**Management of Health Care Waste**

Health care waste is a potential reservoir of pathogenic microorganisms and requires appropriate, safe, and reliable handling. Safe management of health care waste is a key issue in controlling and reducing HAIs. There should be a person or persons responsible for the organization and management (collection, storage, and disposal) of waste. Waste management should be conducted in coordination with the infection-control team. The purpose of proper waste management is to:

* Protect people who handle waste items from accidental injury
* Prevent the spread of infection to patients, clients, and HCWs
* Prevent the spread of infection to the local community
* Safely dispose of hazardous materials (HAZMATs)

Waste from health care facilities can be:

-non-infectious

-infectious, or

-highly infectious.

Certain health care facilities may also generate hazardous waste.

1. **Non-infectious (noncontaminated) waste**

* Non-infectious (noncontaminated) waste poses no infectious risk to persons who handle it.
* Examples of non-infectious waste include paper, trash, boxes, bottles, and plastic containers that contain products delivered to the health care facility.
* It is estimated that approximately 85 percent of the waste generated in hospitals is noninfectious.

1. **Infectious (contaminated) waste**

* Infectious (contaminated) waste is potentially infectious or toxic if it is not disposed of properly.
* Contaminated solid or liquid waste with includes the following:

Blood, body fluids, secretions, or excretions

Items such as sharps and used dressings that have come in contact with blood, body fluids,

secretions, or excretions

 Medicines, medical supplies, or other chemicals that might be toxic

**Principles of Waste Management** Steps in the management of health care waste are as follows: 1. Generation 2. Segregation (separation) 3. Collection 4. Transportation 5. Storage 6. Treatment 7. Final disposal

The following principles are a general guide to waste management in a health care setting:

 Develop a waste management plan that is based on an assessment of the current situation and that minimizes the amount of waste generated.

 Segregate clinical waste in dedicated colour-coded containers with appropriate bin liners. If colour-coded bins and liners are not available, label the containers used.

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Transport waste in a dedicated covered cart or trolley. Ensure that the carts or trolleys used for the transport of segregated waste collection are not used for any other purpose. They should be cleaned regularly. Transport different categories of waste separately.

 Store waste in specified areas with restricted access. Identify a storage area for waste prior to treating or moving it. Mark the storage areas with a biohazard symbol.

 Collect and store sharps in sharps containers.

 Waste handlers should use appropriate PPE and practice hand hygiene after handling waste.

**Waste Generation** Waste generation refers to the quantity of materials or products that enter a waste stream before compositing, incinerating, or recycling. Waste is generated during patient management and care and in other areas of the health care setting. **Waste Segregation** Segregate contaminated and noncontaminated wastes at the point of generation. Separating wastes minimizes costs by reducing the volume of contaminated waste that must be treated with the expensive procedures that are required for managing and disposing of contaminated waste properly.

 Use appropriate colour-coded separate containers for noninfectious, infectious, and highly infectious waste.

 Fill the waste containers not more than three-quarters full.

 Use colour-coded bins and bin liners or label the waste containers (see Figure 14).

 Never

Never sort through contaminated wastes. Do not try to separate noncontaminated waste from

contaminated waste, or combustible from noncombustible waste, after they have been combined. 

**Preferred Method of Disposal of Sharps and Sharps Containers** The main risk that is associated with infection comes from sharps contaminated with blood. Sharps include all objects and materials that pose a potential risk of injury and infection because of their puncture or cutting properties (syringes with needles, blades, wires, broken glass, etc).

 Place sharps in safety boxes that are resistant to punctures and leakage and are designed so that items can be dropped in using one hand and no item can be removed. The safety box should be marked *“Danger Contaminated Sharps”* and with the biohazard symbol indicated on the outside of the box. It should be closed when three-quarters full and then placed in a yellow plastic bag or containers with other hazardous health care waste for removal from the procedure area for disposal.

 Do *not* handle sharps unnecessarily.

 Always put on heavy-duty gloves when handling sharps waste containers.

 In particular, discard all disposable syringes and needles immediately after they are used. The

needle should not be recapped or removed from the syringe—the whole combination should be inserted into the safety box directly after use.

 Destroy sharps together with the hazardous health care waste.

The method of choice for destruction of full safety boxes is incineration, preferably in an

appropriate double-chamber incinerator.

Under exceptional circumstances, full safety boxes may be incinerated in small numbers by

open burning.

The residues of incineration should be safely buried at a depth greater than 1 meter.

 Do not, under any circumstances, dispose of used syringes, needles, or safety boxes in normal garbage or dump them without prior treatment.

***Figure 15: Example of a sharps safety box***

Note: *Sharps are one of the most hazardous health care wastes in a health care facility. They pose great danger to HCWs, waste-management operators, and individuals who scavenge in waste disposal sites.*

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**Encapsulation** Encapsulation is recommended as an alternative method to safely dispose of sharps when burning or burying them is not possible. For encapsulation, sharps are collected in puncture-resistant and leak-proof containers. When the container is three-quarters full, a material such as cement, plastic foam, or clay is poured into the container until it is completely filled. After the material has hardened, the container is sealed and buried. It is permissible to encapsulate chemicals or pharmaceutical waste together with sharps. **Disposal of Liquid Contaminated Waste** Liquid contaminated waste requires special handling, because it could pose an infectious risk to HCWs who handle it. Wastewater from health care facilities might contain various potentially hazardous components, such as microbiological pathogens, hazardous chemicals, pharmaceuticals, and radioactive isotopes. The following basic precautionary practices can reduce the public health risk that is associated with liquid waste and wastewater:

 Always neutralize effluents of all medical-analysis laboratories in a buffer tank before draining them off into the sewer.

 Sterilize blood and other cultures and stocks of infectious agents from laboratory work by steam sterilization (autoclaving) at the earliest opportunity, prior to disposal.

 Discharge radioactive effluents of isolation wards into the sewer or into a septic tank only after they have decayed to background level in adequate retention tanks.

 Wear PPE, including utility gloves, protective eyewear, and a plastic apron when handling and transporting liquid waste.

 Pour waste down a utility-sink drain or a flushable toilet and rinse with water, but avoid splashing. If no sewage system is available, dispose of liquid waste in a deep, covered hole, not into open drains.

 Decontaminate containers by placing them in a 0.5 percent chlorine solution for 10 minutes before washing and rinsing them.

 Remove utility gloves and wash hands and dry hands or use antiseptic handrub.

**Disposal of Solid Waste (Contaminated and Noncontaminated)** Dispose of contaminated wastes separately from noncontaminated waste, because contaminated waste needs the following special handling:

 Wear heavy-duty or utility gloves when handling and transporting solid wastes.

 Place the solid contaminated waste in a plastic or galvanized metal container with a tightly fitting cover.

 Ensure that there are a sufficient number of waste containers, in convenient locations, to minimize carrying contaminated wastes from place to place.

 Collect the waste containers on a regular basis and transport the burnable ones to the incinerator or area for burning.

 Remove gloves and wash and dry hands or use an antiseptic handrub.

 Noncontaminated solid wastes should be managed at the health care-facility level or through the local authority disposal system.

*National Infection* Do not discard any solid waste, contaminated or noncontaminated, into the sewer system (including conduits, pipes, and pumping stations). **Disposal of Hazardous Waste** Hazardous waste material refers to chemical and pharmaceutical waste, as well as any waste that contains heavy metals. Hazardous waste should be incinerated or buried if the quantity is very small. A large quantity of such materials should be sent back to the original supplier. **Special Waste Situations** The following types of waste require special handling. ***Pathological Waste*** Pathological waste includes all organs (including placentas), tissues, blood, and body fluids, which should be handled according to these guidelines:

In operation theatres, all anatomical waste and placentas should be collected separately in a red- coloured bin with a red bin liner.

 Anatomical waste and placentas should be dropped into a concrete-lined placenta pit or buried at a depth greater than 1 meter, inside the health care facility compound in a location totally enclosed and secured from unauthorized access, and at least 100 meters away from any underground water well.

 Anatomical waste that cannot be transported and disposed of immediately should be stored in the mortuary.

 If a patient or family member wants to take home the placenta or body parts for burial, first place them in a plastic bag and then into a rigid container for transport.

***Infectious Waste*** Infectious waste refers to all biomedical and health care waste known or clinically assessed to have the potential of transmitting infectious agents to humans or animals. It should be handled according to these guidelines:

 Place infectious waste in a yellow bin with yellow bin liners marked *“Danger Hazardous Medical Waste.”* When a bag is no more than three-quarters full, seal it with appropriate adhesive tape, remove it, and replace it immediately with a new bag.

 Incinerate infectious waste in double-chamber incinerators; dispose of ashes from the incinerator in an ash pit.

In densely populated areas, use an incinerator that reaches 1,200o C, if possible.

In other areas, use decentralized, low-cost incinerators.

 Health centres and dispensaries may burn infectious waste in oil drum incinerators.

Sanitary landfill or burial is an alternative solution when underground water is not at risk for contamination. But be careful to dispose of solid waste on land in a manner that can protect the environment. For example, spread the waste in thin layers, compact it to the smallest practical volume, and then cover it with soil at the end of each working day. ***Hazardous Pharmaceutical Waste and Cytotoxic Waste*** Hazardous pharmaceutical waste and cytotoxic waste refers to expired pharmaceuticals or pharmaceuticals that are unusable for other reasons (for example, a callback campaign). Pharmaceutical waste can be hazardous (cytotoxic) or nonhazardous.

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 Hazardous pharmaceutical waste should be repacked in specific cardboard boxes that have been marked *“Danger Hazardous Pharmaceutical and Cytotoxic Waste!”* The boxes should be returned to the pharmacy department, which should ensure their disposal at the central level.

 Hazardous pharmaceutical waste should be discharged only into the sewerage system or into a septic tank after it has decayed to background level in adequate retention tanks.

**Methods of Final Disposal of Wastes *Incineration*** Incineration is the controlled burning of solid, liquid, or gaseous combustible wastes to produce gases and residues that contain little or no burnable material. Incineration provides high temperatures and destroys microorganisms. It also reduces the volume of waste to be buried and is the best method for disposing of contaminated wastes. Simple incinerators can be built from locally available materials—bricks, concrete blocks, or used fuel or oil drums. In general, such an incinerator is useful only for small, usually rural, health care facilities that do not have large quantities of medical waste. If the health care facility is large, it is more efficient to build or install an incinerator large enough to accommodate all of the facility‟s waste-disposal needs. To build a drum incinerator:

 Choose a place that is downwind from the clinic to prevent smoke and odours from coming into the health care facility and the neighbouring communities.

 Make sure there are sufficient air inlets on the sides of the oil drum and bottom of the fire bed.

 Place the incinerator on hardened earth or on a concrete base.

For efficient burning, follow these practices:

 Burn only medical waste.

 Treat the

Treat the ash as general waste.

 Use a regular community disposal site for general waste. This will conserve both time and resources.

 Medical waste might not burn easily, especially if it is wet. Add kerosene to make the fire hot

enough to burn all waste. Be sure to add the kerosene before starting the fire—adding kerosene after the fire has started might cause an explosion.

 Bury or otherwise dispose of the ash in a designated area.

The following waste should not be incinerated:

 Pressurized gas containers (aerosol cans)

 Large amounts of reactive chemical waste

 Silver salts and photographic or radiographic wastes

 Plastic containing polyvinyl chloride (blood bags, IV sets, or disposable syringes)

 Waste containing high mercury or cadmium content, for example, broken thermometers, used batteries, and lead-lined wooden panels

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***Burial*** Only contaminated and hazardous waste needs to be buried. For effective and safe burial, follow these guidelines:

 The disposal site should be fenced and off limits to unauthorized persons.

 The burial site should be lined with a material of low permeability, if possible.

 Select a site at least 50 meters away from any water source to prevent contamination of the water table.

 The site should have proper drainage, be located downhill from any wells, free of standing water, and not be in a flood-prone area. The site should not be located on land that will be used for agriculture or development.

To make and use a small burial site for waste disposal, follow these guidelines:

 Find an appropriate location as described above.

 Dig a pit 1-meter square and 2 to 5 meters deep. The bottom of the pit should be 2 meters above water level. Consult the local water engineer or water authority for information about the location of the water table.

 Fence in the area to keep out animals, scavengers, and children.

 Dispose of the contaminated waste in the pit and cover the waste with 10 to 15 centimeters of soil each day. The final layer of dirt should be 50- to 60-centimeters thick and compacted to prevent odors, to keep from attracting insects, and to keep animals from digging up the buried waste.

 Depending on the volume, such a pit should last for 30 to 60 days.

 When the level of the waste reaches within 30 to 50 centimeters of the surface of the ground, fill the pit with dirt, seal it with concrete, and dig another pit.

***Burning*** Burning can be used for combustible, noninfectious waste such as paper. This should be carried out in a simple pit hole and not in the open. Crude tipping or disposing of waste in open sites should be avoided, because it poses infection risks and fire hazards, produces a foul odour, attracts insects, and is unsightly. **General Tips for Waste Disposal**

Use heavy-duty utility gloves and appropriate PPE when handling wastes.

Decontaminate and clean gloves between uses.

Handle wastes carefully to avoid spills or splashes and wear a complete PPE set.

Always wash your hands after removing gloves and handling contaminated wastes.

Avoid transferring contaminated waste from one container to another.

Incineration is the preferred method for waste disposal, as the heat will generally be sufficient to destroy infectious microorganisms and will also prevent scavenging and reuse of discarded items.

If incineration is not possible, then careful burial is the next best alternative.

Dispose of used toxic chemicals or medicine containers properly:

Rinse glass containers thoroughly with water. Glass containers may be washed with

detergent, rinsed

For plastic containers that contained toxic substances, such as glutaraldehyde, rinse three

times with water and dispose of by incineration, burial, or both. These containers may be used for sharps-disposal containers, but do not reuse them for any other purpose.

Equipment that is used to hold and transport wastes must not be used for any other purpose

**Treating Infectious Waste** Infectious waste can be treated by the methods described below to render it noninfectious before disposal. ***Autoclave***

 Autoclaves must be operated at a minimum temperature of 121o C for a minimum of 60 minutes.

 Each package of waste in a load should have heat-sensitive tape or the equivalent to indicate the attainment of adequate temperature conditions.

 All autoclaves must be evaluated monthly under full-load conditions for effectiveness against spores. Those that fail to achieve satisfactory spore-test results should be removed for repair or replacement.

***Chemical Treatment of Cultures***

 Sodium and potassium hypochlorite at 15 percent v/v concentration are approved chemical solutions for treating surface colonies and colonies in suspensions.

 All cultures should be submerged for a minimum of 20 minutes to ensure that waste is rendered noninfectious.

 Cultures can be incinerated.

**Decontamination of Used Instruments and Equipment** Decontamination is the first step in handling used instruments and equipment. **Decontamination Solution** The recommended decontamination agent is a 0.5 percent chlorine solution. Make a fresh solution every morning, or after 8 hours, or more often if the solution becomes visibly dirty. A 0.5 percent chlorine solution can be made from readily available liquid chlorine or chlorine tablets (NaDCC). The formula for making a dilute solution from concentrated solutions is as follows: Total Parts (TP) water = (percentage chlorine in manufacturers concentration ÷ % desired chlorine concentration) - 1 Mix 1 part concentrated bleach solution with the total parts water required. Example: To make a 0.5 percent chlorine solution from 5 percent concentrated chlorine solution: TP water: (5.0% ÷ 0.5%) - 1= 10 - 1 = 9 Add 1 part concentrated solution to 9 parts water. Cover containers containing 0.5 percent chlorine solution and protect them from light. *Note: Do not mix chlorine solutions with ammonia-based solutions, because toxic gas might be produced.* **Decontaminating Equipment** Decontaminate large surfaces that might have come in contact with blood and body fluid, such as pelvic-examination, operating, or delivery tables. Wipe them with a cloth soaked in the 0.5 percent chlorine solution. **Decontaminating Used Instruments and Other Items** Keep surgical or examination gloves on after completing the procedure. Decontaminate the instruments while wearing the gloves:

 Immediately after use, place all instruments in an approved disinfectant, such as 0.5 percent chlorine solution, for 10 minutes to inactivate most organisms, including HBV and HIV.

 Use plastic, noncorrosive containers for decontamination to prevent sharp instruments from getting dull (due to contact with metal containers) and to prevent instruments from getting rusted (due to electrolysis between two different metals when placed in water).

 Remove instruments from 0.5 percent chlorine solution after 10 minutes and immediately rinse them with cool water to remove residual chlorine before thoroughly cleaning them.

 Remove gloves and dispose of them appropriately.

*Note: To prevent rusting, do not soak metal instruments in water for more than one hour, even if they are electroplated.* Once instruments and other items have been decontaminated, they can safely be cleaned and sterilized or high-level disinfected. **9.2 Cleaning** After decontamination and prior to disinfecting or sterilizing, all instruments and equipment MUST be cleaned to remove organic materials or chemical residue. If instruments and equipment are not cleaned properly, organic matter could prevent the disinfectant or sterilizing agent from making

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contact with the instrument or piece of equipment and might also bind and inactivate the chemical activity of the disinfectant. Ensure that all surfaces of instruments and equipment, including channels and bores, are cleaned. **Cleaning Agents** Use liquid soap or enzymatic detergent. Liquid soap suspends grease, oil, and other foreign matters in solution so that they can be removed easily by the cleaning process. Do not use an abrasive cleaner, such as steel wool, for household cleaning, because it can scratch the instruments, which creates potential sites for microorganisms to harbour. If an instrument or piece of equipment cannot be cleaned thoroughly, then do not sterilize or disinfect it—discard it. It should not be reused. **Cleaning Methods *Manual Cleaning*** Follow this procedure to clean instruments manually:

 Wear PPE (a plastic apron, thick rubber gloves, eye protection, a surgical mask or face shield, or both).

 Remove any gross soiling on the instrument by rinsing it in water.

 Take the instrument fully apart and immerse all parts in warm water with a detergent

(biodegradable, noncorrosive, nonabrasive, low-foaming and free-rinsing) or enzymatic cleaner.

 To prevent splashing, keep the items being washed under the surface of the water.

 Rinse in clean water.

 Dry the instrument in a drying cabinet or by using a clean, lint-free cloth.

 Inspect the instrument to ensure it is clean.

 Pay particular attention to instruments with teeth, joints, or screws where organic material can collect. Open all jointed instruments.

***Mechanical Cleaning*** Most modern sterilization units are automated and require minimal handling of dirty equipment by staff. The equipment is placed in trays ready for washing:

 The washing machine gives a cold rinse followed by a hot wash at 71°C for two minutes. This is followed by a 10-second hot-water rinse at 80°C-90°C and then drying by a heater or a fan at 50°C-75°C.

 The washer-disinfector is used for anesthetic equipment. It runs a 45-minute cycle of washing and cleaning, plus a two-minute cycle with water at 80°C-100°C and a detergent solution.

 The ultrasonicator is a sophisticated and expensive, but extremely efficient, piece of equipment that dislodges all organic matter.

**Cleaning New Instruments** All new instruments are supplied without lubrication. Carefully wash and dry all new instruments and lubricate any moving part. Whenever cleaning, regardless of methods, keep ratchets unlocked and box joints open. When they are no longer new, do not let stained steel instruments come in contact with barium chloride, aluminum chloride, or compounds that contain bromide and iodine.

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**9.3 High-Level Disinfection** Disinfection removes microorganisms from instruments and equipment, but it is not a sterilizing process and it should not be used as a convenient substitute for sterilization. Disinfection is used to destroy organisms on delicate or heat-sensitive instruments that cannot be sterilized or when singleuse items are not available. It is not appropriate for instruments that will be used in critical sites, because these instruments must be sterile. Different products and processes provide different levels of disinfection, which are classified as follows: *1. High-level disinfection (HLD)* destroys all microorganisms except some bacterial spores (especially if there is heavy contamination). 2. *Intermediate disinfection* inactivates *Mycobacterium tuberculosis,* vegetative bacteria, most viruses, and most fungi, but it does not always kill bacterial spores. 3. *Low-level disinfection* can kill most bacteria, some viruses, and some fungi, but it cannot be relied on to kill more resistant bacteria such as *M. tuberculosis* or bacterial spores. Although sterilization is the safest and most effective method for the final processing of instruments, it might not always be available or suitable. In these cases, HLD is the only acceptable alternative. High-level disinfection can be achieved by steaming or by using chemical disinfectants. **How to Prepare a High-Level Disinfection Container** For metallic containers, boil water in the covered container for 20 minutes, and then pour out the water. Replace the cover and allow the container to dry. For a plastic container, take the cover off and immerse both the container and cover in 0.5 percent chlorine solution (the container itself should be filled with the solution), and leave both to soak for 20 minutes. Rinse the cover and the inside of the container three times with boiled water and allow them to air dry. Large metal containers cannot be used for HLD using chemicals. **High-Level Disinfection by Steaming** The procedure for HLD by steaming is described below: 1. Place instruments and other items in one of the steamer pans with holes in its bottom. Do not overfill the pan. 2. Repeat this process until as many as three steamer pans have been filled. Stack the filled steamer pans on the top of a bottom pan containing water for boiling. A second empty pan without holes should be placed on the counter next to the heat source. 3. Place the lid on the top pan and bring the water to a full rolling boil. 4. When steam begins to come out between the pans and the lid, start the timer or note the time on the clock and record the time in the HLD log. 5. Steam items for 20 minutes. 6. Remove the top steamer pan and put the lid on the pan that was below it. Gently shake excess water from the pan just removed. 7. Put the pan you just removed onto the empty pan. Repeat until all pans are restacked on this empty pan and the top pan is covered with the lid. 8. Allow items to air dry in the steamer pan before using them. 9. Using HLD forceps, transfer the dry items to a dry, HLD container with a tightly fitting cover.

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Instruments and other items can also be stored in the stacked and covered steamer pans as long as a bottom pan (the one with no holes) is used. **High-Level Disinfection with Chemicals** Chemical disinfection is used most commonly for heat-labile equipment (for example, endoscopes) where single-use equipment is not cost-effective. ***Selecting a Disinfectant*** Different grades of disinfectants are used for different purposes. Only instrument-grade disinfectants are suitable to use on medical instruments and equipment. Hospital-grade or household-grade disinfectants are suitable for environmental purposes only and should never be used on instruments. Glutaraldehyde is generally the most appropriate chemical disinfectant for high-level disinfection. However, this chemical must be used under very strictly controlled conditions and in a safe working environment. If the disinfectant is a multi-use solution, it is important to store it correctly and according to the manufacturers‟ instructions. Be careful not to contaminate the solution when pouring it out for use. The following products should not be used as disinfectants, because they are antiseptics:

 Acridine derivatives

 Cetrimide

 Chlorohexedine gluconate and cetrimide in various concentrations

 Chloroxynelol in alcohol

 Alcohols

 Lodophors

***Steps in Chemical High-Level Disinfection*** Health care workers should wear PPE and follow these instructions when they perform chemical HLD: 1. Decontaminate by soaking instruments for 20 minutes in 0.5 percent chlorine solution that has been prepared using clean water or 2 percent to 4 percent glutaraldehyde or 6 percent hydrogen peroxide. 2. Disassemble, clean, and dry all instruments. 3. Completely immerse all items in the high-level disinfectant. 4. Remove items using HLD (or sterile) forceps and handle items wearing sterile gloves. 5. Rinse items well with sterile water (or boiled and filtered water) three times and air dry them. 6. Use items promptly or store them in a dry, HLD container with tightly fitting lid. ***Factors That Affect High-Level Disinfection*** Several factors affect the HLD process:

 The type and concentration of the disinfectant used

 The Ph of the disinfectant

 The presence of organic or inorganic matter

 The nature of the items to be disinfected

 The number of microorganisms present (More microorganisms require more time.)

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 Resistance of microorganisms:

Some microorganisms are more resistant to disinfection than others, for example, bacterial

spores, mycobacteria, hydrophilic viruses, fungi, vegetative bacteria, and lipid viruses, in that order.

Organisms flourishing in health care-facility environments (*Pseudomonas aeruginosa*, antibiotic-resistant microorganisms) have inherent resistance to certain disinfectants.

 The presence of organic materials such as blood, blood products, body fluids, and faeces that contain significant amounts of proteins that inactivate or slow the action of disinfectants

 Duration of exposure and temperature:

Longer exposures result in higher degrees of disinfection.

Higher temperatures increase the killing power of most disinfectants, whereas lower

temperatures slow the killing power.

 Surface texture (Rough surfaces—such as those with crevices, lumen, or hinges—need a longer time for disinfection.)

***Using Disinfectants*** Disinfectants should be supplied, preferably ready for use, from the pharmacy. If they are to be prepared at point of use (for example, chlorine solution is issued from the pharmacy undiluted), the HCW should follow the manufacturers‟ instructions to ensure that the correct dilution is used. New stocks should be supplied on receipt of empty containers. The health care-facility pharmacy should ensure the following:

 Containers should be thoroughly cleansed, washed, and dried.

 Containers should be clearly labelled with the type of contents, the in-use dilution, and the expiry date.

 None of the disinfectants should be exposed to inactivating substances, such as cork, rubber caps, or incompatible detergents.

Health care workers should follow these guidelines when using disinfectants:

 Do not use a disinfectant in an open container. Open containers of disinfectant should not be tolerated in any health care environment. There is a serious risk of contamination with multiple antibiotic-resistant bacteria such as *Pseudomonas* sp. and spores.

 Always thoroughly decontaminate and then clean articles before disinfecting them.

 When disinfectants are indicated for use on surfaces, wipe the surface. Do not wash, bathe, or flood-wash it.

***Disposing of Chemicals and Storing Containers*** Pour used chemicals carefully down a utility-sink drain or into a flushable toilet and rinse or flush with water. You can also pour liquid waste into a latrine. Avoid splashing. Do not leave partially filled containers on the wards. Do not use empty containers to store other solutions. Disinfectant containers must be thoroughly cleaned or sterilized before refilling between uses. Never top them up. Glass containers that are used for storing chemicals should be washed with soap, rinsed, dried, and reused. Alternatively, thoroughly rinse glass containers with water and dispose of them by burying. Plastic containers that are used for toxic substances should be rinsed with water and disposed of by burning or burying. They should never be reused. To further prevent them from being reused, put a hole in each container before disposal so that it will not hold water or other liquids. Chemical disinfectants should be stored in a cool, dark place.

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*Notes: Disinfectants should be diluted in manageable quantities, for example, 5 liters or less, to reduce waste. Only knowledgeable personnel should dilute disinfectants.* **9.4 Sterilization** Sterilization is the destruction of all microorganisms (bacteria, viruses, fungi, and parasites), including bacterial endospores, from instruments and other items. Sterilization protects patients and is recommended for all instruments and other items that will come in contact with the blood stream or tissues under the skin, as well as on drapes and some surgical attire. Items and equipment can be sterilized by either physical or chemical methods, such as the following:

 High-pressure steam (autoclaving)

 Dry heat (oven)

 Chemical soaking (cold sterilization)

Heat, either steam or dry, is the most effective method of sterilization and is reliable if monitored carefully. It is also less expensive than chemical methods. Heat should be considered first for all medical equipment that can withstand it. Where heat cannot be used, chemicals such as ethylene oxide and glutaraldehyde are the best alternative. Before sterilizing any instrument or equipment ensure that it can withstand the process (e.g., steam under pressure), has been adequately cleaned, and does not require any special treatment. Records should be kept of the sterilization process and for the traceability of instruments. **Wrapping Items for Sterilization** All materials must be wrapped before sterilization. Wrapping helps prevent recontamination after sterilization and prior to the item‟s use. Only wrapped or packed sterilized materials should be described as sterile. The properties of the wrapping material should allow it to act as a barrier against dust particles, to repel water, and to provide an adequate seal of the contents. The wrapper should resist tears and punctures, and be free of holes and toxic ingredients. The sizes necessary to wrap the instruments and items to be processed must be available in sufficient quantities and be stored in a manner that allows HCWs‟ access. All wrappers must be lint free. Wrappers have to completely enclose the instrument or item. The edges need to be properly folded so the tool can be aseptically presented during a procedure. While the edges and corners of the wrapper need to be tucked in, there should not be excessive wrapping material on and around the item as this interferes with the sterilant‟s penetration. Plus, if the wrapper is to be used as a sterile field, it should provide a field of at least six inches beyond the four sides of the table. The wrappers should be used sequentially or simultaneously to wrap the contents. Pins, staples, paperclips, and other sharp objects should never be used to secure a wrapped item. All sterile packages should be handled as little as possible. **Autoclaving** Autoclaving is the use of high-pressure steam to sterilize equipment and instruments. ***Types of Autoclaves*** There are several types of autoclaves:

 Downward (gravity) displacement sterilizers (jacketed and nonjacketed). These are designed for sterilizing waste, solutions, and instruments.

 Self-contained (bench-top) sterilizers. These are recommended for office-based practices, as they are suitable for relatively few or simple items. Bench-top sterilizers do not take wrapped items, which means items must be used immediately after they are removed from the sterilizer.

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 Pre-vacuum (porous load) sterilizers. These are suitable for sterilization of clean instruments, gowns, drapes, toweling, and other dry materials that are required for surgery.

***Guidelines for Operating and Maintaining Autoclave Machines*** An autoclave machine will reliably sterilize items only when it is kept in good working condition and operated correctly. Instructions for the operation and routine maintenance of autoclave machines should be included in HCWs‟ basic training. To ensure proper steam contact, first decontaminate, clean, and dry objects before autoclaving, and then follow these instructions:

 Keep instruments disassembled, opened, and unlocked.

 Do not stack the instruments.

 Do not wrap the packages too tightly.

 Do not arrange the packs in the sterilizer too close to each other.

 Position the containers in a way that air can easily be displaced and steam can have enough

contact with all surfaces.

 Ensure that the small drain strainer at the bottom of the sterilizer is not clogged. This could result

in trapping air inside the sterilizer.

 Maintain the appropriate temperature, timing, and adequate moisture during any autoclaving cycle:

121°C throughout the process

20 minutes for unwrapped items and 30 minutes for wrapped items

100 percent moisture in the steam

 Follow specific operating instructions from the manual that was supplied by the manufacturer.

 Ensure that there is at least 7-8 centimeters (3 inches) of space between the packages and the

autoclave chamber walls.

 Place bottles, solid metal, and glass containers on their sides with lids held loosely in place.

 Place instruments trays (mesh or perforated bottom only) flat.

 Do not overload the sterilizer or make packs too large.

 Apply an autoclaving tape on the pack of instruments to indicate whether a specific temperature

or pressure has been reached.

 Double wrap items using correct wrapping material (cloth, muslin, or kraft).

 Consult the manufacturer‟s manual for proper maintenance of the sterilizer. In some cases, however, a weekly flush of hot liquid soap through the exhaust line will keep it cleaned out.

**Dry-Heat Sterilization** Dry-heat (hot air) sterilization destroys pathogens by the process of oxidation. Dry-heat sterilization can be achieved with a simple oven as long as a thermometer is used to verify the temperature inside the oven. Dry-heat sterilizers have had limited value, because it is difficult to maintain the same temperature throughout the load, while the high temperatures and the length of time required to achieve sterility make this method undesirable for many situations. Use dry-heat sterilization only for items that can withstand a temperature of 170 C (340 F).

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Decontaminate, clean, and dry all instruments and other items before sterilizing them. The manufacturers‟ instructions must be followed, and the door to the unit must not be opened while it is in the sterilizing cycle. Follow these guidelines for sterilizing items using dry heat:

 Wrap instruments in aluminum foil or place in a metal container with a tightly fitting, closed lid to help prevent recontamination prior to use. When using dry heat to sterilize items wrapped in cloth, be sure that the temperature does not exceed 170 C (340 F).

 Instruments with cutting edges should be sterilized at lower temperatures (160 C [320 F]), because higher temperatures can destroy the sharpness of cutting edges.

 Place loose instruments in metal containers or on trays in the oven and heat to the proper

temperature.

 After the appropriate temperature is reached, begin timing. Depending on the temperature

selected, the total cycle time (preheating, sterilization time, and cool down) ranges from 2.5 hours at 170°C to more than 8 hours at 121°C. The recommended length of time depends on the temperature:

60 minutes at 170°C (340°F)

120 minutes at 160°C (320°F)

150 minutes at 150°C (300°F)

180 minutes at 140°C (285°F)

Overnight at 121°C (250°F)

 After cooling, remove packs or metal containers (or both) and store in a cool dry area. Loose items should be removed with sterile forceps and used immediately or placed in a sterile container with a tightly fitting lid.

**Chemical Sterilization** Chemical sterilization, often called *cold sterilization*, is an alternative to high-pressure steam or dryheat sterilization, particularly for items that would get damaged by high-pressure steam or dry heat. Glutaraldehyde is often used for chemical sterilization. Because glutaraldehyde works best at room temperature, chemical sterilization cannot be assured in cold environments (temperatures less than 20oC or 68oF), even with prolonged soaking. First decontaminate, clean, and thoroughly dry all instruments and other items to be sterilized— water from wet instruments and other items dilutes the chemical solution, thereby reducing its effectiveness—and then follow these steps for chemical sterilization: 1. Follow the manufacturers‟ instructions to prepare a 2 percent glutaraldehyde solution or appropriate concentration of another chemical solution. After preparing the solution, put it in a clean container with a lid. Always mark the container with the preparation date and the expiration date. 2. Open all hinged instruments and other items and disassemble those with sliding or multiple parts. Completely submerge all instruments and other items in the solution. Place any bowls and containers upright, not upside down, and fill with the solutions. The solution must contact all surfaces to ensure sterilization. 3. Follow the manufacturers‟ instructions regarding the time necessary for sterilization. In general, if the solution contains 2 percent glutaraldehyde, cover the container and allow the instruments

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and other items to soak for 10 hours. Do not add or remove any instruments or other items after you begin timing. 4. Use large, sterile pickups (lifters, cheatle forceps) or sterile gloves to remove the instruments and other items from the solution. 5. Rinse items thoroughly with sterile water to remove the residue that chemicals leave on instruments and other items. This residue is toxic to skin and tissues. 6. Place the instruments and other items on a sterile tray or in a sterile container and allow them to air dry before use. Use the instruments and other items immediately or keep them in a covered and dry sterile container and use them within one week. *Note: Sterilizing chemicals should be changed after 14 days, when they become visibly dirty, or according to manufacturers’ instructions.* **Monitoring Sterilization Procedures** A variety of indicators can be used to monitor the sterilization process:

 Use biological Indicators at regular intervals: *Bacillus stearothermophilus*, weekly and as needed for steam sterilizers; and *Bacillus subtilis*, weekly and as needed for dry-heat sterilizers.

 Chemical indicators include tape or labels that monitor time, temperature, and pressure for steam sterilization; and time and temperature for dry-heat sterilization.

 Use external indicators to verify that items have been exposed to the correct conditions of the sterilization process and that the specific pack has been sterilized.

 Place internal indicators inside a pack or container in the area most difficult for the sterilization agent (steam or heat) to reach (for example, in the middle of the linen pack).

 Mechanical indicators for sterilization provide a visible record of the time, temperature, and

pressure for that sterilization cycle. This is usually a printout or graph from the sterilizer, or it can be a log of time, temperature, and pressure kept by the person responsible for the sterilization process that day. This is the least expensive way to make sure that the sterilization process was carried out according to the guidelines. **9.5 Storage** Proper storage of sterile instruments and equipment is essential in ensuring that the product maintains its level of sterilization or disinfection. Most instruments and equipment are dry and packaged once they have been sterilized. Store them in a clean, dry environment that is protected from any damage. The storage area should be separate, enclosed, and located next to or connected to the area where sterilization occurs. (In smaller clinics, this area may be just a room close to the Central Supplies Department or in the Operating Room.) The area should be used solely to store sterile and clean supplies for patient care. Access to this area should be limited. **Instructions for Storing Sterile Items**

 Keep the storage area clean, dry, dust-free, and lint-free.

 Keep the temperature at approximately 24⁰C and the relative humidity below 70 percent when possible.

 Store sacks and containers with sterile (or high-level disinfected) items 20-25 centimeters off the floor, 45-50 centimeters from the ceiling

Do not use cardboard boxes for storage. Cardboard boxes shed dust and debris and can harbour insects.

 Date and rotate the supplies (first in, first out). This process serves as a reminder, but does not guarantee the sterility of the packs.

 Distribute sterile and HDL items from the storage area.

 Clean supplies, HLD items, and sterile supplies should not be stored together, that is, supplies that have been cleaned, but not sterilized or disinfected, should be kept separate from items that have been disinfected, etc.

 Unwrapped items should be used immediately and should not be stored.

**Shelf Life** The shelf life of an item after sterilization is event related:

 The item remains sterile until something causes the package or container to become

contaminated—the time that has elapsed since sterilization is not always the determining factor.

 To make sure items remain sterile until you need them, prevent events that can contaminate sterile packs, and protect them by placing them in plastic covers (thick polyethylene bags).

 Before using any sterile item, look at the package to make sure the wrapper is clean, dry, and intact; the seal is unbroken, and no water stains are present.

 If the quality of wrapping cloth is poor and plastic bags are not available, limit the shelf life to help ensure the sterility of the instruments.

**LAUNDRY AND LINEN PROCESSING**

Housekeeping and laundry personnel should follow these general guidelines in all stages of processing linen:

 Wear PPE such as gloves and gowns or aprons as indicated when collecting, handling,

transporting, sorting, and washing soiled linen. Wash reusable utility gloves after use, allow them to air dry, and discard if punctured or torn.

 Wash your hands whenever you change or remove gloves.

 When collecting and transporting soiled linen, handle it as little as possible and with minimum contact to avoid accidents, injuries, and spreading microorganisms.

 Consider all cloth items, such as surgical drapes, gowns, and wrappers, that have been used

during a procedure as contaminated and infectious. Even if there is no visible contamination, the item must be laundered.

 Never place soiled linen on the floor or any clean surfaces.

 Handle soiled linen with minimum agitation to avoid aerosolisation of pathogenic microorganisms. Do not shake linen.



Watch out for sharps, instruments, or broken glass that might be folded into linen or in the laundry bags.

 Do not sort or rinse linen in patient-care areas.

**Practices and Precautions in Laundry Facilities** Hand-washing facilities should be readily available in laundry facilities. Linen and carts for storing and transporting linen should be handled according to these guidelines:

 Separate clean from soiled linen.

 Use separate carts, labelled accordingly, for dirty and clean linens.

 Use procedures that minimize the risk of cross contamination when transporting linen by cart.

 Transport and store clean linen in a manner that prevents its contamination and ensures its cleanliness.

 Laundry carts or hampers used to collect or transport soiled linen should be covered.

Clean carts that are used to transport soiled linens after each use with the recommended cleaning product that is used in the health care facility.

Commercial laundries that are used for laundering linen from health care facilities should comply with the IPC policies and guidelines. In particular, adequate separation of clean and dirty laundry in the truck is essential to ensure that there is no possibility of mixing clean and dirty linens.

**Collecting, Sorting, and Transporting Soiled Linen Collecting Soiled Linen** Collect and remove soiled linen daily and also after each invasive medical or surgical procedure or as needed from patients‟ rooms. Collect used linen in cloth or plastic bags, containers with lids, or covered carts to prevent spills and splashes, and to confine the soiled linen to designated areas (interim storage areas) until transported to the laundry. If linen is heavily contaminated with blood or body fluids, carefully roll the contaminated area into the centre of the linen and place in a leak-proof bag or container with a lid. Large amounts of faeces or blood clots should be removed from linen with a gloved hand and toilet tissue and placed into a bedpan, toilet, or pit latrine. Tie bags securely when they are three-quarters full and transport them to the laundry area. **Sorting Soiled Linen** Carefully sort all linen in the laundry area before washing it. Do not presort soiled linen or wash linen at the point of use. Sorting must be carefully performed because:

 Soiled linen (large drapes and towel drapes) from the operating room or other procedure areas

occasionally contains sharps (scalpels, sharp-tipped scissors, hypodermic and suture needles, etc.).

 Bedding from patients‟ rooms might contain soiled dressing and be bloodstained or wet with other body fluids.

Follow these guidelines for sorting linens:

 Segregate soiled and nonsoiled linen and place used linen in appropriate bags at the point of generation.

 Place wet linen in a fluid-impervious bag for soiled linen or a regular plastic trash bag before depositing it in a cloth bag for soiled linen.

 Contain linen that is soiled with body substances or other fluids within suitable impermeable bags and close the bags securely for transportation to avoid any spills or drips of blood, body fluids, secretions, or excretions.

 The processing area for soiled linen must be separate from other areas such as those used for folding and storing clean linen.

 Ensure adequate ventilation and physical barriers between the clean and soiled linen areas.

 Always wear protective eyewear, utility gloves, gumboots, and a plastic or rubber apron while handling soiled linen.

 Wash hands after removing gloves.

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Cloth bags are adequate for the majority of patient-care linen. They require the same processing as their contents. This helps prevent spreading microorganisms to the environment, personnel, and other patients. Bags should be colour-coded according to the linen they contain:

Red-coded bags should be used for linen from patients with infectious conditions. Disinfect

linen before placing it in bags. Place linen in a strong impervious plastic bag to avoid leakage on the linen bag.

Yellow bags should be used for soiled linen.

White bags should be used for dirty linen from wards and departments and for clean linen

from the laundry.

 Green bags should be used for linen from special departments such as the operating theatre and the labour and delivery wards to be transported to the laundry.

 The storage time for soiled linen before washing is related to practical issues such as available space and aesthetics.

**Transporting Soiled Linen** Follow these guidelines for transporting soiled linen:

 Transport dry linen in sealed plastic bags to the laundry.

 Transport collected soiled linen in closed leak-proof bags, containers with lids, or covered carts to the processing area daily or more often as needed. It is not necessary to double-bag or use additional precautions for used linen from patients in isolation.

 Laundry workers should not carry wet, soiled linen close to their bodies even when they are wearing a plastic or rubber apron.

**OCCUPATIONAL SAFETY AND EMPLOYEE HEALTH** Health care workers are exposed to blood and other body fluids in the course of their work. Consequently, they are at risk of infection with blood-borne viruses including HIV, HBV, and HCV. In addition, they are at risk of contact diseases and respiratory infections. Risk of infection for HCWs depends on the prevalence of disease in the patient population, the nature and frequency of exposure, and their vulnerability. To eliminate or minimize the risk of infection, health care facilities must institute good health and safety measures and ensure that all HCWs adhere to them. These measures include the following:

 Relevant IPC training for HCWs

 Issuing PPE to HCWs

 Establishing an effective occupational health programme that includes immunization, PEP, and medical surveillance

**Policies for Occupational Safety and Employee Health** All health care facilities should institute as many engineering and work practice controls as possible to eliminate or minimize employees‟ exposure to blood, body fluids, and other potentially infectious materials:

 All HCWs should be knowledgeable about specific operating procedures pertinent to their work area.

 All supervisors should be responsible for informing HCWs of any special precautions pertinent to their areas of work.

 All HCWs should adhere to standard precautions and to additional precautions as necessary.

 All health care facilities should have PEP procedures in place.

 All HCWs should immediately report an incident of contact with blood or other potentially

infectious material that is sustained during the course of occupational duties, according to the PEP procedures.

 Susceptible workers,

Responsibility for compliance with IPC policies and guidelines, including PEP, rest with the supervisor and individual employee.

 HBV vaccine should be offered to all HCWs whose occupational tasks place them at risk of exposure to blood or other potentially infectious material

**Managing and Preventing Sharps Injuries Procedures for Sharps Injuries** Immediately following an exposure to blood or body fluids with visible blood, the HCW should follow these procedures:

 Wash sharps injury sites and cuts with soap and water. Do not squeeze the injury site.

 Irrigate eyes with clean water, or saline.

 Report to a designated person and receive the first dose of ARVs.

 Visit the designated clinician for initial assessment and counseling for follow-up testing and appropriate treatment.

 Assess the serological status of the source patient, if known.

 Obtain PEP based on HIV and hepatitis B status.

**Facility Interventions To Reduce Sharps Injuries** Eliminate the use of needles where safe and effective alternatives are available. When sharps must be used, follow these guidelines:

 Use devices with safety features and evaluate their use to determine which are the most effective and acceptable.

 Incorporate improved engineering controls (modifications in devices) into a comprehensive program. Examples of engineering controls include a sheath that can slide over a needle once

