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This material is intended for educational use only by practicing health care workers or students and faculty in a health care field.

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

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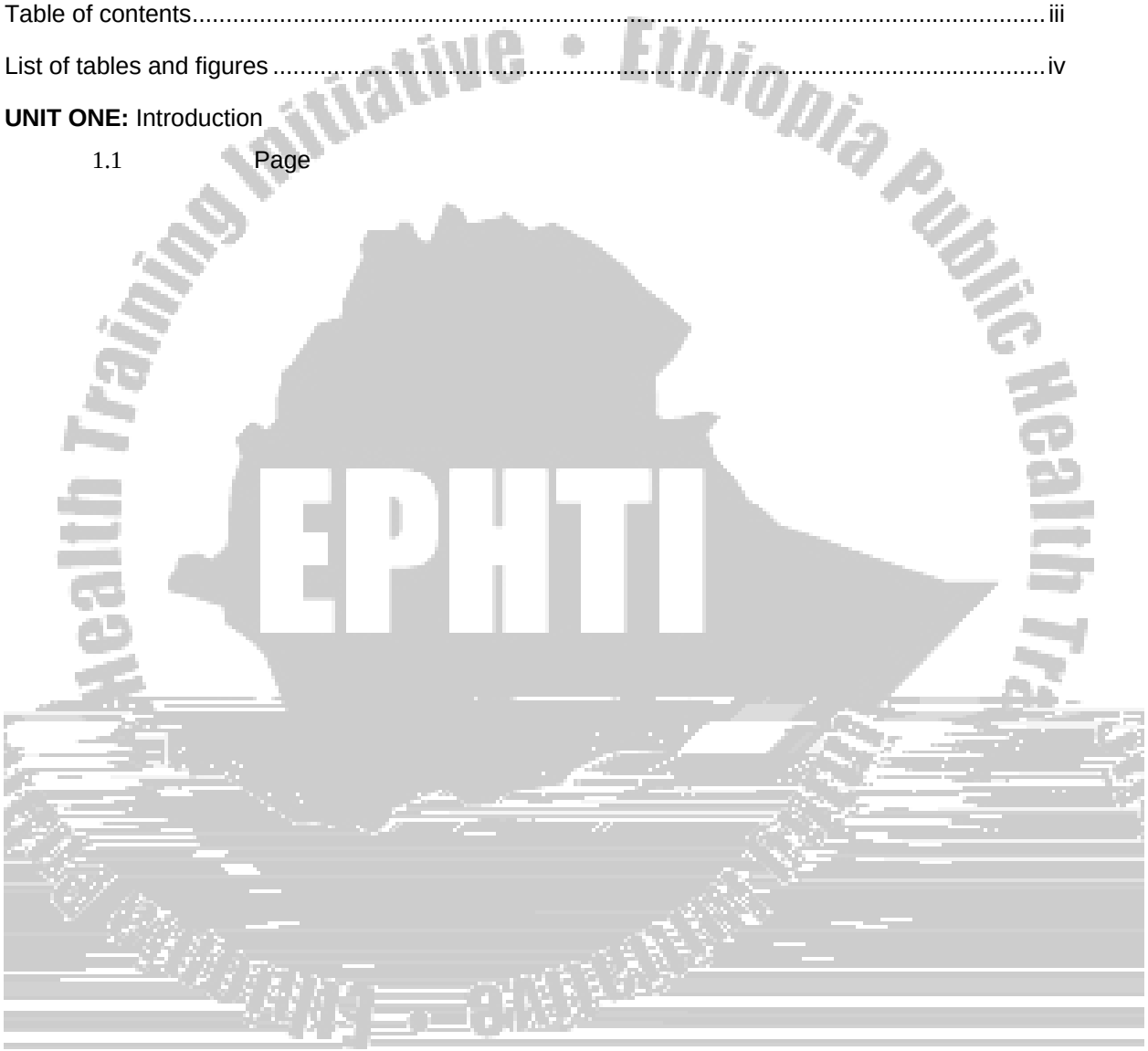

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UNIT ONE

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.

- 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

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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

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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 laborator

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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

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 udy conmu2Decapprin.f

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Infectious Waste Management

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.

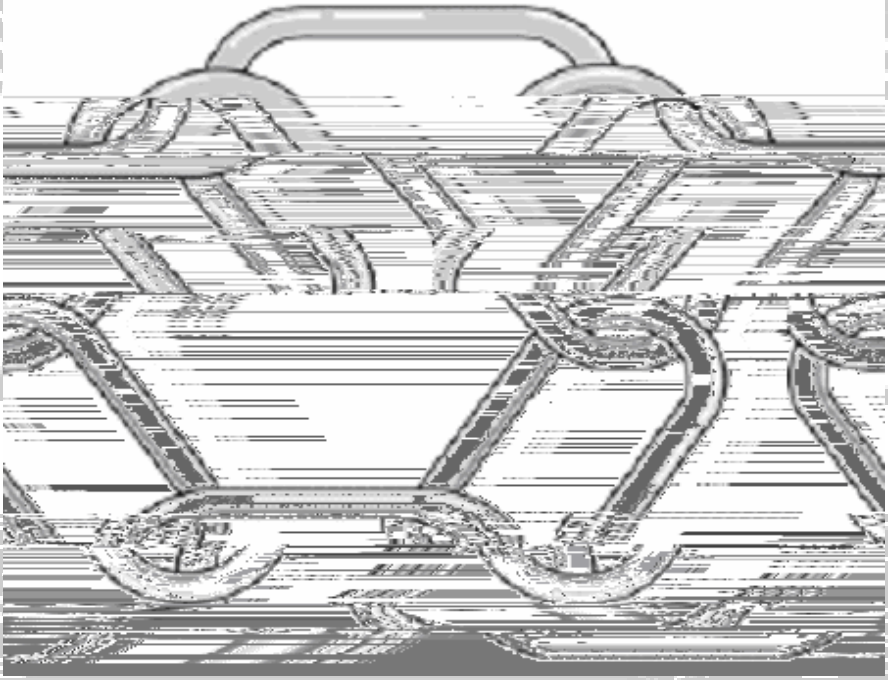
1. Cultures and stocks of infectious agents and associated biological, including without limitation, specimens cultures, cultures and stocks of infectious agent, waste from production of biological and discarded live and attenuated;
2. Laboratory wastes that were, or are likely to have been, in contact with infectious agents that may presents a substantial threat to public health if improperly managed;

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

Infectious Waste Management

2.9 Chains of infections

Microorganisms live everywhere in our environment.



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

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

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

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*

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.
- *Appropriaum2reation*

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 produ

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.

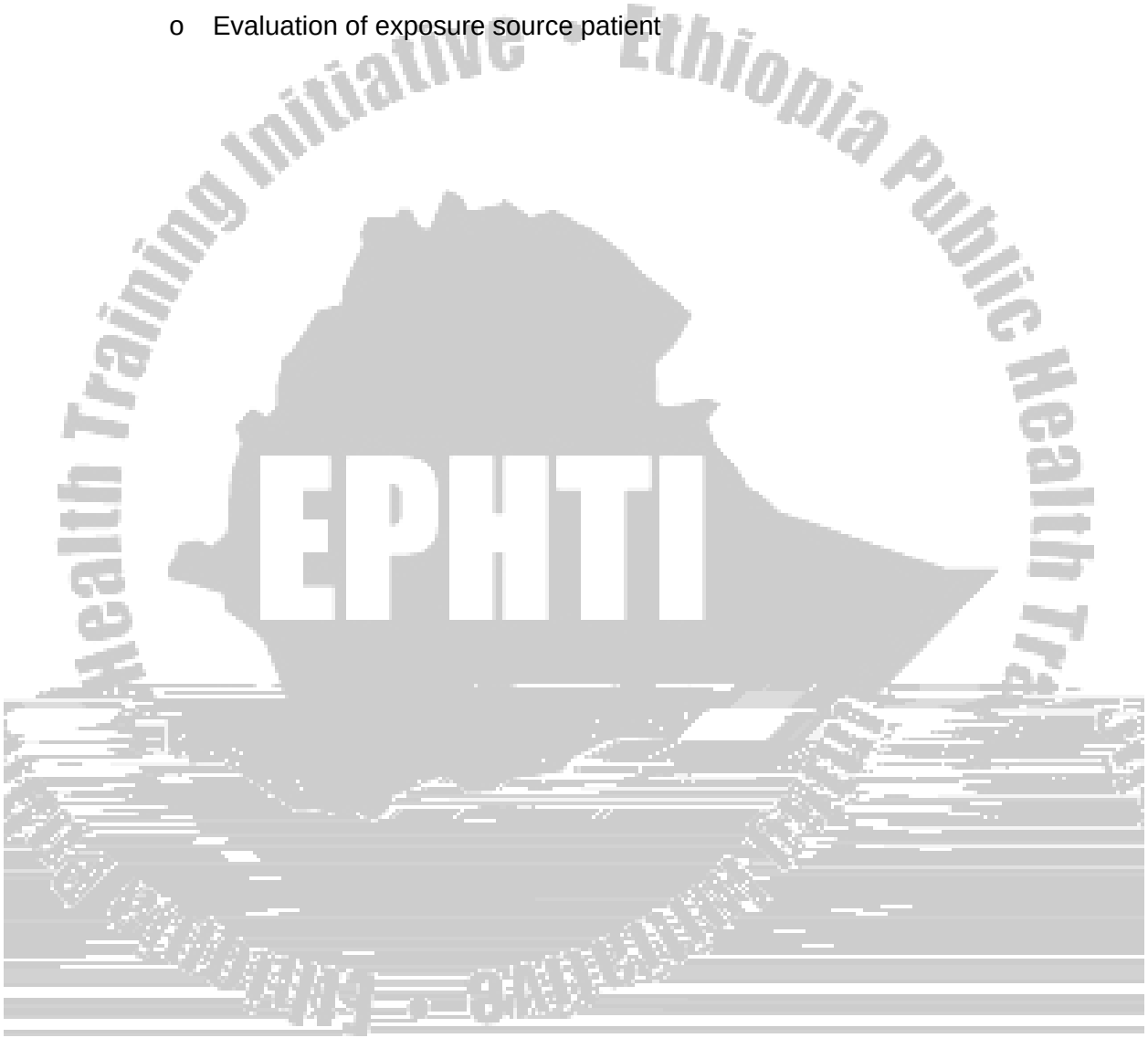
Thorough hand washing with adequate quantities of water and soap removes more than 90% of the transient, flora including all or most contaminants. An antimicrobial soap will further reduce the transient flora, but only if used for several minutes. Hand washing with (non-medicated) soap is essential when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

1. Post-exposure Management

Post-exposure prophylaxis(PEP) connsiderations :

- Evaluate risk
    - Source of fluid or material
    - Type of exposure
    - Evaluation of exposure source patient



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

- 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

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}

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 $\frac{\%\ \text{concentrate}}{\%\ \text{Dilute}} - 1$
-

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3.2.8.9 **Methods of safe disposal of sharp instruments**:

- Avoid recapping used needles

3.3.1.2 Directions for using this satellite module

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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

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.

- **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.

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.

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EPHTI

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:

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).

Dry wastes **Wet wastes**

Needles, cotton, swabs, dressings blood products and other

Vials, scalpel blades, and syringes (*) body fluids, surgical tissue,

Placenta, fetal parts and

Transfusion set (**)

Collection in different

Containers in the Hospital

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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)
-

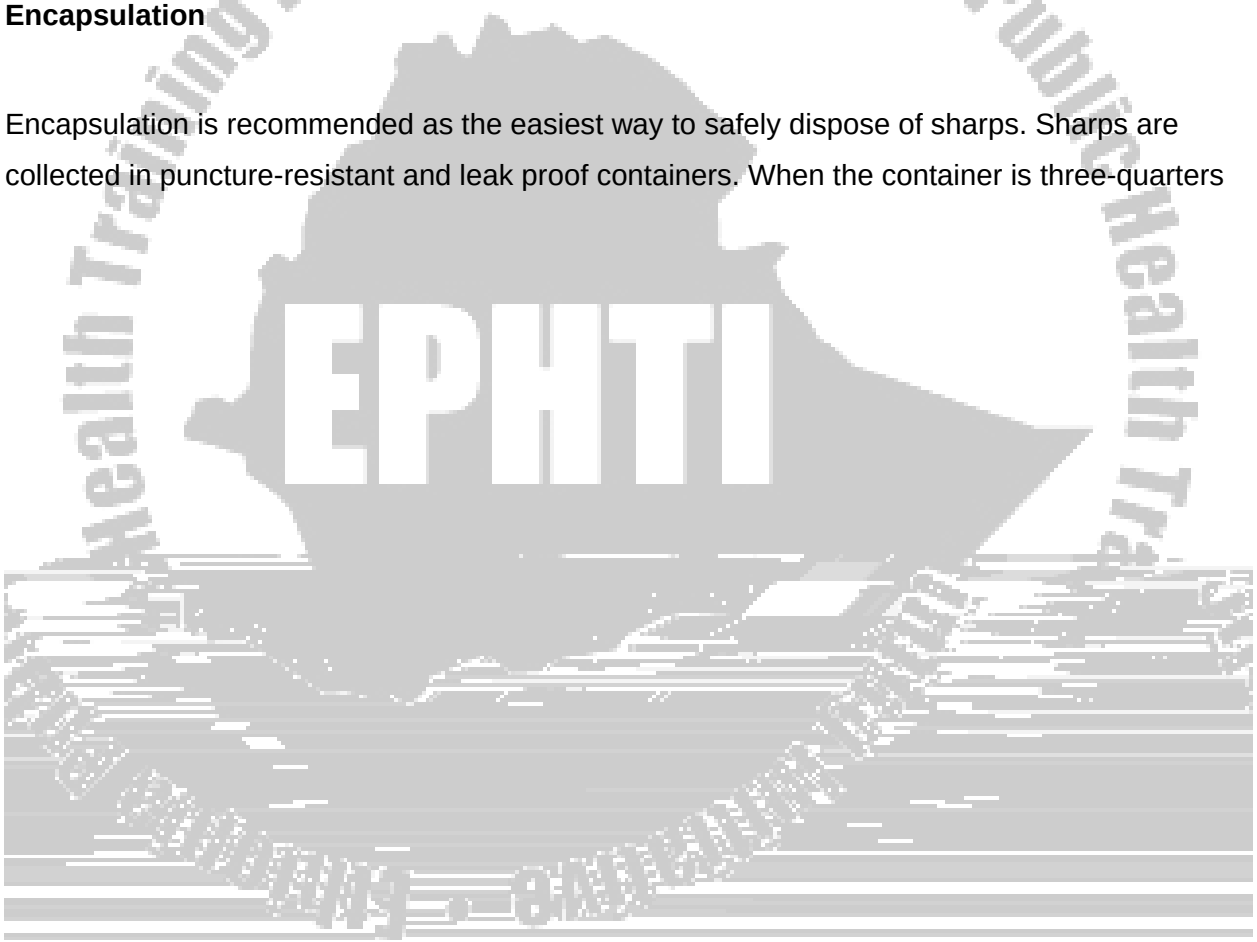
- Use personal protective equipment when handling wastes (e.g. heavy duty utility gloves and closed protective shoes).
- Wash hands or use a waterless, alcohol-based antiseptic handrub after removing gloves when handling wastes.

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



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.

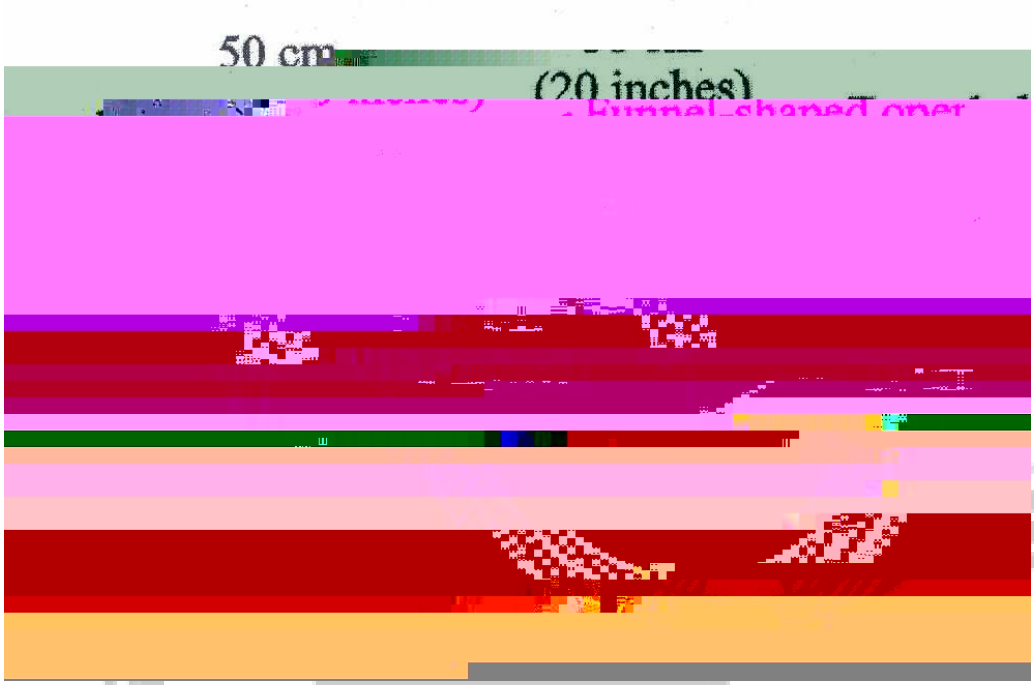


Figure 3.4.3. Plan for a simple oil drum incinerator

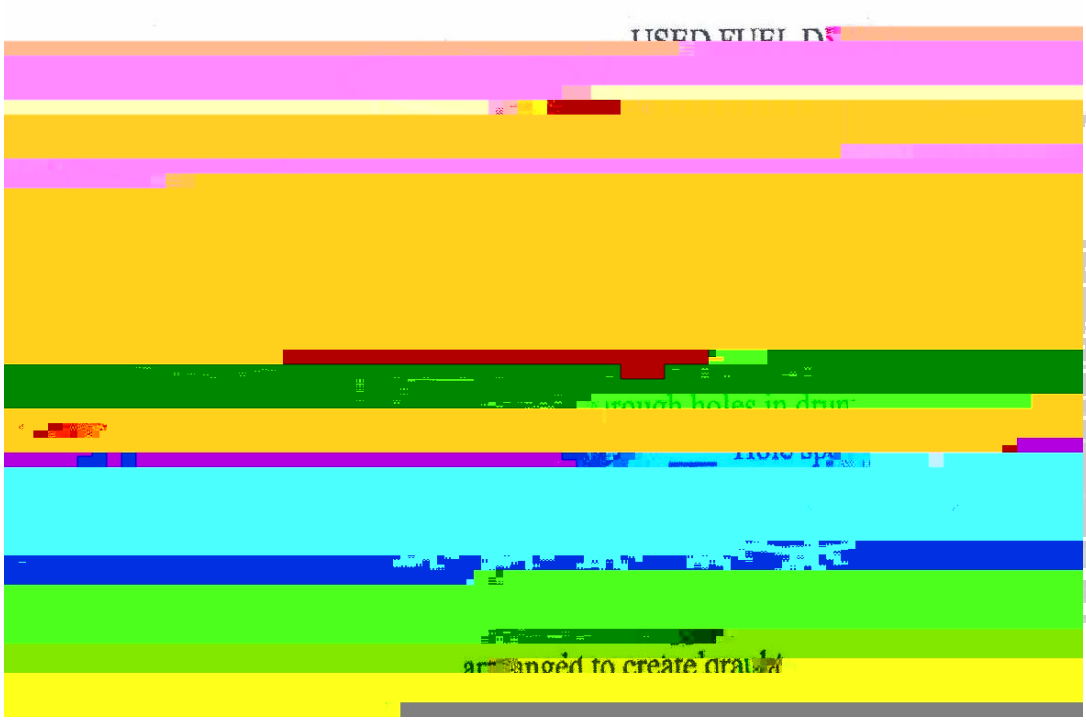


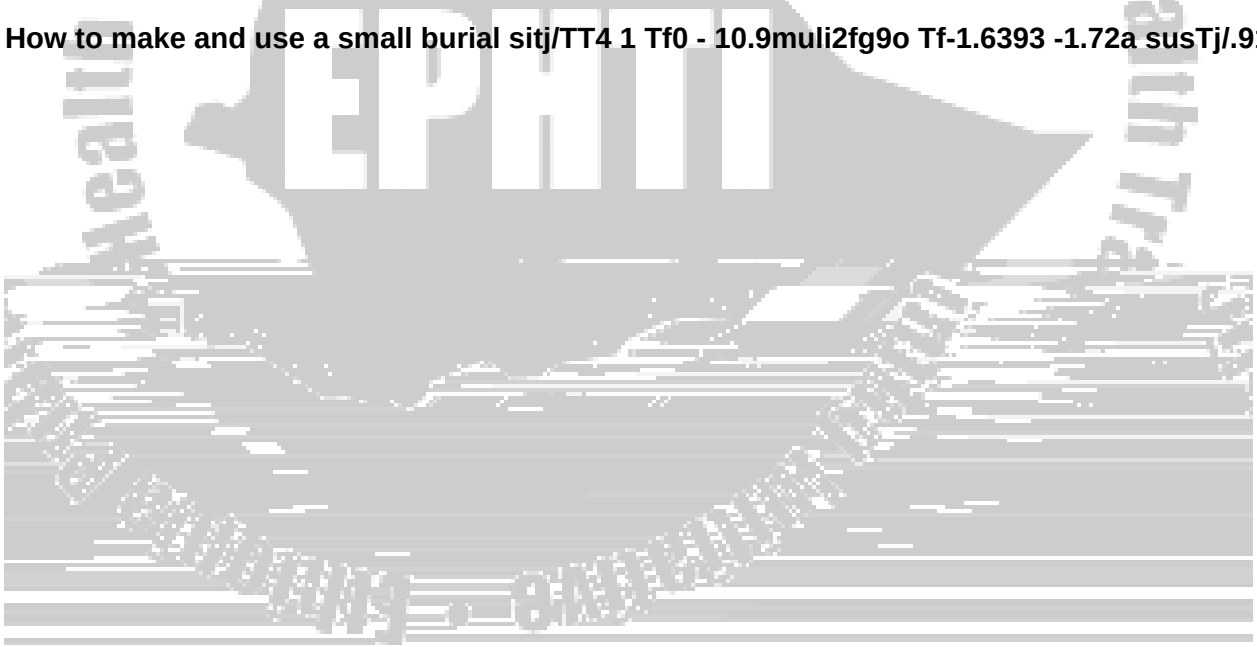
Figure 3.4.4. Design for a simple oil Drum Incinerator. *(Source: SEARO/WHO 1988)*

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 sitj/TT4 1 Tf0 - 10.9muli2fg9o Tf-1.6393 -1.72a susTj/.911uli2fSTEP 1



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.

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 collecting and dispo.1

UNIT FIVE

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**

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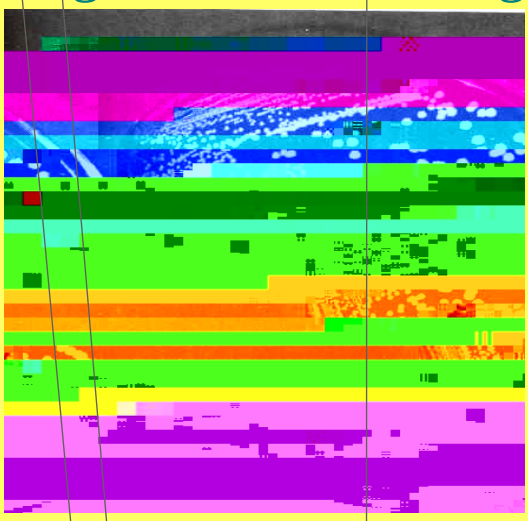
UNIT SEVEN

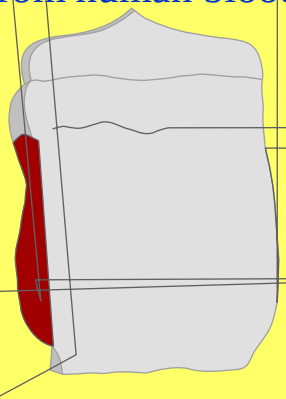
ANNEXES

Cultures and stocks of microorganisms and biologicals



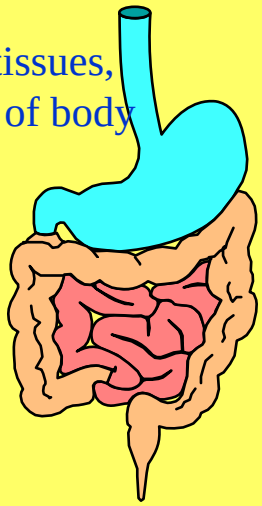
Human Blood & Blood Products

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



Pathological Waste

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

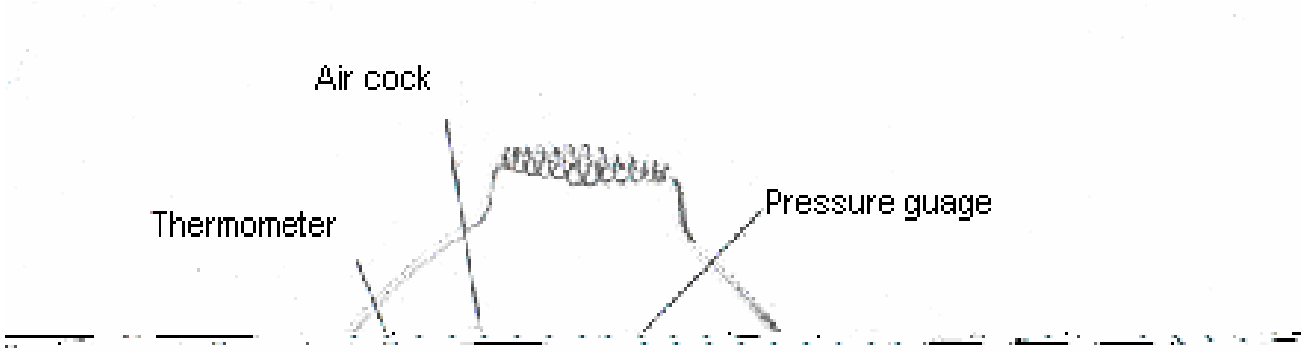


Sharps

- 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



Autoclave

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

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