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Ministry of Health

Infection Prevention And Control Guidelines For Health Care Facilities

July 26, 2010

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INFECTION PREVENTION

AND

CONTROL GUIDELINES

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HEALTH CARE FACILITIES

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FOREWORD

Over the past few decades, the world has seen increased number of outbreaks of diseases that were once better controlled, like TB, and emerging new diseases, such as SARS and Avian flu. Infectious agents that can cause incurable diseases, e.g. HIV, Hepatitis B and C, have become a significant cause of illness and death.

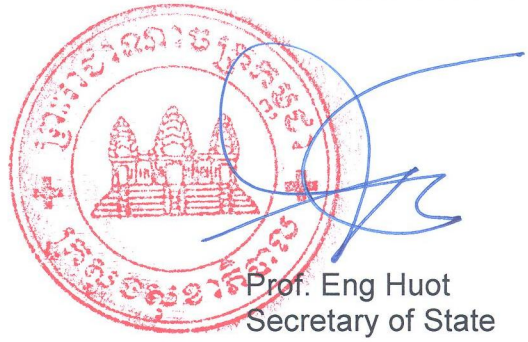
One of the most important explanations for this increase is poor disease control and disease prevention, specifically, prevention of the spread of infections in healthcare settings. With knowledge and application of appropriate infection prevention practices, healthcare workers can provide high-quality, safe services and prevent infections in service providers, other healthcare staff and patients alike. In addition, they can protect the community from infections that originate in healthcare facilities, prevent the spread of antibiotic-resistant micro organisms and lower the costs of healthcare services since prevention is cheaper than treatment.

These guidelines aim to provide administrators and healthcare workers in Cambodia with the knowledge and tools they need to effectively implement infection control. The guidelines apply to all healthcare facilities, from health posts to referral hospitals, and they address all aspects of the infection control programme including healthcare waste management

The manual is based on universally applicable infection prevention principles, but emphasis has been given to those practices and procedures that are feasible for implementation in the Cambodian setting.

The Ministry of Health hopes that these guidelines will be widely used as reference material and as a basis for developing training materials and thus contribute to the reduction of health facility acquired infections.

Phnom Penh...18....., 2010



Prof. Eng Huot
Secretary of State

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ACRONYMS

AIDS	Acquired immunodeficiency syndrome
ARI	Acute Respiratory Infection
BCG	Bacillus Calmette-Guérin (vaccine for TB)
CPR	Cardio Pulmonary Resuscitation
CSSD	Central Sterilizing Service Department
ECG	Electrocardiogram
ER	Emergency Room
HAI	Healthcare Acquired Infection
HBV	Hepatitis B Virus
HEPA	High Efficiency Particulate Air (filters)
HIV	Human Immunodeficiency Virus
HCW	Healthcare waste
HLD	High-level disinfection
ICU	Intensive Care Unit
ID	**I**ntradermal
IM	Intramuscular
IV	Intravenous
MDR-TB	Multi-drug Resistent Tuberculosis
MRSA	Methicillin Resistant Staphylococcus Aureus
MVA	Manual vacuum aspiration
NICU	Neonatal Intensive Care Unit
OR	Operating Room
PPE	Personal Protective Equipment
SARS	Severe Acute Respiratory Syndrome
SC	Subcutaneous
SSI	Surgical Site Infection
TB	Tuberculosis
VRE	Vancomycin Resistant Enterococcus
WHO	World Health Organization
WPRO	Western Pacific Regional Office (of WHO)
XDR-TB	Extensively Drug Resistant Tuberculosis

CHAPTER I: INTRODUCTION

Background

Infection control has an integral role in the provision of a safe healthcare environment for both patients and healthcare workers across the continuum of care. Lack of adherence to safe practices or inadvertent exposure to pathogens in the healthcare environment can lead to significant morbidity and mortality in patients and healthcare workers alike.

People receiving medical care or those working in a hospital or a health centre, are at risk of becoming infected unless precautions are taken to prevent infection. In delivering services, it is important to take measures to prevent infections at all times when attending a health facility.

Since the publication of the first manuals on infection control, considerable progress has been made globally in understanding the basic principles of infection prevention as well as the acceptance and use of evidence-based infection prevention practices. It is now recognized that infection control and prevention has a dual role: it does not only reduce the risk of disease transmission to patients and visitors but also protects healthcare workers, including doctors, nurses, laboratory, cleaning- and housekeeping staff.

Healthcare Acquired Infections (HAI) are significant problems throughout the world, including Cambodia. Most of these infections can be prevented with readily available, relatively inexpensive strategies, such as:

- adhering to recommended infection prevention practices, especially hand hygiene and wearing gloves
- paying attention to well-established processes for soaking and cleaning used instruments and other items, followed by either sterilization or high-level disinfection
- improving safety in operating rooms and other high-risk areas where the most serious and frequent injuries and exposures to infectious agents occur
- taking adequate care of healthcare waste

CHAPTER II: THE INFECTION CONTROL PROGRAMME

An infection control programme incorporates all aspects of infection control at all levels of the healthcare system. It puts together various practices which, when used appropriately, will reduce the spread of infection.

The objectives of the Infection Control Programme

- To reduce the incidence and risk of preventable healthcare associated infection
- To prevent infection transmission within healthcare facilities
- To create an organisational framework that assists with the effective use of resources to deliver healthcare in a safe, cost effective and evidence based manner

The components of the Infection Control Programme

- To ensure that basic measures for infection control, i.e. Standard and additional precautions are in place
- To educate and train healthcare workers
- To protect healthcare workers from transmissible diseases
- To introduce and maintain routine practices essential to infection control, such as:
    - Aseptic techniques,
    - Use of single-use devices,
    - Appropriate processing of reusable instruments and equipment,
    - Appropriate use of antibiotics,
    - Separation/isolation of patients with infectious diseases
    - Management of blood/body fluid exposure, handling and use of blood and blood products,
    - Sound management of medical waste
- To ensure appropriate infrastructure, equipment and supplies are in place to allow for good infection control practices
- To ensure effective work practices and procedures regarding support services (e.g. Housekeeping, food and laundry)
- To carry out surveillance, monitoring and reporting of infection incidents, and investigation of outbreaks
- To carry out infection control in specific situations
- Collect data on infections to use to improve the programme

Assessing infection prevention practices

Based on an assessment, it will be necessary to review the facility's policies, protocols, procedures and common practices to make them consistent with the infection prevention standards. Protocols and practices that are consistent with the standards should be reinforced; protocols and practices that are outdated, not evidence based, not practiced, or practiced improperly should be targeted for change. Health administrators should be made aware of the importance of the infection control programme and that it is essential that healthcare workers are equipped with requisite knowledge, skills and attitudes for good infection control practices. The ***infection control team*** should therefore also:

- Assess training needs of the staff and provide required training through awareness programs, in-service education and on-the-job training for essential infection control practices that are appropriate to their job description
- Provide annual re-training or orientation of staff
- Review the impact of training

At least one member of the infection control team should receive intensive training in infection control practices. This member should be referred to as the infection control officer. Ideally this person could be a nurse but may also be any other person with knowledge or training of infections (e.g. laboratory staff or a medical officer) with the following responsibilities:

- Observe infection control practices and make suggestions for improvement
- Monitor and manage critical incidents
- Help identify problems and assist in problem-solving
- Report to the infection control committee

Good communication and exchange of ideas with staff can improve work habits and attitudes. Staff should be informed about the infection control team and the purpose of the programme.

Hospital management should share ideas and materials with staff, and be ready to listen to their perspective. Good communication at all staff levels is the key to a successful infection prevention programme

Training in Infection Control

An infection prevention programme can be successful only when everyone is involved. People are usually willing to change bad habits to good ones when they understand the reasons and the importance of each procedure. Therefore, it is recommended that each healthcare facility should plan frequent in-service education programmes for staff, patients and visitors. In-service training is an ongoing activity. It should be used to teach good practices, change bad habits, and demonstrate new equipment or procedures.

Every level of staff (i.e. nurses, doctors, laboratory staff, radiology staff, pharmacists, housekeepers, cleaners, students) needs to learn the importance of infection prevention. Even workers who have little contact with patients, such as pharmacy or kitchen staff, should be included.

All staff are important in preventing infections in the healthcare facility.

All healthcare workers should:

- Understand how infection spreads in the healthcare facility;
- Know the important role each staff member plays in preventing infection
- Know early signs and symptoms of common health facility acquired infections
- Be able to describe or demonstrate various methods of preventing the spread of micro organisms, such as hand hygiene

CHAPTER III: BASICS OF INFECTION

Infection is the growth of a micro organism, such as a virus, a parasite, a fungus or a bacterium, within or on the human body. Infection can cause the person to become sick. Spread of infection in hospitals and health facilities is a serious problem, which affects the wellbeing of patients and healthcare workers alike. A breach in infection control practices facilitates transmission of infection between patients, healthcare workers, attendants and visitors. An infected healthcare worker can transmit a large number of micro organisms to a new host. An infected patient can contaminate an object, an instrument, or a surface. Subsequent contact between that item (for example if the item is a surgical instrument that has not been sterilized) and another patient is likely to contaminate the second individual who may then develop an infection.

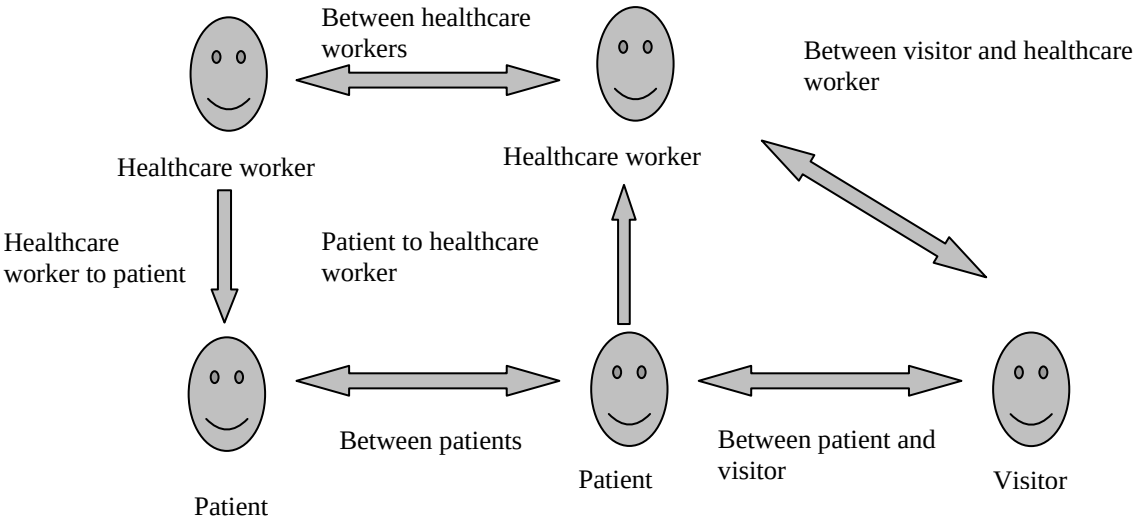


Figure 1 Examples of how infection spreads within a health facility

Cycle of Infection

In order to carry out infection control it is important to understand the routes of transmission and the methods to control them. For an infection to spread certain conditions must be present, also called the **Cycle of Infection**. The cycle of infection is like a chain consisting of six links. To produce disease, each link of the infectious process must be present. The six links are:

1. **The infectious agents:** They are the micro organisms, sometimes called germs that cause the infection. There are many types e.g. bacteria, viruses, fungi, rickettsiae and parasites.

2. **The reservoir:** It is where the micro organisms live, survive and multiply (equipment, humans, animals, plants, water, soil, and where waste collects). Often in the case of humans, they can live happily on one part of the body but

can cause disease if they move to another part (e.g. E. coli is in the gut of all humans however it can cause a urinary tract infection if it finds its way to the bladder). If an intravenous catheter used for giving fluids or antibiotics is kept too long, the natural skin bacteria which normally live on the skin of patients can enter the broken skin through the catheter site and cause cellulitis[1].

3. **Mode of escape or places of exit:** It is how the micro organism leaves the reservoir. The infectious agent can leave the reservoir through the bloodstream, broken skin (e.g. puncture, cut, surgical site, skin lesion or rash), mucous membranes (e.g. eyes, nose, and mouth), the respiratory tract (e.g. lungs), the genitourinary tract (e.g. vagina, penis), the gastrointestinal tract (e.g. mouth, anus), or the placenta by means of blood, excretions, secretions, or droplets that come from these sites.

   For environmental reservoirs, for example, exit may be accomplished by contamination of patient care equipment by micro organisms in tap water used to rinse the equipment.

4. **Mode of transfer or transmission** is how the micro organism enters the host, and it can happen through:

   a. *Direct contact* (e.g. Unclean hands, vectors, such as flies that become contaminated through contact with excreta or secretions from an infected patient and transmit the infective organisms mechanically to other patients, etc)

   b. *Indirect contact* (through a contaminated object or surface)

   c. By *droplets* in the air from coughs or sneezes (if the droplet is large, transmission occurs when contagious droplets produced by the infected host are propelled a short distance and come into contact with another person's conjunctiva, mouth or nasal mucosa)

   d. By *airborne transmission* (these droplet nuclei are very small, and they can hang in the air for a long time attached to dust particles and, as they can travel a long distance, direct contact with someone who is infected is not necessary to become ill)

5. **Mode or places of entry:** It is where the micro organism enters the person (for example broken skin, or though the mucous membranes in the mouth, urethra or the vagina, surgical site or injection site).

6. **A susceptible host:** It is a person who has little or no resistance against the disease-producing organism and is likely to become infected if it enters his or

[1] **Cellulitis:** is the spreading infection of skin and subcutaneous tissues with erythema (redness), swelling, and local tenderness, accompanied by fever and malaise.

her body. The host can be a healthcare worker, a patient, an attendant or a visitor. This person then becomes a reservoir and, in turn can provide the means by which new hosts can be infected.

Important patient factors influencing acquisition of infection include age, immune status, underlying disease, and diagnostic and therapeutic interventions. The extremes of life - infancy and old age - are associated with an increased susceptibility to infection. Malnutrition also carries a high risk.

Patients with a chronic disease such as cancer, diabetes mellitus, leukaemia, renal failure, or AIDS have an increased susceptibility to infections with opportunistic pathogens. [2]

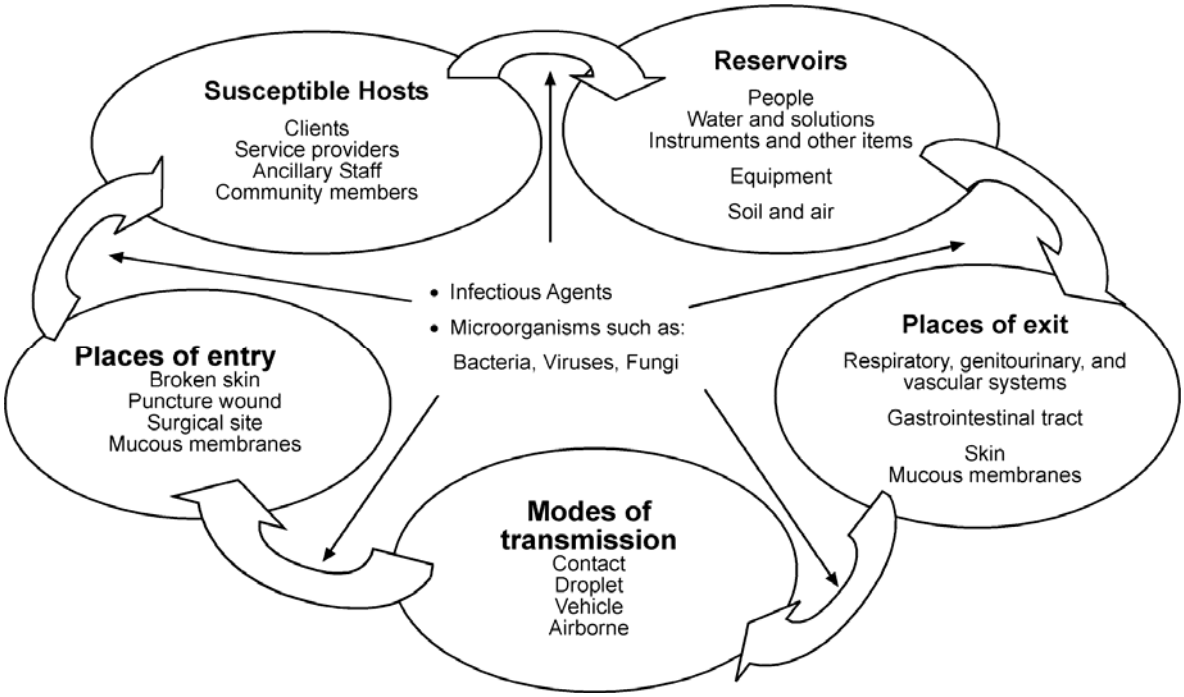


Figure 2 The cycle of infection

Infection prevention largely depends on placing barriers between a susceptible host and the micro organisms. Protective barriers are physical, mechanical or chemical processes that help prevent the spread of infectious micro organisms from person to person (patient or health worker) and/or equipment, instruments and environmental surfaces to people. Removing any one of the six components breaks the chain of infection.

[2] These are organisms that are normally harmless, e.g. they may be part of the normal bacterial flora, but may cause disease when the body's immunological defences are weakened.

Breaking the Cycle of Infection

1. One way of breaking the chain is by destroying the **infectious agents** that cause the disease either:
    a. By using *antibiotics* (they attack certain disease-producing organisms, but do not attack the person's body), or
    b. By *sterilization* - If the organisms that cause disease on surface of instruments are killed, then they won't cause infection.

2. Isolation is an example of a method of controlling the person with the disease, the **reservoir** if it is a human (or an animal). In this way, the likelihood of them becoming in contact with susceptible **hosts** is diminished and so the transmission cycle is broken.

3. **Places of escape** can be closed by the use of proper attire- e.g. covering seeping pustules so that the pus cannot escape and infect others. Alternatively, covering mouth when sneezing or coughing will mean that the infectious agents can't contaminate other surfaces or people.

4. Removing **modes of transmission** can happen in several ways**:**
    a. Diseases that are spread by *direct contact* can be controlled by preventing the contact from occurring by for instance washing hands or wearing surgical gloves when examining a patient's wounds.
    b. Transmission through *indirect contact* can be controlled by decontaminating (soaking), cleaning, and sterilizing objects, instruments and surfaces and by properly taking care of hazardous material. Diseases that are spread through contamination of food and water can be controlled by making the food or water safe for consumption by washing thoroughly and if/when cooked, properly cooking the food item (and not keeping it in room temperature for longer than two hours). Water can be made safe to drink by boiling or filtering.
    c. *Vector-borne* diseases can be prevented by reducing breeding sites and by using mosquito nets and insect repellents
    d. *Droplet* spread prevention includes having a distance of > 1 metre from the source, hand washing and wearing surgical masks
    e. Spread of *airborne* droplet nuclei can be reduced by wearing appropriate personal protective equipment (PPE) and adequate ventilation of the room

5. **Mode of entry:** can be blocked by adding barriers, such as PPE, by using aseptic technique, by avoiding sharp injuries and by disinfection and sterilization of equipment.

6. Targeting the **host:** A host can defend itself against some infectious agent if it

develops immunity to it. Immunity can be acquired naturally, for example when a person has had measles as a child, they become immune to the virus and if they are exposed to it again, they won't become sick. The other way of becoming immune is by artificial immunity i.e. by injecting a vaccine (weakened or killed organisms or their products) into the person's body against a disease. An example of artificial immunity would be childhood vaccination programmes where by vaccinating children against measles, they become immune to it and won't become sick if they are exposed to it.

The transition from contamination to infection

Passage of an infectious organism from an infected person (staff, patient or visitor) to another person or to an object such as a needle, a surgical instrument, a drain or a catheter, which can in turn pass infection to another person, is called *contamination*. Whether or not *infection* will develop after contamination depends upon the interaction between the contaminating organisms and the host. If the infectious agents come in contact with mucous membranes or non-intact skin, there is some risk of infection. If the organisms come in contact with normally sterile body sites, e.g. during operations, the risk for infection becomes very high and even low doses of infectious agents can produce disease.

CHAPTER IV: BASICS OF HEALTHCARE ACQUIRED INFECTION

Healthcare or hospital acquired infection (HAI) is an infection occurring in a patient, staff or visitors which they got while they were in the healthcare facility. For the infection to be classified as an HAI, it must not have been present or incubating at the time of admission. The infection may occur within two or three days after the patient was admitted, but sometimes the symptoms appear when the patient has already been discharged. As a consequence, it can sometimes be difficult to determine the source of the organism causing the infection.

Spreading of healthcare acquired infections (HAI)

Both people and the environment play an important role in how infection spreads in the health facility.

Examples of hospital acquired infections are:

- A patient who develops a wound infection after an operation.
- A patient who develops urinary tract infection from having a urinary catheter inserted using a poor technique or kept in place for too long
- A patient who develops an infection where the IV catheter is inserted because the skin was not cleaned prior to insertion or has been inserted for too long
- A healthcare worker who gets infected by Hepatitis B, C or HIV after injuring themselves with a needle that had been used on an infected patient.
- A patient who gets infected with Hepatitis B, C or HIV from instruments that were not soaked, cleaned and sterilised prior to being used or needles or syringes were reused
- An HIV patient who contracts TB after being exposed to a smear positive TB patient.

The most common HAI sites

The urinary tract

Urinary tract infection is the most common HAI. It is associated with the use of an indwelling bladder catheter. Urinary infections cause less morbidity than other nosocomial (hospital acquired) infections, but can occasionally lead to bacteraemia (bacterial presence in the blood) and death. The main risk factors are the length of catheterization, level of asepsis at insertion, and continuing catheter care. Catheters should only be inserted if absolutely necessary e.g. in operations lasting more than 2 hours. They should not be routinely placed in all surgical patients and it is imperative to remove them as soon as possible.

Surgical site infections

The incidence of surgical site infections varies and depends on pre OP preparation of the site of the incision, use of sterile equipment/instruments the type and length of operation, technique and experience of the surgical team, use of antibiotic prophylaxis, and the presence of foreign bodies including drains.

The lower respiratory tract

HAI pneumonia occurs in several different patient groups. Patients who do not get mobilised post operatively are the most susceptible. Patients need to be encouraged to take deep breaths and cough after operations. They should sit up and get out of bed as soon as possible and be given adequate pain relief to allow mobilisation. Where physiotherapy is available, all stroke and surgical patients should be seen routinely to prevent pneumonia from occurring.

Blood borne

Insertion of intravenous catheters without adequate preparation of skin can lead to bacteraemia. Staff must consider the necessity of IV fluids/medications –i.e. does the patient really need an IV, can alternatives be given? Inappropriate use of IV catheters can lead to morbidity.

Skin

Skin infections are less common however burns and other skin lesions can be infected if not dressed correctly. Inappropriate cleaning of skin prior to IV catheter insertion or leaving a catheter longer than 3 days can also lead to skin infection.

Misconceptions about the incidence of HAI

Healthcare personnel often believe that the incidence of post-procedure and other hospital-acquired infections at their facility is low. Similarly, they may believe that the incidence of serious infections (such as HBV, HCV or HIV) in their community is low and thus not of concern. In reality, it is difficult to track the incidence of post-procedure and other hospital-acquired infections and to know how many people have blood-borne infections because:

- There is little to no surveillance of infection.
- Post-procedure infections may be difficult to identify, especially for many outpatient services.
- Poor recording of infections in patient files
- Infections do not always cause problems serious enough to make patients seek medical attention. Though the infections may prolong the healing process, eventually they may resolve on their own.
- Patients may seek treatment of post-procedure infections at another facility or pharmacy.
- Patients or staff may not find out they are infected with HIV or with the hepatitis viruses until years after the incident of exposure occurred, when little connection to a past clinical procedure or workplace accident would be evident.

CHAPTER V: INFECTION CONTROL PRACTICES

Transmission of infections in healthcare facilities can be prevented and controlled through the application of basic infection control precautions. They can be grouped into standard precautions, which must be applied to all patients at all times, in health centres or referral hospitals regardless of diagnosis or infectious status, and additional (transmission-based) precautions which are specific to modes of transmission (airborne, droplet and contact).

PART 1: STANDARD PRECAUTIONS

Treating all patients in the healthcare facility with the same basic level of "standard" precautions involves a set of recommendations designed to help minimize the risk of exposure to infectious materials by both patient and staff. Standard precautions require that healthcare workers assume at all times that blood and body substances of all patients are potential sources of infection, regardless of the diagnosis or presumed infectious status. Standard precautions involve safe work practices and include six components:

- Hand hygiene
- Use of personal protective equipment
- Appropriate handling of patient care equipment
- Environmental cleaning
- Prevention of needle-stick/sharp injuries
- Appropriate handling of healthcare waste

5.1- Hand washing

The role of hands in disease transmission

Hand hygiene is the single most important technique to prevent and minimize the spread of infection within health facility environments. Throughout the day micro organisms accumulate on the hands from a variety of sources, such as direct contact with people, contaminated surfaces, foods, even animals and animal waste. If people don't wash their hands frequently enough, they can infect themselves with these organisms by touching their eyes, nose or mouth. And they can spread these organisms to others by touching them or by touching surfaces that others also touch, such as doorknobs.

Infectious diseases that are commonly spread through hand-to-hand contact include the **common cold** and more serious illnesses such as **meningitis, influenza, Hepatitis A** and most types of infectious **diarrhoea**.

There are two types of micro organisms on the skin that can lead to infections:

1. **Resident micro organisms** live on the skin and are difficult to remove.
2. **Transient micro organisms** acquired during daily living can be easily removed by hand washing with plain soap and water***.***

Important hand washing recommendations

- A culture of hand hygiene should be encouraged not only among healthcare staff but also in patients and visitors to a facility and the general community at large.
- To ensure that health workers follow recommendations about hand washing procedures it is necessary for the health facility to have basic equipment, such as, sink or washing basin, water, soap, paper towels, and alcohol-based hand rub.
- There are three different types of hand hygiene: hand wash with soap and water, surgical hand scrub, and use of alcohol rub. **Alcohol hand rub should be the standard of care** if hands are not visibly dirty.
- Routine hand washing removes *transient* micro organisms *and soil* (such as dirt, blood and bodily fluids).
- Surgical hand scrub removes *transient organisms and soil,* and *kills or inhibits the growth of resident micro organisms*. This type of hand washing is appropriate prior to surgical procedures. It should take 3 to 5 minutes to clean hands using this method.

If running water is not available, use one of the following:

- A bucket with a tap that can be turned off to lather hands and turned on again for rinsing. Collect used water in a basin and discard in a latrine if a drain is not available.
- A bucket and scoop. Using the scoop, one person pours clear water over the hands of the person who is washing. To avoid contamination of bucket water, hands and scoop handle should never be placed directly in the water in the bucket. Scoops should be cleaned daily with soap and water. The water should be poured into another bucket or basin for collecting the waste water. Water storage containers must also be cleaned regularly (at least weekly) otherwise the water can become contaminated.
- Water must be clean otherwise hands can become contaminated during hand washing

Figure 3 Buckets used for hand washing where there is no tap.
Clean the scoop daily and the water container weekly

Alcohol-based hand rub, available in gel, liquid and foam, which don't require water, are an excellent hand hygiene method. If they contain at least 60 percent alcohol they are actually more effective than soap and water in killing the bacteria and viruses that cause disease. The antimicrobial activity of alcohol results from the ability to denature proteins. Alcohol solutions containing 60-80% alcohol are most effective with higher concentrations being less potent as proteins are not denatured easily in the absence of water.

Note: Whilst alcohol rub should be the standard of care, note that alcohol hand rub can only be used when hands are not soiled with blood or dirt.

Figure 4 Alcohol based hand rub dispensers and sanitizers

Facilities can make their own alcohol preparations. Please see Annex I for instructions on how to make alcohol hand rub. To prevent contamination, all containers once empty should be cleaned then sterilised or high level disinfectant rather than topped up.

When to wash hands in a health facility

- When you arrive at work
- Before and after examining each patient
- After handling specimens or exposure to bodily fluids
- Before putting on gloves for a clinical procedure
- After removing any kind of gloves
- After touching patient surroundings
- After using the toilet or latrine
- Before leaving work

Figure 5 The 5 most important moments for hand hygiene

Methods of hand washing

Routine hand washing

Hands and wrists are washed for 40–60 seconds with soap and water. Hands are dried with a paper towel or, if unavailable, a single-use hand towel or air-dried. ***This type of hand hygiene is suitable for all routine procedures.***

Figure 6 Routine hand washing

If hands are not washed according to the recommendation above, some parts of the hands will never been cleaned and can be a source of infection as shown on the left.

Figure 7 Areas frequently missed during hand washing

Because micro organisms grow and multiply in moisture and in standing water:

- If bar soap is used, provide small bars and soap racks that drain.
- Avoid dipping hands into basins containing standing water.

If liquid soap is used do not add soap to a partially empty liquid soap dispenser. This practice of topping off dispensers may lead to bacterial contamination of the soap. Whilst soap powder is better than using no soap, it is best avoided as it often contains bleach which is abrasive and can lead to small skin abrasions (which can act as a site of entry for infection).

Hand rub using alcohol rub

Remove bacteria from hands with a waterless, alcohol-based hand rub. Apply enough hand rub to cover all areas of the hands. Rub hands until dry. Immersing hands in bowls of antiseptics is not recommended.

This is a standard procedure and should be used by all health care workers routinely

Figure 8 How to hand rub using alcohol

Surgical hand scrub

The purpose of the surgical hand scrub is to reduce **resident and transient** skin flora to a minimum. Proper hand scrubbing for several minutes with **both soap and antiseptics** and the wearing of sterile gloves and a sterile gown provide the patient with the best possible barrier against pathogenic bacteria in the environment and against bacteria from the surgical team. **Surgical hand antisepsis should be carried out before ALL invasive procedures.**

Note: Micro organisms grow and multiply in standing water. You should not scrub your hands in a basin that contains standing water, even if an antiseptic solution is added.

The supplies needed for a surgical hand scrub include:

- Antiseptic soap (liquid soap or bar soap is preferred)
- Running water (when no running water is available, use a bucket with a tap, which can be turned off to lather hands and turned on again (by a buddy) for rinsing, or (again using a buddy to pour the water), use a bucket and scoop.)
- Brush, if used needs to be sterile (either disposable or autoclavable)
- Sterile towels

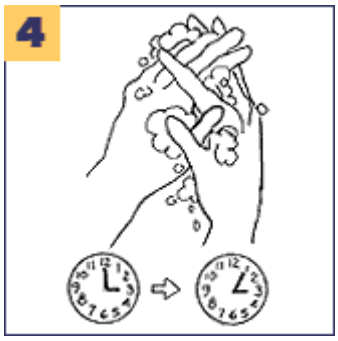
The surgeon, scrub nurse or technician should wear a short-sleeved shirt when performing a surgical hand scrub because it requires scrubbing to the elbows.

Steps 1 & 2

Remove jewelry and watch.
Hold hands above the level of the elbow and wet hands thoroughly.

Step 3

Apply soap, and clean under each fingernail using a brush or a stick. Water should flow from area of least contamination (hands) to most contamination (arms).



Step 4

Holding your hands up above the level of your elbow, apply the soap. Using a circular motion, begin at the fingertips of one hand and lather and wash between the fingers, continuing from fingertip to elbow. Wash between all fingers. Move from fingertips to the elbow of one arm and repeat for the second arm. Moving from area of least contamination to area of most contamination decreases the possibility of spreading. Continue washing in this way for 3-5 minutes.

Step 5

Rinse each arm separately, fingertips first, holding your hands above the level of your elbow. Do not let rinse water flow over clean area. Water should flow from area of least contamination to area of most contamination to decrease the possibility of contamination.

Step 6

Using a sterile towel, dry your arms - from fingertips to elbow - using a different side of the towel on each arm.

Step 7

Keep your hands above the level of your waist and do not touch anything before putting on sterile surgical gloves. Do not touch anything. Contact with soiled objects contaminates clean hands. The area below the level of the waist is considered unclean.

Figure 9 Steps for surgical hand scrub

Aseptic techniques in the operating room are presented in more detail in section 10.3**,** including how to put on surgical gowns, how to put on and remove surgical gloves, how to prepare patients, how to create and maintain a sterile field, how to use safe surgical technique and how to create a safer environment during surgical procedures.

Hand drying

Hands must be properly dried because micro organisms transfer more effectively from wet surfaces. Cloth towels should not be used after they have become damp because they can be a potential source of infection. It is therefore recommended that single-use cloth towels or paper towels be used.

Note: If paper towels are not available, dry hands with a clean towel or air-dry. Shared towels quickly become contaminated and should not be used.

Using your own towel or handkerchief can help to avoid using dirty towels. If you use your own towel, it should be washed every day.

STERILE towels **must** be used after surgical scrub.

All staff must maintain good personal hygiene. Nails must be clean and kept short. False nails or nail polish should not be worn. Hair must be worn short or pinned up.

5.2- Principles for use of personal protective equipment

Using personal protective equipment (PPE) reduces the risk of acquiring or transmitting an infection. It is important that the items are used effectively, correctly, and at all times where there is a risk of disease transmission e.g. contact with blood and body fluids. Continuous availability of PPE and adequate training for its proper use are essential.

PPE includes:

- Gloves
- Masks and respirators
- Eyewear (face shields, goggles or glasses)
- Gowns and aprons

Caps and shoe covers are often included in PPE however caps are used to protect the surgical field rather than protect the health worker. Shoe covers do not have any impact on infection.

Figure 10 Example of PPE

PPE must be used by:

- **Healthcare workers** who provide direct care to patients in situations where they may have contact with blood, body fluids, excretions or secretions
- **Support staff** including cleaners and laundry staff in situations where they may have contact with blood, body fluids, secretions and excretions of patients
- **Laboratory staff**, who handle patient specimens
- **Family members or visitors** who provide care or are in close contact with patients in a situation where they may have contact with blood, body fluids, secretions and excretions of patients

General recommendations for use of PPE

- Avoid any contact between contaminated (used) personal protective equipment and surfaces, clothing or people outside the patient care area.
- Discard used PPE in appropriate disposal bags, and dispose of or burn.
- Do not share PPE
- Change PPE completely and thoroughly wash hands each time you leave a patient to attend another patient
- Disposable PPE should not be reused.

The following principles guide the use of PPE:
PPE should be chosen **according to the risk of exposure**, thus not all PPE should be worn for every exposure. **Make a risk assessment** of the procedure and choose your PPE according to**:**

- The nature of the procedure
- The risk of exposure to blood or body fluids
- The risk of exposure to pathogenic micro organisms
- The risk of contamination

Table 1 PPE risk assessment

PPE to use	**When to use**	**Examples of procedure**
Utility Gloves	At risk of punctures	• Cleaning instruments • Cleaning • Removing waste • Doing laundry
Examination Gloves	Contact with blood, secretions, body fluids, mucous membranes, non intact skin, when a patient has skin infections. when on contact precautions	Taking blood, dressing wounds, setting up and insertion of IV, performing laboratory tests, pelvic examinations (except during delivery), emptying emesis basins, cleaning up spills of body fluids, potential presence of highly infectious and dangerous organisms, When on contact precautions
Sterile Gloves	Performing sterile technique	• surgical procedures including minor surgery • vaginal deliveries • invasive radiological procedures • performing vascular access and procedures (central lines)
Gown	Contact precautions	Patient with skin infections, MRSA (need gloves also if in contact with patient or surrounds),

Apron (if gown permeable)	Risk of splashes	Deliveries, operations, during high risk procedures e.g. bronchoscopy, suctioning laryngeal secretions During cleaning
Mask	Droplet precautions	Within one metre of patient with disease such as influenza, meningitis, pneumonia, whooping cough
Eyewear	Risk for splashing; droplet precautions	Deliveries, operations, during high risk procedures e.g. bronchoscopy, suctioning laryngeal secretions Within one metre of patient with disease such as influenza, meningitis, pneumonia, whooping cough
Protective footwear	Risk for spills	Operating theatre, deliveries, handling soiled linen, laundry, carrying waste

Gloves are not needed for the following (unless the patient is on contact precautions)

- Taking routine BP, Temp, PR
- Performing SC and IM injections
- Bathing and dressing the patient
- Writing in the patient chart
- Giving oral medications
- Distributing or collecting patient dietary trays; removing and replacing linen for patient bed (unless visibly soiled with feces, blood or urine)
- Placing non-invasive ventilation equipment and oxygen cannula
- Moving patient furniture

Remember:
It is the **procedure** that carries the risk rather than the patient. PPE reduces but does not completely eliminate the risk of acquiring an infection. Use of PPE does not replace the need to follow basic infection control measures such as hand hygiene

The *Severe ARI Guidelines* have additional information on PPE.
How to put on and remove PPE is demonstrated in **Annex III**.

Personal Protective Equipment in detail

Gloves

The role of gloves is to:

- Protect the wearer and minimise contamination generally using non-sterile gloves
- Reduce the risk of transmission of infectious micro organisms to patients during aseptic procedures generally using sterile gloves

There are three types of gloves used in healthcare facilities:

Sterile gloves should be used when performing invasive medical or surgical procedures. Sterile gloves are used for all procedures involving contact with tissue deep under the skin (e.g. caesarean section or laparotomy) as well as during minor procedures like suturing, or vaginal examinations during labour.

Figure 11 Sterile glove

Examination gloves provide protection to healthcare workers when performing many of their routine duties. They are used for contact with mucous membranes (e.g. routine pelvic examination) and when exposure to blood or bodily fluid is anticipated. They are single-use.

Figure 12 Examination glove

Utility or heavy-duty household gloves should be worn for handling used instruments and equipment that may have come in contact with blood or body fluids, for handling medical waste and linen and when cleaning contaminated surfaces.

Figure 13 Utility or heavy-duty glove

The following principles are recommended when wearing gloves:

- Pull gloves up over cuffs of gown (if worn) to protect the wrists.
- Change gloves between contacts with different patients.
- Remove gloves immediately after use and before attending to another patient.
- Wash hands with soap and water or use alcohol base hand-rub immediately after removing gloves.
- Disposable gloves should not be reused but should be disposed of according to the policy of the healthcare facility.

Masks

Masks protect mucous membranes of nose and mouth when contact with blood and body fluids are likely. Masks and eyewear or face shields should be worn when performing any task where an accidental splash into the face is likely.

Surgical masks or facemasks

Masks should be large enough to cover the nose, lower face, jaw and facial hair. A **surgical mask** is intended to be worn by health professionals during surgery and at other times to catch the bacteria shed in liquid droplets and aerosols from the wearer's mouth and nose when they speak, cough or sneeze as well as to prevent accidental splashes of blood or other contaminated body fluids from entering the health worker's nose or mouth. They are designed to protect against large droplets (>5 microns) and do not provide protection against small particle aerosols (<5 microns) like droplet nuclei generated by a pulmonary TB patient (see below).

Figure 14 Surgical masks

Respirators

These are specialized types of masks and provide protection against inhalation of small airborne particles (aerosols). They are recommended for situations in which filtering inhaled air is deemed important (e.g. for the care of a person with smear positive drug resistant pulmonary tuberculosis) or for high risk procedures such as intubation or suctioning of a person with airborne illness. They contain multiple layers of filter material and fit the face tightly. They are considerably ***more difficult to breathe through*** and ***more expensive*** than surgical masks. *Respirators* range from single-use, disposable masks (N95) to reusable models with replaceable cartridges (HEPA). Particulate masks, such as **N95-type** respirator masks or **HEPA** masks are unnecessary for activities that never involve exposure to airborne infectious diseases and should not be used for routine surgery or cleaning.

Figure 15 Different N95 respirators

Since different people have different shaped faces, not all N95 respirators will fit them. To maximize their protective benefit to the wearer, they should be trained on the use of N95 respirator and fit testing should be performed where possible (or checking where fit testing is not possible).

See TB Infection Control Standard Operating Procedures for the fit testing procedure.

Once fit testing is done and correctly fitted respirator is found, it can be worn. Most N95 respirators have a metal strip above the nose. This should be pressed down to ensure a snug fit over the nose. There are two straps - one should be placed high on the head, the other lower - under the ears if it is a tight fit. The straps should not cross. No air should leak outside the respirator otherwise the staff member is at risk of being contaminated by airborne droplet nuclei (< 5 microns). It is essential that staff check for a tight fit prior to entering the patient room.

Eyewear

Eyewear includes clear plastic goggles, safety glasses, face shields and visors. They protect staff in the event of an accidental splash of blood or other body fluid by covering the eyes.

Figure 16 Goggles, face shield and safety glasses

Gowns and aprons

Gowns prevent soiling of clothing during procedures that may involve contact with blood or body fluids, excretions or secretion. They can be either cotton, therefore washable, or disposable. The disposable gowns can be of two types –

fluid resistant, in which case an apron is not essential, or permeable in which case aprons must also be worn. A plastic apron may be worn on top of a permeable gown if splashes are anticipated. The gown should be worn with elasticised bands to tie at the back, neck and waist levels.

Figure 17 Disposable and reusable gowns
The left two photos show disposable gowns whereas the gown on the right is washable

Aprons made of rubber or plastic provide a waterproof barrier along the front of the health worker's body. An apron should be worn when cleaning or during a procedure in which blood or body fluid spills are anticipated. Aprons keep contaminated fluids off the healthcare workers' clothing and skin.

Figure 18 Disposable apron and reusable aprons
The left photo shows a disposable apron. The right photo shows a reusable apron.

Caps and boot / shoe covers

Caps are used to keep the hair and scalp covered so that flakes of skin and hair are not shed into the wound during surgery. Caps should be large enough to cover all hair. Their other purpose is to protect the wearer from blood or body fluid splashes and sprays. In aseptic units, operating rooms, or performing selected invasive procedures, staff must wear caps or hoods which completely cover the hair.

Disposable hair cover

Reusable hair cover

Disposable shoe covers

Figure 19 Caps and shoe covers

Footwear is worn to protect feet from splashes and injury by sharps or heavy items that may accidentally fall on them. For this reason, sandals, thongs or shoes made of soft materials should not be worn. Rubber boots or leather shoes provide more protection, but they must be kept clean and free of contamination from blood or other body fluid spills. **Shoe covers** are unnecessary if clean, closed sturdy shoes are available for use only in the surgical area. .

5.3- Appropriate handling of patient care equipment

All medical devices are either single-use or reusable ones. Single use equipment e.g. syringes and needles should not be reused and should be discarded appropriately after use. All reusable equipment must be properly processed between use and between patients. Used instruments and equipment can easily become a reservoir for micro organisms, and therefore can spread infection to patients and staff. The risk of transmission is classified according to the body site where the instrument is to be used. Instruments and other items may be classified based on the risk of transmitting infection into critical, semi-critical or non-critical, depending on the sites[3]. See table 2 below.

Critical: These items and practices affect normally sterile tissues or the blood system and represent the highest level of infection risk. Failure to provide sterile or, where appropriate, high-level disinfected items (e.g. surgical instruments and gloves), is most likely to result in infections that are the most serious.

[3] The classification of risk of transmission of infection by instruments and equipment has been called the “Spaulding Classification.”

Semi-critical: These items and practices are second in importance and affect mucous membranes and small areas of non-intact skin. Management needs are considerable and require knowledge and skills in handling many invasive devices (e.g. gastrointestinal endoscopes and vaginal specula), performing soaking, cleaning and high-level disinfection, and gloving for personnel who touch mucous membranes and non-intact skin.

Non-critical: Items and practices that involve intact skin and represent the lowest level of risk.

Table 2 Classification of reusable equipment

Category	Application	Type of processing	Example of items
Critical	Sterile tissues or the blood system	Sterilization (by heat or chemicals)	Dressing and suture instruments, surgical instruments, delivery sets, diagnostic catheters, dental instruments, bronchoscopes, cystoscopes, etc
Semi-critical	Mucus membranes or non-intact skin	High-level disinfection (HLD) as a minimum Boiling for 20 minutes or Soaking in 0.2% peracetic acid for 10 mins or Glutaraldehyde 2% for 45 mins	Laryngoscope blades, airways, suction cannulae, vaginal specula, instruments for MVA, respiratory therapy and anaesthesia equipment, dental impressions, endoscopes, gastroscopes, etc.
Non-critical	Intact skin	Low level disinfection	Bedpans, toilets, urinals, blood pressure cuffs, ECG leads, thermometers, Stethoscopes, beds, bedside tables

All hospitals and health centres should have a central sterilising and supply department (CSSD) rather than each ward or department being responsible for their own sterilisation. This ensures quality assurance of all sterilised items as well as improving efficiency. Wards and departments must soak, clean, dry and pack instruments before sending for sterilisation which means all wards must have appropriate infrastructure for these steps. A central laundry is preferable to ensure all drapes, packing material etc are cleaned and dried well. An individual ward usually has insufficient space to launder items.

For details on CSSD see page 48.

The following steps of procedures should be used to prevent the spread of infection from **re-usable instruments and equipment**:

1. Soak
2. Clean
3. Dry
4. Pack
5. Sterilization (or High Level Disinfection for semi critical items)
6. Cool then store

The sequence is illustrated below and is separated into the procedure for sterilization (left column) and the procedure for HLD (right column). Each stage of the procedure is discussed in more detail in the pages that follow.

STAGES FOR STERILIZATION	**STAGES FOR High Level Disinfection**
STAGE 1 **SOAK** Soak in water or soapy water	**STAGE 1** **SOAK** Soak in water or soapy water
STAGE 2 **CLEAN** Scrub clean	**STAGE 2** **CLEAN** Scrub clean
STAGE 3 **DRY** Items to be fully dry before packing	**STAGE 3** **DRY**

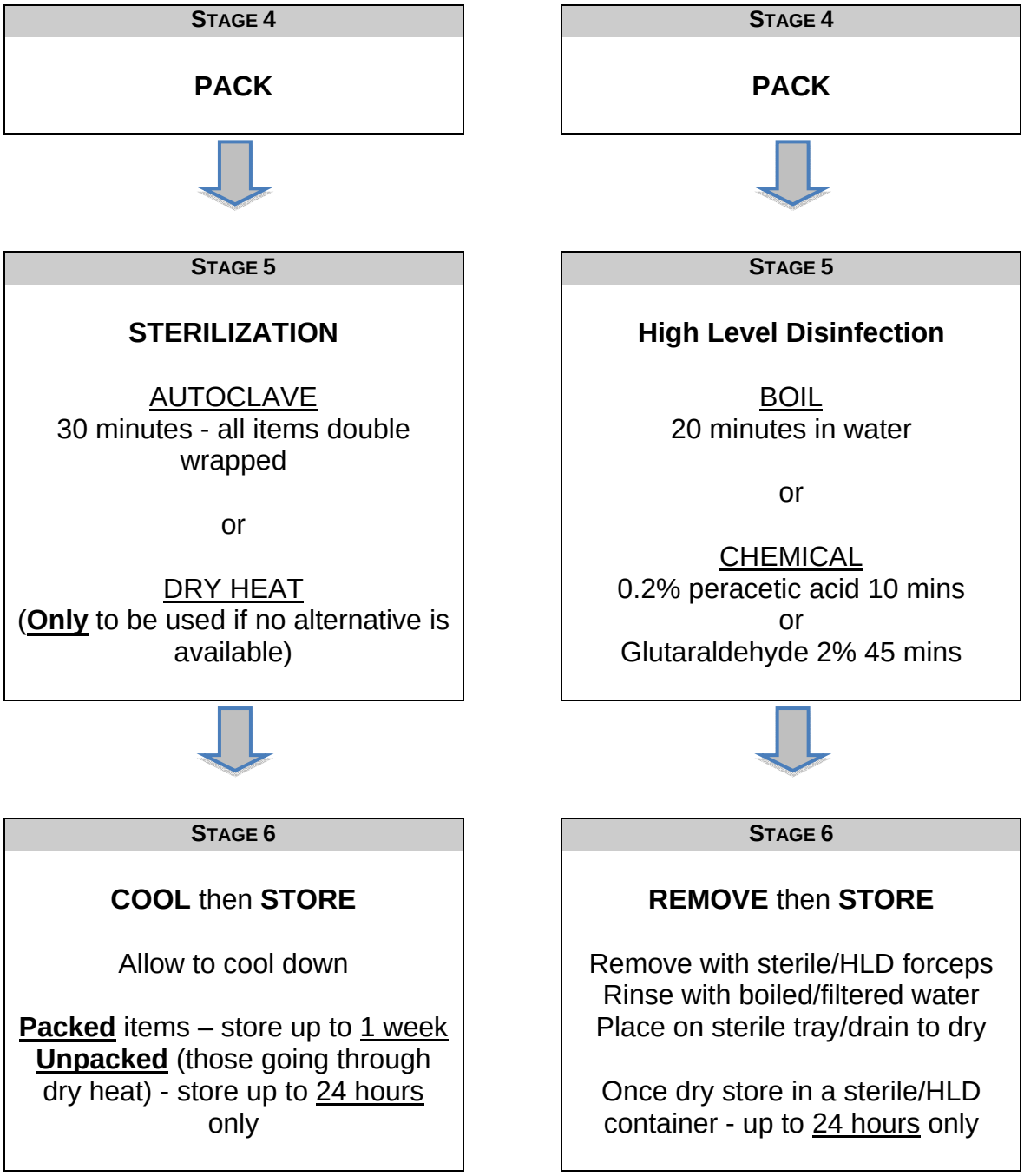


Figure 20 Steps of processing reusable instruments and other items

Stage 1: Soak

Soaking in water or soapy water is a process that makes organic material on objects softer **for easier cleaning.** All surgical instruments and reusable items such as suction cannulae, tubing, and all other instruments, should ***go through the entire sterilization process*** (clean, dry, pack) after the operating procedure even if they were not used.

Steps for soaking equipment

Step 1

Immediately after use, soak all instruments and other items by placing them in a plastic container with water or soapy water. Let them soak for 10 minutes. A container of this solution could be kept in every operating theatre and procedure room so that used items can be placed directly into the bucket. Service providers could put instruments and other items in the bucket as soon as they are finished using each item. Put the timer on for 10 minutes.

Do not leave metal items in the solution for more than 10 minutes since excessive soaking can rust instruments. Always wear utility gloves when removing items from the solution.

Step 2

After 10 minutes, remove the items from the solution.

Figure 21 Steps for soaking instruments

It is **not necessary** to use Chlorine, Chlorhexidine or other disinfectant to soak equipment prior to cleaning.

Stages 2 & 3: Clean and Dry equipment

After soaking, ***cleaning***, is the second step in processing, ***removes organic material, dirt, and foreign matter*** that can interfere with sterilization or HLD. Cleaning also drastically reduces the number of micro organisms, including bacterial endospores, on instruments and other items. Cleaning is a crucial step in processing. If items have not first been cleaned, further processing might not be effective because:

- Micro organisms trapped in organic material may be protected and survive further processing
- Organic material and dirt can make the chemicals used in some processing techniques less effective

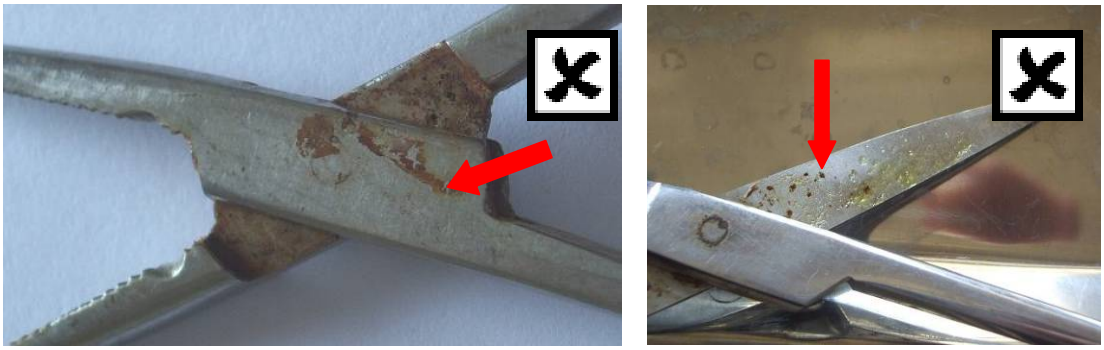


Figure 22 Insufficient cleaning of equipment

Use of detergents in cleaning

Detergents are important for effective cleaning, since water alone will not remove protein, oils, and grease:

- When detergent is dissolved in water, it breaks up and dissolves or suspends grease, oil, and other foreign matter, making them easy to remove by cleaning.
- Liquid soap should be used
- **Do not** use hand soap for cleaning, because fatty acids contained in the soap will react with the minerals of hard water, leaving a residue or scum that is difficult to remove. Do not use soap powder unless liquid soap is unavailable. If soap flakes are used, ensure they are well dissolved. If not, they can remain on instruments which interferes with the sterilisation process

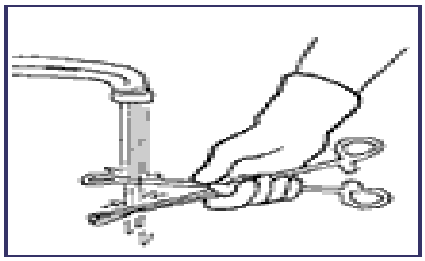
Note: Avoid using steel wool or abrasive cleansers. These products can scratch metal or stainless steel, resulting in grooves that can become a nesting place for micro organisms. This also increases the potential for corrosion**.**

Steps of cleaning

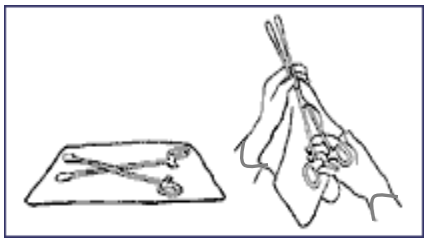
Step 1

Place items in soapy water. Use a **soft brush** or new toothbrush to scrub and completely remove all blood, other body fluids, tissue and other foreign matter.

The brush should be the **right size** for the item to be cleaned. Carefully clean small spaces, teeth of clamps and ensure lumens are well cleaned. For long tubes, it will be necessary to flush the tube many times to ensure it is cleaned. Hold instruments and other items **under the surface of the water** while scrubbing and cleaning to avoid splashing. **Disassemble instruments** and other items with multiple parts, and be sure to brush in the grooves, teeth, and joints of items where organic material can collect and stick.



Step 2
Rinse items thoroughly with clean water to remove all detergent. Any detergent left on the items can reduce the effectiveness of sterilisation of high level disinfection



Step 3
Leave to dry – away from other dirty items – on a clean rack or hang if tubing or items with lumens. It is also possible to dry with a paper towel or clean material towel (towels should be changed regularly. They must not be wet). The towels should only be used for drying instruments not for hands

Figure 23 Cleaning patient care equipment

Note: Always ensure items are dry. Sterilisation and chemical HLD cannot be accurately performed if the items are wet.

Cleaning instruments using other methods

Enzymatic cleaners
These are to be used for fibreoptic instruments, their accessories and other items that are difficult to clean such as items with narrow lumens.
Remember:

- Hot water is not a good choice for cleaning instruments because it coagulates protein, making blood and body fluids hard to remove. Therefore use only warm or cold water.
- Wear utility gloves, a mask, and protective eyewear when cleaning instruments and other items.

Stage 4: Sterilize

Sterilization ensures that instruments and other items are free of **all** micro organisms (bacteria, viruses, fungi, and parasites), including bacterial endospores[4]. Sterilization of inanimate objects is done either by:

- high-pressure steam (autoclave or pressure cooker)
- dry heat (oven)
- chemical sterilants

The most common methods of sterilization in Cambodia are **high pressure steam** (autoclave or pressure cooker) and **dry heat** (hot air oven).

[4] **Endospores** are a dormant form of a bacterium that allows it to survive sub-optimal environmental conditions and are found in soil and water, where they may survive for long periods of time. They cause tetanus and gas gangrene.

The safest and most reliable method for sterilisation is steam sterilisation, which is recommended by the MOH. Facilities and donors should provide steam sterilizers rather than dry heat ovens.

Note: Because sterilization is the only procedure that kills all micro organisms, including bacterial endospores, it is the only option for any items that will come in contact with the bloodstream or sterile tissues.

(If sterilization is not possible or feasible, Health Care Facilities *must* avoid surgical procedures)

Steam is an effective method of sterilization for two reasons. First, saturated steam is an extremely effective "carrier" of thermal energy. Second, steaming is an effective method because any resistant, protective outer layer of the micro organisms can be softened by the steam, allowing coagulation of the sensitive inner portions of the micro organism (similar to cooking an egg white). Certain types of contaminants, however, especially greasy or oily materials, can protect micro organisms against the effects of steam, thus hindering the process of sterilization. This reemphasizes the need for thorough cleaning of objects before sterilization.

Making sure sterilization is effective

To be effective, sterilization requires time, contact, temperature and, with steam sterilization, high pressure. It is important to soak then thoroughly clean instruments and other items before sterilization in order to:

- reduce the number of micro organisms
- eliminate fluids or tissue remains
- remove contaminants that can collect in joints, grooves, and teeth of items

Important: Items must be dry before steam sterilisation

These same considerations apply for effectiveness of High Level Disinfection (HLD)

Steam sterilization (autoclaving)

Steam sterilization in an autoclave is one of the most common forms of sterilization used in healthcare facilities. Steam sterilization requires moist heat under pressure, so there must be sources of both water and heat. Heat can be provided by electricity or by another fuel source (e.g. gas, kerosene burner, wood, charcoal), depending on the type of autoclave being used.

Remember: an autoclave must have a pressure gauge and a source of water (either the machine is hooked up directly to a water source or water is put into the machine before the cycle begins).

There are two types of steam sterilisers recommended for Cambodia – the small portable pressure cooker steriliser and the larger autoclave (electricity or gas).

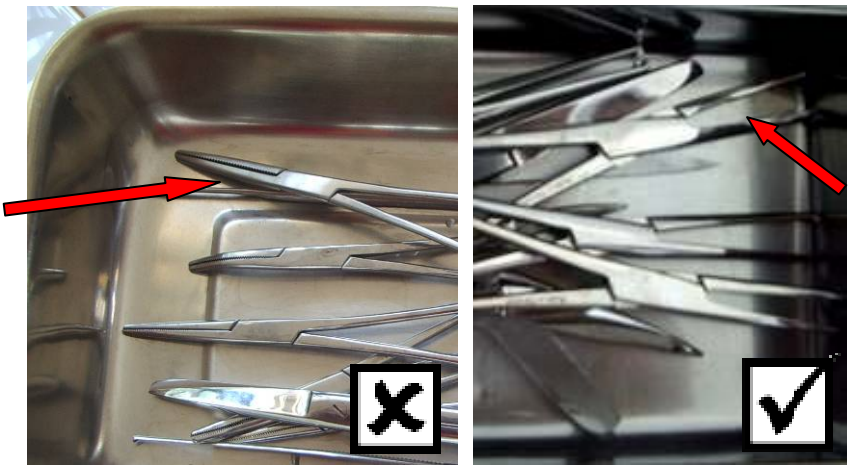
Figure 24 Pressure cooker sterilizer and autoclave

Steam sterilization (Pressure cooker)

For sterilisation to be achieved, it is important to ensure the procedure is correct:

- Put water in the bottom of the autoclave - up to the ridge located on the inner wall.
- Make sure all equipment is double wrapped. Unwrapped items or single wrapping are not allowed See Annex IV for details.
- Place items in the autoclave and arrange them loosely, so steam can circulate around them.
- Steam must reach all surfaces to ensure sterilization is achieved. Instruments must be left open and/or disassembled. Gauze drums must have their vent holes left open to allow steam to pass into the drum; boxes must be left open so that steam can reach all surfaces (unless they have vented holes like gauze drums)

Incorrect – instruments closed



Correct – in open position

Figure 25 Organisation of instruments for sterilization

- Sterilization tape is required both inside the pack (to ensure sterilization of contents) and outside
- Do not overload the steriliser otherwise the items will not be sterilized.
- Place the autoclave over the heat source (e.g. electric stove, gas, kerosene burner, wood or charcoal) and turn to high heat. Once steam is emitted from the pressure valve, begin timing the sterilization cycle. The heat can be reduced, but steam must continue to be emitted for the sterilization to be taking place. If it stops, the temperature and pressure must be reached and timing restarted.
- The pressure must reach 121 °C (250 °F) and 106 kP/15 lbs/inch^2 (psi) and be maintained for 30 minutes.
- Once the time has been reached, turn off the heat or remove from the fire, open the pressure valve to release all steam and allow the autoclave to cool before opening it. The heat within the autoclave will allow items to completely dry.
- Leave instrument packs in the pressure cooker for about 30 minutes so they can dry completely
- Remove items, record sterilization date on the autoclave tape and store them in a cupboard with doors.

For larger autoclaves, the principles are the same i.e.

- Wrap all equipment
- Steam must reach all surfaces to ensure sterilization is achieved. Instruments must be left open and/or disassembled. Gauze drums must have their vent holes left open; boxes without holes must be left open
- Pack the steriliser so that items do not touch the walls of the sterilizer
- Do not overload the sterilizer
- Ensure the correct time, pressure and temperature are reached and maintained for the minimum time (121 °C (250 °F) and 106 kP/15 lbs/inch^2 (psi) of 30 minutes).
- If the autoclave is automatic, the heat will shut off and the pressure will begin to fall once the sterilization cycle is complete. If the autoclave is not automatic, turn off the heat after steam has been escaping for the required time. Wait until the pressure gauge reads "zero" to open the autoclave. Open the lid or door to allow the remaining steam to escape. Leave instrument packs or items in the autoclave until they dry completely, which could take up to 30 minutes.
- Remove items, record sterilization date and store them in a cupboard with doors.

Note: Items must be removed dry. Once removed from the autoclave, damp packs draw micro organisms from the environment and should be considered contaminated.

This picture shows incorrect sterilization procedure as 1) items are not wrapped and 2) boxes have lids which prevent steam from coming into contact with all surfaces. Steam cannot penetrate these metal boxes therefore the lids must be left off during sterilization procedure. Boxes must be kept on their sides to allow steam to enter.

Figure 26 Example 1 of incorrect packing of steam sterilizer

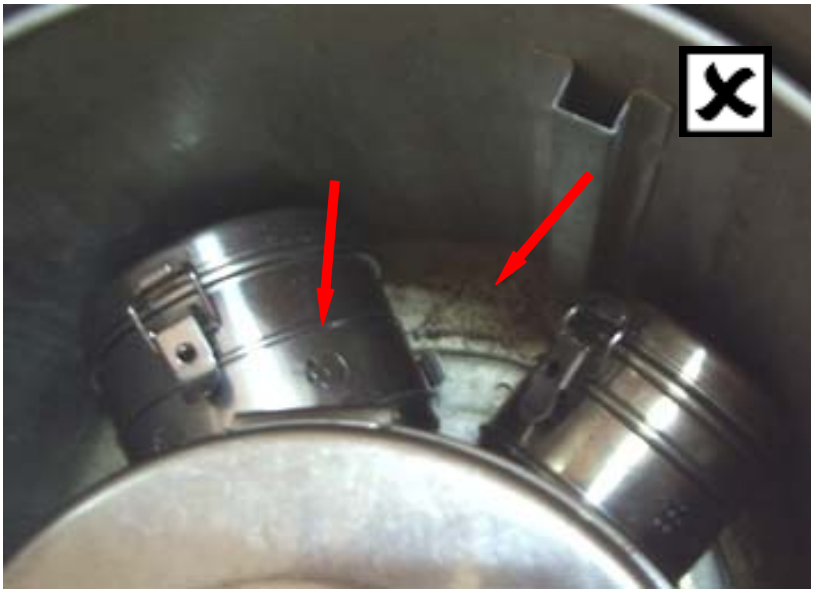


Figure 27 Example 2 of incorrect packing of steam sterilizer.
Please also note 1) ventilation holes are closed and 2) the dirty pressure cooker

The above pressure cooker steriliser shows the following problems:

- Unclean sterilizer
- Holes of the gauze drums are not left completely open to allow steam to penetrate

Gauze drum holes are open however they should be closed AFTER sterilization is complete. In addition, gauze must be wrapped in packs of 5 or 10. Paper or material can be used. Gauze can not be used for wrapping gauze packs.

In the photo on the left, the gauze drum holes were correctly open during sterilization but they were not closed after sterilization leaving all items to be recontaminated.

The gauze is considered unsterile and needs to be resterilized.

Figure 28 Incorrect storage and packing of gauze drum.

For more details about packing and loading see Annex IV

Steps of steam sterilization

Step 1: Soak, clean, dry and pack all instruments/items to be sterilized.

Step 2: Arrange all packs and drums in the chamber of the autoclave in a way that allows steam to circulate freely.

Step 3: Follow the manufacturer's instructions whenever possible. If none then use 121 °C (250 °F) and 106 kP/15 lbs/inch2 (psi) for 30 minutes. Begin timing when the autoclave reaches the desired temperature and pressure.

Step 4: Allow to cool before opening.

Step 5: Remove packs.

Step 6: Place sterile packs in closed cabinets. Packs can be kept for one week unless they become wet or contaminated.

Remember: When instruments and equipment are sterilized by high pressure steam, all surfaces have to be reached by the steam. For example, steam sterilizing closed containers will sterilize only the outside of the containers not the contents inside!

The pick up forceps and their containers should be autoclaved each morning. If they are not sterilized properly, all sterile instruments and supplies will be contaminated immediately.

It is necessary to check the efficiency of the autoclave on a regular basis. Bacterial indicators should be inserted inside a pack and then sterilized. The indicators should have changed colour indicating the autoclave is functioning as intended.

Autoclave maintenance

The autoclave should be checked each time it is used to make sure that it is functioning properly. Before using the autoclave, check the gaskets, gauges, pressure and safety valves for defects and ensure that they are working properly. Clean the chamber and cover regularly.

The autoclave is **not** working correctly if:

- Steam escapes from the safety valve instead of the pressure valve. If this happens, the pressure valve must be cleaned and inspected.
- Steam comes out from under the lid or around the door. If this happens, the gasket must be cleaned, dried or replaced.

If any repairs are necessary, they should be made before the autoclave is used again.

Figure 29 Examples of poorly maintained sterilizers
Photo on the left shows moisture is leaking from the pressure cooker therefore pressure is not maintained and sterilisation is not possible

More information is available about steam sterilization in Annex IV.

Remember: Always sterilize instruments and other items for the *correct amount of time* at the *correct pressure* and *temperature*.

Be sure items are *completely dry* both before sterilizing and before removing them from the autoclave.

Make sure the sterilizer is packed correctly

Dry-heat sterilization (electric oven)

Dry-heat sterilization requires high heat for a specific period of time. For sterilization to be achieved, a constant heat is necessary. Because of the high temperatures, **only glass or metal objects can be sterilized by dry heat.** Do not use this method for other items, such as gauze or cotton which may melt or burn.

Dry heat ovens are not as safe as autoclaves. As they do not maintain consistent heat it may result in lack of sterilization. Therefore the MOH do not recommend them. If there is however no alternative then it is **essential** to use an industrial dry heat oven rather than the common home oven which is not reliable or safe to use. Microwaves are also not appropriate and cannot be used. The oven must have a reliable temperature gauge and where possible a timer. If no timer is available, a portable timer is required.

Figure 30 Examples of inappropriate ovens for dry-heat sterilization
Ovens are domestic ovens and should not be used for medical purposes

Steps of dry-heat sterilization

Step 1: Soak, clean, and dry all instruments and other items to be sterilized.

Step 2: Put unwrapped instruments in a box.

Note: Because **dry-heat sterilization** works by raising the temperature of the entire item to the designated temperature, it is not necessary to open or unlock hinged instruments or other items or to disassemble those with sliding or multiple parts. In addition, instruments and other items can be placed in closed containers as heat can penetrate the box (unlike steam which cannot).

Step 3: Place instruments and other items in the oven, and heat to the designated temperature. Once the oven reaches the designated temperature, start the timer. Do not open the door or add more instruments during the procedure. Once the desired time has been reached, turn off the oven.

Temperature
170 degrees C - 1 hour
160 degrees C - 2 hours
150 degrees C - 2.5 hours
140 degrees C - 3 hours

Note: Because dry heat can dull sharp instruments, these items should not be sterilized at temperatures higher than 160 degrees C.

Step 4: Leave items in the oven to cool before removing. When they are cool remove single items using sterile forceps and use or store immediately (maximum 24 hours).

Step 5: Store items properly. Proper storage is as important as the sterilization process itself. For boxed instruments, store for up to 24 hours.

Note: The entire cycle time – including heating the oven to the correct temperature, sterilization, and cooling – is usually twice as long as the time noted above.

Boxes with lids are only to be used for dry heat sterilization. If used for steam sterilization, the lids cannot be kept on during the process as steam cannot come into contact with all surfaces

Maintenance of dry heat ovens

Maintenance of dry-heat ovens should be part of every sterilization procedure. If the ovens do not reach the correct temperature, sterilization will not be achieved. Be sure to:

- Keep the oven clean.
- Check that the temperature gauge is working correctly on a regular basis- every week by putting a thermometer in the oven and comparing the temperature reading with the one on the gauge.

High-level Disinfection (HLD)

HLD can be used to destroy micro organisms present on delicate or heat-sensitive instruments which cannot be sterilized. It is the elimination of virtually all pathogenic micro organisms (almost all bacteria, fungi, viruses, and protozoa) on inanimate (non-living) objects *with the exception of bacterial endospores*. HLD is suitable for items that will come in contact with broken skin or intact mucous membranes.

There are two methods of HLD:

- Boiling
- Chemical HLD

Boiling (thermal) HLD

Boiling is a simple method of HLD that can be performed in any location that has access to clean water and a heat source. Using this method, instruments and other items are placed in a pot or boiler and the water is heated to boiling for 20 minutes.

Procedure for boiling:
Step 1: Soak and clean all instruments and other items to be high-level disinfected.

Step 2: Completely immerse items in the water. Adjust the water level so that there is at least 2.5 cm of water above the instruments. In addition, make sure all bowls and containers are not face down and are boiled full of water.

Step 3: Close lid over pan and bring water to a gentle, **rolling** boil. (Boiling too vigorously wastes fuel, rapidly evaporates the water and may damage delicate instruments or other items.) Start timing when boiling starts. A timer should be used for this.

Step 4: After boiling for 20 minutes, remove objects with previously sterile or high-level disinfected forceps. Never leave boiled instruments in water that has stopped boiling. As the water cools and steam condenses, air and dust particles are drawn down into the container and may contaminate the instruments.

Remove the items with sterile transfer forceps and store in a HLD or sterile container for up to 24 hours only.

Clean the boiler and replace the water daily or more often if the water becomes dirty. Do not refill without cleaning.

Chemical HLD

High-level disinfectants
They are used for processing instruments and other items (semi-critical items when thermal autoclaving will damage the items or boiling is not available e.g. MVA cannula.)

Chemical HLD is done by using chemicals to kill any bacteria. It is effective against a broad range of micro organisms, including tuberculosis causing micro organisms

The two recommended chemicals for HLD are Gluraldehyde and Peracetic Acid. Place items in 2% Glutaraldehyde solution for 45 minutes at 20 ^{o}C or a 0.2% Peracetic acid solution for 10 minutes then rinse with boiled water. Transfer with sterile forceps or HLD pick up forceps. Drain water and air dry before storing in HLD container. Use within 24 hours unless contaminated.

The following solutions should NOT BE USED for chemical HLD:

- **Chlorine solution is a low-medium level disinfectant and therefore cannot be used to disinfect semi critical items**.
- **Formaldehyde** is a potential carcinogen and extremely irritating to the skin, eyes, and respiratory tract. Therefore, routine use of formaldehyde for processing instruments and other items or for disinfection of environmental surfaces is **not** recommended.
- **Alcohol (60-80% ethyl or isopropyl)** can be used to disinfect thermometers, goggles, ambu bag masks and stethoscopes. Although effective against a wide range of micro organisms, alcohol does not kill all organisms and, therefore, should not be used for HLD.
- **Iodine containing antiseptics:** Because of their low levels of iodine (which allow them to become contaminated with micro organisms), they are not recommended for use as disinfectants. Antiseptics are designed to be used for reducing or destroying micro organisms on the skin or mucous membranes without damaging these tissues. They usually do not have the same killing power as chemicals used for disinfection of inanimate objects. Therefore, antiseptic solutions should **never** be used to disinfect inanimate objects, such as instruments and reusable gloves. In addition, items such as pickup forceps, scissors, scalpel blades, and suture needles should never be left soaking in an ***antiseptic solution***.
- **Flaming:** Wiping items and then burning the alcohol is not a suitable form of disinfection and should be discouraged (see photo below)

Figure 31 Example 1 of incorrect sterilization technique
Wiping items with alcohol then burning the alcohol is an incorrect and unsafe method of sterilization.

Note: Using formaldehyde vapours from gauze soaked in formaldehyde and placed together with instruments is not a suitable way for HLD.

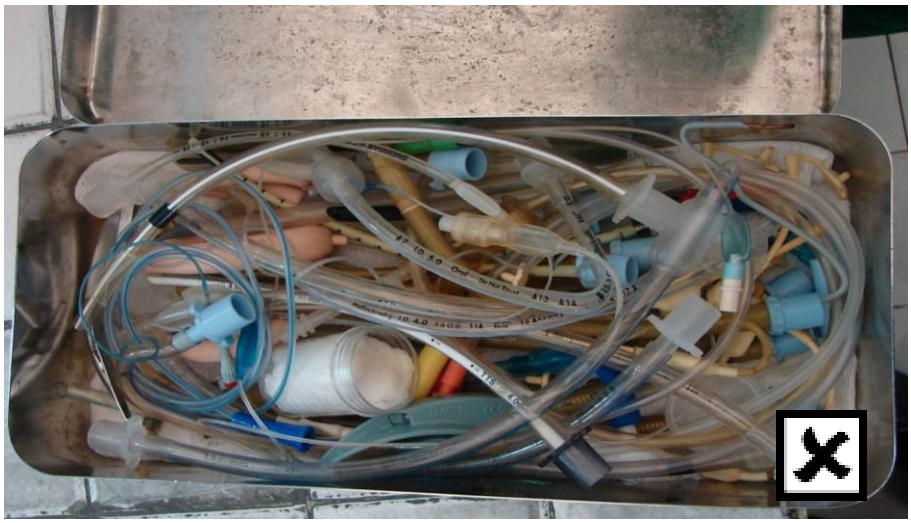


Figure 32 Example 2 of incorrect sterilization technique.
Gauze soaked in formaldehyde then placed in box with tubes is an incorrect method of sterilization.

Important facts about chemicals used for disinfectants

- Chlorine, bleach and other chemical disinfectants should be stored in a ***cool, dark area*** never in direct sunlight or in excessive heat (places where they should not be stored at include upper shelves in a tin-roofed building) and be out of reach for children
- Undiluted bleach liberates a ***toxic gas*** when exposed to sunlight and when it is ***mixed with acidic detergents*** such as those used for toilet cleaning
- Bleach solutions give off chlorine therefore should be prepared in a well ventilated area
- ***Plastic containers*** are recommended for mixing and storing bleach solutions as metal containers are corroded rapidly and also affect the bleach
- Mix bleach with cold water because hot water decomposes the sodium hypochlorite.
- As sodium hypochlorite is caustic, direct contact with skin and eyes should be avoided. Therefore use mask, household rubber gloves, goggles (to protect eyes from splashes) and waterproof apron when preparing diluted bleach. If bleach gets into the eyes, immediately rinse with water for 15 minutes.
- Bleach solutions must be ***prepared daily*** because they lose their strength after 24 hours
- Change the bleach solution if it becomes cloudy
- In special circumstances it may be necessary to use different concentrations of chlorine to those outlined in the table below however, current MOH recommendations are to use 0.05% chlorine for low-medium level disinfection (for non critical items).

Recommended methods for reprocessing of instruments

Table 3 Recommended processing for equipment and instruments

Instruments or other items	Frequency	Cleaning	Low level disinfection	HLD	Sterilization
Airways (plastic), Suction bulbs (rubber)	Between patients	Soak 10 mins. Wash with soap and water. Pass soapy water through lumen three times, removing all particles. Clean using appropriate size brush Rinse with clean water, air or towel dry	Not applicable	Thermal HLD (boil) if plastic allows or Peracetic acid 0.2% or Glutaral-dehyde 2%	Not applicable
Laryngo-scopes	After each use	Disassemble and wash with soapy water. Remove light. Dry thoroughly and reassemble	70% Alcohol 3 applications		
Metal Storage containers for instruments	After each use	Wash with soap and water. Rinse with clean water, air or towel dry	Not applicable	Not applicable	Autoclave or dry heat sterilize
Suction cannulae (plastic) for MVA	After each use	Soak 10 mins. Wash with soap and water. Pass soapy water through cannulae three times, removing all particles. Clean using appropriate size brush. Rinse with clean water, air or towel dry	Not applicable	Thermal HLD boiling or peracetic acid 0.2% or Glutaral-dehyde 2%	Not necessary
Oxygen Humidifiers	After each patient and at least every 3 days	Wash with soap and water. Rinse with clean water, air or towel dry	Not applicable	Thermal HLD boiling or peracetic acid 0.2% or Glutaral-dehyde 2%	
Surgical instruments (metal)	After each use	Soak 10 mins. Scrub with soap and water. Use appropriate size brush to clean. Rinse with clean water, air or towel dry and wrap in packs or individually.	Not applicable	Not applicable	Autoclave or dry heat sterilize
Transfer forceps and container (metal)	Once a day	Wash with soap and water. Rinse with clean water, air or towel dry and wrap in packs or individually.	Not applicable	Not applicable	Autoclave or dry heat sterilize

Urinary catheters (metal) Do not reuse rubber or plastic catheters	Between patients or after each use	Soak 10 mins. Pass soapy water through the cannulae three times, removing all particles. Clean using appropriate size brush. Rinse with clean water, air or towel dry and wrap in packs or individually.	Not applicable	Not applicable	Autoclave or dry heat
Ambu bags and CPR face masks	Between patients	Wash with soap and water. Rinse with clean water, air or towel dry and wrap in packs or individually.	Not applicable	Thermal HLD boiling or peracetic acid 0.2% or Glutaral-dehyde 2%	Autoclave if compatible
Reusable aprons (heavy plastic or rubber)	Once a day	Wash with soap and water. Rinse with clean water and dry	Not necessary	Not necessary	Not necessary
Footwear (rubber shoes or boots)	Once a day	Wash with soap and water. Rinse with clean water and dry	Not necessary	Not necessary	Not necessary
Exam or operating room tables or other large surface areas (carts and stretchers)	Once a day	Wash with soap and water. Rinse with clean water and dry	Chlorine 0.05% or alcohol 70%	Not necessary	Not necessary
Patient equipment such as IV stands, nebulizers, oxygen concentrator, suction machines etc)	Once a day	Wash with soap and water. Rinse with clean water and dry	Chlorine 0.05% or alcohol 70%	Not necessary	Not necessary
Laparo-scopes	After each use	Disassemble, then using a brush wash with soap and water. If applicable pass soapy water through lumen three times, removing all particles. Rinse with clean water, air dry	Not applicable		Sterilize after each use using chemical sterilization. Follow manufacturer ’s guidelines
Stethoscopes	After each use	Wipe with soap and water if visibly dirty.	Alcohol 70%	Not necessary	Not necessary

Mask	After each use	If is not disposable. Wash with soap and water. Rinse with clean water and dry.	Not necessary	Not necessary	Not necessary
Goggles, face shield	After each use	Wash with soap and water. Rinse with clean water and dry	Chlorine 0.05% or alcohol 70%	Not necessary	Not necessary
Thermometers (Always separate rectal from oral thermo meters at all stages)	After each use	Wash with soap and water. Rinse with clean water and dry. Thermometers should be stored dry in a clean place till reused.	Chlorine 0.05% or alcohol 70%	Not necessary	Not necessary
Bed pans, urinals or emesis basins	After each use	Remove all organic material with paper towel. Wash with soap and water. Rinse with clean water and dry	Chlorine 0.05%	Not necessary	Not necessary
Surgical gowns, reusable caps, linen drapes and wrappers	After each use	Wash with soap and water. Rinse with clean water and dry. Wrap in packs or individually.	Not applicable	Not applicable	Autoclave
Ventilator tubing or circuits	Between patients	Wash with soap and water. Pass soapy water through cannulae three times, removing all particles. Rinse with clean water, air or towel dry and wrap in packs or individually.	Not applicable	Thermal HLD Peracetic acid 0.2%	Autoclave if compatible
Blood pressure cuff	Once a week	Wash with soap and water. Rinse with clean water and dry	Not necessary	Not necessary	Not necessary

Please see Annex II for instructions on how to prepare alcohol 70% and Annex V for instructions on how to prepare chlorine 0.05%

Stage 5: Storage

Items should be stored appropriately.

For sterile packs, they must be kept in a closed cupboard. The sterilisation date must be recorded on the pack and all packs must be used within one week of sterilisation.

Individual items must be stored in sterile containers and must be used within 24 hours. If not they must be resterilized.

Remember: If an item comes in contact with dust particles, insects, or any non-sterile item, person, or surface, the item must be considered to be contaminated. Because of the high risk of contamination, unwrapped sterile or HLD items should be used immediately or kept in a covered, sterile or HLD container for no longer than one day after processing.

When in doubt about the sterility of a pack, consider it to be contaminated and resterilize the item before use.

Central Sterilising and Supply Department

The Central Sterilization and Supply Department (CSSD) is a place for sterilizing and supplying sterilized materials in hospitals (and health centres). Wards and departments are responsible for soaking, cleaning, drying and packing of their items before sending to CSSD for sterilization. Consumable items such as gauze and cotton is also sterilized at CSSD and given to the wards.

All items to be sterilized must be received at the CSSD and written in a log book. Items are then sterilized by the CSSD before ward staff return to collect items or CSSD staff return them to the wards.
CSSD is responsible for sterilization and storage of all surgical theatre packs.

CSSD must be set up with appropriate clean and dirty areas i.e. soaking and cleaning areas must be separated from drying and packing areas.

Organizing an area for processing instruments

The objectives of processing are:

- To remove all micro organisms from instruments and other items so micro organisms are not transmitted to patients during clinical procedures.
- To reduce the risk of infection to staff by eliminating harmful micro organisms and viruses that may be present on medical waste and used instruments and other items that come into contact with a patient's fluids or tissues during clinical procedures.

Activities that are involved with the first objective (such as creating a sterile field, donning sterile surgical attire, patient prep, and sterilization, HLD, and storage of processed instruments) are considered "clean" activities. Activities involved with the second objective (soaking, cleaning, waste disposal, etc.) are considered "dirty" activities.

When a "clean" item comes in contact with a "dirty" item (for example, if a sterilized instrument is laid on a used or non-sterile cloth), the item acquires potentially harmful micro organisms. Because of this the working area should be arranged in a way that minimizes the level of contamination in areas where "clean" activities take place.

Areas in which "clean" activities take place include:

- Operating theatres
- Procedure rooms
- Work areas for sterilizing, HLD, and storing items

Areas in which "dirty" activities take place include rooms where instruments and other items are washed, toilets, latrines, sluice rooms, and waste-storage sites.

Contamination of a "clean" area can be minimized by:

- Reducing the number of people permitted in the area. It is important to restrict the number of people in clean areas to only those involved in the activities being carried out.
- Defining the movement of people and activities within the area. When processing instruments and other items, the flow of movement of soiled items should be organized so that clean or sterile/HLD items do not become contaminated. Activity patterns should be established so that soiled items never cross paths with clean, sterile, or HLD items.
- Separating areas where clean and dirty activities take place and limiting the type of activities that take place in the clean areas.
- It is ideal to have separate rooms - one for soaking, cleaning and drying items, another for packing and another for sterilization, HLD, and storage. However, in many settings, this is not possible. When only one room is available for processing instruments and other items, it should be arranged so that activities and objects flow in an organized fashion from receiving to storage. It is necessary to have at least one sink in the processing areas (though two sinks is preferred), sufficient countertop space for receiving dirty items and for drying and packaging clean items, and storage space (preferably closed cabinets)

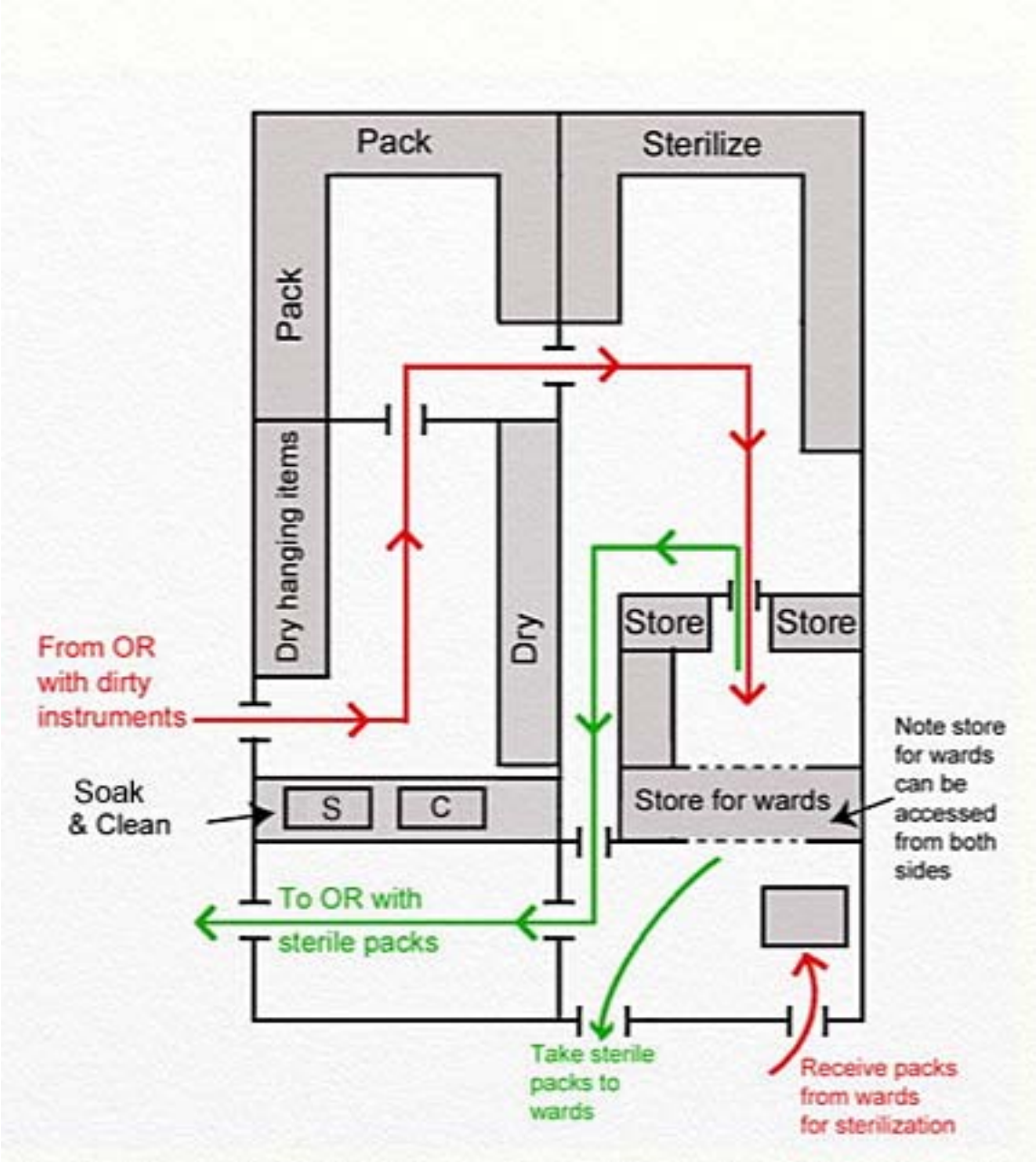


Figure 33 CSSD showing appropriate flow of clean and dirty items
Note wards bring their cleaned and appropriately packed items to the CSSD for sterilization, then return to collect them later.

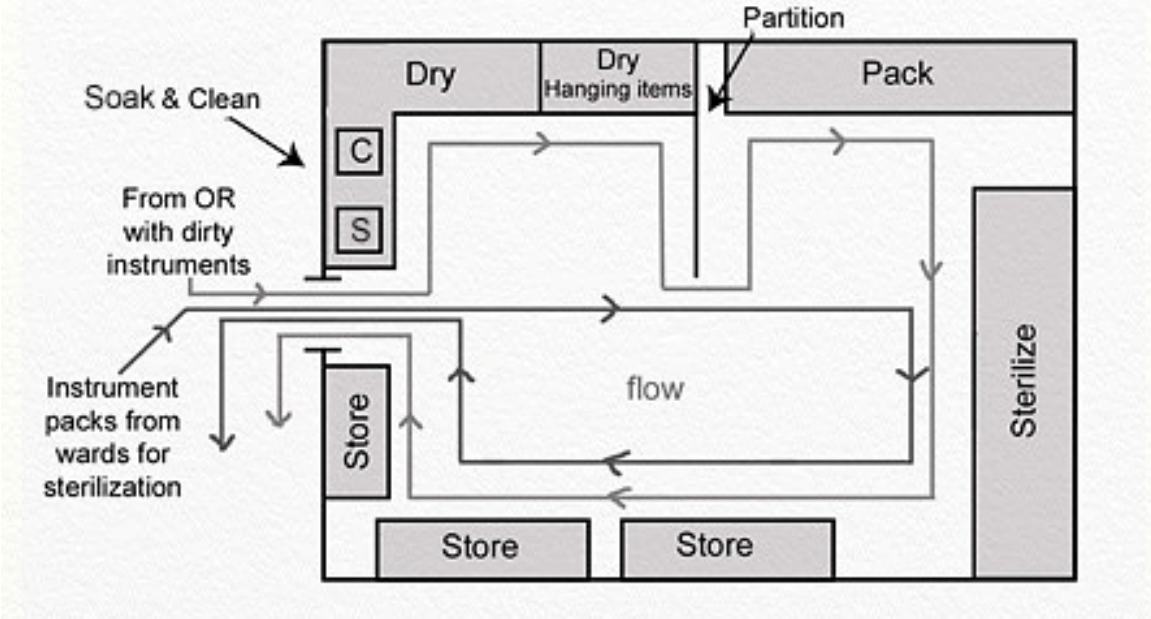


Figure 34 Floor plan for a one-room processing area
One room with soaking, cleaning, drying, packing, sterilization and storage. Note the appropriate flow showing separation of "dirty" and "clean." A partition has been added between drying and packing to further separate dirty and clean.

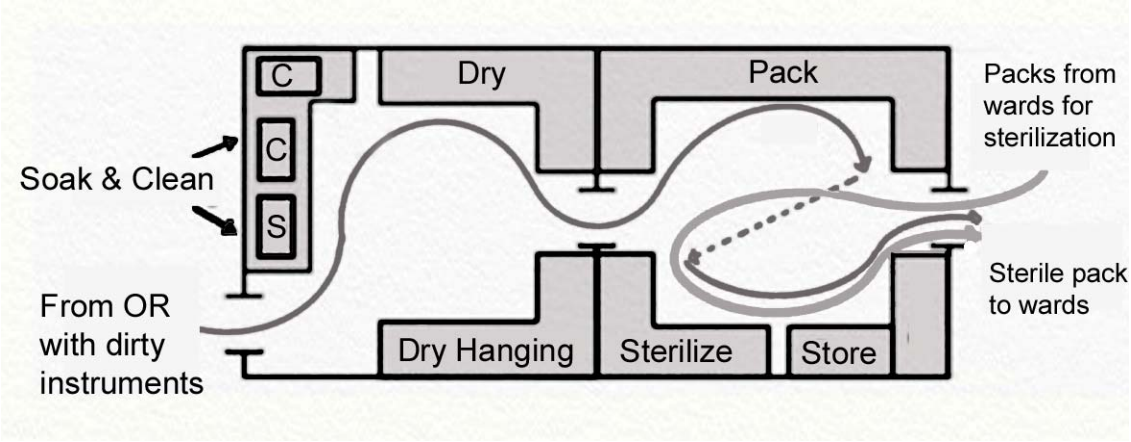


Figure 35 Floor plan for a two-room processing area
Soaking, cleaning and drying are separated from packing, sterilization and storage.

To further minimize contamination:

- Educate staff about which are the clean and dirty areas.
- Designate and label processing areas, particularly when only one room is available.
- Enclose processing rooms to minimize dust and eliminate insects.
- Access to two sinks or basins with a clean water supply (one sink for cleaning, one for rinsing) is recommended. The sinks should be deep enough for instrument cleaning i.e. deeper and larger than a hand sink

- Store clean, sterile, and HLD instruments and other items on shelves with doors to minimize the amount of dust and debris falling onto the packaging.
- Avoid using cardboard boxes for storage, as they can harbour insects and shed dust and debris.
- Remove supplies from all shipping cartons and boxes before bringing them into an operating theatre, procedure room, or clean work area.

Remember: An item that looks "clean" may actually be contaminated. You can't see micro organisms without a microscope. If you're not sure whether an item is clean or sterile, consider it to be contaminated.

5.4- Environmental cleaning

Housekeeping

Housekeeping refers to the general cleaning of hospitals and health facilities, including the floors, walls, and certain types of equipment, tables and other surfaces. The purpose of general housekeeping is to reduce the number of micro organisms that may come in contact with patients, visitors, staff and the community; and provide a clean and pleasant atmosphere for patients and staff. Cleaners have the responsibility of helping to keep the environment clean and safe, not just for patients but for their colleagues as well. Cleaners are an integral part of the healthcare system.

Most areas in hospitals and health facilities are low-risk, such as waiting rooms and administrative offices, and can be cleaned using only soap and water. In high-risk areas where heavy contamination is expected, such as toilets and latrines, or blood and body fluid spills, a disinfectant such as chlorine should be used prior to cleaning with water and detergent. Using a disinfectant before detergent and water is also necessary in other high-risk areas such as operating rooms, pre- and postoperative recovery areas and intensive care units (ICUs). In addition, patient rooms, especially those items that might be touched barehanded by patients and staff, should be cleaned using a disinfectant to minimize the risk of infection.

Note: In many settings, housekeeping staff may not understand their risks of getting infected. It is particularly important for supervisors to ensure that these staff know their risks and follow the appropriate procedures.

Cleaning solutions

Two types of cleaning solutions are used during housekeeping at a health facility. It is essential that housekeeping staff understand the different types of cleaning agents and how each should be used:

- **Plain detergent and water:** This is used for low-risk areas and general cleaning tasks. Detergents remove dirt and organic material and dissolve

or suspend grease, oil, and other matter so it can easily be removed by scrubbing. Liquid soap is recommended as bar soap and soap powder will leave a scum.

- **Disinfectant solution (sodium hypochlorite):** Disinfectants rapidly kill or inactivate infectious micro organisms during the cleaning process. Disinfectants are also used to decontaminate an area so that it is safer for staff to clean with a cleaning solution.

Principles of environmental cleaning

Although certain areas of the clinic require special housekeeping procedures, the following list applies to **all** parts of the clinic:

- **Develop and post cleaning schedules** where all housekeeping staff can see them. Make sure that cleaning schedules are closely maintained. (e.g. “Walls should be cleaned every Tuesday”)
- **Always wear gloves** (preferably thick utility gloves) when cleaning.
- **Use a damp or wet mop or cloth** for walls, floors, and surfaces instead of dry-dusting or sweeping to reduce the spread of dust and micro organisms.
- **Scrubbing** is the most effective way to remove dirt and micro organisms. Scrubbing should be a part of every cleaning procedure.
- **Wash surfaces from top to bottom** so that debris falls to the floor and is cleaned up last. Clean the highest fixtures first and work downward--for example, clean ceiling lamps, then shelves, then tables, and then the floor.
- Isolation rooms and other areas that have patients with known transmissible infectious diseases should be cleaned with a household bleach solution at least daily and after the patient leaves
- **Dusting** is most commonly used for cleaning walls, ceilings, doors, windows, furniture and other environmental surfaces. Dusting should be performed in a systematic way, using a starting point as a reference to ensure that all surfaces have been reached. When doing high dusting (ceiling tiles and walls), check for stains that may indicate possible leaks. (Leaks should be repaired as soon as possible because moist ceiling tiles provide a reservoir for fungal growth.)
- **Change cleaning solutions** whenever they appear to be dirty. A solution is less likely to kill infectious micro organisms if it is heavily soiled.
- Use **separate equipment** (e.g. cloth, brushes and buckets) for cleaning contaminated areas such as toilets.

Frequency of cleaning

Each morning

At the beginning of each day, damp-wipe or mop countertops, tables, trolleys, and floors with soapy water to remove dust and lint that has accumulated overnight.

Between patients

- Clean operating and procedure rooms, examination tables, trolleys or Mayo stands, countertops, lamp handles, and any other potentially contaminated surfaces with a cloth dampened with 0.05% chlorine.
- Wipe any areas with obvious spillage immediately with paper or cloth towel then disinfect with 0.05% chlorine and wash with soap and water.
- Put waste in a leak-proof container. Remove the container from the operating theatre or procedure room whenever it is three-quarters full.
- Clean visibly soiled areas of the floor with a mop soaked in 0.05% chlorine and then soapy water.

At the end of the clinic session or day

- Remove contaminated waste and dispose of it as soon as possible to limit exposure.
- Wipe down all surfaces relevant to patient care including IV stands, bedside table, sinks, etc with a cloth saturated with 0.05% chlorine.
- Pay particular attention to procedure/operating tables, making sure to thoroughly clean the sides, base, and legs with a 0.05% chlorine solution
- Mop contaminated floors with 0.05% chlorine solution and then repeat with soap and water
- Remove soiled linen in closed leak proof containers.

Table 4 Recommended cleaning schedule

Equipment, patient-care articles	**Routine or preferred method**	**Acceptable alternative or additional recommendations**	**Cleaning schedule**
Beds and bed frames	Wash with detergent solution, rinse, and dry.	Infected patients: Disinfect after cleaning with a disinfectant cleaning solution (chlorine 0.05%)	Daily and after discharge
Ceilings	Wash with detergent solution	Keep in good repair. Physical integrity of ceiling is important because fungi and mould can grow on moist/water-damaged surfaces.	Clean if visibly soiled
Crockery and cutlery	Wash with soap and water. Heavy utility gloves should be used	Each patient should have an individual set, either provided by the hospital or brought from home.	After each meal.

Drains	Wearing heavy utility gloves, clean the area around the drain. Wash hands after removal of gloves. Chemical disinfection is not required.	Regular maintenance is a must. Cover with insect screen. When blockage occurs, contact Maintenance Department.	On a regular basis.
Floors	Wash with soap and water. Disinfection is not routinely required except in high-risk areas such as ICU, OT and where visible spillage of bodily fluids or organic material occurs (see above).	If contaminated, clean and disinfect using a 0.05% chlorine solution before soap and water.	At the beginning of the day, and whenever necessary.
Furnishings (Chairs in patient room, tables, lockers etc)	Clean cloths are used for each room, wash with soapy water		Each day, and whenever necessary
Mattresses and pillows	If mattress and pillow covered in plastic, wash with soapy water. If infectious disease e.g. TB or other severe respiratory infection, wipe with 0.05% chlorine solution first.	Infected patients: Disinfect cover with 0.05% chlorine. Allow a suitable contact time (10 mins) then rinse and dry. Do not disinfect unnecessarily as this damages mattress cover.	After each patient and if soiled.
Patient partition	Clean partitions with a detergent solution.	Should be disinfected if contaminated with blood or body fluids.	Each week and if dirty
Toilet bowl and seat	Using heavy-duty utility gloves, wash bowl and seat with a detergent solution and dry the seat with a disposable paper towel. Wash your hands after removal of gloves.	Infected patients or if grossly contaminated: After cleaning, disinfect with chlorine solution (0.05%), rinse and dry. This area should not be cleaned with the same cloths and mops used for cleaning patient areas and items!	Daily, and whenever necessary
Trolleys	Wipe with soapy water	Disinfect with 0.05% chlorine or 70% alcohol.	Daily. Trolley tops before and after use.
Wash basins/sinks	Scrub with detergent; use cleaner for stains, etc.	Disinfection may be required if contaminated (0.05% chlorine)	Each day, and whenever necessary

Waste container	Wash waste container with soapy water and dry. If the bin is used for infectious waste, wipe with 0.05% chlorine.		At the end of the day, and whenever necessary
Walls	Walls must be spot cleaned of spills and splashes immediately. All walls should be completely washed weekly.	Disinfect with 0.05% chlorine if contaminated with blood or body fluids.	The needs increase In high-risk areas, and whenever necessary.
Working surfaces	Clean with soapy water.	If there is visible spillage of blood or organic material, first remove spill and disinfect using a 0.05% chlorine solution.	Several times during the day, and whenever they are soiled.

Cleaning up spills

Clean up spills of potentially infectious fluids immediately. Besides preventing the spread of infection, prompt removal also prevents accidents.

Small spills of blood and other bodily fluids including excreta should be wiped with a paper towel then disinfected with 0.05% bleach before being washed with water and soap.

Note: Contaminated cleaning equipment spreads, rather than reduces, micro organisms in the environment. Supplies and equipment used for cleaning also need to be cleaned. Equipment (such as mops, buckets, and cloths) should be soaked in a disinfectant solution (0.05% chlorine), then cleaned in detergent and water, rinsed in clean water, and dried before reuse.

Cleaning procedures for different clinic areas

Low-risk areas: waiting rooms, administrative areas

These are the areas that are usually not contaminated with dirt or infectious micro organisms. Routine cleaning – the kind of cleaning you would do in your home – is usually good enough for these areas. In general, clean these areas daily with a cloth or mop dampened with detergent and water. If a high risk patient has been in the waiting are, additional cleaning with a disinfectant might be necessary.

Intermediate risk areas: patient wards

These are areas used for the care of patients who are not obviously infectious and not highly susceptible. These areas are usually cleaned by procedures that

control dust, such as damp mopping with detergent cleaners. Dry sweeping or vacuum cleaners are not recommended. The use of detergent solution improves the quality of cleaning. Clean at least once daily, and whenever needed. Spills of blood and body fluids are cleaned up immediately.

High risk areas: isolation wards, ICU, operating rooms, laboratories
These are special care areas. In these areas there is a greater potential for pathogen contamination with infectious materials and more of a concern about potential infection transmission to both patient and clinic staff. These areas must be cleaned with care using chlorine 0.05%. Phenol should be used for sputum spills in TB laboratories.

5.5- Prevention of needle-stick/sharp injuries

In healthcare settings, injuries from needles or other sharp instruments are the number-one cause of occupational exposure to blood-borne infections. **All** staff that come in contact with sharps - from doctors and nurses to those who dispose of the trash - are at risk of infections.

The term **sharps** refers to any sharp instrument or object used in the delivery of healthcare services - including hypodermic needles, suture needles, scalpel blades, sharp instruments, IV catheters, and razor blades.

Improper disposal of sharps poses a great threat to members of the **community.** Sharps that are discarded where they may be found by scavengers, children, and others may cause serious injury and infection. Everyone in the local community is at risk of the spread of infection when scavenged syringes and needles are reused.

Identifying and minimising risk of injury

Many injuries can occur when staff are using and disposing of sharps. Staff can become injured:

- While recapping hypodermic needles after use. This is one of the major causes of sharp-object injuries.
- When manipulating used sharps (bending, breaking, or cutting hypodermic needles), which can cause the blood inside to splatter or cause staff to accidentally injure themselves
- When one staff member accidentally sticks another staff member while carrying unprotected sharps
- When sharp items are found in areas where they are unexpected, such as on surgical drapes or bed linen
- When handling or disposing of waste that contains used hypodermic needles or other sharps
- When sudden movement by the patient at the time of injection causes a provider to be accidentally stuck.

Uncapped or otherwise unprotected sharps should never be passed directly from one person to another. In the operating theatre or procedure room, pass sharp instruments in such a way that the surgeon and assistant are never touching the item at the same time. This way of passing sharps is known as the **"hands-free" technique:**

- The assistant places the instrument in a **sterile kidney basin** or in a designated "safe zone" in the sterile field.
- The assistant tells the service provider that the instrument is in the kidney basin or safe zone.
- The service provider picks up the instrument, uses it, and returns it to the basin or safe zone.

Figure 36 Passing a sharp instrument in a kidney basin

Safe injection practices

Safe injection practices

- using a sterile, single-use, disposable needle and syringe for each injection given
- never reusing a needle or syringe either from one patient to another or to withdraw medicine from a vial
- discarding both needle and syringe once they have been used. It is not safe to change the needle and reuse the syringe - this practice can transmit disease
- using fluid infusion and administration sets (i.e. intravenous bags, tubing and connectors) for one patient only
- use of single-dose vials [5] for parenteral (IV) medications is recommended whenever possible
- never administering medications from single-dose vials or ampoules to multiple patients or combine leftover contents for later use
- ensuring that both the needle or cannula and syringe are sterile when using multi-dose vials[6]

Remember: a safe injection

- does not harm the recipient
- does not expose the provider to any avoidable risks
- does not result in waste that is dangerous for the community

Proper use of multi-dose vials

Multi-dose vials of medication or other fluids can become vehicles for transmitting infections between patients. Before filling a syringe from a multi-dose vial:

- Check the vial to be sure there are no leaks or cracks.
- Check the solution to be sure it is not cloudy and that there is no particulate matter in the vial. (Most solutions that come in vials are clear. Exceptions

[5] **Single-use vial:** is a bottle of liquid medication containing only one dose of medication that is given to a patient through a needle and syringe

[6] **Multi-dose via**l: is a bottle of liquid medication that contains more than one dose of medication and is often used by diabetic patients or for vaccinations

include tetanus toxoid and the injectable contraceptive Depo-Provera, which are both milky).

- Wipe the top of the vial with a fresh cotton swab soaked with 60-90% alcohol, and allow it to dry.

To reduce the risk of transmitting infections between patients:

- **Always** use a new or correctly processed hypodermic needle *and* syringe every time fluid is withdrawn from a multi-dose vial. Reusing the same syringe to give injections to multiple patients - even if the needle is changed - is not a safe practice, because micro organisms can contaminate the multi-dose vial and be transmitted from patient to patient.
- **Never** leave one needle inserted in the vial cap for multiple uses. This provides a direct route for micro organisms to enter the vial and contaminate the fluid between each use.

Figure 37 Incorrect practice – leaving needle in vial after use
Do not leave any needles sticking in any vials after withdrawing solution. This is a dangerous practice.

Remember: Leaving one needle inserted in a multi-dose vial for multiple uses may be convenient or reduce costs, but it is an unsafe practice that puts patients at risk of infections.

To avoid transmitting infections through IV routes:

- Unhook the needle or catheter from the IV line, and dispose of it as you would dispose of other sharps.
- Throw away the IV line and any remaining fluid. Micro organisms can survive and grow in IV fluids; if the IV line and bag/bottle of fluid are used again, infections can be transmitted to other patients.
- Never use the same IV line and fluid bag/bottle with multiple patients.

Safe disposal of sharps

Improper disposal of contaminated sharp objects can cause infections in healthcare facilities and the community. Any delay in the disposal of sharps will increase the occurrence of accidents.

Figure 38 Disposal of needles
Incorrect (left) and correct (right) disposal of needles

To dispose of sharps correctly:

- Do not recap, bend, or break needles before disposal, and do not remove the needle from the syringe by hand.
- Dispose of needles and syringes immediately after use in a puncture-resistant sharps-disposal container.
- Sharps-disposal containers should be incinerated in an industrial incinerator such as SICIM and Stellar incinerator etc, whenever the containers become 3/4 full.

Sharps-disposal containers

Puncture-resistant sharps-disposal containers should be conveniently located in any area where sharp objects are frequently used (such as injection rooms, treatment rooms, operating theatres, labour and delivery rooms, and laboratories).
A sharps-disposal container is a puncture-resistant container used for the disposal of used needles and other sharps. A sharps container may be made out of an empty plastic jug, or a metal container if MOH issued containers are not available for any reason. Cardboard boxes should not be used.

Figure 39 Sharps-disposal containers
Left: Sharps containers currently in use in Cambodia
Right: A plastic container can be used if a sharps container is not available

5.6- Appropriate management of healthcare waste

Uncollected, long-term storage of waste or waste routing within the premises of the healthcare facility must be avoided. A sound waste management system needs to be developed and closely monitored as described in detail in ***Chapter 8 Healthcare Waste Management.***

Remember: Standard precautions are meant to reduce the risk of transmission of blood-borne and other pathogens from both recognized and unrecognized sources. They are the basic level of infection control precautions which are to be used, as a minimum, in the care of **all** patients in **every** healthcare setting.

PART 2: TRANSMISSION BASED 'ADDITIONAL' PRECAUTIONS

Additional or transmission-based precautions are a set of procedures whose goal is to prevent communication of infectious diseases transmitted in a certain manner. They are to be used in addition to the standard precautions described above. There are three types of transmission-based precautions:

- contact precautions
- droplet precautions
- air borne precautions

They may be combined for diseases that have multiple routes of transmission e.g. chicken pox (contact and airborne precautions are required).

5.7- Contact precautions

These precautions reduce the risk of transmission of organisms from an infected or colonised patient through direct or indirect contract. Diseases where these precautions are required include herpes simplex, chicken pox, impetigo, multidrug resistant bacteria e.g. MRSA. In addition, contact precautions should be implemented for patients with skin or eye infections that may be infectious such as wound infections, conjunctivitis.

An as yet important but unrecognised pathogen in Cambodia is the infection by a bacteria called MRSA (Methicillin-resistant or sometimes called multi-resistant *staphylococcus aureus*) which is responsible for difficult-to-treat skin infections in humans. MRSA is resistant to most of the routinely available antibiotics. In hospitals, patients with open wounds, invasive devices, and weakened immune systems are at greater risk for infection than the general public. Once introduced, they spread rapidly, since transmission is usually through the hands of healthcare staff. Hospital staff and visitors need to follow proper sanitary procedures to prevent the transfer of bacteria.

The following precautions need to be taken:

- Always implement standard precautions
- Separate patient from others. If a private room not available, place the patient in room with another patient suffering from the same active infection (cohorting).
- Wear a clean, non-sterile gown if it is anticipated there will be direct contact with the patient and environmental surfaces or items in the patient's room (this is in addition to wearing gloves which come under standard precautions)

- Change gloves after contact with infectious material (e.g. faeces or wound drainage).
- Remove gloves and gown before leaving the room and perform hand hygiene.
- Do not touch potentially contaminated surfaces or items before leaving the room.
- Reserve non-critical patient care equipment for use with a single patient if possible.
- Clean and disinfect any equipment shared among infected and non-infected patients after each use.
- Limit transport of patient to essential purposes only.
- During transport, ensure precautions are maintained to minimize risk of transmission of organisms.

5.8- Droplet precautions

Droplet precautions reduce the risk of transmission of pathogens spread wholly or partly by droplets larger than 5 microns in diameter. Diseases that are transmitted by this mode include ***pneumonia, pertussis*** (whooping cough), ***diphtheria, influenza, mumps, rubella virus and meningitis***. Droplet transmission occurs when there is adequate contact between the mucous membranes (nose, mouth or conjunctivae) of a susceptible person and particle droplets larger than 5 microns. Usually, droplets are generated from the infected person during coughing, sneezing, talking or when healthcare workers undertake procedures such as tracheal suctioning. Droplet transmission requires close contact between the source and the susceptible person because particles remain airborne briefly and travel only about 1 meter or less. It is therefore essential that staff working with patients wear a surgical mask when in close contact with the patient.

The following precautions need to be taken:

- Always implement standard precautions in addition to droplet precautions.
- Separate patients from others. If a private room not available, place the patient in a room with another patient having active infection with the same disease (cohorting).
- If neither option is available, maintain separation of at least 1 meter between patients.
- Wear a mask if within 1 meter of patient (put on the mask when entering the room or if the patient is in a larger ward, ensure the mask is applied before becoming in close contact with the patient. There is no need to change the mask between patients).
- Limit transport of the patient to essential purposes only.
- During transport, the patient must wear a surgical mask.

5.9- Airborne precautions

Airborne precautions are designed to reduce the transmission of diseases spread by airborne particles. Airborne transmission occurs when droplets containing pathogens are spread in the air. These droplet nuclei (evaporated droplets <5 microns in size) can remain suspended in the air for up to several hours and can be spread widely within a room or over longer distances, especially when bound to dust particles. Diseases which spread by this mode include ***pulmonary tuberculosis*** **(TB)**, ***measles and chicken pox*** (which as mentioned above is

also spread by direct contact) therefore airborne precautions are needed for any suspect or confirmed cases.

For airborne precautions, N95 masks are needed for some high risk procedures such as intubation, bronchoscopy, laryngeal aspiration, autopsy with high speed saw etc. They are also recommended for staff working with MDR-TB patients.

The following precautions need to be taken:

- Always implement standard precautions in addition to airborne precautions.
- Suspected and confirmed TB patients should be admitted in wards away from busy areas and thoroughfares. Suspected cases should be separated from confirmed cases. Smear positive patients should be separated from smear negative/extra pulmonary patients. HIV patients should never be in wards with suspect or confirmed TB patients. All windows should be opened. Increasing fresh air in the building is important because it can dilute the concentration of particles in the air, including the tiny droplet nuclei that contain *M. tuberculosis* from a coughing patient with TB in the lungs.
- If an isolation room is not available, place the patient in room with other patients with the same diagnosis i.e. TB suspects together, smear positive TB patients together, drug-resistant TB together and with no other patients (cohorting).
- If chicken pox or measles:
    - Immune persons (those that have had the disease before or are immunized)—no mask required.
    - Susceptible persons—do not enter room without appropriate PPE
- Limit transport of patients to essential purposes only. If transportation of the patient is essential, the patient must wear a surgical mask over their nose and mouth at all times during transport.

5.10- Risk assessment

All staff should assess the risk for all patients. Standard precautions should be taken for **all patients** but staff needs to assess whether additional precautions are also required i.e. does the patient have a cough, suffer from a skin infection etc. See page 21.

CHAPTER VI: CARE OF HEALTHCARE WORKERS

Preventing exposure - through safer practices, barrier precautions, safer needle devices and other methods - remains the most effective strategy for reducing the risk of infection with HIV and other blood-borne pathogens in healthcare settings. Prevention priorities are:

- All healthcare workers should be trained and be able to demonstrate competency in standard precautions;
- Staff should be provided with the necessary materials and protective equipment
- All healthcare personnel who have a reasonable chance of exposure to blood or body fluids should have all the routine childhood immunizations (especially tetanus) and it is also recommended that they should be offered the required three doses of Hepatitis B vaccine. They should be encouraged to be aware of their own immunization status.

Hepatitis B, Hepatitis C and HIV infection

Occupational exposure

Healthcare workers are at risk for occupational exposure to blood-borne pathogens, including Hepatitis B virus (HBV), Hepatitis C virus (HCV), and human immunodeficiency virus (HIV). Exposures occur through needle-sticks or cuts from other sharp instruments contaminated with an infected patient's blood or through contact of the eye, nose, mouth, or skin with a patient's blood.

General advice if a healthcare worker is exposed to the blood of a patient
Immediately following an exposure to blood:

- Wash needle-sticks and cuts with soap and water
- Flush splashes to the nose, mouth, or skin with water
- Irrigate eyes with clean water, saline, or sterile irrigants for 10 minutes

No scientific evidence shows that using antiseptics or squeezing the wound will reduce the risk of transmission of a blood-borne pathogen. Using a caustic agent such as bleach is not recommended.

See ***MOH post-exposure guidelines*** for further information.

The risk of infection after an occupational exposure

HBV Immunisation is the best way of preventing Hepatitis B (HBV) transmission to healthcare staff. Healthcare personnel who have received full course of three Hepatitis B vaccines and have developed immunity to the virus are at virtually no risk of infection. For a susceptible person, the risk from a single needle-stick or cut exposure to HBV-infected blood ranges from 6-30% (one in 16 to one in 3 people) and depends on the infectious status of the source individual. There is no

known risk for HBV infection from exposure to intact skin.

HCV- The average risk for infection after a needle-stick or cut exposure to Hepatitis C (HCV) infected blood is approximately 1.8% (or about 1 in 50). The risk following blood exposure to the eye, nose or mouth is unknown, but is believed to be very small.

HIV- The average risk of HIV (Human Immunodeficiency Virus) infection after a needle-stick or cut exposed to HIV-infected blood is 0.3% (or about 1 in 300). The risk after exposure of the eye, nose, or mouth to HIV-infected blood is estimated to be, on average, 0.1% (1 in 1,000). The risk after exposure of non-intact skin to HIV-infected blood is estimated to be less than 0.1%.

Prevention

There is no vaccine against Hepatitis C and HIV and there is no known treatment after exposure that will prevent infection. ***For these reasons, following recommended infection control practices to prevent sharp injuries is imperative.***

Spreading infection

Hospital employees are not only at risk of becoming infected they can also transmit infections to patients and other employees. The primary breaches in infection control practice that often contribute to outbreaks of, for instance, viral Hepatitis B and C are:

- Reinsertion of used needles into a multiple-dose vial or solution container (e.g. saline bag)
- Needles that are kept in a multi dose vial and used to draw up a drug for multiple patients
- Use of a single needle/syringe to administer medication (IV, IM, SC or ID) to multiple patients
- Preparation of medications in the same workspace where used needle/syringes are dismantled also may be a factor

See section 5.5 for more information on safe injection practices

Tuberculosis (TB)

TB exposure can occur by breathing in droplet nuclei (organisms< 5 microns) that get into the air from coughs, sneezes, speaking or singing of a smear positive pulmonary TB patient. Healthcare workers have varying risks for exposure to TB. Those working in TB-risk areas such as TB and medical wards, chest clinics, bronchoscopy units, radiology units, TB laboratories and HIV wards are at the greatest risk of exposure. Annual screening programmes for TB, such as annual chest radiography, have not been shown to effectively reduce the number of healthcare workers who get diagnosed with TB. Educating healthcare workers about risks and informing them that regardless of previous infection

status or BCG vaccination TB infection could still occur is recommended. When active TB is suspected in a healthcare worker (e.g. if they have a cough that lasts for two weeks or more) a sputum smear should be sent to the laboratory to rule out TB.

When a health worker is diagnosed with active TB, s/he may be infectious to others. S/he should be started on treatment immediately and stay away from work for the first two weeks of treatment or until sputum conversion in the case of smear positive TB.

Please refer to the ***TB Infection Control Standard Operating Procedures*** for further information

Prevention of TB spread

- It is important to know which patients might have tuberculosis. Patients with active TB may have symptoms such as a chronic cough (lasting for weeks and bringing up mucus or blood), weight loss, fever or night sweats. These patients should be kept isolated from other patients.
- Patients should cover their nose and mouth when speaking to others (kromah can be used if surgical masks or tissues are not available)

CHAPTER VII: ENVIRONMENT

Many environmental factors, including the design of patient care areas, operating rooms, air quality, water supply and the laundry, influence the transmission of infections in hospitals.

Health facility design and planning should ensure:

- Adequate safe water supply
- Adequate floor space for beds;
- Adequate inter-bed space
- Adequate hand washing facilities for staff, patients and visitors
- Adequate laundry facilities
- Suitable area for processing instruments and equipment
- Adequate ventilation for isolation rooms and high-risk areas like operation theatres, transplant units, intensive care units, etc.
- Adequate separation or isolation facilities
- Regulation of traffic flow to minimize exposure of high-risk patients and facilitate patient transport
- Precautions to control rodents, pests and other vectors
- Appropriate drainage and septic system
- Appropriate waste management facilities and practices.

7.1- Ventilation

- Ventilation systems should be designed and maintained to reduce microbial contamination.
- Where air conditioners are used the filters should be cleaned regularly. Air should not be recirculated into rooms but directly to the outside
- Isolation rooms should have openings/windows which open directly to the outside and openings like air vents, windows grilles in doors, or upper-level windows that provide good cross ventilation. It is recommended that windows should be screened to prevent insects from entering the room. Screens will also reduce the risk of contact between patient and visitors outside the isolation room (to prevent family members having physical contact).

Ventilation for diseases with airborne precautions

Appropriately ventilated rooms using natural ventilation are adequate for preventing cross infection. It is important to close the doors and keep the windows open to allow adequate airflow in and out of the room. A fan can be placed in the room to direct airflow towards an outside window.

7.2- Safe Water

Each healthcare facility must have a safe, adequate water supply that is free of physical and microbiologic pollution, free from toxic substances, and clear, colourless, odourless and drinkable. There should be enough water for:

- Drinking, bathing and washing patients
- Washing hands and equipment after contact with patients
- Other cleaning activities to maintain a healthy environment

Water can be piped from the mains supply, rainwater stored in tanks, well water or pond. If pond water is used, it must be fenced off from animals and humans and must be filtered prior to use.

7.3- Patient placement and transportation of patients

Appropriate or selective placement of patients is important in preventing the transmission of infections in the hospital setting. General principles in relation to the placement of patients include the following:

Triage

Patients should be triaged in all facilities. Those with potentially infectious illnesses should be separated from other patients and staff should take the necessary precautions based on risk (see above).

Cough etiquette should be explained to patients with respiratory symptoms and masks may be appropriate to provide to some patients.

Spacing between beds

In open plan wards there should be adequate spacing between each bed to reduce the risk of cross contamination/infection occurring from direct or indirect contact or droplet transmission. Optimum spacing between beds is 1-2 metres. All infectious patients should be separated from other patients (*see airborne precautions in Chapter 5.9*). If there is no isolation room then patients can be physically separated from others e.g. put at one end of a ward rather than in the middle. Keep the person close to a window, away from entrance/exits etc so that others don't have to walk past them to enter and exit the building.

Any patient that is either infectious (respiratory symptoms, meningitis, undiagnosed fever, measles) or at high risk of infection (cancer patients, low white cell counts, HIV positive etc) should not be kept close in a ward. If there is no isolation ward, keep infected patient as far from others as possible

Single rooms

Single rooms reduce the risk of transmission of infection from the source patient to others by reducing direct or indirect contact transmission. It is recommended

that single rooms should have the following facilities:

- Hand washing facilities
- Toilet and bathroom facilities

Single rooms used for isolation purposes may include an anteroom. An anteroom is located right before the entrance of the single room. It is used for storing personal protective equipment and a place where healthcare workers change their personal protective clothing.

Cohort rooms

The use of cohort rooms is for infection control purposes. If single rooms are not available, or there is a shortage of single rooms, patients infected with the same organism can be put in the cohort room.

When cohorting is used during outbreaks, these rooms should be in a well-defined area (a designated room or designated ward), which are separated far from other patient care areas in the healthcare facility used for non-infected patients

Transportation of patients

Limiting the movement and transportation of patients from the isolation room for essential purposes only will reduce the transmission of micro organisms to other areas of the hospital.

If transportation is necessary, proper precautions should be taken to reduce the risk of transmission of micro organisms to other patients, healthcare workers or the hospital environment (materials or equipment).

7.4- Healthcare laundry management

The objective of the laundry system is to provide a properly designed laundering programme in a safe and sanitary environment, and to ensure the supply of clean and hygienic laundry. The basic principles of linen management are as follows:

- Place used linen in appropriate bags at the point of generation.
- Contain linen 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.
- Do not rinse or sort linen in patient care areas.
- Handle all linen with minimum agitation to avoid aerosolisation of pathogenic micro organisms.
- Separate clean from soiled linen and transport/store separately
- Autoclave linen before being supplied to the operating rooms/theatres.

Processing linen consists of all the steps required to collect, transport and sort soiled linen as well as to launder (wash, dry and fold or pack), store and distribute it.

Laundering linen

Soaking prior to washing is not necessary If linen is heavily soiled, PPE must be worn. Rinsing of heavily blood or bodily stained linen is recommended prior to washing with soap and water but soaking in bleach is not necessary prior to washing.

The following steps should be taken when laundering soiled linen.

- ***Separately*** wash heavily soiled linen from non-soiled linen.
- Use the washing machine's time cycle using detergent according to the manufacturer's instructions with water temperatures above 71°C (where possible)
- If there is no hot water or washing machine, use soapy water for washing all items. Remember to use appropriate PPE if hand washing is required.
- Staff should wear PPE – the type depends on the risk but in general, gloves, surgical mask, plastic apron or gown, and goggles.
- Mattresses and pillows with plastic covers should be wiped over with a neutral detergent.

7.5- Food safety

The kitchen area plays an important role in the prevention of infection. Cleanliness and safe food preparation and storage practices are critical to:

- Preventing outbreaks of food borne illness among patients
- Minimising microbiologic contamination of food by using appropriate food handling techniques during the preparation of food
- Protecting food from contamination by insects, rodents and moisture

Food services hygiene

If the health facility has a kitchen, all kitchen staff should wear appropriate protective clothing such as waterproof or fabric aprons during food preparation.

It is recommended that in health facilities where patients' food is prepared by relatives there is access to proper hygienic equipment (stoves, water, sinks, etc). Educate relatives in food safety.

Some food service hygiene practices are listed below:

- Wash hands before handling food or utensils and wear plastic gloves when appropriate.
- Wash hands and clean nails after:
    - Arrival
    - Using the toilet
    - Handling any foods
    - Having contact with unclean equipment and work surfaces, soiled clothing and dishcloths
    - Removing gloves

- Hands and fingers should be kept away from hair and face where food contaminant organisms can be picked up and transmitted to food.
- Tongs, forks and spoons should be used when preparing foods to minimise hand contact. Cracked and chipped crockery should be discarded.
- Food should not be tasted with ladle or spoon used in food preparation. Utensils used for tasting should be thoroughly washed between tastes, or disposable utensils used
- Work areas, surfaces and utensils must be cleaned between different preparation tasks. Clean cloths must always be used.
- Do not cut or prepare food on the ground – use benches
- Food service staff must have clean fingernails. Wearing rings and nail polish should be discouraged.
- Staff suffering from diarrhoea should be immediately removed from handling food and contact with patients until all symptoms are fully over for 24–48 hours.
- Clean up benches and equipment properly before, during and after food preparation
- Serve food as soon as possible after cooking (not longer than two hours after preparation). Store and serve food at the correct temperature
- Use correct handling and storage techniques for garbage containers and washing containers after emptying.
- Do not allow any animals into the kitchen at any time

Washing cooking and eating utensils

Procedures for washing cooking and eating utensils:

- Wash all pots, pans, utensils and trays thoroughly with detergent and water (hot water is best). Use a hard brush to remove difficult particles and stains. Rinse with fresh water.
- Wash all surfaces used for cutting or slicing food with a scouring agent and water (hot water is best). Use a hard brush to remove difficult particles and stains. Rinse with fresh water.

CHAPTER VIII: HEALTHCARE WASTE MANAGEMENT

8.1- The importance of proper waste disposal

All staff have a responsibility to dispose of healthcare waste in a manner that poses minimal hazard to patients, visitors, other healthcare workers, and the community.

Proper disposal

- Minimizes the spread of infections and reduces the risk of accidental injury to staff, patients, visitors, and the local community.
- Helps provide an aesthetically pleasing atmosphere
- Reduces odours
- Attracts fewer insects and does not attract animals
- Reduces the likelihood of contamination of the soil or ground water with chemicals or micro organisms

Dangers posed by healthcare waste

To staff

Sharps pose the greatest risk and can cause injury and transmission of serious infections, including HIV, Hepatitis B and C. It is recommended that all staff at risk of waste-related injury should be vaccinated against Hepatitis B.

Patients

Staff members who have improperly handled contaminated waste can easily spread infections to patients.

To the community

Improper disposal of waste is one of the greatest threats to members of the community. For example, contaminated (infectious) waste can be found by children who are playing and cause them injury and infection. Besides, scavenging of contaminated waste is a significant problem. Not only are people who go through contaminated (infectious) waste at risk of injury and infection themselves, but this practice can also put patients and the local community at risk when scavenged waste, such as syringes and needles, IV fluid bags is reused.

Anyone who handles contaminated waste – from the time it is thrown out by a service provider to even after it reaches the site of final disposal – is at risk of infection or injury

The dumping of healthcare waste in uncontrolled areas can have a direct environmental effect by contaminating soils and underground waters.

8.2- Reasons for improper waste handling

Appropriate disposal of waste is such a problem because:

- The staff who collect and dispose of contaminated waste, those who decide on the facility's budgets, and those who handle and dispose of trash once it leaves the facility (such as trash haulers or dump operators) are often unaware of the risks that medical waste poses.
- Many administrators and staff do not know or think about how waste is handled or where it goes – they just assume that waste is being disposed of in an appropriate manner.
- Healthcare facilities are often designed with little consideration for waste disposal.
- There may be a mistaken belief that fancy, expensive waste-disposal technology is necessary in order to dispose of waste properly. If this technology is unavailable or unaffordable, many people believe that little can be done to address the problem of waste disposal.

By educating staff, administrators, and the local community about the dangers of contaminated waste and by instituting low-cost, safe waste-disposal practices, **all** health facilities can minimize the risks associated with waste disposal.

8.3- Kinds of waste in healthcare facilities

There are two kinds of waste found in health facilities: **general** waste and **clinical or medical (contaminated**) waste. It is important to dispose of all kinds of waste properly, but improper disposal of contaminated waste (which is infectious) poses the most immediate health risk to the community.

General waste

General waste is non-hazardous waste and it poses no risk of injury or infections. This is similar in nature to household trash. Examples include paper, boxes, packaging materials, bottles, plastic containers, and food-related waste.

Clinical or Medical waste

Clinical or Medical waste is contaminated material generated in the diagnosis, treatment or immunization of patients. In Cambodia it is categorized as:

- **Infectious Waste**: All waste suspected to contain pathogens (bacteria, viruses, parasites or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. Infectious waste includes, but is not limited to, excreta, tissue, body parts and fluids contaminated with pathogens, utensils and equipment exposed to infected patients and infectious waste generated from the laboratory.
- **Pathological Waste**: All wastes consisting of tissues, organs or various human body parts such as, bloods, lymph, organs or body parts of animal trials, human body liquids from the surgery, autopsy, placenta and infant dead.

- **Sharps Waste*:*** (used or unused), including hypodermic and suture needles, scalpel blades, blood tubes, pipettes, and other glass items that have been in contact with potentially infectious materials (such as glass slides and cover slips)
- **Pharmaceutical Waste*:*** All wastes including expired, unused, spilt and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of.
- **Genotoxic Waste*:*** Hazardous waste that may have mutagenic, teratogenic, or carcinogenic properties. They include cytotoxic drugs, vomit, urine, or faeces from patients treated with cytotoxic drugs, chemicals, and radioactive materials.
- **Chemical Waste**: These are the wastes that are solid, liquid and gaseous chemicals which may be hazardous and have at least one of the following properties:
    - Toxic
    - Corrosive (e.g. acids of pH < 2 and bases of pH > 12)
    - Flammable
    - Reactive (explosive, water reactive, shock sensitive)
- **Wastes With High Content of Heavy Metals:** Wastes representing a subcategory of chemical wastes with high toxic such as, mercury wastes from broken clinical equipment like thermometers, blood pressure gauges and cadmium wastes from discarded batteries.
- **Pressurised Containers:** Emptied or unused gas cylinders, gas cartridges, aerosol cans that may explode if incinerated or accidentally punctured.
- **Radioactive Waste:** Wastes including solid, liquid and gaseous wastes contaminated with radionuclides, which are used for diagnosis, treatment and research.

8.4- Principles of waste management

Creating a waste-management plan

Every health facility – whether a large hospital, a doctor's office, or a small health post – should develop a medical waste-management plan and should designate a staff member to coordinate the management of medical waste

The four components of a waste-management plan

The health facility's waste management plan should contain the following four components, each of which will be discussed in detail in this module:

- **Sorting:** Separating waste by type at the place where it is generated.
- **Handling:** Collecting and transporting waste within the facility.
- **Interim storage:** Storing waste within the facility until it can be disposed of.

- **Final disposal:** Eliminating or transporting solid medical waste, liquid medical waste, sharps, and hazardous chemical waste from the health facility.

Sorting

It is important to train all healthcare workers, including physicians, to keep contaminated and non-contaminated waste separate.

Only a small percentage of the waste generated by a healthcare facility is medical waste that must be specially handled to reduce the risk of infections or injury.

Sorting the waste at the point where it is generated can conserve resources by greatly reducing the amount of waste that needs special handling. Poor separation of waste at the point where it is generated leads to large amounts of waste that must be handled specially – which can overwhelm the disposal system, lead to improper disposal of medical waste, and put everyone at risk.

Tips for sorting waste

Each type of waste should be put in the appropriate waste containers. To help the staff use containers correctly:

- Always keep separate containers in convenient places wherever both general and medical waste are generated.
- Use coloured plastic containers, painted drums, or easily readable labels to help distinguish between general and contaminated waste containers. For example, paint the containers used for contaminated waste yellow or use yellow plastic bags if available (see below).
- Place sharps containers where sharps are used so that staff do not have to walk across the room (or farther) carrying used sharps.
- General (non-clinical) waste must not be mixed with clinical waste, and if they are mixed they should be marked as clinical waste.

Note: All healthcare facilities must mark waste bags or containers with standard colours, symbols and code numbers to classify clinical (contaminated) and general waste.

Table 5 Sorting, colour coding and marking of healthcare waste

Waste Category	Colour of Container and Markings
General Waste	Green
Infectious waste or pathological wastes	Yellow, with black marked “INFECTIOUS” Red, marked “PATHOLOGICAL”
Sharps	Yellow, marked “SHARPS”
Chemical and pharmaceutical wastes	Brown, marked “HAZARDOUS’
Wastes with high content of heavy metals	Brown, marked with the specific heavy metal content and “HAZARDOUS’
Radioactive and genotoxic waste	Red, marked with “RADIOACTIVE SYMBOL”
Pressurised containers	Black

Exceptions

Small quantities of chemical waste or drug waste can be collected together with the infectious waste. Waste that should not be incinerated, such as empty oxygen cylinders (aerosol containers) can be collected together with general waste if the containers are empty. Infectious waste containing low quantities of radioactive content such as cleaning equipment, equipment used for diagnosis or treatment can be collected together with infectious waste if the equipment has been selected for high temperature incineration. Infectious medical waste from TB culture and drug sensitivity procedures should be autoclaved before it leaves the laboratory for further processing.

Combustible (burnable) wastes include paper, cardboard and contaminated wastes such as used dressings and gauze.

Non-combustible (non-burnable) wastes include glass and metals.

Types of waste that should not be burned (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 tubing or disposable syringes)
- Waste with high mercury or cadmium content, such as broken thermometers, used batteries, non-plastics contaminated with blood, body fluids, secretions and excretions and infectious laboratory wastes.

Handling

Staff should handle medical waste as little as possible before storage and disposal. The more waste is handled, the greater the chance for accidents.
Special care must be taken when handling used needles and other sharps, which pose the greatest risk of accidental injury and infection.

Emptying waste containers
Waste containers that are too full also present greater opportunities for accidents. Waste should be removed from operating theatres, procedure rooms, and sluice rooms before the containers become completely full. At the very least, these containers should be emptied once a day. Dispose of sharps containers when they are 3/4 full. (When sharps-disposal containers become too full, people may push sharps into the container, causing injury.)

Staff should wear utility gloves, heavy duty apron and boots when collecting waste.

Do not collect medical waste from patient-care areas by emptying it into open carts or wheelbarrows, as this may lead to spills and contamination of the surroundings, may encourage scavenging of waste, and may increase the risk of injury to staff, patients, and visitors.

Handle medical waste as little as possible.

Never put your hands into a container that holds medical waste.

Remember: Contaminated medical waste poses serious health threats to the community. Never store medical waste in open containers and never throw waste into an open pile.

Interim storage of waste

If possible, final disposal of waste should take place immediately, but it is often more practical to store waste briefly in the facility before final disposal.

Interim storage should be *short-term* –-usually waste should be stored only for a few hours before final disposal. Waste should ***never*** be stored in your facility for more than one or two days.

If it is necessary to store medical waste on-site before final disposal:

- Place waste in a closed area that is minimally accessible to staff, patients, visitors and animals. As few people as possible should come into contact with stored medical waste.
- All containers should have lids to prevent accidental contamination, spillage, and access by insects, rodents, and other animals.

Contaminated medical waste poses serious health threats to the community. Never store medical waste in open containers & never throw waste into an open pile.

Final disposal of waste

General waste, like household trash, can be taken to the regular community waste-disposal point for final collection and disposal. It should be:

- placed in a container that is green in colour;
- placed in an impermeable container with a lid;
- placed in plastic bags that are black in colour;
- segregated from clinical/infectious waste;
- collected on a daily basis;
- transported to disposal site (determined by local authorities)

Methods of medical waste treatment and disposal

Technologies and methods for the treatment and disposal of medical wastes are: incineration (burning), chemical disinfection, wet and dry thermal treatment, microwave irradiation, land disposal (burying), inertization[7] and encapsulation[8]

The most common methods are burning and burying.

[7] *Inertization* is a method for treating waste material contaminated with heavy metals using chemicals so that they become, at least in part, neutralized

[8] *Encapsulation* is a method for disposing of sharps by filling a sharps contain that is three-quarters full with cement or clay, which, after hardening, can be disposed of safely in a landfill.

Treatment and disposal of medical waste

Burning (incineration)

Figure 40 Incinerator

Incineration at high temperature (above 800˚C) is the best way to dispose of most kinds of medical waste. Incineration (burning) is the best option, since the high temperature destroys micro organisms and reduces the amount of waste. Burning in an incinerator or oil drum is recommended. Open burning is not recommended because it causes scattering of waste, is dangerous, and is unattractive. However, if open burning must be done, carry the waste to the site just before burning, and burn it in a small, designated area. Remain with the fire until it is completely out.

Building a drum incinerator

In general, a drum incinerator is only useful for small, usually rural, facilities that do not have large quantities of medical waste. If the 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.

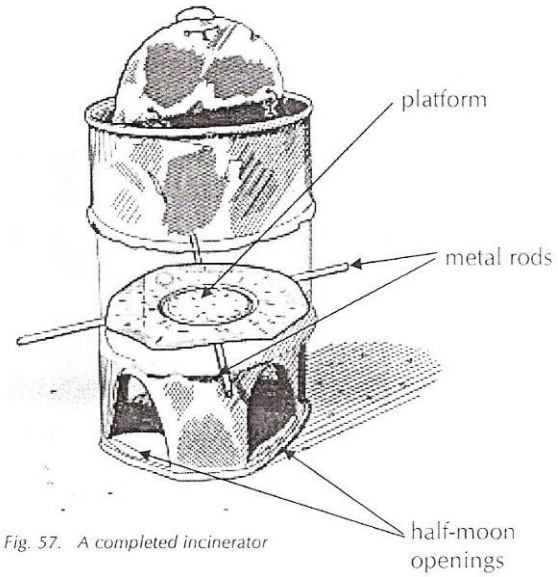


Fig. 57. A completed incinerator

Figure 41 Drum incinerator

When using a drum incinerator:

- **Choose a place that is downwind from the health facility** to prevent smoke and odours from coming into the health facility.
- **Make sure there are sufficient air inlets** on the side of the oil drum and bottom of the fire bed for efficient burning.
- **Place the incinerator on hardened earth or a concrete** base to prevent grass from catching fire during the burning process.
- **Burn only medical waste**. Use a regular community disposal site for general waste. This will conserve both time and resources.
- **Treat the ash as general waste**. Bury or otherwise dispose of it in a designated area.

Burying

On-site burial is the next best option. When burying waste, you must have space for a pit big enough for all the waste generated at the site. The pit should be surrounded by a fence or wall to limit access to it and to prevent scavenging of waste.

Placenta Pit

Organic wastes contain a lot of liquids and are unsuitable for incineration. Burial (with natural decomposition) is a simpler and more efficient disposal method. “Individual burial” is time consuming, however “collective burial” in an organic waste pit is an acceptable alternative.

Placentas are suitable for burial in a placenta pit. You should not use the

placenta pit for burying non-organic wastes such as sharps, other infectious waste (blood soaked gauze etc) or general waste.

Before constructing your placenta pit, consider the following:

- The volume of organic waste generated
- Where the pit should be located

Calculating the pit volume

The size of the placenta pit will depend on the volume of organic waste generated at the health care facility. **Placentas contain over 90% of water and will quickly reduce in size.**

Calculate the average volume of placentas that needs to be disposed of over a period of at least a week. Use this to calculate the capacity of each placenta pit. The suggested lifespan is at least 2 years.

This recommendation contains general guidelines for building small pits suitable for facilities with few placentas (e.g. <30 births per month); as well as larger pits for facilities with higher placenta volumes (>30 birth per month).

The top 0.2-0.5m of the pit should not be used, as it will be filled with dirt when the pit is full.

For very small health posts or health centers with only an occasional delivery (less than 3 per month) a placenta pit isn't required. The placentas can be individually buried.

Pit location

When choosing a pit location, carefully consider the following:

- Height of water table
  The bottom of the pit should be at least 1.5m above the water table. Remember that in some areas the height of the water table can vary considerably between wet and dry seasons. If the water table in your area is shallow you can:
  - Make your pit shallower but wider.
  - Dig several smaller pits close together
  - Find higher ground for the placenta pit
  - Raise the pit above ground level
  - If it is impossible to build above the water table, then the pit can extend into the water table ONLY IF it is located at least 30m from the nearest well or water source.

- Location of wells
  To avoid contaminating wells, site the pit away from water sources. Where the bottom of the pit is at least 1.5m above the water table, the pit should be located at least 5-10m away from the closest water source.

If the bottom of the pit is in the water table, or if the water table will rise above the bottom of the pit in the rainy season, then the pit should be located at least 30m from the closest water source.

- Soil type
  The pit should be dug in permeable soil (soil that lets water flow slowly though it). Sand, stones and cracked rock are permeable; clay is not. If you do not have permeable soil you can:
  - Dig the pit larger than expected (if your soil is very impermeable, you should assume most of the liquid will remain in the pit when calculating the required pit size).
  - Incinerate, but only if the volume of placentas is low compared to the other waste being incinerated as it takes a lot of energy to incinerate a placenta.
- Access
  The pit should be convenient enough to the health facility to make disposal convenient. However the site should be fenced to prevent unnecessary access. In some health facilities it may be possible to have it close to the incinerator allowing fencing of the entire area.

Construction

It is strongly recommended to construct at least two placenta pits from the beginning in order to have a reserve immediately available when the first one is full.

1. Prepare the site for construction: remove all debris and flatten the surface. Bring all the construction material and equipment to the site of the pit.

2. Excavate the pit and line. The lining of the pit should have many small holes to allow liquid to escape. For smaller pits the sides can be lined with concrete rings. For larger pits use bricks or concrete slabs or corrugated iron sheets. Do not use wood.

   The base of the pit should be plain dirt.

   The lining of the pit should extend 0.5m above the surface to prevent flood-water entering the pit.

   Note: Instead of building two separate pits, you can dig a single pit and divide the pit into two parts with a watertight separation.

3. For the top of the pit, make a concrete slab big enough to cover the pit and overlap at the edges by at least 0.1m. This top slab should include:
   a. A hole to drop the organic waste through. This should be at least 0.5m x 0.5m and should let waste be thrown into all parts of the pit evenly. If your pit is rectangular, you might want to make the drop

hole longer (e.g. 0.5m x 1.0m) so that waste will reach the edges of the pit.

b. A small hole for ventilation (about 150mm diameter). The location ventilation hole should not prevent easy access to the drop hole, or get in the way of the drop hole lid opening fully. It is OK to put the ventilation hole near the edge of the pit.

4. Make a lid to cover the drop hole, preferably out of concrete or metal that has been protected against corrosion (as the gasses within the pit are corrosive). The lid should be angled to prevent rainwater collecting on it. Connect the lid to the top slab with some kind of heavy-duty hinge.

5. Connect a short (200mm) plastic pipe to the ventilation hole. (A longer pipe will be attached later). The ventilation pipe should have a diameter of at least 100mm, preferably 150mm. The bottom of the ventilation pipe should sit flush with the bottom of the slab (see left hand side of diagram). If it sticks down further, then flammable gases can accumulate at the top of the pit.

Figure 42 Placenta Pit ventilation
Left hand side shows correct placement of ventilation pipe – gases can easily escape though the pipe. Right hand side shows incorrect placement – a layer of gas is trapped at the top of the pit.

6. Let the top slab dry fully (at least 3 days) before installing on the pit. To ensure the top slab is secure, you should ensure it overlaps the sides by at least 0.1m, and seat it on a layer of mortar at least 10mm thick. .

7. Place the plastic ventilation pipe over the short pipe attached to the slab. The ventilation pipe should be at least 2.5 m long, and should be taller than any nearby trees or buildings. Anchor the ventilation pipe to the ground or fence of the waste zone with cables to prevent the pipe being blown over. The top of the pipe should have a cap that prevents rain and insects entering the pit. A simple rain cap can be constructed from a T pipe connection that has stainless steel mesh over the ends to prevent insects entering the pit.

8. Make a drainage channel around the pit to lead runoff water away. This will protect the walls against erosion.

9. If required, build a fence to restrict access to the pit.

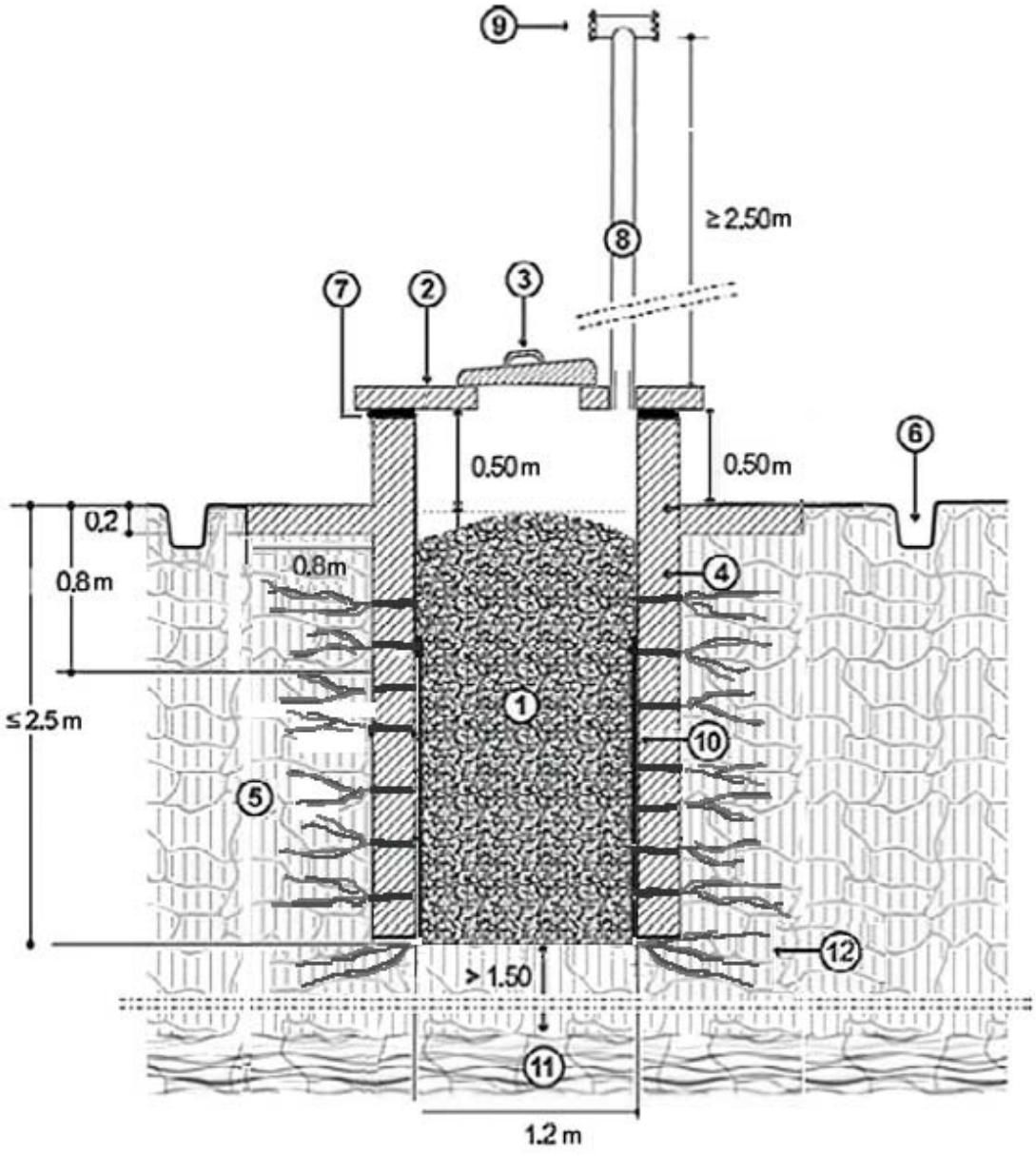


Figure 43 Placenta Pit

1. Pit
2. Top slab
3. Lid
4. Base
5. Permeable soil
6. Drainage channel
7. Mortar layer (at least 10 mm thick)
8. Ventilation pipe
9. Tee with mosquito netting
10. Pit lining (Concrete rings, rendered brick or Corrugated iron sheets)
11. Water table
12. Leaching from base of tank.

Using and maintaining the placenta pit

- Make sure that the placenta pits are always closed with the slab's lid.
- Dispose of the placentas into the pit immediately when they arrive at the waste zone.
- Use only one pit at the time.
- Do not put any plastic or non-organic waste in the pit. If placentas are brought to the pit in the plastic they must be emptied and the plastic discarded of into infectious waste bin.
- Cover the waste in a thin layer of dirt or wood ash to reduce to avoid bad odours and flies. If the smell is still bad you can add some lime, but do not add too much as it will slow decomposition and the pit will fill faster.
- Disinfect the empty organic waste bins with a 0.05 % chlorine solution, rinse them with clean water and finally clean them with water and soap (never mix chlorine and soap together).
- The top slab, lid and surroundings should be cleaned and disinfected with 0.05% chlorine regularly.
- Check frequently to ensure the ventilation pipe isn't blocked. Remove all material that could obstruct the ventilation of the pit by pouring some water trough the pipe. Check also if the screen is still intact and replace when necessary.

Note: do not smoke when opening the pit. The gasses released are flammable.

When the pit is nearly full:

- Start using the second pit for two months. During this time the first pit will compact. After two months use the first pit again until it is 0.2-0.5m from the top.
- Close down the pit when the level of the organic waste is about 0.2-0.5 m underneath the top slab. Put a thick layer of wood ash on top of the organic waste and top up with compacted soil if the pit is closed permanently. Do not use ash from burnt soft waste for this purpose. Most organic waste will decompose into harmless matter, so it is normally possible to empty a pit that has been closed down for at least two years. A new permanent burial place should be found for the organic waste remainders, potentially a controlled tip or a sanitary landfill.
- If the pit is emptied (at least two years after it has been closed down), all its slabs should be removed to permit easy access and safe working conditions. Once all the slabs are removed, wait some time before entering into the pit to evacuate all hazardous gasses.

Disposal of liquid medical waste

Always wear heavy utility gloves and shoes when handling or transporting liquid medical waste of any kind. When carrying or disposing of liquid medical waste,

be careful to avoid splashing the waste on yourself, others, or on the floor and other surfaces.

Carefully pour liquid waste down a sink, drain, flushable toilet, or latrine. If this is not possible, bury it in a pit along with solid medical waste.

Remember: If liquid waste is buried, large quantities (over 1 kg) should not be buried at the same time; burial should be spread over several days.

Moderate quantities of mild liquid or semi-liquid pharmaceuticals such as solutions containing vitamins, cough syrups, intravenous solutions, eye drops (but not antibiotics or cytotoxic drugs), may be diluted in a large flow of water and discharged into municipal sewers. Pharmaceutical wastes shall not be disposed of into slow-moving or stagnant water.

Note: Before pouring liquid waste down a drain or toilet, consider where the drain empties. It is hazardous for liquid medical waste to run through open gutters that empty onto the grounds of the facility.

All facilities should have appropriate drainage. If the facility does not link to a treated municipal water drainage system, then all drainage should be treated locally. This includes appropriate septic and filtration systems.

Remember: Highly infectious waste should be disinfected by proper disinfectants or autoclaved before they are disposed of either by incineration or non-incineration processes. Unless there is an adequate waste-water treatment plant, blood should be disinfected before discharged to a sewer.

Further information on how to handle medical waste is available in the ***PRAKAS on health-care waste management in Cambodia.***

Staff and Community Education

Medical waste, when not correctly disposed of, poses a risk of infections to healthcare staff, patients, and the community at large, but many do not know or understand these risks. Your waste-disposal plans may not be effective until you have educated your staff and community about potential dangers.

Educating staff

The staff who collect and dispose of waste at healthcare facilities are often unaware of the risks that medical and hazardous chemical waste pose. Regular orientations and in-service training are important parts of staff education. In many locations, staff who perform waste-disposal tasks are low-literate/non-literate. If this is the case, development of highly visual training materials is recommended to ensure that these staff clearly understand their risks and the proper disposal practices.

Educating the community

In many low-resource settings, including Cambodia, scavenging of medical waste is a significant problem, made worse by the poor waste-disposal practices at many medical facilities. Numerous cases of the transmission of Hepatitis B are contributed to scavenging medical waste around the world.

It is important for facilities to help educate the local community about the dangers of scavenging medical waste, particularly if scavenging of waste is a common practice. Signs, informational sessions at health fairs, and educational sessions at schools and community centres can be used to alert community members about their risks. Health facility administrators can help target the specific risks within their communities by working in collaboration with community leaders on educational initiatives.

CHAPTER IX: INFECTION CONTROL PRECAUTIONS FOR SELECTED SITUATIONS

The overuse and misuse of antimicrobials has resulted in the development of antimicrobial resistance in many parts of the world, including Cambodia.
In healthcare settings, the spread of ***resistant organisms*** is facilitated when hand washing, infection control precautions, and equipment cleaning are suboptimal.

Antibiotic resistance

Antibiotic or antimicrobial resistance is the ability of microbes, such as bacteria, viruses, parasites, or fungi, to grow in the presence of a chemical (drug) that would normally kill it or limit its growth.

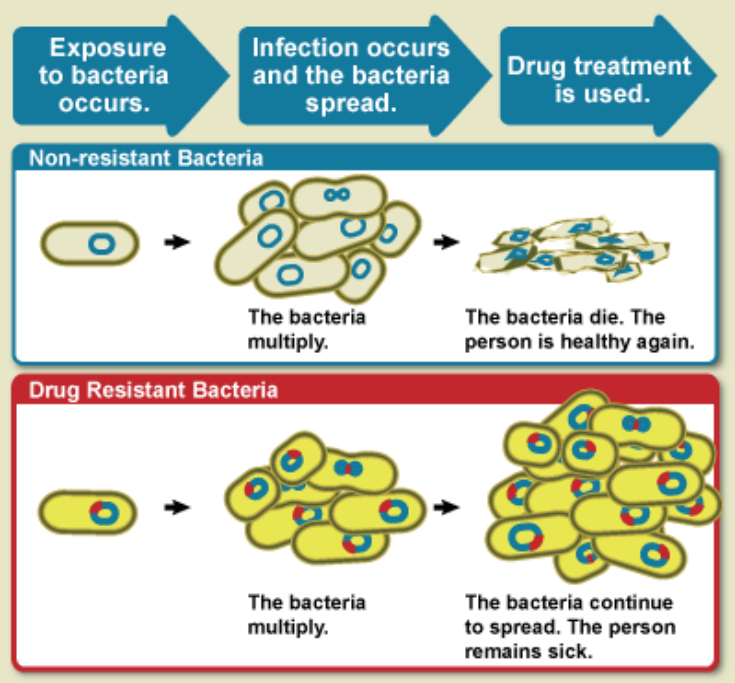


Figure 44 Antimicrobial resistance and infection

After more than 50 years of widespread use, evolution of disease-causing microbes has resulted in many antimicrobials losing their effectiveness. Antimicrobial resistance makes it harder to eliminate infections from the body. As a result, some infectious diseases are now more difficult to treat than they were just a few decades ago. This results in greatly increased cost for healthcare due to prolonged hospital care of the patients and due to treatment with expensive alternative drugs.

Measures to combat antibiotic resistance

One of the most important measures to prevent the spread of resistant organisms in healthcare facilities is by reinforcing ***proper infection control precautions and equipment processing.***

Another vital aspect of the development of antibiotic resistance is related to ***treatment of infections***. Both patients and doctors have a responsibility when they begin an antibiotic regimen to combat an infectious disease.

- Unnecessary antibiotic prescriptions are the most common cause of resistance development. Unnecessary prescriptions of antibiotics are made when antibiotics are prescribed for viral infections (antibiotics have no effect on viruses). This gives the opportunity for indigenous bacteria (normal flora) to acquire resistance that can be passed on to pathogens.
- Often physicians use incomplete or imperfect information to diagnose an infection and thus prescribe an antimicrobial just-in-case or prescribe a broad-spectrum antimicrobial when a specific antibiotic might be better. These situations contribute to the acceleration of antimicrobial resistance.
- Unfinished antibiotic prescriptions may leave some bacteria alive or may expose them to low concentrations of antibiotics for a prolonged period of time and thus contribute to the development of resistant strains of bacteria.

Recommendations for appropriate use of antibiotics

Each healthcare facility should have an "*antimicrobial use policy" or* antibiotic prescribing guidelines. This policy must be overseen by the national task force for infection control and the working group responsible for appropriate drug use at the referral hospital level.

- Antibiotic use must be based on the clinical diagnosis and the known or suspected infecting micro organism and an antibiotic with as narrow a spectrum as possible should be used.
- When possible, the choice of the right antibiotic in an infectious situation should be determined by antibiotic sensitivity testing.
- The choice of antibiotic should be made depending not only on the nature of the disease and that of the pathogenic agents, but on patient tolerance, and the cost of the antibiotic as well.
- The correct dose must be used (low dosages may be ineffective for treating infections, and encourage the development of resistant strains, while excessive doses may have adverse effects, and may not prevent resistance).
- Patients should be informed about the importance of finishing a full course of antibiotics when prescribed the medicine
- Clinicians should refrain from changing back and forth between antibiotics.
- Limit use of topical antibiotics.

- Antibiotic combinations should be avoided, whenever possible.
- In some situations, when necessary, for example in case of certain diseases such as TB (and malaria), patients should be given a combination of drugs to minimize the development of resistance to a single medicine.

Remember: Prophylactic antibiotics – which are often inappropriately used – do not take the place of good infection prevention. Avoid routine use of prophylactic antibiotics. They increase both costs and the development of antibiotic resistance

Infections with multi-drug resistant organisms

Increase in antimicrobial resistance has led to the development of micro organisms that are resistant to most of the available treatments creating a big problem and a heavy burden for healthcare facilities.
The most common examples of multi-drug resistant organisms are: multi-drug-resistant tuberculosis (MDR-TB), MRSA - methicillin-resistant *Staphylococcus aureus* and vancomycin resistant Enterococcus (VRE)

Multi-drug-Resistant Tuberculosis (MDR-TB)

Due to the slow growing nature of the bacterium, treatment programmes last for 18 months up to 2 years. MDR-TB mostly develops during the course of the treatment of fully drug-susceptible TB and is the result of patients missing doses, doctors giving inappropriate treatment, or patients failing to complete a course of treatment. Multi-drug-resistant TB is caused by M. Tuberculosis strains that are resistant to any combination of anti-TB drugs that includes Isoniazid and Rifampicin – the two most effective anti-TB drugs.

Preventive measures against spreading TB include improved ventilation or sunlight. Natural ventilation comes from opening windows and doors to create a cross-breeze, or by using an open air shelter for patients waiting for services. If fans are used, they should move more air through windows, not just mix air within a room. A desk or ceiling fan that just mixes the air without increasing ventilation through a room can actually make a TB risk situation worse by keeping the tiny droplets that contain M. tuberculosis suspended longer.

TB patients need to be isolated from other patients. For example, they need to be removed from the waiting room in an outpatient or health centre setting, or be put in isolation in the hospital setting. TB is the most common opportunistic infection and a leading cause of death in people living with HIV/AIDS. People with HIV-associated immune-suppression may become infected or reinfected with TB if they are exposed to someone with infectious TB disease. They can progress rapidly from a TB infection to TB disease over a period of months. Suspected or confirmed TB patients should never be placed together with HIV positive patients.

Patients suspected of having MDR or even XDR-TB (Extensively Drug-resistant TB) TB should be put on *airborne precautions (see Chapter 5.9)* and the TB Infection Control Standard Operating Procedures.

Severe Acute Respiratory Infections

Please see ***Severe ARI Guidelines*** for further information

Methicillin-Resistant Staphylococcus Aureus

MRSA refers to "Methicillin-resistant *Staphylococcus aureus*", which are strains of the bacterium that are resistant to the action of Methicillin (an antibiotic). Some MRSA are resistant to all but one or two antibiotics.

The following precautions are required if a patient is suspected of having MRSA (e.g. has an ongoing skin infection or has a skin infection that is resistant to treatment):

- Swab the infection site and send the specimen to laboratory for diagnosis if possible.
- Implement contact precautions (see Chapter 5.7)

CHAPTER X: INFECTION CONTROL PRECAUTIONS IN SELECTED AREAS

10.1- Laboratory

Laboratory workers are at occupational risk of exposure to microbiological pathogens that may cause non-apparent to life-threatening infections. Any laboratory worker who handles blood or potentially infected body fluids is at some risk of accidental injury or exposure.

Health facility managers must be made aware of the importance of laboratory safety. For each biosafety level there are types of specialized equipment available to serve as primary barriers between the micro organism and the laboratory technician. These range from simple gloves and other PPE to simple (sealed centrifuge heads) or complex (biosafety cabinets) containment devices.

Ways of getting infected in a laboratory

Inhalation
Mixing, grinding, blending, centrifugation and flaming a loop, may generate aerosols. In addition to airborne pathogens such as M. tuberculosis, airborne transmission in the laboratory may take place with organisms that do not naturally follow this route.

Ingestion

- Subconscious hand-to-mouth actions.
- Placing contaminated articles (e.g. pencils) or fingers (e.g. biting fingernails) in the mouth.
- Food consumption at the workplace or lack of hand disinfection before eating and smoking.
- 13% of all accidental laboratory-acquired infections are associated with mouth pipetting.

Inoculation
Parenteral inoculation of infectious materials through accidents with needles, blades, and broken glassware is one of the leading causes of laboratory-acquired infections.

Needles and sharps used by laboratory workers need to be disposed of in appropriate containers in order to reduce injury risk.

Infections via skin and mucous membranes
Splashes to mucous membranes (eyes, nasal cavity, and mouth), and hand-to-face actions may lead to transmission of pathogenic micro organisms.
Hand washing, proper personal protection and disinfection remain the major measures to prevent laboratory-acquired infections.

Infection control in the laboratory

Containment of hazardous agents is achieved by adherence to strict standard biosafety practices and techniques, supplemented by primary (safety equipment) and secondary barriers (facility design). Laboratory personnel need to be aware of potential hazards of infectious agents/materials. Every laboratory should be supplied with a Laboratory Bio-Safety Manual which describes in detail the practices and procedures required to eliminate the risk of laboratory-acquired infections.

Recommended safety practices in the laboratory

- Keep all benches uncluttered, waste should be sorted at the source. Sharps containers and infectious waste bins should be kept close to areas where they are used.
- Protective clothing such as a laboratory coat should be worn at all times in the laboratory
- Well-fitting latex gloves should be worn at all times when handling biological/clinical specimens.
- Face shields or masks and eye protection should be worn when there is potential for splashing of blood or body fluids.
- Hand hygiene should be practiced whenever gloves are removed or when leaving the laboratory.
- No eating, drinking, or smoking in the laboratory. Food may not be stored in refrigerators used for clinical specimens.
- Never pipette by mouth – use a proper mechanical device or automated pipette. Do not put pens and pencils in mouth.
- Wipe work surfaces with a 0.05% chlorine solution daily and after spills. For sputum spills use phenol.
- Automatic pipettes should be cleaned every day with (0.05% chlorine solution) and then wiped with distilled water and dried.
- Equipment and analyzers contaminated with blood and other infectious material should be cleaned with 70% alcohol and then wiped with clean water and dried
- TB smears should be made in a separate area of the lab (with good ventilation and good technique). Patients should provide samples in an outside area away from the general public.
- Specimens must always be recapped when stored on the work-bench or refrigerator.
- Blood and other bodily fluids must be disposed of into laboratory sinks.
- All clinical specimens and contaminated laboratory material, such as tubes, tips etc must be disposed of according to HCWM guidelines above
- All specimens and laboratory material/waste generated by a bacteriology laboratory must autoclaved before leaving the laboratory for disposal as infectious waste.

10.2- Pharmacy

Medications can become contaminated in the pharmacy with bacteria, fungi, or viruses. Contamination can potentially occur through several routes, including direct contact with human skin, contaminated surfaces, or syringes, when medications are diluted with contaminated liquids or when airborne pathogens are allowed to contaminate solutions.

Products that are meant to be sterile, such as intravenous or intramuscular preparations, must be prepared under strict aseptic conditions. Many products arrive in a dehydrated form and must be reconstituted prior to use. It is vital that the liquid used to reconstitute the medication be ***sterile***. Contaminants on the outside of the container must not be injected into the interior. If liquid is to be injected through a vial membrane, the membrane should be disinfected with alcohol before being pierced. Syringes used to prepared medications should be sterile. Optimally, single-use, disposable syringes and needles should be used.

Infection control in pharmacies

- Employees should be trained in aseptic techniques before preparation of medications.
- Written policies should be in place to describe the proper preparation and storage of medications.
- Employees should not prepare medications if they have active infections.
- Sterile medication should be prepared under aseptic conditions.
- Hands should be washed before and after medications are prepared. Sterile gloves are often required to maintain asepsis. Employees should not prepare any sterile products if they have rashes or broken skin on their hands.
- If storage containers are cracked or damaged, the solution should not be administered.
- The room used for medication preparations must be dust-free and must limit access to a minimum. Surfaces should be clean. In general, medications should not be prepared in the same room that is used for unpacking supplies due to the risk of particulate matter in the air settling into solutions. Similarly, persons preparing sterile medications should wear clean clothing covers to minimize the amount of particles in the air.
- All medications should have an appropriate expiry date printed on the outside of the container.
- Drugs should be dispensed in a bag (unless each drug is given at the time the patient should swallow it). Likewise, drugs coming from the pharmacy should be packed in clean containers.
- A tracking system should be devised in case there is a product recall. The tracking system should allow identification of patients who received potentially contaminated medications.
- In addition to infection control practices within the pharmacy, pharmacists should play a key role in the institution-wide infection control program.

Antibiotic use and misuse are often at the root of outbreaks due to resistant pathogens. Sensible drug utilization requires the active participation of pharmacists.

Infection control guidelines that govern the pharmacy also apply when medications are prepared on the wards or for home therapy.

10.3- Operating Room (OR)

Although considerable progress has been made in understanding the cause and prevention of surgical site infections during the past 100 years, postoperative wound infections remain a leading cause of HAIs. The majority of surgical site infections (SSIs) occur in the OR during the procedure. Few infections are acquired after the procedure when wounds are closed. Most infections arise from the patient's endogenous flora, which contaminate the wound by direct contact. Subsequently, the appropriate pre-operative preparation of surgical patients and maintaining the sterile field during operation are essential in the prevention of surgical wound infections

Suggested practices in the OR

If the OR is not equipped with a positive-pressure system,[9] the focus should be on less expensive strategies, such as:

- Cleaning the operating room between each patient, and at the beginning and end of the day
- Keep personnel to a minimum in the OR during a procedure
- Avoid excessive talking
- Keep doors and windows closed
- Keep entries into the OR to a minimum during a procedure
- Keep the temperature of the OR between 18˚C and 24˚C, with humidity of 50 to 55%.
- Remove all unwanted equipment from OR
- Do not clean any instruments in the OR post operation. They should be removed and taken to a suitable soaking and cleaning area.

Preparation of the patient in the OR

- Avoid shaving the operation area unless hair interferes with the procedure. If hair removal is necessary, use clipping, or a depilatory instead of a razor.
- Removal of hair, if necessary, should be done immediately before surgeons perform the incision, not the night before surgery.
- Scrub the operation site with detergent then apply an antiseptic. Antiseptics proposed for scrubbing are chlorhexidine or iodine.

[9] A positive pressure system ensures that air travels from ORs (aseptic zone) to adjacent areas (clean and protective zone) to remove airborne contaminants generated during surgery by patients or the surgical team.

- Sterile drapes should be applied after proper asepsis of the surgical site.
- If an antibiotic is prescribed for prophylaxis, ensure it is given less than one hour before the surgeon performs the incision, and ideally right before the procedure is begun.

Preparation of the surgical team

- Wear a mask, headgear (which fully covers hair), and proper attire in the OR. Do not wear theatre shoes or clothes outside the operating area.
- Shoe covers can be replaced by ordinary shoes dedicated exclusively to the operating theatre, as no differences exist in floor contamination whether personnel wear shoe covers or ordinary shoes
- Wear scrubs, which cover most bare skin, to decrease shedding of micro organisms from uncovered skin. The practice of wearing scrubs should be followed by all personnel working in the OR, not just those working in or near the operating field.
- Before the operation, perform antiseptic scrub according to the description on page 29.
- Sterile gloves should be of good quality, as approximately 10% of gloves are inadvertently punctured during surgery.
- Two pairs of gloves should be worn in orthopaedic surgery and in other procedures with a high risk of bone fracture punctures (e.g. sternotomies).
- Ensure that all equipment and surgical instruments necessary for the procedure are in the OR before the operation begins, thus reducing traffic and the need to open doors.

Surgical asepsis

Aseptic technique refers to the practices performed immediately before and during a clinical procedure to reduce postoperative infection. These include:

- Hand washing/surgical hand scrub
- Using barriers (surgical attire)
- Patient prep (preparing a patient for clinical procedures)
- Maintaining a sterile field
- Using safe operative technique (making small incisions, avoiding trauma to tissue and surrounding structures, and controlling bleeding)
- Maintaining a safer environment in the surgical/procedure area

Figure 45 Surgical attire

Importance of surgical hand scrub and surgical attire

During surgical procedures, both patients and providers are especially at risk of exposure to potentially infectious micro organisms.

Along with the other elements of aseptic technique, proper surgical attire helps reduce the risk of post-procedure infections in patients by decreasing the likelihood that micro organisms will enter areas of the patient's body during procedures. Some elements of surgical attire are also designed to reduce service providers' risk of exposure to potentially infectious blood and tissue during clinical procedures.

Sterile surgical gloves can become contaminated:

- If you touch the outside of a sterile glove with an un-gloved hand
- If you touch anything that is not sterile-including your face or clothing outside the sterile field-while wearing the gloves
- If your glove becomes torn or punctured
- If your gloved hands drop below the level of your waist

If your gloves become contaminated:

- Stop whatever you are doing.
- Step away from the sterile field.
- Remove the contaminated glove.

- If your hands are soiled with blood or other matter, perform surgical hand scrub and put on new gloves. If not, put on a new glove, making sure not to contaminate the uncontaminated glove.

Patient preparation for clinical procedures

Most infections after surgery are caused by contamination during the procedure–**not** because patients do not keep the wound clean. Proper patient preparation ("patient prep") using antiseptics is critical before a procedure. Patient prep helps keep bacteria on the patient's skin from causing infections in the surgical/procedure site.

Skin prep for surgical/clinical procedures: First, make sure the surgical/procedure site has been cleaned with soap and water. Apply antiseptic and gently scrub the skin in a circular motion–beginning in the centre of the site and moving out–using sterile cotton balls, cotton wool, or gauze sponges held by a sponge forceps.

NOTE: Shaving is no longer recommended because it causes small nicks and breaks in the skin where bacteria can grow and multiply. Hair around the site may be clipped short if it might interfere with the procedure.

Prep for the vagina, cervix, and other mucous membranes: Using sterile cotton balls, cotton wool, or gauze sponges held by a sponge forceps apply an antiseptic liberally to the vagina and cervix before instrumentation of the uterus. Alcohol and alcohol-based antiseptics should not be used on the vagina, cervix, or other mucous membranes because they easily irritate these tissues.

Before giving an injection: Wipe the patient's skin at the intended injection site with an antiseptic solution to minimize the number of micro organisms and reduce the risk of infection.

- If there is visible dirt, wash the injection site with soap and water.
- Using a fresh swab, wipe the site with an antiseptic, wiping in a circular motion from the centre outward.
- If alcohol is used, allow the alcohol to dry in order for maximum effectiveness in reducing micro organisms.

Unexpected patient motion at the time of injections can lead to accidents. Therefore, always warn patients when you are about to give them an injection.
Remember: Good patient preparation helps reduce the risk of postoperative infection by lowering the chances that bacteria from the patient's skin will infect the wound.

To avoid contaminating solutions

- Never leave cotton balls, cotton wool, or gauze sponges soaking in antiseptic solutions. Repeated dipping of forceps or fingers into the container to pick up the items will contaminate the solution and the items.
- Never dip cotton or gauze into the main antiseptic container. Instead either:
    - Pour the amount of antiseptic needed into a small container and dip the cotton or gauze into it. Discard any antiseptic remaining in this container after patient use
    - Pour the antiseptic from the container directly onto the cotton or gauze, making sure not to touch the lip of the container with the cotton or gauze.

Figure 46 Incorrect handling of cotton and gauze
Cotton and gauze should never be left soaking in alcohol as it can become contaminated and then be a source of infection rather than helping to prevent infections.

How to put on a surgical gown

Figure 47 how to put on a surgical gown

Steps for putting on surgical gloves

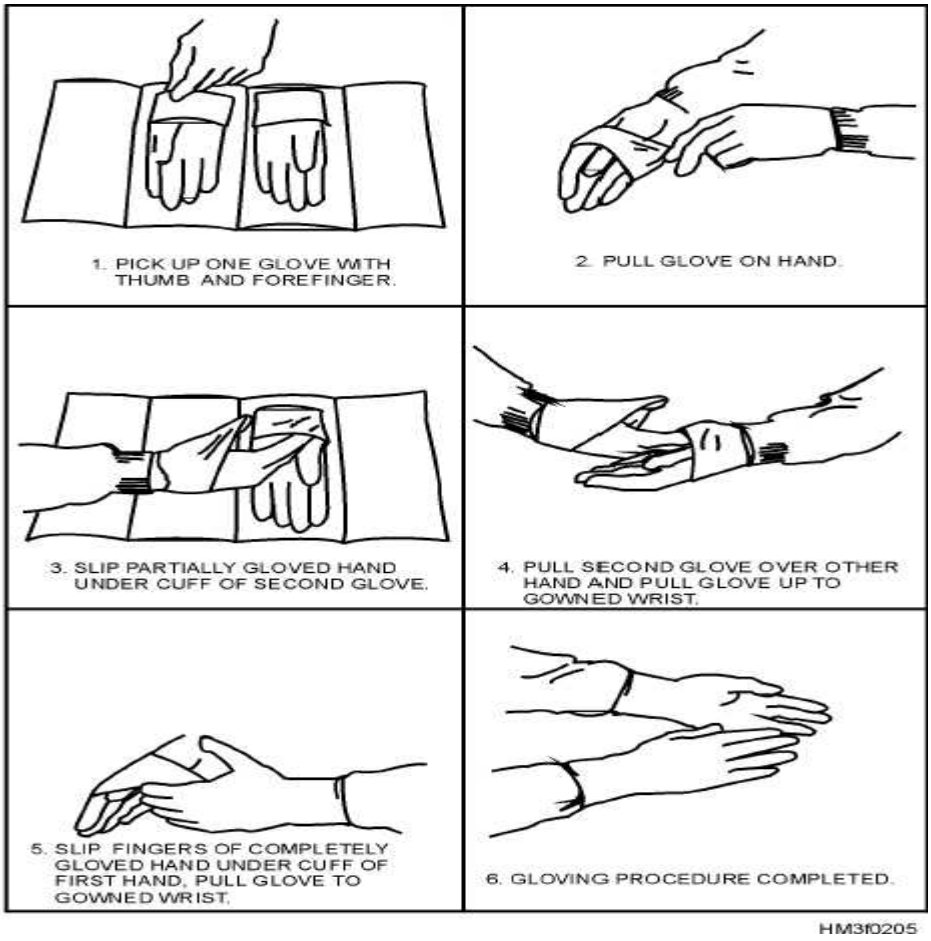


Figure 48 How to put on surgical gloves

Gloves are cuffed to make it easier to put them on without contaminating them. When putting on sterile gloves, remember that the first glove should be picked up by the cuff only. The second glove should then be touched only by the other sterile glove.

Remember: The outside of a package that contains sterile items is not sterile itself. If you are gloving alone, be sure to open the outer glove package before you perform surgical hand scrub.

Tips for removing surgical gloves

As you remove the gloves, avoid allowing the outside surface of the gloves to come in contact with your skin, because the outer surface will have been contaminated with blood and other body fluids. Avoid letting the gloves snap, as this may cause contaminants to splash into your eyes or mouth or onto your skin or other people in the area.

Remove used gloves before touching anything: Countertops, faucets, and pens and pencils are frequently contaminated because healthcare workers touch them while wearing used gloves.

Creating and maintaining a sterile field

A ***sterile field*** is an area created by placing sterile towels or surgical drapes around the procedure site and on the stand that will hold sterile instruments and other items needed during the procedure. When a service provider is properly dressed in sterile surgical attire, the provider's ***sterile area*** is the only area that should come in contact with the sterile field. Only sterile objects and personnel may be allowed within the sterile field.

- When a sterile field is created around a procedure site, items below the level of the draped patient are outside the field and are not sterile.
- A properly gowned and gloved provider's sterile area extends from the chest to the level of the sterile field.
- Areas below the level of the draped patient are considered non-sterile.
- Only sterile items are free of potentially harmful micro organisms. **Once a sterile object comes in contact with a non-sterile object or person or with dust or other airborne particles, the object is no longer sterile. If even one non-sterile object or person enters the sterile field, the field is no longer sterile.** For example, sterile objects become contaminated if you touch the object with your bare hand, if the object comes in contact with dust or other airborne particles, or if the object is held below the level of the sterile field.

Maintaining a Sterile Field

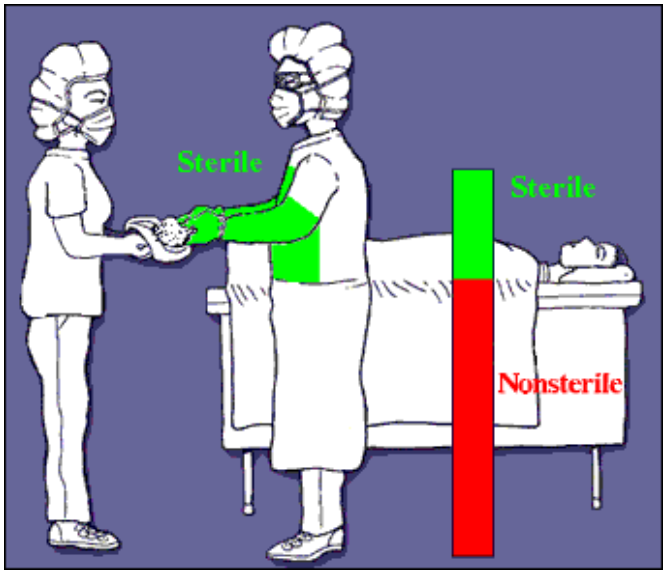


Figure 49 Sterile field in OR

- Place only sterile items within the sterile field.
- Recognize that the edges of a package containing a sterile item are considered unsterile.
- Do not contaminate sterile items when opening, dispensing, or transferring them. .
- Consider items located below the level of the draped patient to be unsterile.

- Do not allow non sterile personnel to reach across the sterile field or to touch sterile items.
- Open, dispense, and transfer items without contaminating them.
- Do not place sterile items near open windows or doors.
- Recognize and maintain the service provider's sterile area.
- If a sterile barrier has been wet, cut, or torn, consider it contaminated.
- Recognize that a sterile or high-level disinfected (HLD) barrier that has been penetrated (wet, cut, or torn) is considered contaminated.
- Be conscious of where your body is at all times, and move within or around the sterile or HLD field in a way that maintains sterility or HLD status.
- When in doubt about whether something is sterile, consider it contaminated.

Using safe surgical technique

Operative techniques can minimize the risk of infection. For example, IUDs can be inserted without being handled by the provider if they are loaded into the inserter within their sterile packaging, thereby reducing the risk of contamination.
Post-procedure infections are more likely to occur:

- In tissue that has been damaged due to rough or excessive manipulation during surgery. Damaged tissue heals slowly and is susceptible to infection.
- When excessive bleeding occurs, because this causes the tissue to become more susceptible to invasion by micro organisms.

Meticulous attention to bleeding and gentle tissue handling during surgery can reduce the risk of infection.

Creating a safer environment

Specific rooms should be designated for performing surgical/clinical procedures and for processing instruments and other items. Limiting the traffic and activities in these areas will lower the risk of infection.

To maintain a safer environment:

- Limit the number of people who enter these areas.
- Close doors and curtains during all procedures.
- Require that all personnel who enter surgical areas wear clean clothes, a mask, a cap, and enclosed footwear.
- Enclose the areas to minimize dust and eliminate insects.
- An air-conditioned room is recommended.

Before a new patient is brought into the room, clean and disinfect (0.05% chlorine solution) any surfaces that may have been contaminated during the last procedure e.g. operating tables, counters, instrument carts, trolleys, and light handles.

10.4- Emergency room (ER) and reception areas

Suggested practices in ER

- Careful hand hygiene before and after each patient encounter. If no water is available, alcohol must be used between patients
- Gloves should be worn when contact with blood and body fluids is likely.
- Goggles or face mask should be worn, if available, whenever splashing of blood or body fluids is likely.
- Triage staff should be trained on how to identify patients with suspected or probable infectious diseases.
- It is recommended that patients who appear unusually ill, especially with cough, should be separated or isolated from other patients.
- Reasonable precautions as suggested above can reduce transmission of most infections in the emergency room, i.e. those transmitted by close contact. There will still be some risk of transmission of airborne diseases, such as those transmitted by droplet nuclei, especially measles and tuberculosis. A room with an exhaust fan will reduce airborne infections. Where the exhaust fan is not available, ventilation will help (open windows). See the TB Infection Control Standard Operating Procedures for further reading

10.5- Intensive Care Unit (ICU) and neonatal ward

Patients in the **ICU** are severely ill and most often bed-ridden. They may have severe diseases, trauma, interruption of normal defence mechanisms (by mechanical ventilation, etc.), malnutrition due to the inability to eat and the inability to ambulate.

They also tend to have many invasive devices such as Foley catheters to measure output, central lines for fluids and monitoring, arterial lines to measure pressures, endotracheal tubes for assisted ventilation, etc., that patients in other parts of the hospital don't have. The presence of an invasive device automatically increases the risk of infection because it provides a ready means of entry by bacteria into a normally sterile space.

The difference between infection control in ICUs versus the wards is one of degree. Strict standard precautions are necessary. Additional precautions will depend on patients' diagnosis and any procedure performed e.g. high risk procedure such as intubation. Hand hygiene is required before and after each patient encounter. ICU patients' severe illnesses and injuries necessitate much more hands-on care than in normal wards.

The **neonatal and paediatric ICUs** also have special issues. Because children and especially premature infants may have immature host defences, they may be at greater risk for infection. Premature infants can have very subtle signs of

distress leading to sepsis, therefore neonatal ICU (NICU) staff should be educated to look for these signs. As with the adults, use of mechanical ventilation, more invasive lines and nutrition concerns can also affect the infection rates. Adherence to aseptic technique, hand hygiene practices, care for invasive lines and ventilator care can do much to reduce the incidence.

The following should be kept in mind:

- The removal of invasive devices as quickly as possible
- Restriction of children visitation during seasonal outbreaks of respiratory viruses, which can reduce exposure to these community viruses
- Vigilance of healthcare workers in observing visitors for signs of infections
- Ideally, individuals with a respiratory, cutaneous, mucocutaneous or gastrointestinal infection should not have direct contact with patients in ICU or neonates

Environmental controls

- Visitors are limited to two at the bedside.
- All visitors are instructed on infection control measures such as hand hygiene.
- Parents are advised not to visit when ill with febrile, upper respiratory, gastrointestinal or flu-like illnesses.
- Masks for staff and visitors with lingering coughs or upper respiratory infection symptoms

Bedside Equipment

- Each patient should have a designated non-shared stethoscope, thermometer, suction source and oxygen supply at the bedside.
- Each patient should have a private supply of disposable supplies
- Upon discharge of a patient, all re-usable equipment must be cleaned by designated support personnel before being used for another patient.
- Incubators must be cleaned daily with disinfectant and changed every two weeks.

The same procedures apply for immuno-compromised patients.

Regarding IC control in dental healthcare, please see ***Effective Cross Infection Control in Dental Practice MOH, 2009.***

ANNEX I: Alcohol Hand Rub

Two formulations for alcohol hand rub are presented below.

Formulation I: Ethanol 80%

To produce final concentrations of **Ethanol 80%** *v/v*, glycerol 1.45% *v/v*, hydrogen peroxide (H_2O_2) 0.125% *v/v*. (v/v = % by volume)

Pour into a 1000 ml graduated flask:

- ethanol 96% *v/v* 833.3 ml
- H_2O_2 3% 41.7 ml
- glycerol 98% 14.5 ml

Top up the flask to 1000 ml with distilled water or water that has been boiled and cooled; shake the flask gently to mix the contents.

Formulation II: Isopropyl Alcohol 75%

To produce final concentrations of Isopropyl alcohol 75% v/v, glycerol 1.45% v/v, hydrogen peroxide 0.125% v/v:

Pour into a 1000 ml graduated flask:

- isopropyl alcohol (with a purity of 99.8%) 751.5 ml
- H_2O_2 3% 41.7 ml
- glycerol 98% 14.5 ml

Top up the flask to 1000 ml with distilled water or water that has been filtered or boiled then cooled; shake the flask gently to mix the contents.

Only pharmacopoeial quality reagents should be used (e.g. The International Pharmacopoeia) and not technical grade products.

Method for local production of larger amounts

For 10-litre preparations: glass or plastic bottles with screw-threaded stoppers can be used.

- For 50-litre preparations: large plastic (preferably polypropylene, translucent enough to see the liquid level) or stainless steel tanks with an 80 to100 L capacity should be used to allow for mixing without overflowing.

The tanks should be calibrated for the ethanol/isopropyl alcohol volumes and for the final volumes of either 10 or 50 litres. It is best to mark plastic tanks on the outside and stainless steel ones on the inside.

Preparation

1. The alcohol for the chosen formulation is poured into the large bottle or tank up to the graduated mark.

2. H_2O_2 is added using a measuring cylinder.

3. Glycerol is added using a measuring cylinder. As the glycerol is very viscous and sticks to the walls of the measuring cylinder, the cylinder should be rinsed with sterile distilled or cold boiled water and emptied into the bottle/ tank.

4. Top the bottle/tank up to the corresponding mark of the volume (10-litre or 50-litre) with distilled or cold, boiled water.

5. To prevent evaporation, place the lid or screw cap on the bottle immediately after mixing.

6. Mix the solution by either gently shaking (for small quantities) or stirring with a wooden plastic or metallic paddle (for large quantities.) Electric mixers should not be used because of the danger of explosion.

7. After mixing, immediately divide the solution into smaller containers (e.g. 1000, 500 or 100 ml plastic bottles).

   These bottles should be sterile. If autoclaving is not possible, they can be boiled. If neither is possible, they can be soaked in Chlorine 0.5% for 10 minutes but they must then be rinsed with sterile or boiled/filtered water before being dried. Once filled with the alcohol solution, the bottles should be kept in quarantine for 72 hours. This allows time for any spores present in the alcohol or the new or re-used bottles to be eliminated by the H_2O_2.

8. Label the bottles.

9. When the bottles are empty they must be cleaned and sterilised before they are refilled. Do not top up partly used bottles.

Understanding alcohol strength

- Alcohol strength is preferably expressed as a percentage by volume of alcohol (% v/v); e.g. 1000 ml of 95% v/v alcohol contains 950 ml absolute alcohol.

- Alcohol strength is sometimes expressed as a percentage by weight of alcohol (% w/w). The percentage of w/w is not equal to the percentage v/v because the mixture of water and alcohol produces a contraction of volume.

- Alcoholic strength is sometimes expressed in degree but this should be discouraged because it is a source of mistakes.
  - There are at least 3 different degrees: the one used in old UK system (degree British proof), the one used in USA (degree proof) and the one used in French speaking countries (1 degree = 1% v/v). e.g. 40% v/v = 70% proof (British system) = 80 degree proof (USA system) = 40% in French speaking countries.

- Use an alcohol meter to check the % of alcohol

Annex II Preparation of 70% Ethanol

This can be used as a low level disinfectant (e.g. disinfecting thermometers) or antiseptic (disinfecting skin prior to injection or IV insertion). Do not apply to the eyes, mucous membranes, wounds or burns because it is painful, irritating and slows the healing process.

Note: ethanol is also known as **ethyl alcohol** or simply **alcohol**. Ethanol is the type of alcohol found in alcoholic beverages, though mixtures of ethanol and water often contain additives to avoid their consumption.

Preparation

Ethanol should be used at the concentration of 70% v/v, which is more effective than higher concentrations. To obtain 1 liter of 70% v/v ethanol use the following formula:

amount (in L) of alcohol required to make up a 1L solution = $\left(\frac{70}{X}\right)$

Where "X" is the percent alcohol available

- Add distilled or filtered water to make up to 1 litre
- Let cool and top up with water again to bring the volume back to 1 litre (mixing water and ethanol together produces a reaction whereby volume is reduced)

The table below shows the quantities of ethanol and water required to prepare 70% ethanol solutions.

Table 6 Preparation of 70% Ethanol

% Ethanol available (v/v)	Amount of ethanol to add to make 1 L (ml)	Amount water to add to make 1 L (ml)
99	707	293
98	714	286
97	722	278
96	729	271
95	737	263
94	745	255
93	753	247
92	761	239
91	769	231
90	778	222
89	787	213
88	795	205

ANNEX III How to put on and take off personal protective equipment

Remember not all of the above items are needed at every patient contact. Staff must select the PPE based on risk assessment in table 1.

Sequence for donning PPE

Gown

1. Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back
2. Fasten in back of neck and waist

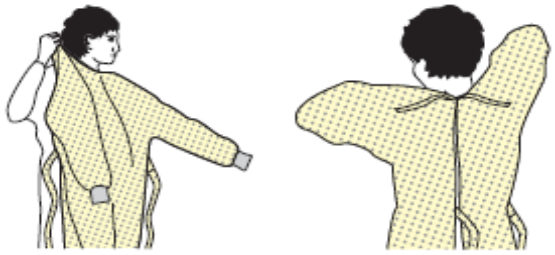


Figure 50 Putting on a gown

Mask or Respirator

1. Secure ties or elastic bands at middle of head and neck
2. Fit flexible band to nose bridge
3. Fit snug to face and below chin
4. Fit-check respirator

Figure 51 Putting on a mask

See the TB Infection Control Standard Operating Procedures for donning of respirators

Goggles or Face Shield

Place over face and eyes and adjust to fit

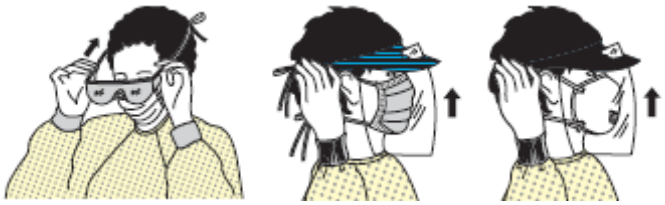


Figure 52 Putting on goggles or face shield

Gloves

Extend to cover wrist of isolation gown

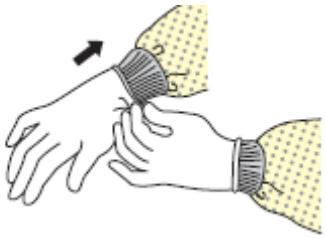


Figure 53 Putting on gloves

Sequence for removing PPE

Gloves

1. Outside of gloves is contaminated!
2. Grasp outside of glove with opposite gloved hand; peel off
3. Hold removed glove in gloved hand
4. Slide fingers of ungloved hand under remaining glove at wrist
5. Peel glove off over first glove
6. Discard gloves in waste container

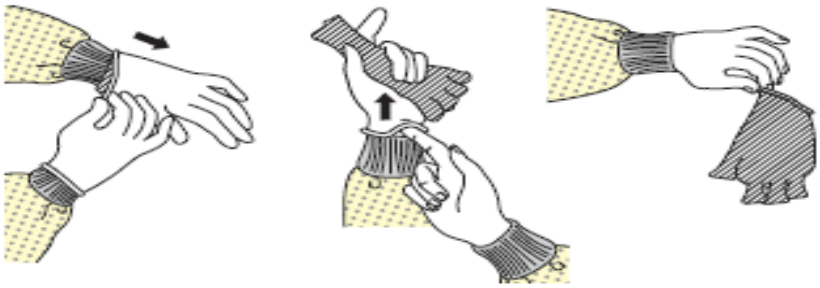


Figure 54 Removing gloves

Goggles or Face Shield

1. Outside of goggles or face shield is contaminated!
2. To remove, handle by head band or ear pieces
3. Place in designated receptacle for reprocessing or in waste container

Figure 55 Removing goggles or face shield

Gown

1. Gown front and sleeves are contaminated!
2. Unfasten ties
3. Pull away from neck and shoulders, touching inside of gown only
4. Turn gown inside out
5. Fold or roll into a bundle and discard

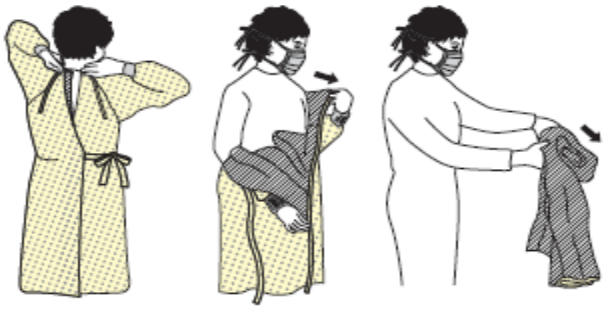


Figure 56 Removing gown

Mask or Respirator

1. Front of mask/respirator is contaminated — DO NOT TOUCH!
2. Grasp bottom, then top ties or elastics and remove
3. Discard in waste container

Figure 57 Removing mask

ANNEX IV Sterilization

Types of steam sterilizers

There are three types of high-pressure steam sterilizers:

1. Gravity displacement
2. Prevacuum and
3. Flash sterilizers (not available in Cambodia)

Gravity Displacement Sterilizers

Small (table-top) to intermediate size sterilizers are frequently used in health centres and some hospitals in Cambodia. Larger in-wall mounted units are sometimes available in hospitals.

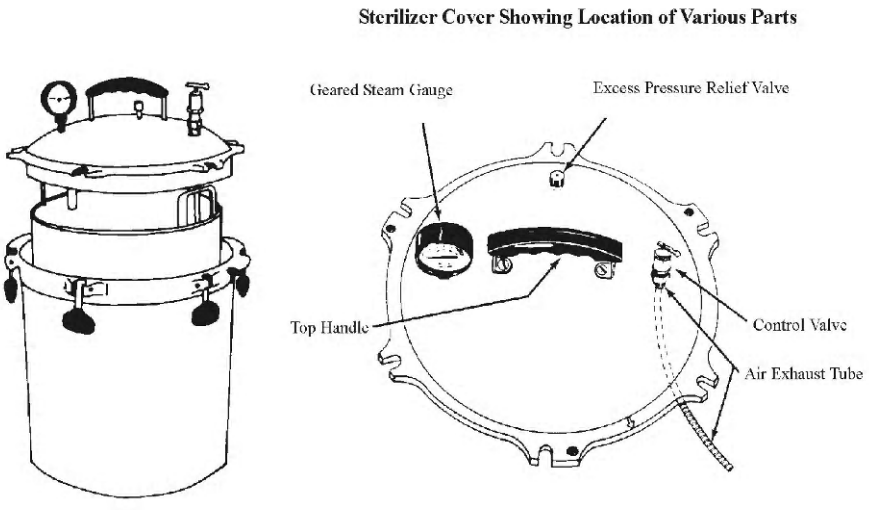


Figure 58 Pressure cooker parts

Table-top models are relatively simple. They are like horizontal pressure cookers. A pool of water in the bottom of the sterilizer is heated with electricity or kerosene until it turns into steam. The steam then rises to the top of the chamber because it is lighter than the cool air in the chamber. As more and more steam is produced, the cool air is forced out of the chamber through the drain near the bottom of the chamber. When the steam has pushed all the cool air out, steam will enter the drain, triggering the valve to close. Once the valve is closed, the steam continues to build up pressure until the operating temperature (normally 121˚C) is reached. At the end of the cycle (30 minutes), the relief valve is opened which allows the steam to escape. After the pressure on the gauge reads zero, the door can be opened 12–14 cm.

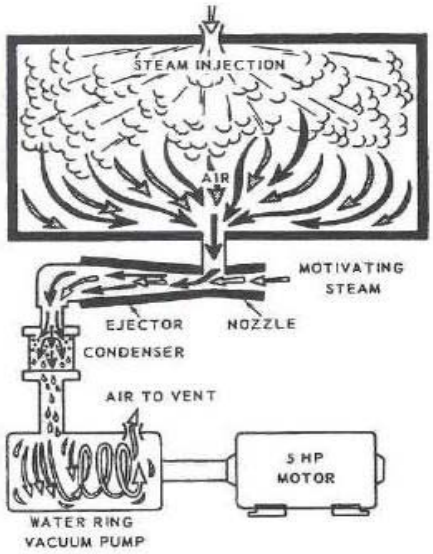


Figure 59 Prevacuum sterilizer

Prevacuum Sterilizers

The prevacuum steam sterilizer provides a more efficient and faster method than the gravity-displacement sterilizer for the removal of air and the injection of steam. This permits the processing of larger quantities of materials in a short time. This sterilizer uses a vacuum pump and a steam injection system. The air in the chamber is almost completely evacuated from the chamber by the vacuum pump. The steam injector preconditions the load and helps eliminate the air from the packages. When the sterilizing steam is admitted to the chamber, it penetrates to the centre of the packages almost instantaneously. Because of this rapid penetration, higher temperature can be used and the time of the overall sterilization cycle can be reduced. The holding and safety period (exposure time) is shortened by the increased temperature. Local procedures for the operation of the prevacuum sterilizer should be carefully followed.

In summary, in most healthcare facilities pressure cooker sterilizers (gravity displacement sterilizers) are the type most frequently found. High-speed vacuum usually are found only in large referral hospitals.

Preparing for sterilization

All instruments and other items should be soaked then thoroughly cleaned and dried before being sterilized. All **jointed instruments** should be open (or in the unlocked position) and disassembled. Reusable **cloth items** should be laundered and dried after use or prior to sterilization in order to remove organic matter and prolong the life of the cloth by restoring the fabric's normal moisture (water) content.

Wrapping items before sterilization

Wrapping items before steam and dry-heat sterilization helps decrease the likelihood that they will be contaminated before use. To wrap instruments and other items for steam sterilization, use two layers of paper, newsprint, or muslin or cotton fabric. Do **not** use canvas for steam sterilization, since steam may not penetrate this material. When wrapping items for dry-heat sterilization, use double-layered cotton or muslin fabric. Wrappers should not be reused if they are torn, stained with oils or if they have hard or gummy deposits. Linen wrappers should be laundered between sterilizations, even if unused in order to restore moisture to them (dried out fibres decrease the ability of the cloth to form a barrier to micro organisms). Materials used for wrappers should:

- Allow air removal and steam penetration
- Act as a barrier to micro organisms and fluids
- Resist tears and punctures and be free of holes
- Be non-toxic and low-lint
- Be inexpensive

General wrapping instructions:

Note: Make points while wrapping items so that the packs can be easily opened without contaminating their contents.

Tips for Wrapping

At least two layers of wrapping should always be used to reduce the possibility of contaminating the contents during unwrapping. Do not wrap packages too tightly. If wrapped too tightly, air can become trapped at the centre of packages, preventing the temperature from getting high enough to kill all the micro organisms. Also, wrapping with strings or rubber bands or tying linen ties too tightly can prevent steam from reaching all surfaces. The outer wrapper of the pack can be loosely secured using linen ties or masking tape. Indicator tape should be used both **inside** the pack and on the outside. The purpose of having both is as follows:

- Steam must penetrate through the packing and therefore the tape inside will indicate that this has happened and the contents have been sterilised
- If the tape is only on the inside, it is not known whether the pack is sterile until it is about to be used.
- Tape on the outside also allows for sterilisation date to be recorded.

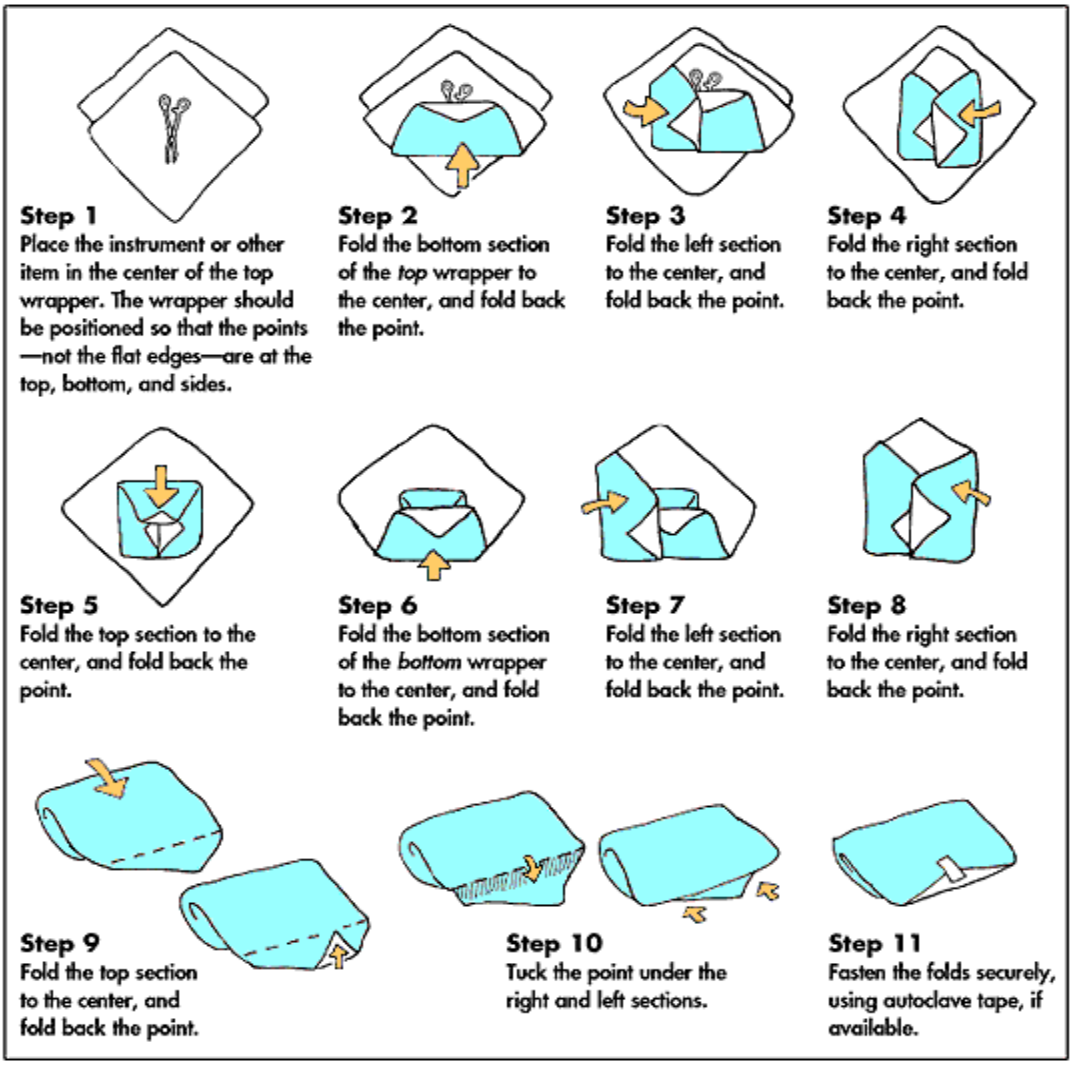


Figure 60 Wrapping instruments for steam sterilization

Loading

When loading, leave sufficient space for steam to circulate freely. Do not overload. Place all packs (linen, gloves) on edge and place canisters, utensils and treatment trays on their sides. Place instrument sets in trays having mesh or perforated bottoms flat on the shelves. In combination loads of cloth (or paper) packs and instruments trays, place linen on top shelves and trays on lower shelves. This prevents any condensation (moisture), which forms on cool metal when steam initially contacts the item, from dripping onto linen packs. Nested packs should be positioned in the same direction to help prevent air pockets, so condensation can drain and steam can circulate freely. Shelves (metal wire) or a loading cart must be used to ensure proper loading. It is preferable to use the cart that comes with the sterilizer.

Recommendations for loading

- Items must not touch chamber walls. Never place items on the floor of the sterilizer. Items placed on the floor could block discharge of air from the sterilizer, or allow air and moisture to be trapped in pockets, resulting in sterilization failure and “wet packs”. Packs touching the chamber walls can be scorched or contents damaged due to excessive heat of the metal walls.
- Always allow 7-8 cm of space between top-most package and top of chamber. This allows displacement of air and free flow of steam.
- Place all fabric packs on the edge (folds perpendicular to shelf); and when loading two layers on one shelf, place the upper layer crosswise to the bottom layer. It is easier for steam to flow down through the folds to penetrate each fibre than through flat, compressed surfaces.
- Place all bottles, solid metal and glass containers of dry materials on their sides with lids held loosely in place. Air will drain out and steam will take its place.
- Place instrument trays (mesh or perforated bottom only) flat on shelves. If instruments have been placed in a solid tray or on a Mayo tray, the tray must be placed on the edge and tipped slightly forward. This facilitates drying.
- Do not compress packages or overload the chamber.

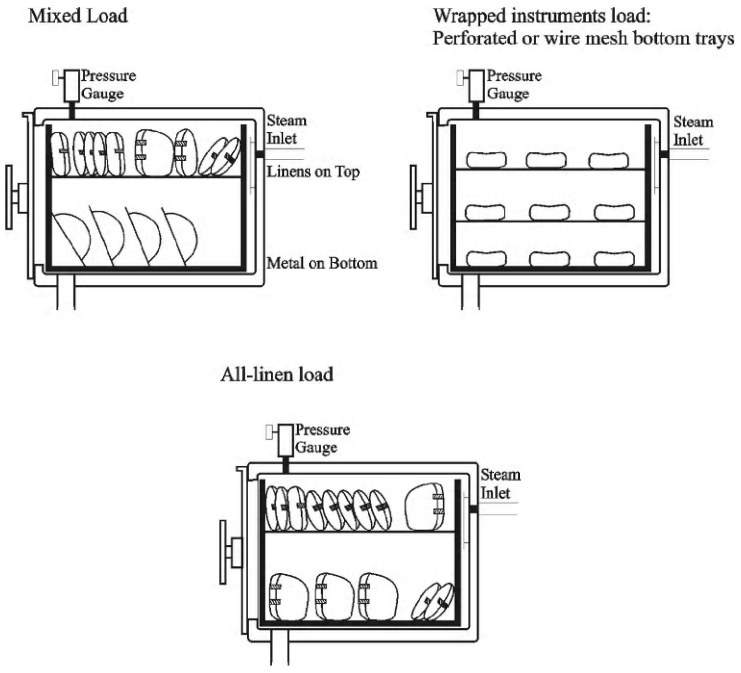


Figure 61 How to pack sterilizers

Remember: Packs containing gowns, drapes, and other linen should not be more than 30 x 30 x 50 cm or 5 kg to allow steam to penetrate the items adequately. Place packs containing sheets, towels, and table covers on their sides to make it easier for the steam to penetrate. (It is easier for steam to go through folds than through flat, compressed surfaces.)

Problem solving

If steam escapes from the safety valve or under the lid, the autoclave is not working correctly and it is merely steaming items at low-pressure (HLD, not sterilization).

What to do?

- If steam escapes from the safety valve instead of the pressure valve, the pressure valve must be cleaned and inspected.
- If steam escapes from under the lid, the gasket (rubber ring) must be cleaned and dried or replaced.

ANNEX V Preparation of 0.05% Chlorine solution

Preparation of chlorine solution for disinfection

There are **three formulas** for working out the amount of bleach to add to water.

- The first formula should be used with chlorine (bleach) solution.
- The second and third formulas should be used with dry preparations containing chlorine (i.e. chlorine powder or tablets).

The percentage concentration or weight of chlorine liberated from the tablets **must be known** otherwise the formulas are not applicable.

To make up chlorine solution using a bleach solution

- Check the percentage (%) of chlorine on the bleach bottle available. This is the % Concentrate in the formula. **Do not** use solutions if additional ingredients are included.
- Determine the required percentage of the solution you need (e.g. 0.05%.) This is the % Dilute in the formula.
- Use the formula below to find out how many parts water and how many parts bleach you need to reach the desired solution

$$\text{Parts water} = \frac{\%Concentrate}{\%Diluate} - 1$$

For example, to get 0.05% chlorine solution from a 5% concentrate bleach:

- The %Concentrate = 5%
- The % Dilute = 0.05%

Therefore the number of parts water is:

$$= \frac{5}{0.05} - 1 = 100 - 1 = 99$$

Use 99 parts of water and 1 part of concentrated bleach to get 0.05% bleach solution, i.e. to make 1 liter of 0.05% chlorine solution, add 10 ml of 5% bleach to 990 ml of water

To get a 0.05% bleach solution from the often available 6% bleach:

$$\textbf{Total part water} = \frac{6}{0.05} - 1 = 120 - 1 = 119$$

Use 119 parts of water and 1 part of concentrated bleach to get 0.05% bleach solution, i.e. add 11.9 liters of water and 100 ml of 6% bleach to get 12 liters of 0.05% bleach solution

To make up chlorine using dry powder or tablet

There are two ways the amount of chlorine in dry powder or tablets can be expressed: either as a percentage (%) or as a weight (mg).

If the amount is expressed as a percent (e.g. 25%)
(e.g. Sodium Hypochlorite powder 25% or 1 g tablet liberates 250 mg = 25%)

Use the following formula when you know the % chlorine.

$$\text{Grams/litre} = \frac{[\%\ \text{dilute}]}{[\%\ \text{concentrate}]} \times \text{volume wanted}$$

For example to get 1 litre of 0.05% chlorine from a 1g tablet that liberates 250mg of chlorine (25%):

- The % dilute = 0.05%
- The % concentrate = 25%
- The volume is 1 litre = 1000 ml

Therefore, the grams of chlorine powder or tablets required for 1 litre of water is:

$$= \frac{0.05\%}{25\%} \times 1000\text{ml}$$

= 2 grams
= 2 tablets of 1g per litre of water

Note: if you know the weight of the dry powder and the weight of chlorine released, you can convert this into a percentage. For example, if a 1g chloramine tablet liberates 250 mg of chlorine.

Remembering that 1g = 1000mg, the percentage released is

$$= \frac{250\text{mg}}{1000\text{mg}} \times 100\%$$

= 25%

If the amount is expressed as weight (e.g. 250 mg or 100 mg)
Use the following formula:

$$\text{no. tabs required} = \frac{[\%\ \text{dilute}] \times \text{vol wanted (ml)} \times 10}{[\text{mg chlorine per tablet}]}$$

If the tablet liberates 100mg, then to make 1L of 0.05% chlorine solution from tablets that release 100mg of chlorine per tablet:

- The % dilute = 0.05%
- The mg of chlorine per tablet = 100mg
- The volume wanted = 1L = 1000 ml

Therefore the number of tablets required is

$$= \frac{0.05\%}{100mg} \text{ X 1000 ml X 10}$$

= 5 tablets per litre of water (to get 0.05% solution)

Note: If the tablets do not state the percentage or mg chlorine liberated, the tablets cannot be used

Common preparation quantities

The following table shows the most common chlorine sources in Cambodia, and the amount of water to add to obtain a 0.5% or 0.05% solution.

Table 7 Preparation of chlorine solution using % solution or tablets

Product	Available chlorine	How to dilute 0.5%	How to dilute to 0.05%
Sodium hypochlorite 5% (liquid bleach) If % is different to this, adjust recipe accordingly	5%	1 part bleach to 9 parts water	1 part bleach to 99 parts water
Sodium hypochlorite 6% (liquid bleach)	6%	1 part bleach to 11 parts water	1 part bleach to 119 parts water
Chloramine tablets (1 g liberates 250 mg chlorine) If amount of chlorine liberated is different to this, adjust % and hence recipe accordingly	25%	20 grams to 1 litre water (20 tablets)	2 grams to 1 litre water (2 tablets)
Tablets that release 100mg of chlorine	100mg	50 tablets per 1 litre of water	5 tablets per 1 litre of water
Tablets that release 250mg of chlorine	250mg	20 tablets per 1 litre of water	2 tablets per 1 litre of water

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GLOSSARY

Additional precautions (transmission-based): Additional or transmission-based precautions are designed for use with patients who are diagnosed with, or are suspected to have, a specific infectious pathogen whose transmission cannot be prevented through standard precautions alone. There are three types of transmission-based precautions: airborne precautions, droplet precautions, and contact precautions.

Airborne transmission: Transfer of particles containing infectious agents that are disseminated in the air. They can be produced by coughing, sneezing, talking or procedures such as bronchoscopy or suctioning. Micro organisms carried this way can be widely dispersed via air currents and can remain infectious in the environment for long periods before being inhaled by or deposited onto the susceptible host.

Alcohol hand rub: A waterless alcohol-based product appropriate for rapid hand cleaning between patient contacts. It is recommended for use when hands are not visibly soiled or contaminated with blood and body fluids.

Antiseptic hand rub or **waterless, alcohol-based antiseptic hand rub**: Fast acting antiseptic hand rubs that do not require use of water to remove transient flora, reduce resident micro organisms and protect the skin. Most contain 60-90% alcohol, an emollient and often an additional antiseptic (e.g. 2.4% chlorhexidine gluconate) that has residual action.

Antiseptic is a chemical agent used to reduce the number of micro organisms on skin and mucous membranes without causing damage or irritation. In addition to removing or killing micro organisms, antiseptics may also prevent the growth and development of some types of micro organisms. Antiseptics are not meant to be used on inanimate objects, such as instruments and surfaces.

Antisepsis: Process of reducing the number of micro organisms on skin, mucous membranes or other body tissue by applying an antimicrobial (antiseptic) agent**.**

Asepsis and aseptic technique: Combination of efforts made to prevent entry of micro organisms into any area of the body where they are likely to cause infection. The goal of asepsis is to reduce to a safe level, or eliminate, the number of micro organisms on both animate (living) surfaces (skin and mucous membranes) and inanimate objects (surgical instruments and other items).

Autoclave: Device that sterilizes instruments or other objects by using steam under pressure. The length of time required for sterilization depends on temperature and pressure.

Body Fluids. Fluids that are directly linked to the transmission of HIV, HBV, and to which standard precautions apply. These are blood, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pericardial and amniotic fluids.

Cellulitis: is a diffuse infection of connective tissue with severe inflammation of dermal and subcutaneous layers of the skin. Erysipelas is the term used for a more superficial infection of the dermis and upper subcutaneous layer that presents clinically with a well defined edge. Erysipelas and cellulitis often coexist, so it is often difficult to make a distinction between the two.

Cleaning: Process that physically removes all visible dust, soil, blood or other body fluids from inanimate objects as well as removing sufficient numbers of micro organisms to reduce risks for those who touch the skin or handle the object. (It consists of thoroughly washing with soap or detergent and water, rinsing with clean water and drying)

Clean water: Natural or chemically treated and filtered water that is safe to drink and use for other purposes (e.g. hand washing and medical instrument cleaning) because it meets specified public health standards. These standards include: zero levels of micro organisms, such as bacteria (faecal coliform and E. coli), parasites (Giardia lamblia) and viruses (Hepatitis A or E); low turbidity (cloudiness due to particulate matter and other contaminants).

Cohorting: Practice of placing patients with the same active infectious disease (e.g. chicken pox)- but no other infection - in the same room or ward.

Contact transmission: The transmission of infectious agents can be divided into two subgroups: direct contact transmission and indirect contact transmission:

- ***Direct contact*** transmission involves direct physical transfer of micro organisms from an infected or colonised person to a susceptible host.
- ***Indirect contact*** transmission involves a susceptible person coming in contact with a contaminated (usually inanimate) object, such as a contaminated instrument or piece of equipment.

Contamination: State of having been actually or potentially in contact with micro organisms. As used in healthcare, the term generally refers to the presence of micro organisms that could be capable of producing disease or infection.

Corrosion: Action of chemical solutions, such as those containing salt (sodium chloride) or commercial bleach (sodium hypochlorite at concentrations above 0.5%), to cause metal instruments to be gradually eaten away (rusted) with prolonged contact.

Decontamination: Cleaning an object by either chemical or physical means to reduce the number of micro organisms on it. This process makes objects safer to handle by staff before cleaning (i.e. inactivates HBV, HCV and HIV and reduces the number of other micro organisms but does not eliminate them). Wiping with 0.05% chlorine solution or soaking in water or soapy water is a simple method for decontaminating items.

Detergents and **soaps (terms used interchangeably)**: Cleaning products (bar, liquid or powder) that lower surface tension, thereby helping remove dirt and debris and transient micro organisms from hands. **Plain** soaps require friction (scrubbing) to mechanically remove micro organisms while **antiseptic**

(antimicrobial) soaps also kill or inhibit growth of most micro organisms.

Disinfection: A process that kills or destroys most disease-producing organisms, but rarely kills spores. Disinfectants are used on inanimate objects as opposed to antiseptics, which are used on living tissue.

Disposal: Intentional burial, deposit, discharge, dumping, placing or release of any waste material into or on air, land or water. Disposal is undertaken without the intention of retrieval.

Droplet transmission: Transfer of infectious agents in the droplets that are generated during coughing, sneezing or talking, and during the performance of certain clinical procedures such as bronchoscopy or suctioning. It needs contact of the mucous membranes of the nose, mouth or conjunctivae of the eye with infectious particles larger than 5 µm in size. Droplet transmission requires close contact between the source and the susceptible person because particles remain airborne briefly and travel only about 1 meter or less.

Disinfectants are chemicals that destroy micro organisms; however they are not suitable for use on skin or tissue.

Dry heat sterilization: Oven that sterilizes metal instruments, glass syringes and bottles and other items by dry heat. Plastic and rubber items cannot be dry-heat sterilized because temperatures used (160-170° C) are too high for these materials.

Encapsulation: Filling a sharps container that is three-quarters full with cement or clay, which, after hardening can be disposed of safely in a landfill.

Endospore or **spore (terms used interchangeably)**: Relatively water-poor round or elliptical resting cell (a state of a bacterium) consisting of condensed cytoplasm and nucleus surrounded by an impervious cell wall or coat. Spores are relatively resistant to disinfectants and sterilants, specifically the bacillus and clostridium species.

Environmental hygiene: Process of maintaining a clean, healthy and pleasing patient and work environment.

Flash sterilization: Process designed for the steam sterilization of patient-care items for immediate use.

Hand washing: Process of mechanically removing soil and debris from the skin of hands using plain soap and water. (

High-level disinfection (HLD): The process that eliminates all micro organisms except some bacterial endospores from inanimate objects by boiling, steaming or the use of chemical disinfectants.

Hand hygiene: Refers to hand washing with soap and water, use of alcohol hand rub and antiseptic solutions.

Hand rub: Waterless, alcohol-based antiseptic hand rub or antiseptic hand rub. Fast acting antiseptic hand rubs that do not require use of water to remove microbial flora, reduce resident micro organisms and protect the skin. Most

contain 60-90% alcohol, an emollient and often an additional antiseptic (e.g. 2-4% chlorhexidine) that has residual action**.**

Inanimate: Object or article (e.g. surgical instrument, gloves or other items) that does not have life (not animate).

Incineration: Controlled burning of solid, liquid or gaseous combustible (burnable) wastes to produce gases and residues containing little or no burnable material.

Infection means when micro organisms are causing an illness or disease in the person.

Infectious micro organisms: Micro organisms capable of producing disease in appropriate hosts.

Infectious waste: The part of medical waste that is capable of causing infectious diseases.

Linen: Cloth items used in healthcare facilities by housekeeping staff (bedding and towels), cleaning staff (cleaning cloths, gowns and caps) and surgical personnel (caps, masks, scrub suits, surgical gowns, drapes and wrappers) as well as by staff on specialty units such as ICUs and other units performing invasive medical procedures (e.g. anaesthesiology, radiology or cardiology).

Micro organisms: They are the causative agents of infection. They include bacteria, viruses, fungi and parasites.

N95 Mask: A disposable filter mask designed specifically to protect the wearer from exposure to airborne (small particle) infectious diseases such as TB. It filters more than 94% of airborne particles

Nosocomial or healthcare facility-acquired infection: Infection that is neither present nor incubating at the time the patient came to the healthcare facility.

Pathogen: a disease causing micro organism

Personal protective equipment (PPE): Specialized clothing or equipment (e.g. gloves, face mask or plastic apron) worn by an employee for protection against exposure to blood or body fluids or other hazards. Uniforms, pants, and shirts not designed to function as protection against a hazard are not considered to be PPE.

Positive pressure system: This ensures that air travels from the operating room's aseptic zone)to adjacent areas (clean and protective zone) to remove airborne contaminants generated during surgery by patients or the surgical team.

Segregation: Systematic separation of solid waste into designated categories.

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

Soaps and detergents: Cleaning products (bar, liquid or powder) that lower surface tension, thereby helping remove dirt, debris and micro organisms from hands. Plain soaps require friction (scrubbing) to mechanically remove micro

organisms, while antiseptic (antimicrobial) soaps also kill or inhibit growth of most micro organisms.

Spaulding classification: Strategy for reprocessing contaminated medical devices. The system classifies medical devices as critical, semi-critical, or non critical based upon the risk from contamination on a device to patient safety.

Standard Precautions apply to blood and all other body fluids, secretions and excretions (except sweat), non-intact skin and mucous membranes. Their implementation is meant to reduce the risk of transmitting micro organisms from known or unknown sources of infection (e.g. patients, contaminated objects, used needles and syringes, etc.) within the healthcare system.

Steam sterilization: Sterilization process that uses saturated steam under pressure, for a specified exposure time and at a specific temperature, as the sterilizing agent

Sterile or **sterility**: State of being free from all living micro organisms. In practice, usually described as a probability function (e.g. the probability of a micro organism surviving sterilization as being one in a million).

Sterilants: Chemicals used to destroy all forms of micro organisms, including endospores. Most sterilants are also high-level disinfectants when used for a shorter period of time. Sterilants are used only on inanimate objects (e.g. surgical instruments) that are used in semi-critical and critical areas (e.g. surgery). Sterilants are not meant to be used for cleaning environmental surfaces.

Sterilization: Process that eliminates all micro organisms (bacteria, viruses, fungi and parasites) including bacterial endospores from inanimate objects by high-pressure steam (autoclave), dry heat (oven), chemical sterilants or radiation.

Surgical asepsis: the use of sterile technique to handle equipment, maintain sterile fields, change dressings and dispose of contaminated materials without introducing harmful microorganisms

Surgical mask: It is a facemask intended to be worn by health professionals during surgery and at other times to catch the bacteria shed in liquid droplets and aerosols from the wearer's mouth and nose.

Visibly soiled: On which dirt or body fluids can be easily seen.

Waste management: All activities, administrative and operational (including transportation activities), involved in the handling, treatment, conditioning, storage and disposal of waste

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