MODULE

Infectious Waste Management

For the Ethiopian Health Center Team

Ethiopia Public Health
Training Initiative

Esayas Alemayehu, Ayalew Tegegn, Getenet Beyene,
Desta Workneh, and Hailu Endale

Jimma University

In collaboration with the Ethiopia Public Health Training Initiative, The Carter Center,
the Ethiopia Ministry of Health, and the Ethiopia Ministry of Education

2005

Funded under USAID Cooperative Agreement No. 663-A-00-00-0358-00.

Produced in collaboration with the Ethiopia Public Health Training Initiative, The Carter Center, the Ethiopia Ministry of Health, and the Ethiopia Ministry of Education.

Preface

The handling and disposal of infectious wastes are public health problem both in developing and developed countries. In developing countries like Ethiopia, there are only very limited reference materials and trained professionals. It is essential to develop and prepare teaching- learning materials for Infectious Waste Management for health professionals particularly for health center teams.

This module is prepared for Ethiopian Health Center Health teams, to enhance their work as group. The module is prepared for the Health Officer, Nurse, Medical Laboratory and Environmental Health technicians. The core module highlights the general principles of infectious waste management which should be read by all categories of students. The satellite modules are designed to address the specific function of different categories of students.

This module does not replace standard text books but will complement reading materials that are available in the health center or in the library. This material should be used as a reference source when conducting training and refresher courses for health center workers.

Acknowledgments

We are very grateful to the Carter Center for providing us the financial supports for all activities, access to their resources materials and moral support: without their support, it would not have been possible to develop this module.

We would also like to extend our sincere thanks to Jimma University for the assistance in providing us materials and for giving permission to the academic staff to work on this project.

The Authors address their heartfelt acknowledgement to reviewers Ato Bishaw Deboch, Vice Dean of Public Health Faculty, Jimma University; and Ato Fantahun Ayalew, Matron of Jimma Hospital; Ato Gebreamanuel Teka, Associate Professor, Dr. Abera Kumie, Ato Embialle Mengistie and Ato Waqtola cheneke, academic staffs in Jimma university.

Finally, last but not least, our sincere thanks goes to the Agaro Teaching Health Center for providing us with rooms during the development of this module.

Table of Contents

Contents **Page**

List of Tables and Figures

List of tables

List of Figures

UNIT ONE

INTRODUCTION

1.1 Purposes and uses of the module

This module is prepared for Health Officer, Nurse, Environmental Health Technician and Laboratory Technician professionals as they work as a team to safely handle and dispose of infectious wastes in health centers in Ethiopia.

The concepts about infectious wastes, including their source and composition, physical, chemical and biological properties, ways of disease transmission, handling, separation and storage, collection and disposal are explained in simple and understandable ways.

This module can also be used as a reference material for other categories of health professionals who are working at the health center as learning material and training workshops.

The module consists of the “Core Module” as well as “Satellite Modules”. The facts stated in the core module is the minimum set of information that should be known by all categories of health workers. Satellite modules deal with the specific knowledge, attitude and practical skills that are required by the respective categories of the health center team members.

1.2 Directions for using the module

Before starting to read this module, please follow the directions given below:-

- First read the introduction, the purpose and use of the module.
- Attempt to answer all the pretest questions (which are designed for all categories of students as well as those specific to the respective professionals)
- Go through the rest of the core module.
- Then each category of student should read their respective satellite modules.

- Attempt to answer all the post-test questions given in the core module.
- Compare results of the pretest and post-test questions by checking against the given answer keys.
- Study and discuss the specific learning objectives, activities and tasks of each category of student.

UNIT TWO

CORE MODULE

2.1 Pre and post test

2.1.1 Questions for all categories of the Health Center Team

Answer the following question accordingly

1. Infectious waste comprises about 25 percent of an average hospital's medical waste stream.

   True

   False

2. Medical waste is defined in part as "any solid waste that is generated in the diagnosis, treatment or immunization of human beings.

   True

   False

3. Blood products and body fluids are considered to be infectious medical waste.

   True

   False

4. Infectious waste minimization strategies include segregation and source reduction.

   True

   False

5. Smart handling of infectious waste while it is still in the health care facilities helps to decrease environmental impacts and occupational exposure.

   True

   False

6. Contaminated sharps containers can never be recycled.

   True

   False

7. Hospitals generally don't need a waste management plan.

   True

   False

8. Infectious wastes are the possible risk of communicable diseases only in developed countries.

   True

   False

9. Medical or related workers and infectious waste handlers are the only groups that are at risk of acquiring infection associated with such wastes.

   True

   False

10. Infectious waste is not a major health concern

    True

    False

11. Infectious waste only causes water and food-borne diseases

    True

    False

12. The majority of infectious waste are generated from health and health related facilities

    True

    False

13. One of potential health risk of infectious risk are HIV/ AIDS and hepatitis viruses

    True

    False

14. The types and quantity of infectious waste in health facilities are easily identified and of quantified.

    True

    False

15. Transmission of disease from infectious waste can be only through direct contact and airborne

    True

    False

2.1.2 Questions for Specific Categories of the Health Center Team

Answer the following questions accordingly

2.1.2.1 Questions for Health Officers

1. What are the standard precautions that you should take when handling infectious wastes?

2. What additional precautions should you take while dealing with infectious waste?

3. How do you manage if you prick some one or yourself with contaminated needle or sharps?

4. What are the chains of infection from the infectious wastes?

5. List five infectious diseases that can be transmitted from infectious wastes?

_____

_____

_____

_____

2.1.2.2 Questions for Nurse

1. All are the roles of the nurse in the management of infectious waste except:
   A. Identify the infectious waste, which is potentially risk for health.
   B. Maintain the cleanliness of the environment
   C. Promote safe environment
   D. Promote conducive environment for infectious waste

2. Which one of the following are not effects of infectious waste?
   A. Diabetes mellitus
   B. HIV/ AIDS
   C. Hepatitis B Virus
   D. Virus
   E. Hepatitis C virus

3. All are principles of infection prevention except:
   A. Considers standard universal precaution
   B. Practice aseptic principles
   C. Promote safe processing of instruments
   D. Promote proper hand washing only after a procedure.

4. Which of the following is not included in the infection cycle?
   A. Infectious agent and reservoir
   B. Susceptible host
   C. Portal of exit and entry
   D. Healthy person

5. Infectious agent includes all <u>except:</u>
    A. Bacteria
    B. Fungi
    C. Host
    D. Parasites
    E. Viruses

6. The purpose of proper disposal of waste includes all <u>except:</u>
    A. Protect those who handle waste from accidental injury.
    B. Prevent spreading of infectious waste to healthy person.
    C. Enhance the transmission of infectious waste
    D. Provide a pleasing atmosphere.

7. Which of the following is <u>not</u> protective waste disposal?
    A. Goggles
    B. Host
    C. Gown
    D. Glove

8. All of the following is / are universal precautions taken for infection Prevention and control <u>except:</u>
    A. Rubbing hands with clean towel
    B. Disinfecting materials
    C. Safe decontamination method
    D. Changing torn protective barriers

9. Identify the incorrect statement:
    A. Cleaning reduces the number of micro- organisms on used instruments and equipment
    B. Sterilization and high-level disinfection procedures are not effective with out prior cleaning
    C. Gloves should be worn while cleaning the instruments and equipment.
    D. Cleaning can destroy all micro- organisms including spore-forming Organisms

10. Which one of the following is correct with regard to the processing of reusable medical and surgical instruments?

    A. High level disinfection, decontamination, cleaning and proper storage.

    B. Decontamination, cleaning, high level disinfection and proper storage.

    C. Cleaning, decontamination, high level disinfection and proper storage.

    D. Proper storage, decontamination, cleaning and high level disinfection.

2.1.2.3 Questions for Medical Laboratory Technicians

1. The most effective and practical method of laboratory waste disposal:

    A. boiling

    B. incineration

    C .burial

    D. all of the above

2. Cultures are best sterilized by:

    A. boiling

    B. disinfection

    C. autoclaving

3. Pathogens in the laboratory can be acquired through:

    A. ingestion

    B. inhalation

    C .inoculation

    D. all of the above

4. Pathogenic organism found in Risk Group 1 can be handled in:

    A. basic laboratory-level 1

    B. basic laboratory-level 2

    C. containment laboratory -level3

    D. maximum containment laboratory-level 4

5. Performing the following in the laboratory are not permitted except one:
    A. Eating
    B. Smoking
    C. Wearing laboratory gown
    D. Applying cosmetics

6. Decontamination of working benches, floors and spillages are commonly done using:
    A. autoclaving
    B. boiling
    C. chemical disinfectant
    D. all of the above

7. All the following are method of decontamination except one:
    A. incineration
    B. autoclaving
    C. disinfection
    D. boiling

8. Before being reused or disposed all infectious laboratory materials should be:
    A. exposed in sunlight for one hour
    B. kept in the laboratory for one month
    C. made non infectious
    D. all of the above

2.1.2.4 Questions for Environmental Health Technicians

1. Which of the following is not included under the sources of infectious waste?
    A. Medical care facilities
    B. Research activities
    C. Biological laboratory service
    D. All industrial activities

2. Effective infectious waste management begins with ---
   A. Proper on - site storage
   B. " disposal
   C. " collection
   D. " transportation

3. Unlike household wastes for instance, careful handling practices are required for infectious wastes because.
   A. Its quantity is not manageable
   B. It has associated risks to public health
   C. Its physical property is difficult to handle
   D. Its chemical " " " "

4. The minimum storage time of infectious waste before collection is
   A. Within 24 hr
   B. 24 hr - 48 hr
   C. 72 hr
   D. within 7 days

5. Which of the following processes is designed to reduce the quantity as well as to destroy the microbial activities of infectious waste?
   A. Incineration
   B. Land filing
   C. Autoclaving
   D. Compaction

6. The storage place & containers for infectious wastes needs to be marked in the management of associated public health problems, so as to:
   A. Facilitate the collection process
   B. " the transportation "
   C. " the disposal "
   D. Indicate biological hazard

7. Which group of a community is at risk of acquiring infectious waste related diseases?
   A. Hospital workers
   B. Children
   C. Waste collection crews
   D. All

8. What are the main purposes of health education in the prevention and control of public health threats associated with infectious waste-?

   _____
   _____
   _____

9. What is/are the first line of defense against the transmission of diseases associated with infectious waste?

   _____
   _____
   _____

10. List some diseases that can be transmitted by infectious waste_____

    _____
    _____

2.2 Significance and brief description of infectious waste management

Infectious waste is a major public concern and should be addressed as effectively as possible. It comprises about 15 to 25 percent of an average hospital's medical waste stream (Leo Uzych, 1990; Erasmus, 1996). With the widespread concern over the possible risk of deadly diseases such as AIDS and hepatitis, infectious wastes are coming under increasing scrutiny by developing countries which are concerned about the health and the well being of the society.

According to the EPA (environmental protection agency) 3.2 million tons of infectious wastes are generated from health and health related facilities yearly. This represents about 2% of the total municipal wastes. This may be more or less true in Ethiopia. Health risk may result from improper management and disposal of infectious waste in the natural environment. This is illustrated by a study conducted in Nigeria, where needle stick accidents are reported by 27% of 474 health care due to handling or disposal of used needles and 18% during needle recapping. The workers engaged in sorting, collection and transporting infectious waste are found to be infected with HIV. In South Africa proper disposal of infectious waste is cited as a means of reducing the sky rocketing of infections in health workers and the population as a whole (Forde, 1993).

The type and quantity of infectious waste in health facilities are not identified and quantified. The collecting and disposal system being practiced at these health facilities is not proper and safe. According to WHO, awareness of infectious waste management practice should be raised among all personnel in health care institution, further training of personnel responsible for handling infectious waste is crucial.

2.3 Learning Objectives

After going through this module the reader should at least be able to:

1. Define what infectious waste is.
2. Identify infectious waste by source and type.
3. Determine the physical, chemical and biological properties of infectious waste.
4. Discuss the public health importance of infectious waste and its management.
5. Describe the ways of disease transmission from infectious waste.
6. Demonstrate the on-site handling, sorting and storage of infectious waste.
7. Explain methods of collection, transportation and disposal of infectious waste.

2.4 Definitions

Infectious waste is any waste generated from health and health related facilities that are capable of producing infectious disease.

Infectious waste management is the systematic administration of activities that provide for the handling, sorting (segregation), storing, transporting, treatment and disposal of infectious waste.

2.5 Public health impact of health-care waste

For serious virus infections such as HIV/AIDS and hepatitis B and C, health-care workers are at risk of infection through injuries from contaminated sharps (largely hypodermic needles). Needle stick injuries are caused by recapping of hypodermic needles before disposal into containers, by unnecessary opening of these containers, and by the use of materials that are not puncture-proof for construction of containers. The public is also at risk if contaminated sharps are not disposed of properly. Certain infections, however, spread through other media or caused by more resilient agents, may pose a significant risk to the general public and to patients. For instance, uncontrolled discharges of sewage from field hospitals treating cholera patients have been strongly implicated in cholera epidemics in some Latin American countries.

Individual accidents and subsequent infections caused by infectious waste are well documented. The overall situation, however, remains difficult to assess, especially in developing countries. It is suspected that many cases of infection with a wide variety of pathogens have resulted from exposure to improperly managed infectious wastes in developing countries.

2.6 Epidemiology of infections from infectious wastes

Infections from infectious waste are infections acquired from the wastes from health and health related facilities. Most infections occur in health facilities which are called nosocomial infections that are not present in the patient at the time of admission to health facilities but develop during the course of the stay in Health facilities.

Healthy people are naturally contaminated by infectious waste. Feces contain about 10^{13} bacteria per gram, and the number of microorganisms on skin varies between 100 and 10000 per cm^2. Many species of microorganisms live on mucous membranes where they form a normal flora. None of these tissues, however, is infected. Micro-organisms that penetrate the skin or the mucous membrane barrier reach subcutaneous tissue, muscles, bones, and body cavities (e.g. peritoneal cavity, pleural cavity, bladder), which are normally sterile (i.e. contain no detectable organisms). If a general or local reaction to this contamination develops, with sub-clinical and clinical symptoms, there is an infection.

Table 2.1 Examples of infections caused by exposure to infectious wastes, causative organisms, and transmission vehicles.

Type of infection	**Examples of causative organisms**	**Transmission vehicles**
Gastroenteric infections	Enterobacteria, e.g. *Salmonella*, *Shigella* spp.; *Vibrio cholerae*; helminths	Feces and/or vomit
Respiratory infections	*Mycobacterium tuberculosis*; measles virus; *Streptococcus pneumoniae*	Inhaled secretions; saliva
Ocular infection	Herpesvirus	Eye secretions
Genital infections	*Neisseria gonorrhoeae*; herpesvirus	Genital secretions
Skin infections	*Streptococcus* spp.	Pus
Anthrax	*Bacillus anthracis*	Skin secretions
Meningitis	*Neisseria meningitidis*	Cerebrospinal fluid
Acquired immunodeficiency syndrome (AIDS)	Human immunodeficiency virus (HIV)	Blood, sexual secretions
Haemorrhagic fevers	Junin, Lassa, Ebola, and Marburg viruses	All bloody products and secretions
Septicaemia	*Staphylococcus* spp.	Blood
Bacteraemia	Coagulase-negative *Staphylococcus* spp.; *Staphylococcus aureus*; *Enterobacter*, *Enterococcus*, *Klebsiella*, and *Streptococcus* spp.	Blood
Candidaemia	*Candida albicans*	Blood
Viral hepatitis A	Hepatitis A virus	Faeces
Viral hepatitis B and C	Hepatitis B and C viruses	Blood and body fluids

2.7 Sources and types of infectious waste

Infectious waste usually comes from health and health related facilities. It includes all of the substance or categories of substances.

1. Cultures and stocks of infectious agents and associated biological, including without limitation, specimens cultures, cultures and stocks of infectious agent, waste from production of biological and discarded live and attenuated;
2. Laboratory wastes that were, or are likely to have been, in contact with infectious agents that may presents a substantial threat to public health if improperly managed;
3. Pathological wastes, including, without limitation, human and animal tissues, organs, and body parts, and body fluid and excreta that are contaminated with or are likely to be contaminated with infectious agents, removed or obtained during surgery or autopsy or to diagnostic evaluation, provided that, with regard to pathological wastes from animals, the animals have or likely to have been exposed to a zoonotic or infectious agents;
4. Waste materials from the rooms of humans, or the enclosures of animals, that have been isolated because of diagnosed communicable diseases that are likely to transmit infectious agent. Also included are waste materials from rooms of patients who have been placed on blood and body fluids;
5. Human and animal specimens and blood products that are being disposed of, provided that with regard to blood specimens and blood products from animals, the animals were or are likely to have been exposed to a zoonotic or infectious agent;
6. Patients care waste such as bandages or disposable gowns that are lightly spoiled with blood or other body fluids , unless such wastes are spoiled to the extent that the generator of the waste determines that they should be managed as infectious wastes;
7. Sharps used in the treatment, diagnosis, or inoculation of human beings or animals or that have, or are likely to have, come in contact with infectious agents in medical, research, or individual laboratories, including, without limitation, hypodermic needles and syringes, scalpel blades, and glass articles that have been broken. Such wastes hereinafter referred to as “sharp infectious waste” or sharps.

8. Contaminated carcasses, body parts, and bedding of animals that were intentionally exposed to infectious agents from zoonotic or human diseases during research, production of biological, or testing of pharmaceuticals, and carcasses and bedding of animals otherwise infected by zoonotic or infectious agents that may represents a substantial threat to public health if improperly managed.
9. Any other waste materials generated in the diagnosis, treatment and immunization of human beings or animals, in research pertaining these, or in the production or testing of biologicals;
10. Any other waste materials the generator designates an infectious waste.

2.8 Classification of infective micro-organisms

Micro-organisms which are found in infectious wastes are classified into hazard groups at different levels on the basis of risks to health personnel, spread in the community, pathogenecity and availability of infective prophylaxis

1. Risk group 1

The organism in this group presents a low risk to the individuals health worker and healthy members of the community. They are unlikely to cause human disease.

Examples include: food spoilage bacteria common moulds and yeasts

2. Risk group 2

These organisms offer a moderate risk to the health worker and limited risk to members of the community. They can cause a serious hazard. Effective preventive measures and treatment are available and the risk of spread in the community is not great

Examples include: staphylococci, streptococci, enterobacteria (except salmonella typhi) clostridia, vibrios, adenovirus, poliovirus, coxsackie viruses, hepatitis viruses, lieshmania, toxoplasmosis.

3. Risk group 3

This group contains organisms that presents a high risk to the health worker but a low risk to the community should they escape from the laboratory. They do not ordinarily spread rapidly from one individual to another. Again there are effective vaccines and the therapeutic materials for most pathogens in this group.

Examples include brucella, Mycobacterium tuberculosis, salemonella typhi, francisella, pasterurella pestis, many arboviruses, LCM virus rickettsiae, chlamydia, coccidioides histoplasma, human immunodeficiency viruses (HIV)

4. Risk group 4

The agents in this group are all viruses. They offer a high risk to the health worker and to the community. They can cause serious diseases and are readily transmitted from one individual to another. At present there are no vaccines or chemotherapeutic materials against these viruses

Examples include of hemorrhagic fevers including Marburg, lassa and ebola, equine and other encepahlities viruses and certain arboviruses.

2.9 Chains of infections

Microorganisms live everywhere in our environment. Humans normally carry them on their skin, respiratory, intestinal and genital tracts. In addition, micro-organisms live in animals, plants, soil, air and water. The following figure shows the infectious process for a specific disease

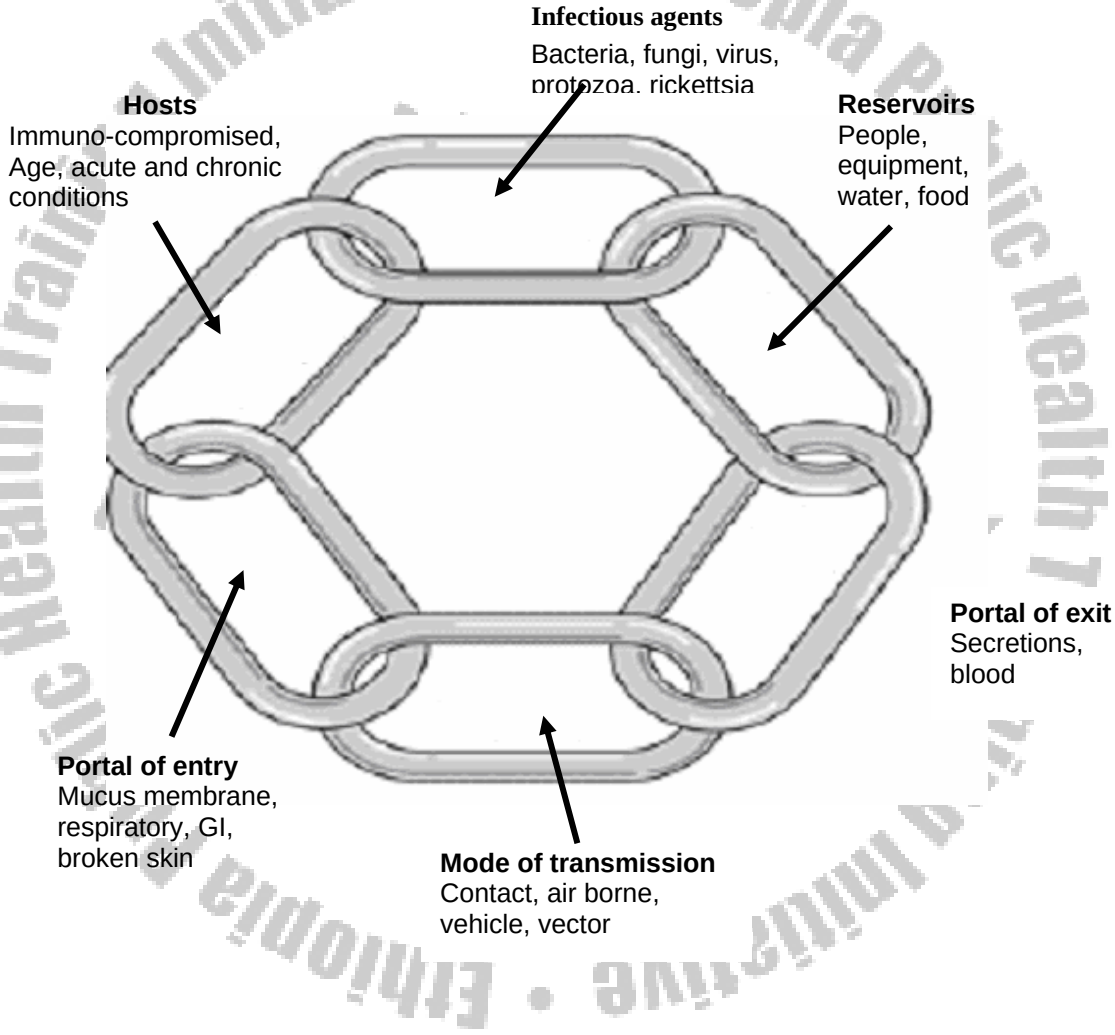


Figure 2.1 Chains of infections

2.10 Transmission of disease from infectious waste

Infection is a disease state resulting from the presence of pathogens in or in the body. For the transmission of infectious diseases from infectious wastes to the healthy person, the chain of events usually involves the following six components

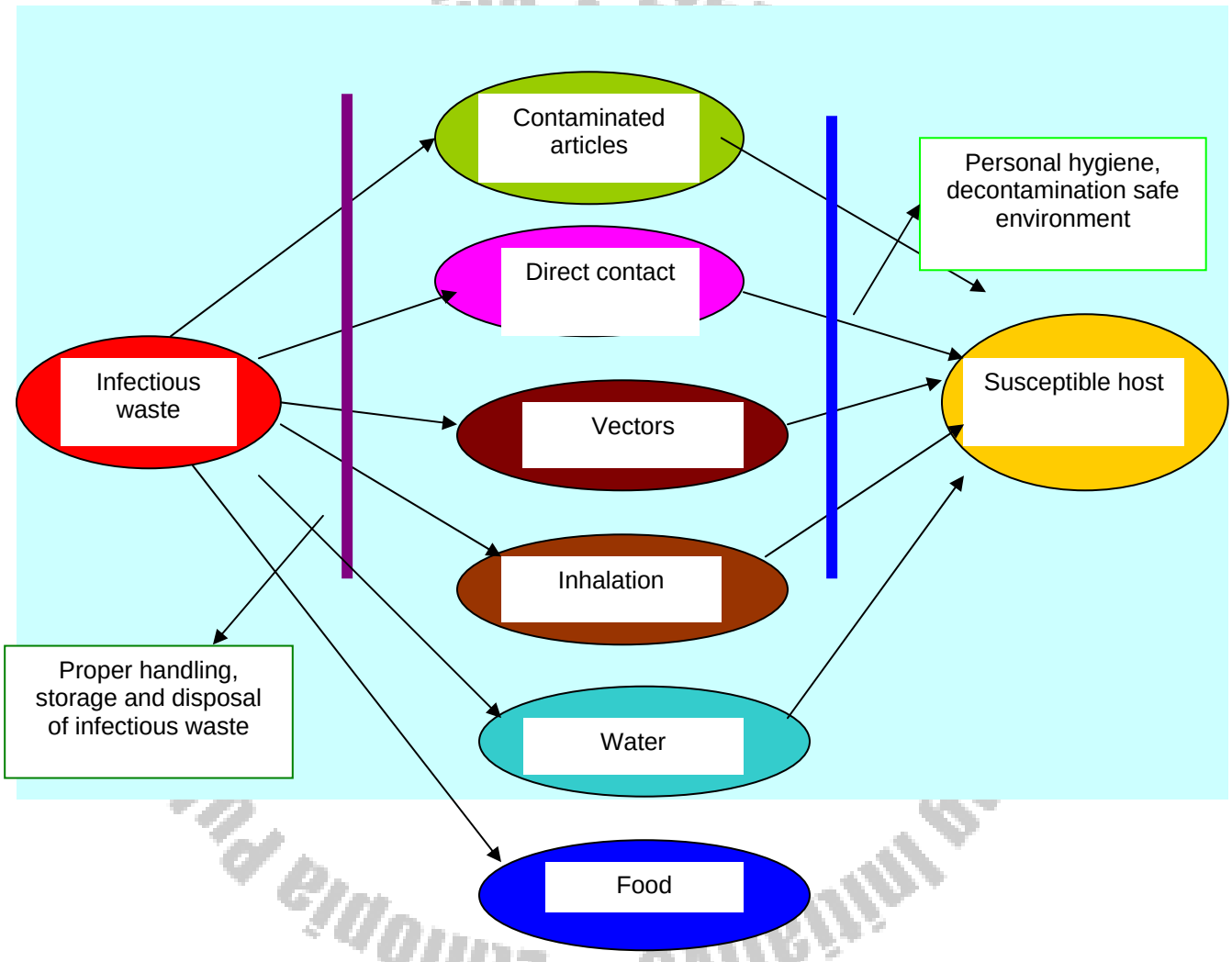


Figure 2.2 Transmission of disease from infectious wastes and ways of breaking the chain of transmission.

One of the first lines of defense against the transmission of diseases is proper infectious waste management and changes in hygiene behavior such as hand washing before and after visiting patients and contaminated articles.

2.11 Onsite handling, separation and storage of infectious waste

2.11.1 Onsite handling and separation

Potential hazards associated with the handling of infectious waste necessitate certain precautions. Infectious waste needs to be sorted as

a. non-contaminated waste that can be disposed of with general waste
b. “sharps”- hypodermic needles, scalpels, knives, broken glass
c. contaminated materials for autoclaving and recycling
d. contaminated materials for disposal
e. Anatomical waste (e.g. human and animal tissues).

The infectious waste should be clearly colored, coded and marked.

2.11.2 Storage of infectious waste

There are no storage time limits for generation of infectious waste. The waste need only be stored in manner to prevent release of the waste and to prevent nuisance conditions. Infectious waste stored at a permitted infectious waste treatment or disposal facility for more than 48 hours must be stored inside an enclosed structure maintained at 45 ^{0}F or less.

2.12 Collection of infectious waste

Collection includes not only the gathering of infectious wastes and responsible materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied.

The safe collection of infectious wastes is the concern of all who are involved in the process: the health officers, laboratory technicians, nurses, environmental health technicians, concerned health workers and others.

Improper collection and transportation of infectious wastes carry the risk of infection for all people engaged in these activities. To avoid such risks

1. infectious wastes containers should be leak-proof, break-resistant, made of plastic or glass, and preferably have screw-caps containers;
2. after the container is closed and sealed it should be wiped with disinfectant and then dried
3. when an infectious waste is received and before the container is opened, it should be wiped with disinfectant and then dried

Guidelines for action in collection of infectious waste

1. If infectious wastes are visible, gather up with a small dust pan and brush or with forceps, taking care to avoid contaminating the hands
2. Insert hands into a plastic bag to form an improvised utility
3. With the hands protected in this way, pick up the package and place it in a plastic bag of suitable size
4. Discard the improvised mittens into the same bag
5. Seal the bag and keep it away in a safe place
6. If any fluid has leaked from the package, disinfect the contaminated area
7. Wash hands thoroughly

2.13 Disposal of Infectious Waste

Health personnel have a responsibility to protect themselves, the patients, the community and the environment from injury or damage originating from infectious wastes and to minimize the hazards involved in decontamination, reuse (recycling) and disposal.

Before being washed and reused, discarded (disposed) all infectious materials and contaminated articles should be made non infectious (by soaking these contaminated items for 10 minutes in 0.5% chlorine solution).

Most wastes may be treated by :

- Autoclaving
- Boiling
- Use of chemical disinfectant

Infectious waste including packaging disposal needles, syringes and scalpels are best disposed of by incineration providing proper temperature, oxygen and residence time and by autoclaving followed by capitation and shredding.

A landfill or incinerator is used as a means of disposing autoclaved wastes.

UNIT THREE

SATELLITE MODULES

3.1 Satellite Module for Health Officers

3.1.1 Introduction

3.1.1.1. Purpose

The infectious waste management satellite module is prepared for Health Officers students. This module emphasizes only topics not covered in the core module but relevant to this category of students.

3.1.1.2. Directions for using this satellite module

Before embarking on the contents of satellite module, the students must read and understand the contents of the core module and should work on the pre-test for the module of infectious waste management. The students can read other satellite modules that are designed for other categories of health professionals (Public Health Nurses, Medical Laboratory technician and Environment Health workers). The students are advised to read and cross reference to the core module wherever important.

3.1.2 Learning Objectives

At the end of this satellite module, students should be able to:

- Analyze the situation, make a plan, implement, monitor and evaluate infectious waste management in health care facilities
- Describe the chain of infection from infectious waste
- Explain the prevention of infections from infectious wastes
- Describe the General safety practices to health officers towards infectious wastes
- Explain the standard precautions to be used in the care of all patients to avoid infections from infectious waste

3.1.3 Analyze the situation, make a plan, implement, monitor and evaluate infectious waste management in health care facilities

3.1.3.1 Situational analysis in infectious waste management

Before planning infectious waste management in the health care facilities, one has to do analysis of the situation in health care unit so that problem can be identified in the process of infectious waste management. This would help to plan and design for the subsequent activities in the management of infectious waste

3.1.3.2 Planning and implementation

As you are a leader of the health team in primary health care unit your are expected to:

1. lead the other health center staff for infectious wastes management
2. draw plan of action and design the management of infectious waste
3. plan and provide training for other staff for infectious waste management
4. coordinate staff in health care facilities for infectious waste management
5. develop and provide guidelines and manuals for staff for the management of infectious wastes
6. develop and distribute protocols for staff on the management of infectious wastes
7. communicate and mobilize staff for infectious wastes that are generated in the health care facilities

3.1.3.3 Monitoring and Evaluation

Monitoring and evaluation of infectious waste management should be seen as an important part of assessing the performance of staff pertaining to infectious waste management. Monitoring is to check in a continuous way the progress and performance whereas evaluation is to compare achievements with targets in a periodic way (targets: specific measurable objectives which are expected to be achieved in a specific period of time). Monitoring and evaluation is a useful model for measurement of efficiency and effectiveness in the infectious waste management.

3.1.4 The chain of infections in infectious waste

Infectious wastes play a critical role in nosocomial infections in health care facilities. As any infectious process, infection, which resulted from infectious waste, has six components. It represents a series of events which must occur in order for disease-causing organisms to cause infection

3.1.4.1 Infectious agents

The agents in infectious waste range from viruses to complex multi-cellular organisms. Infectious pathogens from infectious waste can be classified into three categories

1. **Conventional pathogens**: Cause disease in healthy individuals in the absence of specific immunity.

   Examples: Staphylococcus aureus, Streptococcus pyogenes, Salmonella spp., Shigella spp., Corynebacterium diphtheriae, Mycobacterium tuberculosis, Bordetella pertussis, hepatitis A and B viruses, rubella virus, rotaviruses, human immuno-deficiency virus (HIV).
2. **Conditional pathogens**: Cause disease, other than trivial local infections, only in persons with reduced resistance to infection (including newborn infants) or when implanted directly into tissue or a normally sterile body area.

   Examples: Enterococcus spp., Clostridium tetani, Escherichia coli, Klebsiella spp., Pseudomonas aeruginosa, Candida spp.
3. **Opportunistic pathogens**: Cause generalized disease, but only in patients with profoundly diminished resistance to infection.

   Examples: typical mycobacteria, Nocardia asteroides, Pneumocystis carinii.

3.1.4.2 Reservoirs (The sources of infectious agents)

In a health-care facility, the sources of infection, and of the preceding contamination, may be the personnel, the patients, or the inanimate environment, and largely contaminated medical instruments.

The hospital environment can be contaminated with pathogens. *Salmonella* or *Shigella* spp., *Escherichia coli* O157:H7, or other pathogens may be present in the food and cause an outbreak of disease just as they can in a community outside the hospital.

3.1.4.3 Portal of exit of infectious agent

Portal of exit is the way where the infectious agent leaves the reservoir. Possible portals of exit for infectious waste include all body secretions and discharges: mucus, saliva, tears, breast milk, vaginal and cervical discharges, excretions (feces and urine), blood, and tissues.

3.1.4.4 Mode of transmission infectious agent

Microorganisms can be transmitted from their source to a new host through direct or indirect contact.

Vector-borne transmission is typical of countries in which insects, arthropods, and other parasites are widespread. These become contaminated by contact with excreta or secretions from an infected patient and contaminated and transmit the infective organisms mechanically to other patients. Example: Cholera, Shigellosis

Direct contact between patients does not usually occur in health-care facilities, but an infected health-care worker can touch a patient and directly transmit a large number of microorganisms to the new host. Example: Hemorrhagic Fever, Anthrax, and STDs

The most frequent route of transmission, however, is indirect contact. The infected patient touches - and contaminates - an object, an instrument, or a surface. Subsequent contact between that item and another patient is likely to contaminate the second individual who may then develop an infection. Example: Viral Hepatitis B and C

During general care and/or medical treatment, the hands of infectious workers often come into close contact with patients. The hands of the clinical personnel are thus the most frequent vehicles for nosocomial infections. Transmission by this route is much more common than vector-borne or airborne transmission or other forms of direct or indirect contact.

3.1.4.5 Portal of entry to susceptible host

It is where the infectious waste pathogen enters the next susceptible host. Any opening in the body can be a portal of entry:

- Respiratory tract
- Ears, eyes
- Gastrointestinal tract
- Genitourinary tract
- Broken skin

3.1.4.6 Susceptible host

The susceptible human host is the final link in the infectious process. Whether or not a tissue will develop an infection after contamination depends upon the interaction between the contaminating organisms and the host.

Healthy individuals have a normal *general resistance* to infection. Patients with underlying disease, pregnant women, newborn babies, and the elderly have less resistance and will probably develop an infection after contamination.

Local resistance of the tissue to infection also plays an important role: the skin and the mucous membranes act as barriers in contact with the environment. Infection may follow when these barriers are breached. Local resistance may also be overcome by the long-term presence of an irritant, such as a cannula or catheter; the likelihood of infection increases daily in a patient with an indwelling catheter.

3.1.5 Prevention of infection from infectious waste

3.1.5.1 General Principles

1. Consider all patients' blood, and body fluids as infectious materials.
2. Equipment, instruments, and utensils, which come in contact with patient excretions, secretions and body fluids, are considered contaminated.

3.1.5.2 Precautions

All health-care workers should routinely use appropriate barrier precautions to prevent skin and mucous-membrane exposure when contact with blood or other body fluids of any patient is anticipated. The purpose of protective equipment is to keep blood and other potentially infectious material from contacting skin, eyes, and mucous membranes. In some cases, adequate protection is provided solely by gloves. In other cases, masks and eye protection will also be needed. And still other situations, gowns, aprons and head covering may be required.

3.1.5.3 Procedures

1. Wash hands frequently and always between patients and after glove removal. Gloves should be changed after contact with each patient and immediately if they're torn or punctured.

2. Wear gloves when exposed to any patient's blood and body excretions and/or secretions such as when touching mucous membranes or non-intact skin, handling soiled equipment or vascular access procedures such as finger or heel sticks and vein-punctures. (Other examples include):
    - Collecting specimens.
    - Mouth care and eye care.
    - Beginning/discontinuing/converting intravenous and intraosseous therapies.
    - Removing naso-gastric drainage and wound drainage
    - Cleaning any surface the patient has contact with, spills of blood or body fluids.
    - Handling tissues or clothing contaminated with tears or perspiration.
    - Performing suctioning or intubations
3. Place disposable syringes and needles, scalpel blades, and other sharp items into designated, puncture-resistant containers. Do not recap, bend or break off needles.
4. Place all infectious waste not suitable for disposal in "sharps" container into red (biohazard) plastic bags.
5. Wear gowns if splashing or soiling by blood and body fluids is likely. After exposure, remove protective clothing to avoid contaminating self. Place in the assigned area or container.
6. Wear other protective covering (e.g., masks, goggles, face shields, etc.) as indicated by particular situations such as patients with infections, during invasive procedures, or when splashing is likely. Wash after removing protective equipment and as soon as possible after blood contact with skin, eyes, or mucous membranes.
7. Health officers assigned to the nursery or delivery room must wear gown and gloves when handling a newborn until the baby is given its first bath.
8. Individuals with exudative lesions or exposed skin surfaces should refrain from direct patient care and from handling patient-care equipment. Small cuts and scrapes should be covered with an occlusive adhesive dressing or bandage and monitored closely for integrity during patient care activities.

3.1.5.4 Isolation of infected patients

The first essential measure in preventing the spread of infections from infectious waste is *isolation* of wastes, which are potentially infectious. Disease-specific precautions should include details of all the measures (private room, wearing of masks or gowns, etc.) to be taken in the case of a specific disease caused by a defined organism.

3.1.5.5 Standard Precautions towards infectious wastes:

The so-called standard precautions, summarized below essentially protect health-care workers from blood borne infections caused by human immunodeficiency virus and hepatitis B and C viruses.

Standard Precautions are precautions**,** which apply to ***all clients and patients*** attending healthcare facilities. Because most people with blood-borne viral infections such as HIV and HBV do not have symptoms, nor can they be visibly recognized as being infected, "Standard Precautions" are designed for the care of all persons— patients, clients and staff—regardless of whether or not they are infected. Standard Precautions apply to blood and all other body fluids, secretions and excretions (except sweat),non-intact skin and mucous membranes.

Their implementation is meant to reduce the risk of transmitting microorganisms from known or unknown sources of infection (e.g., patients, contaminated objects, used needles and syringes, etc.) within the healthcare system. Applying Standard Precautions has become the primary strategy to preventing infections.

The following actions create protective barriers for preventing infections in clients, patients and health-care workers and provide the means for implementing the new.

3.1.5.5.1 The followings are the standard precautions to be used in the care of all patients

A. **Hand washing (antiseptic hand rub)**

- Wash hands after touching blood, secretions, excretions and contaminated items, whether or not gloves are worn. Wash hands immediately after gloves are removed, between patient contacts.
- Use a plain soap for routine hand washing.
- Use an antimicrobial agent for specific circumstances.

B. **Gloves**

- Wear gloves when touching blood, body fluids, secretions, excretions, and contaminated items. Put on clean gloves just before touching mucous membranes and non-intact skin.

C. **Mask, goggle, face shield**

- Wear a mask and eye protection or a face shield during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.

D. **Gown**

- Wear a gown during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions.

E. **Patient-care equipment**

- Ensure that reusable equipment is not used for the care of another patient until it has been cleaned and reprocessed appropriately.
- Handle soiled equipment to prevent contact with skin or mucus membrane and contaminating the environment.

F. **Environmental control**

- Ensure that the health-facilities have adequate procedures for the routine care, cleaning, and disinfection of environmental surfaces.

G. **Linen**

- Handle used linen, soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures, and that avoids transfer of microorganisms to other patients and environments.

H. **Occupational health and blood-borne pathogens**

- Take care to prevent injuries when using needles, scalpels, and other sharp instruments or devices.
- Use ventilation devices as an alternative to mouth-to-mouth resuscitation methods

I. **Patient placement**

- Place a patient who contaminates the environment or who does not assist in maintaining appropriate hygiene in an isolated (or separate) room.

J. **Sharps**

- Avoid recapping used needles
- Avoid removing used needles from disposable syringes.
- Avoid bending; breaking or manipulating used needles by hand.
- Place used sharps in puncture-resistant container.

K. Patient resuscitation:

- Use mouse pieces, resuscitation bags or other ventilation devices to avoid mouth-to-mouth resuscitation.

3.1.5.6 Additional precautions

1. Personal hygiene

Basic personal hygiene is important for reducing the risks from handling infectious waste, and convenient washing facilities (with warm water and soap) should be available for personnel involved in the task.

2. Immunization

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

3. **Management practices**

- *Waste segregation*: careful separation of different types of waste into different and distinct containers or bags defines the risk linked to each waste package.
- *Appropriate packaging*: prevents spillage of waste and protects workers from contact with waste.
- *Waste identification* (through distinct packaging and labelling): allows for easy recognition of the class of waste and of its source.
- *Appropriate waste storage*: limits the access to authorized individuals only, protects against infestation by insects and rodents, and prevents contamination of surrounding areas.

3.1.6 Cut off any means of transmission by cleaning, sterilization and disinfections

3.1.6.1 Cleaning

One of the most basic measures for the maintenance of hygiene, and one that is particularly important in the health care facilities, is cleaning. The principal aim of cleaning is to remove visible dirt. It is essentially a mechanical process: the dirt is dissolved by water, diluted until it is no longer visible, and rinsed off. Soaps and detergents act as solubility-promoting agents.

The microbiological effect of cleaning is also essentially mechanical: bacteria and other microorganisms are suspended in the cleaning fluid and removed from the surface. The efficacy of the cleaning process depends completely on this mechanical action, since neither soap nor detergents possess any antimicrobial activity. Thorough cleaning will remove more than 90% of microorganisms.

However, careless and superficial cleaning is much less effective; it is even possible that it has a negative effect, by dispersing the microorganisms over a greater surface and increasing the chance that they may contaminate other objects. Cleaning has to be carried out in a standardized manner or, better, by automated means that will guarantee an adequate level of cleanliness.

Diluting and removing the dirt also removes the breeding-ground or culture medium for bacteria and fungi. Most non-sporulating bacteria and viruses survive only when dirt or a film of organic matter protects them; otherwise they dry out and die. Non-sporulating bacteria are unlikely to survive on clean surfaces. Prior or simultaneous cleaning increases the effectiveness of disinfection and sterilization.

3.1.6.2 Sterilization

An object should be sterile, i.e. free of microorganisms, after sterilization. However, sterilization is never absolute; by definition, it effects a reduction in the number of microorganisms by a factor of more than 10^6 (i.e. more than 99.9999% are killed). Standard reference works, such as pharmacopoeias, often state that no more than one out of 1000000 sterilized items may still bear microorganisms. It is therefore important to minimize the level of contamination of the

material to be sterilized. This is done by sterilizing only objects that are clean (free of visible dirt) and applying the principles of good manufacturing practice.

Sterilization can be achieved by both physical and chemical means. Physical methods are based on the action of heat (autoclaving, dry thermal or wet thermal sterilization), on irradiation (g-irradiation), or on mechanical separation by filtration. Chemical means include gas sterilization with ethylene oxide or other gases, and immersion in a disinfectant solution with sterilizing properties (e.g. glutaraldehyde).

3.1.6.3 Disinfection

The term disinfection is difficult to define, as the activity of a disinfectant process can vary widely. The guidelines of the Centers for Disease Control allow the following distinction to be made:

1. *High-level disinfection*: can be expected to destroy all microorganisms, with the exception of large numbers of bacterial spores.
2. *Intermediate disinfection*: inactivates *Mycobacterium tuberculosis*, vegetative bacteria, most viruses, and most fungi; does not necessarily kill bacterial spores.
3. *Low-level disinfection*: can kill most bacteria, some viruses, and some fungi; cannot be relied on to kill resistant microorganisms such as tubercle bacilli or bacterial spores.

There is no ideal disinfectant and the best compromise should be chosen according to the situation. A disinfectant solution is considered appropriate when the compromise between the antimicrobial activity and the toxicity of the product is satisfactory for the given application.

The principal requirements for a good antiseptic are absence of toxicity and rapid and adequate activity on both the natural flora and, especially, pathogenic bacteria and other microorganisms after a very short exposure time. Essential requirements for a disinfectant are somewhat different: there must be adequate activity against bacteria, fungi, and viruses that may be present in large numbers and protected by dirt or organic matter.

In general, use of the chosen disinfectant, at the appropriate concentration and for the appropriate time, should kill pathogenic microorganisms, rendering an object safe for use in a patient, or human tissue free of pathogens to exclude cross-contamination.

3.1.5.2 Hand hygiene

As the hands of health-care workers are the most frequent vehicle of nosocomial infections, hand hygiene - including both hand washing and hand disinfection - is the primary preventive measure.

Thorough hand washing with adequate quantities of water and soap removes more than 90% of the transient, flora including all or most contaminants. An antimicrobial soap will further reduce the transient flora, but only if used for several minutes. Hand washing with (non-medicated) soap is essential when hands are dirty and should be routine after physical contact with a patient.

Killing *all* transient flora with all contaminants within a short time (a few seconds) necessitates hygienic hand disinfection: *only alcohol or alcoholic preparations act sufficiently fast*. Hands should be disinfected with alcohol when an infected tissue or body fluid is touched without gloves.

During a surgical intervention, a high proportion of gloves become perforated. Hands should therefore be disinfected with a long-acting disinfectant before gloves are put on. This will not only kill all the transient flora, but will also prevent the micro-organisms of the resident (or deeper) flora from taking the place of the transient flora during the intervention. For this purpose, hands should be washed for at least 10 minutes with an antibacterial detergent containing chlorhexidine or an iodophore, or rubbed twice for 2 minutes with an alcoholic solution of one of these antiseptics.

3.1.6 Response to injury and exposure to infectious wastes

A significant exposure is defined as:

a. A needle stick or cut caused by a needle or sharp that was actually or potentially contaminated with blood or body fluids.

b. A mucous membrane exposure (i.e., splash to the eye or mouth) to blood or body fluids.

c. A cutaneous exposure involving large amounts of blood or prolonged contact with blood - especially when the exposed skin was chapped, abraded, or afflicted with dermatitis.

1. **Post-exposure Management**

Post-exposure prophylaxis(PEP) connsiderations :

- Evaluate risk
    - Source of fluid or material
    - Type of exposure
    - Evaluation of exposure source patient
        - HIV status, HBV status
        - Stage of infection
- Test health care worker for HIV after exposure as baseline , if available

2. **Post exposure prophylaxis.**
    - Treatment, if stated should be initiated immediately after exposure, with in hours
    - HBV vaccination for health care workers if not already done

3.2 Satellite module for Nurses

3.2.1 Introduction:

3.2.1.1 Purpose

It is not possible to know whether a patient is caring/ infected with dangerous disease causing microorganisms. Instruments such as needles, syringes, and other items should also be considered as potentially infectious and handled carefully. Careful infectious management and disposal plays a great role to minimize contamination that will result in serious infection. This again prevents the transmission of serious life threatening diseases including Hepatitis-B and HIV/AIDS.

This satellite module is designed to strengthen the contribution of diploma Public Health and Clinical Nurse students in the health care system. The major points regarding the health topic are described in the core module and, activities specific to nursing are highlighted here. Moreover in order to strengthen interactive learning case studies and study questions are incorporated in this module.

3.2.1.2 Directions for using this satellite module

- Before going to this satellite module you need to go through the core module.
- In order to get informed and appreciate what other categories in the team are doing, you also need to read the satellite modules of other team members.
- Attempt the case studies and study questions both before and after you read the module then see your progress.

3.2.2 Learning objectives:

- Describe what infectious waste is
- Identify the types of infectious waste
- Describe the risk of infectious waste
- Explain how to manage infectious waste
- Enumerate the preventive measures of infectious waste.
- Prepare stock solution from 3-5 % hypochlorite solution (Berekina).
- Demonstrate the procedure of care of contaminated instruments

3.2.3 The role of Nurse in infectious waste management

- Identify those wastes with the potential for causing infection during handling and disposal (e.g. laboratory waste, pathological waste, blood specimens or blood products).
- Incinerate or landfill infective waste
- Carefully pour bulk blood, suctioned fluids, excretions and secretions down a drain connected to a sanitary center.
- Observe hygienic and common sense storage and processing of clean and solid linens
- Handled solid linen as little as possible and with minimum agitation
- Bag all soiled linens at the location where it is used
- When you participate in invasive procedures, use appropriate barrier methods; gloves surgical masks, protective eye wear, face shields, gowns, aprons

- When you perform or assist vaginal deliveries, especially handling the placenta, blood or amniotic fluid and post delivery care of umbilical cord wear gloves, mask and gowns.
- If a glove is torn, needle stick or other injury occurs, remove the glove and use the new glove then remove the needle or instrument used in the incident.

3.2.4 Effects of Infectious waste

Infectious waste can result in different health risks, if not properly handled and managed. Such health risks can be minor to serious diseases:

- Diarrhea (acute gastroenteritis)
- Hepatitis B virus infections
- HIV/AIDS
- Hospital acquired pneumonia
- Any infections related to lack of aseptic techniques

3.2.5 Principles of infection prevention

In addition to monitoring environmental safety a major concern of health professionals is preventing the spread of microorganisms from person to person and from place to place

Microorganisms are naturally present in the environment. Most of them are harmful and pathogenic to human beings. The collective efforts of health professionals and the community at large can prevent and control the spread of pathogenic/harmful microorganisms and make the environment safe through a variety of methods.

Prevention of infections becomes a major focus for health professionals. Identifying prevention and control measures and teaching clients about infection.

3.2.6 Standard universal precaution for infection prevention and control

- Proper hand washing before and after every patient contact, medical& surgical procedures.
- Proper handling of sharp instruments
- Using protective barriers (gloves, plastic apron, mask, goggles)

- Safe and proper processing of medical instruments
- Treating all blood and body fluids from all patients as if infectious
- Environmental cleanliness
- Proper waste disposal

- **Hand washing as a means of infection prevention and control**

Hands are the most common vehicles for spreading of infection. Hand washing is an essential step in preventing infection. Unfortunately, it is also one of the most neglected steps in the health care setting. Health care staff should always wash their hands:

- Before and after each contact
- Before and after wearing gloves
- After touching any object that might be contaminated
- After using the toilet
- Before departure from work

Note: 1. when water is not available, hand washing with antiseptics like soap or rub with 60-90 % alcohol

2. Since shared towels can transmit germs, it is ideal to use a disposable towel or a clean towel for each hand washing

3.2.7 Care of contaminated instruments: Necessary steps

Immerse with antiseptic solution in a basin immediately (0.5% chlorine solution)

After 10 minutes, then wash with soapy water/Omo and rub with brush effectively in running water under pressure in sink

Dry after effectively washing and cleaning

Pack and level and send it to autoclave room or boil in steam under pressure for a reasonable time

Store and make ready for reutilization

*Note: -clean instruments should be dried and returned to utility room for the next use until they are sent for sterilization.

-Use personal protective barriers (such as mask, apron, utility glove etc)

3.2.8 Processing contaminated surgical and medical supplies or instruments.

3.2.8.1 Processing Reusable medical and surgical supplies

If medical and surgical instruments are not properly processed and proper infection prevention techniques are not used, patients, workers and other communities or people are at risk. Therefore proper processing of instruments is very important. Follow these steps to process instruments for reuse:

Step 1. Decontamination

Step 2. Cleaning

Step 3.Sterilization or high level disinfection

Step 4. Storage or immediate use

3.2.8.2 Sterilization

Definition: the process that eliminates all microorganisms including bacterial endospores from inanimate objects.

Methods of sterilization:

- High pressure steam sterilization (autoclave)

  Temperature should be 121 ^{0}C (250 ^{0}F): pressure 160 KPA (15 LBS/in^2) for 20 minutes.

- Dry heat (oven)

  170 ^{0}C (340^{0}F) for one hour

  160 ^{0}C (320 ^{0}F) for two hours – then cool from two to five hours

- Chemical sterilization

  1. Formaldehyde (35-40 %)

     Time needed for sterilization 24 hours

     Change every 14days; Sooner if cloudy

  2. Gluteraldehyde (Cidex)-- 2-4%

     Time needed for sterilization 10hours

     Change every 14-28 days; Sooner if cloudy

3.2.8.3 High Level Disinfection

Definition: The process that eliminates all microorganisms except bacterial endospores from inanimate objects.

1. **Boiling**:

Boiling in water is an effective practical way to high level disinfects instruments and other items. Although boiling instruments in water for 20 minutes will kill all vegetative forms of bacteria; virus (including HBV, HCV and HIV), yeasts and fungi, boiling will not kill all endospores relatively.

Remember: 1. Always boil for 20 minutes in a pot with a lid
2. Start timing when the water begins to boil
3. Metal instruments should be completely covered with water during boiling
4. Do not add any thing to the pot after timing begins.

Note: How to prepare diluted solution from 'Berekina'

Determine the total amount of water needed the formula below**:**

- Total parts of water $\left[\frac{\text{\% concentrate}}{\text{\% Dilute}}\right]$ - 1

- Mix one part concentrated bleach with the total amount of water required.
- Ex: prepare 0.5% dilute solution from ***5% concentration***.
  Step 1: calculate total amount of water

$\left[\frac{\text{5 \% (concentration at hand)}}{\text{0.5 \% (concentration needed)}}\right]$ -1___10-1= 9 ie, 1 part of concentrated solution (berekina) added into 9 parts of Water.

3.2.8.4 Step one: decontaminating instruments

- Because it is very difficult to remove dried blood from small spaces like inside the tip of a canula soak the instrument in decontaminating 0.5% chlorine solution for 10 minutes. It is essential to wear gloves during instrument processing as micro-organisms can survive the decontaminating soak.

- Keep a plastic bucket with decontaminating solution in the procedure room. The solution needs to be changed at least once daily.

  Note: use gloves or forceps to remove instruments

3.2.8.5 Step two

Clean all instruments to remove remaining tissue or blood by washing all surfaces thoroughly in warm water and preferably detergents while cleaning

- Wear personnel protective barriers, such as gloves, gown, goggles and face protection
- Use detergents and soft brush
- Clean all surfaces
- Disassemble items
- Rinse and dry with air or towel

3.2.8.6 Step Three: Sterilization or high-level disinfection

The Sterilization process ensures that all microorganisms including bacterial endospores are destroyed. This can be achieved by autoclaving (high pressure steam), dry heat or by using chemicals (chemical sterilization/ cold sterilization).

High-level disinfection (HLD) can be used when sterilization is not possible and is an alternative possibility. Soaking instruments in various chemical disinfectants can achieve HLD.

3.2.8.7 Step Four: Proper storage and making ready for use.

3.2.8.8 Processing Disposable Medical and Surgical Supplies and other wastes.

Waste products such as blood, blood products and placenta should be collected in water proof containers and disposed in a deep hole prepared for this purpose.

Sharp instruments, (eg, scalpel, needle, syringe etc) should also be disposed properly. The greatest risk of blood borne pathogen transmission in the health care setting is through pre-cutaneous exposure. Efforts to prevent this transmission must focus on preventing injury from contaminated sharp instruments by encouraging safe handling and disposal of sharps.

3.2.8.9 Methods of safe disposal of sharp instruments:

- Avoid recapping used needles
- Avoid removing used needles from disposable syringes.
- Avoid bending; breaking or manipulating used needles by hand.
- Place used sharps in puncture-resistant container.

3.2.8.10 Patient resuscitation:

- Use mouse pieces, resuscitation bags or other ventilation devices to avoid mouth-to-mouth resuscitation.

3.2.8.11 Other incidents of contamination.

- If blood or body fluid s splash into your eyes, mouth, and nose or skin immediately wash thoroughly with clean water or saline solution.
- Wash the cuts or puncture wound immediately with water or saline solution.

***Precaution*:** wear protective barrier s to prevent the above incidents of contamination.

3.3. SATELLITE MODULE FOR MEDICAL LABORATORY TECHNICIANS

3.3.1 Introduction

3.3.1.1 Use and purpose of the satellite module

This satellite module provides a specific tasks and skill that should be done by medical laboratory technicians in a health team. The module emphasizes only on specific areas that were not covered in the core module.

3.3.1.2 Directions for using this satellite module

- Students and laboratory workers should read the core module before reading the satellite module and advised to refer to the core module whenever indicated
- After completely reading this satellite module answer all the questions under the core module(post test)
- Compare your results with that of the pretest

3.3.2 Learning objectives

After going through this module the learner will be able to:

- Explain routes of laboratory acquired infections
- Describe the different Biosafety Levels of laboratory
- State mandatory day to day safety measures
- Tell how to decontaminate infectious material
- Describe how to dispose of laboratory wastes

3.3.3 Microbial Hazard

Preventing laboratory associated infections depends on laboratory staff under standing

- The routes by which infections are acquired in the laboratory. These may be different from 'natural' infections.
- Which organisms are the most hazardous so that time and labor are not wasted on unnecessary precautions.
- Which techniques are the most hazardous so that these may be replaced by those that are safer.
- How the laboratory worker can reduce direct contact with infectious material and use safe working practices.

3.3.3.1 Laboratory acquired infections*:*

Infections in the laboratory occurs when

a. pathogens are accidentally ingested
b. pathogens are accidentally inoculated
c. pathogens are accidentally inhaled in infected airborne droplets (aerosols)

3.3.3.2 Biosafety Levels of Laboratory

Biosafety includes every activity related to safeguarding a population from biologically unwanted effects of infectious agents. Working with organisms in different risk groups (refer in the core module) requires different conditions for containment to ensure organisms do not escape from their specimen or culture vessels or from the laboratory. To handle infectious organism found in different risk groups, there are four biosafety levels of laboratory:

1. **Basic laboratory, level 1:** This is the simplest kind and is adequate for work with organism in risk group 1.
2. **Basic laboratory, level 2:** This is suitable for work with organisms in risk group 2
3. **Containment laboratory, level 3:** This is more sophisticated and is used for work with organisms in risk group 3 e.g. culture work.
4. **Maximum containment laboratory, level 4**:-this is intended for work with viruses in risk group 4, for which the most strict safety precautions are necessary.

3.3.4 Mandatory day to day safety measures in laboratory:

All laboratory personnel including auxiliary staff should avoid the risk of exposure to hazardous organisms by observing the following basic principles of safety measures

1. Mouth pipetting is prohibited.
2. Eating, drinking, smoking, storing food in laboratory room (refrigerator) and applying cosmetics are not permitted in the laboratory working area.
3. The laboratory must be kept neat, clean and free of materials not pertinent to the work.
4. Work surfaces should be decontaminated at least once a day and after each spill of viable material.
5. Persons should wash their hands after handling infectious materials and animals, and when they leave the laboratory.
6. All procedures should be conducted carefully to minimize the creations of aerosols.
7. All contaminated liquid or solid wastes should be decontaminated before being disposed of or otherwise handled.
8. Laboratory coats, gowns, or uniforms must be worn in the laboratory

9. Safety glasses, face shields or other protective devices must be worn to protect the eyes and face from splashes and impacting objects.
10. Gloves must be worn for all procedures that necessitate direct contact with infectious materials.
11. Use puncture resistant, leak proof containers for storing and disposing used sharps.

3.3.5 Decontamination of infectious material and disposal of laboratory waste

3.3.5.1 Decontamination

Before being washed and reused, discarded, or leaving the laboratory, all infectious materials and contaminated articles should be made non infectious.

Methods of decontamination: - Methods used to decontaminate infectious materials include:-

- **Autoclaving: -** autoclaving is the most effective method of decontamination because it is capable of sterilizing infectious waste, i.e. destroying all bacteria, bacterial spores, viruses, fungi, and protozoa.
- **Boiling:-** Heating in boiling water at 100^0C for 20 minutes at altitudes below 600 meters (2000 feet) is sufficient to kill all non-sporing bacteria, some bacterial spores, fungi, protozoan and all viruses including hepatitis viruses and HIV.
- **Chemical disinfectants: -** Chemical disinfectants are expensive, hazardous to health, and when compared with autoclaving and boiling, chemical disinfection is the least reliable and controllable method for the treatment of laboratory infectious waste.

The following are the most commonly used chemical disinfectants.

- **Phenolics: -** These are active against all non sporing bacteria including mycobacterium. They do not kill spores and are poorly active against viruses.
- **Chlorine releasing disinfectants: -** It is highly active against Gram positive and Gram-negative bacteria and viruses including HIV and hepatitis B virus. Chlorine releasing products are used in discard containers and for treating spillages of blood (e.g. Sodium hypochlorite).
- **Aldehydes (Formaldehyde, Glutaraldehyde):-** Formaldehyde gas is an effective disinfectant against all micro-organisms including viruses. Glutaraldehyde rapidly inactivates bacteria and viruses including HIV and hepatitis B virus.

- **Alcohols (70-80% ethanol, propanol):-** Alcohols are highly active against mycobacteria, non-sporing Gram-positive and Gram-negative bacteria, and fungi. Enveloped viruses including HIV, hepatitis B and C viruses are also inactivated.

3.3.5.2 Disposal

Methods used to dispose of laboratory waste include:

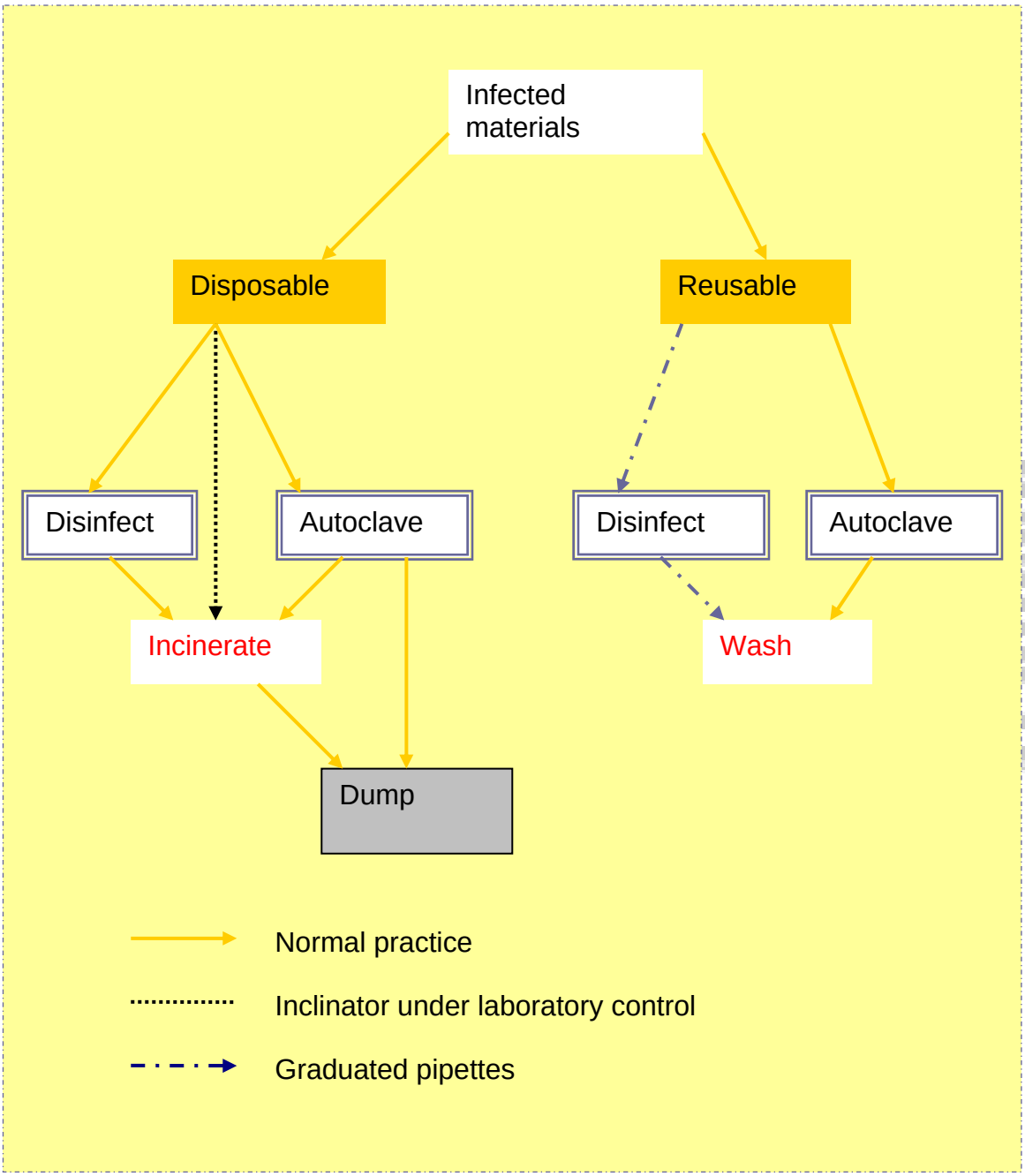
a. **Incineration: -** Incineration, i.e. destruction by burning, is a practical and effective method of disposing of laboratory waste including contaminated disposables and specimens in non-reusable container.

b. **Burial in a deep pit or landfill:-** when incineration is impossible, decontaminated material and waste should be disposed of in a controlled landfill.

Table 3.3.1 processing of infectious laboratory waste and reuse of non disposable items

1.Specimen - in reusable containers - in disposable containers	- if it is fluid, discard the specimen in sink and decontaminate the sink and container by disinfectant, boil or autoclave the container. - dispose by incineration
2. Haematocrit tubes	-dispose by incineration
3. Swabs	decontaminate with disinfectant before disposal.
4.Cultures	- prior to disposal decontaminate with autoclaving.
5.Microscopic slides, cover glass and pipettes	-before reusing decontaminate by soaking in chlorine or other disinfectant.
6. Lancet, needles and syringes	-can be decontaminated or sterilized and reused by boiling or autoclaving.
7. Disposable wastes: syringes, contaminated cotton and wool	- incinerate and bury the waste in a deep covered pit.
8.Decontaminating working areas	-use chlorine or phenolic disinfectants to decontaminate working surfaces. - Spillages: soak up any spillage of infectious material with disinfectant or use rags soaked in disinfectant.
9. Inoculating wire loops and ends of forceps	- decontaminate and sterilize by flaming.

Figure 3.3.1 processing of infected laboratory material.



3.4. Satellite Module for Environmental Health Technicians

3.4.1 Introduction

3.4.1.1 Purpose

This satellite module emphasizes on area that are specific to environmental health students and not covered in the core module.

3.4.1.2 Directions

- Before reading this satellite module be sure that you have completed the pre-test and studied the core module
- Continue reading this satellite module. You are also advised to refer the core module wherever indicated

3.4.2 Learning Objectives

At the end of this session, you should be able to:

1. Explain the steps/sequence of functional elements of infectious waste management
2. Identify the importance and the technical aspects of improving infectious waste management in the health care facilities
3. Practice the interventions in prevention and control of diseases related to infectious wastes
4. Increase the awareness of health care workers and others about infectious waste management through hygiene education

3.4.3. The role of environmental health technician in infectious waste managements:

a. Explain ways of disease transmission from infectious wastes to the susceptible host.
b. Plan, organize and provide health education.
c. Define the barriers for the development of waste management sector.
d. Describe factors that are important in the selection of waste management technologies.

e. Suggest the proper technologies based on their acceptability, sustainability, reliability, etc.
f. Describe each available and acceptable waste disposal technology and their construction methods.
g. Plan and organize proper on-site handling, collecting and disposing of infectious waste.
h. Select appropriate waste storage and disposal sites.
i. Involve communities for prevention and control of infection from infectious waste.

3.4.4. Exercise: Learning Activity One:

Study the functional elements (from cradle to grave) of waste management

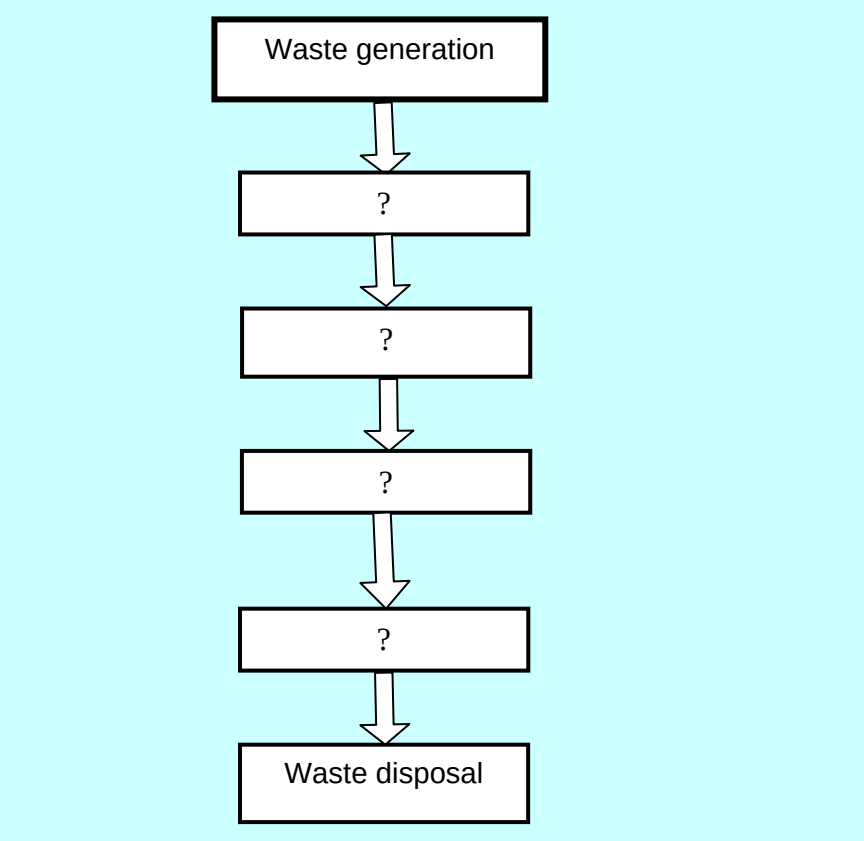


Figure 3.4.1. The six functional elements/ physical activities in waste management.

Identify and discusses the functional elements of waste management shown on figure 3.4.1

A. Waste generation :
B. _____:
C. _____:
D. _____:
E. _____:
F. waste disposal :

3.4.5. The purpose of infectious waste management is to:

a. Prevent the spread of infection to healthcare workers who handle wastes
b. Protect people who handle waste items from accidental injury
c. Prevent the spread of infection to the local community, and
d. Safely dispose of infectious materials

3.4.6. Preventive and control of diseases associated with infectious waste

Proper handling, segregation, packaging, marking, storage, transport, treatment and disposal of infectious wastes are necessary to minimize the potential risks to public health. Proper planning and utilization of the components of infectious waste management are pertinent as to the prevention and control of associated public health risks

3.4.6.1. Proper Handling, Segregation and Packaging of infectious wastes

Handling of infectious wastes should be different from those practices of household or other wastes (municipal). Therefore, these wastes may be categorized and segregated as culture and stock of infectious agents and associated biological, human blood and blood products, pathological wastes, used sharps (needles, syringes, surgical blades ,pointed and broken glasses),and contaminated animal carcasses.

Infectious waste handlers are expected to be aware of the importance of clear color (red) coding and marking of the segregated wastes at the source of generation. The wastes need to be packaged with material that can maintain its integrity during handling, storage, and transportation depending on the type of materials packaged.

3.4.6.2. Proper Storage of infectious waste

Storage of infectious wastes in the most proper manner is the beginning of disposal, since unkept or simple dumps are sources of nuisance, flies, smells or hazards. Generally on-site storage of infectious wastes should consider these factors:

1. The effects of storage on the waste components
2. The type of container to be used
3. The container location and
4. Public health and aesthetics

Furthermore the storage time should be minimal (treated within 24 hours) and the storage places and containers clearly marked with the universal biological hazard symbol and secured. The packaged waste is placed in rigid or semi rigid containers and transported in closed leak-proof containers or dumpsters. It must at all times be kept separate from regular trash and other refuse.

3.4.6.3 Collection and transportation of infectious waste

Figure 3.4.2 is a flow diagram for the separate collection and disposal of wet and dry wastes that was first described in Bangladesh (Juncker T et al 1994).

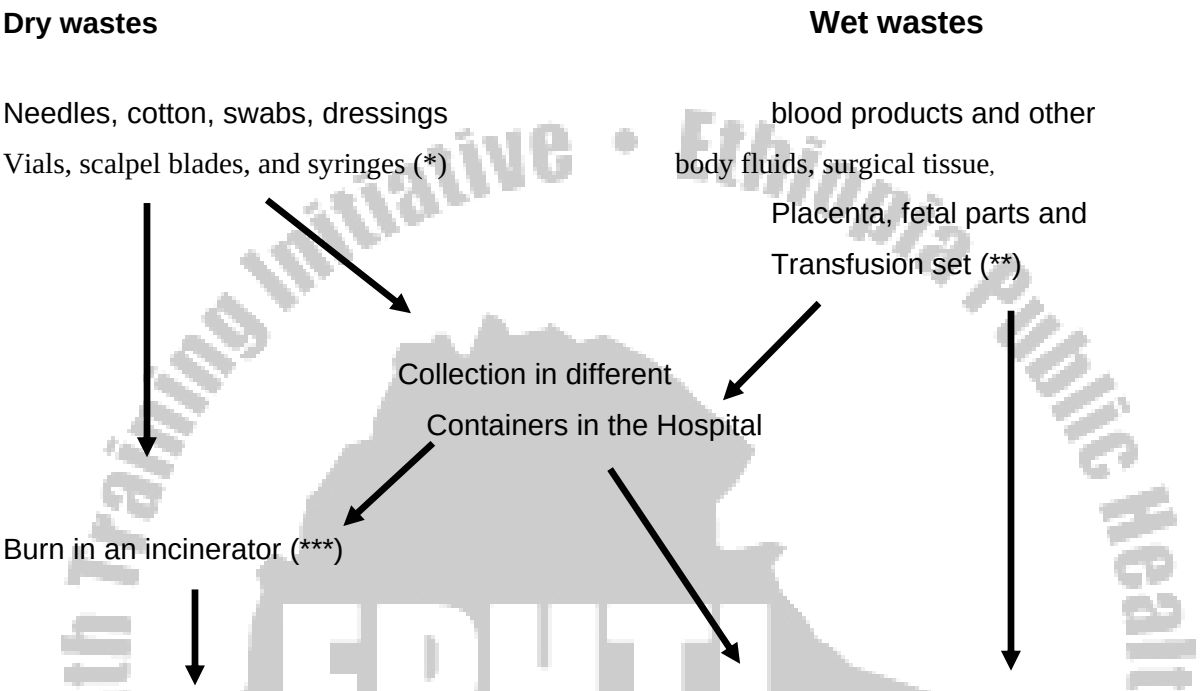


Figure 3.4.2 Flow Diagram: Collection and transportation of infectious waste

Small quantity of syringes made of polyethene or polypropene can be incinerated **outside with out producing any environmental health hazard.*

***Transfusion sets or syringes made of polyvinyl chloride (PVC) should not be incinerated because they release hazardous chemicals.*

****Built with local materials (e.g. drum incinerator; see figure 3.4.3)*

3.4.6.4 Treatment and disposal of infectious waste

Most infectious wastes can be treated for disposal by incineration or autoclaving. The residue can be disposed of in an approved landfill. Liquid may be chemically disinfected; pathological wastes may be buried if permitted or cremated, blood wastes may be discharged to a municipal sanitary sewer provided secondary treatment is employed. Infectious wastes may also be

rendered innocuous by shedding disinfections (sodium hypochlorite) thermal inactivation (boiling, autoclaving and burning) and gas vapor treatment.

3.4.6.4.1 Open piles of waste should be avoided because they:

- Are risks to those who scavenge and unknowingly reuse contaminated items,
- Allow persons to accidentally step on sharp items and injure themselves,
- Produce foul odors, and
- Attract insects and animals.

3.4.6.4.2 Proper disposal of contaminated waste may include:

- Incinerating (burning) to destroy the item as well as any microorganisms. (this is the best method for disposal of contaminated waste. Burning also reduces the bulk volume of waste and ensures that the items are not scavenged and reused)
- Pouring liquids or wet waste directly into a safe sewerages system.
- Burying contaminated wastes to prevent further handling.
- Use plastic or galvanized metal containers with tight-fitting covers for contaminated wastes. Many facilities now use colored plastic bags to alert handlers to the contents and to keep the general (co contaminated) waste separate from contaminated waste.
- Use puncture-resistant sharps containers for all disposable sharps (sharp that will not be used)
- Place waste containers close to where the waste is generated and where convenient for users (carrying waste from place to place increases the risk of infection for handlers). This is especially important for sharps, which carry the highest risk of injury for health workers and staff.
- Equipment that is used to hold and transport wastes must not be used for any other purposes in the clinic or hospital. (Contaminated waste containers should be marked as such.)
- Wash all waste containers with a disinfectant cleaning solution (0.5% chlorine solution plus soap) and rinse with water regularly.
- When possible, use separate containers for combustible and noncombustible wastes prior to disposal. This step prevents workers from having to handle and separate wastes by hand later.

- Use personal protective equipment when handling wastes (e.g. heavy duty utility gloves and closed protective shoes).
- Wash hands or use a waterless, alcohol-based antiseptic handrub after removing gloves when handling wastes.

3.4.6.4.3 Disposing of contaminated sharps

Disposable sharp items (hypodermic needles, suture needles, razors and scalpel blades) require special handling because they are the items most likely to injure the healthcare workers who handle them as well as people in the community if these items go to the municipal landfill.

Encapsulation

Encapsulation is recommended as the easiest way to safely dispose of sharps. Sharps are collected in puncture-resistant and leak proof containers. When the container is three-quarters full, a material such as cement (mortar), plastic foam or clay is poured into the container until completely filled. After the material has hardened, the container is sealed and may be landfilled, stored or buried. It is also possible to encapsulate chemical or pharmaceutical waste together with sharps (WHO 1999).

Disposal in the procedure Area

Step 1: Do not recap needle or disassemble needle and syringe.

Step 2: After use, to decontaminate the assembled hypodermic needle and syringe, hold the needle tip under the surface of a 0.5% chlorine solution, fill the syringe with solution and push out (flush) three times (if the syringe and/or needle will be reprocessed, fill the syringe with 0.5% chlorine solution and soak for 10 minutes for decontamination).

Step 3: Place assembled needles and syringes to be disposed of in a puncture- resistant sharps container such as a heavy cardboard box, plastic bottle or tin can with lid. The opening in the lid should be large enough that items can be easily dropped through it, but small enough that nothing can be removed from inside. (Old intravenous fluid bottles may also be used, but they can break.)

Step 4: When the container is three- quarters full, it should be removed from the procedure area for disposal.

3.4.6.4.4 Disposing of the Sharps Container

Step 1: Wear heavy-duty utility gloves.

Step 2: When the sharps container is three- quarters full it should be capped, plugged or taped tightly closed. Be sure that no sharp items are sticking out of the container.

Step 3: Dispose of the container by burning, encapsulating or burying.

Step 4: Remove utility gloves (wash daily or when visibly soiled, and dry).

Step 5: wash hands and dry them with a clean cloth or towel or air dry. (Alternatively, if hands are not visibly soiled, apply 5 ml, about 1 teaspoonful, of an antiseptic handrub and rub the solution vigorously into hands until dry.)

3.4.6.4.5 Disposing of liquid contaminated wastes

Liquid contaminated wastes (e.g., human tissue, blood, feces, urine and other body fluids) require special handling because it may pose in infectious risk to health care workers who contact or handle the waste.

Step 1: Wear PPE (utility gloves, protective eyewear and plastic apron) when handling and transporting liquid wastes.

Step 2: Carefully pour wastes down a utility sink drain or into a flushable toilet and rinse the toilet or sink carefully and thoroughly with water to remove residual wastes. **Avoid splashing**.

STEP3: If a sewage system doesn't exist, dispose of liquids in a deep, covered hole, not into open drains.

STEP 4: Decontaminate specimen containers by placing them in a 0.5% chlorine solution for 10 minutes before washing them.

STEP 5: Remove utility gloves (wash daily or when visibly soiled and dry).

STEP 6: Wash and dry hands or use an antiseptic hand rub as described above.

NOTE: In case of cholera epidemic, hospital sewage must also be treated and disinfected. *Vibrio cholerae*, the causative agent of cholera, is easily killed and does not require use of strong disinfectants. Buckets containing stools from patients with acute diarrhea may be disinfected by the addition of chlorine oxide powder or dehydrated lime oxide (WHO 1999).

3.4.6.4.6 Disposing of solid contaminated wastes

Solid contaminated wastes (e.g. surgical specimens, used dressings and other items contaminated with blood and organic materials) may carry microorganisms.

STEP 1: Wear heavy- duty or utility gloves when handling and transporting solid wastes

STEP 2: Dispose of solid wastes by placing them in a plastic or galvanized metal container with a tight- fitting cover.

STEP 3: Collect the waste containers on a regular basis and transport the burnable ones to the incinerator or area for burning. Drum incinerator is the simplest form of single-chamber incinerator. It can be made inexpensively and is better than open burning.

How to build and use a simple drum incinerator for waste disposal

STEP1: Where possible, select a site downwind from the health station, water supplies and human living quarters to minimize the risk from toxic fumes and by products which might be sometimes created from incinerators.

STEP 2: Build a simple incinerator using local materials (mud or stone) or a used oil drum (e.g. a 55- gallon drum). The size depends on the amount of daily waste collected (figure 3.4.3 & 3.4.4).

STEP 3: Make sure the incinerator has:

- Sufficient air inlets underneath for good combustion
- Loosely placed fire bars to allow for expansion
- An adequate opening for adding fresh refuse and for removal of ashes
- A long enough chimney to allow for a good draft and evacuation of smoke

STEP 4: Place the drum on hardened earth or concrete base.

STEP 5: Burn all combustible waste, (such as paper and cardboard) as well as used dressings and other contaminated wastes. If the waste or refuse is wet, add kerosene so that a hot fire burns all the waste. Ash from incinerated material can be treated as noncontaminated waste.

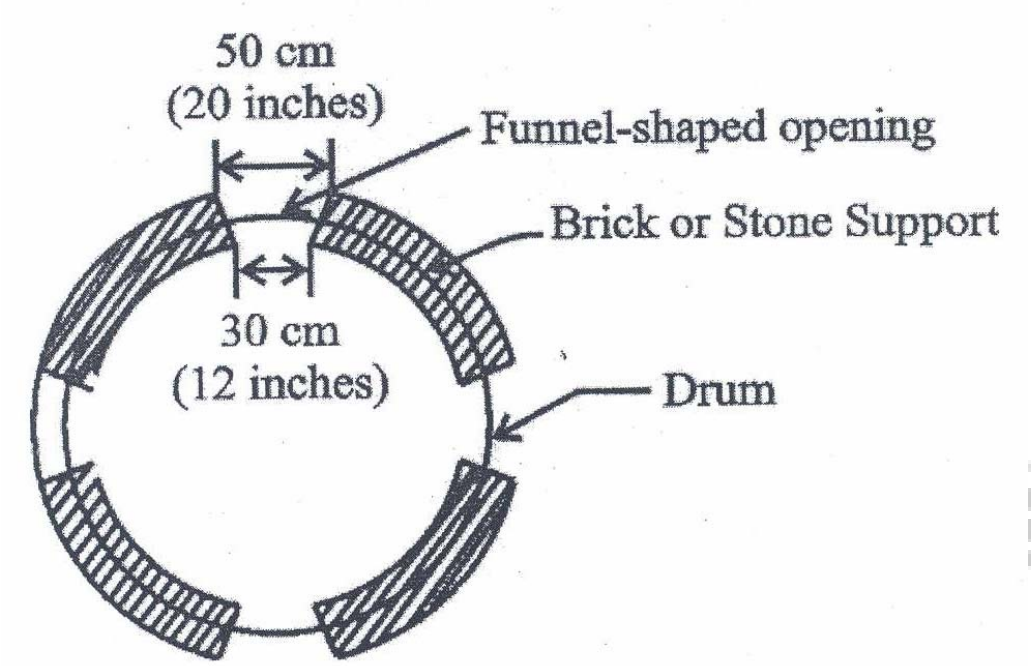


Figure 3.4.3. Plan for a simple oil drum incinerator

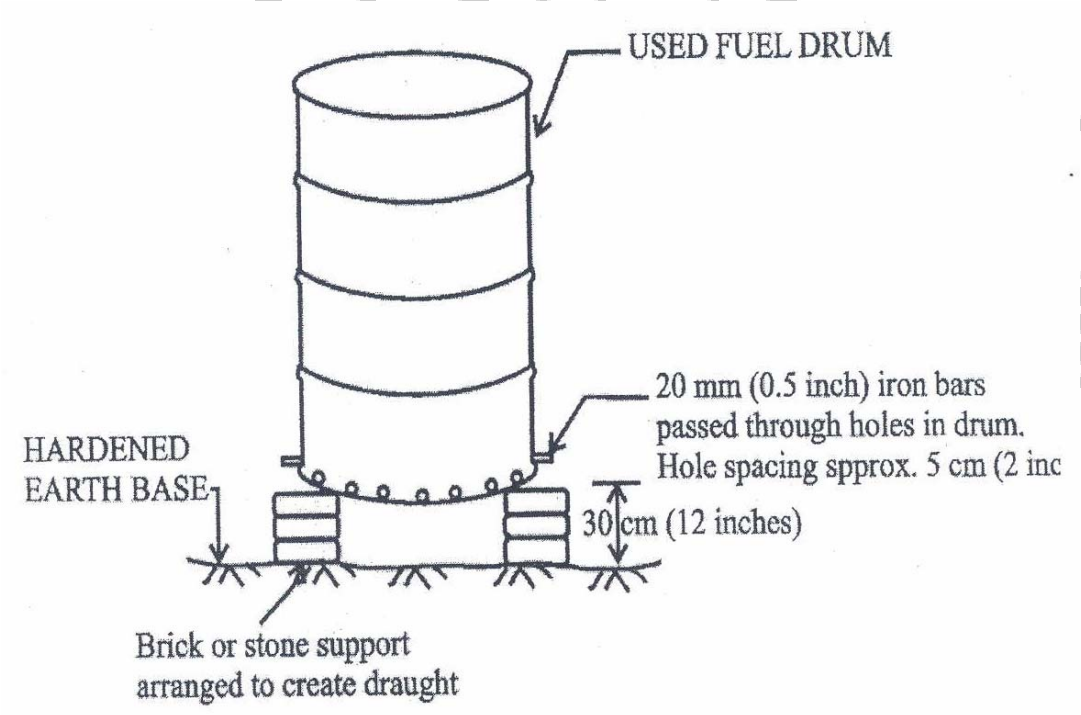


Figure 3.4.4. Design for a simple oil Drum Incinerator. *(Source: SEARO/WHO 1988)*

3.4.6.4.8 Burying Wastes

In healthcare facilities with limited resources, safe burial of wastes on or near the facility may be the only option available for waste disposal. To limit health risks and environmental pollution, some basic rules are:

- Access to the disposal site should be restricted. (build a fence around the site to keep animas and children away)
- The burial site should be lined with a material of low permeability (e.g. clay), if available.
- Select a site at lowest 50 meters (164 feet) away from any water source to prevent contamination of the water table.
- The site should have proper drainage, be located downhill from any wells, free of standing water and not in an area that flood.

How to make and use a small burial site for waste disposal

STEP 1: Find an appropriate location

STEP 2: Dig a pit 1 meter (3 feet) square and 2 meters (6 feet) deep. The bottom of the pit should be 2 meters (6 feet) above the water table (Burial can be used as a method of waste disposal only where the water table is more than 12 feet below the surface.

STEP 3: Dispose of the contaminated waste in the pit and cover the waste with 10-15 cm (4-6 inches) of earth each day. The final layer of dirt should be 50-60 cm (20-24 inches) and compacted to prevent odors and attraction of insects, and to keep animals from digging up the buried waste.

3.4.7. Hygienic education

Because most of the wastes from healthcare facilities can be sent to a municipal landfill or dumpsite (the least expensive and easiest way to dispose of wastes), it is important to train all healthcare workers (including physicians) to keep contaminated and noncontaminated wastes

separate. For example, throwing a hypodermic needle into a wastebasket in a patient's room automatically makes that container hazardous for housekeeping staff to handle. And, if discovered, that wastebasket now needs to be handled and disposed of as contaminated waste.

A well-planned hygienic education plays an important role and should be one of the earliest considerations. The main purpose of hygienic/health education: -

i. To create desire, interest, awareness on the relation of health and infectious waste and for general improvement of infectious waste management
ii. To increase the health workers', communities' or community health workers' awareness/knowledge and practice related to:
    - Proper handling and storage of infectious wastes
    - Proper infectious waste collection and disposal
    - Health care facilities sanitation
    - Personal hygiene
    - Proper ventilation of health care facilities/ rooms
iii. To secure sustained community participation in the management of infectious waste.

3.4.8. Health institutions sanitation

The main objective of sanitation in health institutions is maintaining a high degree of cleanliness and hygiene in order to prevent disease related to infectious waste.

Therefore, health institutions should satisfy the following conditions and facilities:

- Proper collection and disposal of infectious waste
- The provision of adequate sanitary facilities and other personal services
- Proper strategies to prevent accidents while handling infectious wastes
- General cleanliness and maintenance of health care facilities
- Maintaining good ventilation and proper illumination systems
- The provision of safe and adequate water supply
- Hand washing facilities, toilets facilities, and personal protection devices should be adequately available.

UNIT FOUR

ROLE AND TASK ANALYSIS

Table 4.1: Knowledge: Objectives and Activities for professional students

Learning Objectives	Learning Activities			
	Health Officer	Nurse	Environmental Health Technician	Medical Laboratory Technician
Define infectious waste and its type	Define infectious waste Mention the types of infectious	Define infectious waste Mention the types of infectious	Define infectious waste Mention the types of infectious	Define infectious waste Mention the types of infectious
Identify sources of Infectious waste	Sort out the sources of infectious waste generations	Sort out the sources of infectious waste generations	Sort out the sources of infectious waste generations	Sort out the sources of infectious waste generations
Describe different ways disease transmission	Describe the chain of infections from Infectious waste	Describe the chain of infections from Infectious waste	Describe the chain of infections from Infectious waste	Describe the chain of infections from Infectious waste State the mode of transmission
Identify the different methods of decontamination	Mention methods of decontamination Identify and enumerate safe disposal options	Mention methods of decontamination Identify and enumerate safe disposal options	Mention methods of decontamination Identify and enumerate safe disposal options	Mention methods of decontamination Identify and enumerate safe disposal options
Describe different prevention and control measures of disease	List the possible prevention and control measures of infectious waste	List the possible prevention and control measures of infectious waste	List the possible prevention and control measures of infectious waste	List the possible prevention and control measures of infectious waste

Table 4.2: Attitude: objectives and activities for profession student

Learning Objectives	Learning Activities			
	Health Officer	Nurse	Environmental Health Technician	Medical Laboratory Technician
Accept infectious waste as a major public health problem	Give emphasis to infectious waste	Give emphasis to infectious waste	Give emphasis to infectious waste	Give emphasis to infectious waste
Consider proper handling as a key step in safe management of infectious waste	Give emphasis to proper onsite handling Stress on prevention and control of infectious waste	Give emphasis to proper onsite handling Stress on prevention and control of infectious waste	Give emphasis to proper onsite handling Stress on prevention and control of infectious waste	Give emphasis to proper onsite handling Stress on prevention and control of infectious waste
Help community believe that infectious diseases is caused by improper infectious waste management	Convince community that proper infectious waste management reduces the risks of infection	Convince community that proper infectious waste management reduces the risks of infection	Convince community that proper infectious waste management reduces the risks of infection	Convince community that proper infectious waste management reduces the risks of infection
Appreciate adequate health education in the prevention and control of diseases from infectious waste	Stress on Health Education Convince community through health education on proper handling of infectious waste management	Stress on Health Education Convince community through health education on proper handling of infectious waste management	Stress on Health Education Convince community through health education on proper handling of infectious waste management	Stress on Health Education Convince community through health education on proper handling of infectious waste management

Table4.3: Practice objectives and activities for professional students

Learning Objectives	Learning Activities			
	Health Officer	Nurse	Environmental Health Technician	Medical Laboratory Technician
Apply proper onsite handling, sorting, storage, collection transportation and disposal of infectious waste	Plan and organize proper onsite handling, collecting and disposing of infectious	Plan and organize proper onsite handling, collecting and disposing of infectious	Plan and organize proper onsite handling, collecting and disposing of infectious	Plan and organize proper onsite handling, collecting and disposing of infectious
Demonstrate general safety practice towards infectious waste	Perform proper safety practice towards infectious waste	Perform proper safety practice towards infectious waste	Perform proper safety practice towards infectious waste	Perform proper safety practice towards infectious waste
Provide health education about infectious waste management	Plan, organize and provide health education Involve comments for prevention and control of infection from Infectious waste	Plan, organize and provide health education Involve comments for prevention and control of infection from Infectious waste	Plan, organize and provide health education Involve comments for prevention and control of infection from Infectious waste	Plan, organize and provide health education Involve comments for prevention and control of infection from Infectious waste

UNIT FIVE

GLOSSARY AND ABBREVIATIONS

Aerosols: Infectious air born droplets.

Bacteria: microscopic organism, which can cause disease

Biosafety level: Levels of laboratory according to the category of hazard which an organism presents.

Biosafety: Activity related to safeguarding a population from biologically unwanted effects of infectious agent

Containment: Confining or prevention of dissemination of a potentially hazardous agent.

Decontamination: Destruction of contaminants from material before final disposal or reuse.

Disinfectant: Chemical which removes or kills most but not all viable organism.

Disinfection: It is the selective elimination of certain unwanted/undesirable organism in order to prevent their transmission.

Generator: An individual, firm, facility, or company that produces infectious waste.

Host: Animal or human up on which or with in which micro- organisms live.

High-level disinfecton (HLD): Process that eliminates all microorganism except endospores from inanimate objects.

Incineration: Destruction of infectious microorganisms by burning.

Infections waste management - The systematic administration of activities that provide for the handling, sorting (segregation), storing, transporting, treatment and disposal of infections waste.

Nosocomial or hospital-acquired infection: Infection that was neither present nor incubating at the time the patient came to the health care facility

Infectious Waste: Any waste generated from health and health related facilities that are capable of causing infectious disease.

Risk group: Categorization of disease causing microorganisms based upon their degree of pathogenesity, risk to laboratory staff and availability of effective prophylaxis and treatment.

Segregation: Separation of noninfectious waste from infectious waste.

Sharps: Suture needles, scalpel blades, scissors wire sutures broken glass or any that can cause a puncture or cut.

Sterilization: Process of making an article (material) free from all forms of microorganism.

Storage: The actual containment of wastes on either temporary basis or a long-term basis.

Transportation: The movement of infectious waste from the point of generation to any intermediate points or to the point of ultimate treatment or disposal

Treatment: The application of a method, a technique, or process, including incineration, designed to render infectious waste sterile.

Zoonotic agent: Microorganism that causes disease in vertebrate animals and that is transmissible to human beings and causes or significantly contributes the cause of increased morbidity or mortality of human beings.

UNIT SIX

BIBLIOGRAPHY

1. **Craven. (1992)** Fundamental of Nursing: Health and function J.B Lipincott company, Philadelphia. London. Pp: 481-489.
2. **Dejene Hailu, Kebede Faries, Mengesha Admassu, Solomon Tassew. (2002)** Lecture note series, housing and Institutional Health, for Environmental Health students, Dilla college of Health Sciences, Ethiopia.
3. **Joseph A. Salvato, P.t Dee (1992)** Environmental engineering & sanitation, 4th edition, John Wiley and Sons New York. USA.
4. **JUNCKER T. et al. 1994.** Clinical disposal at the THC level. MCH-FP Extension project (rural). ICDDR: Bangladesh.
5. **Kebede Faries, Tadesse Alemayehu, Mamo Wubshet, Dejene Hailu. (2002)** Lecture note series, Human & other liquid waste management, for Environmental Health Students. Jimma University, Ethiopia.
6. **Linda T., Debora B., and Noel M. (2003)**, Infection Prevention: Guidelines for Health care Facilities with Limited Resources. U.S.A.
7. **P.Walton Purdom (1980)** Environmental Health, 2nd edition, New York, USA.
8. **South East Asia Regional Office (SEARO), world Health Organization.1998**. A manual on Infection Control in Health Facilities. SEARO: New Delhi, pp 72-88.
9. **Takele Tadesse, Mengesha Admassu, Kebede Faries. (2002)** Lecture not series, Occupational Health Safety and Hygiene, for Environmental Health Students, Gonder College of Medical Sciences, Ethiopia.
10. **Taylor Fundamental of Nursing. (1989)**: The art and science of Nursing care, J.B Lipincott company Philadelphia, New York. pp: 501-525.
11. **WHO (1999).** Safe Management of Wastes from Health care activities. WHO: Geneva.
12. **Leo Uzych (1990).** Medical Waste Management Journal of Env. Health V 52 Number 4.
13. **Erasmus C.M. (1996)** An Infectious Control view of Clinical Waste Management: Hospital supplies.
14. **WHO (1993)** News letter on Environmental Health Number 20
15. **WHO (1993)** News letter on Environmental Health Number 12

UNIT SEVEN

ANNEXES

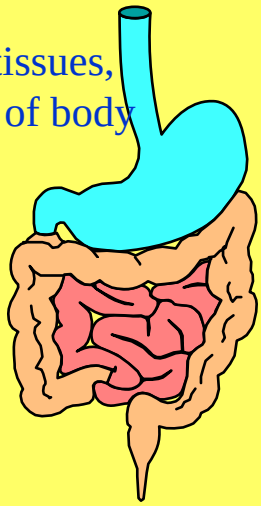
Cultures and stocks of microorganisms and biologicals

Human Blood & Blood Products

- All human blood (wet or dried)
- Products from human blood.

Pathological Waste

- Human pathological wastes - tissues, organs, body parts, containers of body fluids



Sharps

- Any article that can puncture or cut, and have been used in animal/human patient care or treatment
- Examples: needles, syringes, scalpel blades, razors, forceps

Animal Waste

- **Contaminated** animal carcasses, body parts, animal bedding known to have been exposed to **infectious agents** during research

Autoclaving

1. Add the correct volume of water to the autoclave as instructed by the manufacturer.
2. Put the basket containing the material to be sterilized in the autoclave.
3. Secure the lid as directed by the manufacturer. Open the aircock (air outlet) and close draw-off knob.
4. Adjust the safety valve to the required pressure, i.e. 10 psi to give a temperature 115^{o} C or 15psi to give 121^{o}C.
5. Begin heating the autoclave.
6. Watch the air outlet valve until a jet of steam appears. Wait 3 or 4 minute until the jet of steam is uniform and continuous and then close the aircock.
7. When the required pressure has been reached and the excess steam begins to be released from the safety valve reduce the heat and begin timing.
8. At the end of the sterilizing time, turn off the heat, and allow the autoclave to cool naturally. This usually takes a few hours.
9. Check that the pressure gauge is showing zero. When at zero, open the aircock and then wait for a few minutes before opening the lid to allow time for the autoclave to become fully vented.
10. Unscrew the lid clamps and take off the lid, leave to cool. Then remove carefully basket of sterilized equipments.

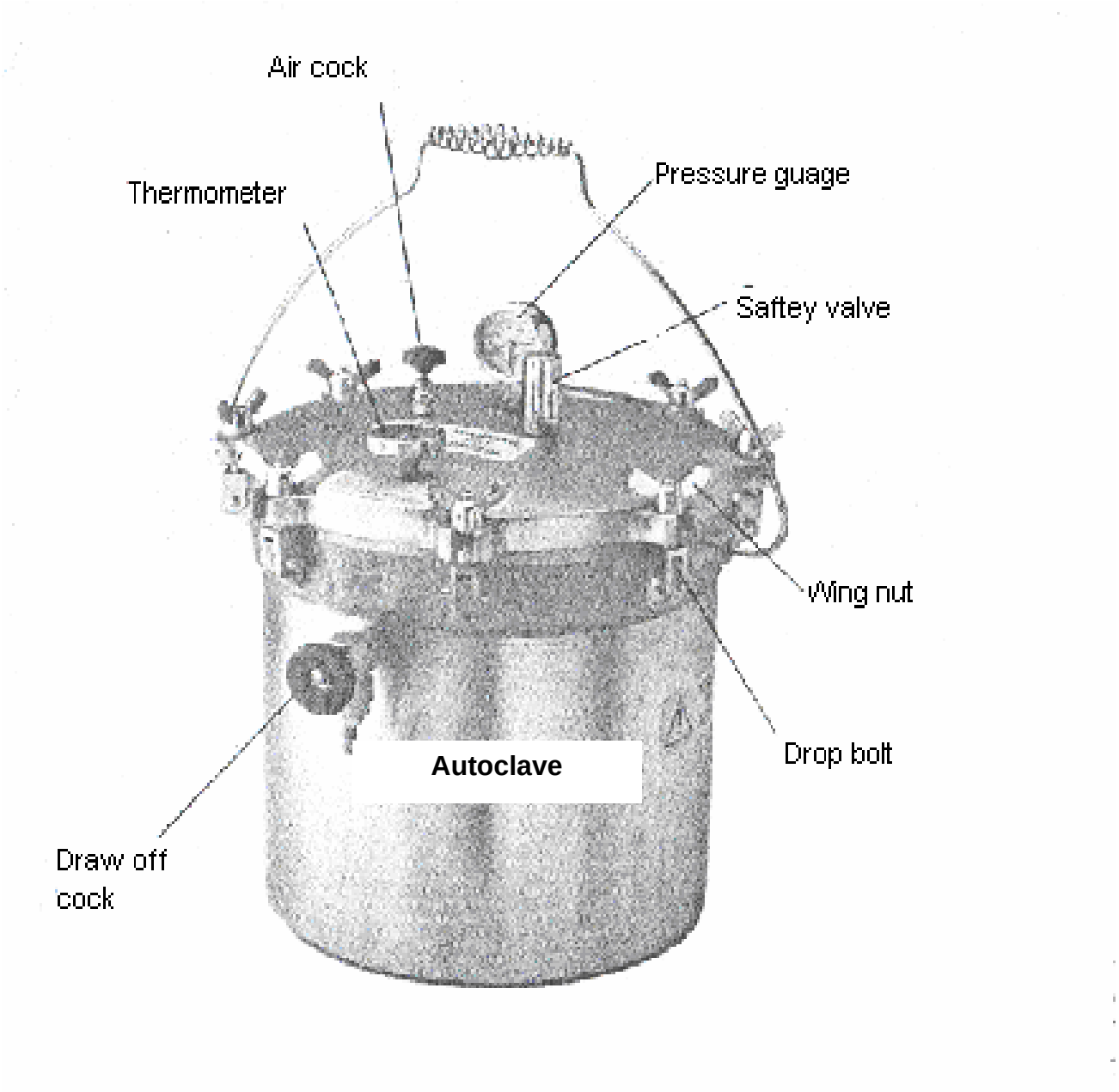


Figure- Dixon non-electric autoclave of 14 liters capacity

Answer Key

2.1 Pre and post test

2.1.1. For All Categories

1. True
2. True
3. True
4. True
5. True
6. False
7. False
8. False
9. False
10. False
11. False
12. True
13. True
14. False
15. True

2.1.2. For specific categories

2.1.2.1. For Health Officer

1. - Hand washing
   - wearing gloves and gown
   - Wearing masks, eye protection, face shield
   - Taking care to prevent injuries when using sharps
   - Provide environmental control for health-care facilities
   - place a patient who contaminate in a separate room (Isolation)

2. Personal hygiene, Immunization and good management practice of infectious waste

3. post-exposure management

Post-exposure prophylaxis(PEP) connsiderations :

- Evaluate risk
    - Source of fluid or Material
    - Type of Exposure
    - Evaluation of Exposure source patient
        - HIV status
        - Stage of infection
- Test health care worker for HIV after exposure as baseline, if available

Post exposure prophylaxis.

- Treatment, if stated should be initiated immediately after exposure, with in hours

4. Infectious agent

Reservoir,

Portal of exist,

Mode of transmission,

Portal of entry

Susceptible host

5. HIV/AIDS

Hepatitis B infection

Hospital acquired pneumonia

Sexually transmitted diseases

Gastroenteritis

2.1.2.2. For Nurses

1. D
2. A
3. D
4. D
5. C
6. C
7. B
8. A
9. D
10. B

2.1.2.3. For Laboratory technician

1. B
2. C
3. D
4. A
5. C
6. C
7. A
8. C

2.1.2.4. For environmental health technicians

1. D
2. A
3. B
4. A
5. A
6. D
7. D

8. – To create desire, interest, awareness about the relation of public health and infectious wastes;
   – To increase the awareness or knowledge of health workers/community about proper infectious waste management;
   – To secure sustainable participation in the management of infectious waste.

9. – Proper infectious waste management
   – Hygienic behavior

10. – HIV AIDS
    – Viral Hepatitis
    – Skin infections

3.4.3. For Satellite module (Environmental health students) - Exercise: Learning Activity one;

A. waste generation
B. waste storage
C. waste collection
D. waste transportation
E. wastes reuse and recycle
F. waste disposal

The Authors

Esayas Alemayehu /BSc.,MEng.,MSc./ is Registrar (Ass.), and Lecturer in the Jimma University. He obtained His Diploma in Sanitary Science and B. Sc. in Environmental Health from Jimma University, Faculty of Public Health and received M. Eng. and M. Sc. In Sanitary Engineering from UNISCO – IHE institute for water education, the Netherlands. He was a Head of the School environmental health sciences, Faculty of public health, Jimma University.

Ayalew Tegegn (MD, MCommH), Assistant Professor of Jimma University working in the department of Epidemiology, in the Public Health Faculty of Jimma University. He obtained his degree of doctor of Medicine (MD) from Jimma University and his Master in Community Health (MCommH) from the Liverpool School of Tropical Medicine, The University of Liverpool, United Kingdom.

Getenet Beyene (BSc.,MSc.), Lecturer in School of Medical Laboratory Technology. He obtained his BSc in Biology from Addis Ababa University and his MSc. from India (Roorkee University) in Biosciences.

Desta Workneh / R.N, BSC./ Assistant Lecturer and vice head of School of Nursing, Faculty of public Health,Jimma University. He obtained his diploma in Nursing from the former Jimma Institute Health Sciences, his BSC. from the former Jimma Institute of health science, currently Jimma University.

Hailu Endale (Dip, BSc), Assistant Lecturer in the School of Environmental Health sciences, Jimma University, He has a Bachelor of Sciences in Environmental Health, a warded form Jimma University (the former Jimma institute of Health Sciences).