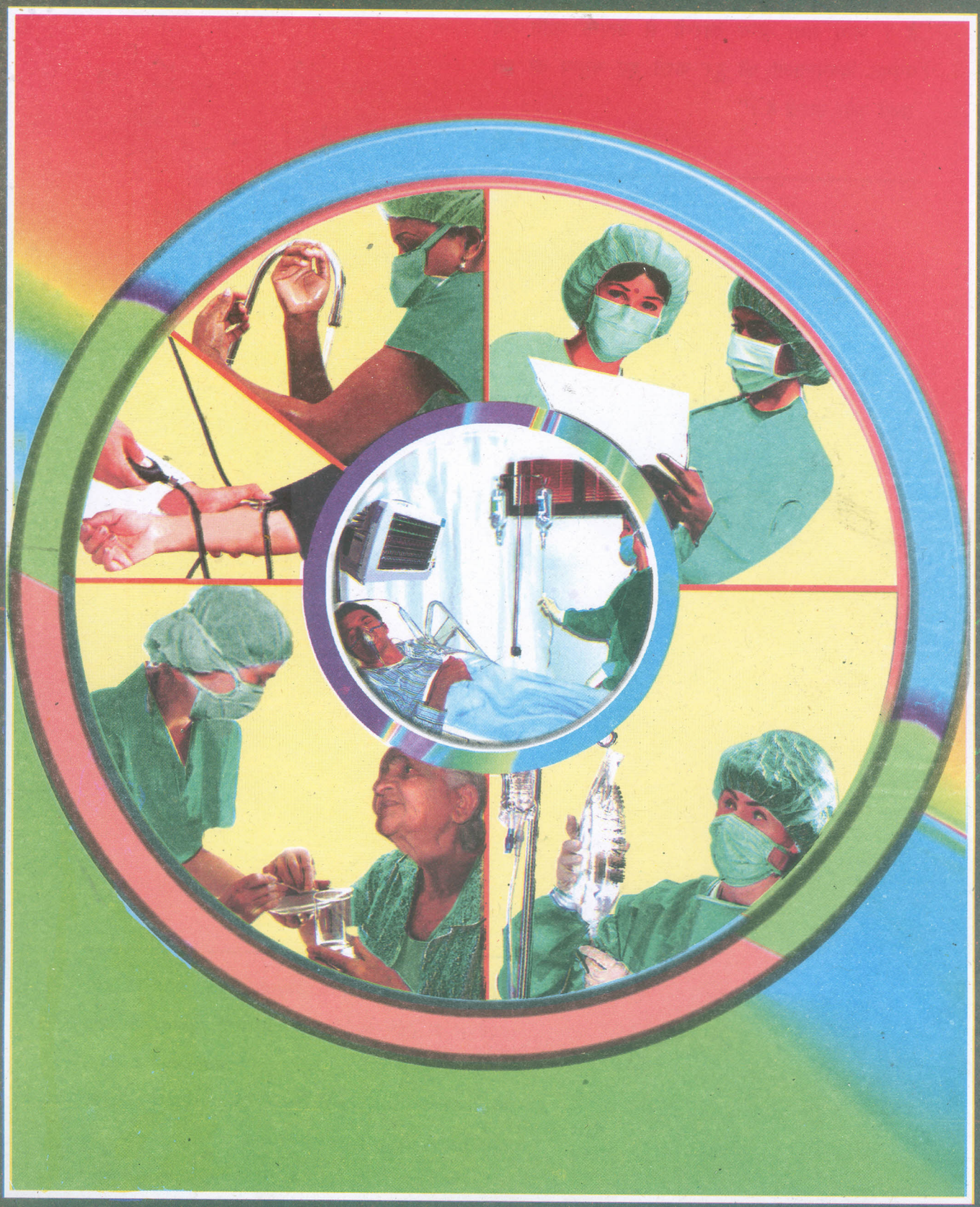
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BNS-031
Concepts and Principles in Critical Care Nursing



Infection Control in Critical Care Unit 4

"शिक्षा मानव को बन्धनों से मुक्त करती है और आज के युग में तो यह लोकतंत्र की भावना का आधार भी है । जन्म तथा अन्य कारणों से उत्पन्न जाति एवं वर्गगत विषमाताओं को दूर करते हुए मनुष्य को इन सबसे ऊपर उठाती है ।"

– इन्दिरा गांधी

"Education is a liberating force, and in our age it is also a democratising force, cutting across the barriers of caste and class, smoothing out inequalities imposed by birth and other circumstances."

- Indira Gandhi

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Block

4

INFECTION CONTROL IN CRITICAL CARE UNIT

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BLOCK INTRODUCTION

Health Care associated infections (HAI) previously known as nosocomial infections are the fourth leading cause of death among hospitalized patients, particularly when they are in ICU. Infections with resistant pathogens increase both morbidity and mortality rates among the patients.

This block will focus on early identification, preventive strategies, and the use of protective measures for prevention of infection in Critical Care Units.

As a critical care nurse you must be aware of all policies and procedures related to patient care. This block will help you to develop knowledge and skills in preventing infection through transmission of potentially deadly microorganisms in ICU.

The block comprises 3 units :

Unit 1 Deals with Health Care Associated Infections.

Unit 2 Relates to Infection Control Protocols.

Unit 3 Focuses on Biomedical Waste Management.

UNIT 1 HEALTH CARE ASSOCIATED INFECTION

Structure

1.0 Introduction

1.1 Objectives

1.2 Review of Asepsis

- 1.2.1 Medical Asepsis – Basic Principles
- 1.2.2 Surgical Asepsis – Basic Principles
- 1.2.3 Difference between Medical and Surgical Asepsis

1.3 Current Modalities of Disinfection and Sterilization

- 1.3.1 Methods of Sterilization
- 1.3.2 Disinfection
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1.4 Normal defense mechanisms and altered body defense in Critical Illness

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1.10 Glossary

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1.0 INTRODUCTION

Health Care Associated infections (HAIs) as you know, are secondary infections that are contracted during the course of medical treatment and manifest within the first 48 hours of medical treatment. These were known as 'hospital acquired infections' or 'nosocomial infections' in the past.

Patients hospitalized in Intensive Care Units (ICUs) or in Critical Care Units (CCUs) are 5 to 10 times more likely to acquire nosocomial infections than

other hospital patients. The frequency of infections at different anatomic sites and the risk of infection varies with the type of ICU, the immunity status of patients as well as the virulence of pathogenic organisms present in the environment.

Nosocomial infections have received increasing attention in recent years and are believed to involve about 2 million clients per year. The Joint Commission on Accreditation of Health Care Organizations included reducing the risk of health care associated infections as one of the 2006 National Patient Safety Goals. The most common setting where nosocomial infections develop are hospital surgical or medical intensive care units. Reports from the National Nosocomial Infection Surveillance System (NNIS) have revealed that the urinary tract, respiratory tract, bloodstream and wounds are the most common sources of nosocomial infection sites.

Nurses are responsible in preventing nosocomial infections in CCUs. This is achieved by meticulous use of medical and surgical asepsis to prevent transport of potentially infectious microorganisms.

Many nosocomial infections can be prevented using proper hand hygiene technique, environmental control, using sterile technique when needed, and identification and management of clients at risk for infection. In this unit we will review basic concept of infection, current modalities of disinfection and sterilization, normal defense mechanism and altered body defenses in critical illness, chain of infection and different stages of infection process. We will also focus on Health Care Associated Infections and Nurses' role in maintaining biologically safe environment.

1.1 OBJECTIVES

After completing this unit you will be able to:

- Review asepsis
- Define Health Care Associated infection, standard precaution and surveillance
- Discuss current modalities of disinfection and sterilization;
- Review chain of infection
- Discuss different stages of infectious process
- Describe Nosocomial infections occurring in Critical Care Units and
- Discuss nurses' role in maintaining biologically safe environment.

1.2 REVIEW OF ASEPSIS

Asepsis means absence of germs. The microorganisms of different types are present everywhere in our environment and in the human body. We practice medical and surgical asepsis to prevent microorganisms on hands, surfaces or equipment from being introduced to susceptible patient or site.

1.2.1 Medical Asepsis – Basic Principles

Medical asepsis is the removal or destruction of disease organisms or infected material. The basic principles of Medical Asepsis that you need to keep in mind include following:

- Wash hands frequently, especially before handling foods, before eating, after using a handkerchief, after going to the toilet, before and after each client contact, and after removing gloves.
- Keep soiled items and equipment away from touching the clothing.
- Do not place soiled bed linen or any other items onto the floor.
- Avoid having client's cough, sneeze, or breath directly on others.
- Move equipment away from you when brushing, dusting, or scrubbing articles.
- Avoid raising dust.
- Clean the least soiled areas first and then more soiled areas.
- Dispose soiled or used items directly into appropriate containers.
- Pour liquids that are to be discarded directly into the drain so as to avoid splattering in the sink and onto you.
- Avoid leaning against sinks, supplies or equipment.
- Avoid touching your eyes, face, nose or mouth.
- Use practices of personal grooming that help prevent spreading microorganisms.
- Follow guidelines conscientiously for isolation or barrier techniques as prescribed by your agency.

1.2.2 Surgical Asepsis – Basic Principles

Surgical Asepsis also known as Sterile Technique requires strict adherence to ordered and specific procedures which render an area free from all microorganisms including spores. An object or area is described as being sterile or unsterile (not sterile). Surgical Asepsis is used in the Critical Care area, during surgical procedures, catheterization, change of dressing and during any invasive procedures.

Basic principles of Surgical Asepsis include:

- Only a sterile object can touch another sterile object.
- Open sterile packages so that the first edge of the wrapper is directed away from the worker to avoid the possibility of a sterile wrapper touching unsterile clothing.
- Avoid spilling any solution on a cloth or paper used as a field for a sterile set-up.
- Hold sterile objects above the level of the waist.
- Avoid talking, coughing, sneezing, or reaching over a sterile field or object.
- Never walk away from or turn your back on a sterile field.
- All items that need to be brought into contact with broken skin or used to penetrate the skin in order to inject substances into the body, or to enter normally sterile body cavities, should be sterile.
- Use dry, sterile forceps when necessary.
- Consider the edge (outer 1 inch) of a sterile field to be contaminated.

- Consider an object contaminated if you have any doubt as to its sterility.

1.2.3 Difference between Medical and Surgical Asepsis

The major differences between medical and surgical asepsis are given in Table 1.1.

Table 1.1: Difference between Medical and Surgical Asepsis

Medical Asepsis	Surgical Asepsis
The number, growth and transmission of micro-organisms are limited/controlled Transmission of pathogenic organism can be prevented. A clean technique is used (hair combing, mouthwash etc.).	Objects / articles are free from pathogenic and non-pathogenic organisms. Pathogenic and non-pathogenic organism are totally destroyed. A sterile technique is used (giving injection and doing surgical dressing).

1.3 CURRENT MODALITIES OF DISINFECTION AND STERILIZATION

Several processes are used to destroy microorganisms. **Disinfection** destroys all pathogenic organisms except spores. **Sterilization** destroys all microorganisms including spores. Disinfection can be used when preparing the skin for a procedure or cleaning a piece of equipment that does not enter a sterile body part. Sterilization is usually performed on equipment that is entering a sterile portion of the body. Disinfection and sterilization of contaminated or infected objects and good hand hygiene diminishes and often eliminates microorganisms as potential sources of infection. Let us define the Sterilization and disinfection and discuss about their methods.

Disinfection is the destruction of pathogenic microorganisms but not usually bacterial spores. **Sterilization** is the process by which an object becomes free of all microorganisms. By sterilization both the pathogenic and non – pathogenic organisms are destroyed.

1.3.1 Methods of Sterilization

There are various methods used for sterilization of articles, which include thermal, chemical, radiation and Plasma sterilization. We shall discuss about each one of them.

1) Thermal methods

Thermal methods include following:

(a) Boiling

Boiling is an effective method of sterilization. Boiling for five to ten minutes at boiling point kills all the bacteria except spores and virus. Boiling is the most commonly used method in day-to-day working. A boiler is shown in Figure 1.1.

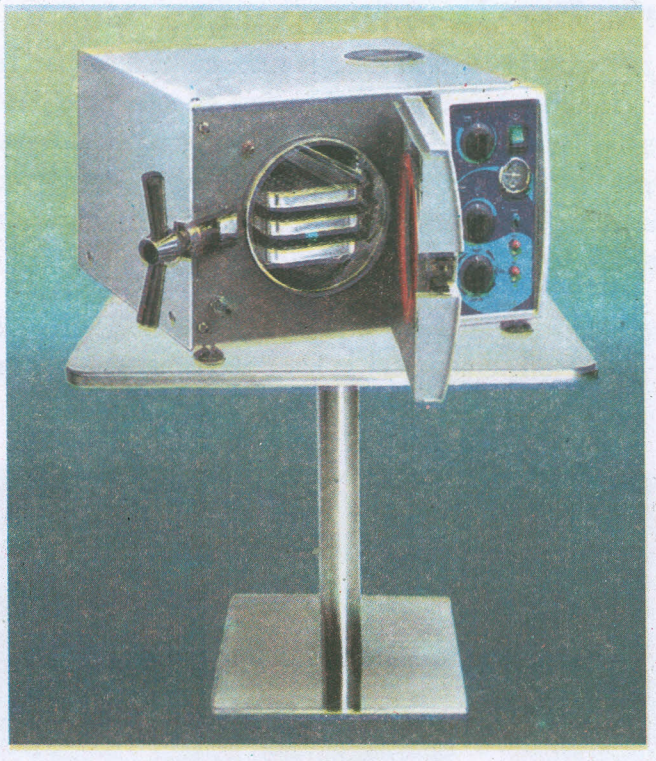


Fig.1.1: Boiler/Steriliser

Advantages of boiling:

Boiling can be used in the home environment and other situations when other methods are not available. It is one of the most economic ways of sterilization of articles.

Disadvantages of boiling:

Some bacteria, virus and all spores are resistant to boiling. Thus, boiling becomes ineffective in sterilizing articles. The boiling method cannot be used for the articles, which are destroyed by moisture and heat.

Points to remember in boiling

- All articles should be clean and free of any organic material.
- The articles should be fully submerged in water.
- The water should be boiling when the articles are put in except for glass articles, which should be wrapped and put in cold water and then brought to boil.
- Note the time when the water begins to boil. Let the articles remain in the boiling water for five to ten minutes.
- To assure sterilization, the articles may be boiled intermittently especially when spores are doubted.
- Never put articles in-between in the sterlizer when the boiling is in process.
- Keep the sterlizer always closed.
- Keep the bowls inverted to prevent the air trapped in them because air has the effect of preventing contact with the water and lower the temperature.
- Sharp instruments should not be put for boiling. Boiling makes them blunt.

(b) Autoclaving /Steam Under Pressure

Autoclaving is a method of sterilization by steam under pressure. It is the most widely used, economical and one of the most effective methods of destroying micro-organisms. This method uses high temperature, pressure and humidity to destroy all types of micro-organisms including spore forming micro-organisms. The steam under pressure maintains the necessary high temperature and it allows rapid penetration of articles packed in it.

For effective sterilization autoclaving is done at 15lbs per square inch pressure and 121^{0}C temperature for at least 20 minutes. An autoclave is shown in Fig.1.2.



Fig.1.2: An Autoclave

Advantages:

Autoclaving is used to sterilize all kinds of articles except those which are destroyed by high temperature and steam, e.g., plastic and rubber goods.

Important points to consider in the autoclaving

- All the air from the inner chamber must be driven out and replaced by steam otherwise the desired temperature of 121^{0}C at 15lbs/inch^2 of pressure would not be reached.
- The packed material and articles therein for sterilization should be packed loosely to allow penetration of the steam.
- The packed material should not be very large and should be well separated to allow the circulation of steam.

(c) Dry Heat Sterilization

Dry heat in the form of hot air is used primarily to sterilize anhydrous oils, petroleum products, and talc, where steam and ethylene oxide gas cannot penetrate. The destruction of microbial life by dry heat is a physical oxidation or low burning process that involves coagulating the protein in cells. Higher temperatures are required in the absence of moisture, because the microorganisms are destroyed through a very slow process of heat absorption by conduction.

Advantages of Dry Heat Sterilization

Hot air penetrates certain substance that cannot be sterilized by steam sterilization or other methods. Dry heat is a protective method of sterilizing some delicate, sharp, or cutting-edge instruments. Steam may erode or corrode cutting edges.

Disadvantages of Dry Heat Sterilization

A long exposure period is required, because hot air penetrates slowly and possibly unevenly. The time and temperature required will vary for different substances. Overexposure may ruin some substance.

2) Chemical Method

A chemical disinfection acts by coagulating the bacterial protein or by changing the composition of protein so that it no longer exists in the same form. You must be aware of the particular hospital policy in using the strength of disinfections for specific items.

Advantages:

This is the method used to sterilize the articles that are destroyed by heat and the metallic objects prone to corrosion. This is the easiest method of disinfecting articles especially in an emergency.

Disadvantages:

This method does not ensure sterilization because the disinfectants do not destroy the spores and some disinfectants are injurious to the skin and articles.

Important points to remember

- Chemicals should be used in correct strength.
- Articles should be fully submerged in is the chemicle
- They should be applied for a sufficient length of time.
- They should not be injurious to the skin and articles.
- The article should be thoroughly cleaned and dried before immersing in the disinfectant to remain free from organic material, which will protect the bacteria against the action of disinfectants. The disinfectant should be inexpensive.
- Instruments soaked in disinfectants must be adequately rinsed with sterile water before being used.

a) Ethylene Oxide Sterilization

Ethylene oxide (EO) gas is used to sterilize items that are sensitive to heat or moisture. EO is a chemical alkylating agent that kills microorganism (including spores) by interfering with the normal metabolism of protein and reproductive process, resulting in cell death. Used in the gaseous state, EO must have direct contact with microorganisms or in the items to be sterilized. EO is highly inflammable and explosive in air and therefore must be used in an ex losion – proof sterilizing chamber in a controlled environment. It is used for sterilization of Endo Tracheal Tubes (ET Tubes) central venous pressure (CVP) cannula, ambu bags etc.

Advantages of EO Gas Sterilization—

- EO gas is an effective substitute agent that can be used to sterilize most items that cannot be sterilized by heat, such as plastics with low melting points.
- EO gas provides an effective method of sterilization for items that are damaged by steam.
- EO gas completely permeates all porous materials.

Disadvantages of EO Gas Sterilization—

- EO gas sterilization is a complicated process that needs careful monitoring.
- EO sterilization takes longer than steam sterilization; it is a long slow process.
- EO Gas requires special, expensive equipment. Gas is somewhat expensive per cycle.
- It does not penetrate oils, liquids, or powder. If the material is spread thin the gas will penetrate; but it will not pass through bulk. Hence EO gas sterilization is not recommend for oils, liquids and, powders.
- Items that absorb EO gas during sterilization, such as rubber, polyethylene, or silicone, require an aeration period. Air admitted to the sterilizer at the end of the cycle only partially aerates the load.

b) Chemical sterilants in solution

Liquid chemical agents registered as sterilants by the Environmental Protection Agency (EPA) provide an alternative method for sterilizing minimally invasive, heat-sensitive items if a gas or plasma sterilizer is not available or if the aeration period makes EO gas sterilization impractical.

Advantages of Chemical Sterilants

The solution has a low surface tension, it penetrates into crevices and is readily rinsed from items.

- It is non corrosive, nonstaining, and safe for instruments that can be immersed in a chemical solution.
- It does not damage lenses or cement on lensed endoscopes.
- It is not absorbed by rubber or plastic.
- It has low volatility and is stable for time specified by the manufacturer.

Disadvantages of Chemical Sterilants

- Prolonged exposure to a chemical sterilant may be necessary for sterilization.
- Some chemical sterilants have hazardous effects associated with exposure.
- Even if a chemical has low toxicity and irritation, items must be thoroughly rinsed in sterile distilled water before use.
- Failure to adequately rinse an endoscope can cause a chemically induced colitis.
- Sterile transfer is difficult, because items are wet.
- Chemically sterilized items cannot be held in long term sterile storage.
- The solution can become diluted during use if an item is wet when placed in it.

3) Radiation

Following methods are used for sterlization of articles by radiation.

a) Ultraviolet radiation

It has a poor penetrating power and is adsorbed extensively by glass, plastics and turbid liquids. It is suitable only for sterilizing air and water in thin layer, and hard impermeable substances.

Advantages

Ultraviolet light sterilization is effective for disinfecting working surface and air inside rooms.

Disadvantages

- Light travels in straight lines. It penetrates only the surface of an object in direct line with the ultraviolet source. Any bacteria in shadows remain unaffected.
- All surfaces should be exposed to the rays.
- Ultraviolet rays do not penetrate the liquids.
- Prolonged exposure to the ultraviolet rays causes conjunctival damage. To prevent this, dark glasses should be worn.
- It is also injurious to the skin and tissues.
- It is expensive. The cheapest form of ultraviolet radiation is obtained free from the sun.

b) Gamma radiation

It is highly penetrative and does not leave residual radioactivity on object being sterilized. It produces negligible temperature rise in the irradiated object at normal dosage. It is used for sterilizing some thermolabile pharmaceuticals and surgical products.

4) Plasma Sterilization

It is an advanced sterilization product of new Sterad technology. A gas phase sterilant. Plasma is the fourth state of matter (others being solid, liquid and gaseous states), produced from hydrogen peroxide as a reactive cloud of ions, electrons and neutral atomic particles by a strong electric or magnetic field, a low temperature glow discharged is plasma. The sterilization cycle (1-4 hours) is short, no aeration is required. A Plasma sterilizer is shown in Fig.1.3.



Fig.1.3: Plasma sterilizer

Advantages

- Low Temperature Plasma Sterilizer doesn't cause erosion or toxin medical instruments.
- The whole disinfecting process lasts only 25-50 minutes with 100% sterilization.
- Provides low temperature and high efficiency sterilization for costly instruments (such as endoscopes, special multi-electrode diagnostic catheter, micro-catheters and medical instrument which are sensitive to heat and humidity).
- Catheter with 1mm internal diameter, can be easily sterilized, it is an effective method of sterilisation.

1.3.2 Disinfection

Disinfection as you have seen earlier is the destruction of pathogenic microorganisms but not usually bacterial spores. The process does not kill all microorganisms but reduces them to a level, which is not harmful to health. Some of the disinfecting agents you must have used in ICU include following.

a) Halogens

These are chlorine-based disinfectants that include Sodium hypochlorite/ Hypochlorate/ hypobromite.

Uses

- They are the disinfectants of choice for dealing with viral infections, e.g., Hepatitis B, C, and HIV.
- Help in environmental disinfection of blood / body fluid spillage.

b) Gluteraldehyde (Cidex 2%)

It is used to disinfect heat sensitive items i.e., endoscopes.

c) Formaldehyde (Formalin)

Formaldehyde is used mainly as a gaseous fumigant to disinfect safety cabinets and to fumigate rooms of patients with a highly dangerous and transmissible infectious disease who are kept in strict isolation.

> **Remember**
>
> **Though still practiced in many hospitals in India, "fumigation" is now an outdated practice and should not be used to sterilize rooms etc. Instead you must insist on thorough cleaning, washing and dusting.**

1.3.3 Disinfection Procedure

Let us review the procedure of disinfection /sterilization of various articles

All articles to be disinfected / sterilized must first be cleaned with detergent and water.

Airways and Endotracheal tubes

Use single use disposables or sterilize using autoclave or 2% Gluteraldehyde or EO.

Urinals

Empty and wash in detergent water then put in a big drum of water at 80^0 C for 10 minutes or chemical disinfection in 2% Carbolic or 2% Phenol for 15 minutes. Rinse well.

Blood spill

Cover with absorbent material. Pour 1% hypochlorite, 2% carbolic acid, leave for 10 minutes and remove with gloves.

Blood stained linen

Soak in fresh bleach solution (Bleaching powder 14g/l) for 30 min. Rinse and send to Laundry.

Cleaning of Mops

Use disposable mops if possible. Reusable mops are sent to laundry separately. Catheters are discarded after use, if these are to be reused then treat by ETO or Autoclave after washing.

Hand wash:

Use plenty of soap and running water if heavily contaminated. Use alcoholic hand rubs before touching the patients.

For any sterilization/disinfection refer to individual hospital policy.

Check Your Progress 1

i) Define the following:

a) Asepsis

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b) Disinfection

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c) Health Care Associated Infection

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d) Surveillance

ii) Differentiate between medical asepsis and surgical asepsis.

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iii) List the items you use in the CCU that require Ethylene Oxide

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iv) How will you clean blood stained linen?

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1.4 NORMAL DEFENSE MECHANISMS AND ALTERED BODY DEFENSE IN CRITICAL ILLNESS

In this section we shall discuss abut normal defenses and altered body defenses in critical illness.

1.4.1 Defenses Against Infection

The body has normal defenses, which protect the body against infection. Normal body flora that reside inside and outside of the body protects a person against pathogens. Intact skin protects the body from pathogens, and linings of the nasal passageways act to prevent organisms from entering the lungs. Each body organ system has defense mechanisms that work to prevent exposure to infection. The inflammatory response is a protective reaction that serves to neutralize pathogens and repair body cells. If any of the body's defenses fail, an infection occurs. This infection leads to a serious health problem in Critical Care Unit where the clients are prone to develop infection.

Normal Flora: The body normally contains microorganisms that reside on the surface and deep layers of skin, in the saliva, oral mucosa, gastrointestinal and genitourinary tracts. A person normally excretes trillions of microbes daily through the intestines. Normal flora does not usually cause disease when residing in their usual area of the body but instead participate in maintaining health.

- Normal flora of the large intestine exists in large numbers without causing illness. Normal flora also secretes antibacterial substances within the intestinal walls.
- The skin's normal flora exerts a protective, bactericidal action that kills organisms landing and invading the skin.
- The mouth and pharynx are also protected by normal flora which impairs growth of invading microbes.
- Normal flora maintains a sensitive balance with other microorganisms to prevent infection. Any factor that disrupts this balance places a person at increased risk for acquiring a disease. For example, the use of broad-spectrum antibiotics for the treatment of infection can lead to suprainfection. A suprainfection develops when broad-spectrum antibiotics eliminate a wide range of normal flora organisms, not just those causing infection. When normal bacterial flora are eliminated, the body's defenses are reduced, which allows for disease-producing microorganisms to multiply, causing illness.

Body System Defenses: A number of the body's organ systems have unique defenses against infection. The skin, respiratory tract, and gastrointestinal tract are easily accessible to microorganisms and pathogenic organisms can adhere to the skin's surface, can be inhaled into the lungs, or ingested with food. Each body's system has defense mechanisms physiologically suited to its specific structure and function. For example, the lungs cannot completely control the entrance of microorganisms. However, the airways are lined with moist mucous membranes and with hair like projections, or cilia that rhythmically beat to move mucus or cellular debris up to the pharynx to be expelled. Let us have a look on various body system defenses.

- **Intact skin and mucous membranes:** Body's first line of defense against microorganisms.
- **Nasal passage:** Have a defensive function owing to their moist membrane and small hair like projections called cilia, which trap microorganism, dust and foreign materials.
- **Lungs:** Have alveolar macrophages.
- **Oral Cavity:** Has saliva that helps in preventing infection due to its buffering action, lysozymes, lactoferrin, secretory leucocyte proteinase inhibitor.
- **Eye:** Is protected from infection by tears.
- **Gastrointestinal Tract:** The high acidity of stomach, resident flora of large intestine, enterobecteria, etc. contribute to prevention of infections.
- **Vagina:** P^H of vagina helps in prevention of certain infections.

The anatomical defenses are shown in Fig.1.4.

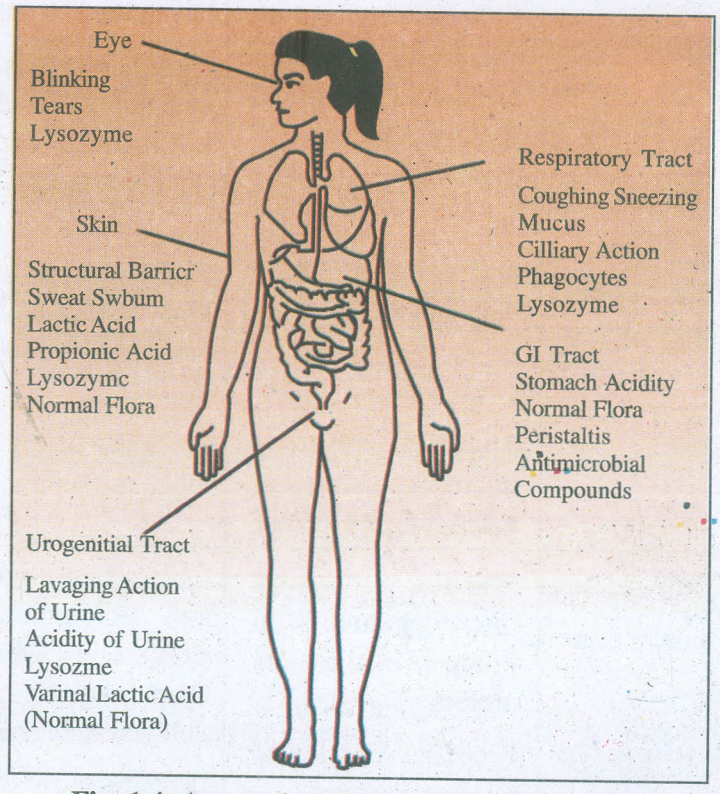


Fig. 1.4: Anatomical defense of the body tissue

1.4.2 Factors that alter defense mechanisms in Critically Ill Client

The normal defense mechanisms, their action and the factors that can alter these defense mechanisms in critically ill clients are given in following Table 1.2.

Table 1.2: Factors that alter defense mechanisms in critically ill client

Defense Mechanisms	Action	Factors that may alter defense mechanisms
Skin Intact multilayered surface (body's first line of defense against infection). Shedding of outer layer of skin cells.	Provides barrier to microorganisms and antibacterial activity. Removes organisms that adhere to skin's outer layers.	Cuts, abrasions, puncture wounds, areas of maceration. e.g., IV canulation, surgical drains, endotracheal tubes. Failure to bathe regularly, improper hand-washing technique.
Mouth Intact multilayered mucosa Saliva	Provides mechanical barrier to microorganisms Washes away particles containing microorganisms Contains microbial inhibitors (e.g., lysozyme).	Lacerations, trauma, extracted teeth Poor oral hygiene, dehydration **Oxygen** inhalation causes dry oral mucosa Endotracheal intubation Patients on nil by mouth
Eye Tearing and blinking	Provides mechanisms to reduce entry (blinking) or to assist in washing away (tearing) particles containing pathogens, thus reducing dose of organisms.	Unconscious patients and patients on ventilator getting paralyzing agents have absent corneal reflex. Injury, exposure-splash/ splatter of blood or other potentially infectious material into the eye.
Respiratory Tract Cilia lining upper airway, coated by mucus. Macrophages	Trap inhaled microbes and sweep them outward in mucus to be expectorated or swallowed. Engulf and destroy microorganisms that reach lung's alveoli.	Smoking, high concentration of oxygen and carbon dioxide, decreased humidity, cold air Presence of endotracheal tube, suctioning.
Urinary Tract Flushing action of urine flow. Intact multilayered epithelium.	Washes away microorganisms on lining of bladder and urethra. Provides barrier to microorganisms.	Obstruction to normal flow by urinary catheter placement, obstruction from growth or tumor, delayed micturition Introduction of urinary catheter, continual movement of catheter in urethra.

Gastrointestinal Tract Acidity or gastric secretions.	Administration of antacids.	Administration of antacids.
Rapid peristalsis in small intestine.	Prevents retention of bacterial contents.	Prevents retention of bacterial contents.
Vagina At puberty, normal flora causing vaginal secretions to achieve low pH.	Inhibit growth of many microorganisms.	Antibiotics and oral contraceptives disrupting normal flora, e.g., poor perineal care.

1.5 CHAIN OF INFECTION

The presence of a pathogen does not mean that an infection will occur. Infection occurs in a cycle that depends on the presence of all the following elements in a chain as shown in Fig. 1.5.

Source for pathogen growth

- An infectious agent or pathogen
- A reservoir
- A portal of exit from the reservoir
- A mode of transmission
- A portal of entry to a host
- A susceptible host

Infection can develop if this chain remains uninterrupted. It is imperative for you to follow infection prevention and control practices to break the chain so that infection will not develop, more so as a critical nurse.

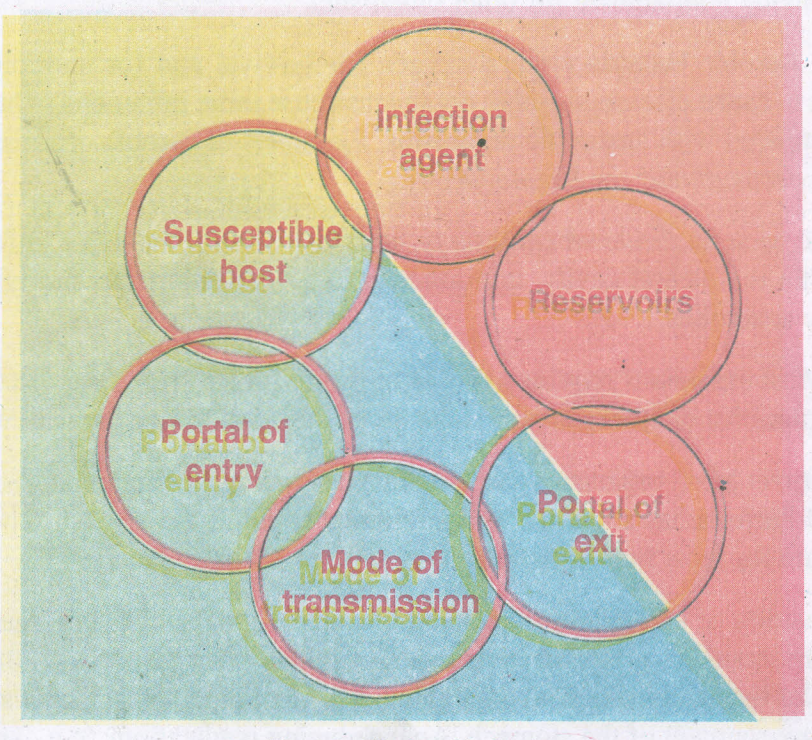


Fig.1.5: Chain of infection

1.5.1 Infectious Agent

Microorganisms include bacteria, viruses, fungi, and protozoa. Microorganisms on the skin are either resident or transient flora. Resident organisms (normal flora) are permanent residents of the skin, where they survive and multiply without causing illness. In fact, they serve as a major part of the body's protection. Resident flora on the skin covers the entire exterior of the body and protects against pathogens. It is important to retain and maintain resident flora.

Transient microorganisms get attached to the skin when a person has contact with another person or object during normal activities. For example, when you touch a used kidney tray, a contaminated dressing, transient bacteria adhere to the nurse's skin. The organisms attach loosely to the skin or under fingernails. These organisms may be readily transmitted unless they are removed by using hand hygiene. If hands are visibly soiled with proteinaceous material, soap and water is the preferred practice. If hands are not visibly soiled, use of an alcohol-based hand product or hand washing with soap and water is acceptable for disinfecting hands of health care workers.

1.5.2 Reservoir

A reservoir is a place where a pathogen can survive but may or may not multiply. For example, hepatitis A virus survives in shelfish but does not multiply. *Pseudomonas* organisms may survive and multiply in nebulizer reservoirs used in the care of clients with respiratory problems. The most common reservoir is the human body. A variety of microorganisms live on the skin and within the body cavities, fluids, and discharges. The presence of microorganisms does not always cause a person to become ill. Carriers are persons who show no symptoms of illness but who have pathogens in their bodies that can be transferred to others. To thrive, organisms require a proper environment, including appropriate food, oxygen, water, temperature, P^H, and light as explained below:

Food: Microorganisms require nourishment. *Escherichia coli,* consume undigested foodstuff in the bowel. Carbon dioxide and inorganic material such as soil provide nourishment for other organisms.

Oxygen: Aerobic bacteria require oxygen for survival and for multiplication sufficient to cause disease. Aerobic organisms cause more infections in humans, when compared with anaerobic organisms. Examples of aerobic organisms are *Staphylococcus aureus* or *Streptococcus.*

Anaerobic bacteria thrive where little or no free oxygen is available. Infections deep within the pleural cavity, in a joint, or in a deep sinus tract are typically caused by anaerobes.

Water: Most organisms require water or moisture for survival. For example, a frequent place for microorganisms is the moist drainage from a surgical wound.

Temperature: Microorganisms can live only in certain temperature ranges. Each species of bacteria has a specific temperature at which it grows best. The ideal temperature for most human pathogens is 20°C to 43° (68°C to 109° F).

P^H: The acidity of an environment determines the viability of microorganisms. Most microorganisms prefer an environment within a P^H range of 5 to 7. Bacteria in particular thrive in urine with an alkaline P^H. Most organisms cannot survive the acid environment of the stomach. Acid-reducing medications (e.g., antacids

and H_2 blockers) may cause an overgrowth of gastrointestinal organisms, which can contribute to health care-associated pneumonia in a client receiving these medications.

Light: Microorganisms thrive in dark environments such as those under dressing and within body cavities. This is also the reason you must insist on a well and brightly lit ICU.

In critical care units, common reservoirs are air conditioning ducts, cracks and crevices on floors and walls, torn bed mattresses and all equipment used in the care of patients.

1.5.3 Portal of Exit

Microorganisms find a site to grow and multiply, they must find a portal of exit if they are to enter another host and cause disease. Portals of exit include sites such as blood, skin, mucous membranes, respiratory tract, genitourinary tract, gastrointestinal tract, and Transplacental (mother to fetus).

Skin and Mucous Membranes: The skin may be considered a portal of exit because any break in the integrity of the skin and mucous membranes may allow pathogens to exit the body. This may be exhibited by the creation of purulent drainage. For example, Staphylococcus. *aureus* causes a characteristic yellow, creamy drainage, and infection with *Pseudomonas aeruginosa* causes a greenish, creamy drainage. The presence of purulent drainage is a potential portal of exit.

Respiratory Tract: Pathogens that infect the respiratory tract, such as *Mycobacterium tuberculosis* or influenza virus, can be released from the body when an infected person sneezes or coughs. The act of coughing or sneezing allows for organisms to exit the respiratory tract. In clients with artificial airways such as tracheostomy or endotracheal tubes, organisms easily exit the respiratory tract through these devices when the device is manipulated or suctioned.

Urinary Tract: Normally urine is sterile. However, when a client has a urinary tract infection (UTI), microorganisms exit during urination or through urinary diversions such as urostomies and suprapubic drains.

Gastrointestinal Tract: The mouth is one of the most bacterially contaminated sites of the human body, but most of the organisms are normal flora. Organisms that are normal flora in one person can be pathogens in another. Organisms can exit when a person spits out saliva. Kissing can also provide means of exit. Organisms also exit through bowel elimination, drainage of bile via surgical wounds, or drainage tubes.

Reproductive Tract: Organisms such as *Neisseria gonorrhoea* and HIV may exit through a man's urethral meatus or a woman's vaginal canal during sexual contact. HIV is present in much higher numbers in semen than in female vaginal secretions.

Blood: The blood is normally a sterile body fluid, but in the case of viral infections like Hepatitis B or C or HIV it becomes a reservoir for pathogens. Caregivers may become exposed during activities such as collecting blood samples, starting an intravenous (IV) line, or giving an injection unless standard precautions are taken and needle-safe devices are used. A blood-borne pathogen exposure involves being stuck with a sharp that is contaminated with infected blood.

1.5.4 Modes of Transmission

Each disease has a specific mode of transmission. For example, some types of encephalitis are transmitted by infected mosquitoes. The mosquito serves as a vector, transmitting the virus when it bites the host. Some microorganisms may be transmitted by more than one route.

The major route of transmission for pathogens identified in the health care setting is the unwashed hands of the health care workers. Equipment used within the environment (e.g., a stethoscope, blood pressure cuff, bedside commode, etc.) can become a source for the transmission of pathogens. All hospital personnel providing direct care (e.g., nurses, physical therapists, and physicians) and persons performing diagnostic and support services (e.g., laboratory technicians, respiratory therapists, and dietary workers) must follow infection prevention and control practices to minimize the spread of infection. For example, starting a line of IV infusion introduces bacteria if the skin is not properly cleansed (See Fig.1.6).

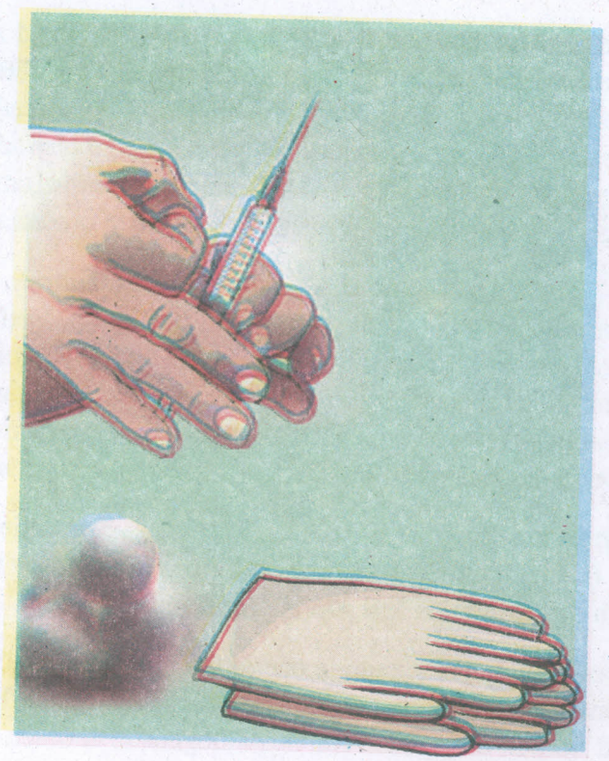


Fig. 1.6: Modes of Transmission

Common modes of transmission of microorganism from reservoir to the susceptible host are given below:

Contact

- **Direct Contact:** Direct physical transfer between an infected person and a susceptible host (e.g., turning clients in bed, giving bath, sexual contact with an infected person).
- **Indirect Contact:** Personal contact of a susceptible host with a contaminated inanimate object (e.g., needles, bed pan, instruments, dressings, linen etc.)
- **Droplet Contact:** Infectious agent like small particles of saliva and mucus secretions coming in contact with conjunctiva, nose or mouth of a susceptible host (droplets travel up to 3 feet and therefore contact is not air borne) e.g., coughing, sneezing.

Air

- **Droplet Nuclei** or residue of evaporated droplets remaining suspended in air (e.g., coughing, sneezing, talking).
- **Dust** contains an infectious agent.

Vehicles

- Contaminated items, liquids, water, drugs, blood, food and improperly handled or stored fruit and vegetables.

Vectors

- Insects: mosquitoes, flies, ticks, lice, animals (cows, pigs, rats etc).

1.5.5 Portal of Entry

Organisms enter the body through the same routes which they use for exiting. For example, when a needle pierces client's skin, organisms enter the body if a proper skin preparation is not performed. Any obstruction to the flow of urine from a urinary catheter allows organisms to migrate up the urethra. Factors that reduce the body's defenses enhance the chances of pathogens entering the body. A diagrammatic representation of mammalian portals of entry and exit of microorganism are given in Fig.1.7.

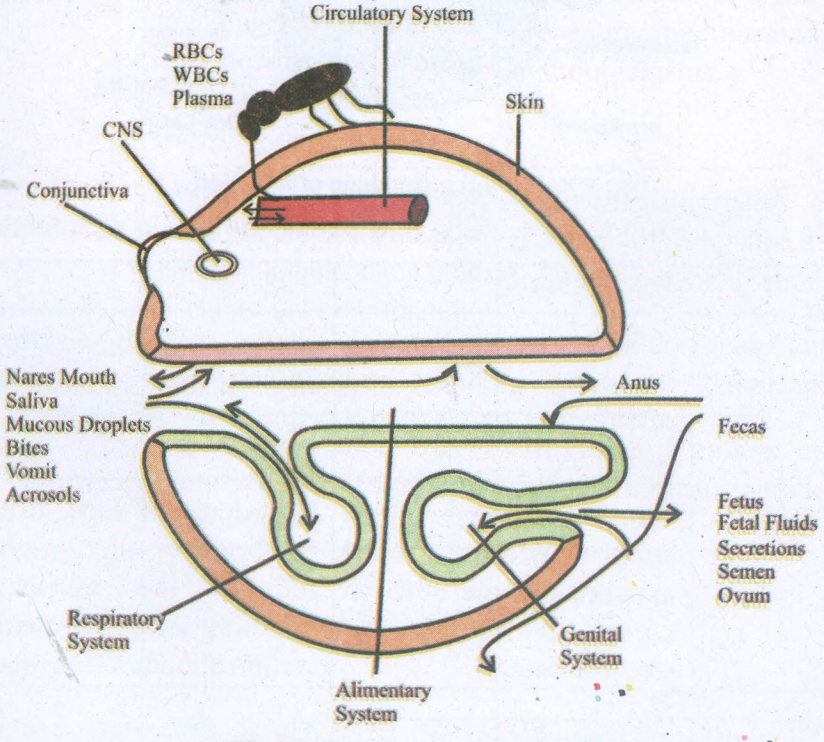


Fig.1.7: Portals of entry and exit

1.5.6 Susceptible Host

Whether a person acquires an infection depends on susceptibility to an infectious agent. Susceptibility depends on the individual degree of resistance to a pathogen (immune response). Although everyone is constantly in contact with large numbers of microorganisms, an infection does not develop until an individual becomes susceptible to the strength and numbers of microorganisms (dose) capable of producing infection. The more virulent an organism and the greater the dose, the more likely a person will develop an infection. Some of the factors that influence a person's susceptibility (resistance) include age, nutritional status, presence of chronic disease, trauma, and smoking.

1.5.7 Breaking the Chain of Infection

The process of transmission of infectious agents and the development of infection can be broken at any link in the chain of infection (Fig.1.8). To interrupt the process, nurses must understand interventions that can be applied to each link. The appropriate nursing interventions and their rationale are given in Table 1.3.

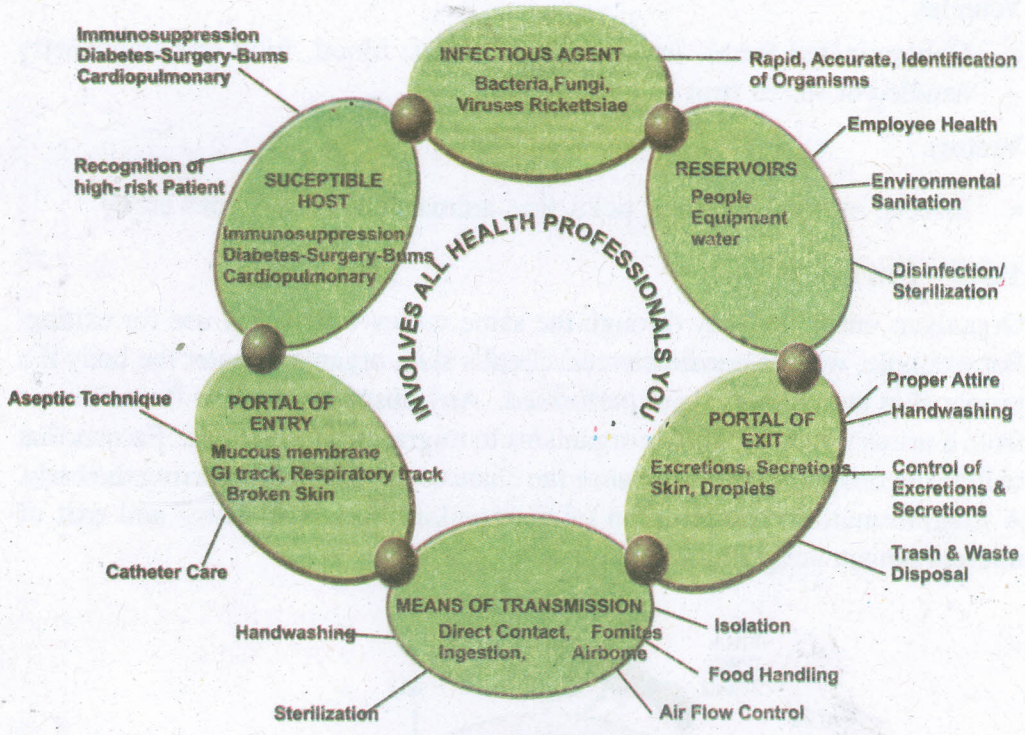


Fig. 1. 8: Breaking the chain of infection

Table 1.3: Nursing Interventions that Break the Chain of Infection

Link	Interventions	Rationales
Etiologic Agent (microorganisms)	Ensure that articles are correctly cleaned and disinfected or sterilized before use.	Correct cleaning, disinfecting, and sterilizing reduces or eliminate microorganisms.
	Educate clients and support persons about appropriate methods to clean, disinfect, and sterilize articles.	Knowledge of ways to reduce or eliminate microorganisms reduces the number of microorganisms present and the likelihood of transmission.
Reservoir (source)	Change dressings and bandages when they are soiled or wet.	Moist dressings are ideal environments for microorganisms to grow and multiply.
	Assist clients to carry out appropriate skin and oral hygiene.	Hygienic measures reduce the number of resident and transient microorganisms and the likelihood of infection.
	Dispose of damp, soiled linen appropriately.	Damp, soiled linen harbour more microorganisms than dry linen.
	Dispose of faeces and urine in appropriate receptacles.	Urine and faeces in particular contain many microorganisms.

Link	Interventions	Rationales
	Ensure that all fluid containers, such as bedside water jugs and suction and drainage bottles are covered or capped.	Prolonged exposure increases the risk of contamination and promotes microbial growth.
	Empty suction and drainage bottles at the end of each shift or before they become full, or according to hospital policy.	Drainage harbours micro-organism, if left for long periods, proliferate and can be transmitted to others.
Portal of exit from the reservoir	Avoid talking, coughing, or sneezing over open wounds or sterile fields, and cover the mouth and nose when coughing and sneezing use of masks.	These measures limit the number of microorganisms that escape from the respiratory tract.
Method of transmission	Cleanse hands between client contacts, after touching body substances, and before performing invasive procedures or touching open wounds.	Hand cleansing is an important means of controlling and preventing the transmission of microorganisms.
	Instruct clients and support persons to cleanse hands before handling food or eating, after eliminating, and after touching infectious material.	Hand cleansing helps prevent transfer of microorganisms from one person to another.
	Wear gloves when handling secretions and excretions.	Gloves and gowns prevent soiling of the hands and clothing.
	Wear gowns if there is danger of soiling clothing with body substances/ fluids.	
	Place discarded soiled materials in moisture-proof refuse bags.	Moisture proof bags prevent the spread of microorganisms to others.
	Wear masks and eye protectors when in close contact with clients who have infections transmitted by droplets from the respiratory tract or when sprays of body fluids are possible (e.g., during irrigation procedures).	Masks and eyewear reduces the spread of droplet-transmitted microorganisms.

Link	Interventions	Rationales
Portal of entry to the susceptible host	Initiate and implement aseptic precautions for all clients. Use sterile technique for invasive procedures (e.g., injections, catheterizations).	Invasive procedures penetrate the body's natural protective barriers to microorganisms.
	Use sterile technique when exposing open wounds or handling dressings.	Open wounds are vulnerable to microbial infection.
	Place used disposable needles and syringes in puncture – resistant containers for disposal.	Injuries from needles contaminated by blood or body fluids from an infected client or carrier are a primary cause of HBV and HIV transmission to health care workers.
	Provide all clients with their own personal care items.	People have less resistance to another person's microorganisms than to their own.
Susceptible host	Maintain the integrity of the client's skin and mucous membranes.	Intact skin and mucous membranes protect against invasion by microorganisms.
	Ensure that the client receives a balanced diet.	A balanced diet supplies proteins and vitamins necessary to build or maintain body tissues.
	Educate the public about the importance of immunizations.	Immunizations protect people against infectious diseases.

Check Your Progress 2

i) Discuss the factors that alter defense mechanism in critically ill patient.

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ii) Describe chain of infection.

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1.6 STAGES OF INFECTION PROCESS

An understanding of the stages in the development of an infection is necessary to intervene and disrupt the infection cycle. An infection progresses through the following phases:

- Incubation period
- Prodromal stage
- Full stage of illness
- Convalescent period.

The course and severity of the infection, as well as the clients response, influence the type and extent of nursing care provided.

Incubation Period

The incubation period is the interval between the invasion of the body by pathogen and the appearance of symptoms of infection. During this stage, the organisms are growing and multiplying. The length of incubation may vary. For example, the common cold has an incubation period of 1 to 2 days, whereas tetanus has an incubation period ranging from 2 to 21 days.

Prodromal Stage

A person is most infectious during the prodromal stage. Early signs and symptoms of disease are present, but these are often vague and nonspecific, ranging from fatigue and malaise to a low-grade fever. This period lasts from several hours to several days. During this phase, the clients often does not realize that he or she is contagious. As a result, the infection spreads.

Full stage of Illness

The presence of specific signs and symptoms indicates the full stage of illness. The type of infection determines the length of the illness and the severity of the manifestations. Symptoms that are limited or occur in only one body area are referred to as localized symptoms, whereas symptoms manifested throughout the entire body are referred to as systemic symptoms.

Convalescent Period

The convalescent period is the recovery period from the infection. Convalescence may vary according to the severity of the infection and the patient's general condition. The signs and symptoms disappear, and the person returns to a healthy state. However, depending on the type of infection, the person may have a temporary or permanent change to his or her previous health state even after the convalescent period.

A person may continually pass through the four phases with the same infectious process, such as with Herpes simplex. Although there may have been only one infectious exposure, the infection may continue to cycle through these phases.

1.7 HEALTH CARE ASSOCIATED INFECTIONS (HAIs)

Clients in hospital and health care setting can easily acquire infection because they are in high-risk groups. Such infections are transmitted by health care delivery systems.

Common risk factors leading to HAI are as follows:

- Impaired host defense.
- Severity of illness
- Length of stay
- Invasive devices
- Colonization and cross infection.

1.7.1 Modes of Health Care Associated Infections

Iatrogenic infections:

It is a type of health care associated infections that result from a diagnostic or therapeutic procedure, e.g., urinary tract infection may result due to catheterization.

Exogenous infections:

This arises from microorganisms external to the individual, which do not exist as normal flora. For example, Clostridium tetani.

Endogenous infection:

This can occur when part of the client's flora becomes altered and an overgrowth results; e.g., infections due to enterococci, yeast, streptococci, etc.

Antibiotic Resistant:

Infections in CCU – like multidrug resistant organisms, Methicillin Resistant Staphylococcus Aureus (MRSA), due to the use of broad spectrum antibiotics.

1.7.2 Sites and Causes of Health Care Associate Infections in CCUs

The various sites and causes of HAIs are highlighted in Table 1.4.

Table 1.4: Sites and causes of HAIs

Sites	Causes
Urinary Tract	• Insertion of urinary catheter. • Catheter and tube becoming disconnected. • Poor specimen collection technique. • Obstruction with urinary drainage. • Closed drainage system becoming open. • Poor hand washing technique. • Poor nursing care of perineal area and catheter site.

Sites	Causes
Surgical or Traumatic wounds	• Poor Skin preparation/handling. • Poor hand washing before and after dressing. • Use of contaminated antiseptic solutions.
Respiratory Tract	• Use of contaminated equipment. • Improper disposal of mucous secretions. • Prolonged artificial ventilation.
Blood Stream	• Contamination of IV fluids by tubing or needle changes. • Improper insertion of drugs in I/V fluids. • Improper care of needle insertion site, three way stop cocks. • Contaminated needles or catheters. • Poor technique during administration of blood products.

1.7.3 Common Types of Hospital Acquired Infections

Let us discuss the common types of hospital acquired infections as below:

Urinary Tract Infections (UTI).

This is the most common Health Care Associated infection in critical care units.Eighty per cent (80%) of infections are associated with the use of indwelling urinary catheter. Urinary infections are associated with less morbidity than other nosocomial infections, but can occasionally lead to bacteremia and death. The bacteria get entry into the bladder from the gut flora, either normal (*Escherichia coli*) or acquired in hospital (multiresistant *Klebsiella*).

Prevention of urinary tract infections

- Maintaining hand hygiene.
- Urinary catheters should be used as last resort.
- Strict aseptic technique when inserting the catheter to prevent transmission of bacteria into the bladder.
- Catheter should be taken out as soon as medically feasible because the longer the catheter is in place, the greater the risk of developing an infection.
- Selection of small size catheter to minimize the trauma to the urethra.
- Anchor the catheter to prevent it from moving in and out of the urethra to prevent transmission of bacteria from catheter-meatal junction into the bladder.
- Urine specimens should be collected from the rubber portal on the drainage.
- Keep the collection bag below the bladder level at all times to prevent reflux of urine into the bladder, but it should not touch the floor.
- Bladder irrigation should not be a routine practice.

- If frequent irrigations are necessary, then three way catheter drainage system with continuous bladder irrigation is recommended.
- Use of sterile closed drainage system to prevent entry of organisms from distal end.
- Daily practice of perineal and catheter care once per shift or every 8 hours should be followed.

Surgical Site Infections (SSI)

Surgical site infections also occur frequently. The incidence varies from 0.5% to 15% depending on the type of operation and underlying client status.

The infection is usually acquired during the operation itself; either exogenous (e.g., from the air, medical equipment, surgeons and other staff), or endogenously from the flora on the skin, the operation site or rarely from blood used in surgery.

Many wound infections manifest within a week of surgery. *Streptococcus. Pyogenes* and *clostridial* infections appear within a day or two, while *staphylococcal* infections typically take four to five days and Gram negative bacilli infections take six to seven days to appear.

Prevention of surgical site infections

- Maintaining hand hygiene.
- Reducing the period of preoperative hospital stay.
- Pre-operative bathing with antiseptics.
- Hair removal (preferably by depilatory or clipping) in the period immediately before the surgery. Skin shaving is no longer recommended.
- Traffic control in CCU.
- Maintenance of asepsis during emptying of wound drainage.
- Implementation of a hospital antibiotic policy developed by the Infection Control Committee. This results in avoiding indiscriminate use of antibiotics.

Respiratory tract infections

Nosocomial pneumonia occurs in patients with several conditions (different patient groups). Respiratory intubation is a major risk factor because endotracheal, nasotracheal and tracheostomy tubes bypass the patient's defense mechanisms of upper respiratory tract. It is associated with the highest mortality rate of all nosocomial infections. The most important are clients on ventilator in CCU, where the rate of pneumonia is 3% per day.

Microorganisms colonize the stomach, upper airway and bronchus and cause infection in the lungs. They are often endogenous (digestive system, nose and throat), but may be exogenous, often from contaminated respiratory equipment.

Prevention of nosocomial pneumonia

- Hand washing is mandatory before and after contact with clients and respiratory devices because these devices contain moisture, which makes them ideal reservoirs for gram-negative organisms such as *pseudomonas* and *serratia* species.
- Sterile gloves should be worn for handling all respiratory secretions and devices.

- Endotracheal / tracheostomy Suctioning should be done under strict sterile conditions.
- Preoperative teaching of deep breathing exercise and post operative chest physiotherapy should be done to maintain pulmonary hygiene.
- Ventilator tubings and breathing circuits should be changed routinely.
- Large volume air humidifiers should not be used.

Nosocomial bacteriemia

These infections represent a small proportion of nosocomial infections (approximately 5%) but mortality rates are high. The infection may occur at the skin entry site of the intravascular devices, or in the subcutaneous path of the catheter (tunnel infection). Organisms colonizing the catheter within the vessel may produce bacteriemia without visible external infection. The resident or transient cutaneous flora is the source of infection. The main factors are the length of central / peripheral venous /arterial catheterization, level of asepsis at insertion, and maintenance of these vascular devices.

Prevention of nosocomial bacteriemia

Prevention is mainly the nurses role. You must ensure the following practice in the CCUs:

- Intravenous and intra-arterial catheters should be inserted under strict sterile conditions.
- Aseptic precautions should be taken during catherer, insertion.
- A sterile dressing should cover the insertion site.
- The catheter should be secured to prevent in and out movement and tracking of bacteria into the cannula site.
- Aseptic technique should be followed when mixing and adding drugs, changing the infusion or manipulating connections or stopcocks.
- It is recommended that central venous tubing be changed every 72 hours.
- You should check the IV fluids for turbidity and particulate matter and for leaks in the system.
- Intravenous/flush solutions should be discarded after 24 hours of opening the bottle.
- The insertion site should be inspected every shift for any signs of infection such as redness, swelling, exudates, purulence, or warmth or any complaint of pain by client at the insertion site.
- Peripheral catheters should be changed every 72 hours or more often if there is a complication such as infiltration or phlebitis.

1.8 ROLE OF NURSE IN MAINTAINING BIOLOGICALLY SAFE ENVIRONMENT

Hand hygiene is considered the single most important procedure in breaking the chain of infection. The ideal hand washing technique is shown in Fig. 1. 9. In the absence of a true emergency, personnel should always wash their hands at the following times:

- Before performing invasive procedures.
- Before taking care of particularly susceptible clients such as those who are severely immunocompromised and newborns.
- Before and *after* touching wounds, whether surgical, traumatic, or if associated with an invasive device.
- After situations during which microbial contamination of hands is likely to occur, especially those involving contact with mucous membranes, blood or body fluids, secretions, or excretions.
- After touching inanimate sources that are likely to be contaminated with virulent or epidemiologically important microorganisms; these sources include urine measuring devices or secretion-collecting apparatus.
- After taking care of an infected clients or one who is likely to be colonized with microorganisms of special clinical or epidemiologic significance, for example, Methicillin Resistant Staphylococcus aureus (MRSA).
- Use alcoholic hand rubs between contacts with clients in Critical Care Units.

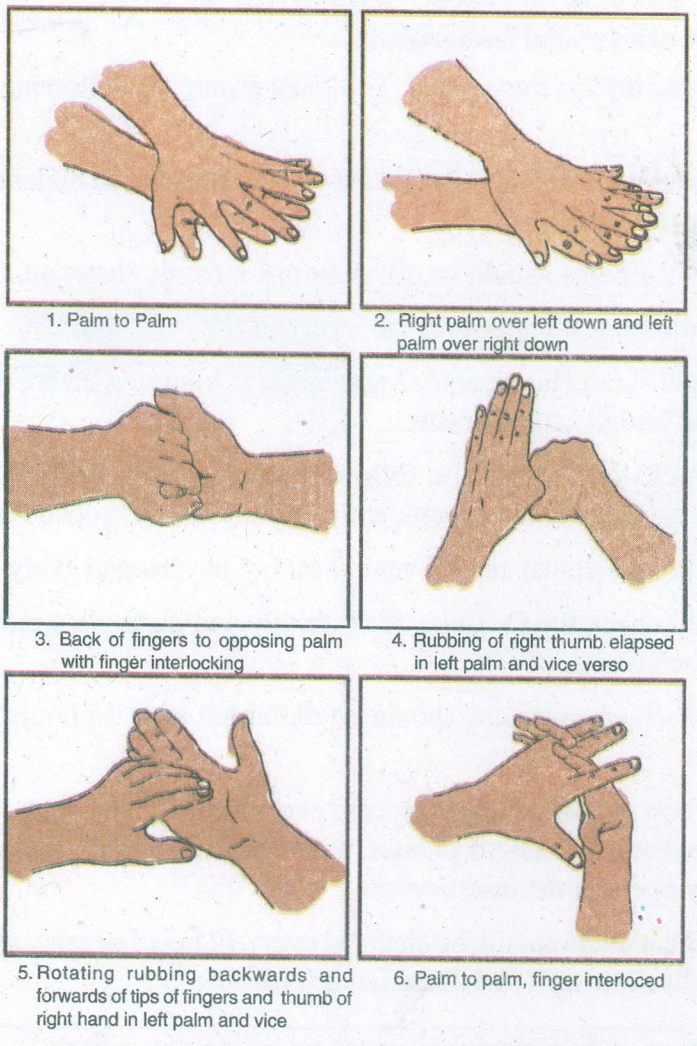


Fig.1.9: Hand washing technique

Nurses giving indirect client care should take precautions as follows:

- Ensure strict work discipline e.g., Hand hygiene.
- Nondisposable sharp instruments should be carried in a puncture-resistant container to the area where they can be cleaned; they should not be carried in one's hand.

- Reusable articles and equipment should be scrubbed of all debris and blood, before disinfection; rinsing with water is not sufficient.
- Persons who are doing the cleaning should wear gloves. Boxes of disposable gloves and plastic bags should be kept in nonsterile utility room and in clients bathrooms to encourage the use of the gloves and bags during handling of contaminated items.
- Work areas, counter tops, emergency stretchers, specimen analysis kits, and monitoring equipment that have been contaminated with blood or body fluids should be wiped with absorbent towels to remove excess materials and then wiped with isopropyl alcohol, a 1:10 dilution of sodium hypochlorite (household bleach), or other suitable germicide approved by the Environmental Protection Agency.

Be cautious with sodium hypochlorite because it is corrosive to metals, especially Aluminum.

- Disposal of wastes should be carried out properly.
- Blood, body fluid drainage, or other contaminated liquids should be carefully poured into a drain and flushed into the sewage system.
- Solid contaminated items should be placed in sturdy plastic bags, labeled, and disposed off according to hospital policy for contaminated items.

Check Your Progress 3

i) List the common sites and causes of nosocomial infection in critical care unit.

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ii) Describe the nurses role in prevention of Nosocomial infection.

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1.9 LET US SUM UP

In this unit we have reviewed principles of asepsis and methods of sterilization and disinfection. We focused on body's defense mechanism, chain of infection responsible for causing infection and how to break that chain. We have also emphasized and described the importance of hand hygiene which is the most effective way of preventing all types of infections, the stages of infectious process, types and causes of HAIs. We have explained the role of nurse in maintaining biologically safe environment to enable you to prevent HAIs in your clients.

1.10 GLOSSARY

Asepsis : It is a state of being free from pathogenic organisms or infection. Surgical asepsis means a sterile technique where different precautions are taken. It requires absence of all microorganism, including spores and pathogens. It is also a combination of efforts made to prevent the entry of microorganisms into any body area where they are likely to cause infection.

Antisepsis : It is the prevention of sepsis / infection. It inhibits the growth and development of micro-organisms on skin and other body tissues by using a chemical agent (antiseptic).

Antiseptics : These are types of nontoxic disinfectants that may be applied to the skin and other living tissues. An antiseptic should not be used to disinfect instrument or the environment.

Bioload : The number of organisms suspended in air. Bioload in a room is dependent upon the number of people in a room and their movements. To lower the bioload in critical care areas like ICUs, the visitors' entry to such high risk areas should be strictly restricted.

Chemical sterilants : These are a small group of chemical compounds, which under controlled conditions can kill all living organisms including spores, e.g., Glutaraldehyde, Ethylene oxide.

Cleaning : This is physical removal of organic material or soil from an object. It is usually achieved by applying water with or without a detergent.

Community acquired infection : Infection acquired by clients before admission to the hospital. Such infection usually presents within the first 48 hours of hospital admission.

Cross Infection : Infection acquired in hospital from other people either clients or staff is known as cross infection.

Disinfection : A procedure that achieves killing of vegetative organisms and reduction of microbial load to safe levels, spores will not usually be destroyed.

Disinfectant : A chemical agent used for disinfection.

Endogenous infection : Infection caused by microorganisms, which the patient carries normally or in septic areas of the body.

Epidemic infection	:	Outbreak of infection due to a microorganism not normally present in the hospital.
Exogenous infection	:	Infection caused by microorganisms from outside the clients body. The source of such infection could be other clients, staff, medical equipment or the environment.
Hospital acquired (Nosocomial) infection	:	Infection acquired by hospital staff or by clients while they are in the hospital. Such infection usually presents after 48 hours of hospital admission. It is also known as health care associated infection (HAI).
Infection	:	Deposition and multiplication of microorganisms in tissues, where they can cause adverse effects.
Inflammation	:	Active reaction of the body tissues against any infection, injury or irritation.
Sepsis	:	Presence of inflammation and other signs of illness in a wound colonized by microorganisms and in tissue to which such infection has spread.
Standard Precautions (earlier term - Universal Precautions)	:	Refers to practices in health care to avoid spread of infection by following different protocols e.g., wearing gloves, gowns, mask, goggles etc. whenever there is a likelihood of contact with blood or body fluids.
Sterilization	:	A procedure that achieves complete killing or removal of all types of microorganisms, including resistant spores.
Surveillance	:	Surveillance is defined as the ongoing systematic collection, analysis and interpretation of health data.

1.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

i) a) **Asepsis:** It is a state of being free from pathogenic organisms or infection. Surgical asepsis means a sterile technique where different precautions are taken. It requires absence of all micro-organism, including spores and pathogens. It is also a combination of efforts made to prevent the entry of micro-organisms into any body area where they are likely to cause infection.

b) **Disinfection:** A procedure that achieves killing of vegetative organisms and reduction of microbial load to safe levels, spores will not usually be destroyed.

c) **Health Care Associated Infection** (HAI).

Infection acquired by hospital staff or by clients while they are in the hospital. Such infection occur AFTER 48 hours of hospital admission.

d) **Surveillance:** Surveillance is defined as the ongoing systematic collection, analysis and interpretation of health data.

ii) **Difference between medical and surgical asepsis**

Medical Asepsis	Surgical Asepsis
The number, growth and transmission of microorganisms are limited / controlled.	Objects / articles are free from pathogenic and non-pathogenic organisms.
Transmission of pathogenic organism is prevented.	Pathogenic and non-pathogenic organism are totally destroyed.
A clean technique is used e.g., hair combing mouthwash etc.	A sterile technique is used, for giving injection and doing surgical dressing.

iii) E.T tubes, CVP cannula, Ambu bags.

iv) Soak in fresh bleach solution for 30 minutes. Rinse. Send to laundry.

Check Your Progress 2

Factors that alter defense mechanisms in critically ill patient include following

Defense Mechanisms	Action	Factors that may alter Defense Mechanisms
Skin Intact multilayered surface (body's first line of defense against infection). Shedding of outer layer of skin cells.	Provides barrier to microorganisms and antibacterial activity. Removes organisms that adhere to skin's outer layers.	Cuts, abrasions, puncture wounds, areas of maceration. e.g., IV canulation, surgical Drains, endotracheal tubes. Failure to bathe regularly, improper hand-washing technique.
Mouth Intact multilayered mucosa Saliva	Provides mechanical barrier to microorganisms Washes away particles containing microorganisms Contains microbial inhibitors (e.g., lysozyme).	Lacerations, trauma, extracted teeth Poor oral hygiene, dehydration **Oxygen** inhalation causes dry oral mucosa Endotracheal intubation Clients on nil by mouth
Eye Tearing and blinking	Provides mechanisms to reduce entry (blinking) or to assist in washing away	Unconscious clients and clients on ventilator getting paralyzing agents have absent corneal reflex.

Defense Mechanisms	Action	Factors that may alter Defense Mechanisms
	(tearing) particles containing pathogens, thus reducing dose of organisms.	Injury, exposure-splash/ splatter of blood or other potentially infectious material into the eye.
Respiratory Tract Cilia lining upper airway, coated by mucus. Macrophages	Trap inhaled microbes and sweep them outward in mucus to be expectorated or swallowed. Engulf and destroy microorganisms that reach lung's alveoli.	Smoking, high concentration of oxygen and carbon dioxide, decreased humidity, cold air Presence of endotracheal tube, suctioning.
Urinary Tract Flushing action of urine flow Intact multilayered epithelium.	Washes away microorganisms on lining of bladder and urethra Provides barrier to microorganisms.	Obstruction to normal flow by urinary catheter placement, obstruction from growth or tumor, delayed micturition Introduction of urinary catheter, continual movement of catheter in urethra.
Gastrointestinal Tract Acidity or gastric secretions Rapid peristalsis in small intestine.	Administration of antacids Prevents retention of bacterial contents.	Administration of antacids Prevents retention of bacterial contents.
Vagina At puberty, normal flora causing vaginal secretions to achieve low pH.	Inhibit growth of many microorganisms.	Antibiotics and oral contraceptives disrupting normal flora, e.g., poor perineal care.

4) Describe chain of infection.

ii) Chain of infection

An infectious agent or pathogen

A reservoir or source for pathogen growth

A portal of exit from the reservoir

A mode of transmission

A portal of entry to a host

A susceptible host

(Ref. Fig. 1.5) for details.

Check Your Progress 3

i) Common sites and causes of nosocomial infection in CCU.

Sites and causes of HAIs/Nosocomial infection

Sites	Causes
Urinary Tract	• Insertion of urinary catheter. • Catheter and tube becoming disconnected. • Poor specimen collection technique. • Obstruction with urinary drainage. • Closed drainage system becoming open. • Poor hand washing technique. • Poor nursing care of perineal area and catheter site.
Surgical or Traumatic wounds	• Poor Skin preparation/handling. • Poor hand washing before and after dressing. • Use of contaminated antiseptic solutions.
Respiratory Tract	• Use of contaminated equipment. • Improper disposal of mucous secretions. • Prolonged artificial ventilation.
Blood Stream	• Contamination of I/V fluids by tubing or needle changes. • Improper insertion of drugs to I/V fluids. • Improper care of needle insertion site, three way stop cocks. • Contaminated needles or catheters. • Poor technique during administration of bloodproducts.

ii) Nurses role in prevention of Nosocomial infection:

- Follow principles of Hand hygiene
- Nondisposable sharp instruments should be carried in a puncture-resistant container to the area where they can be cleaned; they should not be carried in one's hand.
- Reusable equipment should be scrubbed of all debris and blood, then disinfected; rinsing with water is not sufficient.
- Persons who are doing the cleaning should wear gloves.
- Boxes of disposable gloves and plastic bags should be kept in nonsterile utility room and in clients bathrooms to encourage the use of the gloves and bags during handling of contaminated items.

- Work areas, countertops, emergency stretchers, specimen analysis kits, and monitoring equipment that have been contaminated with blood or body fluids should be wiped with absorbent towels to remove excess materials and then washed with isopropyl alcohol, a 1:10 dilution of sodium hypochlorite (household bleach), or other suitable germicide approved by the Environmental Protection Agency. One should be cautious with sodium hypochlorite because it is corrosive to metals, especially aluminum.
- Disposal of wastes should be carried out properly.
- Blood, body fluid drainage, or other contaminated liquids should be carefully poured into a drain and flushed into the sewer system.
- Solid contaminated items should be placed in sturdy plastic bags, labeled, and disposed off according to hospital policy for contaminated items.

1.12 REFERENCES

1) Kozier and Erb's (2008). *"Fundamentals of Nursing", Concepts , Proces, and Practice*, 8th Edi. Pearson Education, Copy right.

2) Potter Perry (2009). *"Fundamentals of Nursing"* 7th Edition.

3) Reddy T. Sriniwas (2006). *"Health Care Associated infection Control Manual"* 1st . Paras Medical Book Pvt. Ltd., Hyderabad.

4) Perry AG and Potter PA (1998). *Clinical Nursing Skills and Techniques* (4th ed). St. Louis: Mosby – Year book, Inc. P989 – 1017.

5) Potter PA and Perry AG (2001). *Fundamentals of Nursing* (5th ed). St. Louis: Mosby. P834 – 883.

UNIT 2 INFECTION CONTROL PROTOCOLS

Structure

2.0 Introduction

2.1 Objectives

2.2 Infection Control Team/Committee

- 2.2.1 Functions of the Infection Control Committee
- 2.2.2 Members of the Infection Control Committee
- 2.2.3 Functions of Individual Members

2.3 Infection Control Protocols

- 2.3.1 Safety for Health Care Workers - Preventing Needle Stick Injuries
- 2.3.2 Peripheral Catheters
- 2.3.3 Central Venous Catheters
- 2.3.4 Urinary Tract Infections
- 2.3.5 Ventilator associated Pneumonia
- 2.3.6 Isolation Protocol
- 2.3.7 Protocol for Cleaning Critical Care Unit

2.4 Surveillance Protocols

- 2.4.1 Methods of Surveillance
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2.5 Standard Precautions and Transmission based Precautions

- 2.5.1 Standard Precautions
- 2.5.2 Occupational Health and Blood borne Pathogens
- 2.5.3 Transmission – based Precautions

2.6 Roles and Responsibilities of a Nurse

2.7 Let Us Sum UP

2.8 Answers to Check Your Progress

2.9 References

2.0 INTRODUCTION

Infection prevention and control professionals are valuable resources in controlling health care associated infections. These professionals are specially trained in infection prevention and control. They are responsible for advising health care personnel regarding infection prevention and control practices and for monitoring infections within the hospital.

Hospital infection control is based on surveillance which is a continuous process of scrutiny of aspects of all occurrences and spread of diseases that can be effectively controlled. A proper and scientific surveillance can cut down the infection rate by one third. It also helps to control threatening outbreak of an infection.

In this unit you will be studying infection control protocols, infection control committee members, their functions and standard precautions / transmission based precautions to be followed in hospital.

2.1 OBJECTIVES

After completing this unit you will be able to:

- Discuss the functions of Infection control team/committee;
- Describe infection control protocols;
- Discuss Surveillance protocols;
- Describe Standard precaution/ Universal precaution; and
- Explain the roles and responsibilities of a nurse in infection control.

2.2 INFECTION CONTROL TEAM/COMMITTEE

Infection Control Committee (ICC) is a multidisciplinary committee of experts to develop plans and policies for infection control and monitor overall activities.

2.2.1 Functions of the Infection Control Committee

- Continued surveillance of hospital acquired infections.
- Development and formulation of preventive and corrective programmes in view of infectious hazards.
- Develop a hospital antibiotic policy.
- Formulate and update patient care policies from time to time.
- Develop a system of identifying, reporting, investigating and controlling the hospital acquired infections.
- Periodically educate the health care workers of the institution on infection control policies and protocols.
- Regularly meet every month to discuss any issues related to Health Care Associated Infections (HAIs) and develop outcomes.
- Formulate policies and protocols on the methods of sterilization and disinfection.
- Formulate and implement guidelines for segregation and disposal of biomedical waste.

2.2.2 Members of the Infection Control Committee

You may find variations among institutions but the personnel mentioned below are usually included.

- Infection control committee chairman: Consultant Microbiologist
- Infection control coordinator: Physician
- Infection control: Nurse
- Infection control surveillance: Technician
- Head Nurse CCU / ICU / OT

Other Members of the ICC

- Administrator / Director of the Institution
- Head of medicine and surgery
- Director of Nursing/Nursing Superintendent/Chief Nursing Officer
- Consultant Anaesthiology
- Biomedical Engineer / Head of Maintenance Department
- House keeping Manager
- C.S.S.D Manager.

2.2.3 Functions of Individual Members

The functions of various members are given below:

Infection Control Chairperson

- Is an expert in the field of infection control and is always available to advice on all aspects of infection control.
- Liaisons between the infection control committee members and the hospital administration.
- Receives all the surveillance reports and information pertaining to hospital-acquired infection, and initiates necessary action based on the reports.
- Initiates research activities and surveillance programmes in the institution.
- Keeps oneself abreast with the recent developments in the field.
- Educates and provides feedback to the clinicians using surveillance data.
- Conducts monthly meetings of the infection control committee.

Infection Control Coordinator (Doctor)

- Takes hospital visits periodically to ensure all the infection control practices are being practised.
- Co-ordinates with the chairperson in planning infection control programmes and protocols.
- Keeps track of any infectious outbreaks.
- Participates and guides in research activities.
- Implements proper isolation techniques.
- Ensures provision of hand washing or alcohol based hand cleansing solutions.
- Develop standards for management of proper insertion and maintenance of all medical devices.
- Maintain records of minutes of meetings and compile all surveillance data.

Infection Control Surveillant / Nurse (ICN)

Infection control nurse is a full time senior staff nurse to carry out day-to-day surveillance activities in infection control and reports to infection control team on daily basis. She carries out following functions:

- Identifies all high risk areas in a hospital such as All Critical care areas, OT, CSSD, Kitchen, Laundry etc.
- Prepares a schedule for visiting and surveying these areas, daily, weekly, fortnightly as felt necessary according to the degree of risk involved.
- Works as a clinical supervisor by ensuring that all the established policies and protocols are practiced e.g., hand washing procedures, use of hand scrubs, isolation policies, care of vascular access and urinary catheters, standard precautions, terminal cleaning/ disinfection and follow up of needle-stick injuries.
- Works as an investigator along with the infection control committee to track down outbreaks, evaluates equipment to detect risks leading to infection hazards.
- Visits all patients identified as high risk for infection in laison with the charge nurses.
- Works as an educator by participating in formal and informal teaching programmes for nurses and other healthcare workers. Attends appropriate courses and workshops.
- Works as a researcher in co-ordination with other members of the committee.
- Ensures adequate isolation precautions based on the reports of microbiology especially about nosocomial strains e.g., Methicillin Resistant Staphylococcus Aureus (MRSA).
- Performs surgical site infection surveillance for clean and contaminated cases.
- Spot surveillance once a month to assess peripheral lines, urinary catheters, Central Venous Catheters (CVC) and biomedical waste disposal.
- In open cases of TB, informs the nurse and concerned consultant if required for immediate discharge or transfer of the client to isolation room (negative pressure area).

Infection Control Surveillant – Technician

- Carries out Critical care unit surveillance for all nosocomial infections.
- Collects monthly antibiotic susceptibility data of intensive care units and floors.
- Performs tests for food handlers.
- Carries out break analysis.
- Air and water sampling and disinfectant testing.
- Processing all the infection control samples.

2.3 INFECTION CONTROL PROTOCOLS

The infection control protocols are discussed in following subsections.

2.3.1 Safety for Health Care Workers — Preventing Needle Stick Injuries

- Use vacutainers designed with a lock to prevent needle stick injury.
- Health Care Workers (HCWs) are advised never to recap the needles after use.
- All sharps are disposed off in the disposable sharp container and puncture proof containers in the nursing stations.
- Safety cannula (Autoguard) is being used for all known sero positive patients.
- Self retracting lancets are being used for monitoring the blood glucose levels.
- It is recommended that Infection Control Team should plan an ongoing Post Exposure Prophylaxis (PEP) program for employees. Ensure that all occupational exposures are documented, treated immediately, counselled and followed up for a period of 6 months by the Infection control Nurse.
- Practice cleaning, sterilization and disinfection meticulously.

2.3.2 Peripheral Catheters

- Establish the vein prior to disinfection of site.
- Upper extremity is preferred over lower extremity.
- Perform procedural hand washing with antimicrobial soap prior to insertion of the line.
- Disinfect the selected site with 70% isopropyl alcohol. In case of Immuno-compromised patients disinfect the selected area using the "3 swab method" with isopropyl alcohol and 10% povidone/iodine alternatively and wait till it dries.
- Do not touch the site after disinfection.
- Do not reuse a vascular access device.
- Change peripheral line every 72 hours or earlier if infected, or any signs of infiltration (If difficulty in establishing access, you may make an exception).

2.3.3 Central Venous Catheters (CVC)

- Use Teflon catheters as they are preferred over PVC and polyethylene catheters.
- Use Subclavian catheters as they are preferred over jugular and femoral.
- Use minimum number of lumens.
- Practice surgical hand washing prior to procedure.
- Use maximum barrier precautions (cap, mask, gown and sterile gloves).

2.3.4 Urinary Tract Infections

- Educate personnel in correct techniques of catheter insertion and care. Periodically re-educate personnel in catheter care.
- Catheterize only when necessary. Condom catheter drainage, suprapubic catheterization, and intermittent urethral catheterization can be useful alternatives to indwelling urethral catheterization.
- Use smallest suitable bore catheter consistent with good drainage and to minimize urethral trauma.
- Follow procedural hand washing with antimicrobial soap.
- The collecting bags should always be kept below the level of the bladder.
- Maintain a closed drainage system.
- If breaks in aseptic technique, disconnection, or leakage occur, the collecting system should be replaced using aseptic technique after disinfecting the catheter-tubing junction.
- Daily meatal care with povidone-iodine solution and daily cleansing with soap and water does not reduce the incidence of urinary tract infections and is not routinely recommended.
- Indwelling catheters should not be changed at arbitrarily fixed intervals but should be removed as soon as they are not needed. However, you must ensure that perineal hygiene is addressed at least every 8 hours.

2.3.5 Ventilator Associated Pneumonia

- Perform endotracheal intubation with sterile technique after procedural handwashing with antimicrobial soap/hand rub and sterile gloves.
- Maintain patients in a semi recumbent position (30°- 45° elevation of the head of the bed) unless there are contraindications.
- Avoid gastric over distention.
- Avoid unplanned extubation and reintubation.
- Use a cuffed endotracheal tube with in-line or subglottic suctioning.
- Maintain an endotracheal cuff pressure of at least 20 cm H_2O.
- Remove the condensed water in the patient circuit periodically.
- Use sterile water in the humidifier.
- Do not routinely sterilize or disinfect the internal machinery of mechanical ventilators.

2.3.6 Isolation Protocol

To minimize transmission of pathogenic microorganisms to, from and between patients and the health care workers follow the guidelines as given below:

- Follow standard precautions for all patients admitted to the hospital irrespective of their diagnosis.

- Follow special transmission based precautions i.e., blood borne pathogen isolation (BBP), airborne isolation (AI), droplet isolation (DI) and contact isolation (CI) for patients having specific diseases.
- Critical care patients requiring isolation are those with active respiratory tuberculosis, MRSA Hepatitis C. Immuno - compromised patients require reverse barrier nursing.

2.3.7 Protocol for Cleaning CCUs

- Wearing gloves and masks by staff is essential. Hand washing with soap and water is mandatory.
- Daily cleaning is must. Hands on training have to be given for reconstitution of disinfectants. (Measuring cylinder should be used). A logbook for this has to be maintained.
- Periodically supervisors (housekeeping in charge of cleaning) have to check that disinfection is done properly. Log book also should be checked.
- Daily vacuum cleaning and frequent wet mopping is to be done, dry sweeping and use of brooms must not be allowed in any of the high risk areas.
- Weekend disinfection is to be done for all equipment and beds in the unit. (Dated sticker to be attached to each). No area or surface must be visibly dirty.
- Restriction of visitors to CCUs should be followed.
- Use of disposable shoe covers is quite popular in current times while change of footwear are practiced by some.
- All used equipment should be cleaned with a disinfectant.
- Wet mopping of the area has to be done with a disinfectant.
  (Correct concentration to be reconstituted as per the manufacturer's guidelines.)
- Weekend calibration to be done for all equipment and beds in the ward. (Dated sticker should be attached to each).
- All equipment used on a patient — the ventilator tubing, suction tubing etc. must be disposed off.
- All excretion and secretion of the patient should be flushed off. The spittoon, kidney tray and bedpan should be washed with soap and water and disinfected, before reuse.
- All blood / body fluid spills should be covered with disinfectant. (1% sodium hypochlorite) for ten minutes before cleaning with gloved hands.
- Engineering or maintenance head should be informed immediately in case of cracks, damp walls, leakages, peeling of paint for repair. These are reservoirs for microorganism.

Check Your Progress 1

Define the following:

i) Infection contol committee (ICC)

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ii) Infection control nurse (ICN)

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iii) Fill in the blanks

a) Surgical stie infection surveillance is performed to .....

b) Spot surveillance is carried out once in a month for .....

2.4 SURVEILLANCE PROTOCOLS

Nosocomial infection surveillance is a programme designed to investigate, control and prevent hospital acquired infections.

Purpose of surveillance is to:

- Collect and analyse data for timely and appropriate action.
- Provide patients and health care workers with optimum protection from development of nosocomial infections.

2.4.1 Methods of Surveillance

Laboratory record scrutiny

- Infection control nurse examines laboratory reports daily and discusses it with the infection control doctor or microbiology lab-technician.
- She visits the relevant patients and gathers necessary information. She determines whether it is hospital acquired infection or community acquired infection. She encourages the ward staff to report to her or send samples for all patients with suspected infection.
- Helps in identifying cross infections and outbreaks.

Daily visit to critical care units

- Infection control nurse has to visit the CCUs daily or several times a week and examine all records of all clinical infections.

Nosocomial infection rates

- Regular surveillance studies are carried out to identify various infection rates like Surgical site infection (SSI) rates, in clean as well as contaminated wounds.

- Intravascular catheter infection rates per thousand catheter days.
- Ventilator associated pneumonia rates per thousand ventilator days.
- Urinary tract infection rates per thousand catheter days.
- Appropriate case definitions of each nosocomial infection as described by the **Centre for Disease Control** (CDC) are used.

The CDC (Centre for Disease Control) Nosocomial infection Criteria in the Intensive Care Units.

The criteria for identifying nosocomial infection in the intensive care unit is given below:

Laboratory Confirmed Blood Stream Infection (LCBI)

Criteria 1: at least **ONE** of the following not related to infection elsewhere:

a) Fever > 38°C

b) Chills.

c) Hypotension.

Criteria 2: Blood culture percutaneous positive from **one** or more sites not related to infection elsewhere. (For common skin commensals i.e., diptheroids, coagulase negative Staphylococcus, Propionibacterium, Micrococci, two peripheral line cultures must be positive, drawn on separate occasions).

Clinical sepsis

At least **ONE** of the following not related to infection elsewhere:

a) Fever > 38°C

b) Hypotension < 90mm Hg

c) Oliguria < 20ml/hr

d) Positive blood culture (drawn retrograde through a central venous catheter).

Ventilator acquired pneumonia (VAP)

Rales/dullness on percussion of chest OR chest X ray with new infiltrate. Consolidation, cavitations or pleural effusion **PLUS** at least one of the following:

a) New onset of purulent sputum/ change in character of sputum.

b) Organism isolated from blood.

c) Isolation of etiologic agent from Transtracheal aspirate, bronchial brushing or biopsy.

d) Histopathologic evidence of pneumonia.

Urinary tract infection (UTI)

a) Fever > 38°C

b) Urgency / frequency/dysuria/ suprapubic tenderness.

c) Colony count > 105 organisms /ml (not more than two species).

Since continuous surveillance of nosocomial infections is often difficult, time consuming and costly these rates can be determined periodically to define time trends.

2.4.2 Responsibilities of Infection Control Nurse (ICN) towards Surveillance in the CCU

The following details should be collected:

- Daily information about details of patients admitted in the CCU.
- Daily record of the highest temperature, lowest systolic B.P., line insertion along with days in situ, ET (Endo Tracheal tubes) tube insertion along with days in-situ.
- Any blood, urine, tracheal, surgical site and CSF positive cultures are noted daily.
- A Nosocomial infection is diagnosed according to the CDC definitions and after the patient has spent more than 48 hours in the hospital.
- If a patient has acquired a nosocomial infection, the antibiotics they were getting are noted along with the mode of administration, dose per day and duration of administration.
- The applicable positive culture etiology/ bacterial agent is recorded along with the date of culture, type of nosocomial infection (according to CDC), the site of infection and the antimicrobial susceptibility patterns.
- Surveillance of hand washing is carried out for doctors, nurses and physicians in the morning, afternoon and evening shifts.
- Surveillance of vascular catheters — sterile gauze, date of insertion and condition of gauze.
- Surveillance of urinary catheters — position, any kinks and for reflux of urine.
- Mechanical ventilator surveillance — tubing free of water, mucus, 30-45^0 head end elevation.
- Surgical Site Infection surveillance is done for clean and clean contaminated cases.

Check You Progress 2

i) Name the methods of surveillance protocols.

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ii) List the infections that are tracked through surveillance by infection control nurse

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iii) Describe responsibilities of Infection Control Nurse in CCU.

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2.5 STANDARD PRECAUTIONS AND TRANSMISSION BASED PRECAUTIONS

Standard Universal precautions, as defined by CDC, are a set of precautions designed to prevent transmission of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other blood borne pathogens when providing first aid or health care. Under transmission based precautions, blood and certain body fluids of all patients are considered potentially infectious for HIV, HBV and other blood borne pathogens.

2.5.1 Standard and transmission based Precautions

The standard precautions are given below:

Hand Washing (See Fig.2.1)

- Wash hands after touching blood, body fluids, secretions, excretions, and contaminated items, whether or not gloves are worn.
- Wash hands immediately after gloves are removed, between patient contacts, and when otherwise indicated to avoid transfer of microorganisms to other patients or environments.
- It may be necessary to wash hands between tasks and procedures on the same patient to prevent cross-contamination of different body sites.
- Use a plain (non-antimicrobial) soap for routine hand washing.
- You can use hand rub instead of hand wash when hands are not visibly contaminated. refer to Fig 1.9, unit 1 for 6 step hand washing technique.



Fig.2.1: Hand washing

Gloves (See Fig.2.2)

- Wear gloves (clean, non-sterile gloves are adequate) when touching blood, body fluids, secretions, excretions, and contaminated items.
- Put on clean gloves just before touching mucous membranes and non-intact skin. Change gloves between tasks and procedures on the same patient after contact with material that may contain a high concentration of microorganisms.

- Remove gloves promptly after use, before touching non-contaminated items and environmental surfaces and before caring for another patient. Wash hands immediately to avoid transfer of microorganisms to other patients or environment.



Fig 2.2: Wearing gloves

Mask, Eye Protection, Face Shield (See Fig.2.3)

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

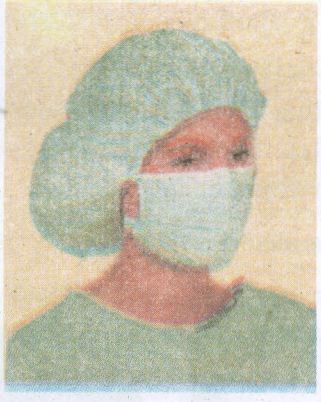


Fig. 2.3a: Mask



Fig. 2.3b: Eye shield

GOWN (See Fig.2.4)



Fig. 2.4: Wearing Gown

- Wear a gown (a clean, non-sterile gown is adequate) to protect skin and to prevent soiling of clothing during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions.
- Remove a soiled gown as promptly as possible and wash hands to avoid transfer of microorganisms to other patients or environment.

Patient Care Equipment

- Handle used patient-care equipments soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of microorganisms to other patients and environment.
- Ensure that reusable equipment is not used for the care of another patient until it has been cleaned and reprocessed appropriately.
- Ensure that single-use items are discarded properly.

Environmental Control

- Ensure that the hospital has adequate procedures for the routine care, cleaning, and disinfection of environmental surfaces, beds, bedrails, bedside equipment and other frequently touched surfaces, and ensure that these procedures are being followed.

Linen

- Handle, transport and process used linen soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures and contamination of clothing and that avoids transfer of microorganisms to other patients and environments.
- Soiled linen should be disinfected and separated at source.

The standard precautions are summarized in Fig. 2.5.



Fig.2.5: Standard precautions

2.5.2 Occupational Health and Blood borne Pathogens

- Take care to prevent injuries when using needles, scalpels, and other sharp instruments or devices (when handling sharp instruments after procedures; when cleaning used instruments; and when disposing off used needles).
- Never recap used needles, or otherwise manipulate them using both hands, or use any other technique that involves directing the point of a needle toward

any part of the body, rather, use either a one-handed 'scoop' technique or a mechanical device designed for holding the needle head. Do not remove used needles from disposable syringes by hand, and do not bend, break, or otherwise manipulate used needles by hand.

- Place used disposable syringes and needles, scalpel blades, and other sharp items in appropriate puncture-resistant containers, which are located as close as possible to the area in which the items were used, and place reusable syringes and needles in a puncture resistant container for transport to the reprocessing area.
- Use mouthpieces, resuscitation bags, or other ventilation devices as an alternative to mouth to mouth resuscitation methods in areas where the need for resuscitation is predictable.

2.5.3 Transmission-based Precautions

Airborne Isolation (A.I)

- Negative – pressure room is preferred.
- For patients with chicken-pox, or measles, only immunized staff should provide care.
- For patients with open tuberculosis, wear an N 95 disposable mask before entering the room.
- Limit patient's movement. Place a surgical mask if patient is to be transported outside.

Contact Isolation (C.I)

- Wear gloves prior to any patient contact.
- Wear clean non-sterile gown if any contact with body fluids, infectious materials or spillage is anticipated.
- Remove the gloves and gown; perform proper hand hygiene before leaving the room/ patient care area.
- Limit patient transportation.

Droplet Isolation (D.I)

- Private room is preferred / or cohort of patients with same illness/ or ensure three feet spatial separation between patients if put in same room.
- Wear a mask at all times when delivering care within the three feet space around the patient.
- Limit transportation. If unavoidable, ensure patient wears a mask during transportation.

Blood Borne Pathogen Isolation (B.B.P)

- Wash hands before and after patient contact and wearing gloves.
- Wear gloves if contact with blood, body fluids, secretions, excretions and contaminated items is anticipated.
- Wear mask, eye protection and gown before activities likely to generate splashes and sprays.
- Take utmost care to prevent needle stick injury; use safety cannulas.
- Handle all patient care items properly; dispose appropriately waste and sharps.

Check Your Progress 3

i) List the Standard Precautions.

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2.6 ROLE AND RESPONSIBILITIES OF A NURSE

In order to prevent infection in CCU you have to undertake following responsibilities:

How to Clean and Disinfect CCU

- Teach cleaners how to do the cleaning.
- Wet mop the room thoroughly, frequently and as and when required.
- Wash floors, walls, ceilings with clean warm soap water. Let it dry.
- Make proper concentration solution of water with cleaning agent (e.g., Bacillofloor) Read manufacturer's instructions to make the solution.
- Clean up any spillage immediately.
- Use hard brush (not a mop) to scrub floors, walls, ceilings etc. thoroughly, mechanically, effectively.
- Clean beds, furniture and fans etc. with soft cloth soaked in Bacillocid solution.
- Be careful while cleaning equipments e.g., ventilators, monitors etc.
- Leave room and its contents to dry for 15 to 30 minutes.
- Spray "Bacillocid" or other similar chemical. Wait for 2 hours before using the facility.
- Fumigation is outdated. Following the above mentioned steps thoroughly for complete disinfection steps mentioned means proper disinfection.
- Discard the mop and chemical solution. Use a new one before moving to clean other room.

Prepare cleaning solutions daily or as needed, and replace with fresh solution frequently according to facility policies and procedures.

2.7 LET US SUM UP

In this unit you have learnt about infection control Team/Committee (ICC), Infection Control Nurse (ICN) and their functions. You have also learnt various protocols practiced in CCUs, and transmission based precautions. It will help you to develop an insight into identifying and performing Roles and Responsibilities of nurses to prevent infection in CCUs.

2.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

i) **Infection control committee (ICC):** A committee of experts to develop plans and policies for infection control and monitor overall activities.

ii) **Infection control surveillant–nurse (ICN) :** A full time senior staff nurse to carry out day-to-day surveillance activities in infection control and reports to infection control team on daily basis.

iii) a) Clean and contaminated cases.

b) Assess peripheral lines, urinary catheters, Central Venous Catheters (CVC) and biomedical waste disposal.

Check Your Progress 2

i) a) Laboratory record scruting,

b) daily visit to critical care unit

c) Nosocomial infection rates.

ii) SSI, UTI, CVC, VAP.

iii) Daily information about details of patients admitted in the CCU.

- Daily record of the highest temperature, lowest systolic B.P., line insertion along with days in situ, ET tube insertion along with days in-situ.
- Any blood, urine, tracheal, surgical site and CSF positive cultures are noted daily.
- A Nosocomial infection is diagnosed according to the CDC definitions and after the patient has spent more than 48 hours in the hospital.
- If a patient has acquired a nosocomial infection, the antibiotics they were receiving are noted along with the mode of administration, dose per day and duration of administration.
- The applicable positive culture etiology/bacterial agent is recorded along with the date of culture, type of nosocomial infection (according to CDC), the site of infection and the antimicrobial susceptibility patterns.
- Surveillance of hand washing is carried out for doctors, nurses and physicians in the morning, afternoon and evening shifts.
- Surveillance of vascular catheters — sterile gauze, date of insertion and condition of gauze.
- Surveillance of urinary catheters — position, any kinks and for reflux of urine.
- Mechanical ventilator surveillance — tubing free of water, mucus, 30-45^0 head end elevation etc.
- Surgical Site Infection surveillance is done for clean and clean contaminated cases.

iii)
- Performs surgical site infection surveillance for clean and contaminated cases.
- Spot surveillance once a month to assess peripheral lines, urinary catheters, Central Venous Catheters (CVC) and biomedical waste disposal.

Check Your Progress 3

i) Standard Precautions/Universal Precautions include the following

Handwashing, use of Personal protective equipment like gloves, gown, mask, eye shield, proper patient care equipment, healthy infection control practices, environmental control, bio-medical waste management and care of linen.

2.9 REFERENCES

1) Kaplow R, Hardin S. *Critical Care Nursing,Synergy for Optimal Outcomes*. Jones & Barlett Publishers. 2007.

2) Perry AG and Potter PA (1998). *Clinical Nursing Skills and Techniques* (4th ed). St. Louis: Mosby – Year book, Inc. P.989 – 1017.

3) Reddy T. Sriniwas *"Health Care Associated infection Control Manual"* 1st Edi. 2006, Paras Medical Book Pvt. Ltd., Hyderabad.

UNIT 3 BIOMEDICAL WASTE MANAGEMENT

Structure

3.0 Introduction

3.1 Objectives

3.2 Review of Classification and Collection of Biomedical Waste

- 3.2.1 Types of Waste
- 3.2.2 Types of Containers and Color Coding

3.3 Rules and Regulations of Biomedical Waste Management

3.4 Infection Control Indicators

3.5 Disposal of Biomedical Waste

- 3.5.1 Waste Minimization
- 3.5.2 Safe Reuse and Recycling
- 3.5.3 Waste Segregation at Source
- 3.5.4 Accumulation and Storage
- 3.5.5 Transportation
- 3.5.6 Treatment Options
- 3.5.7 Record Keeping
- 3.5.8 Training
- 3.5.9 Waste Audit

3.6 Role of Critical Care Nurse in Bio-Medical Waste Management

3.7 Let Us Sum Up

3.8 Glossary

3.9 Answers to Check Your Progress

3.10 References

3.0 INTRODUCTION

As you know that infectious waste material coming out of hospitals is a growing concern, due to exposure of Public to discarded needles, syringes and other harmful waste from the Municipal Garbage bins and disposal sites. Incorrect technique of hospital waste disposal is harmful not only to the medical and paramedical people, but also to labourers, waste handlers, rag-pickers and general public at large. The harmful effects of improper waste disposal are innumerable. It not only spreads diseases, but also poses a financial burden to the hospital, municipal administration and thereby to the society. You need to learn/review the proper ways of Bio-medical waste management so that you can protect your patients, and the public at large including yourself. In this unit we shall discuss about categories of waste, type of containers and colour code for collection of biomedical waste, rules and regulations of biomedical waste management, infection control indicators, disposal of biomedical waste and role of Critical Care Nurse in bio-medical waste management,

3.1 OBJECTIVES

After completing this unit you will be able to:

- Differentiate between the categories of biomedical waste and colour code of containers;
- Discuss Rules and regulations of biomedical waste management;
- Describe infection control indicators;
- Explain current methods of disposal of biomedical waste management; and
- Discuss the role of Critical Care nurse in biomedical waste management.

3.2 REVIEW OF CLASSIFICATION AND COLLECTION OF BIOMEDICAL WASTE

Hospital waste means all waste coming out of hospital of which more than 80% is actually non-hazardous, around 10 - 15% is infectious waste and 5% is non-infectious but hazardous waste. Hospital waste is generated during the diagnosis, treatment, immunization of human beings or animals in research activities in these fields; and in the production or testing of biologicals. The biomedical wastes include sharps, soiled wastes like dressings, bandages, plaster casts, disposables like syringes, catheters, cannula, and tubings, anatomical waste the removed organs, blood and body fluids, human tissue; surgical specimen, human excreta, cultures, discarded medicines, chemical wastes, radioactive materials etc. Most of these are infectious. Infectious wastes include all kind of waste, which may transmit viral, fungal, bacterial or parasitic diseases or cause other hazards to human beings or animals. Sharps are one of the most hazardous categories of waste generated in health care facilities. Bio-medical waste poses a real threat if handled improperly or are not disposed properly. Due to the risks associated with these biomedical wastes, it is very important to dispose off properly to ensure safety to the health care workers and the community at large. Before disposal let us become familiar with the different categories of biomedical wastes as given by World Health Organization as well as Govt. of India.

3.2.1 Types of Waste

The World Health Organisation (WHO) has classified medical waste into different categories. These include following:

Infectious:

Material containing pathogens in sufficient concentrations or quantities, if exposed can cause diseases. This includes waste from surgery and autopsies on patients with infectious diseases, sharps, disposable needles, syringes, saws, blades, broken glasses, nails or any other item that could cause a cut.

Pathological:

Tissues, organs, body parts, human flesh, foetus, blood and body fluids, drugs and chemicals that are returned from wards, spilled, outdated, contaminated or are no longer required.

Radioactive:

Solids, liquids and gaseous waste contaminated with radioactive substances used in diagnosis and treatment of diseases like toxic goiter.

Others:

Waste from the offices, kitchens, rooms, including bed linen, utensils, paper etc.

Government of India has shown very serious concern in this issue and through an extraordinary Gazette Notification has brought out the Bio-Medical waste (management and handling) Rules, 1998 on Monday, July 27, 1998. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle biomedical waste in any form. Afterwards 'The Bio-Medical waste (Management and handling) (Amendment) Rules, 2000 and the Bio-Medical waste Management and handling (Second Amendment) Rules, 2000, were published in the Gazette of India on Tuesday, March 7, 2000. The Ministry of Environment and Forests notification came on 2nd June 2000. These Bio-Medical waste Management and handling (Second Amendment) Rules, 2000 came into force on the date of their publication in the Official Gazette. The ten Categories of biomedical wastes as per Govt. of India are shown in Table 3.1.

It is also mandatory that each health care institution follows these rules strictly. The prescribed authority for enforcement of these rules shall be the State Pollution Control Boards in respect of states and the Pollution control committees in respect of the Union territories. The Municipal Body of the area shall continue to pick up and transport segregated non-biomedical solid waste generated in hospitals and nursing homes, as well as duly treated biomedical wastes for disposal at municipal dump site.

Table 3.1: Categories of Bio-Medical Waste (Schedule I)

	Waste Category	Treatment & Disposal
1	**Human Anatomical waste** (human tissues, organs, body parts.)	Incineration @/ deep burial*
2	**Animal Waste** (animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses)	Incineration @ / deep burial*
3	**Microbiology and Biotechnology Waste** (Wastes from laboratory cultures, stocks or specimens of microorganisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	Local autoclaving / micro-waving /incineration@
4	**Waste sharps** Needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts includes both used and unused sharps.	Disinfection (chemical treatment @@/ autoclaving /micro-waving and mutilation/ shredding #
5	**Discarded Medicines and Cytotoxic drugs** wastes comprising of outdated, contaminated and discarded medicines	Incineration @/ destruction and drugs disposal in secured landfills.

6	**Soiled Waste** Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, linen, beddings, other material contaminated with blood.	Incineration @autoclaving / microwaving
7	**Solid Waste** wastes generated from disposable items other than the waste sharps such as tubings catheters, intravenous sets etc.	Disinfection by chemical treatment @@ autoclaving/ microwaving and mutilation / shredding##
8	**Liquid Waste** waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities.	Disinfection by chemical treatment @@ and discharge into drains
9	**Incineration Ash** ash from incineration of any bio-medical waste	Disposal in municipal landfill
10	**Chemical waste** chemicals used in production of biologicals, chemicals used in disinfection, insecticides, etc.	Chemical treatment @@ and discharge into drains for liquids and secured landfill for solids

**Deep burial shall be an option available only in towns with population less than five lakhs and in rural areas.*

@ There will be no chemical pre-treatment before incineration. Chlorinated plastics shall not be incinerated.

@@ Chemical treatment using at least 1% hypochlorite solution or any other equivalent chemical reagent. It must be ensured that chemical treatment ensures disinfection.

Mutilation / shredding must be such so as to prevent unauthorized reuse.

The classification and disposal of hospital waste is shown in Fig 3.1 below:

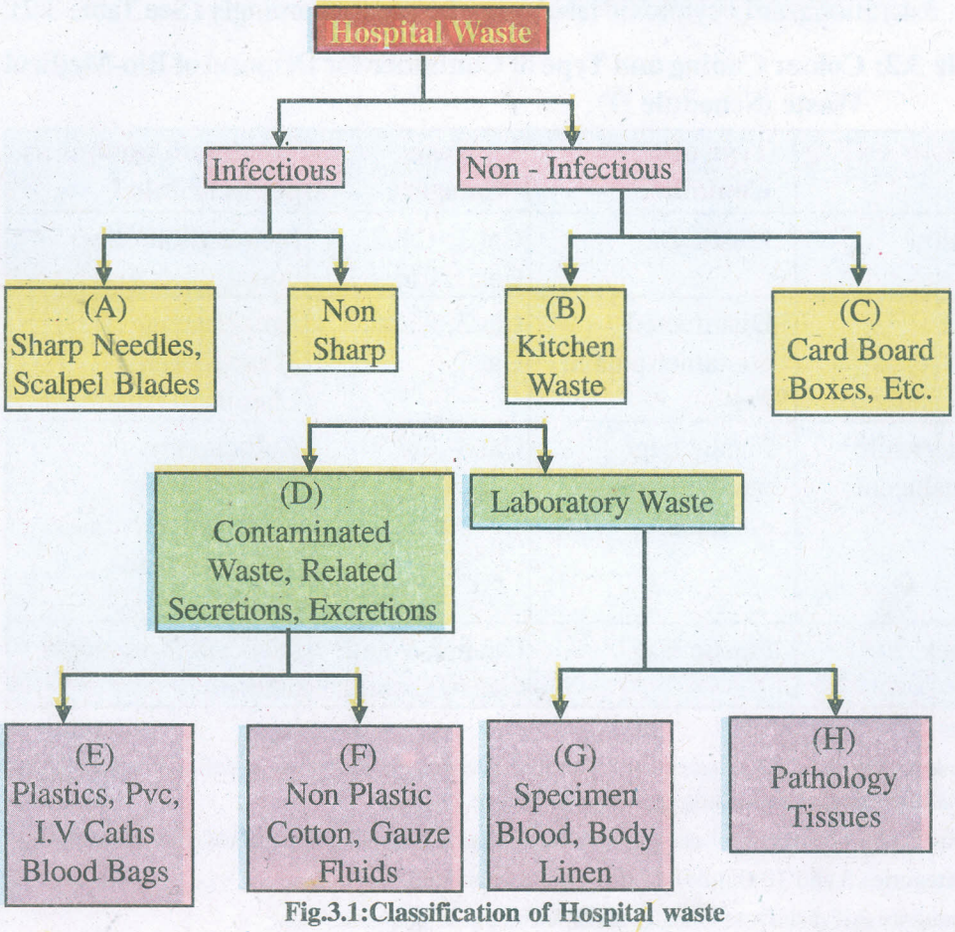


Fig.3.1:Classification of Hospital waste

Key:

A = Dispose in puncture proof containers containing 1% hypochlorite solution (destroy needle in cutter / burner depositing in container.

B = Dispose off in black bags – (1) biodegradable (2) non-biodegradable

C = Collect in big boxes or bags – for selling to Raddiwala or to scrap dealer

D = Secretions excretions – decontaminate – autoclave.

E = Blood bags – autoclave under supervision and incineration.
Plastic tubing – I. V. put in sodium hypochlorite – shred – recycle

F = Cotton gauze – Incineration.
Linen – decontaminate, dip in 5% sodium hypochlorite and wash in hot soap water – laundry.

G = Lab. Specimen – microwave
Culture autoclave – general waste
Fluids – decontaminate – drain

H = Pathological tissue formaline – incineration
Animal Caracas – incineration.

3.2.2 Type of Containers and Colour Coding

The waste must be segregated and collected in colour-coded containers, color-coded labeled polythene bags according to the category of waste as well as the stipulated method of disposal. The colour coding prescribed for disposal of Bio-Medical waste in India is given in Table 3.2 based on ten categories of Bio-medical waste as given in Table 3.1 earlier. This colour code may vary from institution to institution (See Fig.3.2). Bags and containers for infectious waste should be marked with the biohazard label (Fig. 3.3.) Cytotoxic waste should be collected in strong, leak proof containers clearly labeled "Cytotoxic wastes". (Fig. 3.4.) Biohazard / cytotoxic labels may be used accordingly (See Table 3.2).

Table 3.2: Colour Coding and Type of Container for Disposal of Bio-Medical Waste (Schedule II)

Colour coding	Type of Container	Waste Category	Treatment options as per Schedule I
Yellow	Plastic Bag	Cat.1, Cat.2, Cat.3, Cat. 6	Incineration/ deep burial
Red	Disinfected container/plastic bag	Cat.3, Cat.6, Cat.7	Autoclaving/ Microwaving/ Chemical Treatment
Blue/white translucent	Plastic bag/ puncture proof container	Cat.4 ,Cat.7	Autoclaving/ Microwaving/ Chemical Treatment & Destruction/ shredding
Black	Plastic Bag	Cat.5 & 9 and Cat.10 (solid)	Disposal in secured landfill

Notes:

1. Colour coding of waste categories with multiple treatment options as defined in Schedule I, shall be selected depending on treatment option chosen.
2. Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.
3. Categories 8 and 10 (liquid) do not require containers/bags.
4. Category 3 if disinfected locally need not be put in container/bags.

Different color-codings are used by different institutions for segregating wastes. One example of segregating the waste based on different color codes is given below (see figure 3.2 above).

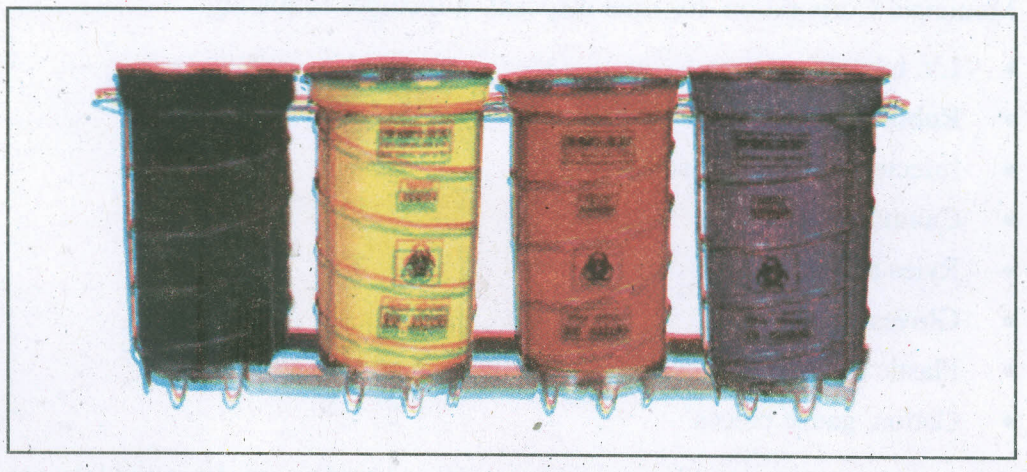


Fig. 3.2: Colour Coding and Type of Container for Bio-Medical Waste

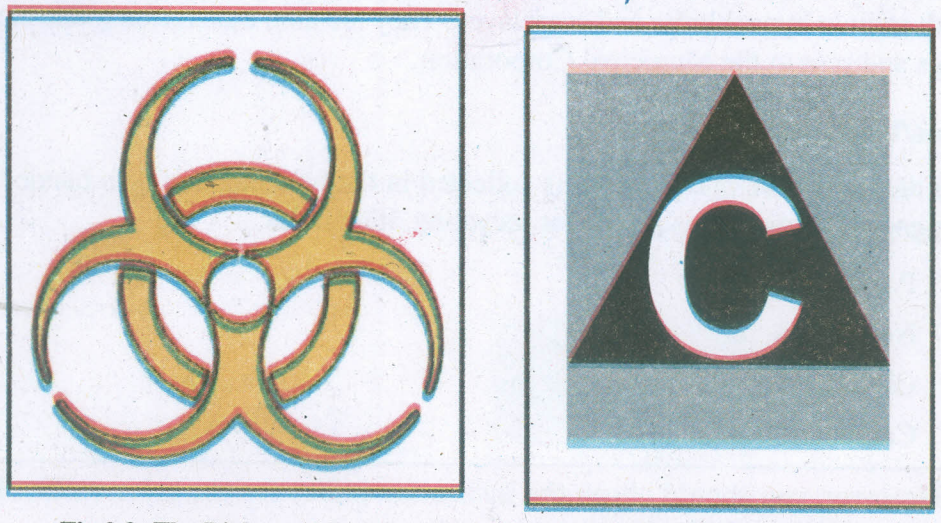


Fig.3.3: The Biohazard Label (Labels for Bio Medical Waste containers)

Black bag

This encompasses general waste, sent to the Municipal Corporation for final disposal. It includes:

- Office papers
- Paper cups
- Tissue papers
- Kitchen waste.
- Post autoclave shredded waste.

Yellow bag

This encompasses biomedical waste, which is finally disposed by incineration or deep burial. It includes following :

- Human Tissues
- Organs and body parts
- Cytotoxic drugs – ampoules and vials
- Expired or discarded drugs.

Red bag

This encompasses the infectious waste, basically infected plastics which are first autoclaved and then converted into fine pieces by the shredder and sent to Municipal Corporation for final disposal. It includes following:

- I.V. tubings
- Rubber-catheters
- Infected Intravenous sets
- Cannula
- Ryles tubes
- Gloves
- Plastic syringes
- Cotton, gauze pieces.

All the infectious waste like vacutainers, glass test tubes etc. from the labs are collected in the red bag and sent to the washing room. Here they are disinfected with sodium hypochlorite and autoclaved. They are then transferred to the black bags and sent to the Municipal Corporation.

Blue/White translucent

All the recyclable plastic waste is collected in the blue bag and then handed to assigned, contractors as scraps for recycling, it includes:

- Packing Material
- Non-infected plastic bottles
- Oil Tins
- Cardboard boxes.

However, you should check the institution policy for the color codes of bags as it may differ from state to state.

Sharps (Puncture proof container)

This has 1% hypochlorite. These are then handed over to the Municipal Corporation for disposal. The Municipal Corporation disposes these sharps containers by autoclaving and shredding. These include following:

- Needles
- Syringes
- Scalpels
- Blades
- Infected glass waste.

Topping up of sharp containers is only required when the contents are not in contact with the 1% sodium hypochlorite solution, which is filled up to a third level of the container.

Glass waste (Cardboard box)

All the non-infected glass waste is collected in the cardboard box and then handed over to the Municipal Corporation for disposal. It includes —

- Broken glasses
- Glass I.V. Bottles
- Glass Petri dishes
- Non-infected glass bottles
- Ampoules.
- Glass slides.

Radioactive waste

It encompasses the syringes and the needles used to administer the radioactive dye and the radioactive isotopes.

i) The syringes and needles are collected in radio opaque cans, which are stored in the dark room till they are free of the radioactivity. Each can be dated with date of usage and date to be discarded (free of radioactivity).

ii) The isotopes are stored in the lead containers till they are free of radioactivity, then the lead containers are sold as scrap.

Check Your Progress 1

i) Describe Categories of Bio-medical waste as per Govt. of India

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ii) Describe the colour coding of Bio-medical waste as per Govt. of India.

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3.3 RULES AND REGULATIONS OF BIOMEDICAL WASTE MANAGEMENT

- Disinfect the waste so that it is no longer the source of pathogenic organisms.
- Reduce the bulk in order to reduce requirements for storage and transportation.
- Make waste unrecognizable for aesthetic reason.
- Make recyclable items unusable, e.g., cutting up syringes and damaging the needles.

- Recycling of infectious plastic wastes can be considered only after adequate disinfection /sterilization, e.g., glass, paper, corrugated cardboard, aluminium, X-Ray film, reclaimed silver from X-ray film, plastics (non-infectious components).
- Disposable items like gloves, syringes, etc., should be mutilated after use to prevent illegal packing and reuse.
- Waste minimization can be done by:
  - Purchase of reusable items made of glass, rubber, metal, etc.
  - Select non-PVC plastic.
  - Strengthen sterilization procedure.
  - Adopt proper procedure and policies of Biomedical waste management (BMW).
  - Establish effective sound recycling policy.
- There should be three types of containers available at each point separately for general waste, infected non-sharp waste and infected sharp waste.
- Color-coding of bags is done as per rules.
- Needles, syringes other sharp instruments and objects, should be placed in a puncture-resistant plastic/metal container at the workstation.
- Needle, syringes and such other items should be boiled, hydroclaved/ autoclaved or chemically disinfected and then disposed.
- Alternatively, transport sharps to a central site for treatment, reuse containers if at all only after cleaning and disinfecting.
- Forty percent needle prick injuries are due to recapping /resheathing, so do not recap.
- Reusable glass syringes and needles are treated as follows before sterilisation.
  - Aspirate hypochlorite solution.
  - Immerse in flat tray for 20 minutes.
  - Rinse with water several times.
- Chemical disinfection prior to disposal is required for sharps, disposable infectious plastics/rubber, infectious glassware, blood and body fluids, by:
  - Using one per cent hypochlorite or equivalent disinfectant. Proper concentration is essential.
  - Ensuring all surfaces come in contact with chemical (including lumen).
  - Contact time at least 30 minutes.
  - Changing chemical solutions frequently at least once a day.
  - Always handle with gloves and masks. Apron and boots to be used if splashing is expected.
  - Use sharp decontaminating unit made up of outer, solid plastic puncture proof and inner perforated container with handles and filled 1/3 with hypochlorite.

- Do not chemically treat incinerable waste.
- Use available chemical disinfectants as per rules.
- Clean air and clean bedding by hygienic method of dust removal by wet mopping or vacuum cleaning must be recognized as basic requirement of housekeeping.
- Mistakes in segregation are to be corrected by housekeeping and nursing staff.

3.4 INFECTION CONTROL INDICATORS

The infection control indicators and the measures to follow are given as a checklist in Table 3.3.

Table 3.3: The Infection Control Indicators

Indicators	Checklist
Indicator 1	Sharp instruments are handled safely to minimize the risk of a sharp injury: • Appropriate puncture-proof sharp container • Container less than three – quarters full. • Sharp instrument are not protruding from the container. • No recapping or one-hand recapping.
Indicator 2	Instruments decontaminated fully — • Sterilizer available and in good working order. • Equipment thoroughly cleaned after use. • Clean instruments are stored in cupboards.
Indicator 3	Hands are washed appropriately to prevent cross-infection — • Soap and water available • Clean towels available • Staff observed to wash and dry hands after contact with body fluid, removal of gloves and contact with patients.
Indicator 4	A protective barrier is worn to prevent exposure to blood. The following protective barriers are available for use by staff (depending on the clinical area and risk of exposure): • Disposable gloves • Heavy-duty gloves • Masks • Aprons • Protective eyewear.
Indicator 5	Waste disposed safely • Evidence of deep burial or burning regularly. • No contaminated waste visible.

Check Your Progress 2

1) List the rules and regulations in hospital waste management.

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3.5 DISPOSAL OF BIOMEDICAL WASTE

Biomedical waste management and disposal is a very important task in any institution. This should be in accordance with the rules and the guidelines prescribed by the government. Multiple handling of waste should be discouraged. Waste disposal, principles to be followed are mentioned below.

3.5.1 Waste Minimization

This is highly desirable, as it would reduce the cost of waste disposal. It can be done by following methods.

Source reduction:

It includes measures such as purchasing restrictions to ensure the selection of methods or supplies that are less wasteful or generate less hazardous waste.

Recyclable products:

It means use of materials that may be recycled, either on-site or off-site.

Product substitution:

It includes use of needle-less I.V. sets (instead of those with needle), reusable items instead of disposable, and use of non-hazardous items instead of hazardous ones.

3.5.2 Safe Reuse and Recycling

Medical and other equipment used in health care establishment may be reused provided that it is designed for the purpose and will withstand the sterilization process. Reusable items may include scalpels, glass syringes etc. Recycling is the reuse of items that would have otherwise gone as wastes. This is usually not practised by health care facilities. However, this can result in savings — either through reduced disposal costs or through payments made by the recycling company. The items like cardboard boxes, paper, glass, noninfected plastics etc. fall in this category.

3.5.3 Waste Segregation at Source

Segregation is the key to any waste management scheme. Segregation means separation at the point of generation according to the category of waste into different color coded bags/containers. Careful segregation of waste matter into different categories helps to minimize the quantities of hazardous waste. If infectious waste, which forms a small part of hospital waste, is mixed with the other hospital waste the entire waste will have to be treated as infectious waste thus increasing the cost of biomedical waste disposal. It requires distinct color-coded waste collection bags and containers as per the category of waste. There should be clear instructions at the point of generation explaining the color code as well as proper training and supervision for enforcing this. All waste must be placed in appropriate color-coded bags/containers at the point of generation.

Segregation helps in following:

- Reducing total treatment cost.
- Preventing general waste from becoming infectious.
- Reducing the chances of infecting Health care worker.

Sharps handling and Disposal: Care should be taken to prevent injuries, while using, handling and disposing needles, scalpels, and other sharp instruments or devices. All the sharps and glass ampoules should be placed in separate puncture proof containers. The bins will be cleaned after every shift or when they are ¾ full. Freshly prepared Bleach solution (50 – 100ml) should be poured into the container for sharps as per institutional protocol (prepared by adding 30 gm, of Bleaching powder to 1 liter of water).

Handling: The containers/bags are closed before removal. The bags/containers need frequent replacements to avoid spillage. If the containers/bags get torn or is found to be leaking, then it is put in another leak – proof intact container/bag. The waste handlers must wear protective clothing to reduce the chances of infection.

3.5.4 Accumulation and Storage

Accumulation means temporary holding small quantity of waste at the point of generation. Storage means holding large quantity of waste for a long time before final disposal. Storage could be near or away from the point of generation. It should be conveniently located and should have good transport facility. It requires good ventilation, but no floor drains. It should have impervious floor and walls. It requires frequent disinfections and temperature control.

3.5.5 Transportation

All hospital waste must be segregated /separated as Infectious and Non-infectious material. This will have to be bagged into colour-coded bags for identification. These bags have to be secured and fastened well to ensure that there is no leakage or spillage within the hospital during transportation to the common collection point. Separate trolleys should be used for collection and transport of hospital wastes to the storage area. A separate special vehicle should be used for transportation of hospital waste to point of disposal (Fig.3.4).



Fig.3.4: Transportation of Bio Medical Waste

3.5.6 Treatment Options

Disposal without treatment

This option is not suitable for sharps/cutting instruments, human tissues and cultures. The method could be landfill. The items mentioned in "black bag" category earlier can be disposed of without any treatment.

Sanitary sewer

Disposal of some hospital waste can be made in the public sewerage system. This system is usually capable of handling some of hospital wastes like bulk blood, body fluids. The risk of splash and aerosols to the handlers exists. Workers need personal protective equipment (PPE) like goggles, gloves, aprons, etc. Technique of 'grind, soak and dispose' is used at some places for solid wastes.

Chemical treatment and disinfection

Infectious wastes like needles, syringes need disinfection before final disposal. Adequate contact period, and use of correct disinfectant in correct strength is essential. Blood spillage should be covered immediately with cotton rag piece to prevent spread. Then pour 1% Sodium hypochlorite carefully over the rag piece from outside to center to avoid spread, leave it for 10 minutes before disposal and final cleaning.

Incineration

It is widely used method for most hazardous health care wastes. Incineration requires no pretreatment, provided that certain waste types are not included (e.g., Sealed ampoules, used batteries, broken mercury thermometer, plastics like PVC items, pressurized gas containers, radiographic wastes etc.). Chlorinated plastic should not be incinerated because it emits toxic gases (dioxins), which are hazardous. Items mentioned in the "Yellow bag" category can be disposed of by incineration. Pyrolytic incinerators or double chamber incinerators are the most reliable and commonly used treatment process. Pyrolysis is the method in which the waste is shredded into fine particles and is heated to above 800 - 900° C in the absence of air or in an atmosphere of low oxygen. After incineration/ pyrolysis, the waste is reduced to gases and solid ashes, which can be disposed of like ordinary waste. Some incinerators are unable to treat metallic objects (like needles, blades).

3.5.7 Record Keeping

There should be a written policy for waste management, which identifies the staff responsible for record keeping. Accurate record keeping, documenting compliance, expenditure, etc., makes the whole exercise of waste management effective. Important information that should be recorded include following:

- Amount and types of waste generated by each Department and the entire hospital.
- Direct costs for supplies and materials used for collection, transport, storage, treatment and disposal, decontamination, cleaning and training.
- All labour costs associated with waste management.
- Cost for prevention of waste related injuries and illnesses such as immunizations, post exposure prophylaxis, etc.
- Repairs and associated cost for incineration and other technology.
- Type and cost of contractor service.
- Record of amount of waste disposal and modes of disposal.

3.5.8 Training

Training of all employees to implement the waste management plan is of crucial importance for success. Training should be imparted to Doctors, Nurses, technicians, ward boys, ayahs, etc., and it should include all aspects of hazardous waste management. Each employee should be aware of his or her own responsibility in this aspect and should carry out their share of duties diligently. Departmental heads / Supervisors should receive relevant information and material to chalk out a quality training programme and carry it out, which includes teaching and practice of standard precutions/universal precautions with all clients, at all levels of health care. Appropriate Communication – posters, reminders – colour code through charts etc.

3.5.9 Waste Audit

This is an important aspect of waste management, as it gives us an insight into the type and quantity of waste generated. It helps in further planning and implementation of the plan.

3.6 ROLE OF CRITICAL CARE NURSES IN BIO-MEDICAL WASTE MANAGEMENT

Patients in C.C.U. are in critical state and require interventions often and hence generation of infectious waste in the form of I.V. tubing, cannula, blood bag, syringes, sharps etc. Many a times procedures are required to be performed in emergency.

A proper foot press type of small container can be provided at the foot end of each bed. The waste is collected after emergency procedure and immediately removed as the patients in C.C.U. have poor resistance to infection and they have full time care taker. To prevent cross infections the infectious waste generated must be removed immediately to waste container kept just outside C.C.U. The bins for infectious and non-infectious waste should be kept outside the C.C.U. to prevent spread of infection within the patients.

Role of the nursing staff in prevention of infection

Implementation of patient care practices for infection control is the role of the nursing staff. Nurses should be familiar with practices to prevent the occurrence and spread of infection, and maintain appropriate practices for all patients throughout the duration of their hospital stay.

The senior nursing administrator is responsible for following:

- Participating in the Infection Control Committee.
- Promoting development and improvement of nursing techniques, and ongoing review of aseptic nursing policies, with approval by the Infection Control Committee.
- Developing training programmes for members of the nursing staff.
- Supervising the implementation of techniques for the prevention of infection in specialized areas such as Critical Care Unit.
- Monitoring of nursing adherence to policies.

The nurse in charge of the CCU is responsible for following:

- Maintaining hygiene, consistent with hospital policies and good nursing practice in CCU.
- Monitoring aseptic technique, including handwashing and use of alcohol handrub.
- Reporting promptly to the attending physician any evidence of infection in patients under the nurses' care.
- Initiating patient isolation and ordering culture specimens from any patient showing signs of a communicable disease, when the physician is not immediately available.
- Limiting patient exposure to infection from visitors, hospital staff, other patients, or equipment used for diagnosis or treatment.
- Maintaining a safe and adequate supply of ward equipment, drugs and patient care supplies.

The nurse in charge of infection control is a member of the infection control team and is responsible for the following:

- Identifying nosocomial infections.
- Investigation of the type of infection and infecting organism.
- Participating in training of personnel.
- Surveillance of hospital infections.
- Participating in outbreak investigation.
- Development of infection control policy and review and approval of patient care policies relevant to infection control.
- Ensuring compliance with local and national regulations.

Protocol for accidental needle stick/sharps injury/ splash of blood or body fluids

- In case of blood /body fluids splash to mucous membrane/ nonintact skin mucocutaneous exposure), wash the affected area thoroughly with the soap and water. Do not keep injured finger in mouth (unhealthy culture to be discouraged). If the eye is affected, wash it thoroughly with water.
- In case of needle stick injury, do not press immediately, instead keep the part low and allow to bleed a little by gravity.
- Afterwards wash with soap and water, dry the area and apply band aid/ dressing.
- Report all sharps injury as well as blood /body fluids splashes to the concerned authorities (ward sister, Infection Control Nurse (ICN), Nursing/Supdt etc.).
- Provide further treatment and continued surveillance of the employee as per hospital policy. In case the injury has occurred from the same sharp instrument being used for a Hepatitis B +ve patient, the healthcare worker should immediately be given Immunoglobulin and HBV vaccine.

3.7 LET US SUM UP

Proper waste management is one of the major tasks of any health care system or institution. Right from the source to the separation, handling, and treatment and then disposal, every step has to be managed with utmost care and perfection. Since segregation is the most important factor of waste management, it should be done at the source level, which eliminates subsequent confusion in handling the same, and does not infect the general waste. The principles laid down for the waste management, have to be followed diligently by everyone working in CCU.

In this unit you have learnt about disposal and management of Biomedical waste.

3.8 GLOSSARY

Bio-medical waste : Means any waste which is generated during the diagnosis, treatment of immunization of human beings or animals or in research activities pertaining thereto or in Schedule 1:

Disinfection : Treatment to reduce the number of microorganism to safe or relatively safe level.

Incineration : is a high temperature dry oxidation process that reduces organic and combustible waste to inorganic incombustible matter and results in a very significant reduction of waste volume and weight. It is usually selected to treat wastes that can not be recycled, reused, or disposed of in a landfill site.

Recycling : Collection of waste materials for reuse or production of new products.

Sanitary Land filling : An engineering method of disposing solid waste or land in such a manner that protects the environment.

Segregation : is the key to any waste management scheme. Segregation (separation) means separation at the point of generation according to the category of waste into different containers. Proper separation and identification of health care waste is important for effective health care management, and to minimize the quantities of waste requiring specialized treatment.

3.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

i) Categories of Bio-medical waste as per Govt. of India.

Waste Category

Human Anatomical waste (human tissues, organs body parts).

Animal Waste animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research; waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses.

Microbiology and Biotechnology Waste

Wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures.

Waste sharps needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts include both used and unused sharps.

Discarded Medicines and Cytotoxic drugs wastes comprising of outdated, contaminated and discarded medicines.

Solid Waste Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, linen, beddings, other material contaminated with blood.

Solid Waste wastes generated from disposable items other than the waste sharps such as tubings catheters, intravenous sets etc.

Liquid Waste waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities).

Incineration Ash ash from incineration of any bio-medical waste.

Chemical waste chemicals used in production of biologicals, chemicals used in disinfection, insecticides, etc.

ii) Colour coding of Bio-medical waste as per Govt. of India.

Disposal of Bio-Medical Waste (Schedule II)

Colour coding	Type of Container	Waste Category	Treatment options as per Schedule I
Yellow	Plastic Bag	Cat.1, Cat.2, Cat.3, Cat. 6	Incineration/ deep burial
Red	Disinfected container/plastic bag	Cat.3 ,Cat.6, Cat.7	Autoclaving/ Microwaving/ Chemical Treatment
Blue/white translucent	Plastic bag/ puncture proof container	Cat.4, Cat.7	Autoclaving/ Microwaving/ Chemical Treatment & Destruction/ shredding
Black	Plastic Bag	Cat.5 &9 and Cat.10 (solid)	Disposal in secured landfill

Check Your Progress 2

Rules of biomedical waste management:

- Disinfect the waste so that it is no longer the source of pathogenic organisms.
- Reduce the bulk in order to reduce requirements for storage and transportation.
- Make waste unrecognizable for aesthetic reason.
- Make recyclable items unusable, e.g., cutting up syringes and damaging the needles.
- Recycling of infectious plastic wastes can be considered only after adequate disinfection /sterilization, e.g., glass, paper, corrugated cardboard, aluminium, X-Ray film, reclaimed silver from X-ray film, plastics (non-infectious components).
- Disposable items like gloves, syringes, etc., should be mutilated after use to prevent illegal packing and reuse.
- Waste minimization can be done by:
  - Purchase of reusable items made of glass, rubber, metal, etc.
  - Select non-PVC plastic.
  - Strengthen sterilization procedure.
  - Adopt proper procedure and policies of BMW management.
  - Establish effective sound recycling policy.
- There should be three types of containers available at each point separately for general waste, infected non-sharp waste and infected sharp waste.
- Color-coding of bags is done as per rules.
- Needles, syringes other sharp instruments and objects, should be placed in a puncture-resistant plastic/metal container at the workstation.

- Needle, syringes and such other items should be boiled, hydroclaved/autoclaved or chemically disinfected and then disposed.
- Alternatively, transport sharps to a central site for treatment, reuse containers if at all only after cleaning and disinfecting.
- Forty per cent needle prick injuries are due to recapping /resheathing, so do not recap.
- Reusable glass syringes and needles are treated as follows before sterilisation.
  - Aspirate hypochlorite solution.
  - Immerse in flat tray for 20 minutes.
  - Rinse with water several times.
- Chemical disinfection prior to disposal is required for sharps, disposable infectious plastics/rubber, infectious glassware, blood and body fluids, by:
  - Using one per cent hypochlorite or equivalent disinfectant. Proper concentration is essential.
  - Ensuring all surfaces come in contact with chemical (including lumen).
  - Contact time at least 30 minutes.
  - Changing chemical solutions frequently at least once a day.
  - Always handle with gloves and masks. Apron and boots to be used if splashing is expected.
  - Use sharp decontaminating unit made up of outer, solid plastic puncture proof and inner perforated container with handles and filled 1/3 with hypochlorite.
- Do not chemically treat incinerable waste.
- Use available chemical disinfectants as per rules.
- Clean air, clean bedding and hygienic method of dust removal by wet mopping or vacuum cleaning must be recognized as basic requirement of housekeeping.
- Mistakes in segregation are to be corrected by housekeeping or nursing staff.

3.10 REFERENCES

1) *A manual of Hospital Waste Management*, Bombay Municipal Corporation, Mumbai.

2) Government of India. (1998). The Gazette of India. Extraordinary Part II-Section 3–Sub section (ii).New Delhi: Monday, July 27.

3) Government of India. (2000). *The Bio-Medical Waste (management and handling)* (Amendment) Rules & *The Bio-Medical Waste (management and handling)* (Second Amendment) Rules, 2000. The Gazette of India. Extraordinary Part II- Section – Sub section (ii). New Delhi: Tuesday, March 7, 2000.

4) Kishore J and Ingle GK. (2004). *Biomedical Waste Management in India.* New Delhi:Century Publications.

5) Reddy T. Sriniwas (2006). *"Health Care Associated infection Control Manual"* 1st Edn. Paras Medical Book Pvt. Ltd., Hyderabad.

6) The Trained Nurses Association Of India, (2007). *Fundamentals of Nursing, A procedure Manual.*

7) WHO (2005). *Safe Management of Bio-Medical Sharps Waste in India.* New Delhi: http://www.searo.who.int/LinkFiles/SDE_mgmt-bio-medical.pdf accessed on 9th October 2009.

NOTES

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