

The suggested colours for the containers for the different categories of waste are shown in figure below.

Signs and Symbols for waste segregation:

Sign and symbols are necessary to achieve effective segregation. Labels including the symbols for different waste must be used. Likewise, health care facilities are recommended to use labels and stickers with pictures to assist all the visitors for proper segregation of the waste generated. The recommended color-coding for the containers for different categories of waste as well as the international symbols for risk waste categories are provided in Table 1.

Table 1: Recommended color-codes for the container, labelling and international signs for segregation of HCW

Waste Category, symbol and label		**Colour of Container**
Non-risk HCW	Biodegradable	Green
	Non-biodegradable	Blue
Risk HCW	Pathological waste  Danger! Pathological waste	Red
	Sharps Waste  Danger! Contaminated sharps	Red

	Infectious Waste 	Red
	Pharmaceuticals waste	Red
	Cytotoxic Waste 	Red
	Chemical Waste   Danger! To be discarded by authorized staff only	Yellow
	Radioactive Waste  Danger! Radioactive Waste	Black

The necessary containers for the segregation of waste depend on the types of the waste generated at the HCF, the available technology for the treatment and disposal, and the local environmental conditions of the HCF. HCFs should categorize and segregate the HCWs as mentioned above.

A modified medication trolley with extra containers for the separation of waste at source should be used in hospital. Risk and general waste are distinctly separated on opposing sides of the trolley, i.e. risk waste on the left, general waste on the right. This is to avoid mixing and confusion during segregation.

6.2.3 Waste Collection

Some larger units in a facility may consists of dirty utility room or interim storage, where the wastes are stored properly after every shift or when required before the waste are transported to the final waste treatment area. If utility rooms are not available, at least the infectious waste can be stored at another designated location near to a medical area but away from patients and public areas. These waste needs to be collected and transported away in daily basis. Proper colour coded bins should be used for waste collection.

6.2.4 Waste Transportation

Health care waste collection and transportation practices should be designed to achieve an efficient movement of waste from point of generation to storage or treatment. A program for collection of HCW should be established as part of the HCWM plan. Certain recommendations should be followed by the auxiliary worker in-charge of waste collection:

- Suggested frequency of collection on room to room basis is once every duty shift. Time of collection regardless of category should be at the start of every shift. In case of difficulty in the collection of waste in every shift, waste should be collected on daily basis (or as frequently as required) and transported to the designated central storage site of HCF.
- No bags should be removed unless they are labelled with their point of production (hospital and ward or department) and contents.
- The bags or containers should be replaced immediately with new ones of the same type.
- A supply of fresh collection bags or containers should be readily available at all locations where waste is produced.

6.2.4.1 On-site transport

The waste disposal plan of HCF should include procedures for on-site and off-site transport of wastes. During movement of waste segregation must be maintained and the batch of waste should be managed according to the component with the highest level of risks. On- site transport of waste from the point of generation to an assembly storage or treatment area should be carried out by wheeled trolleys, containers or carts without spoil. Wherever possible, the transport of waste should be separate from route with maximum flow of patients and visitors. Hazardous and infectious HCW and non- risk HCW should be transported on separate trolleys. The transportation must follow specific routes through the HCF to reduce the passage of loaded carts through wards and other clean areas. The trolleys or vehicles should be:

- Easy to load and unload.
- Have no sharp edges that could potentially damage waste bags or containers during the loading and unloading.
- Easy to clean.
- Well functional and having wheel

Simplified Transportation Trolley

Health care waste needs to be transported in trollies for safe handling. The trollies used for health care waste transportation should not be used for any other purposes. Generally, two types of trollies are used in health care setting, one for transporting waste within a unit, e.g. a modified medication trolley with extra containers for the separation of waste at source. Another is the waste transportation trolley is for the transportation from the source to the collection point, i.e. from the different units to the treatment site.

Wheeled containers, trolleys (e.g. modified medication trollies) or carts used for transferring health-care waste within health-care facilities should be designed and constructed so that:

1. Separate bins for all the different types of waste that need to be separated are available.
2. Risk and general waste are distinctly separated on opposing sides of the trolley, i.e. risk waste on the left, general waste on the right.
3. Edges on the trolley are dull and blunt. Sharp edges must be avoided to not run the risk of waste bags tearing open during loading and unloading.
4. An edge or similar is available to contain any leakage from damaged waste bags.
5. The surface and material of the trolley can easily be cleaned, disinfected and drained.
6. The waste may be easily loaded, secured and unloaded.

For the transportation from source to collection point, there should be separate trollies for the transportation of risk and general waste with separate transportation routes. Therefore, for the second trolley type the separation on opposing sides of the trolley is not necessary as there is no general waste on the risk waste trolley and vice versa. Trolleys must be cleaned and disinfected daily using chlorine solution and phenolic compounds.

6.2.4.2 Responsibility of in-site waste transportation:

Responsibility of in-site waste transportation will be of concerned heath institution. Responsibility of segregated waste transportation from source to collection point or temporary storage point and up to treatment house, lies to designated waste worker appointed by hospital. The people transporting the waste should be equipped with appropriate personal protective equipment including full sleeved Apron, Mask, Caps, Eye protector, face shield (if necessary), gloves and boots

6.2.4.3 Off-site transport

The HCW producer is responsible for the safe packaging and appropriate labelling of the waste to be transported off-site as well as for the authorization of its destination i.e. the CTF and need to be safely disposed at landfill site after proper treatment. Vehicles used for transporting clinical and related waste should be exclusively reserved for this purpose wherever possible. Vehicles must be easy to load, unload, clean and can be closed properly with proper spill management facility. Furthermore, they should be equipped with spillage collection sumps or other suitable spill controls. The vehicle should be marked with the name and address of the waste carrier. The hazardous and infectious symbols should be prominently displayed on the vehicle.

A fundamental requirement is for the vehicle transporting hazardous waste to be roadworthy and labelled to indicate its load, and its payload to be secured to minimize the risk of accidents and spillages. Any vehicle used to transport health-care waste should fulfil several design criteria:

- The body of the vehicle should be of a suitable size commensurate with the design of the vehicle.
- There should be a bulkhead between the driver's cabin and the vehicle body, which is designed to retain the load if the vehicle is involved in a collision.
- There should be a suitable system for securing the load during transport.
- Empty plastic bags, suitable protective clothing, cleaning equipment, tools and disinfectant, together with special kits for dealing with liquid spills, should be carried in a separate compartment in the vehicle.
- The internal finish of the vehicle should allow it to be steam-cleaned and internal angles should be rounded to eliminate sharp edges to permit more thorough cleaning and prevent damage to waste containers.
- The vehicle should be marked with the name and address of the waste carrier.
- An international hazard sign should be displayed on the vehicle and containers, as well as an emergency telephone number.
- The driver should be provided with details of the waste being carried (WHO 2014).

6.2.4.4 Responsibility of off-site waste transportation:

According to Solid Waste Management Act 2068 (2011) with edited version of 2074 Kartik, Chapter 2 section 9 sub-section 1, 2 and 3 states the responsibility of transportation of the solid waste from collection point to transformation centre and up to waste management place will be lies to local

government or of the organization or body assigned by local government. Off-site transportation of properly treated healthcare waste can be managed in coordination with concerned local government.

6.2.5 Spill Management

HCFs are responsible for clinical and related waste spills that may accidently occur at on-site and CTF management committee or private company contracted for HCWM transportation are responsible for off-site spill management. HCF in care of onsite and CTF management committee in case of off-site, must include a spill management plan with well-defined procedures for handling spills safely in its HCWM plan. Personnel responsible for spill management must receive education and training in emergency procedures and handling requirements. They must be fully aware of all procedures, i.e. how, when and which emergency service should be called for advice and assistance. Spill kits should be made easily accessible and should contain absorbents, disinfectants, buckets, shovel, broom, gloves, disposable overalls, facemasks or shields, torch, disposable containers and plastic waste bags with appropriate labelling.

6.2.6 Waste Storage

In order to avoid accumulation of waste, it must be collected and transported to a central storage area within the HCF on a regular basis before being treated or removed.
For infectious waste the maximum storage time before treatment or disposal is no longer than 48 hours during the cooler season and no more than 24 hours during the hot season.

Storage facilities should be inside the health care facility premises. These areas should be sized according to the quantity of the waste generated, the waste collection and transportation frequency and lastly according to available recycling and disposal options. These areas should store only the specified waste types, this means waste types should not be mixed, i.e. infectious waste should not be stored along with the pharmaceutical waste. Each waste type needs to be stored separately and labelled properly

To ensure a proper control of the waste management system, records of the stored wastes, the undergone treatment and the respective disposal dates need to be kept.

All the collected HCW should be stored in waste storage area until transported to a designated treatment facility. This area must be marked with warning sign. Storage facilities for waste should be suitably established within the HCF, however, these areas are to be located away from patient rooms, laboratories, hospital function and operation rooms or any area with public access. The storage facility should be lockable, hygienic and appropriately sign-posted. They must be kept secured at all the times.

HCFs are responsible for providing:

- Designated storage areas with adequate lighting, cross ventilation as well as protection from sun, rain, strong winds and floods.
- Location and site selection as per experts' recommendation.
- Design of storage area that enables the storage of segregated waste as per the type of waste
- Storage areas designed in such a way that routine cleaning and maintenance to hygienic standards and post- spill decontamination are easy to undertake.
- Water supply for cleaning purposes.
- Supply of cleaning equipment, protective clothing and waste bags or containers located close to the storage area

- Spill kits for the containment of spills within the storage area
- Waste security and restriction of access to authorized persons.
- Easy access for waste collection vehicles.

6.3 TREATMENT AND DISPOSAL METHODS

HCFs can chose whether they want to follow an on-site treatment or an off-site treatment approach. Independently of whether the HCFs chose off-site treatment, in a central treatment facility (CTF), or on-site treatment, on the hospital premises, ultimately the HCFs are responsible for the proper treatment and disposal of their HCW. The HCWM plan and system for each HCF must be tailored to the chosen approach. The two approaches are outlined in the following

6.3.1 On-Site Treatment

According to the SWM Act 2011, any institution which generates hazardous or medical wastes are themselves responsible for the management of respective wastes. Thus, HCFs are responsible to capacitate themselves for the management of wastes and require the treatment of infectious wastes before transporting out of the facility. The practice of mixing untreated infectious wastes with municipal wastes might generate high chance of cross-infection to the waste handlers and those who are exposed to such type of wastes. In this modality health care facility, they operate a waste treatment centre, where all the hazardous waste generated within a health care facility is treated and rendered safe before final disposal. Section 7.2 highlights the detailed steps for development of on-site treatment facility within a facility premises.

6.3.2 Off-Site Treatment

Health care institutions ranging from small clinics to larger health facilities are dispersed throughout the cities. A majority of the health care facilities in the urban context might not have the required space for setting up a treatment facility for the waste generated within their facility.

In such scenarios, central treatment facilities are a good option for better management of the health care waste generated. CTF operated by either the public body of private sectors, serve as a common treatment area for all the health care waste generated throughout the city. The cost of treatment and disposal are mainly determined by the type of the treatment technology used and volume of waste in the CTF. Some of the issues that needs to be considered for operation of CTF are listed below:

- As specified by Government of Nepal in Environment Regulation 2020, all hazardous waste treatment site need to conduct EIA prior to operation, before establishing any hazardous waste treatment site. Prior to setup and operation of the plant, an environmental impact assessment of the site needs to be completed and approved by the concerned authorities.
- CTF operated within a municipality needs to be owned by the local body. In some instances, a CTF might be bringing waste from different municipalities, in such cases, a municipality where the facility is installed may take the ownership. The ownership can be transferred to private sectors with agreement with the municipality.
- CTF can be operated in a public private partnership model or by the municipality itself.
- CTF should never be installed or operated within a health facility premises. Collection of potentially hazardous waste inside health care facilities should be strictly prohibited.

- CTF as a service provider may charge health-care facilities on a per-volume, per-weight or per-bed basis.

6.4 SELECTION OF TREATMENT METHODS

The methods for treatment and disposal of HCWs depend on specific factors applicable to the HCF, relevant legislation and environmental aspects affecting the public. The bulk of HCW falls into the category of general waste, much of which can be recycled or reused. With correct segregation, low amounts of waste are categorized as hazardous waste requiring specific attention. Hazardous waste must be treated with approved treatment methods. Once treated, the waste may be re-classified for disposal. Currently available waste treatment options have various capabilities and limitations. As technology changes, HCFs should evaluate treatment alternatives regarding their safety, effectiveness, environmental impacts, costs and compliance with the country requirements. Any treatment option for HCW should:

- Render sharps incapable of causing penetration injury.
- Achieve a significant volume reduction with no hazardous by-products.
- Result in residues being suitable for approved landfill disposal without harmful leaching to the environment.
- Result in minimum levels of hazardous or toxic by-products including POPs such as polychlorobiphenyls.
- Reduce the potential for transmission of infection.
- Be verifiable for the treated wastes.
- Have automatic controls and built-in safe mechanism.
- Provide continuous automatic monitoring and recording.
- Ensure that waste cannot bypass the treatment process.
- Meet occupational health and safety standards.
- Have a safe alternative treatment and disposal in case of emergency.
- Be tested and maintained as defined by the manufacturer's technical datasheet, to ensure optimal performance. In case of autoclave, tests need to be first validated and regular testing needs to be performed at least annually.

The below listed techniques are currently available for the treatment and disposal of HCW and will be further elaborated in this section:

a. Biological Procedures
b. Autoclave
c. Integrated steam-based treatment system
d. Microwave
e. Chemical treatment
f. Frictional heat treatment system
g. Encapsulation and inertization
h. Sanitary Landfill
i. Burial
j. Septic concrete vault
k. Incineration

l. Emerging technologies

During selection of treatment technologies these environmental and operational aspects should always be considered. Annex III provides the table with comparison of types of technologies available which comply with the Stockholm and Basel Conventions. Similarly table in Annex IV compares interim treatment technologies which do not meet the two conventions requirement and are considered as interim solutions. These tables rate available technologies based on their environmental impacts, capital cost and operating costs (WHO, Overview of technologies for the treatment of infectious and sharp waste from health care facilities 2019). (• =low, •• = medium, ••• = high and •••• = very high) Likewise this treatment technologies ladder aid in providing a clear picture of the acceptable technologies in all scenarios (WHO, Overview of technologies for the treatment of infectious and sharp waste from health care facilities 2019).

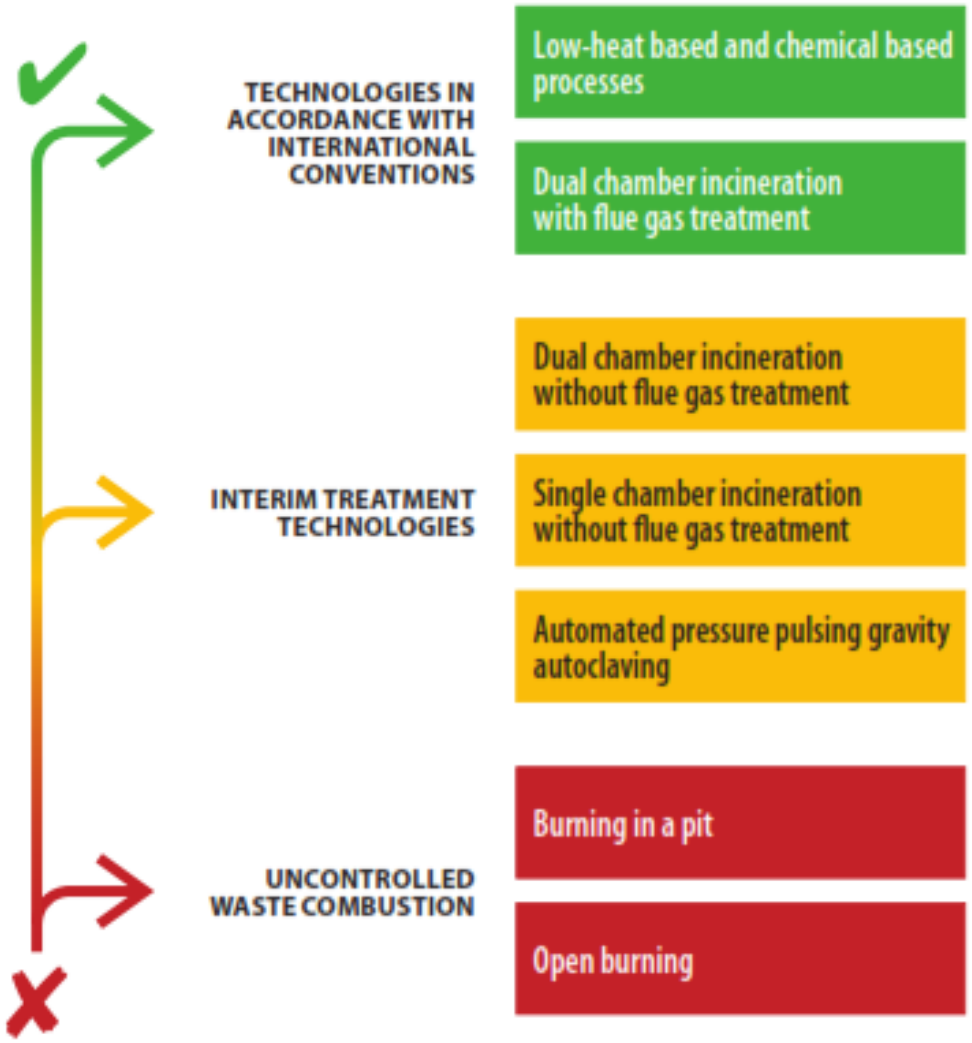

Figure 2: Treatment Technologies Ladders

6.4.1 Biological Procedures

Biological procedures require a controlled regulation of temperature, pH and enzyme levels and other variables. Presently, biological procedures are gaining popularity for the disposal of non-

hazardous biodegradable HCW. The most common biological procedures are composting, vermicomposting and anaerobic digestion.

Composting

Composting is the recommended technique for non-hazardous and biodegradable HCW. Composting is the natural, biological decomposition of organic matter by fungi, bacteria, insects, worms and other organisms. Successful composting entails the management of the decomposition process so that it is safe and clean. Organisms that decompose organic matter require the following basic inputs and conditions to maximize the process and efficiency:

- A suitable food source;
- A suitable temperature;
- Water; and
- Oxygen (if decomposing aerobically)

Poorly managed composting may produce offensive odours, encourage pests and vermin, spread plant and animal pathogens, cause environmental contamination and generate a product of inferior quality through extended processing times that will be inefficient and inappropriate in a commercial composting operation. Proper compost management therefore is important.

Vermicomposting

Vermicomposting is the process of degradation of biodegradable matter through worms. The specialized worms used can speed up the digestion process through the vigorous digestion of the materials. The worms also support the process by increasing the aeration and drainage of moisture through the compost. Earthworms of the Eisenia fetida species are popular in Nepal for vermicomposting of solid household biodegradable waste.

Placenta Pit

Placenta pits are commonly used for the disposal of pathological waste especially the placentas. Around 90% of the waste is liquid which is gradually soaked into the ground and the remaining human tissues are left for biological degradation. The decomposition process is usually anaerobic process, though some aerobic decomposition occurs at the top layers. The waste should not be pretreated with chemicals, which shall delay the decomposition process by killing the pathogens required for the decomposition process in the pit.

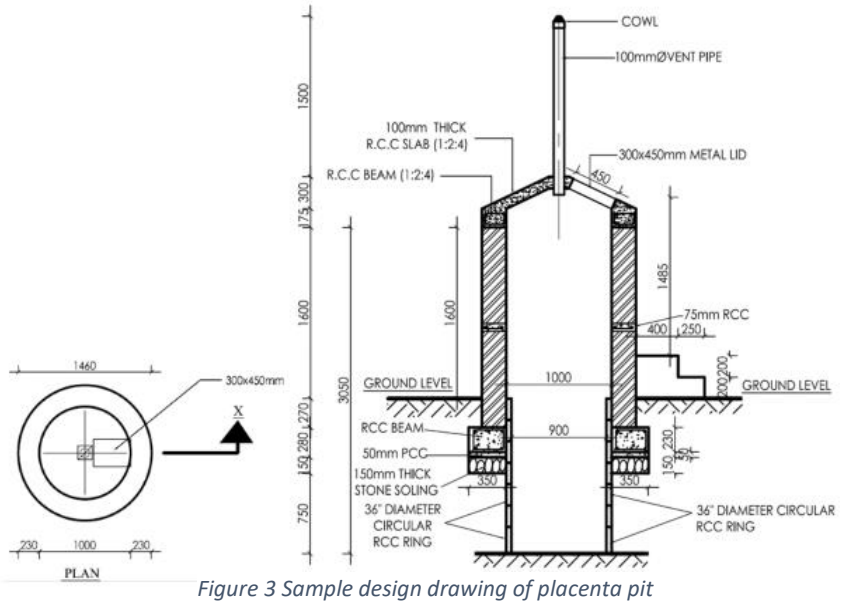

Figure 3 Sample design drawing of placenta pit

Source: Health Infrastructure Design and construction Guideline, GoN, 2073)

Anaerobic digestion

During anaerobic digestion biodegradable waste is degraded in absence of oxygen. The process occurs due to anaerobic organisms, which results in production of methane as a by-product. Anaerobic systems operate in different temperature ranges, psychrophilic (5-15˚C), mesophilic (25-40 ˚C) or thermophilic (55-70 ˚C). The temperature, pressure, retention time and the anaerobic condition aids in destroying pathogens.

There are many instances in health care facilities of Nepal, where anaerobic digesters have been used for the treatment and disposal of biodegradable health care waste. Though a very efficient technology, the system needs to be closely monitored and controlled. The outlet should be tested regularly for the presence of any harmful pathogens, before the slurry is disposed in the sewer system. As research has shown that the presence of roundworm eggs (ascaris ova) in the outlet is possible, close monitoring is key (WHO 2014).

6.4.2 Low heat thermal-based treatments

Low heat thermal based treatments can make hazardous waste safe by killing all pathogens including spores. Some commonly used technologies are summarized below:

Autoclave

Autoclave is a process of steam sterilization under pressure. It is a low heat process in which steam is brought into direct contact with the waste material for a sufficient duration to sterilize the material. This technology has been used for a long time in HCFs for sterilization of reusable medical equipment in health facilities of Nepal. Typically, autoclaves are used in hospitals for the sterilization of medical equipment and to render infectious waste harmless. The pressurized steam within the autoclave (270˚ F, 30 psi) is enough for most contaminants. Radioactive material or any material that may be contaminated by radiation, combustible, flammable or volatile liquids, any liquid in a sealed container, any material contained in such a manner that it touches the interior surfaces of the autoclave should never be placed inside autoclave.

Integrated steam-based treatment system

The integrated steam-based systems combine internal shredding, steam treatment-mixing and drying in a continuous unit. These technologies are designed for achieving more uniform heating of the waste and rendering the waste unrecognizable. Since most autoclaves and hybrid autoclaves operate in batch processes, these technologies are sometime referred as advanced steam treatment technologies treating waste in continuous process (WHO 2014)

Examples of such technologies include:

- Steam treatment-mixing-fragmenting followed by drying and shredding
- Internal shredding followed by steam treatment-mixing and then drying
- Internal shredding-steam treatment-mixing followed by drying
- Internal shredding followed by steam treatment-mixing-compaction.

Microwave

Microwave treatment is a steam-based treatment technology where microwave energy generates moist heat and steam by heating the moisture in the waste. Microwave radiation is used for the treatment of the infectious HCW. Radiation with a frequency of about 2450 MHz and a wavelength of 12.24 cm heats the water contained in the waste and produces steam.

Waste similar to the waste treated in autoclaves, such as infectious waste, sharp waste, cultures for laboratories, and others can be treated in microwaves. Pharmaceutical waste, chemical waste and cytotoxic wastes, metals should not be treated in a microwave system.

In the context of Nepal, the use of microwaves for the treatment of HCW is a new technology. Integrated microwave systems are popular worldwide, where all waste fed into the system is shredded. This practice overlooks segregation of the waste and minimises the possibilities of recycling the recyclable part of waste. Hence, such integrated systems are not recommended for the treatment of health care waste.

Frictional heat treatment System

This technology uses both steam as well as dry heat. Frictional heat with temperatures of 135˚C to 150˚C are used for several minutes. Highspeed rotating shredders generate heat and the well as moisture in the waste turns into steam. Such technologies can achieve an up to 80% decrease in volume reduction When all fluids have evaporated, the waste inside the chambers is further be heated to dry superheated condition. The system capacity ranges from 10 kg to 500 kg per hour. This process not only shreds the waste into small pieces, it additionally causes damage to the cell membranes, which along with the steam and dry heat, results in the destruction of pathogens.

6.4.3 Chemical treatment

There are various methods of chemical treatment of the health care waste. Some of them are listed below:

Chemical disinfectants:

Chemical disinfections are one of the most popular methods for the treatment of infectious and pathological wastes, especially in rural settings. Chemicals such as aldehydes, chlorine compounds and phenolic compounds are added to HCW to kill or inactivate pathogens. By using these as a treatment methodology, exposure to chemicals such as chlorine disinfectants, glutaraldehyde, various sterilant (such as ethylene oxide) and others result in skin and respiratory sensitization, eye and skin irritation, weakness, exhaustion, dizziness, numbness, drowsiness and nausea. (WHO 2014).

Alkaline hydrolysis

Some chemical systems use heated alkali solutions to destroy tissues, organ, body parts and other anatomical waste. It is a process that converts animal carcasses, human body parts and tissues into a decontaminated aqueous solution. Steam-jacketed, stainless-steel tanks and a basket are used in this technology. The waste is loaded in the basket and put in the tank, alkali (sodium or potassium hydroxide) is added along with water in proportion to the volume of waste added. This is further heated to a temperature between 110˚C and 127˚C and stirred. Usually, it takes around six to eight hours for complete digestion, depending upon the alkali concentration and temperature.

Chemical decomposition:

Chemotherapy waste (including bulk cytotoxic agents) can be treated by chemical decomposition. Examples are reactions with 5% sodium hypochlorite; acid hydrolysis followed by alkaline hydrolysis; reduction using zinc powder, degradation using 30% hydrogen peroxide; and destruction using heated alkali.

Micro-organism types, degree of contamination, type of disinfectant, contact time and other relevant factors such as temperature, pH, mixing requirements and the biology of the microorganism should be considered when using chemical treatments. Occupational health and safety should be taken in consideration while using chemical disinfection. Ultimate disposal of chemically treated waste should be in accordance with national and local requirements.

6.4.4 Burial based disposal methods

Burial of waste is one of the oldest and popular techniques of waste disposal. There are many ways of burial; some of which are summarized below:

Encapsulation and Inertization

Encapsulation involves the filling of the containers with waste, adding an immobilizing material and sealing the container. The process uses either cubic boxes made of high- density polyethylene or metallic drums. When containers are three quarters filled with sharps, pharmaceuticals and chemical waste, an immobilizing agent such as plastic foam, bituminous sand, cement mortar or clay is poured into it. The material dries and the container is sealed and disposed safely in the landfill. Encapsulation is effective in reducing the risk of scavengers gaining access to the hazardous waste. It is particularly suitable for sharps and pharmaceutical waste.

Inertization is a suitable disposal method for the pharmaceuticals and incinerated ashes with heavy metal content (WHO 1999). In this technique, HCW is mixed with cement and other substances in a composition of 65% waste, 15% lime, 15% cement and 5% water. The formed mixture is allowed to set into cubes or pellets and then is transported to a suitable storage site. For proper setting of the mixture into cubes and pellets, the waste must be grinded. This technique helps to minimize the risk of contamination of toxic substances through migration to surface water or ground water and prevents scavenging.

Sanitary landfill

Sanitary landfills are an engineered method, designed and constructed to keep the waste isolated from the environment. There should not be any contamination of the soil, surface, and ground water. Furthermore, it should limit air pollution, smells and direct contact with the public. Some essential features of sanitary landfills are:

- Easy access to the site and working areas for waste delivery.
- Personnel should be available on-site for effectively controlling the daily operation.
- The site should be planned appropriately and divided into manageable phases, before starting the landfill.
- Lining of the base and sides of the sites must be adequately sealed to minimize the movement of wastewater.
- Landfill site should be at least 500 meters away from water sources.
- There must be landfill gas control measures, environmental monitoring points and bore holes (for monitoring air and ground water quality).
- There must be adequate and efficient mechanisms for leachate collection and treatment.
- The site must be well organized in a small area, i.e. proper spreading, compaction, and daily covering the waste with soil.
- The landfill site must be protected with wire bar or fences to prevent from unauthorized access by people and animals.

- Final cover must be constructed to prevent and minimize rainwater infiltration after each phase of the landfill is completed.

Burial pit

Hazardous waste can be buried in a special pit. For this purpose, the pit should be 2-5 m deep and 1-2 m wide. The bottom of the pit should be at least 2 m above the water table. After each waste load, it should be covered with a 10–30 cm thick soil layer. If coverage with soil is not possible, lime may be deposited over the waste. When the level of the waste reaches up to 30 to 50 cm to the surface of the ground, the pit needs to be filled with dirt, sealed with concrete and a new pit should be dug if necessary. The following rules need to be established for proper HCWM in burial pit:

- Access to this dedicated disposal area should be restricted to authorized person only.
- The use of a pit should be supervised by landfill staff to prevent scavenging.
- Water deposition around the burial pit should be prevented.
- The burial site should be lined with a material of low permeability, such as clay, to prevent pollution of ground water.
- Large quantities (higher than 1 kg) of chemical/pharmaceutical wastes should not be buried.
- The burial site should be managed as a landfill, with each layer of waste covered with a layer of soil to prevent the attraction from rodents and insects as well as limit odours.
- Burial site should not be located in flood prone areas.
- The burial site should be fenced with warning signs.
- The location of waste burial pit should be down-hill or down-gradient from any nearby wells and about 50 meters away from any water body such as rivers or lakes.
- HCF should keep a record of the size and location of the existing burial pits to prevent construction works.

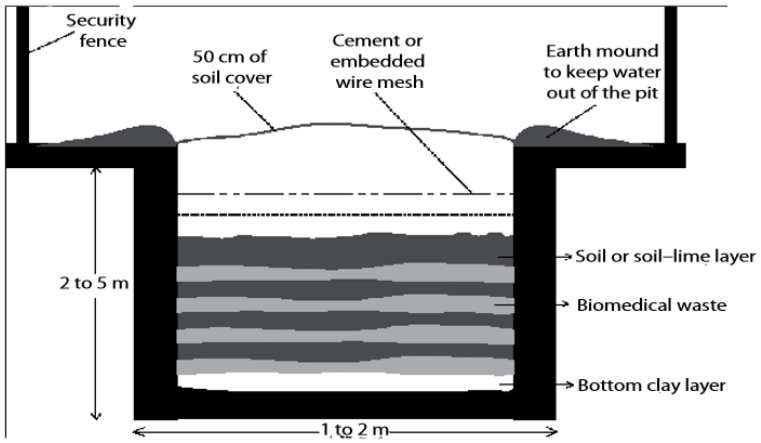

Figure 4: Burial Pit (MoHP 2020)

Septic or concrete vault

This method can be used for the disposal of used sharps and syringes. In this method a concrete pit of slabs of (1m x 1m x 1.8m depth), enough to accommodate sharps and syringes for certain period without reaching the ground water level is constructed. The site must be isolated and at least 5 m away from the ground water sources and dwelling units

6.4.5 Emerging Technologies

Suitable selection of technology is a very important step for the successful implementation of a health care waste management system. Especially emerging technologies should be carefully reviewed prior to installation and operation. Some of the examples of emerging technologies are plasma pyrolysis, superheated steam, ozone and promession.

Plasma pyrolysis

Plasma pyrolysis involves plasma arc torches or electrodes which use ionized gas in the plasma state to convert electrical energy to super high temperatures, up to several thousand degrees Celsius. The process operates in presence of little or no air.

Superheated steam

This technology uses superheated steam at 500˚C to pulverize infectious, hazardous chemical or pharmaceutical wastes. These steams are further heated up to temperatures of 1500˚C. These technologies are expensive and pollution control equipment prior to the release of the gas from the system are required.

Ozone

Ozone (0_3) gas can be used as a disinfecting agent for waste. Ozone (0_3) can break down to more stable forms such as Oxygen (0_2) easily. The wastes are shredded and exposed to the agent. As exposure to higher concentration of ozone can cause physical harm, occupational safety needs to be considered.

Promession

Promession combines a mechanical process with the removal of heat to destroy pathological waste. It uses liquid nitrogen and mechanical vibration to disintegrate the pathological waste into a powder before burial.

The emerging technologies still need to be carefully evaluated and have long way to go before they are ready for regular application.

6.5 MANAGEMENT OF HAZARDOUS HCW

According to Solid Waste Management Act 2011, the responsibility for processing and management of hazardous waste, medical waste, chemical waste and industrial waste under the prescribed standards goes to the person or institution that has generated the waste (NLC 2011). Thus, the responsibility of management of HCWs of the HCF is the responsibility of the chief of the facility. This chapter provides basic guidance for the management of HCW for different categories of the waste types. A table for the treatment option and its applicability is provided in the matrix below along with the detailed description of the waste types and various technologies applicable.

Table 2: Types of waste and various treatment technologies applicable

Type of Waste Category	**Infectious**	**Sharps**	**Pathological**	**Chemical**	**Pharmaceutical**	**Cytotoxic**
Type of technologies						
Biological Procedure	No	No	Yes	No	No	No
Autoclave	Yes	Yes	No	No	No	No
Microwave	Yes	Yes	No	No	No	No
Chemical Treatment	Yes	Yes	No	Yes	No	Yes

Type of Waste Category	**Infectious**	**Sharps**	**Pathological**	**Chemical**	**Pharmaceutical**	**Cytotoxic**
Encapsulation and Inertization	No	Yes	No	Yes	Yes	Yes
Sanitary Landfill	Yes after sterilization	Yes after encapsulation	No	Yes after encapsulation	Yes after encapsulation	Yes after encapsulation
Burial	Yes after sterilization	Yes after encapsulation	Yes	No	No	No
Septic Concrete Vault	Yes after sterilization	Yes	No	No	No	No

6.5.1 Infectious Waste

1. Autoclave

Autoclave treatment of infectious waste is the preferred option under this document for federal, provincial and local level hospitals. Treatment of such waste prior to disposal is mandatory for the health care facilities, where no off-site treatment is available. Air exhausted from autoclave operations must be treated by passing it through a high-efficiency particulate air (HEPA) filter or steam treatment. Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, other hazardous chemical waste and radiological waste should not be treated in an autoclave. Performance of autoclave units shall be verified periodically using biological indicators.

2. Chemical disinfection

Where chemical disinfection of waste is permitted, aldehydes, chlorine compounds, or phenolic compounds may be applied to waste to inactivate pathogens. Chemical disinfection is the preferred treatment for liquid infectious wastes, but it can also be used in treating solid infectious waste when such material is shredded prior to disinfection. This technique is most suitable in treating blood, urine, stools and sewage.

3. Others:

Besides these technologies, various other non-burn technologies can be used for the treatment of the infectious waste. Technologies such as microwave, frictional heat based, integrated steam-based technologies are some examples of the other technologies that can be used for the treatment of infectious waste

6.5.2 Sharps Waste

1. Autoclave

Infectious sharp waste such as used needles, blades, glass slides used in laboratory and others can be treated with autoclaves prior to disposal. Sharp waste such as needle of the syringes can be destroyed in the needle cutters to minimize the risk during the handling of such waste.

2. Encapsulation:

The sharp waste can be encapsulated and sent to landfill after autoclaving if infectious. These waste needs to be carefully handled. The waste once autoclaved, can be encapsulated and landfilled.

3. Septic Concrete Vault:

Sharps waste can be collected and disposed of in septic concrete vault. These wastes need to handle with care due to its potential hazards. Both the glass and the metal sharps can be disposed in the septic concrete vault. These vaults need to sealed with cement mortar once is filled and next vault can be constructed for further use.

6.5.3 Pathological waste disposal

1. Placenta pits

The dimensions of a placenta pit depend on the average number of births and infiltration rate of the soil. The bottom of the pit should be at least 1.5m from the groundwater level. Placenta pits should not be used in sites where the water table is near the surface or in areas prone to flooding. When the level of waste reaches a height of 0.5 m underneath the slab a thick layer of wood ash should be applied to the surface and the pit should be closed to further use for a minimum of two-years. The pit should be constructed at a distance of 25 meters away from the water sources.

2. Anaerobic digestion:

Biodegradable health care waste can be fed to an anaerobic digester, which results in fuel and compost. It is not recommended to fed the digester with only pathological waste. Wastes such as pathological waste should be fed in small amount compared to other general biodegradable waste. Digester fed with pathological waste needs to be monitored closely and should occur in a controlled system. It is not recommended to use the slurry as manure. Histopathological waste mixed with formaldehyde should not be fed into the digester. Such waste should be either encapsulated or disposed in controlled landfill.

6.5.4 Pharmaceutical waste disposal

1. Return back policy

The waste after its expiry can be returned back to the suppliers for proper management of the pharmaceutical waste.

2. Procurement policy

The health facilities needs to make sure to prescribe as less medicine as possible. For example, the health care provided should be able to limit the use of antibiotics.

3. Encapsulation/Inertization

Pharmaceutical waste may be encapsulated. The waste must be inertized prior to encapsulation. Solid, liquid, and semi-liquid wastes can be encapsulated in metal drums

4. Sanitary Landfill disposal

Small quantities of pharmaceutical waste produced on a daily basis may be landfilled provided that they are inertized and encapsulated.

Large quantities of pharmaceutical wastes shall not be landfilled unless the wastes are encapsulated and disposed of in a sanitary landfill. They shall not be disposed of with general waste nor shall they be diluted and discharged into sewers.

5. Discharge to a sewer

Moderate quantities of mild liquid or semi-liquid pharmaceuticals such as solutions containing vitamins, proteins, intravenous solutions, may be diluted in a large flow of water and discharged into municipal sewers or the hospitals' septic tanks. All pharmaceutical wastes should not be disposed of into slow-moving or stagnant water. Antibiotics, cytotoxic drugs and hormonal drugs needs to be disposed separately in controlled manner. A separate guideline needs to be developed for its disposal.

6.5.5 Chemical waste disposal

Chemical wastes should be stored in leak-proof containers and labelled to identify the contents. Hazardous chemical wastes of different composition should be stored separately to avoid unwanted chemical reactions. Any waste that cannot be properly treated should be handled and disposed of by an authorized waste management organization.

1. Return back policy

Hazardous chemical can be returned to the original supplier who should be equipped to deal with them safely.

2. Encapsulation / Inertization

Small amount of chemical waste may be encapsulated. The waste must be inertized prior to encapsulation. Solid, liquid, and semi-liquid wastes can be encapsulated in metal drums. Large amounts of chemical disinfectants should never be encapsulated as they are corrosive and sometimes flammable.

3. Discharge to a sewer

Non-hazardous chemical wastes such as sugars, amino acids and certain organic and inorganic salts, which are widely used in transfusion liquids can be disposed into the sewer system or the health facility septic tank. Hazardous chemical wastes should not be discharged into sewerage systems.

4. Burial Pit

Non-hazardous chemical waste may be disposed in the burial pit. Large amounts of chemical waste should not be buried as they may contaminate water sources.

6.5.6 Cytotoxic waste disposal

1. Limitations on use of cytotoxic drugs

The use of cytotoxic drugs should be limited to specialized (e.g oncological) health-care facilities which are better able to handles those waste. Health-care facilities, using cytotoxic products, must develop specific guidelines on their safe handling for the protection of personnel and the environment in their health-care waste management plans.

2. Requirements for procurement of cytotoxic drugs

Provision should be made in the procurement of all cytotoxic drugs that expired and disused supplies must be taken back by the supplier for safe disposal upon request of the purchasing unit.

3. Chemical degradation and neutralization:

Most of these methods are relatively simple and safe, they include oxidation by potassium permanganate ($KMnO_4$) or sulfuric acid (H_2SO_4), de-nitration by hydrobromic acid (HBr), or reduction by nickel and aluminium. The methods are not appropriate for the treatment of contaminated body fluids.

Chemical neutralization through Advance Oxidation using Sodium hypochlorite can be applied as alternative method for the treatment of cytotoxic waste on the principles of chemical oxidation.

4. Encapsulation

Small quantities of cytotoxic wastes can be encapsulated and sent to landfill for final disposal.

6.5.7 Radioactive Waste Materials

1. Limitations on use of radioactive materials.

The use of radioactive should be limited to specialized (e.g oncological) health-care facilities which are better able to handles those waste. Health-care facilities, using radio-active materials, must develop specific guidelines on their safe handling for the protection of personnel and the environment in their health-care waste management plans.

2. Requirements for procurement of equipment with radioactive materials

Provision should be made in the procurement of all radioactive materials that expired and disused supplies must be taken back by the supplier for safe disposal upon request of the purchasing unit.

3. Decay:

As radio isotopes decay itself with time. If stored in a leak proof container for 10* half-life, it will lose 99.9% of its radio activity which is considered to be at safe level. Leak proof container means shielding with lead which blocks 99.9% of the radio activity to go outside. This is the most common practice because the half-life for maximum isotopes are not more than few days.

4. Disposal to general waste stream:

Vials, cotton swabs, syringes, tissue paper are considered low activity articles which can be disposed as other medical waste if activity is less than 1.35 micro-curies.

5. Drainage:

Liquid Isotopes with activity less than 1 micro-curies can be drained to the sewer with adequate flushing with water. However, amount of daily allowances is different for different isotopes.

6. Burial:

Exclusively, for Isotopes with long half-life. e. g. Half-life in years. But these isotopes are rarely used. Burial site should be approved for radioactivity.

6.6 MONITORING AND EVALUATION

Regular monitoring and evaluation of the plan in each HCF should be performed. Regular reviews help in identifying potential loopholes and bottle necks and enable the HCFs to reveal new issues which may arise while managing HCW. Formulating recommendations and pointing out shortcoming of the programs also provides an opportunity to involve and educate staff and furthermore reinforces good practices. The monitoring and evaluation process should be conducted by the HCWM committee in frequent intervals on compliance of rules, regulations and HCWM standards specified in section 10 of this document

7. CIRCULAR ECONOMY

Circular Economy

The concept of circular economy envisions a system in which end-of-life products can be reused, recycled or reinvented into new useful products. Rather than a cradle-to grave system, this emphasize the cradle-to-cradle system which generates revenue and saves resources with minimum production of waste. It is aligned with the concept of zero waste. In economics the approaches to move away from a linear economy to a more sustainable alternative can be summarized under the idea of a circular economy. Core ideas of the circular economy idea are show in figure 3. Integration of policies on materials, product and chemicals management, and use of life-cycle oriented waste and materials management and related policies is an important aspect in achieving resource efficiency and productivity. Examples include 3R policies (reduce, reuse, recycle), sustainable materials management, sustainable manufacturing, resource efficiency and circular economy policies. Waste prevention can be encouraged through eco-design, reuse, repair, refurbishment, re-manufacturing, and extended producer responsibility (EPR) schemes. (OECD 2020)

Figure 5: Flow chart with steps to achieve a circular economy (UNIDO 2017)

8. HEALTH AND SAFETY PRACTICES

Management of HCW is an integral part of hospital hygiene and infection control. HCW should be considered as a reservoir of pathogenic micro-organisms, which can cause contamination and give rise to infection. If waste is inadequately managed, these micro-organisms can be transmitted by direct contact, in the air, or by a variety of vectors. Infectious waste may lead to the risk of nosocomial infections, putting the health of hospital personnel and patients at risk. It must be emphasized here that other environmental health considerations, such as adequate water supply and sanitation facilities for patients, visitors, and health care staff are also of prime importance. HCWM plans should include provision for the continuous monitoring of workers' health and safety to ensure that correct handling, treatment, storage and disposal procedures are being followed. Essential occupational health and safety measures include the following basic measures:

- Proper training of workers (no training/no hiring policy should be instituted; immunization on the first day of work).
- Provision of equipment and clothing for personal protection.

- Establishment of an effective occupational health program that includes immunization, post-exposure prophylaxis (PEP) treatment and continuous medical surveillance.
- Information, Education and Communication (IEC) activities.

Training on health and safety should ensure that workers know and understand the potential risks associated with HCW, the value of immunization against viral hepatitis B and the importance of consistent use of personal protection equipment (PPE). Workers at risk include health care providers, hospital cleaners, maintenance workers, operators of waste treatment equipment, and all operators involved in waste handling and disposal within and outside health care establishments.

8.1 INFECTION PREVENTION

Everyone who works at, receives care at or visits HCFs is at risk of infections. Thus, infection prevention is the responsibility of everyone. As a result of being at a HCF, staff, clients and visitors may be exposed to infectious diseases that others at the facility have. We can, however, prevent transmission of infections in many cases. The only way to prevent infections is to stop the transmission of micro-organisms that cause infections. The best way to prevent infection is by following standard precautions, which include the following:

- Washing hands often and thoroughly.
- Wearing PPE such as gloves, eye protection, face-shields, and gowns.
- Use of tongs for separation of waste if ever required.
- Following appropriate respiratory hygiene/cough etiquette.
- Preventing injuries by correctly handling sharps.
- Correctly processing instruments and client-care equipment.
- Maintaining correct environmental cleanliness and waste-disposal practices.
- Handling, transporting and processing used and potentially soiled linens correctly.

8.2 PERSONAL HYGIENE AND HAND HYGIENE

Basic personal hygiene is important for reducing the risks from handling HCW, and convenient washing facilities (with warm water and soap) should be available for personnel involved. As the hands of health care workers are the most frequent vehicle of nosocomial infections; hand hygiene including both hand washing and hand disinfection are the primary preventive measures. An antimicrobial soap will reduce the transient flora, only if the standard procedure for hand washing is applied. Hand washing with non-medicated soap is essential when hands are dirty and should be routine after physical contact with a patient. Killing all transient flora with all contaminants within a short time (few seconds) necessitates hygienic hand disinfection. Only alcohol or alcoholic preparations act sufficiently fast. Hands should be disinfected with alcohol when an infected tissue or body fluid is touched without gloves.

8.3 WORKERS' PROTECTION

The generation, segregation, collection, transportation, treatment, and disposal of HCW involves the handling of potentially hazardous and infectious material. Protection against personal injury is, therefore, essential for all workers who are directly involved in handling potentially hazardous and infectious HCW. The individuals responsible for the management of HCW should ensure that all risks are identified and that suitable protection from those risks is provided. A comprehensive risk assessment of all activities involved in HCWM should be carried out during the preparation of the

HCWM plan, which will allow the identification of necessary protection measures. These measures should be designed to prevent exposure to hazardous materials or other risks, or at least to keep exposure within safe limits (WHO 1999). Suitable training should be provided to the related personnel on this aspect.

8.3.1 Protective clothing

The type of protective clothing usage depends, to an extent, upon the risk associated with the HCW. The following should be made available to all personnel who are directly involved to collect and handle HCWs:

- Helmets or cap with or without visors, depending on the operation
- Face masks, depending on operation
- Disposable gloves (medical staff), utility gloves or heavy-duty gloves (waste workers), both obligatory
- Eye protectors (safety goggles), depending on operation
- Overalls (coveralls), obligatory
- Aprons, obligatory
- Leg protectors and or boots, obligatory

Figure 6: An example of full set of PPE

Boots and heavy-duty gloves are particularly important for waste workers. The thick soles of the boots offer protection in the storage area, as a precaution from spilled sharps, and where floors are slippery. If segregation is inadequate, needles or other sharp items may have been placed in plastic bags; such items may also pierce thin-walled or weak plastic containers. If it is likely that HCW bags will come into contact with workers' legs during handling, leg protectors may also need to be worn. An example of appropriate PPE is shown in Figure 6.

8.3.2 Immunization

Viral hepatitis B infections have been reported among health care personnel and waste handlers, and immunization against the disease is; therefore, recommended. Tetanus immunization is also recommended for all personnel handling waste.

8.3.3 Injection Safety

Medical professionals and health care workers must be made aware on the injection safety. Injections are most commonly used among health care procedure worldwide. In developing and transitional countries alone, some 16 thousand million injections are administered each year. Most injections, more than 90%, are given for therapeutic purposes while 5 to 10% are given for preventive services, including immunization and family planning procedures. (WHO 2015) A safe injection does not harm the recipient, does not expose the health care worker to any avoidable risk and does not result in waste that is dangerous for the community. Unsafe injection practices (reuse of syringes and needles in the absence of sterilization) must be discouraged. The disposable needle and syringe should be rendered useless after use. The needle from the syringe should be cut/crushed and disposed safely.

8.3.4 Response to injury and exposure

Health care facility should establish program that prescribes the actions to be taken in the event of injury or exposure to a hazardous substance. All staffs who handle HCW should be trained to deal with injuries and exposures. The program should include the following elements:

- Immediate first-aid measures, such as cleansing of wounds and skin, and irrigation (splashing) of eyes with clean water.
- An immediate report of the incident to a designated responsible person.
- Retention, if possible, of the item involved in the incident; details of its source for identification of possible infection.
- Additional medical attention in an accident and emergency or occupational health department, as soon as possible; such as availability of post-exposure prophylaxis (PEP).
- Medical surveillance
- Blood or other tests if indicated.
- Recording of the incident;
- Investigation of the incident, and identification and implementation of remedial action to prevent similar incidents in the future.

The purpose of incident reporting should not be seen as punitive; active support by managers should encourage prompt and accurate reporting.

8.3.5 Special precautions for spillages of potentially hazardous substances

Spillage usually requires clean-up of the only contaminated area. For clearing up spillages of body fluids or other potentially hazardous substances, particularly if there is any risk of splashing, eye protectors and masks should be worn, in addition to gloves and overalls. Respirators (gas masks) are also needed if an activity is particularly dangerous, for e.g., if it involves toxic dusts, the clearance of incinerator residues, or the cleaning of contaminated equipment. Residues should be recovered as completely as possible using hand tools (e.g. a shovel), and then packed safely. It is especially important to recover spilled droplets of metallic mercury. If a leakage or spillage involves infectious material, the floor should be cleaned and disinfected after most of the waste has been recovered.

8.4 SAFE USE OF CYTOTOXIC DRUGS AND RADIOACTIVE MATERIALS

Health care facilities, which use cytotoxic products and radioactive materials, should develop specific guidelines on their safe handling for the protection of personnel and the environment. It is difficult to ensure safe use of cytotoxic and radioactive material, it is recommended that the use of these substances be limited to specialized (e.g., oncological) HCFs, which are better able to implement safety measures. The guidelines handling cytotoxic products should include rules on the following waste handling procedures:

- Separate collection of waste in leak proof bags or containers, and labelling for identification
- Return of date expired drugs to suppliers. Take back policy should be applied for these kinds of materials. Agreement should be signed while purchasing the cytotoxic and radioactive materials and these materials should be collected back by the suppliers after usage.
- Safe storage separately from other HCW
- Provisions for the disposal of contaminated material, for the decontamination of reusable equipment, and for the treatment of spillages.

- Provisions for the treatment of infectious waste contaminated with cytotoxic products, including excreta from patients and disposable linen used for patients.

Hospital staff should ensure that the families of patients undergoing chemotherapy are aware of the risks and know how they can be minimized or avoided. Minimal protective measures for all waste workers who handle cytotoxic waste should include protective clothing, gloves, goggles and masks.

8.5 EMERGENCY RESPONSE IN CASE OF SPILLAGE

Spillage is the most common type of emergency involving infectious and other hazardous materials. Spills are inadvertent discharges that occur at different place of HCF. Spills include accidental tipping over containers, dropping and breaking of containers. It may also occur during manual transfer, overfilling and leaks in the process. The response process for the spillage includes:

- Evacuation of the contaminated area.
- Immediate decontamination of the eyes and skin of exposed personnel immediately.
- Informing immediate supervisor for the further action.
- Appropriate PPE should be worn before the clean-up process.
- Neutralization or disinfection of the contaminated materials and area.
- Collect all spilled materials. (in case of blood and other fluids, apply 0.5% chlorine solution for 10 minutes and then collect/ In case of chemical spill, it has to be neutralized prior to collection of the materials)
- The decontamination should be carried out by working from the least to the most contaminated part, with a change of cloth at each stage. Dry cloths should be used in the case of liquid spillage; for spillages of solids, cloth impregnated with water (acidic, basic or neutral, as appropriate) should be used.
- The area should be properly rinsed and wiped with absorbent cloth.
- Impacts must be limited on patients, medical, other personnel and environment.
- In case of skin contact with hazardous substances, immediate decontamination needs to take place by washing
- In case of eye contact with corrosive chemicals, the eye should be irrigated continuously with clean water for 10-30 minutes. For this, the entire face should be submerged in a basin with eyes being continuously opened and closed.

9. HEALTHCARE WASTE MANAGEMENT IN AN EMERGENCY

Emergency can be of different kinds ranging from natural disasters like earthquake, landslide, flood, fire to medical emergencies like disease endemic/pandemic (e.g Ebola, Covid-19 etc). In all kind of emergency, the major issues are generation of huge volume of health care waste and its management by selecting appropriate waste treatment technologies.

During emergency it is advised to do quick rapid assessment to identify the waste generation volume, population affected and types of waste which helps for further development of quick action plan for individual, organization and team involved for emergency management.

As per WHO emergency guideline, as a basic starting point and to avoid sharp infection and injuries, health care waste generated during healthcare activities in any setting like tent, temporary hospitals, mobile hospitals, camps should be segregated using three bin system that is collecting waste as sharps,

general and hazardous and needs to keep separately until its treatment and final disposal. Burial of sharps and other waste in pits or trenches may be considered as an interim solution in emergency situations following the national standard. Burning of healthcare waste is not desirable, but if there is more risk of spreading highly infectious diseases through the waste and it is only the option available in emergency, it should be undertaken in a confined area (burning within a dugout pit, followed by covering with a layer of soil). But it is highly discouraged even for emergency and is not the management option if other options can be feasible. In any condition, plastic waste is never burnt.

Different preventive measures should be followed during an emergency response to reduce occupational health risks:

- Provide hepatitis B vaccine to all healthcare staffs and waste handlers involved in emergency response
- Use PPE by waste handlers with appropriate training or mentoring on it
- Practice hand hygiene (frequent washing with soap water or use alcohol-based hand rubber)
- Contain and promptly clean up spillage of infectious materials and disinfect quickly to avoid pathogen transmission

As an emergency response progresses and more aid resources become available, the management of healthcare waste should be as per national standard and needs to be segregated on standard color-coded bins for different types of waste.

9.1 WASTE MINIMIZATION IN AN EMERGENCY:

Where feasible, minimizing the amount of waste that is produced by a health care facility is a good waste management practice. Waste minimization is most commonly applied at the point of generation, but it can also happen before items even enter the health care facility. Some examples of good waste minimization practice include:

Selecting materials with minimal packaging, choosing equipment that can be reprocessed locally, changing (or substituting) products etc.

Segregation and packaging:

Segregate and use hazardous bag for packaging the waste following national standard. If in emergency hazardous bag are not available, containers for non-sharp waste should be washed and disinfected after being emptied.

Dead Body should be safely stored and disposed of depending upon types of emergency and following local culture and customs. For instance, in disease pandemic situation which has a chance to spread infection even from dead bodies should be avoided in contact with others and dispose of following national guideline of dead body management.

9.2 COLLECTION AND TRANSPORTATION:

- All the waste bins shall be emptied once it is ¾ full and cleared away from the patients' area at least once every day
- Exclusively allocated trolleys should be used. Two transportation trollies, one for the hazardous waste and other for the general waste shall be used. These trollies shall be place with appropriate bins, properly labelled, easy to load/unload, easy to clean and with no sharp edges.

- All the biohazard bags collected shall be properly labelled (date, name of unit, type of waste) and are tied/closed with rope/lock before collection.
- The bags or containers shall be replaced immediately with new ones of the same type.

9.3 STORAGE

- Segregated waste should be stored preferably in specific restricted waste storage area. The area should be locked room or guarded enclosure. If the room is not available, a large container with lids may be used for temporary storage and be kept in a restricted area with a symbol that is understood locally to differentiate general and hazardous waste.
- These areas shall have adequate lighting, ventilation and provision for the containment of spills (infectious, chemical) and be protected from sun, rain and wind and always kept clean.
- Infectious wastes shall not be stored for more than 24 hours during the hot season and 48 hours during the cold season.

9.4 TREATMENT AND DISPOSAL:

Any treatment technologies that might have substantial impact on environment and public health shall be considered as transitional means of treatment and disposal and immediately replaced with environment friendly technologies.

- All the waste generated shall be treated prior to disposal.
- Alternative treatments shall be designed for the treatment of infectious health care waste, such as steam treatment methods. Steam treatment shall preferably be on-site, although once treated, sterile/non-infectious waste may be mutilated and disposed of in municipal landfill.
- The treatment processes shall be validated and periodically tested to ensure they function properly using biological indicators (e.g.: spores) or other test assays.
- Needle cutters/destroyers shall be used in all the locations where syringes are used.
- Decontaminated sharps waste can be disposed of in concrete-lined sharps pits on facility premises or encapsulated by mixing waste with immobilizing material, such as cement, before disposal.
- Liquid infectious waste can be disposed of directly into a closed sewer system (such as a utility sink drain or flushable toilet) or onsite septic tank system by staff wearing PPE and taking precautions to avoid splashing. If neither is available, this waste should be poured directly into a pit latrine. Disposing of liquid infectious waste into pipes that go to open drainage canals should not be conducted without pre-treatment. If you use the sink or toilet for disposal of liquid infectious waste, be sure to thoroughly rinse with water and clean and disinfect the sink or toilet using 0.5% chlorine solution to remove residual waste.
- In resource constraints settings as per emergency types, minimal treatment and disposal practices should continue to be used as following:
    - Onsite burial in pits or trenches (follow national standard)
    - Disposal in special designated area in municipal dumping sites
    - Burning in a dugout pit and then covering with soil (less desirable)
    - Encapsulation or inertization can be used to dispose of small quantities of sharps, chemicals, or pharmaceutical waste.

10. TRAINING

Training of health care providers is crucial for the successful implementation of the health care waste management programme. The overall aim of training is to enhance the knowledge, skill and attitude of health care provider on health, safety, and environmental issues relating to health-care waste, and how these can affect employees in their daily work. It should highlight the roles and responsibilities of health-care personnel in the overall management of programme.

10.1 TRAINING RESPONSIBILITY

The need identification of the HCWM training will be done by Management Division at the central level and provincial Health Directorate at the provincial level. National Health Training Centre (NHTC) in coordination with the Management Division/ DoHS is responsible for development of learning resource package and pool of trainers on HCWM. The pool of trained personnel on integrated package of HCWM will roll out training on HCWM at sub national level in coordination with Provincial Health Training Centre and Provincial Health Directorate. The record of all training sessions should be well documented in systematic manner. The content of the training programs should be periodically reviewed and updated as per latest technological development and requirements. The Administration/Management Section of health care facilities should ensure that all staffs of HCFs are aware about HCWM plan and their roles, responsibilities and commitment in this regard.

10.2 TRAINING MODALITY

The training modality can be Whole site which includes managerial level staff as well as staff working at the ground level of the whole health facility. Likewise, group-based training can also be organised as per need.

10.3 TRAINING APPROACH

Cascade model of training approach will be implemented for rolling out integrated package of HCWM. NHTC in coordination with Management Division will develop Pool of trainers at the federal and provincial level. The trained personnel on training package will then further organise training at the province and local level.

10.4 ROLLING OUT TRAINING

Environmental Health and Healthcare Waste Management Section/ Management Division will be responsible to ensure required technical and financial resource in order develop the training package and rolling out the training throughout the country

10.5 TRAINING PACKAGE

National Health Training Centre (NHTC) will develop a comprehensive training package on HCWM in close coordination with Environmental Health and Healthcare Waste Management Section/ Management Division, Department of Health Service/ MoHP. The package should be suitable for various types of HCFs, including government, private, teaching and dental hospitals, polyclinics, health centre, health care research institutions and medical laboratories. The document will also be useful for more general educational establishments and for organizations that provide services for HCW management and disposal. The training package including reference materials will be as per NHTC standard and MOHP/Government of Nepal will approve it. This integrated training

package on HCWM, Environmental Health and WASH including Management module will be recommended for comprehensive knowledge management and skill enhancement for all.

10.6 EMPLOYEES TO BE TRAINED

Training: All hospital personnel, including medical doctors, public health officials should be convinced of the need for a comprehensive HCWM plan and the related training. Separate training activities should be designed for the following personnel:

- Hospital managers, public health officials and administrative staff responsible for implementing regulations on HCWM.
- Medical doctors
- Nurses and Paramedical staffs, cleaners, porters, staff and waste handlers

Orientation: In addition to this, there should be orientation programme planned for patients, visitors at HF level and awareness programme to surrounding community on basic knowledge on HCWM like segregation at source and safe disposal.

A separate module of orientation package including Management Module to managers and decision makers on Integrated HCWM can be developed and implemented at all levels.

10.7 CONTENT

The training program should include:

- Information on, and justification for, all aspects of the health care waste plan
- Information on the role and responsibilities of each hospital staff member in implementing the plan
- Technical instructions, relevant for the target group, on the application of waste management practices.

These should be periodically reviewed and updated. Periodic repetition of courses will provide refreshment training as well as orientation for new employees and for existing employees with new responsibilities; it will also update knowledge in line with policy changes. In general, the training should include the following information:

- Concept of health care waste and basic steps for health care waste management
- Legal provisions, policies and international commitments
- Impact of HCW on health and environment
- Health care waste management
- Management of mercury spill
- Injection safety
- Health and safety
- Health care waste management at different levels of HCF
- Field visit and action plan

10.8 SELECTION OF PARTICIPANTS AND TRAINERS

The ideal number of participants in a training course is 20. The ratio of trainers and trainees will be 1:4. Courses should be aimed at all categories of personnel; discussions may be easier and more

useful if the group is composed of trainees from various disciplines (e.g. supervisors, medical and nursing staff, laboratory staff, engineers, health officials). It may also be valuable to include senior administration staff and heads of departments in certain training groups to demonstrate their commitment to the waste management policy and to show the relevance of the policy to all personnel of health care establishments.

Subject experts and TOT holders on the training package will be the facilitators of the training. Senior Officers from Management Division and NHTC will be resource person for the training.

11. RAISING AWARENESS

11.1 PUBLIC EDUCATION ON HAZARDS LINKED TO HEALTH-CARE WASTE

Promotion of the appropriate handling and disposal of medical waste is important for community health, and every member of the community should have the right to be informed about potential health hazards.

The objectives of public education on health-care waste are the following:

- To prevent exposure to health-care waste and related health hazards
- To create awareness and foster responsibility among hospital patients and visitors to health-care establishments regarding hygiene and HCWM.
- To inform the public about the risks linked to HCWM.

Various IEC/BCC activities will be carried out for public education on risks, waste segregation, or waste disposal practices.

12. CANCELLATION AND DEFENCE

12.1 hereby the Heath Care Waste Management Guideline 2014 will be cancelled after endorsement of this National Healthcare Waste Management Standards and Operation Procedures 2077 (2020).

12.2 All activities been carried out as per Heath Care Waste Management Guideline 2014, will be considered as implemented according to National Healthcare Waste Management Standards and Operation Procedures 2077 (2020).

13. HEALTHCARE WASTE MANAGEMENT STANDARDS 2077 (2020)

According to Public Health Service Act 2075 (2018), article 41, sub article (1) and (2) and Public Health Service Regulation 2077 (2020) Rule 11, Sub-rule (5) of Rule 12, sub-rule (3) of Rule 13 and Rule 25 related annex -8 "Health Facility Operation Standards - 11", this "**Healthcare Waste Management Standards 2077 (2020)"** has been prepared with objective of safe management of healthcare waste at all level of health institutions and mentioned in Annex-VI, It will be implemented at all level of health institutions in Nepal after its endorsement and publication in "Nepal Rajpatra".

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2. Healthcare waste management in the context of COVID – 19 emergency, 2020 MoHP, Nepal government
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4. Dead body management guideline 2020, MoHP, Nepal government

		Source
Page 51	Figure 5	HECAF360
Page 67	Annex 13.1	GPN/HECAF360
page 68	Annex 13.2	HCWH / HECAF

15.Annex:

15.1 Annex I: A Format for waste assessment

Waste Generation Record Sheet

Name of HCF/ Hospital: Address:

Unit/ Ward:

Fiscal Year:

Date:																
Day																
Occupancy (%)																
Pre Separation	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**
Risk Waste (Mixed)																
Infectious waste																
Sharp waste																
Pathological waste																

Pharmaceutical waste																
Chemical Waste																
Others risk waste																
Total Risk Waste (A)																
Non-Risk Waste (Mixed)																
Biodegrable																
Bottle & Cans																
Glass																
Paper																
Plastics x																
Plastic y																
Plastic Z																
Others																
Total Non-Risk Waste (B)																
Total waste (A+B) -Pre separation																
Post Separation	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**	**W. Kg.**	**V. Ltrs.**
Risk Waste (Mixed)																
Infectious waste																
Sharp waste																
Pathological waste																
Pharmaceutical waste																

Chemical Waste																
Others risk waste																
Total Risk Waste (A1)																
Non-Risk Waste (Mixed)																
Biodegrable																
Bottle & Cans																
Glass																
Paper																
Plastics x																
Plastic y																
Plastic Z																
Others																
Total Non-Risk Waste (B1)																
Total Waste (A1+B1)l																

15.2 ANNEX II: DAILY MONITORING CHECKLIST OF HCWM AT HCFS

Name of HCF/ Hospital: Address:

Ward/ Unit: Month/ Year:

	Equipment Supply					Waste Handling					Maintenance					
Day	Correct bins and bags	Needle Destroyer/ Sharp puncher proof container	Signage and labelling	Spill kit	Log book/ Incident record	Bins Overfilled	Waste Spilled	Waste segregated properly	Sharp handled correctly	Any Needle Stick Injury or accident?	Bins and bags maintained	Needle cutter working	Signage and labelling clear	All equipment clean and functional	Log book/ forms filled in	Observer (Initial Signature)
1																
2																
3																
4																
5																
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32															

15.3 ANNEX III: COMPARISON OF INFECTIOUS AND SHARP WASTE TREATMENT TECHNOLOGIES WHICH COMPLY WITH STOCKHOLM AND BASEL CONVENTIONS

Type of Technology	Capacity (kg/h)	Environmental Impact	Capital Cost	Operating Costs
Vacuum Autoclave	5-3000	•	•	•
Autoclave with integrated shredding	5-3000	•	••	••
Batch wise microwave	1-210	•	•	••
Continuous microwave	100-600	•	••	••
Frictional heat treatment	10-500	•	••	••
Sodium hypochlorite treatment	600-3000	••	•••	••
Ozone treatment	45-1000	•	•••	•
Incineration including flue gas treatment	50-3000+	••	••••	••••

15.4 ANNEX IV: COMPARISON OF INTERIM TECHNOLOGIES USED IN LOW RESOURCE SETTINGS.

Type of Technology	Capacity (kg/h)	Environmental Impact	Capital Cost	Operating Costs
Automated pressure pulsing autoclave	5-50	•	•	•
Dual chamber incinerator	5-500	••	••	••
Single chamber incinerator	5-500	•••	•	•
Open burning	Not Available	••••	Not available	Not available

15.5 ANNEX V: HEALTHCARE WASTE MANAGEMENT PRACTICES OBSERVATION CHECKLIST.

Name of Health Care Facility:

Address:

Name of Focal Person:

Contact Detail:

***Scoring Table:**

Indicator meets the standards (in %)	**Score**
0 to 50%	**0**
50 to 70%	**1**
70 to 85%	**2**
85 to 100%	**3**

S.N	**Indicators**	**Score (0 to 3) according to scoring table***	**Remarks**
1	The facility has a yearly HCWM Improvement plan in place		
2	The facility has a HCWM committee with clearly defined roles and responsibilities along with designated and trained HCWM Focal Person?		
3	Waste are correctly segregated as per their category into appropriate coded bin at the source?		
4	All waste bins properly labelled with pictorial and text messages?		
5	The medication trollies in the ward are well equipped with proper bins for waste segregation along with needle cutter?		
6	All needles in syringes destroyed at source using needle cutter/destroyer and are not recapped?		
7	Waste collected frequently in leak proof biohazard bags before the bins are 3/4 full?		
8	Wastes are transported properly (transporter using proper PPE, designated time and avoiding crowded places) using separate waste transportation trollies for general and hazardous waste?		
9	Vehicle transporting waste out of the facility meets required standards in case of off-site treatment?		
10	The facility have designated area for interim storage and final storage of the waste as per required standard?		
11	All hazardous waste is treated and rendered safe as per the categories before final disposal?		
12	All health workers and waste handlers vaccinated against Hepatitis B and Tetanus?		
13	The facility have a injury recording system and availability of PEP in case of injury?		

S.N	Indicators	Score (0 to 3) according to scoring table*	Remarks
14	Wastewater is treated and finally discharged as per the national standard?		
15	Recording system for all the waste related processes (waste generation, treatment, disposal, operation of equipment) is in place?		
16	Information related to health care waste management are demonstrated in public places through banners or posters within the facility premises?		
17	Health care workers and waste handlers are provided refresher training on regular basis?		
18	Equipment used for waste treatment are regularly maintained and tested for efficiency using testing indicators as recommended by national standards?		
19	The facility have a mechanism of monitoring of the HCWM system both internally and externally at least once a year?		
20	Mechanism of onsite coaching to the patients and the visitors regarding HCWM is in place?		
	Total Score (X):		
	Total Score in % ((X/20)*100):		

Total Score and Colour Coding of HF:

Total score in (%)	Colour Coding	
0 to 50%	white	
50 to 70%	Yellow	
70 to 85%	Blue	
85 to 100%	Green	

Source: Minimum Service Standard 2076 MoHP

Date of Assessment: Assessment Conducted by:

15.6 ANNEX VI: **HEALTHCARE WASTE MANAGEMENT STANDARDS 2077 (2020) - DRAFT**

स्वास्थ्यजन्य फोहोरमैला व्यवस्थापन सम्बन्धि मापदण्ड २०७७ (मस्यौदा)

जनस्वास्थ्य सेवा ऐन २०७५ को धारा ४१ उपधारा (१) र (२) तथा जनस्वास्थ्य सेवा नियमावली २०७७ को नियम ११, नियम १२ को उपनियम (५), नियम १३ को उपनियम (३) र नियम २५ सँग सम्बन्धित अनुसूची ८ को **स्वास्थ्य संस्था सञ्चालन मापदण्ड** ११ को आधारमा रहि सबै तहका स्वास्थ्य संस्थाहरुमा सुरक्षित तरिकाले स्वास्थ्यजन्य फोहोरमैला व्यवस्थापन गर्ने उद्देश्यले यो मापदण्डहरु तयार पारिएको छ। यी मापदण्डहरु जुनसुकै स्वास्थ्य संस्थाहरुमा स्वास्थ्यजन्य फोहोरमैला व्यवस्थापनको लागी आधारभुत कुराहरु हुन्। सोही ऐनको धारा ४१ उपधारा (४) बमोजिम् प्रत्येक स्वास्थ्य सस्थाले यस निर्देशिकामा तोकिएका मापदण्डहरु बमोजिम् जोखिम रहित र जोखिमयुक्त फोहोरहरूलाई छुट्याई उचित व्यवस्थापन गर्नु पर्ने हुन्छ।

स्वास्थ्यजन्य फोहरमैला व्यवस्थापन सम्बन्धि मापदण्ड

क्र. सं.	कार्यविधि	विवरण	मापदण्डहरु
१	स्वास्थ्यजन्य फोहरमैला व्यवस्थापनका लागि योजना तर्जुमा (HCWM Planning)	योजना	हरेक स्वास्थ्य संस्थामा स्वास्थ्यजन्य फोहरमैला व्यवस्थापनका अद्यावधिक कार्ययोजना तयार अवस्थामा हुनुपर्नेछ
२	स्वास्थ्यजन्य फोहरमैला व्यवस्थापन समिति गठन गर्ने (HCWM Committee)	स्वास्थ्यजन्य फोहरमैला व्यवस्थापनका लागि निर्दिष्ट व्यक्ति (HCWM Focal Person)	स्वास्थ्यजन्य फोहरमैला व्यवस्थापनका लागि तालिम प्राप्त निर्दिष्ट व्यक्ति (HCWM Focal Person) अनिर्वाय रुपमा तोकिएको वा व्यवस्था गरिएको हुनुपर्नेछ।
		स्वास्थ्यजन्य फोहरमैला व्यवस्थापनमा सुशासन	सरकारका तीनै तहमा स्वास्थ्य संस्था प्रमुखको नेतृत्व तथा हरेक विभागहरुको सदस्यता रहने गरी स्वास्थ्यजन्य फोहरमैला व्यवस्थापन समिति गठन गर्ने र हरेक पदाधिकारी तथा सदस्यहरुको भुमिका तथा जिम्मेवारीहरु निर्दिष्ट रुपमा परिभाषित गरी जानकारी गराएको र पालना गर्नु पर्नेछ।
३	श्रोतमै फोहर छुट्याउने र वर्गीकरण गर्ने (Segregation of waste at Source)	श्रोतमै फोहर छुट्याउने र वर्गीकरण गर्ने	फोहोरको उत्पादनमानै कमि ल्याउने कार्यहरु गरिनु पर्दछ।
			स्वास्थ्य संस्थाहरुमा फोहोरको वर्गीकरण गर्न उपलब्ध विभिन्न रंगका बाल्टि तथा विनहरुको उचित प्रयोगसहितको व्यवस्थापन गर्नुपर्नेछ।
		रंग कोडिङ्ग (Color Coding)	प्रत्येक किसिमको फोहरका लागि रगं कोडिङ्ग मापदण्ड लागू गरिएको हुनुपर्छ। हरियो रगं : कुहिने सामान्य फोहरका लागि नीलो रगं : नकुहिने सामान्य फोहरका लागि रातो रगं : जोखिमयुक्त फोहरका लागि (संक्रमित, प्याथोलोजिकल, धारिलो, औषधीजन्य तथा साइटोटोक्सिक) पहेलो रगं : जोखिमयुक्त रसायनिक फोहरका लागि कालो रगं : जोखिमयुक्त रेडियोधर्मी फोहरका लागि बिन/बाल्टीनहरुको रगं कोडिङ्ग सबै संस्थाहरुमा एकरुपताका साथ नियमितरुपमा लागू हुनुपर्नेछ।

क्र. सं.	कार्यविधि	विवरण	मापदण्डहरु
		लेबलिङ्ग (Labeling)	फोहोर बर्गिकरण , संकलन तथा भण्डारणमा प्रयोग भएका हरेक बिन/बाल्टीनहरुमा तस्वीर तथा विवरण सहितको उचित प्रकारले लेबलिङ्ग गर्नुपर्नेछ।
		फोहर छुट्याउने रंगीन बाल्टीनहरु सहितको औषधी उपचार गर्ने ट्रलि	उपचारको क्रममा प्रयोग गरिने औषधी उपचार ट्रलि (Medication trolley) मा राम्ररी लेबलिङ्ग (Labeling) गरेको फोहर छुट्याउने रंगीन बाल्टीनहरु भएको र संक्रमित सुई नष्ट गर्ने उपकरण (Needle Cutter वा Needle destroyer) समेतको प्रावधान भएको हुनुपर्नेछ।
		सुईको व्यवस्थापन	क) सुई लगाउने हरेक स्थानहरुमा संक्रमित सुई नष्ट गर्ने उपकरण राख्नु पर्नेछ। ख) सुई लगाउने व्यक्ति ले नै संक्रमित सुई नष्ट गर्ने उपकरण प्रयोग गरी सुई काट्नु पर्नेछ।
४	फोहर संकलन (Collection)	फोहर संकलन	क) सामान्य र जोखिमयुक्त फोहोर छुट्टाछुट्टै संकलन गर्नुपर्नेछ। ख) धारिला (Sharp) फोहोरहरुको लागी नछेडिने (Puncture proof) र अन्य फोहोरहरुको हकमा बायो हजार्ड ब्याग (Bio-hazard bag) सहितका नफुटने, छिद्र नभएका भाडाहरु (बिर्का भएका विन, वाल्टि) मा सुरक्षित तरिकाले संकलन गर्नुपर्दछ। ख) नियमित अन्तरालमा फोहर संकलन गर्नुपर्ने र बाल्टीनमा फोहर तीन चौथाइ (¾ ४) भन्दा बढी भरिन नदिने गरि व्यवस्थापन गर्नुपर्नेछ।
५	फोहर ओसार पोसार (Transportation)	स्वास्थ्य संस्था भित्र स्थलगत फोहर ओसार पसार (On-Site Transportation)	क) सामान्य र जोखिमयुक्त फोहर ओसारपसारका लागि छुट्टा छुटै ट्रलिको व्यवस्थापन गर्नुपर्छ। ख) सामान्य र जोखिमयुक्त फोहर ओसारपसारका लागी छुट्टा छुट्टै कर्मचारीले पुरा व्यवत्तिगत सुरक्षाका सामाग्री (PPE) लगाई भिडभाड नहुने समय र क्षेत्र हुदै फोहर ओसारपसार गर्नुपर्छ।
		स्वास्थ्य संस्था बाहिर फोहर ओसार पोसार (Off-Site Transportation)	बिशेष गरी चारैतिरबाट बन्द गरिएको, फोहोर बोक्न तयार पारिएको, भित्र सजिलै सफा गर्न मिल्ने स्टेनलेस स्टिल भएको तथा स्पष्ट रुपमा बायोहार्जाड लेबल गरिएको गाडि अथवा अन्य साधनमा स्वास्थ्य संस्था बाहिर फोहोर ओसारपसारको लागी प्रयोग गर्नुपर्नेछ।
६	भन्डारण क्षेत्र (Storage Area)	अन्तरिम व्यवस्थापन	क) फोहर भन्डारणका लागि हावा र प्रकाश राम्ररी आउने छुट्टै क्षेत्र/ठाउँ सुनिश्चि हुनु पर्नेछ। ख)संक्रमित फोहर लाई गर्मी मौसममा २४ घण्टा र जाडो मौसममा ४८ घण्टा भन्दा बढी समय भन्डारण नगर्ने सुनिस्चित गरिएको हुनु पर्नेछ। ग) उपचार भवन वा भण्डारण कक्षभित्र तोकिएको अधिकार प्राप्त व्यत्तिहरु मात्र प्रवेश गर्न पाउने व्यवस्था गर्नुपर्नेछ। घ) साधारण, संक्रमित, धारिलो, औषधीजन्य तथा साइटोटोक्सिक, रसायनिक र रेडियोधर्मी जस्ता फोहरलाइ छुट्टा छुट्टै भन्डारण गनुपर्छ।
		अन्तिम व्यवस्थापन	उपचारपछि संक्रमित फोहरको र अन्य सामान्य फोहरको भन्डारणका लागि एउटा निश्चित क्षेत्र/स्थान छुट्याइएको हुनुपर्छ।
७	जोखिमयुक्त फोहरको उपचार (Treatment)		सबै संक्रमित फोहरहरुको अन्तिम विसर्जन गर्नु भन्दा पहिला उचित प्रविधिद्वारा अनिवार्य रुपमा उपचार गर्नुपर्छ।
		संक्रमित फोहर	संक्रमित फोहर उपचार प्रणालिमा प्रयोग हुने प्रविधि निम्नलिखित किसिमको हुनु पर्नेछ क) नबाल्ने प्रविधिहरु (Non-burn technologies) जस्तै अटोक्लेभ (autoclave), माइक्रोवेभ (microwave), घर्षण तापमा आधारित (frictional heat based) आदि ख) रसायनिक विधिमा आधारित (Chemical Disinfection)

क्र. सं.	कार्यविधि	विवरण	मापदण्डहरु
		धारिलो संक्रमित फोहर	धारिला संक्रमित फोहर उपचार प्रणालिमा प्रयोग हुने प्रविधि निम्नलिखित किसिमको हुनुपर्दछ । क) नबाल्ने प्रविधिहरु (Non-burn technologies) जस्तै अटोक्लेभ (autoclave), घर्षण तापमा आधारित (frictional heat based) तथा अन्य ख) सिरिन्जको सुइहरुलाई उत्पादन हुने स्थानमै Needle cutter प्रयोग गरि काटेको/भाचेको हनुपर्नेछ ग) इनक्यापसुलेशन (Encapsulation) घ)सेपटिक कंक्रिट भल्ट (Septic concrete vault)/धारिलो संक्रमित फोहर खाडल
		प्याथोलोजिकल फोहर Pathological	प्याथोलोजिकल फोहर उपचार प्रणालि निम्नलिखि तरिकाले हुनु पर्नेछ । क) साल हाल्ने खाल्डो/प्लासेन्टा पीट ख) एनारोबिक डाइजेस्टर/बायोग्यास
		रसायनिक फोहर	रसायनिक संक्रमित फोहर उपचार प्रणालि निम्नलिखित किसिमको हुनु पर्नेछ । क) निर्यातकर्ता/उत्पादकलाइ नै फिर्ता गर्ने नीति (Return Back Policy) ख) इनक्यापसुलेशन (Encapsulation)/ निष्कृय पारेर (Inertization)
		औषधीजन्य फोहर	औषधीजन्य संक्रमित फोहर उपचार प्रणालि निम्नलिखित तरिकाले हुनुपर्दछ । क) निर्यातकर्ता/उत्पादकलाइ फिर्ता गर्ने नीति (Return Back Policy) ख) इनक्यापसुलेशन (Encapsulation)/ निष्कृय पारेर (Inertization) ग) अल्कलाइन हाइड्रोलाइसिस Alkaline Hydrolysis
		Cytotoxic साइटोटक्सिक फोहर	Cytotoxic साइटोटक्सिक संक्रमित फोहर उपचार प्रणालि निम्नलिखित तरिकाले हुनुपर्नेछ । क) निर्यातकर्ता/उत्पादकलाइ फिर्ता नै गर्ने नीति (Return Back Policy) ख) इनक्यापसुलेशन (Encapsulation) ग) रसायनिक तथा भौतिक उपचार (Neutralization, Detoxification, Chemical reduction or oxidation, Hydrolysis and others)
८	विसर्जन (Disposal)		साधारण फोहोरलाई तोकिएका प्रविधिहरुबाट उपचार गरे पश्चात नगरपालिकाको फोहर संकलन तथा व्यवस्थापन प्रणालीसँग एकिकृत रुपमा विसर्जन गर्ने
			सम्भव भएसम्म सम्पुर्ण पुनचक्रिय गर्न मिल्ने असंक्रमित सामग्रीहरुलाई पुनचक्रिय प्रणालिमा लैजाने
			कुहिने फोहोरमैलाहरुलाई प्राङगारिक मल बनाएर वा बायोग्यास (anaerobic digestion/biogas)प्रविधि प्रयोग गरि विसर्जन गर्नुपर्नेछ ।
			यदि उपलब्ध भएमा सम्पुर्ण फोहोरलाई अनुमति प्राप्त केन्द्रिय फोहोरमैला उपचार केन्द्र Central Treatment Facility मा उपचार तथा व्यवस्थापनको लागी पठाउनु पर्नेछ
९	व्यक्तिगत सुरक्षाका उपायहरु	व्यक्तिगत सुरक्षाका सामाग्री	फोहर व्यवस्थापन सम्बन्धित कर्मचारीले फोहोर चलाउदा, संकलन गर्दा, ओसारपसार तथा उपचार गर्दा कर्मचारीले सम्पुर्ण व्यक्तिगत सुरक्षाका उपकरणको सामग्री (टोपी, मास्क, ग्लोवस, चस्मा, बुट, गाउन, फेस सिल्ड इत्यादि) पुर्णरुपमा प्रयोग गर्नुपर्नेछ ।
		खोप	सबै स्वास्थ्यकर्मी र फोहर संकलक तथा सम्बन्धित पेशाकर्मीहरुले प्रोटोकल अनुसारको हेपाटाइटस बी (Hepatitis B), टीटानस (Tetanus) संक्रमण विरुद्ध खोप लगाएको हुनु पर्नेछ ।

क्र. सं.	कार्यविधि	विवरण	मापदण्डहरु
		चोटपटक तथा घाइते भएको घटना	यदि संस्थाभित्रै सुविधा नभएको खण्डमा रोगनिरोध - Post Exposure Prophylaxis PEP) केन्द्रहरुको पहिलेनै पहिचान गरिएको हुनुपर्दछ, यसबारे उचित पुर्वतयारी हुनु पर्नेछ तथा सम्पुर्ण कर्मचारीबिच यो विषयहरुबारे उचित जानकारी भएको हुनु पर्नेछ। (घटना भएमा अस्पतालबाट दिइने)
१०	तरल फोहरमैलाको व्यवस्थापन	उपचार	तरल फोहरको विसर्जन पूर्व उचित प्रविधिद्वारा उपचार गरिएको हुनु पर्नेछ।
		विसर्जन	राष्ट्रिय मापदण्ड अनुरुप उपचार गरिएको संक्रामक तरल फोहरको उचित प्रविधिद्वारा विसर्जन गर्नु पर्नेछ।
११	रेकर्डिङ तथारिपोर्टीङ्ग प्रणालि	अभिलेख तथा	फोहर उत्पादन, उपचार र विसर्जनको दैनिक रेकर्डिङ्ग तथा रिपोर्टीङ्ग गर्नुपर्नेछ साथै प्रविधिले उचित कार्य गरे नगरेको समय समयमा चेकजाँच गरेको रेकर्डिङ्ग तथा रिपोर्टीङ्ग गर्नुपर्नेछ।
		चोटपटक तथा घाइते भएको घटना	क) सम्पुर्ण पेशागत जोखिम तथा दुर्घटनाहरुबारे घटनापिच्छे नै रेकर्डिङ्ग तथा रिपोर्टीङ्ग गर्नुपर्नेछ। ख) घटनाहरुको व्यवस्थापनसम्बन्धि पुर्वतयारी सुनियोजित तथा सम्पुर्ण कर्मचारीबिच यो विषयहरुबारे उचित जानकारी भएको हुनु पर्नेछ।
१२	फोहर व्यवस्थापन संचालन तथा मर्मत सम्भार		नियमित तथा आवधिक रुपमा परिक्षण तथा आवश्यकता अनुसार मर्मत सम्भार गर्ने
१३	सार्वजनिक सूचना Public information	नियमित हुनु पर्ने	हाल प्रयोग भइराखेको सुरक्षित स्वास्थ्यजन्य फोहरमैला व्यवस्थापन प्रणालीको जानकारी सार्वजनिक ठाउँमा सबैले देख्ने गरी सूचना प्रदर्शन गरिएको हुनु पर्नेछ।
१४	गुणस्तर नियन्त्रण	गुणस्तर सुनिश्चितता (Quality Assurance)	क) स्वास्थ्यजन्य फोहोरमैलासंग संसर्ग हुने स्वास्थ्यकर्मिहरुलाई आधारभुत तथा नियमितरुपमा रिफरेसर फोहोर व्यवस्थापन कर्मचारीहरुलाई नियमित रुपमा सम्बन्धित तालिमहरु दिनु पर्नेछ। ख) उपचार गर्ने प्रविधि, प्रणलि तथा मेशिनहरुको विभिन्न परिक्षण माध्यमहरुबाट (biological indicators (e.g.: spores) or other test assays) नियमित रुपमा परिक्षण तथा भ्यालिडेसन (Validation) गरि निर्मलिकरण गर्ने क्षमताको नियमन गर्नु पर्नेछ। ग) सेवा ग्राहीको पृथपोष्ण (feedback) अनुसार सुधार गर्नु पर्ने
१५	अनुगमन तथा समिक्षा	अनुगमन	स्वास्थ्यजन्य फोहोरमैला व्यवस्थापन समिति द्वारा नियमित तथा बाह्य प्राविधिक विज्ञहरुको टोलीबाट फोहोरमैला व्यवस्थापन प्रणलिको आवधिक (कम्तिमा वर्षको एक पल्ट) रुपमा अनुगमन तथा समिक्षा गर्नुपर्छ।
१६	स्थलगत प्रशिक्षण (Onsite Coaching) र सहयोगमुखि सुपरिवेक्षण (supportive Supervision)	सुपरिवेक्षण	वार्ड भित्रका कर्मचारी र सम्बन्धित व्यक्ति साथै बिरामि र बिरामि कुरुवालाई स्वास्थ्यजन्य फोहरमैला व्यवस्थापन सम्बन्धि अभिमुखीकरण गरि श्रोतमै फोहर छुट्याउने (Segregation) को राम्रो अभ्यास गरेको हुनु पर्नेछ र कर्मचारीहरुलाई नियमित स्थलगत प्रशिक्षण (Onsite Coaching) गरेको हुनु पर्नेछ।