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Foreword

It is indeed a great pleasure and privilege for NHRC to prepare a document entitled 'National Health Care Waste Management Guidelines' in collaboration and support from the World Health Organization.

NHRC is currently exploring new idea to face the challenge of health field. I hope, health care waste management builds on these initiatives. I believe this guideline is a good beginning. The present guidelines for health care waste management have been prepared with the aim to help health care institutions to develop sound health care waste management system. The guideline will be successful to sensitize the government, health care institutions, policy makers, planners, and environmentalist of Nepal.

It is believed that with the concreted efforts and collaboration of Government, NHRC, WHO, private, public and other relevant organizations, our goal of preparing national guidelines will ultimately lead to development of sound hospital waste management system in Nepal.

The task ahead is to follow the activities proposed in guidelines. I am confident that government, health care institutions, and last but not the least individual will contribute to make it success.

My thanks goes to WHO, NHRC staff and consultants involved in preparation of this guidelines.

Professor G. P. Acharya
Chairman
Nepal Health Research Council

Preface

Sound management of health care waste has become a need to safeguard the public health from adverse effects caused due to improper management of health care waste. The solution to this problem is a national need, though it is not yet taken up seriously in the past and we find absence of national policy regarding this matter. Realizing this need, Nepal Health Research Council (NHRC) is assisting His Majesty's Government of Nepal in preparation of health care waste management guidelines. The objective of this task is to develop national guidelines establishing norms and regulations for safe management of health care waste in Nepal.

On behalf of NHRC, I wish to thank WHO, Mr. Chandra Sekhar Yadav, Team leader, Mr. Salil Devkota, environment expert, and Mr. Sharad Aryal, environmental health specialist for their valuable support in preparation of this guideline.

It may not be possible to achieve all standards mentioned in a guideline at a time. The aim should be to make improvements and gradually move towards sustainable system. It is envisioned that all level of health care institutions would find it useful.

Dr. Anil Kumar Mishra
Member Secretary
Nepal Health Research Council

Acknowledgement

With the intent of tackling waste management issues related to health care institutions, NHRC, through its Environmental Health Unit, has developed these National Health Care Waste Management Guidelines.

Sincerest gratitude is expressed to **Professor G. P. Acharya**, Chairman NHRC and **Dr. Anil Kumar Mishra**, Member-Secretary NHRC for their support and encouragement in the formulation of this document.

Special thanks are also due to the WHO for providing assistance in the development of this document, especially to **Mr. Jan A. Speets**, Environmental Health Advisor for generously sharing his ideas in the conceptualization of this document.

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Deep appreciation is also extended to all staffs at the NHRC.

Chandra Sekhar Yadav
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Team Leader

1 Introduction

1.1 About These Guidelines

These guidelines provide a minimum standard for safe and efficient waste management for Health Care Institutions in Nepal. The sections of these guidelines are arranged to represent the flow of key strategies of waste management in Health Care Institutions. All Health Care Institutions must be committed to waste management from generation to final disposal. The establishment of a waste management committee and the development of waste management plan will implement waste management

These guidelines continue with the concepts of waste segregation into several streams viz. labeling and containment, handling, storage and transport, treatment/disposal, occupational health and safety, training, and implementation aspects.

1.2 Purpose of the Guidelines

The purpose of the guidelines is to provide a framework of waste management strategies to assist in the long-term management of health care waste by implementing the following essential strategies.

- Waste management, committees, plans and waste audits;
- Waste minimization, avoidance, segregation, recycling, and re-use;
- Waste labeling and containment;
- Proper waste handling;
- Storage, and transport;
- Proper waste treatment and safe disposal.

1.3 Aims

The aims of these guidelines are to:

- Protect public health and safety,
- Provide a safer working environment, and
- Minimize waste generation and environmental impacts of waste treatment/disposal.

1.4 Background

Health Care Institutions generate large amounts of diverse wastes that require disposal. Much of the waste is hazardous and must therefore be collected, transferred, and disposed of properly to protect both the persons handling it and the environment. It affects not the

generators of waste but also the operators and general public.

Wastes from health care institutions can be categorized as infectious or noninfectious. Infectious wastes include human, animal, or biological wastes and any items that may be contaminated with pathogens. Noninfectious wastes include toxic chemicals, cytotoxic drugs, and radioactive, flammable, and explosive wastes. A manifest impact of mismanagement of this waste is the alarming incidence of hospital-acquired infection.

Since the early recovery of the patient and health of clinical staff directly depends on infection prevention practices used in health care institutions, waste management is one of the essential components of good infection prevention practices. It is essential that health care waste is collected, stored and disposed of in a proper and scientific manner. General hygiene is a prerequisite for good medical waste management in health care institutions. It is also vital that the whole health care institutions be kept clean and on a satisfactory state of hygiene.

With the steady increase in the number of health care institutions in Nepal, the amount of medical wastes generated is also increasing. But due to the lack of Health Care Institutions proper waste management, guidelines, policies, and legislations, most of the wastes from health care institutions are being disposed haphazardly, which is causing environmental and public health problem. Realizing the urgent need to manage health care institutions waste in Nepal, Nepal Health Research Council (NHRC) is assisting His Majesty's Government of Nepal in the preparation of Health Care Waste Management Guidelines.

1.5 Effect of Human Health and Environment

Besides the effect of waste on health care institutions' personnel and patients, the impact on human health and environment outside the health care institutions is also important. A part of the health care waste is hazardous and it may cause a threat to the health and life not only to patients and staff but also to the community at large.

The greatest risk of health care waste is from the infectious component. The potential for transmission of infectious disease has been documented. Hepatitis B, Hepatitis C, HIV, Tetanus, and staphylococcal infections are the ones that can get transmitted as a result of improper management of health care waste. All these infections lead to serious complications and death.

The persons most at risk are the staff of health care institutions particularly nurses and other health care providers, waste handlers both within and outside the health care facility. In countries such as ours, scavengers and rag pickers are at serious risk. It is necessary in such a condition that attention is paid to (a) collect the waste properly and preventing at access to unauthorized persons at every stage (b) initiate awareness within health care institutions and the community about the potential hazard of medical waste (c) decontaminate or disinfect the infectious component of the waste at site of generation (d) discourage the single limited use items to prevent their reuse, (e) dispose the waste properly with close observation of trained manpower.

1.6 Current Situation of Health Care Institutions Waste Management in Nepal

Health care waste management is a major problem in Nepal. In recent years, medical waste disposal has become even more difficult due to the use of disposal needles, syringes, and similar items. Many studies and surveys have already been conducted related to health care waste management in Nepal. Studies revealed that majority of health care institutions do not practice safe waste handling, storage and disposal methods. Many institutions have addressed these issues. But the studies conducted so far dealt on project-by-project and case-by-case basis. The health care waste management didn't get adequate attention despite its need. Recently it was realized that it is necessary to develop national level policies, legislation, and standards to solve the problem of health care waste. More than 85% of surveyed institutions in the past have shown commitment to start a health care waste management system. Considering all the above, it is proposed that a "step by step" approach has to be developed in order to deal with health care waste management in Nepal. Safe management of the health care waste in Nepal needs a systematic approach. It is not only of question of technology but of human behavior and attitude of technical and management personnel at health care institution including cleaning staff. The proposed systematic approaches for safe health care waste management in Nepal are highlighted under annex-I of this document. The objectives of this task are to develop national guidelines establishing norms and regulations for safe management of health care waste in the country. This guidelines aimed at creating awareness regarding growing concern about handling, and disposal of waste from health care institutions and was targeted to institutions, doctors, clinical staff, administrations, governments, and other relevant personnel directly involved to this field.

2 Legal Framework, Plan, Policies, of Government of Nepal for Health Care Waste Management

2.1 Background

Most health care institutions depend upon the municipality services for the disposal of waste material collected, in addition to burning and burying within the institutional premises. There is no separate mechanism for the proper mechanisms for the proper treatment of medical wastes and both medical and general waste is treated as municipal waste.

In Nepal, there are no special policies, legislation or guidelines related to wastes from health care institutions. The statistics presented at the workshop on waste management held in January 2001 revealed that more than 50% of the government institutions do not practice proper waste segregation. The reasons are mainly:

- Poor management,
- Absence of policy/guidelines,
- Lack of awareness/understanding on the part of health staff and the general public, and
- Large influx of patients to government hospitals

Unfortunately, there is no reliable data currently existing on injuries or illness related to health care waste in Nepal. Ineffective waste disposal and subsequent contamination of the population through the environment has a negative impact on the morbidity and mortality rates. Poor management of health care waste exposes health care workers, waste handlers and the community to infectious, toxic effects and injuries. It may also damage the environment. In addition, it creates opportunities for the collections of disposable medical equipment (particularly syringes) and its resale and potential reuse without sterilization leading to increased disease worldwide. It is believed that a positive impact could be achieved through the implementation of effective and sustainable waste management strategies. And has advised the government to introduce health care waste management as an integral part of health care system.

Policies and plan for safe management of health care waste should address these three elements:

1. The establishments of a comprehensive system of health care waste management from generation of waste to its disposal to be implemented gradually;
2. The training for concerning staff
3. The selection of safe and environment friendly options for the management of health care waste.

2.2 Related Policies

There were no specific national policies on the waste till 1996. Earlier policies were encompassing all kinds of environmental pollution including solid waste but were not effective to deal the matters of solid waste management as desired. The adopted policy for the waste management in Nepal has following activities:

- To make solid waste management system simple and effective
- To minimize the adverse effect of solid waste on the environmental and public health
- To mobilize the solid waste as a resources
- To promote public awareness for greater public participation on the solid waste management

The important measures related to solid waste were considered in Eighth and Ninth Plan. According to the Eighth Plan, causes for air, water, and land related pollution was supposed to be investigated through on-the spot observation and management mitigation plans. In this regard emphasis were laid on adopting technology required for minimizing waste. However pollution control program launched during this period included limited assessment studies of existing situations in the areas of solid waste along with other sectors; air, water, noise etc. Utilization of appropriate technology still needs to be developed in the areas of solid waste including health care waste. Research on the cause of air, soil, and water related problems still need to be investigated and analyzed to prepare indicators and action oriented guidelines. Management work plans to control pollution caused by solid waste needs to be implemented.

The solid waste aspect has also been mentioned in the Ninth Plan. The Plan includes consideration for engagement of NGOs and private sector for the management of solid waste, emphasis for composting for municipal wastes, setting of norms and standards in this field and its strict implementation in every municipality, and capacity building of local municipalities for handling solid waste related issues. These policies didn't specifically mention health care waste management.

Under the National Health Care Technology Strategy of the Second Health Plan (1997-2017), a functional guideline to manage medical waste at all levels, including private sector, has been envisioned.

Recently for the first time a bill has been tabled in the parliament with provision of managing health care waste.

2.2.1 Policy and Strategy Shortcomings

Though the development plans recognized the importance of solid waste management issues, the policy lack emphasis on health care waste related issues. (1997 -2017), a functional guideline to manage medical waste at all levels, including private sector, has

been envisioned.

Recently for the first time a bill has been tabled in the parliament with provision of managing health care waste.

2.2.1 Policy and Strategy Shortcomings

Though the development plans recognized the importance of solid waste management issues, the policy lack emphasis on health care waste related issues. Till 1996, the national policy was limited to minimization of the adverse impacts of solid waste in the public health and the other environmental resources. The goal was obviously precise, but the means to achieve the goals were confusing. Various waste Act have been enacted in this period. These Acts to some extent streamlined some of the policy initiatives but as a tool to control the pollution emanating from the solid waste. Besides, the waste definition itself was very confusing. In the implementation level, only the household garbage from the urban areas has been regarded as the waste.

The policy and strategies adopted in 1996 have incorporated many of the prevailing concepts of best waste management. For the first time waste is regarded as resource and emphasis was given for waste recycling. Need to public participation, and privatization of the waste management system was recognized. However, the strategies to implement the policy remained still unclear.

The policy and strategies recognized adoption of waste management system based on nature and volume of waste but failed to define the waste categories which require separate system of management at least in a broader prospective.

Two tiers of institutions have been emphasized for the waste management i.e. at the central level and at the local level. But the role and responsibilities of these institutions were not precise.

Polluters pay principle has been adopted with a half heart. It recognized the need of collection of fees from the private organizations and institutions at the final disposal site, but was unclear about the collection of waste from the households or any individual producers at the source level.

The strategies were very much unclear about the generation of resources for the solid waste management. Besides the policy seems to have aimed only for the municipal waste and does not foresee the waste generated from health care institutions and other sectors. Apart from the above, the adopted policy by the Government never been translated into legislation nor into institutional arrangements.

2.3 Related Legislation

2.3.1 The Constitution of Kingdom of Nepal, 1990

Article 26(4) embodies following policy mandates:

"The state shall give priority to protection of the environment and also to the prevention of its further damage due to physical development activities by increasing the awareness of the general public about environmental cleanliness and the state shall make the arrangement for the special protection of the rare wildlife, the forest, and vegetation."

With the above provisions, some constitutional responsibilities and duties have been vested upon the state for safeguarding the environment.

2.3.2 The Environment Protection Act, 1997

Environmental protection Act 1997, and environmental protection rules have made provisions dealing with pollution control, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), conservation of national heritage etc. Section 7 of Act refers to pollution control, which states "A person shall not cause pollution or allow pollution to be caused in a manner which is likely to have significant adverse impact on the environment or harm human life or public health or shall not emits, discharge sound, heat, radioactive from any machine, industrial enterprises or any other place above the prescribed standard."

The law has also listed chemicals, drug related industries as polluting industries, and requires that such industries obtain pollution control certificates from the Ministry of Population and Environment.

The Chapter 3 of Act has provided various provisions under rules 15 to 29 for preventing and controlling pollution. These provisions include stopping emission and discharging solid waste against the standards (rule 15) to install and maintain properly the equipment or treatment plants (rule 16). EIA is also mandatory for the establishment of facilities, including treatment plant, recycling plant, storage and landfill for management of hazardous waste

Rule 3, annex- 2 of the Act states that an EIA is necessary prior to the development of any health care facility with 25 or more beds. Safe disposal of Health Care waste is also made mandatory for this category of health care facility.

2.3.3 Solid Waste Management and Resource Mobilization Act, 1987

This Act is one of the key legislation in Nepal for the management of solid waste. The main objectives of this Act are:

- To manage the solid waste and to mobilize the resources
- To minimize the adverse effect of the solid waste on the public health and environment

For the execution of the objectives of the Act, Solid Waste Management and Resource Mobilization Center (SWMRMC) Rule was formulated in 1989. These Rules laid down

procedures for the management of solid waste. The Act and Rules empower the Solid Waste Management and Resource Mobilization Center in the matter of the solid waste management.

Fundamentally, the Act conferred power and responsibility to the Solid Waste Management Board to carry the functions especially for Kathmandu Valley. On behalf of the Board, SWM&RMC carries out day-to-day activity.

2.3.4 The Labor Act, 1991

The Labor Act 1991, which is administrated by the Ministry of Labor, is the main regulation regulating the working environment. Chapter 5 of this Act deals with occupational health and safety. Section 27 of Chapter 5 requires the management to make certain arrangements such as the removal of waste accumulated during production process and prevention of accumulation of dust, fume, vapor, and other impure materials, which would adversely affect health of workers. Section 28 and 29 require management to provide protective clothing and devices to workers handling chemical substances and other hazardous and explosives substances. In order to prevent accidents, section 30 of the Act requires the proprietor to make arrangements for fire safety equipment and emergency equipment while section 31 requires the placement of sturdy fences around hazardous machines and equipment operated by energy.

2.3.5 Industrial Enterprise Act, 1992

As provided in industrial policy, this Act provides that industrial license is required if it is related with defense, public health and environment. Section 11 clearly provides that license or registration certificate shall contain provisions regarding concessions, exceptions, facilities that will be given to enterprise and prescribed conditions to be fulfilled by them.

Section 13 also provides that the industrial promotion board establishment under the Act can direct the industries to make arrangements for controlling environmental pollution. The Act gives priority to industry based on waste products and industry manufacturing pollution control devices. Similarly, section 25 (2) empowers HMO to punish those who don't comply with the conditions mentioned in the license or registration certificate.

2.3.6 The Town Development Act, 1988

Clause 9 of this Act empowers the Town Development Committee to regulate, control or prohibit any act or activity that has an adverse effect on public health or the aesthetic of the town, or in any way pollutes the environment. It contains penalty provisions in the form of fines for the violation of the Act.

2.3.7 The Local Self- Governance Act, 1999

The Local Self-Governance Act, 1999 makes municipalities responsible for managing

domestic solid waste. Municipalities are also supported to preserve water bodies such as lakes and rivers, assist in controlling water, air, and noise pollution and prevent the spread of infectious disease. The Act does not require the local governments to manage hazardous waste but empowers them to fine anyone up to Rs. 15000.00 for haphazard dumping of solid waste.

As Nepal does not have any policies or legislation on hazardous or medical waste, the government should immediately formulate a national policy and legislation on hazardous waste management. The legislation should be in the form of a set of regulations and under the existing Environmental Protection Act. These documents should clearly define hazardous waste and designate responsibilities for managing medical waste.

2.3.8 Shortcomings and Effectiveness of Legal Provisions

Except for the Solid Waste Management and Resource Mobilization Act, rest of the other Acts and Rules are primarily concerned with regulating the structure, duties and functions of different institutions, therefore are indirectly related to solid waste management.

The Solid Waste Act suffers from numerous weakness and deficiencies of which two of most important are

- The Act exclusively focused on solid waste management in the Kathmandu Valley, and therefore doesn't provide a comprehensive national framework law.
- It contains a mixture of both framework provisions and very specific regulatory powers e.g. definitions of what constitute an offence under the Act, and the penalties, which may be imposed upon conviction for specific offences under the Act.

The structure of the Act is thus rather inflexible and several of its provisions also appear somewhat contradictory and ambiguous. Many aspects of this Act have never been enforced and for all practical purposes, the Act appears to have become obsolete.

3 Designation of Health Care Waste

3.1 Health Care Waste Definition

Health care waste includes all the generated by health care institutions, research facilities and laboratories. It means any waste, which is generated during diagnosis, treatment, or immunization of human beings or animals or in research activities thereto or in the production or testing of biologicals, and including categories mentioned below.

3.2 Designation of Health Care Waste

3.2.1 Designation of Health Care Institutions As Per World Health Organization (WHO)

WHO recommends that health care waste be separated at the source into the following categories:

1. Infectious waste
2. Pathological waste
3. Sharps
4. Pharmaceutical waste
5. Genotoxic waste
6. Chemical waste
7. Waste with high content of heavy metals
8. Pressurized containers
9. Radioactive waste
10. General waste

3.2.2 Designation of Health Care Institutions Waste As Per Bio- Medical Waste Rules, 1998 of India

According to the Indian rules, health care waste was segregated into ten different categories. These categories can be listed as:

1. Human anatomical waste
2. Animal waste
3. Microbiology and biotechnology waste
4. Sharps
5. Discarded medicines and cytotoxic drugs
6. Soiled waste
7. Solid waste
8. Liquid waste
9. Incinerator ash
10. Chemical waste

3.2.3 Designation of Health Care Waste: Nepalese Context

It was realized that the designation of waste as per WHO, Indian Standard, or any other standard will be complicated, and unnecessary as most health care institutions do not practice separating waste. In addition, different types of treatment options for different categories of waste are not available in Nepal. Nepal is still in infancy stage regarding management of health care waste. Without proper institutional arrangements, improvement in waste handling practices, infrastructure, budget allocation, improved social habits, duplication of such a multiple and specific categorization of waste management could become a fiasco. So rather than becoming more sophisticated and unrealistic, more applied, realistic method of designation is necessary. Thus the best alternative for the time being in Nepal would be more appropriate to separate waste into three categories: General, Hazardous, and Sharps. The above categories are based on the characteristics of health care waste. In future, necessary amendments for the further classification of health care waste could be developed as required.

Sharps:

Sharps includes whether infected or not, needles, syringes, scalpels, blades, glass, infusion sets, saws, knives, broken glass and item that can puncture human skin and cause infection. Sharps, whether contaminated or not contaminated should be collected separately from other infectious waste. Used needle should never be recapped, bend or mutilated by hand. When recap is necessary, one hand technique should be used. For collection of sharp metal or high density plastic containers resistant to penetration and leakage should be used. The containers shall be colored yellow and marked "DANGER! CONTAMINATED SHARPS" and in Nepali "सावधान ! हानिकारक धारिला फोहर". The prescribed way to label the container is shown in annex-3⁴

Hazardous Waste:

Hazardous wastes are waste with potential to cause hazard to health and life of human beings. These includes, cotton, gauze, soiled bandages, cotton used for dressing, blood bags, human and animal tissue, body parts, chemicals, drugs, wastes generated by cleaning spills of hazardous waste, and any other soiled materials that has been used for treatment.

The containers shall be colored yellow and marked "DANGER! HAZARDOUS WASTES" and in Nepali "सावधान ! हानिकारक धारिला फोहर". The prescribed way to label the container is shown in annex-3^B

General Waste:

General waste includes paper, cardboard, metal containers, floor sweeping, and kitchen waste. It doesn't need special treatment and storage facilities it still needs to be collected separately from infectious waste. If separate collection of such waste is not practiced strictly, the entire process of medical waste treatment system will be affected and it will not function as efficiently as desired. General waste should be placed in a suitable container lined with a black plastic bag. Adequate numbers of general waste containers shall be placed in all areas of health care institutions and notices affixed to encourage visitors to use them.

If an autoclave is used for waste treatment, the hazardous component should further be categorized into infectious autoclavable and non-autoclavable (pathological and chemical waste). Non-autoclavable waste can be incinerated or buried. If a combination of autoclave, incineration and deep burial is used for waste treatment, then segregation into five categories namely; general waste, sharps, autoclavable infectious waste, pathological/chemical waste for incineration, and waste for deep burial can be practiced.

Wastes arising from microbiology and biotechnology laboratories, wastes from infected patients or isolation wards could be autoclaved. High-density wastes such as large body parts, and other wastes like pathological waste, chemical waste, pharmaceutical waste and cytotoxic waste should not be autoclaved.

The above designation of wastes is based on the type of treatment options used. The details of waste designation as per characteristics of waste, and treatment methods are shown in flow diagram (Annex-2).

In the future if health care institutions in Nepal became more used to with the system, advance technologies become available, change was demanded, and necessity was felt, then the designation could be revised as applied to that context of change.

3.3 Operational Terms

The definition given here may not necessarily valid in other contexts.

Antineoplastic:

Inhibiting or preventing the development of neoplasms.

Cytotoxic Waste:

Waste contaminated with cancer or chemotherapy drugs.

Chemical Waste:

"Chemical Waste" includes chemical from diagnostic and experimental work, cleaning process, housekeeping and disinfecting procedures, mercury waste such as from broken clinical equipment and spillages, and preparation and administration of such drug.

Disinfection:

Process of using chemicals to kill pathogenic organisms but limited to spores.

Disposal:

Intentional burial, deposit, discharge, dumping, placing, or release of any waste material into or on any air, land, or water.

Encapsulation:

A method of treatment of waste before land disposal by mixing with a hardening agent such as clay, plastic foam or cement to reduce mobilization and restrict access to the waste so treated.

Ground water:

The water present in the porous underground layer as a result of infiltration from the ground surface.

Handling:

The functions associated with the movement of solid waste materials excluding storage, processing, and ultimate disposal.

Hazard:

Intrinsic potential property or ability (e.g. of any agent, equipment, material, or process) to cause harm.

Hazardous Waste:

Waste with potential to cause hazard to health and life of human beings.

Health Care Institution:

A hospital, clinic, dispensary or any other institution involved in the care and treatment of patients.

Hospital:

Institutions where patients are diagnosed and treated. Hospital consists different units such as laboratory, dispensary, operating theater, indoor and outdoor patients department, blood bank, etc. Privately owned hospitals are called nursing homes.

Incineration:

Method for treatment and disposal of waste by combustion at high temperature leading to near complete destruction of hazardous components of waste.

Infectious Waste:

Infectious waste is defined as waste capable of producing an infectious disease. This definition requires a consideration of certain factors necessary for induction of diseases. These factors include; presence of a pathogen of sufficient virulence, dose, portal of entry, resistance of host. The six categories listed below are recommended as infectious waste categories:

- Isolation wastes: wastes generated by hospitalized patients who are isolated to protect others from communicable diseases.
- Cultures and stocks of infectious agents and associated biologicals
- Human blood and blood products
- Contaminated sharps
- Contaminated animal carcasses, body parts, and bedding and other miscellaneous wastes

Inertisation:

A method of treatment of waste before land disposal to neutralize and immobilize it to prevent the contamination of soil or ground water.

Microorganism:

Any microbiological entity, cellular or non-cellular, capable of replication or of transferring genetic material.

Monitoring:

The measurement of a concentration or other parameter (radiation or radio nuclide

concentration in the context of radioactive waste management) for purposes of assessment or control of environmental quality and exposure and the interpretation of such measurements. Monitoring can be continuous or noncontinuous.

Leachate:

Liquid from a landfill containing substances that were present in the waste, either as liquid or solids and were dissolved by the water passing through the waste.

Municipal Waste:

Substances discarded by private households' offices, shops, etc as unusable. Generally collected by a local authority for dumping, sanitary landfill, composting, or pyrolysis.

Offsite:

Outside from health care institution compound or premises.

Onsite:

In the health care institution compound or premises.

Pretreatment:

Treatment of waste at site of generation, it may include disinfections /sterilization and/or mutilation.

Pathological Waste:

Pathological waste includes tissue, organs, body parts, fetuses, blood and body fluids

Pharmaceutical Waste:

Pharmaceutical waste includes expired or unused pharmaceutical products, spilled contaminated pharmaceutical products surplus drugs, vaccines or sera, and discarded items used in handling pharmaceuticals such as bottles, boxes, gloves, masks, tubes, or vials.

Radioactive Waste:

Radioactive waste includes liquid, solid and gaseous waste contaminated with radionuclides generated from in-vitro analysis of body tissue and fluid, in-vivo body organ imaging and tumor localization, and investigation and therapeutic procedures;

Radionuclide:

Atoms of specified atomic number and mass number that exhibit spontaneous disintegration, liberating energy accompanied by emission of one more type of radiation, such as α and β particles and γ rays.

Recycling:

The recovery and reuse of material from wastes.

Sanitary Landfill:

Dump of domestic refuse, compacted on site and covered regularly by a layer of earth. Microorganism decomposes the organic part of the refuse. This is engineered burial of refuse, but in many places the term is synonymous with a rubbish dump or waste hip.

Scavenging:

The manual sorting of waste and removal of usable material by rag pickers.

Segregation:

Separation of different types of waste based on the requirement of pretreatment, treatment and method of disposal.

Treatment:

Treatment of waste to render it non-hazardous, non-infectious, reduce the bulk or mutilate it within the health care institution (onsite) or outside the health care institution (offsite). May be done by chemicals, incineration, and microwaving, shredding, autoclaving.

4 Waste Management

4.1 About This Section

This section summarizes the action necessary to implement a Waste Management Plan.

4.2 Waste Management Policy

Each health care institution should develop a Waste Management Policy, outlining the accountabilities and responsibilities of managers, employees, and staff. It is the responsibility of health care institution to comply with guidelines, to ensure proper classification, segregation, containment, treatment, and disposal of waste.

4.3 Waste Management Committees

Each health care institution must establish "Waste Management Committee", which will have the main function of implementing Waste Management Policy,

4.3.1 Composition of a Waste Management Committee

The Medical Superintendent/Director of hospitals shall constitute a Waste Management Committee comprising the following, by whatever designed called

- a. The Hospital Superintendent, who shall be the Chairman;
- b. The Heads of all hospital departments/units;
- c. The Chief Pharmacist;
- d. The Radiology Officer;
- e. The Matron;
- f. The Head of Administration;
- g. Hospital Engineer (if any)
- h. The House Keeper
- i. Representative from support staff, e.g. sweeper

In hospital where the posts mentioned in sub guideline (1) do not exist, the hospital superintendent shall either himself perform, or designate another staff member to perform, the duties and responsibilities of the holder of such posts, as described in guideline 4.3.1.1 b to 4.3.1.1 g.

As described in the guideline in this section 4.3.1, team/members shall be informed in writing by appointment and their duties.

4.3.1.1 Duties and Responsibilities of the Waste Management Committee

The waste management committee shall be responsible for the preparation, monitoring, periodic review, revision or updating if necessary, and implementation of the waste management plan. In order to meet the above requirements, the committee shall meet regularly to review situation and action plan, develop hospital management policy/guidelines, involve in regular monitoring and supervision, identify problems and develop action plan to solve problems, allocate resources for waste management.

a. Duties and Responsibilities of the Hospital Superintendent

The Hospital Superintendent shall

- Constitute the Waste Management Committees;
- Designate the Waste Management Officer;
- Supervise implementation, monitoring and review of the Waste Management Plan, ensure that it is kept up-to-date;
- Arrange for a waste audit of the hospital by an external agency, review of existing waste stream and assessment of existing waste management practices;
- Allocate sufficient financial and manpower resources to ensure efficient and 'effective implementation of the Waste Management Plan; and
- Ensure adequate training and refresher courses for the concerned hospital staff members.

b. Duties and responsibilities of the Heads of the Departments / Units:

Heads of the departments / units shall be responsible for the proper management of waste generated in their respective departments, and in particular shall

- Ensure that all doctors, nurses, non-clinical staff in their respective departments are aware of, and where required properly trained in, waste management procedures;
- Arrange proper supervision of the sanitary staff and sweepers to ensure that they comply with waste management procedures at all times; and
- Liaise with the waste management officer for effective monitoring and reporting of mistake and errors in implementation of the waste management plan.

c. Duties and Responsibilities of the Chief Pharmacist:

The chief pharmacist shall be responsible for the sound management of pharmaceutical stores and in particular shall

- Give advice regarding formulation of appropriate procedures for management of pharmaceutical waste, and coordinate implementation of these procedures; and
- Ensure that the concerned hospital staff members receive adequate training in pharmaceuticals waste management procedures.

d. Duties and responsibilities of the Radiology Officer:

Radiology officer shall be responsible for the sound management of radioactive waste, and in particular shall

- Give advice regarding formulation of appropriate procedures for management of radioactive waste and coordination implementation of these procedures; and
- Ensure that the concerned hospital staff members receive adequate training in radioactive waste and management procedures

e. Duties and Responsibilities of the Matron and Head of Administration:

The Matron and Head of the Administration shall be responsible for ensuring training of nursing staff, medical assistants and clinical helper/support staff and sweepers in waste management procedures, and basic personal hygiene. They shall also;

- Provide support to the waste management committee
- Ensure regular supplies needed for efficient management of waste

f. Duties and responsibilities of the Hospital Engineer (If Provisioned):

The Hospital Engineer shall be responsible for the installation, maintenance and safe operation of waste storage facilities and waste handling equipment and, where installed, the hospital incinerator, and shall ensure that the concerned hospital staff members are properly trained for these purposes.

g. Duties and Responsibilities of the House Keeper or Waste Management Officer (if provisioned):

The House Keeper or Waste Management Officer shall be responsible for the day-to-day implementation and monitoring of the Waste Management Plan and in particular, shall

For waste collection:

- Ensure proper collection (ref. chapter 7 for details) of waste and their transport to the central storage facility of the hospital on a daily basis;
- Liaise with the stores and supplies department to ensure that an adequate supply of waste containers, protective clothing and collection trolleys are available at all times;
- Ensure that sanitary staff and sweepers immediately replace used bags and containers with the new bag and containers of the same type and, where a waste bag is removed from container, that the container is properly cleaned before a new

- bag is fitted there in; and
- Directly supervise the hospital sweepers assigned to collect and transport the waste.

For Waste Storage:

- Ensure correct use of the central storage facility (ref. Chapter 7 for details) and that it is kept secured from unauthorized access; and
- Prevent unsupervised dumping of waste bags and waste containers on the hospital premises, even for short periods of time.

For waste disposal:

- Co-ordination and monitoring to ensure that waste disposal (ref. section 8.5) process is done properly. Ensure that the correct methods of transportation of waste are used on-site to the central storage facility or if any other methods employed on-site for treatment, and off-site by the municipality, and
- Ensure that the waste is not stored on hospital premises for longer than 24 hours, by coordinating with on-site and off-site operators of treatment facilities.

For staff training and information:

- ❖ Liaise with the Head of departments, Head of Administration and Matron to ensure that all doctors, clinical staff, nursing staff, and medical assistants are fully aware of their duties and responsibilities under the Waste Management Plan;
- ❖ Ensure that sanitary staff and sweepers are not involved in segregation and that only handle waste bags and containers, in the correct manner.

For incident management and control:

- ❖ Ensure that emergency procedures are available and in the place at all times and all the staff members are aware of the action to be taken by them;
- ❖ Investigate, record and review all incidents reported regarding hospital waste management; and
- ❖ Record the quantities of waste generated by each department on weekly basis.

4.4 Waste Management Plan

Each health care institution must implement a Waste Management Plan.

Each health care institution needs to establish a Waste Management Plan. A responsible person at the institution should prepare a comprehensive document that outlines policies and procedures for the management of health care waste.

To implement an effective Waste Management Plan, health care institution should consider several issues including the following:

- Establish a Waste Management Committee at institution level
- Coordinate major issues such as avoidance, reduce, reuse, and recycle
- Conduct an audit to assist with performance improvement. Audit procedures in the Waste Management Plan, and
- Establish benchmarks to facilitate monitoring of waste management

Waste Management Plan should be widely promoted within the institution to all staff involved in waste management. It provides a practical framework to establish and document the health care waste management committee's objectives and to supplement and support these guidelines. The following seven key issues are considered essential components of Waste Management Plan.

1. Introduction

- Waste Management Plan should specify goals and savings targets to be achieved within set time frames. It should provide details on how these objectives will be achieved.
- Incorporate waste reduction and purchasing plans.

2. Definition of Waste

- Health care institution should ensure that wastes are classified in accordance with these guidelines.

3. Organization Issues

- Institution's legal responsibilities
- Employees responsibilities
- Responsibilities of Waste Management Committees/Members }P> Purchasing policies
- Education and training

4. Waste Management Strategies

4. Waste Management Strategies

- Hospital waste audit
- Segregation audit
- Waste minimization

5. Waste handling, containment and transport

- Waste handling by staff
- Spill management
- Containment and sharps containers
- Tracking
- Trolleys
- Holding areas
- Transport

6. Waste Disposal

- Contracts with waste transporters and waste treatment/disposal sub contractors must be documented and should be consisted with relevant regulations
- Waste volumes/weights are to be recorded

7. Occupational Health, Safety, and Training

- Provision of information, education and training and safe systems of work
- Employee's responsibilities
- Occupational health and safety committee
- Monitoring performance
- Personal protective equipment
- Standard operating procedures

5 Waste Minimization

5.1 About this section

This section explains the opportunities for waste minimization in health care institution. Effective waste minimization strategies include waste avoidance, reduction, re-use and recycling. Waste minimization has the potential to reduce hazards to human health and the environment, reduce costs, conserve resources, and protect the environment.

5.2 Avoidance

Health care institution should review housekeeping and purchasing policies to avoid excessive waste, without compromising work standards or environmental outcomes.

Simple product modifications to minimize waste streams include requesting the manufacturer and supplier and/or central sterile supply departments to remove unnecessary materials supplied in sterile procedure packs, e.g. dressing, venipuncture, and lumbar puncture sets.

This may include requesting the manufacture and supplier to reduce unnecessary packaging or replace polystyrene foam with recyclable or biodegradable filters.

5.3 Reduction

Reduction can also be achieved through product substitutions, product modifications and procedural changes.

5.3.1 Product Substitution

Products should be assessed prior to purchase in terms of their potential to generate problematic waste, result in toxic emissions, or be detrimental to the operation and maintenance of treatment facilities. Product assessment can be achieved through; evaluating product material safety data sheets, liaisons with manufactures and suppliers to determine the composition of the product and potential waste output, considering percentage of recycled material used or recyclable components.

Product selection and purchase criteria should incorporate controls to ensure that less toxic/hazardous products are selected, without compromising product performance. Products such as PVC (Polyvinyl chloride) plastic compounds should be progressively replaced by products made from ethylene vinyl acetate copolymers. Organic pigments should replace heavy metals pigments, commonly used for coloring waste bags and sharps containers.

5.3.2 Product Changes

Where substitution can't be achieved due to limited range of products, management should approach manufactures/suppliers to determine whether it is possible to change the product. There are many examples of product changes which set precedents eg changp from solvent based products to water based, lead based paints to less hazardous alternatives.

5.3.3 Procedural Changes

Simple changes to patient care procedures can be made to minimize the wastes generated eg:

- When preparing for dressing, clean and sterile procedures, practitioners should critically assess material required. When "setting up" unwanted extra materials should be removed for re-sterilization or reuse. This should occur prior to commencing the procedure, therefore minimize the potential of contamination;
- Review frequency of waste collection, size and location of containers and bags.

5.4 Re-Use

Re-useable items should be preferred to disposable items whenever it is clinically appropriate, environmentally sound, practical and cost effective to do so. Do not discard items that may be feasibly reused, not including patient care items, or items that are contaminated with blood and/or body fluids.

Choose items, which may be reused such as washable nappies, crockery, cutlery, and reusable kidney dishes. The cleaning and reprocessing of all reusable items must be considered.

5.5 Recycling

A large number of recyclable items are generated by health care institution and should be separated for recycling. By separating recyclables quantities of waste to landfill could be reduced substantially. Health care institutions with recycling facility will have immediate cost reductions and increasing benefits in the future. As disposal volumes decrease, cost savings should increase.

6 Waste Segregation

6.1 About this section

This section explains the significance of waste segregation, which should follow immediately after waste is generated. Effective segregation will reduce costs, promote recycling and protect the health and safety of all.

6.2 What is Segregation?

Waste segregation is the practice of classifying waste and placing it into the appropriate waste container immediately after the waste is generated.

The segregation of waste will follow the criteria described in Section 3.2. Segregation of waste at source is the most important activity for an effective medical waste management, therefore should be made mandatory in all health care institutions in Nepal. Waste segregation practices at different health care institutions may vary to certain extent depending on the treatment system used and the policies and practices within the individual health care institutions. However, there needs to be some standard practices, described in this guideline, which apply to all institutions.

Every health care institution should segregate their waste at the source that is at ward side, Operation Theater, laboratory, or any other room in the hospital where the waste is generated in to three categories viz. sharps, hazardous, and general. If autoclave is being used to treat part of the waste, infectious waste should also be separated for autoclaving.

It is highly recommended that all health care institutions recycle their general waste into organic (food residue, garden waste etc) and non-organic waste (paper, glass, plastics, etc). In such cases different color bins should be used to collect organic and inorganic waste.

Waste can be composted or recycled within the health care institution premises or sent off site for the treatment purpose. General waste, which is not com posted or recycled, should be treated as general municipal waste and sent for land filling.

7 Handling, Labeling, Containment, Transport, and Storage of Health Care Waste

7.1 About this Section

This section explains the importance of streamlining the process of waste collection, handling and transport to ensure compliance with environmental requirements of Nepal

7.2 Waste Collection

- i. Waste collection must be done in accordance with the schedules specified in the waste management plan.
- ii. Clinic staff and sweepers shall, when handling waste, wear protective clothing at all the times including face masking, industrial aprons, leg protectors, industrial boots and disposable or heavy duty gloves, as required
- iii. Sanitary staff and sweepers shall ensure that:
 - a) Waste is collected at least daily, but more often if necessary;
 - b) All bags should be labeled before removal, indicating the point of production, ward and hospital, and contents; and
 - c) Bags and containers which are removed are immediately replaced with new ones of the same type; and
 - d) Where a waste bag is removed from a container, the container is properly cleaned before a new bag is fitted there in.

7.3 Waste Transportation

- a. For on-site transportation, the waste collection trolley shall be free of sharp edges, easy to load, unload, and clean. The trolley shall be cleaned regularly, and especially before any maintenance work is performed on it.
- b. The sealed plastic bags shall be carefully loaded by hand onto trolley to minimize the risk of punctures or tears.
- c. Yellow-bagged hazardous waste and black-bagged general waste shall be collected on separate trolleys, which shall be painted or marked in the corresponding colors.
- d. The collection route shall be the most direct one from the final collection point to the central storage facility designed in the Waste Management Plan. The collected waste shall not be left even temporarily anywhere other than the designated central storage facility.
- e. All yellow-bagged waste is collected at least once daily;
 - i. All staff members handling yellow-bagged waste protective clothing;
 - ii. Yellow -based waste is transported separately from the other waste

- iii. Vehicles used for the carriage of yellow-bagged waste are not used for any other purpose, are free of sharp edges, easy to load and unload by hand, easy to clean/disinfect, and fully enclosed, preferably with hinged and lockable shutters or lids, to prevent any spillage in the health care institution premises or on the highway during transportation;
- iv. All concerned staff members are properly trained in handling, loading and unloading, transportation and disposal of yellow bagged waste, and are fully aware of emergency procedures for dealing with accidents and spillages;
- v. All vehicles should carry adequate supply of plastic bags, protective clothing, cleaning tools and disinfectants to clean and disinfect any spillage;
- vi. The transportation of waste is properly documented, and all vehicles carry a consignment note from the point of collection to the incinerator or landfill or other final disposal facility; and
- vii. All vehicles are decontaminated, cleaned, and disinfected after use.
- f. Wastes should be transported during low patient flow times
- g. Waste transport should be done in the way where patient and visitors don't walk very often.

7.4 Waste Storage

- i. A separate central storage facility shall be provided for your yellow-bagged waste, with a sign prominently displaying the biohazard symbol and clearly mentioning that the facility stores risk waste.
- ii. The designated central storage facility shall
 - a. Be located within the health care institution premises close to the incinerator, if installed, but **away** from food storage or food preparation areas;
 - b. Be large enough to contain all the hazardous waste produced by the health care institution, with spare capacity to cater for collection and transfer for disposal
 - c. Be easy to clean and disinfect, with an impermeable hard-standing base, plentiful water supply and drainage, lightning and ventilation;
 - d. Have adequate cleaning, equipment, protective clothing and waste bags and containers located nearby; and
 - e. Be easy accessible to collection vehicles and authorized staff, but to be fully enclosed and secure from unauthorized access, and especially in accessible to animals, insects and birds.
- No materials other than yellow-bagged waste shall be stored in the central storage facility
- No waste shall be stored at the central storage facility for more than 24 hours
- Containers with radioactive waste shall be stored in a specially marked area in a lead-shielded storage room
- Containers with chemical waste which are to be sent to specialized treatment facilities

- shall also be stored in a separate room or area
- The central storage facility shall be thoroughly cleaned in accordance with procedures stipulated in Waste Management plan

8 Waste Treatment/Disposal

8.1 About this section

This section outlines the treatment/disposal/utilization options for waste streams generated in health care institution. Disposal methods must confirm to environmental and other relevant requirements stipulated by laws.

8.2 Responsibility

The health care institution has the responsibility to ensure that its wastes are transported and treated appropriately before disposal. The health care institution must determine mechanisms in monitoring contractors for waste transportation and disposal.

8.3 Treatments and Disposal of Health Care Waste

Several methods are used for health care waste treatment, depending on the type of waste material. These treatment methods include incineration, chemical disinfections, microwave, encapsulation, sanitary landfill, and Inertization etc. Acceptable treatment methods for the various types of wastes are listed in Table 8:1. The choice of treatment system should be made carefully, on the basis of various factors, many of which depend on local conditions. In choosing a treatment or disposal method for health care waste, particularly if there is a risk of toxic emissions or other hazardous consequences, the relative risks, as well as the integration into the overall framework of comprehensive waste strategy should therefore be carefully evaluated in the light of local circumstances and prevailing environmental regulations. Advantages and drawbacks of the various treatment and disposal technologies in the guidelines are summarized in annex-4.

Table 8.1 Overview of Disposal and Treatment Options for Different types of Health Care Waste

<i>Method</i>	<i>Infectious</i>	<i>Pathological</i>	<i>Sharps</i>	<i>Pharmaceutical</i>	<i>Cytotoxic</i>	<i>Chemical</i>	<i>Radioactive</i>
Rotary kiln	Yes	Yes	Yes	Yes	Yes	Yes	Low-level Infectious waste
Pyrolytic incinerator	Yes	Yes	Yes	Yes	No	Small Quantities	Low-level Infectious Waste
Single chamber incinerator	Yes	Yes	Yes	No	No	No	Low-level Infectious Waste
Drum of brick incinerator	Yes	Yes	Yes	No	No	No	No
Chemical disinfections	Yes	No	Yes	No	No	No	No
Wet thermal treatment (Autoclave)	Yes	No	Yes	No	No	No	No

Microwave	Yes	No	Yes	No	No	No	No
Encapsulation	No	No	Yes	Yes	Small Questions	Small Questions	No
Safe burial on hospital premises	Yes	Yes	Yes	Small Questions	No	Small Questions	No
Sanitary landfill	Yes	No	No	Small Questions	No	No	No
Discharge to sewer	No	No	No	Small Questions	No	No	Low-level liquid waste
Inertization	No	No	No	Yes	Yes	No	No
Other method	-	-	-	Return expired Drugs to supplier	Return expired Drugs to supplier	Return expired Drugs to supplier	Decay by Storage

Source: Pruss. et. Al. 1999 Sharps:

All sharps should be treated primarily within the health care institutions and they should not be sent out for treatment for this purpose. Syringes and needles should be rendered unusable (with the help of needle destroyer) or should be disinfected with a suitable disinfectant. The best option for treatment would be disinfections in chlorine solution and destruction using a needle destroyer. There is another way to dispose the used sharp as mentioned below.

- *Collect sharps in puncture proof container*
- *Burn them in a tin by putting little kerosene*
- *After burn it remain in hard mass*
- *Dispose hard mass as other waste*

Hazardous waste:

Hazardous waste should be collected at the point of generation in covered yellow plastic buckets lined with yellow plastic bags. The size of the bucket will vary according to the amount of waste produced. The capacity of the bucket placed at a point of waste generation, however, should be at least 50% more than the average volume of waste generated in that particular location. In nursing station, there should be a 50-liter capacity container made of tough plastic (bucket) for the collection of hazardous waste. The bag shall be removed when it is not more than three quarters full and sealed, preferably with self-locking plastic sealing tags and not by stapling.

The plastic bags used for collecting hazardous waste should have the following specifications:- Each bag shall be labeled, indicating date, point of production/ward/Health Care Institutions, quantity and description of waste, and prominently displaying the label "Danger! Hazardous Waste, "सावधान ! हानिकारक धारित फोहर". and biohazard symbol shown in annex 3B. The bag removed should be immediately replaced with a new one of the same type.

- The plastic bag should be bigger than the containers so that the bags can be folded out on the rims of the containers.
- Minimum 20- micron thickness LDPE or HDPE bags for up to 20 lit. Capacity bags.
- Minimum 50-micron thicknesses LDPE or 35 micron HDPE for 50-100 lit. Capacity bags.

General waste:

As it is highly recommended that all health care institutions recycle their non-medical waste, general waste should be separated into organic (food residue, garden waste etc) and non-organic waste (paper, glass, plastics, etc). In such cases different color bins should be used to collect organic and inorganic waste.

Waste can be composted or recycled within the health care institution premises or sent off site for the treatment purpose. General waste, which is not composted or recycled, should be treated as general municipal waste and sent for land filling.

8.3.1 Incineration

Incineration converts combustible materials into noncombustible residue or ash. Gases are ventilated through the incinerator stacks, and the residue or ash is disposed of in a sanitary landfill. If incinerators are properly designed, maintained, and operated, they are effective in killing organisms present in infectious waste and also helps to reduce volume of waste. Although all types of infectious waste can be disposed of by incineration, the process is especially useful for anesthetic disposal of pathological wastes such as tissues and body parts. Incineration also renders contaminated sharps unusable. The principal factors to consider when incinerating infectious wastes are variations in waste composition; the waste feed rate, and the combustion temperature. Infectious wastes containing antineoplastic drugs should be disposed of in an incinerator that provides high temperatures and enough time for the complete destruction of these compounds. The incinerator's effectiveness in disposing of chemical wastes should be documented before such use. There are different types of incinerators. A special type of incinerator can be built which can operate with very low fuel. Emission guidelines for incinerators are given in annex-5.

8.3.2 Chemical Disinfections

Chemical disinfections are the preferred treatment for liquid infectious wastes, but it can also be used in treating solid infectious waste. The following factors should be considered when using chemical disinfections:

- Type of microorganism
- Degree of contamination
- Type of disinfectant
- Contact time.
- Other relevant factors such as temperature, pH, mixing requirements, and the biology of the microorganism

Ultimate disposal of chemically treated waste should be in accordance with national and local requirements.

8.3.3 Autoclaving, Steam Sterilization

Steam sterilization, autoclaving, involves the use of saturated steam within a pressure vessel at temperatures high enough to kill infectious agents in the waste. Sterilization is accomplished primarily by steam penetration. Steam sterilization is most effective with low-density material such as plastics. An alternative treatment method, e.g. incineration, should be used on high-density wastes such as large body parts or large quantities of animal bedding or fluids because they inhibit direct steam penetration and require longer sterilization times.

Containers that can be used effectively in steam sterilization are plastic bags, metal pans, bottles, and flasks. High-density polyethylene and polypropylene plastic should not be used in this process because they do not facilitate steam penetration to the waste load. Heat-labile plastic bags allow steam penetration of the waste, but they may crumble and melt. If heat-labile plastic bags are used, they should be placed in another heat-stable container that allows steam penetration, such as a strong paper bag, or they should be treated with gas/ vapor sterilization.

The following precautions should be taken when using steam sterilization:

- Special autoclavable bags should be used
- To facilitate steam penetration, bags should be opened and caps and stoppers should be loosened immediately before they are placed in the steam sterilizer.
- Care should be taken to separate infectious wastes from other hazardous wastes.

The following precautions should be taken when using steam sterilization:

- Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging.
- To facilitate steam penetration, bags should be opened and caps and stoppers should be loosened immediately before they are placed in the steam sterilizer.
- Care should be taken to separate infectious wastes from other hazardous wastes.
- Infectious waste that contains noninfectious hazards should not be steam sterilized because of the possibility that the equipment operator will be exposed to toxic, radioactive, or other hazardous chemicals.
- Waste that contains antineoplastic drugs, toxic chemicals, or chemicals that would be volatilized by steam should not be steam-sterilized.
- Persons involved in steam sterilizing should be trained in handling techniques to minimize personal exposure to hazards from these wastes. Some of these techniques include:
 - ❖ Use of protective equipment
 - ❖ Minimization of aerosol formation
 - ❖ Prevention of waste spillage during autoclave loading and unloading
 - ❖ Prevention of burns from handling hot containers
 - ❖ Management of spills
- The autoclave temperature should be checked with a recording thermometer to ensure that the proper temperature is being maintained for a long enough period during the cycle.
- Steam sterilizers should be routinely inspected and serviced, and the process should be routinely monitored to ensure that the equipment is functioning properly.

The standard for the operation of autoclave is given in annex-6.

8.3.4 Encapsulation

This is a method for treatment and containment of waste to make it safer for deposition in municipal landfill. It can be used for disposal of sharps, pharmaceuticals and chemical waste.

- Waste is deposited in drums made for metal or rigid polyethylene. When containers are % full, an immobilizing agent such as plastic foam, bituminous sand, cement mortar or clay is poured into it. Material is allowed to dry and the container is sealed.
- Encapsulation is effective in reducing the risk of scavengers gaining access to the hazardous waste. It is particularly suitable for sharps and pharmaceutical waste. It should not be used for non-sharp infectious waste.

8.3.5 Sanitary Landfill

Sanitary landfill are designed and constructed to prevent the contamination of soil, surface, and ground water and to limit air pollution, smells and direct contact with public. Some essential features of sanitary landfills are:

1. Access to the site and working areas for waste delivery.
2. Presence of personnel on sites to effectively control the daily operation.
3. Adequate sealing and lining of base and sides of the site to minimize the movement of waste water. Site should be 50 meter away from water sources.
4. Adequate methods of leachate collection and treatment.
5. Organized depositing of wastes in a small area, spreading, compaction, and covering daily with soil.
6. Protect with wire bar/fence to prevent unauthorized persons, animals, and birds.

8.3.6 Burial

Hazardous waste can be buried in a special pit. The standards and design of this pit are given in annex-?

8.3.7 Inertisation

This is the mixture of waste with cement and other substances before disposal in order to minimize the risk of toxic substances migrating into surface water or ground water and to prevent scavenging. It is particularly suitable for pharmaceutical waste and incineration ash with high metal content.

- The waste is ground and mixed with lime and cement in a cement mixer in the following proportions: 65% waste,] 5% lime cement and 5% water.
- The mixture of water, lime, cement, and water is allowed to set into cubes or pellets and then these are transported to suitable storage site.

8.4 Health Care Waste Disposal

- Depending upon the type and nature of the waste material and the organisms in the waste, waste should be inactivated or rendered safe before final disposal by a suitable thermal, chemical, irradiation incineration, filtration or other treatment method, or by a combination of such methods involving proper validation and monitoring procedures. Effluent from the waste treatment methods shall also be periodically tested to verify that conforms to the National level/WHO level discharged into the sewerage system.
- Yellow-bagged waste shall be disposed by burning in an incinerator or by burial in a landfill, or by any other method of disposal approved by the government of Nepal.
- Sharp containers, which have not been placed in yellow bags for incinerator, shall be disposed of by encapsulation or other method of disposal approved by the government of Nepal.
- The method of disposal, whether by burning in an incinerator or by burial in a land -fill or otherwise, shall be operated by health care institution only after approval of its environmental impact assessment in accordance with the provisions mentioned in environment protection act.
- All hazardous waste delivered to incinerator shall be burned within 24 hours.
- Ash and residues from incineration and other methods shall be placed in robust, noncombustible containers and sent to the local authority's designated landfill site.
- Landfills shall be located at sites with minimal risk of pollution of ground water and rivers. It should be located; 50 meter from water source, site shouldn't be flooded during raining season, scavengers, dogs, animals, and birds shouldn't enter the area.
- Access to sites shall be restricted to authorize personnel only. Hazardous waste shall be buried in a separate area of the landfill under a layer of each or non hazardous waste at least I meter depth which shall then be cooperated. The landfill shall be regularly monitored by the municipality to check groundwater contamination and air pollution. The municipality shall also ensure that the landfill operator's use properly trained, especially in safe disposal, use of protective equipment and hygiene and emergency response procedure.

9 Occupational Health and Safety

9.1 About this section

Each health care institution is responsible to provide safe, healthy workplace, and safe system of work for all. The management of waste presents a number of potential hazards to employees requiring the appropriate measures of risk identification, risk assessment, and risk control. Employees have an obligation to follow instructions regarding safe work practices. This section explains their responsibilities and obligations.

9.2 Employer Responsibilities

Health care institution is responsible for providing appropriate information, education, training and ensuring that safe systems of work are developed and maintained. Approved work practices should be documented and promoted. Multilingual translations are to be provided to personnel as required. Standard Operating Procedures (SOP) should;

- Specify the Waste Management Plan, waste segregation procedures and approved waste handling procedures;
- Detail appropriate training required for waste generators, and handlers
- Specify personal protective equipment required for waste handling tasks
- Detail spill management strategies, and designate trained personnel for spill management on-site;
- Specify how to operate the information, education, training and safe working systems

9.3 Employees Responsibilities

Employees are to comply with health care waste management policies, procedures, and instructions given for the protection of their own health and safety and health and safety of others. This includes the correct use of safety and protective equipment.

9.4 Occupational Health & Safety (OH&S) Responsibility in Institution

Instead of forming a new committee of OH&S, waste management committee could be given additional responsibility to look after OH&S activities. The committee should have responsibilities for:

- The provision and installation of facilities and protective equipment,
- Work practices,
- Incidents and accidents,
- Provision and status of information, education and training,
- Relevant records, and
- Material safety data sheets.

9.5 Monitoring Performance

Incident and accident recording is an essential management information system for identifying causative factors to waste handling injuries. It is also an effective tool for determining the effectiveness of the Waste Management Plan in reducing the incidence and severity of these injuries.

9.6 Hygiene

Regular washing and maintenance of equipment used to contain and transport waste. Provide hand-washing facilities for employees and promote regular hygiene procedures. It may be useful to designate specific area for equipment maintenance and hygiene that are properly equipped with emergency showers and drainage to sewer. Emergency showers and location of spills equipment should be identified through out the health care institution.

9.7 Manual Handling

Collection and storage processes should be streamlined to reduce manual handling effort and risks. The use of smaller mobile garbage bins greatly reduces the handling and lifting of waste. Where manual handling risks have been identified the tasks should be assessed and the risks should be controlled in accordance with the code of practice on manual handling. That is where loads exceed 16 kgs team handling procedure or mechanical aids should be used. Wheeled bins should not be lifted.

9.8 Personal Protective Equipment (PPE)

PPE must be worn when required. PPE is the last option in the hierarchy of hazard controls and should only be used if elimination, engineering controls and or changes to work practices do not adequately remove/reduce the risks. Assess risks and provide suitable PPE for the nature and degree of hazard. Waste collectors must include under a statutory obligation to wear appropriate PPE (NSW, Waste Management Guidelines for Health Care Facilities, 1998). The risk of spills or splash exposures necessitates the wearing of face and eye protection. Carrying bags is to be minimized and where it cannot be avoided the waste collector is to wear protective gauntlets and apron to minimize the risk of injury. Protective gauntlets should be worn whenever collecting waste, even if the process involves wheeling a locked mobile garbage bins to the holding areas.

9.9 Employee Vaccination Programs

Each health care institution should have an employee vaccination program. Maintain and keep long- term records to ensure booster injections are given as required.

10 Training

10.1 About this section

This section explains the importance of training in the processes of achieving continuous improvement in waste management.

10.2 Training Needs Assessment

In order for the organization to develop proper training procedures it is required to carry out training needs assessment. A training need assessment has been defined, as the process to establish a clear understanding of who in an organization requires training and type(s) of training, as they need.

10.2.1 Carrying Out A Training Needs Assessment

The following steps outline a training needs assessment

Step 1

Conduct a training analysis to establish who in the organization requires which type of training. Almost all personnel within the institution will require some basic health care waste management awareness training. During the training analysis institution should

- Clearly document the training analysis;
- Review the health care waste management objectives and targets to determine the necessary training for each employee;
- Review operational procedures; and
- Determine which employees have been given health care waste management duties. This will ensure they receive proper training.

Step 2

Prepare a training matrix. Be sure to include the significant health care waste management aspects.

Step 3

Develop a training plan. This will help implement the different training types and ensure training is carried out in a thorough and concise manner. There are many resource guides on health care waste management training available, however a general training plan should include:

- Persons responsible for coordinating the training;
- Types of training necessary;
- The organization that will deliver the training (e.g. human resources, operations);
- Course and/ or training material to be provided;
- Examinations or certificates, if applicable;
- Where the training will take place (e.g. classroom, on-the-job); and
- Identification of the trainees.

10.2.2 Training and Promotion

Health related institutions and hospitals must train managers, supervisors, and employees in waste management and reinforce knowledge with promotional activities and special emphasis programs. Training program must be revised as new equipment is introduced or as technological change occurs. All casual staff needs to be trained in waste management before starting employment.

Continuous improvement may be achieved by regularly reinforcing awareness of waste management issues. The following topics should be covered:

- Operating manuals, outlining safe and approved work practices
- Material safety data sheet (MSDS)
- Staff awareness of policies at orientation to the health care institution
- Legislative compliance
- Provision of and compliance with the use of personal protective equipment;
- Hygiene procedures
- Waste stream definitions and waste segregation practices
- Costs and benefits of waste management
- Explanation of recycling programs
- Details of employee vaccination program
- Waste management plan

10.3 Types of Training

- Health Care Waste Management Awareness Training
- Job Orientation Training
- Job Specific Training
- Regularly Required Training

Education and training should be provided at the induction of new employees, or an ongoing basis, with the introduction of new equipment, and at times of technological change. Approved work practices should be documented and promoted.

11 Monitoring System

11.1 Background

Regular monitoring must be performed in each institution with regard to health care waste management. The importance of monitoring lies in the fact that it provides:

- Feedback to the state of affairs in the various stages of health care waste management;
- Information on the trends of waste generation for proactive future action;
- Information on the areas of weakness and strength so as to reinforce the management system with appropriate corrective actions;
- Information on the effectiveness of various health care waste management strategies;
- Information on the achievements of stated targets and standards

Monitoring is the measure of success or failure of the waste management system and also provides timely inputs for progressive improvement of the health care waste management system.

Three types of monitoring mechanism need to be enforced for the progressive improvement and sustainability of the health care waste management system. They are;

- Baseline monitoring
- Compliance monitoring
- Impact monitoring

Baseline and compliance monitoring are performed by the person (s)/authority designated by existing waste management committee. Impact monitoring is performed externally.

11.2 Baseline Monitoring

Baseline monitoring monitors the changes in baseline environmental conditions. The following parameters should be monitored to examine changes in baseline environmental conditions.

- Waste handling and management practices at health care institutions
- Present practices/trend of waste handling in institutions
- Air quality at treatment facility
- Water quality at treatment facility, or at landfill site

11.3 Compliance Monitoring

Compliance monitoring ensures that all the parties concerned in the health care waste management system follows the provisions of guidelines or rules. Compliance monitoring should be done at two stages, one during construction treatment unit/facility and another during the operation of entire operation. During construction it is important to check that the right kind of equipment is being bought and installed in a proper way. During operation, it is important to ensure that hazardous is being handled properly and the equipment is being operated as per the instruction of the manufacturer. Both the institution and the operator of the waste management system should be monitored. The following parameters should be monitored to check compliance with EIA recommendations and regulations:

- At the source of waste generation
 - ❖ Preparation of waste management plan by health care institutions
 - ❖ Training to all employees
 - ❖ Follow up of occupational health and safety requirements
 - ❖ Waste segregation in all areas of health care institutions, use of proper container, and labeling
 - ❖ System for transportation of hazardous waste within health care institutions
 - ❖ Disinfections and destruction of sharps
 - ❖ Use of proper storage facility
 - ❖ Collection schedule
 - ❖ Record keeping
 - ❖ Emergency response
 - ❖ Training
- At Common Treatment Facility
 - ❖ Use of waste treatment equipment as per required specification
 - ❖ Construction of waste treatment facility as per specifications
 - ❖ Operation of all waste treatment facilities including incinerator, autoclave and landfill sites as per the instruction of the equipment manufacturer
 - ❖ Restricted access to treatment facilities

11.4 Impact Monitoring

Impact monitoring identifies any positive or negative changes that have been brought by the established health care waste management system. It requires a repetitive measurement of certain key indicators *for* the establishment of cause effect relationship. The following parameters could be monitored to evaluate the impact of the health care waste management system.

- ❖ Opinion of patients and visitors
- ❖ Opinion of workers in health care institution
- ❖ Opinion of health care institution
- ❖ Inventory of waste handled
- ❖ Payment by health care institutions to service providers, etc

11.5 Monitoring the Effectiveness of Health Care Waste Management System

Without monitoring there is no mechanism *for* evaluating the success of the management system or measures taken to minimize or avoid certain effects *from* the waste in the waste management facilities. Monitoring the effectiveness of the system provides important information that allows *for* more effective planning or provides timely corrective actions to improve the environmental performance of the management facility.

A comprehensive lists of indicators *for* compliance, and impact monitoring must be developed *for* effective monitoring of health care waste management. It is envisioned that a monitoring protocol shall be established by Ministry of Population and Environment in coordination with national, district, local level institutions, and government line agencies.

12 Enforcement Instruments for Implementation of Health Care Waste Management Guidelines

Implementation of above guidelines requires a set of instruments to influence the behavior of health care waste producers and waste management operators. The instruments can be directed at the financial or economic behavior of health care waste producers and waste management operators. They can be directed to regulate the behavior by legislation or can be directed at influencing the behavior by convincing and by facilitating communication between relevant parties.

Enforcement instruments can be classified into following categories:

12.1 Charges

These can be considered as the price that a polluter health care institution has to pay for the damage that is done to the environment. The charge internalizes the costs of the waste generation caused into the private cost-benefit analysis of the polluter health care institution. There are various kinds of charges. These charges are based on the quantity or quality of produced waste. The goal of such charges is to relate waste generation costs of disposal, for instance by charging the quantity of a waste that needs to be disposed. The charge is related to overall costs of waste processing, regardless of the type of treatment. In general the advantages of the charges are the following;

The most important advantage of charges is that a clear relation between costs of waste generation and the costs of prevention of waste is made. When only legal standards are prescribed, every health care institution is obliged to abate pollution up to the point of the standard, regardless of the costs of waste disposal are clear, the benefits of avoiding waste are clear. Health care institution will be able to make its own cost benefit analysis.

A second advantage of the charge system is the continuous incentive to abate pollution. In the regulative system no incentives are left for a health care institution to reduce pollution once the standards are reached, charges from a continuous incentive to save money by abating more pollution.

12.2 Subsidies

These are financial aids provided, e.g. by the government to health care institutions in order to stimulate technological innovation or install waste recycling equipment, final health care waste disposal facilities etc. Several types of subsidies that can be provided are discussed below.

Soft loans, e.g. loans carrying a lower interest rate than market rates, often with grace periods;

Tax facilities, e.g. accelerated depreciation of environmental investments, VAT exemption etc

12.3 Enforcement Incentives

This instrument is primarily a legal rather than an economic instrument: non compliance of this regulation is dealt by charging a fine when non- compliance has occurred. This instrument forms an integral part of the laws or permits, without it these instruments fail to comply with their goals.

This instrument can be used as an economic instrument in two ways. The returns from the fines are allocated to the national health care waste management fund from which subsidies can be granted to health care institutions that follows the guidelines. The fines can be conditional: the company does not need to pay the fine if compliance is achieved within a given time period. The health care institution must present within a very short time a plan in which the measures described in guidelines will be implemented, including time frames.

For the strict implementation of **above** guideline, it should be included as one of the requirement for the registration of health care institution. A certificate must be- awarded to health care institutions complied with above guidelines.

12.4 Legislative and Regulative Instruments

The purpose of the legislative and regulative instruments is to establish legal authoritative institutions to regulate the health care waste management from the Government. Formulation and enactment of legislative and regulative instruments should give considerations on:

- Current health care waste management guidelines
- Existing status of waste management legislation
- Adequacy of the existing national legislation
- Efficacy of the existing arrangements and procedures for enforcement
- Current and proposed environmental quality objectives and emission standards
- Current and proposed National and Waste Policy objectives
- Current and proposed level of peoples participation (communities, private, entrepreneurs, NGO, CBOs, etc) in the waste management

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Annex-I

Action Plan for the Development of National Program for Sound Management of Health Care Waste in Nepal

Management of Health Care Waste:

Health care waste management involves the storage and disposal of waste produced by health care institutions using techniques that will help to spread of diseases.

Long-term Goal of the Project:

To Develop a System for Sustainable Health Care Waste Management in Nepal

Immediate Objectives:

1. To Develop a National Guideline for Health Care Waste Management in Nepal.
2. To establish a unit responsible for Health Care Waste Management
3. To establish a model of Regional Treatment/Cooperative Treatment Facility

Purpose:

This plan of action will lead to the development and implementation of a national system to:

- Provide guidance to hospitals and other health care institutions in the establishment of effective waste management program,
- Develop national guidelines, legislations, and standards regarding the medical waste,
- Explore and suggest the best achievable technology in health care waste management system,
- Development of institution related to health care waste management
- Reduce the overall health risk to patients, workers, the public, and the environment

Approach:

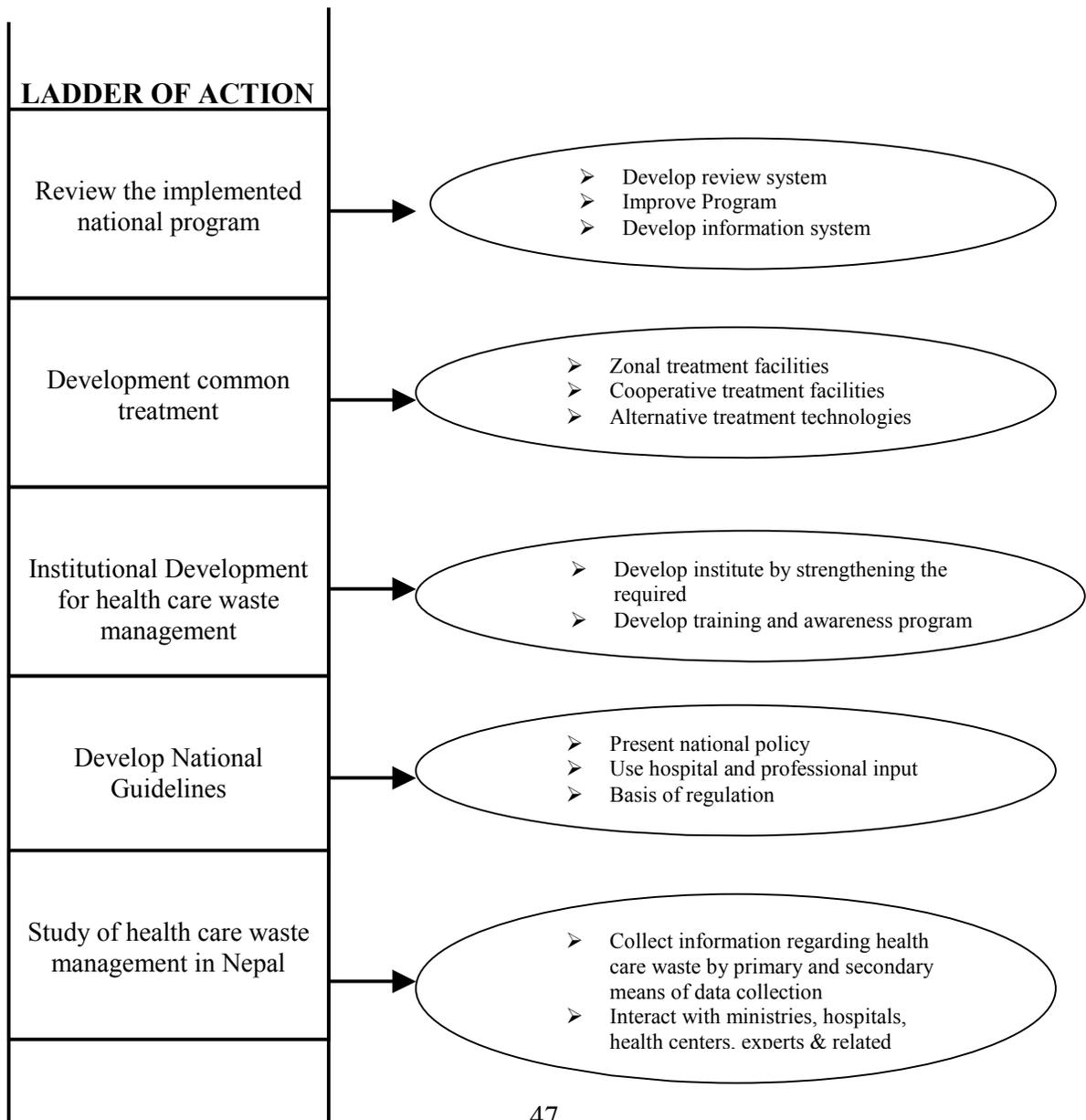
1. Development of national guidelines, legislation and standards regarding the health care waste management in Nepal.
2. Implementation of centralized waste management system; detail research on health care waste will be performed and the system will be proposed for city/district.

3. Establishment of health care waste monitoring cell under the MOH (proposed, though; it will be clearly reflected in legislation), besides monitoring this unit will emphasis on creating awareness of the problems and motivating and educating the concerned people.

4. Strengthening NHRC for research activities related to health care waste

As shown in figure below, the framework may be thought of as a ladder with each rung of the ladder a detailed plan of action that aims to accomplish a goal and provides the basis for moving up to the next level, leading ultimately to the sound development of a sound national level health care waste management at the top.

Action Plan for National Program of Sound Health Care Waste Management



Executing Agency:

Ministry of Health will serve as the principal authority, realizing it will interact and work closely with other ministries/agencies or departments. Nepal Health Research Council will act as a facilitator and establish liaison with related agencies in this work and will assist MoH.

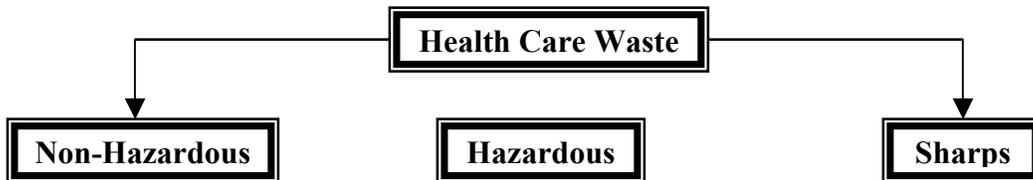
Organizational and Implementation Procedures:

Steering committee, Project Implementation Unit, Experts, Timetable, Costs and financing plan, donor coordination will be developed by MoH.

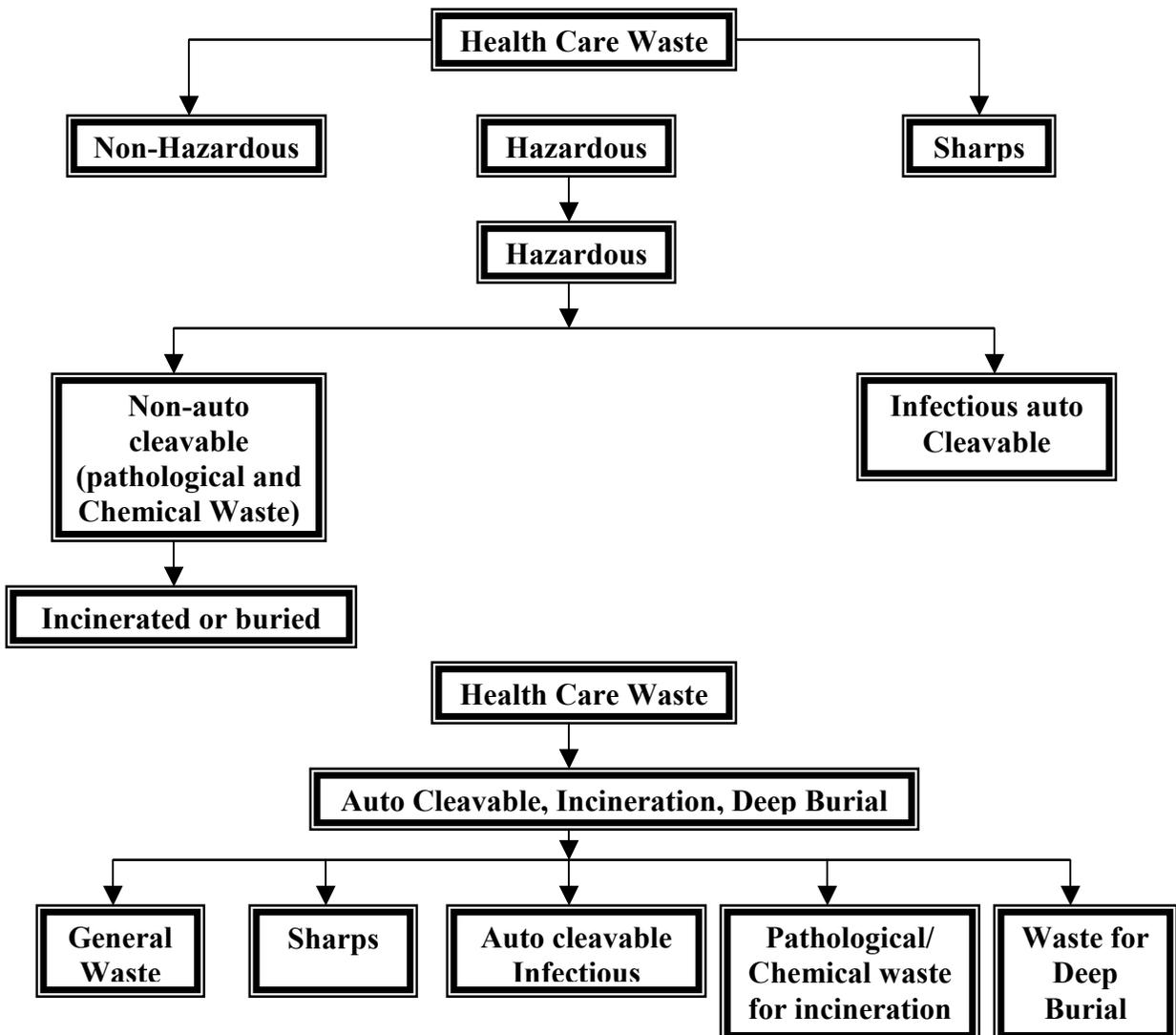
Annex - 2

Classification of Health Care Waste in the Context of Nepal

Based on Characteristics of waste



Based on Treatment Technology



- **Annex - 3^A**



Danger ! Contaminated Sharps
सावधान ! हानीकारक धारिला फोहर

- **Annex - 3^B**



Danger ! Hazardous Waste
सावधान ! हानीकारक फोहर

Annex-4

Summary of Main Advantages and Disadvantages of Treatment and Disposal Options

Treatment / Disposal Options	Advantages	Disadvantages
Rotary Kiln	Adequate for all infectious waste, most chemical waste, and pharmaceutical waste	High investment and operating cost.
Pyrolytic Incineration	Very high disinfections efficiency, adequate for all infectious waste and most pharmaceutical and chemical waste	<u>Incomplete destruction of cytotoxics, relatively high investment and operating costs</u>
Single Chamber Incineration	Good disinfections, drastic reduction of weight and volume of waste. The residues may be disposed of in landfills, no need for highly trained operators, relatively low investment and operating costs.	Significant emissions of atmospheric pollutants, need for periodic removal of slag and soot. inefficiency in destroying thermally resistant chemicals and drugs such as cytotoxics.
Drum or brick incinerator	Drastic reduction of weight and volume of the waste, very low investment and operating costs.	Destroys only 99% of microorganisms. No. destruction of many chemicals and pharmaceuticals massive emission of black smoke, fly ash, toxic flue gas and odors
Chemical disinfections	Highly efficient disinfections under good operating conditions, some chemical disinfectants are relatively inexpensive, drastic reduction in waste volume	Requires highly qualified technicians for operation of the process, uses hazardous substances that require comprehensive safety measures, inadequate for pharmaceutical chemical and some types of infectious waste
Wet thermal treatment	Environmentally sound, drastic reduction in waste volume, relatively low investment and operating costs	Shredders are subject to frequent breakdowns and poor functioning, operation requires qualified technicians, inadequate for anatomical, pharmaceutical and chemical waste and waste that is not readily steam permeable
Microwave irradiation	Good disinfections efficiency under appropriate operating conditions, Drastic reduction in waste volume, environmentally sound.	Relatively high investment and operating costs, potential operation and maintenance problems
Encapsulation	Simple, low cost. and safe, may also be applied to pharmaceuticals.	Not recommended for non-sharp infectious waste
Safe Burying	Low costs, relatively safe if access to site is restricted and where natural infiltration is limited	Safe only if access to site is limited and certain precautions are taken.
Inertization	Relatively inexpensive	Not applicable to infectious waste.

Annex-5A

Emissions guidelines for "hospital/medical/infectious waste" Incinerators (constructed after June 1996)

Incinerators			
Pollutant	Small	Medium	Large
	(<=91 kglh)	(>91-227 kglh)	(>227 kglh)
Particular matter	115 mg/m	369 mg/m ³	
Carbon monoxide (CO)	40 ppmv	40 ppmv	
Dioxins /furans	125 ng/m ³ total CCD/CCF or 2.3 ng/m ³ TEQ	125 ng/m ³ total CCD/CCF or 2.3 ng/m ³ TEQ	125 ng/m ³ total CCD/CCF or 2.3 ng/m ³ TEQ
Hydrogen Chloride (HCl)	100 ppmv or 93% reduction	100 ppmv or 93% reduction	100 ppmv or 93% reduction
Sulfur dioxide (SO ₂)	55 ppmv	55 ppmv	55 ppmv
Nitrogen oxides	250 ppmv	250 ppmv	250 ppmv
Lead	1.2mg/m ³ or 70% reduction	1.2mg/m ³ or 70% reduction	1.2mg/m ³ or 70% reduction
Cadmium	0.16 mg/m ³ or 65% reduction	0.16 mg/m ³ or 65% reduction	0.16 mg/m ³ or 65% reduction
Mercury	0.55 mg/m ³ or 85% reduction	0.55 mg/m ³ or 85% reduction	0.55 mg/m ³ or 85% reduction

Source: Safe Management of Wastes from Health Care Activities. WHO

Annex-5B

Indian Standards for Operation and Emission of Incinerator

Operating Standards

1. Combustion Efficiency (CE) must be at least 99.99%
It is calculated as $CE = \frac{\%CO_2}{\%CO_2 + \%CO} \times 100$
2. The temperature of the primary chamber must be 800 + 50 °C
3. The secondary chamber gas residence time shall be at least 1 (one) second at 1050+ 50°C, with a minimum of 3% oxygen in a stack gas.

Emission Standards

Parameters	Concentration in mg/Nm ³ (at 12% CO ₂ correction)
Particulate Matter	150
Nitrogen Oxides	450
HCl	50

Minimum stack height should be 30 meters above ground level
Volatile organic compounds in ash should not be more than 0.01%

Note:

- Suitably designed pollution control devices should be installed/retrofitted with the incinerator to achieve the above emission limit, if necessary.
- Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
- Chlorinated plastics shall not be incinerated.
- Toxic metals in incinerator and shall be limited within the regulatory quantities as defined under the Hazardous Waste Management (Management and Handling Rules) 1989
- Only low sulphur fuel like LD.O/LS.H.S/Diesel shall be used as fuel in incinerator

Source: Hospital Waste Management, Guidelines for Implementation, GO/WHO/ India. EHH 001, 2000

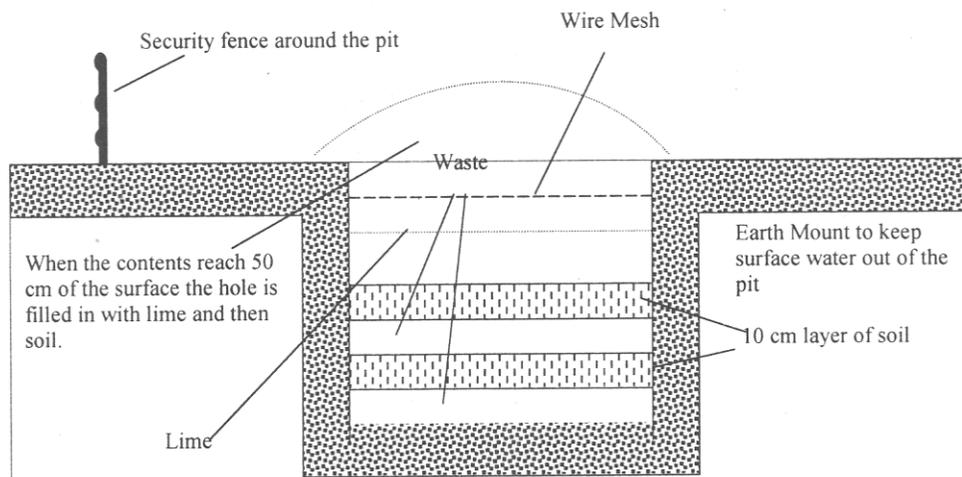
Annex- 6

Indian Standard for Operation of Autoclave

1. When operating a gravity flow autoclave, medical waste shall be subjected to:
 - I. A temperature of not less than 1210 C and a pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or
 - II. A temperature of not less than 1350 C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or
 - III. A temperature of not less than 1490 C and a pressure of 52psi for an autoclave residence time of not less than 30 minutes.
2. When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one pre vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following;
 - I. A temperature of not less than 1210 C and pressure of 15psi for an autoclave residence time of not less than 45 minutes; or
 - II. A temperature of not less than 1350 C and a pressure of 31psi for a residence time of not less than 30 minutes.
3. Medical waste must not be considered properly treated unless the time temperature and pressure indicators indicate the required time; temperature and pressure were reached during the autoclaves process. If for any reasons, time, temperature pressure indicates that the required time, temperatures and pressures were not reached, the entire waste load of medical waste must autoclaved again until the proper temperature, pressure and residence time were achieved.
4. **Recording of operational parameters:** Each autoclave shall have graphic or computer recording devices, which will automatically and continuously monitor and record dates, times of day, load information number and operating parameters throughout the entire length of the autoclave cycle.
5. **Validation Test:** The autoclave should completely and consistently kill. The approved biological indicator for autoclave at the maximum design capacity of each autoclave unit. Biological indicator for autoclave shall be a bacillus stearothermophilus spore using vials or spore strip, with at least 1×10^4 spores per milliliter. Under no circumstances will an autoclave have minimum operating parameters less than residence time of 30 minutes, regardless of temperatures and pressure, a temperature less than 1210 C or a pressure less than 15psi.
6. **Routine Test:** The chemical indicator strip/tape that changes color when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste package at different location to ensure that the inner content of the package has been adequately autoclaved.

Annex - 7

BURIAL PIT FOR HEALTH CARE WASTE



Annex- 8

List of Resource Persons Involved for the Preparation of Health Care Waste Management Guidelines

S.N	Name	Institution
1	Dr. Anil Kumar Mishra	Member Secretary, Nepal Health Research Council,
2	Mr. Jan. A. Speets	Environmental Health Advisor, WHO
3	Mr. Sharad Adhikari	National Operating Officer, WHO
4	Dr. Sushil Koirala	President, National Dental Hospital
5	Mr. Dirgha Raj Shrestha	Coordinator, ENGENDER HEALTH
6	Mr. Narendra Pokharel	Chief, Pollution Unit, Ministry of Population and Environment
7	Mr. Arjun Bahadur Singh	Sr. Public Health Administrator, Ministry of Health
8	Mr. Babu Raja Shrestha	Waste Expert, BMC-AES (P)Ltd, Biratnagar
9	Mr. Kedar Joshi	Director, Performance Evaluation Unit, The Auditor
10	Dr. Roshan Raj Shrestha	General's Office President, ENPHO
11	Mr. Mingma G Sherpa	Environmentalist, ENPHO
12	Ms. Anjali Manandhar	Environmentalist, ENPHO

Corrigendum

	Errors	Corrected
Page 28, Line 4	Yellow-based	Yellow-bagged
Page 29, Line 1	herd-standing	hard-standing
Page 29, Line 2	lightning	lightning
Page 34, 16-23 lines		Cross-out
Page 42, Line 19	to the health care institution	Cross-out
page 46, Line 30	inventive	incentive