Infection Prevention

A reference booklet for health care providers

2nd edition

EngenderHealth
for a better life

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EngenderHealth works to improve the health and well-being of people in the poorest communities of the world. We do this by sharing our expertise in sexual and reproductive health and transforming the quality of health care. We promote gender equity, advocate for sound practices and policies, and inspire people to assert their rights to better, healthier lives. Working in partnership with local organizations, we adapt our work in response to local needs.

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Preface

Infectious diseases are constantly in transition. New diseases develop, known diseases become widespread or reemerge, and occasionally a disease is eradicated. Infectious diseases such as HIV, tuberculosis, and cholera are significant causes of illness and death in many parts of the world. Health care personnel are on the front lines, helping to protect their clients from infectious diseases and treating them when infections occur. During the course of their work, health care personnel perform clinical procedures or other activities that can expose both them and their clients to potentially infectious microorganisms. Many of their clients are sick and thus may be more susceptible to infections or may have infections that can be transmitted to others.

Fortunately, all staff working at health care facilities can perform simple procedures to minimize risk—to themselves and clients—and reduce the spread of infections. These practices can be integrated at minimal cost into the routine workday at clinics and hospitals around the world. This reference booklet is specifically designed for use at all levels of the health care system, from the largest hospitals to the smallest dispensaries or health posts, in settings where resources are scarce.

This booklet, which was first published in 1999, has now been updated. While most practices remain the same, there have been a few important changes—for example, in recommendations related to hand hygiene and standard precautions. Nonetheless, this booklet continues to present practical recommendations for simple and relatively low-cost procedures that can be implemented anywhere, with basic supplies and little to no high-technology equipment.

The contents of this booklet represent EngenderHealth's collaboration with health care organizations from around the globe, and they reflect the latest recommendations from the World Health Organization and the U.S. Centers for Disease Control and Prevention. Working with our partners, we are committed to offering quality health services to women, men, and children around the world.

Acknowledgments

This is the second edition of the Infection Prevention Handbook, which was first published in 1999. After having reprinted the book several times, we thoroughly reviewed its content, incorporated new information, and redesigned some sections, while maintaining its friendly size, the clarity of its content, and its direct link to routine service delivery practices.

This review incorporated feedback from first-line users—the health care service providers in charge of infection prevention practices, those who used it in their daily work—as well as from trainers and from managers and supervisors. We thank them for sharing their comments.

We would like also to thank EngenderHealth clinical advisors, program officers, and trainers all around the world who used the booklet and took the time to share with us their suggestions and needs. Dr. Mark Barone, Senior Clinical Advisor at EngenderHealth, was the main reviewer, under the guidance and support of Dr. Carmela Cordero, Clinical Support Leader. EngenderHealth Senior Clinical Advisors Dr. Levent Cagatay, Dr. Mulamba Diese, Dr. Joseph Kanama, and Dr. Mizanur Rahman and Fistula Care Clinical Director Dr. Joseph Ruminjo provided key contributions and insights.

The illustrations on pages 12, 13, 18, and 19 are taken from: World Health Organization (WHO). 2009. *WHO guidelines on hand hygiene in health care*. Geneva. We are grateful to WHO for their permission to reproduce these illustrations.

The design and production of this second edition was led by Michael Klitsch, Cassandra Cook redesigned the interior of the book and developed the cover, with helpful advice from Tor de Vries.

Introduction

Without proper precautions, a health care facility or provider can cause the spread of infections and diseases. When offering health services, it is essential to prevent the transmission of infections at all times.

This booklet is specifically designed for use at all levels of the heath care system, from the largest hospitals to the smallest dispensaries or health posts, in settings where resources are scarce. It presents practical recommendations for simple and relatively low-cost procedures that can be implemented anywhere, with basic supplies and little to no high-technology equipment, to drastically reduce the likelihood of transmitting infections to clients, providers, other staff, and those living in the surrounding community. Preventing health care–associated illnesses (HAIs) and reducing the risks to health care staff does not require fancy equipment, expensive products, or specialized departments and staff. In fact, every person working at a health care facility shares the responsibility of preventing these infections, no matter his or her job or the size or type of the facility or health care setting.

This reference booklet is geared toward all staff working in health care services, whether at an actual facility or providing services in an outreach or community setting. The term "health care staff" includes those providing direct medical services (e.g., physicians, nurses, clinical officers, midwives, dentists, medical and dental assistants, and respiratory therapists), as well as ancillary staff (e.g., aides, laboratory technicians, cleaners, receptionists, and mortuary staff).

Importance of infection prevention practices

Over the past few decades, the world has seen increased outbreaks of diseases that were once better controlled and of previously unidentified infectious agents that can cause serious incurable diseases. Human immunodeficiency virus (HIV), hepatitis C, tuberculosis (TB), severe acute respiratory syndrome (SARS), and new influenza viruses (e.g., avian or swine flu viruses) have become a significant cause of illness and death in many parts of the world. In addition, HAIs are a continuing problem everywhere in the world, especially those caused by antibiotic-resistant microorganisms, such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococcus (VRE), and *Clostridium difficile*.

There are many complex reasons for these developments, including:

- Increased population, combined with rising poverty, leading to crowded living conditions, poor sanitation, and malnutrition—all of which foster the spread of disease
- Environmental degradation and widespread air, soil, and water pollution, which also increase the spread of infection

- Improved transportation, leading to easier spread of disease
- Inadequate or deteriorating public health infrastructure, resulting in lowered quality and availability of health services and reduced treatment effectiveness
- Widespread, and often inappropriate, availability and use of antibiotics, which may increase antibiotic resistance in some microorganisms and can reduce treatment effectiveness
- Poor disease control and disease prevention efforts, which result in a higher number of people having infectious diseases and thus more people exposed to potentially harmful infections

Infections in health care settings

HAIs are infections that health care clients acquire while receiving services or treatment within a health care setting. Additionally, service providers and other staff are at risk of infections while they are doing their jobs. Although we do not often think about it, health care facilities and other health service settings are ideal for transmission of disease because:

- Invasive procedures, which can introduce microorganisms into parts of the body where they can cause infections, are performed routinely.
- Service providers and other staff are constantly exposed to potentially infectious materials and people as part of their work.
- Many of the people seeking health care services are already sick and may be more susceptible to infections.
- Some of the people seeking services have infections that can be transmitted to others. In some cases, these people may not be aware that they have an infection such as HIV or hepatitis C, and those providing health care services may not either.
- Services are sometimes provided to many clients in a limited physical space, often during a short period of time.

With appropriate infection prevention practices, you can:

- Prevent procedure-related infections
- Provide high-quality, safe services
- Protect yourself and others (both service providers and other staff)
- Protect the community from infections that originate in health care facilities
- Prevent the spread of antibiotic-resistant microorganisms
- Lessen the costs of health care services, since prevention is often cheaper than treatment

Infection prevention, infection control, and biosecurity

Traditionally, the term "infection control" implies programs and activities that work to both prevent and control HAIs. This includes monitoring specific device- and procedure-associated infections (e.g., ventilator-associated pneumonia, surgical site infections, and catheter-associated urinary tract infections) and investigating and managing infection outbreaks when they occur at a facility. More recently, because of the increasing incidence of and morbidity associated

with several microorganisms that can be easily transmitted in health care settings, routine monitoring of such organism-specific infections as MRSA and *Clostridium difficile* has become more common.

In some countries, the term "biosecurity" is used to describe the practices outlined in this booklet (though it is often used differently in different contexts). In its broadest sense, biosecurity can be defined as measures designed to address threats posed to the economy, the environment, and human or animal health by reducing risks posed by infectious diseases, quarantined pests, invasive species, modified living organisms, and bioterrorism.

The term also may be used more specifically to describe measures designed to manage biological threats to agriculture, livestock, and forestry. Yet it can also be used in the context of preventing the theft or escape of biological materials, dangerous pathogens, or toxins from laboratories. In still other contexts, it is taken to mean reducing the risk of biological attacks or epidemics.

In this booklet, we have chosen to use the term "infection prevention," to emphasize that it outlines practices designed to prevent infections but does not include monitoring levels of infections or investigating outbreaks—traditionally important parts of infection control programs. We also avoid using the term "biosecurity," because of the range of meanings noted above.

Who is at risk of infection?

Everyone who works at, receives care at, or visits a health care facility, or who provides or receives health care services in some other setting, is at risk of infection, as are those living around any site delivering health care services. That is why infection prevention is everybody's business. Just as everyone involved in health care provision is at risk of infection, every health care provider and staff member has a role to play in practicing appropriate infection prevention. For infection prevention to be effective, each staff member must do his or her part.

Risks to staff

Service providers, laboratory staff, and support staff are at significant risk of infection because they are exposed to potentially infectious blood and other body fluids on a daily basis. Staff who process instruments and other items, clean up after procedures, clean operating theaters and procedure rooms, and dispose of waste are particularly at risk. Transmission from client to health care worker can occur through exposure to infectious blood and other body fluids:

- When a health care worker's skin is pierced or cut by contaminated needles or sharp instruments
- When fluids are splashed on the mucous membranes of the health care worker (e.g., eyes, nose, or mouth)

- Through broken skin due to cuts, scratches, rashes, acne, chapped skin, or fungal infections

Almost all cases of occupationally acquired hepatitis B and HIV among health care workers have occurred through preventable accidents, such as puncture wounds.

Risks to clients

Clients are at risk of infection when, for example, service providers do not wash their hands between clients and procedures, when they do not adequately prepare clients before a clinical procedure, and when used instruments and other items are not processed correctly.

Transmission of bloodborne infections such as HIV and the hepatitis viruses from an infected health care worker to a client is extremely rare, especially when appropriate infection prevention practices are followed. In such cases, the risk to the client is very small; consequently, in most circumstances, health care workers with those infections may continue to perform their regular activities without risking the transmission of infections to clients, provided that appropriate infection control practices are followed. Health care workers who are suspected of being infected with a viral hemorrhagic fever (e.g., Ebola or Marburg) should immediately cease providing clinical care and should be isolated like all other suspected cases.

Staff should take care to avoid passing on to clients common infections that are transmitted via contact, droplets, or airborne means. For example, if you have a respiratory infection, you should avoid activities that involve direct contact with clients, especially those who might be at high risk (e.g., pediatric clients or the immunocompromised). If contact with clients in unavoidable, then staff should wear a mask.

Risks to the community

The community is also at risk of infection, particularly from inappropriate disposal of medical waste, such as contaminated sharps (e.g., needles, scalpels, and other sharp instruments). Improperly discarded medical waste—including contaminated dressings, tissue, needles, syringes, and scalpel blades—can be found by children or others scavenging in open dumps or can scatter on the ground where adults and children travel, putting them at risk of injury and infection. In addition, some infections can be spread by staff to their family members or others in the community. For example, Ebola and Marburg virus outbreaks in Africa have sometimes been spread throughout communities because of poor infection prevention practices at health care facilities.

How are infections transmitted?

Infections are caused by microorganisms, which can only be seen under a microscope. Microorganisms are everywhere—on your skin, in the air you breathe, and in animals, plants, soil, and water.

Some microorganisms are normally present on your skin and in your respiratory, intestinal, and genital tracts. These are called normal flora. Other microorganisms are normally not found on or in the human body and are usually associated with disease. These are known as pathogens. Under the right circumstances, most microorganisms, including normal flora, can cause infection or disease.

Infections are transmitted either when pathogens are introduced into the body or when normal flora are introduced into an area of the body where they are not typically found.

Modes of transmission in health care settings

Infections are transmitted in health care settings in three main ways:

- Contact transmission is the most common mode.
  - *Direct transmission* involves the transfer of microorganisms directly from an infected person to someone else, through touch (such as with staphylococcus or viral hemorrhagic fevers) or when blood or body fluids from the infected individual come into contact with mucous membranes or breaks in the skin of an uninfected person (such as with HIV or hepatitis C).
  - *Indirect transmission* involves an object or person (sometimes called a vehicle) that serves as a means of transfer of microorganisms from an infected person to someone who is not infected, such as on the hands (e.g., *Staphylococcus aureus, Clostridium difficile*, or viral hemorrhagic fevers), on instruments or other items used during clinical procedures (e.g., hepatitis B, HIV, tetanus, or pseudomonas), in food (e.g., salmonella or hepatitis A), or in water (cholera or shigella).
- Droplet transmission is technically a form of contact transmission and involves transfer of small droplets, released when an infected person coughs, sneezes, or talks or during some medical procedures (such as endotracheal intubation or suctioning). The droplets travel directly to someone else's susceptible mucous membranes (e.g., in the nose or mouth). Influenza and SARS are examples of infections transmitted via droplets. Droplet transmission requires people to be in close proximity to each other, approximately 1 meter (3 feet) apart.
- Airborne transmission occurs when some microorganisms are carried by air currents, remain in the air for prolonged periods, and are dispersed over long distances (e.g., tuberculosis, measles, or chicken pox), such that people who have not had face-to-face contact with an infected person are still at risk of infection.

Vector transmission—where an invertebrate animal transmits the microorganism (e.g., mosquitoes transmitting malaria or yellow fever)—is not directly associated with HAIs. However, if your facility is in an area that has vector-transmitted infections, you should take steps to reduce the risks to clients, such as by using bed nets in inpatient wards, especially pediatric and maternity wards, to reduce malaria transmission.

Stopping transmission of infections

Health care staff cannot provide services without conducting procedures that put clients and staff at some risk of exposure to potentially infectious materials. In addition, as a result of being at a health care facility, staff, clients, and visitors may be exposed to infectious diseases that others at the facility have. We can, however, prevent transmission of infections in many cases. The only way to prevent infections is to stop the transmission of microorganisms that cause infections.

Standard precautions

The best way to prevent infections is by following *standard precautions*. These are a set of recommendations designed to help minimize the risk of exposure to infectious materials by both clients and staff. The chapters in this booklet give detailed explanations of how to apply the standard precautions to your everyday work in a health care setting.

Standard precautions include the following:

1. Wash your hands.
2. Wear personal protective equipment, such as gloves, eye protection, faceshields, and gowns.
3. Follow appropriate respiratory hygiene/cough etiquette.
4. Prevent injuries with sharps.
5. Correctly process instruments and client-care equipment.
6. Maintain correct environmental cleanliness and waste-disposal practices.
7. Handle, transport, and process used/soiled linens correctly.

Universal versus standard precautions

Universal precautions were developed in the 1980s primarily to protect health care workers from exposure to bloodborne pathogens. Universal precautions promoted the use of personal protective equipment and practices to prevent injuries caused by sharps, to reduce the likelihood that health care workers would be exposed to infectious agents from clients.

In the mid-1990s, a new set of recommendations—called standard precautions—were developed. They expanded upon universal precautions to include practices

that reduce the risk of infection not only in health care workers, but also among clients and visitors to health care facilities. Use of standard precautions reduces the risk of occupational exposure to infectious agents among health care workers and also HAIs among clients and visitors.

Although technically the two are different, in practice the terms often are used interchangeably. The important point to remember is that the practices listed above under standard precautions should be followed with every client, regardless of whether you think the client might have an infection. This is important because it is not always possible to tell who is infected with viruses such as HIV and the hepatitis viruses, and often the infected persons themselves do not know that they are infected. It is safer to act as if every client is infected rather than to apply standard precautions to some clients and not others. Respiratory hygiene/cough etiquette apply not only to health care facility staff, but also to clients and visitors.

Transmission-based precautions (also called isolation precautions)

While standard precautions should be followed with every client receiving services, transmission-based precautions are reserved for people who are infected or highly suspected of being infected with certain microorganisms (e.g., *Mycobacterium tuberculosis, Clostridium difficile, Staphylococcus aureus*, SARS, measles, or chicken pox) that are transmitted by contact, droplet, or airborne routes. Standard precautions alone do not completely interrupt transmission of these microorganisms. People suspected of having these infections (based on history, symptoms, and clinical signs) should be treated as if they are infected until it is proven otherwise. Always remember that transmission-based precautions are used in addition to standard precautions.

Contact precautions (e.g., against *Clostridum difficile*, rotavirus, SARS, MRSA, or viral hemorrhagic fevers)

- Place all clients in single rooms. If this is not possible, keep each client's bed at least 3 feet from others, to reduce the likelihood that items will be shared.
- Staff should wear clean, nonsterile gowns and gloves when they are in contact with clients, potentially contaminated items, or the surrounding environment. Put the gown and gloves on as you enter the room, and remove/discard them before you exit the client's room.
- Visitors must be kept to a minimum and should follow the above recommendation about wearing a gown and gloves. They should be educated about how to reduce the risk that the infection will spread to others.
- Use an alcohol-based handrub, or wash your hands with antiseptic and water after removing gloves.
- Be sure to maintain contact precautions if a client must be transported outside of his or her room.

Droplet precautions (e.g., against influenza, SARS, mumps, or viral hemorrhagic fevers)

- Place all clients in single rooms. If this is not possible, keep each client's bed at least 3 feet from others, to reduce the likelihood of transmission, and keep a curtain drawn around the client, if possible.
- Health care staff should wear a mask when in close contact with infectious individuals (within 1 meter or 3 feet). The mask should be put on upon entry into the room.
- Visitors must be kept to a minimum, should be given masks to wear while in close contact with the client, and should be educated about how to reduce the risk that the infection will spread to others.
- If clients on droplet precautions must be transported outside of their room, they should wear a mask, if tolerated, and should follow respiratory hygiene/cough etiquette.

Airborne precautions (e.g., against pulmonary TB, chicken pox, measles, or SARS)

- Ideally, clients who need airborne precautions should be placed in an airborne infection isolation room (AIIR), which is equipped with special air handling and ventilation capacity. When this is not possible, clients should wear a mask and should be placed in a private room with the door closed. If necessary, clients with the same infection can be placed in the same room. Room air should be exhausted to the outside using a fan or filtration system.
- In settings where resources are limited and electricity is unreliable, opening windows to ventilate rooms/wards with clients on airborne precautions (e.g., tuberculosis clients) will reduce the risk of infection.
- Staff should wear a mask or respirator—the latter, if available and indicated (e.g., suspected/confirmed tuberculosis cases).
- Nonimmune health care workers should not care for clients with vaccine-preventable diseases, such as measles or chickenpox, that are transmitted via the airborne route.
- Visitors should be kept to a minimum, especially if they are susceptible to the infection (e.g., not immune to measles or chicken pox).
- If it is necessary to transport clients within the facility, they should wear a mask during the entire time they are out of their room, whenever possible.

Tuberculosis precautions for at-risk health workers

Some health care workers are at increased risk of exposure to tuberculosis, especially in areas of the world where the incidence of tuberculosis is high. These include staff working in HIV, tuberculosis, and chest clinics; HIV and medical wards; radiology and bronchoscopy units; laboratories performing tuberculosis diagnosis or handling sputum samples; and autopsy rooms. Ideally, these staff should have yearly Mantoux tests (also called the tuberculin skin test or the PPD test), with follow-up radiographs and clinical reviews for those who test positive.

Vaccination of health care workers

Another way to reduce the risk of infections in health care workers is vaccination. Those providing health services are at increased risk of acquiring or transmitting hepatitis B, influenza, measles, mumps, rubella, varicella, tetanus, diphtheria, and pertussis. All of these are vaccine-preventable illnesses. Facility managers should follow national guidelines, international recommendations, and manufacturers' instructions for immunization schedules, for testing to document immunity, and for administration of boosters.

Respiratory hygiene/cough etiquette

Respiratory hygiene and cough etiquette is a recent addition to standard precautions. In general, standard precautions are practices recommended for health care personnel to follow during client care. However, respiratory hygiene and cough etiquette applies more broadly to anyone finding themselves in a health care setting—not only health care workers, but also clients and visitors.

Several simple measures can reduce the likelihood that clients and health care workers will spread respiratory infections to others in health care settings. Respiratory hygiene and cough etiquette includes the following:

- Covering the nose and mouth with a tissue (or a mask) when coughing or sneezing, or using the crook of the elbow to contain respiratory droplets. Discard used tissues and masks in the nearest waste bin.
- Cleansing hands with an alcohol-based handrub or washing hands with soap and water immediately after contact with respiratory secretions or potentially contaminated objects, specimens, or other materials.
- Giving clients with signs and symptoms of respiratory illness a mask to wear while waiting in common areas or putting them immediately into examination rooms or another area at least 1 meter (3 feet) away from others.
- Placing cough etiquette signs around the health facility and providing tissues, masks, wastebaskets, and alcohol-based handrub in waiting and other common areas.

The basic principles behind the practices presented in this reference booklet apply to all medical, clinical, and dental procedures, from the most simple to the very complex, as well as to laboratories where clinical specimens are handled. Specific guidelines are not necessary for different medical and clinical specialties—simply apply the basic principles to whatever clinical area you work in, and you will greatly reduce the risk of transmitting infections to clients and members of the community or of becoming infected yourself as you do your work.

Hand Hygiene

Use of a 60–80% alcohol-based handrub is now considered the "gold standard" for hand hygiene in health care settings, because it is very effective at rapidly inactivating a wide variety of potentially harmful microorganisms. Additionally, such handrubs are less likely to cause skin irritation when frequent hand hygiene is necessary.

Hand hygiene with alcohol-based handrubs

Use of an alcohol-based handrub is the preferred hand hygiene method when hands are not visibly soiled (see page 12). Because cleansing hands with an alcohol handrub is quicker and simpler than handwashing with soap and running water, it may improve hand hygiene among health care workers. If an alcohol-based handrub is unavailable, wash hands with soap and running water.

Appropriate times for staff to use alcohol-based handrub:

- Immediately when arriving at work
- Before and after examining each client
- After touching anything that might be contaminated
- After contact with body fluids or excretions, mucous membranes, nonintact skin, or wound dressings
- After handling specimens
- Before putting on gloves for clinical procedures
- After removing any type of glove
- Before handling an invasive device or doing an invasive procedure (inserting a central venous or indwelling catheter, spinal tap, etc.)
- Before leaving work

Cleaning hands with an alcohol-based handrub kills or inhibits microorganisms, but this does **not** remove microorganisms or soil. Alcohol-based handrub is used only if hands are not visibly dirty. Because using alcohol alone tends to dry the skin, it is best to use a commercially available product. If none are available, make an alcohol handrub solution by adding together 2 mL of glycerine, propylene glycol, or sorbitol and 100 mL of 60–80% alcohol.

Always clean and disinfect reusable bottles used to store alcohol handrub solutions before refilling them.

Handwashing with soap (plain or antimicrobial) and running water

Wash hands with soap and running water when they are visibly dirty or soiled with blood or other body fluids (e.g., urine, feces), when they are contaminated with proteinaceous material (e.g., mucus), or after you have used the toilet or latrine (see page 13).

If an alcohol-based handrub is unavailable, wash hands with soap and running water at all of the times indicated on page 10. Water temperature is not important in terms of reducing the numbers of microorganisms, although warm water may be helpful if hands are heavily soiled. Hot water should be avoided, as it may irritate the skin.

If running water from a faucet is not available, use:

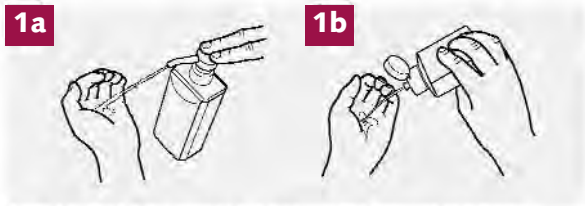
- A bucket with a tap that can be turned off and on
- A bucket and pitcher (one person pours the water over the other's hands)

☛ Hand Hygiene Tips:

- Keep alcohol-based handrub in places where it is often needed or in small bottles that staff can carry in a pocket.
- Keep bar soap on a rack to allow drainage.
- Always use running water—avoid dipping or washing hands in a basin of standing water.
- Use small bars of soap, or cut large ones into small pieces.
- Always use a clean towel, or air-dry your hands.

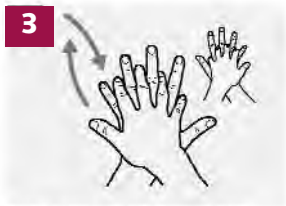
Hand Hygiene with Alcohol-Based Handrub

Duration of the entire procedure: 20–30 seconds



Apply a palmful of the product in a cupped hand, covering all surfaces;

Rub hands palm to palm;



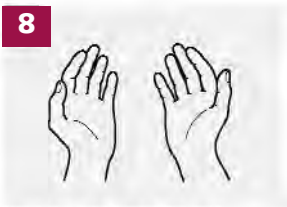
Rub right palm over back of left hand with interlaced fingers and vice versa;

Rub palm to palm with fingers interlaced;

Rub backs of fingers to opposing palms with fingers interlocked;

Rotating, rub left thumb clasped in right palm and vice versa;

Rotating, rub backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Once dry, your hands are safe.

Note: **Hands should remain wet from the alcohol handrub product through Step 7; if necessary, apply more handrub.**

Adapted from: WHO, 2009. Used with permission.

Hand Hygiene with Soap and Water

Duration of the entire procedure: 40–60 seconds

Adapted from: WHO, 2009. Used with permission.

Gloves

Gloves protect both clients and staff by acting as a barrier against infectious microorganisms. Staff should wear gloves whenever they expect that their hands will come in contact with a client's blood, other body fluids, or tissue. Staff should also wear gloves whenever their hands may come into contact with medical waste.

Three kinds of gloves

1 Sterile gloves

These are used when there will be contact with the bloodstream or with tissues under the skin (for example, surgical procedures, pelvic examination for women in labor, etc.). Such gloves should be discarded after one use. Never use the same pair of gloves to care for more than one person.

2 Single-use exam gloves

These gloves, which are clean but are not sterile, are used when there will be contact with intact mucous membranes or where the primary purpose of gloving is to reduce the provider's risk of exposure. These gloves should be discarded after one use. Never use the same pair of gloves to care for more than one person.

3 Utility or heavy-duty household gloves

These are used for handling contaminated items, handling medical or chemical waste, and performing housekeeping activities.

☛ Gloving Tips:

- Always wash utility gloves before you take the gloves off your hands.
- Always cleanse hands with an alcohol-based handrub after removing any type of gloves, or wash hands with soap and running water if they are visibly contaminated.
- Always discard sterile and single-use gloves after one use. Never process or reuse these gloves (regardless of past practices at your facility), as this has been associated with the transmission of infections.

Situations requiring various types of gloves

Type of glove indicated	Situations
Sterile gloves	When there will be contact with the bloodstream or with tissue under the skin. For example: • All surgical procedures • Vaginal delivery (*Note:* Sterile gloves should be used for vaginal delivery because of the increased risk of infection once the membranes have ruptured.) • Invasive radiological or vascular (e.g., central line) procedures • Preparation of total parenteral nutrition or chemotherapeutic agents
Clean gloves	When contact with blood or other body fluids is possible or when there will be contact with potentially infectious material, such as mucous membranes, nonintact skin, tissue specimens, etc. For example: • Inserting or removing intravenous (IV) catheters • Drawing blood • Changing dressings • Conducting pelvic and vaginal examinations • Suctioning nonclosed systems of endotracheal tubes • Handling laboratory specimens
Utility gloves	During instrument processing, housekeeping activities, or disposal of waste, when contact with blood, body fluids, or other potentially infectious material is possible. For example: • Handling/cleaning used instruments • Handling and disposing of medical wastes • Cleaning up spills of blood or other body fluids • Handling used linens • Emptying emesis basins
No gloves	When there is no potential for exposure to blood or other body fluids or to a contaminated environment. For example: • Taking blood pressure, temperature, or pulse • Performing subcutaneous or intramuscular injections • Bathing, dressing, or transporting clients • Manipulating vascular lines in the absence of blood leakage

Adapted from: World Health Organization. 2006. *The first global patient safety challenge: Clean care is safer care: Glove use (technical)*. Information Sheet 6. Geneva. Accessed at www.who.int/gpsc/tools/Infsheet6.pdf.

Aseptic Technique

Aseptic technique refers to the practices performed just before or during a clinical or surgical procedure to reduce the risk of transmission of infection, by reducing the likelihood that microorganisms will enter areas of the body where they can cause infection.

Aseptic technique includes:

- Using barriers (surgical attire)
- Surgical hand preparation and gloving
- Client preparation
- Establishing and maintaining a sterile field
- Using good surgical technique
- Creating a safer surgical/procedure area

Barriers: Surgical attire

Gloves prevent microorganisms on the provider's hands from entering the client and protect the provider's hands from contact with blood, other fluids, or tissues.

Masks prevent microorganisms expelled during talking, coughing, or breathing from entering the client and protect the provider's mouth and nose from splashes of blood or other fluids.

Eyecovers and faceshields protect the provider's eyes, nose, and mouth from splashes of blood or other fluids.

Gowns and waterproof aprons prevent microorganisms from the provider's arms, torso, and clothing from entering the client and protect the provider's skin and clothes from splashes of blood and other fluids.

Caps prevent microorganisms from hair and skin on the provider's head from coming into contact with the client.

Footwear that is clean and sturdy (closed rubber or leather boots or shoes) helps minimize the number of microorganisms brought into the surgical/procedure area and protects the service provider's feet from injury or splashes of blood and other fluids. Sandals should not be worn, as they do not provide adequate protection. When staff at a facility share protective footwear, it should be regularly cleaned, to prevent transmission of infection.

Surgical hand preparation

Before putting on surgical gloves, perform a surgical scrub with a commercially available alcohol-based product with long-lasting antimicrobial activity or an antiseptic or antimicrobial soap. The effectiveness of alcohol-based products is superior to that of other antiseptics, and WHO recommends that preference be given to alcohol-based products.

Surgical hand preparation reduces the client's risk of infection in case surgical gloves develop holes or tears. Warm, moist conditions inside gloves promote the growth of microorganisms. Performing surgical scrub with an alcohol-based product with long-lasting antimicrobial activity or an antiseptic before gloving removes or kills many microorganisms, and also helps prevent this growth.

1. Surgical hand preparation with alcohol-based products

Use of a commercially available alcohol-based product that has long-lasting antimicrobial activity is now recommended instead of traditional surgical scrubbing. Wash hands and forearms with plain soap and water, dry them completely, then apply the alcohol-based solution, following the manufacturer's instructions. Do not use a brush or sponge. Hands should be wet with the alcohol solution throughout the procedure. Allow the hands and forearms to dry thoroughly before putting on sterile gloves.

Surgical procedures may be carried out one after the other without the need for handwashing, provided the technique for surgical hand preparation is followed before the first case and between cases (images 1–17, pages 18–19).

☛ Surgical Hand Preparation Tips:

- If you routinely perform surgical procedures, you should keep your fingernails short.
- Always keep your hands above your elbows during and after scrubbing with alcohol-based handrubs or antiseptic solutions.
- Always follow the manufacturer's recommendations for the use of alcohol-based handrubs or antiseptic solutions.
- Warm water makes antiseptics work more effectively. Avoid using hot water, which removes protective oils from the skin.

Surgical hand preparation technique with alcohol-based product

This technique for surgical hand preparation must be performed on perfectly clean, dry hands. On arrival in the operating theater and after having donned theater clothing (cap/hat/bonnet and mask), hands must be washed in soap and water before the alcohol-based surgical scrub is begun.

After the operation, when removing gloves, hands must be rubbed with an alcohol-based handrub or washed with soap and water if any residual talc or biological fluids are present (e.g., the glove is punctured).

Put approximately 5ml of alcohol-based solution in the palm of your left hand, using the elbow of your other arm to operate the dispenser.

Dip the fingertips of your right hand into the solution to decontaminate under the nails (5 seconds).

Smear the solution on the right forearm up to the elbow.

Images 4-7: Ensure that the whole skin area is covered by using circular movements around the forearm until the solution has fully evaporated (10–15 seconds).

Put approximately 5ml of alcohol-based solution in the palm of your right hand, using the elbow of your other arm to operate the dispenser.

Dip the fingertips of your left hand into the solution to decontaminate under the nails (5 seconds).

continued

Adapted from: WHO, 2009. Used with permission.

Surgical hand preparation technique with alcohol-based product *continued*

10

Smear the solution on the left forearm up to the elbow. Ensure that the whole skin area is covered by using circular movements around the forearm until the handrub has fully evaporated (10–15 seconds).

11

Put approximately 5ml of alcohol-based product in the palm of your left hand, using the elbow of your other arm to operate the distributor. Rub both hands at the same time up to the wrists, and ensure that all steps represented in images 12–17 are followed (20–30 seconds).

12

Cover the whole surface of the hands up to the wrist with alcohol-based solution, rubbing palms against palm with a rotating movement.

13

Rub the back of the left hand, including the wrist, moving the right palm back and forth, and vice versa.

14

Rub palm against palm back and forth with fingers interlinked.

15

Rub the back of the fingers by holding them in the palm of the other hand with a sideways back-and-forth movement.

16

Rub the thumb of the left hand by rotating it in the clasped palm of the right hand and vice versa.

17

When the hands are dry, sterile surgical clothing and gloves can be donned.

Repeat the above-illustrated sequence (average duration, 60 seconds) as needed, without exceeding the total duration recommended by the manufacturer for surgical hand preparation with an alcohol-based solution.

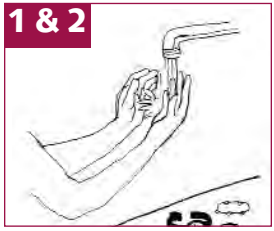
2. Water-based surgical scrub with antiseptic

Scrubbing with an antiseptic such as chlorhexidine or an iodophor for 3–5 minutes will reduce the risk of infection in clients following surgery.

Studies have shown that using a brush during surgical scrub provides no greater reduction of microorganisms on the hands than scrubbing with antiseptic alone. Surgical scrub may be performed using either a soft brush or sponge or using an antiseptic alone. Avoid using a hard brush, which is not necessary and may irritate the skin.

Steps of Water-Based Surgical Scrub

1 & 2



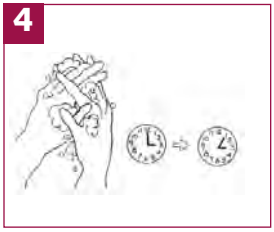
Remove all jewelry on your hands and wrists.

Adjust the water to a warm temperature and wet your hands and forearms thoroughly. If hands are soiled, wash them with plain soap and running water.

3

Clean under each fingernail with a stick or brush. It is important for all surgical staff to keep their fingernails short.

4



Holding your hands up above the level of your elbow, apply the antiseptic. Using a circular motion, begin at the fingertips of one hand and lather and wash between the fingers, continuing from fingertip to elbow. Repeat this for the second hand and arm. Continue washing in this way for 3–5 minutes.

5

Rinse each arm separately, fingertips first, holding your hands above the level of your elbow.

6

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

7

Keep your hands above the level of your waist and do not touch anything before putting on surgical gloves.

Note: Ideally, surgical scrub should be performed before every procedure. However, to prevent skin irritation from too-frequent scrubbing in high-volume settings, use 3–5 mL of an alcohol handrub solution between clients, rubbing your

hands together until the alcohol dries. Then scrub every hour or after every four clients, whichever comes first. Note that alcohol handrub does not remove soil or organic material such as blood. If gloves are torn or punctured, or if there is blood or other body fluids on your hands after you remove your gloves, a surgical scrub should be performed.

☛ Surgical Scrub Tips:

- If you routinely perform surgical procedures, you should keep your fingernails short.
- Always keep your hands above your elbows during and after scrubbing with alcohol-based handrubs or antiseptic solutions.
- Avoid using a hard brush during scrubbing.
- Always follow the manufacturer's recommendations for the use of antiseptics.

Sterile gloves

Wear sterile gloves for any procedure where your hands will come in contact with the client's bloodstream or tissues under the skin. It is important to put on and remove the gloves correctly. Gloves become contaminated if:

- You touch the outside of the glove with your bare hand.
- You touch anything that is not sterile or high-level disinfected while wearing the gloves.
- You hold your gloved hands below the level of your waist.
- Either glove develops a hole, tear, or puncture.

Double Gloving

The WHO recommends that double gloving (i.e., wearing two pairs of sterile gloves) be used in countries with a high prevalence of hepatitis B, hepatitis C, and HIV for surgical procedures anticipated to last longer than 30 minutes, for procedures where contact with large amounts of blood or other body fluids is likely (e.g., vaginal deliveries), and for high-risk orthopedic procedures. A review of research studies showed that wearing a second pair of sterile gloves significantly reduced perforations to the inner gloves (and thus would—in theory—lessen the likelihood that an infection will be transmitted to the health care worker), without apparently affecting surgical performance. A single pair of gloves generally provides appropriate protection to health care workers during nonsurgical client care that may involve contact with blood or other body fluids; in these cases, double gloving is not recommended, because it unnecessarily wastes resources.

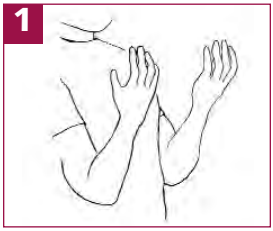
Putting on sterile gloves

Sterile 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 glove.

Remember that the outside of the glove package is not sterile. If you will open the outer package of gloves yourself, do so before you cleanse you hands.

Steps of Putting on Sterile Gloves

1



Prepare a large, clean, dry area for opening the package of gloves. Either open the outer glove package and then cleanse your hands, or practice hand hygiene and ask someone else to open the package of gloves for you.

2

Open the inner glove wrapper, exposing the cuffed gloves with the palms up.

3

Pick up the first glove by the cuff, touching only the inside portion of the cuff (the inside is the side that will be touching your skin when the glove is on).

4

While holding the cuff in one hand, slip your other hand into the glove. (Pointing the fingers of the glove toward the floor will keep the fingers open.) Be careful not to touch anything, and hold the gloves above your waist.

5

Pick up the second glove by sliding the fingers of the gloved hand under the cuff of the second glove. Be careful not to contaminate the gloved hand with the ungloved hand as the second glove is being put on.

6

Put the second glove on the ungloved hand by maintaining a steady pull through the cuff. Adjust the glove fingers and cuffs until the gloves fit comfortably.

Removing contaminated sterile gloves

As you remove the gloves, do not allow the outside surface of the gloves to come in contact with your skin. 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.

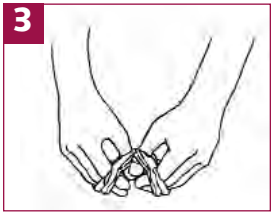
Remove used gloves before touching anything: Countertops, faucets, and pens and pencils are frequently contaminated because health care workers touch them while wearing used gloves.

Reprocessing gloves by sterilization or high-level disinfection in order to use them again is not recommended. It is difficult to do adequately, and the gloves are easily damaged. It is not necessary to rinse gloves in decontamination solution before disposal.

Steps of Removing Sterile Gloves

Grasp one glove near the cuff and pull it partway off. The glove will turn inside out. Keep the first glove partially on before removing the second one to protect you from touching the outside of a glove with your bare hand.

Leaving the first glove over your fingers, grasp the second glove near the cuff and pull it partway off. Keep the second glove partially on.



Pull off the two gloves at the same time, being careful to touch only the inside surface of the gloves with your bare hand.

Dispose of the gloves immediately. Cleanse hands with an alcohol-based handrub after gloves are removed, since tiny holes or tears in gloves may leave staff at risk of exposure to contaminated fluids. Wash hands with soap and running water if they are visibly soiled.

☛ Sterile Glove Tips:

- The outside of the glove package is not sterile. Either open the outer package before hand cleansing, or have another person open it for you.
- If the gloves become contaminated during a procedure, stop what you are doing, step away from the sterile field, remove the contaminated gloves, and put on new gloves.
- Do not let gloves snap while you are removing them, or blood and other matter may splash on you or on those around you.
- During removal, do not allow the outside surface to contact your skin.
- Remove your used gloves before touching anything—including countertops, faucets, pens, and pencils.

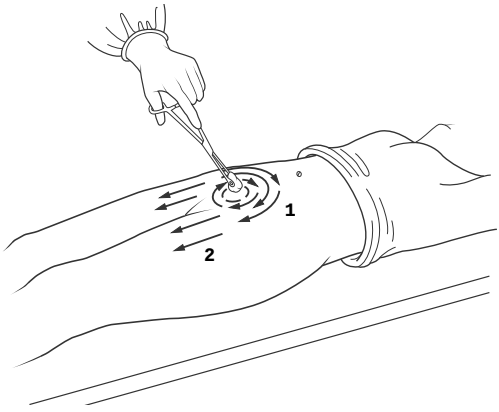
Client preparation

Proper client preparation with antiseptics before a clinical or surgical procedure is critical, since bacteria from a client's skin or mucous membranes can cause infections.

Shaving the surgical/procedure site is no longer recommended, because it causes small nicks and breaks in the skin where bacteria can grow and multiply, and it can lead to increased risk of postprocedure infections. Hair around the surgical/procedure site may be clipped very short if it interferes with the procedure. If the site *must* be shaved: 1) use antimicrobial soap and water or shave dry; and 2) shave as soon as is practical before the start of the procedure, in the operating theater or the procedure room.

To properly prepare a surgical/procedure site:

1. Wash the area with soap and water.
2. Apply an antiseptic and gently scrub the skin in a circular motion, beginning in the center of the site and moving out, using sterile cotton balls, cotton wool, or gauze sponges held by a sponge forceps.



For the mucous membranes, the vagina, and cervix: Do not use alcohol or alcohol-based antiseptics on mucous membranes. Using sterile cotton balls, cotton wool, or gauze sponges held by a sponge forceps, apply an antiseptic liberally to the cervix and vagina before instrumentation of the uterus.

☛ Client Preparation Tips:

- Never leave cotton balls, cotton wool, or gauze sponges soaking in an antiseptic.
- Never dip cotton or gauze into the antiseptic container. Instead, pour some antiseptic into a small container, dip the cotton or gauze into this small container, and discard the unused antiseptic left over after client preparation.
- Shaving the surgical site is not recommended, because it causes small nicks or cuts in the skin where bacteria can grow and multiply. Instead, hair may be clipped short.

About antiseptics

An antiseptic is a chemical agent used to reduce the number of microorganisms on skin and mucous membranes without causing damage or irritation. Besides removing or killing microorganisms, antiseptics may also prevent the growth and development of some types of microorganisms. Antiseptics are used for:

- Skin, cervical, or vaginal preparation before a clinical procedure
- Surgical scrub

Antiseptics are not meant to be used on inanimate objects, such as instruments and surfaces. Antiseptics are designed to be used for reducing or destroying microorganisms on the skin or mucous membranes without damaging these tissues. They do not have the same killing power as chemicals used for disinfection of inanimate objects. Never use antiseptic solutions to disinfect inanimate objects, such as instruments, and never leave items such as pickup forceps, scissors, scalpel blades, and suture needles soaking in an antiseptic solution.

Common antiseptics used for client preparation:

- Iodophors (generally 7.5–10% povidone-iodine—e.g., Betadine)
- 4% chlorhexidine gluconate (e.g., Hibiclens)
- 1–3% iodine, followed by 60–90% alcohol (ethyl or isopropyl)
- Chlorhexidine gluconate with cetrimide (e.g., Savlon)

AVOID using:

- Hydrogen peroxide (0.3%), which is not appropriate for hand hygiene or client preparation
- Products containing quaternary ammonium compounds, such as benzalkonium chloride (e.g., Zephiran), which are disinfectants and should not be used as antiseptics
- Compounds containing mercury (such as mercury laurel), which are highly toxic

Properties of Common Antiseptics

Antiseptics vary between countries, and a variety of products are available throughout the world. This section notes the most common antiseptics and provides the trade names of commonly available products. In general, these have been studied extensively and their effectiveness is known. The information here reflects the most up-to-date scientific studies available. If possible, use these antiseptics, since others may not have been properly studied and their effectiveness may not be known.

Most antiseptics are packaged at the concentration at which they should be used for hand hygiene and skin preparation. Do not dilute them with water or other liquids unless the manufacturer's instructions direct you to do so.

Iodophors, such as povidone-iodine (e.g., Betadine), contain iodine in a complex form, making them relatively nonirritating and nontoxic.

- **Antimicrobial spectrum:** Effective against a range of microorganisms.
- **Advantages:** Less irritating to the skin than iodine; can be used on mucous membranes.
- **Disadvantages:** Effectiveness is moderately reduced by blood or other organic material.
- **Usage:** Recommended for surgical scrub and client preparation, and is the best antiseptic for use in the genital area, vagina, and cervix. Effective 1–2 minutes after application; for optimal effectiveness, wait several minutes after application. Use at full strength; do not dilute.
- **Comments:** Iodophors are distinctly different from iodine. Iodophors are sudsy; iodine is not.

Chlorhexidine gluconate (e.g., Hibitane, Hibiclens, Hibiscrub); **chlorhexidine gluconate with cetrimide** (e.g., Savlon)

- **Antimicrobial spectrum:** Effective against a range of microorganisms, but has a minimal effect on tuberculosis and fungi.
- **Advantages:** Good, persistent effect; remains effective for at least 6 hours after being applied. Effectiveness is not reduced by organic material.
- **Disadvantages:** On rare occasions, products containing chlorhexidine have been reported to cause irritation, especially when used in the genital area. Effectiveness can be reduced by hard water, hand creams, and natural soaps.
- **Usage:** Recommended for surgical scrub and skin preparation. Solutions without cetrimide are preferable. While products containing chlorhexidine are ideal for surgical scrub and skin preparation, they may cause irritation if used in the genital area, vagina, or cervix. Chlorhexidine is the best alternative if an iodophor is not available.

- **Comments:** The concentration of chlorhexidine in products with the name Savlon may vary from one country to another. Savlon products containing at least 4% chlorhexidine are appropriate for use as antiseptics. Savlon products containing less than 4% chlorhexidine in an alcohol base are also adequate, but should not be used on mucous membranes.

Iodine; tincture of iodine (iodine and alcohol)

- **Antimicrobial spectrum:** Effective against a range of microorganisms.
- **Advantages:** Fast acting.
- **Disadvantages:** Can cause skin irritation. Effectiveness is markedly reduced by blood or other organic material.
- **Usage:** Too irritating for routine use in surgical scrub or for use on mucous membranes. Because of potential irritation when used for skin preparation, iodine must be allowed to dry and then should be removed from the skin with alcohol.

Alcohol (60–90% ethyl or isopropyl)

- **Antimicrobial spectrum:** Effective against a range of microorganisms.
- **Advantages:** Kills microorganisms rapidly. Most effective in reducing microorganisms. Effectiveness is moderately reduced by organic material.
- **Disadvantages:** Has a drying effect on skin. Cannot be used on mucous membranes.
- **Usage:** Cannot be used when skin is dirty; wash the area before applying. It must dry completely to be effective.
- **Comments:** 60–70% strength is most effective because alcohol must be diluted for optimal effectiveness, and it is also less drying to skin.

***Para*-chloro-*meta*-xylenol, PCMX, chloroxylenol** (all three also known as Dettol)

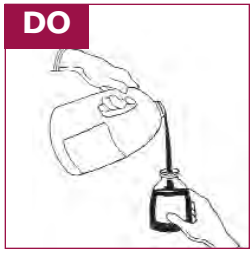
- **Antimicrobial spectrum:** Fairly effective against most microorganisms.
- **Advantages:** Has a persistent effect over several hours. Activity is only minimally reduced by blood or other organic material.
- **Disadvantages:** Less effective than chlorhexidine and iodophors.
- **Comments:** Not recommended for routine use. Antiseptic PCMX preparations containing alcohol should not be used on mucous membranes. Disinfectant preparations should not be used as antiseptics.

To Prevent Contamination of Antiseptic Solutions

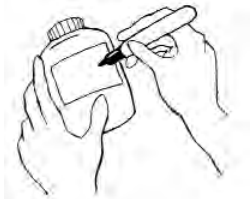
Using contaminated solutions can cause infections in clients. Solutions become contaminated when:

- The water used to dilute a solution is contaminated.
- Containers in which the solution is placed are contaminated.
- Microorganisms from skin or objects contact the solutions during use (such as when removing cotton balls from a solution for use in skin preparation).
- The area in which solutions are prepared or used is not clean.

Proper handling will reduce the chances of contaminating antiseptic solutions. Pour solutions into smaller containers for use during service delivery to avoid contaminating the stock container. Pour solutions out of the container without touching the rim or the solution itself with your hands, a cotton swab, cloth, or gauze. These can contaminate the entire container of solution. Store solutions in a cool, dark area, because direct light or excessive heat may reduce their strength, making them more susceptible to contamination.



Pour solutions into smaller containers for use during service delivery to avoid contaminating the stock containers. Because solutions in these smaller containers are opened, closed, and handled repeatedly, they are at increased risk of contamination. After one week, clean reusable containers with soap and water, and air-dry them before refilling.

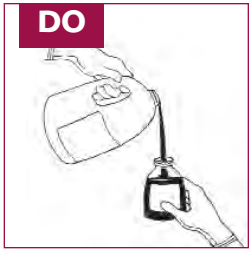


Label reusable containers with the date each time they are washed, dried, and refilled.

Pour the amount of antiseptic needed for one client into a small bowl or gallipot before starting the procedure. Discard any remaining solution at the end of the procedure.

continued

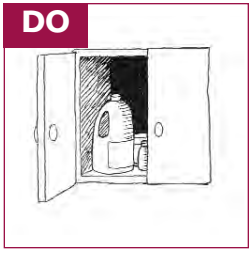
To Prevent Contamination of Antiseptic Solutions *continued*



Pour solutions out of the container without touching the rim or the solution itself with your hands, a cotton swab, or gauze; these can contaminate the entire container of solution.

Keep bottles secure by carefully closing their caps or tops. When removing the bottle cap or top, be careful where you place it. If it becomes contaminated, the entire bottle will become contaminated once the cap or top is replaced.

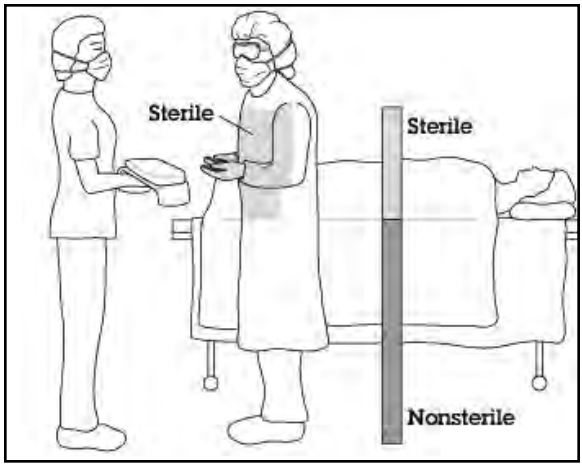
Store gauze, cotton wool, and cotton balls separately from antiseptic solutions. Storing them in antiseptic solutions increases the likelihood of contaminating the solutions, since gauze and cotton provide a good medium for microorganisms to grow. Contamination can occur when microorganisms from the service provider's hands or a contaminated instrument or other item come in contact with the gauze/cotton and antiseptic.



Store antiseptics and disinfectants in a cool, dark area. Avoid storing them in direct light or excessive heat, as this may reduce their strength.

Establishing and maintaining a sterile field

A sterile field is created by placing sterile towels or surgical drapes around the surgical/procedure site. A sterile field should also be established on the stand or area that will hold sterile instruments and other items needed during the procedure.



Items below the level of the draped client are outside the field and are not sterile. A gowned and gloved provider's sterile area extends from the chest to the level of the sterile field. Sleeves are sterile from 5 cm above the elbow to the cuff.

To maintain a sterile field:

- Allow only sterile items and personnel within the sterile field.
- Do not contaminate items when opening, dispensing, or transferring them.
- Consider any sterile item that has been penetrated (cut, wet, or torn) to be nonsterile.
- Never set up a sterile field near a door or an open window.
- When in doubt about whether or not an item is still sterile, consider it to be contaminated.

Good surgical technique

Meticulous attention to bleeding and gentle tissue handling during surgical and clinical procedures can help reduce the risk of infection. Postprocedure infections are more likely to occur in tissue that has been damaged due to rough or excessive manipulation during surgery or when there is excessive bleeding (because the tissue is then more susceptible to invasion by microorganisms).

Use of prophylactic antibiotics

The use of prophylactic antibiotics (giving antibiotics before a procedure to prevent infections from developing) does not take the place of good infection prevention. In general, prophylactic antibiotics may be indicated in contaminated or clean-contaminated surgical procedures, in those involving implantation of a foreign body, or when the client is severely immunosuppressed.

Prophylactic antibiotics are often used inappropriately—such as when the antibiotic chosen is not effective against the most likely contaminating microorganism, or when they are given at the wrong time in relation to the procedure (e.g., when given postoperatively instead of pre- or intraoperatively), thus decreasing the likelihood that they will have any effect.

When indicated, prophylactic antibiotics should be administered no sooner than 30–60 minutes prior to starting the incision. They should always be given before the start of the procedure and in general are not recommended postoperatively. It may be necessary to give additional doses during longer procedures, to ensure adequate tissue levels throughout the procedure.

Avoid routine use of prophylactic antibiotics: It increases costs and increases the likelihood of promoting antibiotic resistance.

Creating a safer surgical/procedure area

Specific rooms should be designated for performing surgical/clinical procedures.

Limiting the traffic, activities, and the number and movement of people in these areas will lower the risk of infection, since the number of people and amount of activity influence the number of potentially disease-causing microorganisms. To maintain a safer environment:

- Reduce the number of people permitted in the area. (It is important to restrict the number of people to only those involved in the activities being carried out.)
- Define the movement of people and activities within the area.
- Close doors and curtains during all procedures.
- Require that personnel in surgical areas wear clean clothes, a mask, a cap, and sturdy footwear.
- Enclose these areas to minimize dust and eliminate insects.
- Air-condition the areas, if possible.
- Before a new client is brought into the procedure room, clean and disinfect examination/operating tables, counters, instrument carts or trolleys, light handles, and any other surfaces that may have been contaminated with blood or other body fluids during a procedure.

Use and Disposal of Sharps

In health care settings, injuries from needles and other sharp items are the primary cause of infections in staff from bloodborne pathogens. All staff who touch sharps are at risk of infection. Most sharps injuries occur during use of a device on a client, after use but before disposal, and during or after disposal. More than half of all sharps injuries are from hollow-bore needles (e.g., hypodermic needles, winged steel needles), and a substantial share of the rest are due to suture needles. Health care workers can be injured:

- When they recap, bend, or break hypodermic needles
- When they are stuck by a person carrying unprotected sharps
- When sharps show up in unexpected places, like linens
- During procedures in which they use many sharps, cannot see their hands, or are working in a small, confined space (such as during many gynecological procedures)
- When they handle or dispose of waste that contains used sharps
- When clients move suddenly during injections

Giving injections

Before giving an injection, wash the injection site with soap and water if there is visible dirt on the skin. Wipe the client's skin at the injection site with an antiseptic solution to minimize the number of microorganisms and reduce the risk of infections. Using a fresh swab, wipe in a circular motion from the center outward. If alcohol is used, allow the alcohol to dry in order to provide maximum effectiveness in reducing microorganisms.

Providers can be stuck or splashed with blood if a client moves suddenly; clients can be infected if the needle, syringe, or solution is contaminated. To minimize risks:

- Always warn the client before giving an injection.
- Always use a new needle and syringe for every injection.

IV fluids and multidose vials

Infections may be transmitted through these items if proper procedures are not followed.

IV fluids. Microorganisms can survive and grow in IV fluids; never use the same IV line and fluid bag/bottle with multiple clients. When the procedure is finished, unhook the needle or catheter from the IV line. Dispose of the needle in a sharps-disposal container. Throw away the catheter and IV line and any remaining fluid.

Multidose vials. Before filling a syringe from a multidose vial, check the vial to be sure there are no leaks or cracks. Check the solution to be sure that it is not cloudy and that there is no particulate matter in the vial. (Most solutions that come in multidose vials are clear.) Wipe the top of the vial with a fresh cotton swab soaked with a 60–80% alcohol solution and allow it to air-dry. Always use a new hypodermic needle and syringe every time medication is withdrawn from a multidose vial. Reusing the same syringe with multiple clients—even if the needle is changed—is not a safe practice. Also, never leave one needle inserted in the vial cap for multiple uses. This provides a direct route for microorganisms to enter the vial and contaminate the fluid between each use.

Safe handling of sharps

Health care workers can accidentally stick each other when passing sharps during a procedure. Always pass sharps in such a way that the surgeon and assistant are never touching the item at the same time. This is known as the "hands-free" technique.

To use the hands-free technique:

- The assistant puts the sharps in a "safe zone" using a designated part of the instrument stand or area on the field where instruments can be placed.
- The assistant tells the service provider that the sharps are in the safe zone.
- The provider picks up a sharp item, uses it, and returns it to the safe zone.

Disposal of sharps

Improper disposal of contaminated sharps can cause infection throughout the community. To avoid injuries during sharps disposal:

- Do not recap needles unless absolutely necessary
- Do not bend, cut, or break needles
- Do not remove needles from syringes before disposal
- Dispose of sharps in a puncture-resistant sharps container, such as a metal box, heavy cardboard box, or an empty plastic jug
- Wear utility gloves when disposing of sharps containers

Sharps-disposal containers

Use a puncture-resistant container for the disposal of used sharps. Sharps-disposal containers are commercially available, or one can be made out of a heavy cardboard box, an empty plastic jug, or a metal container. Sharps-disposal containers should be located in any area where sharps are used (injection rooms, treatment rooms, operating theaters, labor and delivery rooms, and laboratories).

Recapping needles

Whenever possible, dispose of needles immediately without recapping them. When recapping is necessary (for example, to avoid carrying an unprotected sharp), always use the "one-hand" technique.

Steps of the One-Hand Technique

Step 1
Place the cap on a flat surface and remove your hand from the cap.

Step 2
With one hand, hold the syringe and use the needle to "scoop up" the cap.

Step 3
When the cap covers the needle completely, use the other hand to secure the cap on the needle hub. Be careful to handle the cap at the bottom only (near the hub).

☛ Sharps Tips:

- Handle hypodermic needles and other sharps minimally after use, and use extreme care whenever sharps are handled.
- Avoid recapping needles, and do not bend, break, or cut them before disposal.
- Dispose of hypodermic needles, scalpel blades, and other sharps in puncture-resistant containers immediately (or as soon as possible) after use.
- Always wear utility gloves when disposing of sharps containers.
- Always wear utility gloves when washing reusable sharps such as scissors, trocars, etc.
- Use the "hands-free" technique to pass sharps during clinical procedures.

Risk of occupational transmission of bloodborne infections

A number of factors, including the type and severity of the injury, affect the risk of transmission following occupational exposure to bloodborne infections such as HIV, hepatitis B, and hepatitis C. The average risk following a percutaneous exposure, such as a needlestick or some other sharp-object injury, is generally estimated as 0.3% for HIV, 30–40% for hepatitis B, and 1.8% for hepatitis C. After mucous membrane exposure to HIV-infected blood, the risk of transmission is estimated at 0.09%. (No specific estimates are available for risk of hepatitis B or hepatitis C transmission after mucous membrane or nonintact skin exposures.) In all cases, the transmission risk increases with larger volumes of fluid and more severe injuries, such as deeper wounds and those caused by hollow-bore needles.

Management of exposures

All facilities should have policies and guidelines in place for handling occupational exposure to bloodborne diseases such as HIV and hepatitis B. If a staff member or a client have been exposed to blood or other body fluids via a needlestick, some other sharps injury, or a splash to the eyes, nose, mouth, or nonintact skin, check immediately with the in-charge about how to manage the exposure and determine if postexposure prophylaxis (PEP), if available, is appropriate.

Following exposure to blood or other potentially infectious body fluids:

- Immediately wash cuts, puncture wounds, or exposed tissue with soap and water.
- Flush splashes to the skin of the nose and mouth with water.
- Irrigate splashes to the eyes with water or saline.

There is no evidence that cleaning a wound with an antiseptic or squeezing a wound decreases the risk of infection. Do not use caustic agents, such as bleach or disinfectants.

Body fluids known, presumed, and not known to be infectious

Body fluids **known** to be infectious	Body fluids **presumed** to be infectious	Body fluids **NOT known** to be infectious (if not visibly bloody)
Blood Any fluid with blood Semen Vaginal secretions Breast milk	Cerebral spinal fluid Pleural fluid Pericardial fluid Peritoneal fluid Amniotic fluid Synovial fluid	Tears Saliva Urine Feces Sweat Vomit

Postexposure prophylaxis

PEP is the immediate provision of drugs or other therapy (e.g., vaccines) following exposure to potentially infected blood or other body fluids, so as to minimize the risk of transmission of some bloodborne pathogens. If PEP is not available at the facility, an HIV care and treatment center should be visited or an infectious disease specialist should be consulted, if possible.

Whether PEP is indicated following exposure to blood or other body fluids depends on a number of factors that reflect the likelihood that the person was exposed to a bloodborne infection and the risk of transmission if he or she was. Factors to consider in the decision include: the infection status of the source client, or the likelihood of exposure to an infectious agent if the source client is unknown; the type of exposure (e.g., a splash to the skin versus a deep puncture wound, or exposure of the mucous membranes to a small volume versus a large volume of fluid); whether the exposed person has been vaccinated against hepatitis B; and the availability of drugs or other therapy, such as vaccines. Generally speaking, to be most effective, PEP should be initiated as soon as possible after the exposure. Antiretroviral drugs (ARVs) are not indicated for PEP later than 72 hours after exposure.

Some therapies include:

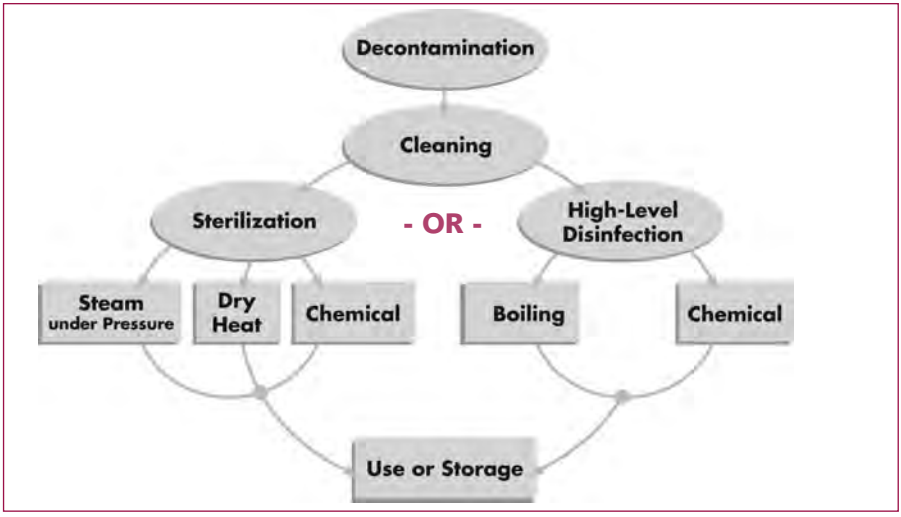
- **For HIV:** Several ARVs have been recommended to reduce the risk of HIV transmission following accidental exposure in health care workers. Either two or three ARV regimens are recommended, depending on the HIV status of the source and the type or severity of the exposure. Generally, PEP is not warranted if the HIV status of the source is unknown, although it could be considered if the source has risk factors for HIV or, in the case of an unknown source (such as an injury from a needle in a sharps disposal container), if exposure to an HIV-infected person is likely. It is beyond the scope of this document to provide specific details for HIV PEP drug regimens, given the wide variety of ARV drug combinations that can be used and the varying availability of these drugs from one part of the world to another.
- **For hepatitis B:** Hepatitis B immune globulin and hepatitis B vaccine can reduce the risk of infection after a worker's exposure to blood or other body fluids containing hepatitis B virus. Decisions about specific PEP treatment protocols should be based on the hepatitis B vaccine status of the exposed health care worker and the hepatitis B infection status of the source. If the vaccine is available, it should be given to all unvaccinated health care workers who have an occupational exposure to blood or body fluids.
- **For hepatitis C:** There is no PEP available for hepatitis C. Neither immune globulin nor antiviral drugs have been shown to reduce the risk of hepatitis C transmission.

Instrument Processing

Proper processing is critical for reducing infection transmission during clinical or surgical procedures. Correct handling and processing also reduces staff's risk of infection.

The steps of processing

There are four steps to processing instruments and other items used during clinical and surgical procedures: 1) decontamination; 2) cleaning; 3) sterilization (preferred) or high-level disinfection (HLD) (the only acceptable alternative); and 4) use or storage.



Step 1: Decontamination

The first step in processing instruments and other items for reuse, decontamination kills viruses (such as hepatitis B, other hepatitis viruses, and HIV) and many other microorganisms, making items safer to handle by the staff who perform cleaning and further processing. Decontamination also makes items easier to clean by preventing blood, other body fluids, and tissue from drying on them. Cleaning is still necessary, however, since decontamination does not remove all of the body fluid, tissue, or dirt on the items.

It is important for staff to know how to decontaminate items and to know that they should place items in the decontamination bucket without splashing the solution.

To decontaminate items, use a 0.5% chlorine solution or a solution made from another acceptable disinfectant. (Because chlorine is usually the cheapest and most universally available disinfectant, this booklet will focus on the use of a 0.5% chlorine solution.)

How to make a 0.5% chlorine solution

A solution that is too weak (less than 0.5% active chlorine) may not adequately kill microorganisms during the recommended time for soaking. A solution that is too strong (more than 0.5% active chlorine) may increase the cost of supplies by using more bleach than necessary and may damage instruments, other items, and environmental surfaces.

Chlorine solutions are recommended because of the low cost and wide availability of the liquid or powdered bleach needed to prepare them. A chlorine solution can be made from:

1. **Liquid household bleach**—sodium hypochlorite
2. **Bleach powder**—chlorine compounds available in powder form (calcium hypochlorite or chlorinated lime)
3. **Chlorine-releasing tablets**—sodium dichloroisocyanurate

Chlorine-containing compounds are described as having a certain percentage of "active" (or available) chlorine. It is the active chlorine in these products that kills microorganisms. The amount of active chlorine is usually described as a percentage, and differs from one product to another. This is important so that a chlorine solution with 0.5% "active" chlorine can be prepared.

About Chlorine

Chlorine is one of the oldest and most common compounds used as a disinfectant because:

- It is a proven and powerful killer of microorganisms, including HIV, hepatitis viruses, and *Mycobacterium tuberculosis*.
- It deodorizes.
- It is not poisonous to humans in the concentrations in which it is used.
- It is colorless, easy to handle, and economical to use.

Note: In countries where French products are available, the amount of active chlorine is usually expressed in "degrees chlorum." One degree chlorum is equivalent to 0.3% active chlorine.

1. Using liquid household bleach

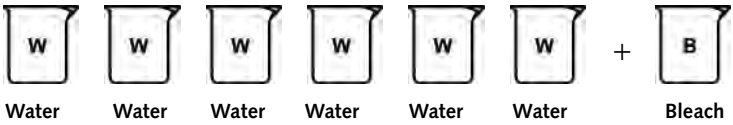
Chlorine in bleach comes in different concentrations. You can use any type of bleach, no matter what the concentration, to make a 0.5% chlorine solution by using the following formula:

[% active chlorine in liquid bleach ÷ 0.5%] - 1 = parts of water per part bleach

Note that "parts" can be used for any unit of measure (e.g., ounce, liter, or gallon) and need not even represent a defined unit of measure (e.g., a pitcher or container may be used).

Example: To make a 0.5% chlorine solution from bleach with 3.5% active chlorine, the calculation is as follows:

[3.5% ÷ 0.5%] - 1 = [7] - 1 = 6 parts water for each part bleach:

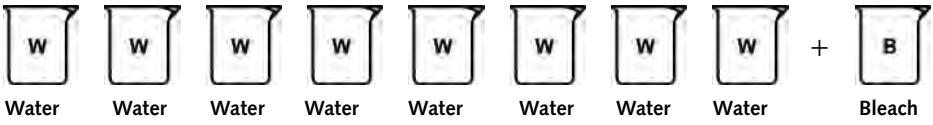


Therefore, you must use six parts water to one part bleach.

To make a 0.5% chlorine solution from bleach containing 15° chlorum, the calculation is as follows:

Convert degrees chlorum to % active chlorine by using the following formula: [°chlorum x 0.3]=% active chlorine in the bleach (15 x 0.3 = 4.5% active chlorine)

Then use the formula as above: [4.5% ÷ 0.5%] – 1 = [9] – 1 = 8 parts water for each part bleach:



Therefore, you must use eight parts water to one part bleach.

2. Using bleach powder

If using bleach powder, calculate the ratio of bleach to water using the following formula:

[0.5% ÷ % active chlorine in bleach powder] x 1,000 = g powder per liter of water

Example: To make a 0.5% chlorine solution from calcium hypochlorite powder containing 35% available chlorine:

$$[0.5\% \div 35\%] \times 1{,}000 = [0.0143] \times 1{,}000 = 14.3 \text{ g}$$

Therefore, you must dissolve 14.3 g calcium hypochlorite powder in 1 liter water to get a 0.5% chlorine solution.

Note that when bleach powder is used, the resulting chlorine solution is likely to be cloudy (milky).

3. Using chlorine-releasing tablets

Follow the manufacturer's instructions, since the percentage of active chlorine in these products varies. If the instructions are not available with the tablets from your supply source, ask for the product's instruction sheet or contact the manufacturer.

Steps of Decontamination

Step 1

Immediately after use, decontaminate instruments and other items by placing them in a plastic container of 0.5% chlorine solution. Let them soak for 10 minutes. A container of this solution should be kept in every operating theater and procedure room, so that used items can be placed directly into the bucket. Service providers should put instruments and other items into the chlorine solution as soon as they are finished using each item. Open or unlock jointed instruments, such as hemostats and scissors. Disassemble those instruments with sliding or multiple parts.

Step 2

After 10 minutes, remove the items from the chlorine solution and either rinse with water or clean immediately. Do not leave items in the solution for more than 10 minutes, since excessive soaking in the solution can damage instruments and other items. Always wear utility gloves when removing instruments and other items from a chlorine solution.

It may be useful to set up a bucket of tap water next to the bucket of decontamination solution. This way, when the items are ready to be removed from the decontamination solution, they can be placed in the water until the appropriate staff member is ready to clean them.

Items that require special consideration:

- **Linens (caps, gowns, masks, and surgical drapes):** Decontamination of linens is impractical and is not recommended. Handle, transport, and process linens that are soiled with blood, other body fluids, secretions, and excretions in a way that prevents exposure to skin and mucous membranes, contamination of clothing, and transfer of microorganisms to clients or the environment. Do not shake or handle them in any way that might lead to microorganisms becoming airborne. When transporting linens to washing areas, place the linens in leakproof containers or fold them so that the portions that are contaminated are on the inside, surrounded by dry linen. Always wear heavy utility gloves when handling, transporting, and processing used linens, and wash hands immediately after removing gloves. If linen will be processed outside of the facility, make sure that the person who transports them to the processing site wears utility gloves.
- **Storage containers:** Fill containers with a 0.5% chlorine solution and soak for 10 minutes before cleaning. Rinse or clean immediately.
- **Endoscopes (including laparoscopes, arthroscopes, colonoscopes, etc.):** There is no effective way to decontaminate endoscopes and cables. They cannot be soaked in chlorine solution, since chlorine can damage the endoscope and cable. In addition, alcohol should not be used, as it can fog the lens or dissolve the cement holding the lens in place. After use, endoscopes and cables should be cleaned and then disinfected or sterilized. When handling potentially contaminated endoscopes, always wear utility gloves.

☛ Tips for Decontamination:

- Chlorine solution for decontamination can be made cheaply from locally available liquid or powder bleach.
- Use 0.5% chlorine solution; lower concentrations are not effective, and higher ones can damage instruments and other items.
- To avoid damage to instruments and other items, remove them from the chlorine solution after 10 minutes and rinse.

Step 2: Cleaning

While decontamination makes items safer to handle, cleaning, 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 microorganisms, including bacterial endospores, on instruments and other items.

Cleaning refers to scrubbing with a brush, detergent, and water and is a crucial step in processing. Without cleaning, further processing might not be effective because:

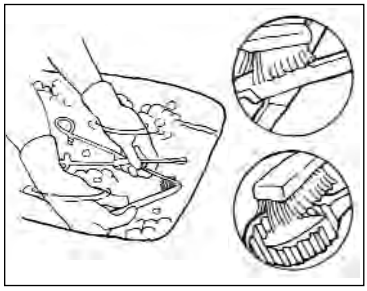
- Microorganisms trapped in organic material may be protected and survive further processing.

- Organic material and dirt can make the chemicals used in some processing techniques less effective.

Detergent is important for effective cleaning, because 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. Do not use hand soap for cleaning instruments and other items, because the fatty acids contained in the soap will react with the minerals of hard water, leaving a residue or scum that is difficult to remove.

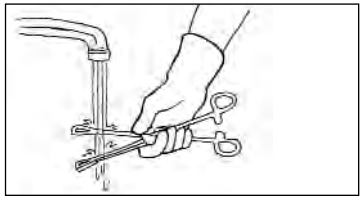
Steps of Cleaning

Always wear utility gloves, a mask, and protective eyewear when cleaning instruments and other items. Avoid using steel wool or abrasive cleansers. These products can scratch or pit metal or stainless steel, resulting in grooves that can become a nesting place for microorganisms. This also increases the potential for corrosion of the instruments and other items.



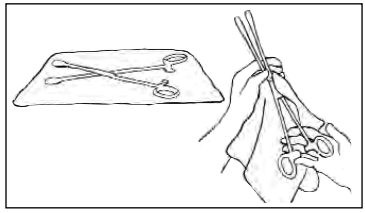
Step 1

Using a soft brush or old toothbrush, detergent, and water, scrub instruments and other items vigorously to completely remove all blood, other body fluids, tissue, and other foreign matter. Hold 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 running water to remove all detergent. Any detergent left on the items can reduce the effectiveness of further chemical processing.



Step 3

Allow items to air-dry (or dry them with a clean towel).

Note: Instruments that will be further processed with chemical solutions must dry completely to avoid diluting the chemicals; items that will be high-level disinfected by boiling do not need to be dried first.

Items that require special consideration:

- **Linens (caps, gowns, masks, and surgical drapes):** Wash with detergent and hot water and rinse with clean water. Air- or machine-dry. To reduce the risk of exposure to infectious material, machine washing is recommended. When machine washing is not possible, staff who wash linens by hand should wear protective gear, such as utility gloves, waterproof aprons, and either faceshields or eyecovers and a mask, to reduce the likelihood of exposure to blood and other body fluids.

☛ Tips for Cleaning:

- Always wear utility gloves, a mask, and protective eyewear to protect yourself, and always hold items under water while cleaning them.
- Use detergent to effectively remove organic matter. Do not use hand soap.
- Scrub with a brush, getting into all grooves, teeth, and joints to remove blood, tissue, and other foreign matter.
- Rinse thoroughly under running water, as detergent can interfere with the effectiveness of sterilization or HLD.
- If no sink with running water is available, clean instruments in a bucket containing water and detergent, and then rinse the items in another bucket filled with clean water.

Step 3: Sterilization or HLD

Sterilization ensures that items are free of all microorganisms (bacteria, viruses, fungi, and parasites), including bacterial endospores, that can cause infections in clients. Because sterilization kills all microorganisms, it is recommended for items like needles and surgical instruments that come in contact with the bloodstream or tissues under the skin. When sterilization is not available, HLD is the only acceptable alternative for these items.

Caution

Items should be sterilized or high-level disinfected, but not both.

The basic concepts described in the following pages apply no matter which method of sterilization or HLD you use. The methods described in detail are those most likely to be available and practical in resource-poor settings; however, other approaches are also in use around the world. If you have access to other sterilization or HLD technologies and products—e.g., ethylene oxide, hydrogen peroxide gas plasma, or liquid peracetic acid sterilization—closely follow the manufacturer's instructions to ensure proper processing. These more high-tech

methods are more costly, yet they are no more effective than the techniques detailed here.

Note: Flaming (holding an item in a flame) is *not* an effective method of sterilization or HLD, because it does not effectively kill all microorganisms.

Using sterilization

The effectiveness of any method of sterilization depends on the amount and type of microorganisms, organic material (blood, other fluids, tissues), and other matter (such as dirt) present on the item and the amount of protection the item gives the microorganisms (such as whether the item has grooves or other areas in which microorganisms can hide). Therefore, it is important to thoroughly clean instruments and other items before sterilization:

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

There are three methods of sterilization: steam sterilization (also known as "autoclaving" or "moist heat under pressure"), dry-heat sterilization (electric oven), and chemical ("cold") sterilization. You should have more than one method of sterilization or HLD available to use as a backup for when your equipment breaks down, supplies run low, or electricity is unavailable.

Note: Boiling is *not* a method of sterilization; it is a method of HLD and is described on page 57.

Wrapping items before sterilization

Wrapping items before steam and dry-heat sterilization helps decrease the likelihood that sterilized items will be contaminated before use. Under optimal storage conditions and with minimal handling, properly wrapped items can be considered sterile as long as they remain intact and dry. To wrap 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 foil or double-layered cotton, or muslin fabric.

Steps of Wrapping Items for Sterilization

Step 1

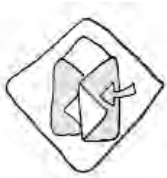
Place the instrument or other item in the center of the top wrapper. The wrapper should be positioned so that the points—not the flat edges—are at the top, bottom, and sides.

Step 2

Fold the bottom section of the *top* wrapper to the center, and fold back the point.

Step 3

Fold the left section to the center, and fold back the point.



Step 4

Fold the right section to the center, and fold back the point.

Step 5

Fold the top section to the center, and fold back the point.

Step 6

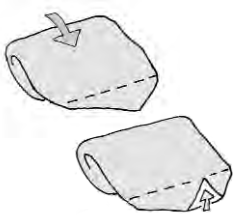
Fold the bottom section of the bottom wrapper to the center, and fold back the point.

Step 7

Fold the left section to the center, and fold back the point.

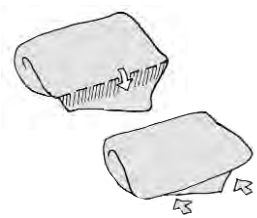
Step 8

Fold the right section to the center, and fold back the point.



Step 9

Fold the top section to the center, and fold back the point.



Step 10

Tuck the point under the right and left sections.

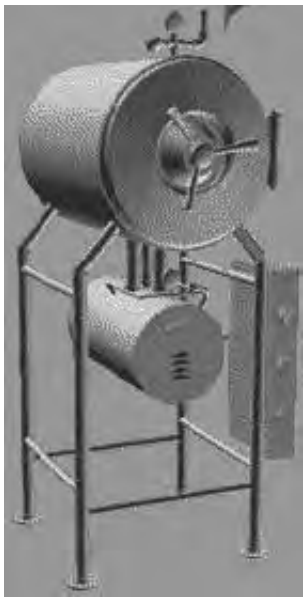
Step 11

Fasten the folds securely, using tape,* if available.

*Autoclave or dry-heat indicator tape, depending on the sterilization method you plan to use.

1. Steam sterilization (autoclaving)

Steam sterilization in an autoclave is one of the most common forms of sterilization used in health care 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., kerosene burner), depending on the type of autoclave being used.



It is important to know whether you are using an autoclave or a dry-heat oven, since different procedures are used with each. Remember that if you are using an autoclave, it must have 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) and a pressure gauge.

Steps of Steam Sterilization

Step 1

Decontaminate, clean, and dry all instruments and other items to be sterilized.

Step 2

Open or unlock all jointed items, such as hemostats and scissors, and disassemble those with sliding or multiple parts. (This allows steam to reach all surfaces of the item.) Avoid arranging the items together tightly, because this prevents steam from reaching all surfaces.

Step 3

If items are to be wrapped before steam sterilization, use two layers of paper, newsprint, or cotton or muslin fabric (do not use canvas). Instruments and other items should not be placed in a closed container. If drums are being used, make sure that the holes of the drum are open and that items are not tightly packed inside the drum.

Step 4

Arrange all packs, drums, or unwrapped items (e.g., laboratory glassware, bottles with liquids) in the chamber of the autoclave in a way that allows steam to circulate freely, since steam must touch all surfaces for sterilization to be achieved with autoclaving.

Step 5

Because there are many types of autoclaves, this booklet cannot provide specific instructions for each. Follow the manufacturer's instructions whenever possible. In general, sterilize wrapped items for 30 minutes and unwrapped items for 20 minutes at 121˚C (250˚F) and 106 kPa (15 lb/in^2) pressure. (Do not begin timing until the autoclave

reaches the desired temperature and pressure. If you forget to start timing the procedure, start timing at the point at which you realize this.)

Note: The units of pressure marked on an autoclave's pressure gauge may be different on different machines. The following amounts (which are approximately equivalent) are the desired pressure for autoclaving:

15 lb/in^2 (15 pounds per square inch)
106 kPa (106 kilopascals)
1 atm (1 atmosphere)
1 kgf/cm^2 (1 kilogram of force per square centimeter)
776 torr
1 bar
776 mm Hg (776 millimeters of mercury)

Step 6

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 or remove the autoclave from the heat source after 30 minutes if items are wrapped, 20 minutes if items are unwrapped. 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).

Note: Items must be removed dry: Damp packs will draw microorganisms from the environment and should be considered contaminated.

Step 7

Remove the packs, drums, or unwrapped items from the autoclave (use sterile pickups for handling unwrapped items). To prevent condensation, place packs or drums on a surface padded with paper or fabric until they are cool. Do not store packs, drums, or unwrapped items until after they reach room temperature (which may take several hours).

Step 8

Store items properly, as follows:

- Under optimal storage conditions and with minimal handling, properly wrapped items can be considered sterile as long as they remain intact and dry. For optimal storage, place sterile packs in closed cabinets in areas that are not heavily trafficked, have moderate temperature, and are dry or of low humidity. When in doubt about the sterility of a pack, consider it contaminated and resterilize the items.
- The risk of contamination is high when items such as cotton balls or gauze sponges are sterilized in a drum that is repeatedly opened and closed each time an item is removed. If it is necessary to sterilize items in this way, use small drums and resterilize the drums frequently, to reduce the risk of contamination.
- Use unwrapped items immediately after removal from the autoclave or keep them in a covered, dry, sterile container for up to one week.

Pressure cooker–type autoclaves

Pressure cooker–type autoclaves are common (especially in rural areas) and often do not come with instructions. The following can be used as instructions:

- Put water into the bottom of the autoclave (up to the ridge located on the inner wall).
- Place items in the autoclave and arrange them loosely, so that the steam can circulate around them. Fasten the cover in place securely.
- Place the autoclave over the heat source (e.g., electric stove, kerosene burner) and turn to high heat. Once steam is emitted from the pressure valve, begin timing the sterilization cycle. (For this type of autoclave, 20 minutes is suggested, regardless of whether items are wrapped or unwrapped.)
- Turn the heat down, but make sure that steam continues to come out of the pressure valve. This will reduce the amount of fuel used.
- After 20 minutes, remove the autoclave from the heat source, open the pressure valve to release the steam, and allow the autoclave to cool for 15–30 minutes before opening it.

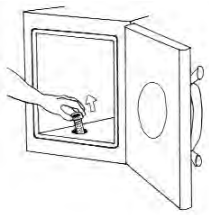
Sterilizing medical instruments in a pressure cooker–type autoclave.

A pressure cooker–type autoclave in use.

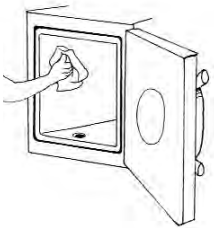
General Guidelines for Routine Maintenance that Are Likely to Apply to Many Autoclaves

Daily

- Remove the outlet screen, and clean with detergent and a brush under running water.



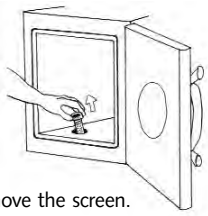
- Clean the chamber using a cloth. Do *not* use abrasive cleansers or steel wool; they will scratch the surface and increase corrosion.



- Clean the door or lid gaskets with a cloth and check for defects. Replace defective gaskets.
- Clean the shelves in the autoclave or the basket or cart that holds packs (including the wheels of the cart) with detergent and a cloth.

Weekly

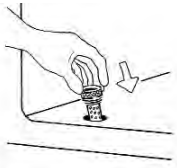
Check the manufacturer's instructions for maintenance of the exhaust line. If the instructions are unavailable, flush the exhaust line or chamber drain to keep it free of material that may interfere with air and steam leaving the chamber, as follows:



1 Remove the screen.

2 Pour 1 liter of detergent and hot water solution down the drain with a funnel.

3 Pour 1 liter of hot water down the drain to rinse out the detergent solution.



4 Replace the screen.

Autoclave maintenance

If you use steam sterilization at your facility, the autoclave should be checked each time it is used to make sure that it is functioning properly. If any repairs are necessary, they should be made before the autoclave is used again. If the autoclave is faulty, sterilization will not be achieved. The autoclave is not working correctly if:

- Steam comes out of 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 and dried or replaced.

Each time you prepare to use the autoclave, check the gaskets, gauges, and pressure and safety valves for defects. Regularly clean the chamber and cover.

Routine maintenance should become standard procedure. (Follow the manufacturer's instructions whenever possible, since autoclave maintenance varies depending on the type of autoclave used.)

2. Dry-heat sterilization (electric oven)

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

It is important to know whether you are using an autoclave (steam sterilizer) or a dry-heat oven, since different procedures are used with each. Remember that a dry-heat oven does not use water or have pressure gauges.

Maintenance of ovens

If you use dry-heat sterilization at your facility, routine maintenance is important to ensure that the oven is functioning properly. If the oven does 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 few weeks is sufficient—by putting a thermometer in the oven and comparing the temperature reading with the one on the gauge.

Steps of Dry-Heat Sterilization

Step 1
Decontaminate, clean, and dry all items to be sterilized.

Step 2
Either 1) wrap the items using foil or double-layered cotton or muslin fabric; 2) put unwrapped items on a tray or shelf; or 3) place items in a metal, lidded container.

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.

Step 3
Place items in the oven and heat it to the correct temperature. (The oven must contain a thermometer or temperature gauge.) Use the following list to determine the time required to sterilize items at different temperatures. Do not begin timing until the oven reaches the desired temperature, and do not open the oven once timing has begun. (Use a timer or make sure to record the time.) If you forget to start timing the procedure, start timing at the point at which you realize this.

Temperature	Time
170˚C (340˚F)	1 hour
160˚C (320˚F)	2 hours
150˚C (300˚F)	2.5 hours
140˚C (285˚F)	3 hours

Note: This list shows the amount of time that items must be kept at the desired temperature to ensure that sterilization is achieved. Keep in mind that the total cycle time—including heating the oven to the correct temperature, sterilization, and cooling—is usually twice as long as the time noted here. Because dry heat can dull sharp instruments, they should not be sterilized at temperatures higher than 160˚C.

Step 4
Leave items in the oven to cool. When they are cool, remove items and use or store immediately. (Use sterile pickups to remove unwrapped items.)

Step 5
Store items properly, as follows:

- *Wrapped items*. Under optimal storage conditions and with minimal handling, properly wrapped items can be considered sterile as long as they remain intact and dry. For optimal storage, place sterile packs in closed cabinets in areas that are not heavily trafficked, have a moderate temperature, and are dry or of low humidity. When in doubt about the sterility of a pack, consider it contaminated and resterilize the items.
- *Unwrapped items*. Use unwrapped items immediately after removal from the oven or keep them in a covered, dry, sterile container for up to one week

3. Chemical ("cold") sterilization

Chemical sterilization is used for items that are heat-sensitive or when methods that require heat are unavailable. Items are sterilized by soaking them in an appropriate chemical solution (such as one containing glutaraldehyde) and rinsing them in sterile water.

Cidex, which contains glutaraldehyde, is a commonly available solution used for sterilization. Other products containing glutaraldehyde or other chemical sterilants may be locally available, but you should make sure that the solution you want to use is appropriate for sterilization. The length of time that commercially available glutaraldehyde solutions can be used varies, usually from 14–30 days. Always follow the manufacturer's instructions regarding proper storage temperatures and expiration date. Solutions should be replaced anytime they become cloudy.

Glutaraldehyde is irritating to the skin, eyes, mouth, and respiratory tract. Acute or chronic exposure to fumes from this solution can lead to stinging sensations and tearing in the eyes; discomfort in the nose, throat, or chest; and runny nose, coughing, or sneezing. Exposing the skin to glutaraldehyde solutions can cause dermatitis, and splashing it in the eyes can cause serious injury. Health care workers may be exposed to high levels of glutaraldehyde when solutions are being prepared, when spills occur, when items are being processed (placed in or removed from immersion baths, or rinsed), or when solutions are used in poorly ventilated rooms. Limit exposure to glutaraldehyde solutions and their fumes by: using this chemical in a well-ventilated area or under a ducted exhaust hood; ensuring that tight-fitting lids are used for containers holding glutaraldehyde; limiting the time that staff are exposed to solutions/fumes; and wearing heavy utility gloves (not latex gloves) and goggles at all times when these solutions are being used (including while rinsing instruments after they have soaked in glutaraldehyde).

Caution

Formaldehyde is potentially cancer causing and extremely irritating to the skin, eyes, nose, and respiratory tract. Therefore, routine use of formaldehyde for sterilizing instruments and other items is *not* recommended.

Steps of Chemical Sterilization

Step 1
Decontaminate, clean, and thoroughly dry all instruments and other items to be sterilized. Water from wet instruments and other items dilutes the chemical solution, thereby reducing its effectiveness.

Step 2
Prepare the glutaraldehyde or other chemical solution by following the manufacturer's instructions or use a solution that was prepared previously, as long as it is clear (not cloudy) and has not expired. (Most commercially available glutaraldehyde solutions can be used for at least two weeks after preparation; follow the manufacturer's instructions. Ideally, an indicator strip should be used each time the solution is to be used to determine if the solution is still effective.) After preparing the solution, put it in a clean container with a lid. Always mark the container with the date the solution was prepared and the date it expires.

Step 3
Open all hinged instruments and other items and disassemble those with sliding or multiple parts; the solution must contact all surfaces in order for sterilization to be achieved. Completely submerge all instruments and other items in the solution; all parts of the instruments and other items should be under the surface of the solution. Place any bowls and containers upright, not upside down, and fill them with the solution.

Step 4
Cover the container. Follow the manufacturer's instructions regarding the time necessary for sterilization to be achieved. Do not add or remove any instruments or other items once timing has begun. In general, if the solution contains glutaraldehyde, allow the instruments and other items to soak for at least 10 hours.

Step 5
Remove the instruments and other items from the solution using large, sterile pickups (lifters, cheatle forceps).

Step 6
Rinse thoroughly with sterile water to remove the residue that chemical sterilants leave on instruments and other items; this residue is toxic to skin and tissues. *Note:* Boiled water is not sterile, because boiling does not guarantee that bacterial endospores have been killed. Therefore, rinsing with boiled water can contaminate sterilized instruments and other items.

Step 7
Proper storage is as important as the sterilization process itself. Place the instruments and other items on a sterile tray or in a sterile container and allow them to air-dry before use or storage. Use the instruments and other items immediately or keep them in a covered, dry, sterile container and use within one week.

Monitoring the effectiveness of sterilization

There are three ways to monitor the effectiveness of sterilization:

1. Mechanical indicators.

These indicators, which are part of the sterilization equipment (the autoclave or dry-heat oven), record and allow you to observe time, temperature, and/or pressure readings during the sterilization cycle.

2. Chemical indicators.

These include:

- Tape with lines that change color when the intended temperature is reached
- Pellets in glass tubes that melt, indicating that the intended temperature and time have been reached
- Indicator strips that show that the intended combination of temperature and time (and, in an autoclave, steam exposure) has been achieved
- Indicator strips that show that sterilization chemicals are still effective

3. Biological indicators.

These indicators use heat-resistant bacterial endospores to demonstrate whether sterilization has been achieved. (If the bacterial endospores have been killed after sterilization, you can assume that all other microorganisms have been killed as well.) The advantage of this method is that it directly measures the effectiveness of sterilization. The disadvantage is that this indicator is not immediate, as are mechanical and chemical indicators. Bacterial culture results are needed before sterilization effectiveness can be determined.

Recommended monitoring system:

- Record all information (temperature, time, pressure, or all three, depending on the method being used) in a log each time you perform sterilization, and review the log after each load. (Some sterilization equipment has a built-in recording chart that will do this for you.)
- For methods that require heat or steam, place heat- and steam-sensitive indicators on the inside and outside of each pack.
- Perform testing with biological indicators weekly (or monthly, if testing weekly is not possible).
- If using chemicals, use an indicator strip to determine whether the solution is still effective before performing sterilization and replace the solution if necessary.

In case of failure:

If monitoring indicates a failure in sterilization, immediately attempt to determine the cause of the failure. First, check that equipment is being used correctly. If correct use of equipment has been documented and monitoring still indicates a failure in sterilization, discontinue use of the equipment and have it serviced. Any items processed in the faulty equipment should be considered nonsterile and must be processed again when the equipment is functioning.

Special considerations

Special considerations must be taken when sterilizing liquids and linens.

Liquids

Liquids (such as water used to rinse items after chemical sterilization) can be sterilized only by steam sterilization, not by dry-heat or chemical sterilization. Special procedures must be followed to safely and properly sterilize liquids.

Liquids must be sterilized separately from other items, such as instruments or linens. Place liquids in heat-resistant glass (e.g., Pyrex) bottles with self-sealing caps, and autoclave them at the same temperature and pressure used for other items. The time necessary to autoclave liquids depends on many factors, the most important of which is the volume of liquid being autoclaved. In general:

75–100 mL = 20 minutes
250–500 mL = 25 minutes
1,000 mL = 30 minutes
1,500 mL = 35 minutes
2,000 mL = 40 minutes

Once sterilization is complete, the chamber pressure must be released slowly—over a period of at least 10–15 minutes. Rapid release will cause liquids to boil violently, which may cause the caps to blow off or the bottles to burst. After the pressure has been released, open the autoclave door slightly and allow liquids to cool for approximately 30 minutes before removal.

Linens (gowns and surgical drapes)

Only steam sterilization should be used for these items. Many fabrics burn at the high temperatures used for dry heat. Packs containing gowns, drapes, and other linens should not be more than 30 x 30 x 50 cm (12 x 12 x 20 in.) or 5 kg (12 lb.) to allow steam to penetrate the items adequately. Place packs containing linens 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.)

Using HLD

HLD eliminates bacteria, viruses, fungi, and parasites, but does not reliably kill all bacterial endospores, which cause diseases such as tetanus and gas gangrene. Because sterilization kills all microorganisms, including bacterial endospores, it is preferable for instruments and other items that will come in contact with the bloodstream or tissues under the skin. ***When sterilization is not available or feasible, HLD is the only acceptable alternative to sterilization for these items.*** HLD is also suitable for items that will come in contact with broken skin or intact mucous membranes.

The effectiveness of HLD depends on the amount and type of microorganisms, organic material (blood, other fluids, tissues), and other matter (such as dirt) present on the item and the amount of protection the item gives the microorganisms (such as whether the item has grooves or other areas in which microorganisms can hide). Therefore it is important to thoroughly clean instruments and other items before HLD:

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

There are two methods of HLD: boiling and chemical HLD. You should have more than one method of sterilization or HLD available to use as a backup for when your equipment breaks down, supplies run low, or electricity is unavailable. Many facilities use a method of HLD as a backup to their primary method of sterilization.

1. HLD by boiling

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, the water is heated to boiling, and the items are left to boil for 20 minutes.

To Minimize Lime Deposits

Note: A white, scaly deposit may be left on items that have been boiled frequently and on the pot or boiler itself. These are lime deposits caused by lime salts in the water. To minimize lime deposits:

- Add some vinegar to the water to remove deposits on the items or the inside of the boiler.
- Boil the water for 10 minutes to precipitate the lime (to make it come out of the water and settle on the bottom or sides of the boiler instead of on the items to be boiled) before the items are added.
- Use the same water throughout the day, adding only enough to keep the items below the surface.
- Drain and clean out the boiler at the end of each day.

Steps of HLD by Boiling

Step 1
Decontaminate and clean all instruments and other items to be high-level disinfected.

Step 2
Open all hinged instruments and other items and disassemble those with sliding or multiple parts. Place any bowls and containers upright, not upside down, and fill with water. Because water must touch all surfaces for HLD to be achieved, completely submerge all instruments and other items in the water in the pot or boiler.

Step 3
Cover the pot or close the lid on the boiler and bring the water to a gentle, rolling boil.

Step 4
When the water comes to a rolling boil, start timing for 20 minutes. Use a timer or make sure to record the time that boiling begins. From this point on, do not add or remove any additional water, instruments, or other items.

Step 5
Lower the heat to keep the water at a gentle, rolling boil; too vigorous a boil will cause the water to evaporate and may damage the instruments and other items if they bounce around the container and hit the sidewalls and other instruments or items. The lower heat also saves fuel/electricity.

Step 6
After 20 minutes, remove the instruments and other items using dry, high-level disinfected pickups (lifters, cheatle forceps). Place the instruments and other items on a high-level disinfected tray or in a high-level disinfected container, away from insects and dust and in a low-traffic area. Allow to air-dry before use or storage. Never leave boiled instruments and other items in water that has stopped boiling; they can become contaminated as the water cools down.

Step 7
Use instruments and other items immediately or keep in a covered, dry, high-level disinfected container and use within one week.

☛ Tips for HLD by Boiling:

- Items must be completely covered with water. Open all hinged instruments and disassemble items with sliding or multiple parts.
- Always boil for 20 minutes. Start timing when the water reaches a rolling boil.
- Do not add or remove anything once boiling begins.

2. Chemical HLD

HLD performed with the use of a disinfectant liquid is called chemical HLD. Chemical HLD is used for heat-sensitive items, like endoscopes, or when a heat source is not available. Chemical HLD is different from chemical sterilization because:

- Either glutaraldehyde or chlorine may be used for HLD. (Chlorine cannot be used for sterilization.)
- The soaking time is shorter for HLD.
- HLD items may be rinsed with boiled water. (Sterilized items must be rinsed with *sterile* water.)

About Disinfectants

Disinfectants are used to kill microorganisms on inanimate objects; they should not be used on skin or mucous membranes. Disinfectants are used in three ways:

- **During decontamination**: A disinfectant is used as the solution for decontamination.
- **During chemical HLD and sterilization**: Certain disinfectants can be used to sterilize or high-level disinfect instruments and other items.
- **During housekeeping**: Disinfectants are used to make the disinfectant cleaning solution used to clean high-risk areas.

☛ Tips for Chemical HLD:

- Items must be completely covered with solution. Open all hinged instruments and disassemble items with sliding or multiple parts.
- Soak for 20 minutes. If you forget to start timing, start at the point at which you remember.
- Do not add or remove anything once timing begins.
- Rinse items thoroughly with boiled water.

Steps of HLD Using Chemicals

Step 1
Decontaminate, clean, and thoroughly dry items. (Water from wet items dilutes the chemical solution, reducing its effectiveness.)

Step 2
When using glutaraldehyde: Prepare the solution as per the manufacturer's instructions or use a prepared solution, so long as it is clear (not cloudy) and has not expired. (Most glutaraldehyde solutions can be used for at least two weeks; follow the manufacturer's instructions. Ideally, use an indicator strip to determine whether the solution is effective.) After preparing the solution, put it in a clean container with a lid. Mark the container with the date the solution was prepared and the date it expires.

When using a chlorine solution: Follow the instructions on pages 39–40 for preparing a 0.5% chlorine solution. If you have problems with corrosion of instruments or other metal items, use a 0.1% chlorine solution prepared with *boiled* water. Filter the water before boiling if it is cloudy. To prepare a 0.1% chlorine solution, follow the instructions on pages 39–40, but substituting 0.1% for 0.5% in the formula you use. Fresh solution should be made each day (or sooner, if the solution becomes dirty). Put the solution in a clean container with a lid.

Step 3
Open all hinged instruments and disassemble those with sliding or multiple parts (the solution must contact all surfaces in order for HLD to be achieved). Completely submerge all items so that all parts are under the surface. Place bowls and containers upright, not upside down, and fill with the solution.

Step 4
Cover the container, and allow the items to soak for 20 minutes. Do not add or remove items once timing has begun.

Step 5
Remove the items from the solution using dry, HLD pickups (lifters, cheatle forceps).

Step 6
Rinse thoroughly with boiled water to remove chemical residue, which is toxic to skin and tissues.

Step 7
Place the items on an HLD tray or in an HLD container and allow to air-dry before use or storage. Use items immediately or keep in a covered, dry, HLD container and use within one week.

Properties of Common Disinfectants

High-Level Disinfectants

In most settings, the only chemicals appropriate for HLD are chlorine, glutaraldehyde, and *Ortho*-phthalaldehyde (OPA). High-level disinfectants are used for instrument processing. Some (such as glutaraldehyde) are chemical sterilants and, given sufficient time, will destroy bacterial endospores.

Chlorine—available in liquid (sodium hypochlorite), powder (calcium hypochlorite or chlorinated lime), and tablet (sodium dichloroisocyanurate) form.

- **Uses:** Disinfection during housekeeping, decontamination (by soaking for 10 minutes), and HLD (by soaking for 20 minutes). (*Note*: Should not be used on endoscopic equipment.)
- **Rinsing:** Because chlorine leaves a residue, items should be rinsed thoroughly with boiled water after HLD.
- **Warnings:** Chlorine can be corrosive to metals with prolonged contact and can be irritating to the skin, eyes, and respiratory tract.
- A new solution should be prepared daily (or whenever it becomes heavily contaminated).

Glutaraldehyde—available as Cidex and Cidex Plus

- **Uses:** Commonly used for processing equipment, such as endoscopes, that cannot be sterilized or high-level disinfected with heat; can be used for HLD (by soaking for 20 minutes) and sterilization (by soaking for 10 hours*).
- **Rinsing:** Because glutaraldehyde leaves a residue, items should be rinsed thoroughly with boiled water after HLD and with sterile water after sterilization.
- **Warnings:** Glutaraldehyde can be irritating to the skin, eyes, and respiratory tract. When using it, wear gloves, limit your exposure time, and keep the area well-ventilated (see page 52 for more details).

OPA—available as Cidex OPA and Metricide OPA

- **Characteristics:** Does not need to be activated, has a barely perceptible odor, and is not irritating to mucous membranes. OPA products tend to be more expensive than those containing glutaraldehyde.
- **Uses:** Has shorter soaking times than glutaraldehyde, but cannot be used for sterilization. Soaking times vary (ranging from five to 12 minutes) for OPA-containing solutions made in different regions, so always follow the manufacturer's instructions.

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* *Note*: Times apply to use of Cidex only; times for sterilization with other products may vary. Follow the manufacturer's instructions.

- **Rinsing:** Thorough rinsing of items is necessary after they have soaked in OPA.
- **Warnings:** OPA will cause eye irritation with direct contact and stains skin and mucous membranes a gray color, so gloves and goggles should be worn when handling it.

Do <u>not</u> use the following for HLD:

- Hydrogen peroxide (6%), which has not been as well studied as other disinfectants.
- Formaldehyde, which is potentially cancer causing and extremely irritating to the skin, eyes, and respiratory tract.
- Alcohol (60–90% ethyl or isopropyl), which does not kill all viruses.
- Sporicidin, which is a glutaraldehyde-based product that has been shown to be ineffective.
- Carbolic acid (e.g., Lysol, Phenol), which is a low-level disinfectant.
- Chlorhexidine gluconate with cetrimide (e.g., Savlon), chlorhexidine gluconate (e.g., Hibitane, Hibiscrub), chloroxylenol (e.g., Dettol), or iodophors (e.g., Betadine), which are all antiseptics.

Low-Level Disinfectants

Low-level disinfectants are used for cleaning surfaces, such as floors and countertops. These should not be used for instrument processing. Some low-level disinfectants, such as phenols (carbolic acid—e.g., Phenol, Lysol) and quaternary ammonium compounds (such as benzalkonium chloride—e.g., Zephiran), are suitable for cleaning and disinfecting surfaces, but most of these products have few advantages over using a disinfectant cleaning solution made with chlorine and detergent (see page 39), which is less expensive and often more readily available.

- Hydrogen peroxide (3%) is suitable for disinfecting surfaces.
- Alcohol (60–90% ethyl or isopropyl) can be used to disinfect thermometers and stethoscopes, although they should not remain soaking in an alcohol solution.
- Carbolic acid (e.g., Phenol, Lysol) is suitable for disinfecting surfaces.

Step 4: Storage

Items should be used or properly stored immediately after processing so that they do not become contaminated. Proper storage is as important as proper decontamination, cleaning, and sterilization or HLD. If items are not stored properly, all the effort and supplies used to properly process them will have been wasted, and the items may be contaminated.

Specific instructions for proper storage depend on whether sterilization or HLD has been performed, the method used, and whether the items are wrapped or unwrapped. (In this booklet, any method-specific instructions for storage have been noted as the last step in the sterilization or HLD process.)

Note: No matter what method is used, do not store instruments or other items (such as scissors, canulae, and pickups) in solutions: always store them dry. Microorganisms can live and multiply in both antiseptic and disinfectant solutions, and items left soaking in contaminated solutions can lead to infections in clients. In addition, antiseptic solutions should *not* be used to process objects.

Remember: If an item comes in contact with persons, surfaces, dust particles, insects, or any item that is not sterile or HLD, the item must be considered 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 week after processing.

Storage of wrapped, sterile items

The length of time a wrapped, sterile item is considered sterile depends on whether or not a contaminating event occurs—not necessarily on how long the item has been stored. The shelf life of a wrapped item is affected by a number of factors, including:

- The type of packing material used
- The number of times the pack is handled
- The number of people who handle the pack
- The cleanliness, humidity, and temperature of the storage area
- Whether the packs are stored on open or closed shelves
- Whether dust covers (such as sealed plastic bags) are used

For optimal storage, place sterile packs in closed cabinets in areas that are not heavily trafficked, have moderate temperatures, and are dry or of low humidity. Under optimal storage conditions and with minimal handling, properly wrapped items can be considered sterile as long as they remain intact and dry.

Storage time and the handling of sterile packs should be kept to a minimum, since the likelihood of contamination increases over time and with increased handling. When in doubt about the sterility of a pack, consider it to be contaminated and resterilize the item before use.

Organizing an area for instrument processing

Remember, the objectives of processing are:

- To remove as many microorganisms as possible so that microorganisms are not transmitted to clients during clinical procedures
- To reduce the risk of infection to staff by eliminating harmful microorganisms on items that have been in contact with a client's fluids or tissues during clinical procedures

When processing items, activity patterns should be established so that soiled items never cross paths with clean, sterile, or HLD items.

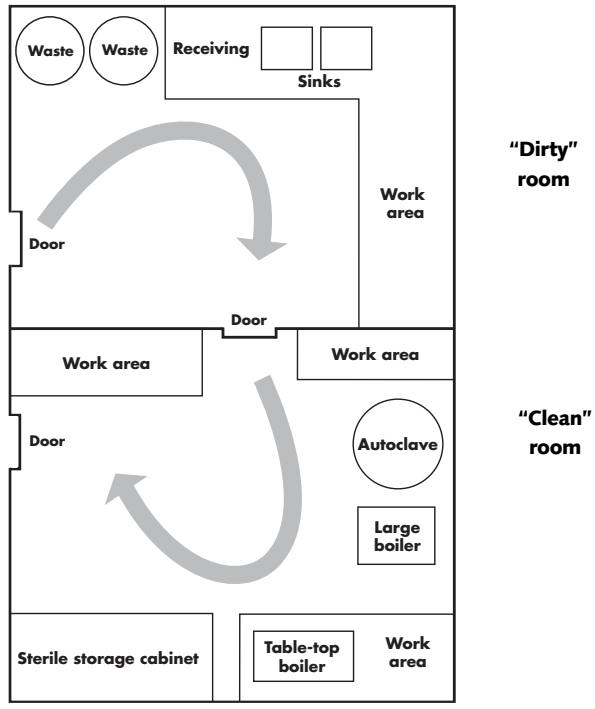
It is ideal to have separate rooms—one for receiving and cleaning items and another for sterilization, HLD, and storage. However, in many settings, this is not possible. When only one room is available for processing, it should be arranged so that activities and objects flow in an organized fashion from receiving to storage (see pages 64–65). It is necessary to have at least one sink in processing areas (though having two sinks is preferred), sufficient countertop space for receiving dirty items and for drying and packaging clean items, and storage space (preferably closed cabinets).

Avoid using cardboard boxes for storage, as they can harbor insects and shed dust and debris. Remove supplies from all shipping cartons and boxes before bringing them into an operating theater, procedure room, or clean work area.

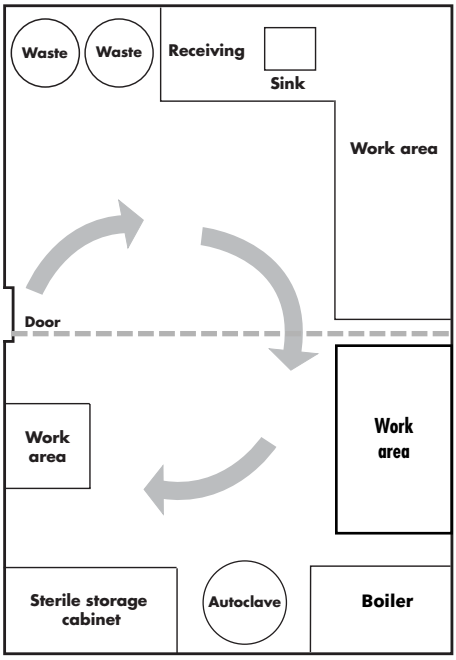
☛ Tips for Organizing a Processing Area:

- Educate staff about the need to keep clean and sterile/HLD items from coming into contact with soiled items.
- Designate and label processing areas, particularly when only one room is available.
- Enclose processing rooms to minimize dust and eliminate insects.
- If possible, ensure access to two sinks or basins with a clean water supply (one sink for cleaning, one for rinsing).
- 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.

Separate Rooms for Processing Instruments and Other Items



Single Room for Processing Instruments and Other Items



Housekeeping and Waste Disposal

The general cleanliness and hygiene of a facility are vital to the health and safety of staff, clients, visitors, and the community at large. Good housekeeping and waste disposal practices are the foundation of good infection prevention. Housekeeping and waste disposal staff are at a high risk of infection because they are exposed to blood, other body fluids, used sharps, and other contaminated objects as a routine part of their jobs. Facility management should develop and post cleaning schedules where all housekeeping staff can see them, and make sure that cleaning schedules are closely maintained.

General housekeeping guidelines

Although certain areas of the clinic require special housekeeping procedures, the following list applies to staff cleaning any part of the clinic:

- 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 microorganisms.
- Scrub during cleaning, as it is the most effective way to remove dirt and microorganisms.
- 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.
- Change cleaning solutions whenever they appear to be dirty. A solution is less likely to kill infectious microorganisms if it is heavily soiled.

Cleaning solutions

Three 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:

1. 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 for easy removal by scrubbing.

2. Disinfectant (0.5% chlorine solution)

Disinfectants rapidly kill or inactivate infectious microorganisms during the cleaning process. Disinfectants are used to clean up spills of blood or other body fluids.

3. Disinfectant cleaning solution

This solution, which contains a disinfectant, detergent, and water, is used for cleaning areas that may be contaminated with infectious materials (such as operating theaters, procedure rooms, latrines, and sluice rooms). The solution must contain both a disinfectant and a detergent. Disinfectants rapidly kill or inactivate infectious microorganisms during the cleaning process, while detergents remove dirt and organic material, which cannot be done by water or disinfectants alone.

In most settings, a 0.5% chlorine solution made from locally available bleach is the cheapest disinfectant, but alternatives include commercial disinfectants that contain 5% carbolic acid (such as Phenol or Lysol) or quaternary ammonium compounds. For information about how to make a 0.5% chlorine solution, see page 39.

Caution

Chlorine solutions should never be mixed with cleaning products that contain ammonia, ammonium chloride, or phosphoric acid. Combining these chemicals will result in the release of a chlorine gas, which can cause nausea, eye irritation, tearing, headache, and shortness of breath. These symptoms may last for several hours. If you are exposed to an unpleasantly strong odor following the mixing of a chlorine solution with a cleaning product, leave the room or area immediately until the fumes have cleared completely.

To make a disinfectant cleaning solution:

Prepare a 0.5% chlorine solution following the instructions on page 39 (or obtain any disinfectant that contains 5% carbolic acid, such as Phenol or Lysol, or quaternary ammonium compounds). Add some detergent and mix. Continue adding detergent until the solution is mildly sudsy.

Cleaning procedures for different clinic areas

Low-risk areas (waiting rooms, administrative areas)

These are the areas that are usually not contaminated with infectious microorganisms, and the risk of infection is minimal. Routine cleaning—the kind of cleaning you would do in your home—is usually good enough for these areas. In general, clean these areas once a week (or whenever they appear to be dirty) with a cloth or mop dampened with detergent and water. Vacuum carpeted areas once a week and shampoo as needed. In unusual circumstances in which contamination occurs in these areas, use the appropriate practices described on page 68.

Toilets, latrines, and sluice rooms

These areas are usually heavily contaminated and should be cleaned daily—or more often if traffic in your facility is high. Use different supplies to clean these areas than the supplies you use for cleaning client-care areas.

Cleaning Schedule: Toilets, Latrines, and Sluice Rooms

Task	Schedule
Clean walls	Wipe with a disinfectant cleaning solution each day (or more often, if necessary).
Clean counters and other surfaces	Wipe with a cloth saturated with a disinfectant cleaning solution each day (or more often, if necessary).
Clean floors	Use a mop and a disinfectant cleaning solution each day (or more often, if necessary).
Clean sinks and toilets/latrines	Scrub with a disinfectant cleaning solution and rinse with clean water each day (or more often, if necessary).
Empty waste containers	Each day (or more often, if necessary)
Clean waste containers	Scrub to remove soil or organic material with a disinfectant cleaning solution each day (or more often, if necessary).
Clean ceilings	Wipe with a disinfectant cleaning solution each week (or more often, if necessary).

Client-care areas (operating theaters, procedure rooms, laboratories, areas where instruments are cleaned and processed)

These areas must be cleaned with special care using a disinfectant cleaning solution. In these areas, there is a greater potential for contamination with infectious materials and more of a concern about potential infection transmission to both clients and clinic staff.

Cleaning Schedule: Client-Care Areas

At the beginning of each day	Clean horizontal surfaces—operating/procedure tables, examination couches, chairs, trolley tops or Mayo stands, lamps, counters, and office furniture—with a cloth dampened with water, and clean floors with a mop dampened with water to remove dust and lint that have accumulated overnight.
Between clients	• Clean operating/procedure tables, examination couches, trolley tops or Mayo stands, counters, lamps, and any other potentially contaminated surfaces in operating theaters and procedure rooms with a cloth dampened with a disinfectant cleaning solution. Alternatively, spray the solution onto the surfaces, using a spray bottle, and wipe with a cloth dampened with water. • Clean spills of blood or other body fluids with a 0.5% chlorine solution immediately. • Clean visibly soiled areas of the floor, walls, or ceiling with a mop or cloth dampened with a disinfectant cleaning solution. • Put waste in a leakproof container, and empty the container when it is three-quarters full.
At the end of each clinic session or day	• Wipe down all surfaces—including counters, tables, sinks, lights, door handles/plates, and walls—with a cloth dampened with a disinfectant cleaning solution, or spray the solution onto the surfaces using a spray bottle and wipe them down. Remember to wipe from top to bottom. Pay particular attention to operating/procedure tables, making sure to clean the sides, base, and legs thoroughly. Rinse sinks with clean water after cleaning. • Clean the floors with a mop soaked in a disinfectant cleaning solution. • Check sharps-disposal containers and remove and replace them if they are three-quarters full. • Remove medical or hazardous chemical waste, making sure to burn or bury it as soon as possible to limit contact with potentially infectious waste. (This is covered in detail on pages 75–78.) • Wash waste containers with a disinfectant cleaning solution and rinse with water.
Each week	• Clean ceilings with a mop dampened with a disinfectant cleaning solution.

Cleaning up spills

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

When cleaning up spills:

- Always wear gloves.
- If the spill is small, wipe it with a cloth that has been saturated with a disinfectant (0.5% chlorine) solution.
- If the spill is large, cover (flood) the area with a disinfectant (0.5% chlorine) solution, mop up the solution, and then clean the area with a disinfectant cleaning solution.
- Do not simply place a cloth over the spill for cleaning up later; someone could easily slip and fall on it and be injured.

Remember

Contaminated equipment spreads, rather than reduces, microorganisms in the environment. Supplies and equipment used for cleaning also need to be cleaned. Equipment (such as mops, buckets, and cloths) should be decontaminated with a disinfectant (0.5% chlorine) solution, cleaned in detergent and water, rinsed in clean water, and dried before reuse.

Ineffective practices

Two housekeeping practices—fumigation and the use of ultraviolet (UV) light—are common in many health facilities, particularly in some parts of the developing world, but should be eliminated. These practices are time-consuming, waste valuable resources, and do not decrease the risk of infection in your facility.

1. Fumigation (also called "disinfectant fogging")

Fumigation with formalin, formaldehyde, or paraformaldehyde is an ineffective method of reducing the risk of infection. It is a perfect example of a practice that is not based on scientific findings.

Besides being ineffective, these agents are toxic and irritating to the eyes and mucous membranes. Fumigation is time-consuming and makes rooms unavailable for use, often leading to disruption of services or unnecessary inconvenience to clients and staff. Thorough cleaning with a disinfectant cleaning solution and scrubbing should be used instead of fumigation.

If you have a problem with insects, rodents, or other pests, follow the manufacturer's instructions for fumigation with insecticides or pesticides, to control the problem.

2. Ultraviolet (UV) light

In general, this is neither practical nor cost-effective. In the largest and best-designed scientific study on this topic, no decrease was shown in the surgical-site infection rate when UV light was used. Although UV light does have some uses in specialized sites (such as tissue culture laboratories), UV light is unsatisfactory for general use in health care facilities because:

- The killing ability of UV light decreases sharply: 1) if relative humidity is greater than 60–70%; 2) if dust is present (in the air, on surfaces, or on the bulb itself); and 3) with increasing distance from the lamp.
- UV light does not penetrate most substances (including fluids and organic matter, such as mucus) and will therefore kill only microorganisms directly on the surface that are exposed to the UV light.
- The intensity of UV light needed to effectively kill microorganisms is damaging to humans. Prolonged exposure can lead to eye or skin irritation.
- UV lighting fixtures are expensive to install and maintain. Regular servicing, including removing dust from the bulbs, is required.

Remember

Cleaning by scrubbing with a disinfectant cleaning solution is the most efficient and cost-effective way to clean potentially contaminated areas in your facility.

Handling and disposal of waste from health care facilities

All staff have a responsibility to dispose of waste in a manner that poses minimal hazard to clients, visitors, other health care workers, and the community. Anyone who handles infectious 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.

Proper disposal:

- Minimizes the spread of infections and reduces the risk of accidental injury to staff, clients, visitors, and the local community
- Helps provide an aesthetically pleasing atmosphere
- Reduces odors
- Attracts fewer insects and animals
- Reduces the likelihood of contamination of the soil or ground water with chemicals or microorganisms

A large percentage of staff (including nurses, midwives, nursing aides, and cleaning and maintenance staff) report having experienced waste-related injuries and infections. Sharps pose the greatest risk and can cause injury and transmission of serious infections, including HIV and hepatitis B. If possible, all staff at risk of waste-related injury should be vaccinated against hepatitis B.

Improper disposal of waste is also one of the greatest threats to members of the community. In many low-resource settings, scavenging of medical waste is a significant problem. Not only are scavengers at risk of injury and infection themselves, but this practice can also put others at risk when scavenged waste, such as syringes and needles, is reused.

The four kinds of waste

There are four kinds of waste that are generally found in health facilities: sharps; nonsharps infectious waste; nonsharps noninfectious waste; and hazardous waste.

Waste should be sorted (i.e., separated) by type at the point of generation, so that each type can be properly handled. This reduces costs and the risk of infection among those handling waste and the community at large. In the average health care facility, the majority of waste is noninfectious. If a facility does not sort waste, then all waste must be considered infectious and handled as such. This increases costs and makes proper waste disposal more difficult, as the *total volume of waste* must be burned or buried on-site or transported to a designated facility, instead of just the sharps and nonsharps infectious waste.

1 Sharps

Sharps (used or unused) include hypodermic and suture needles, scalpel blades, blood tubes, pipettes, and other glass items (such as glass slides and coverslips).

2 Nonsharps infectious waste

Nonsharps infectious waste consists of material generated in the diagnosis, treatment, or immunization of clients, including blood, blood products, and other body fluids, as well as materials containing fresh or dried blood or body fluids, such as bandages and surgical sponges, exam and surgical gloves, human tissue, and body parts.

3 Nonsharps noninfectious waste (general waste)

This is nonhazardous waste that poses no risk of injury or infection. It is similar in nature to household trash. Examples include paper, boxes, packaging materials, bottles, plastic containers, and food-related trash.

4 Hazardous waste

Hazardous waste consists of materials that are potentially toxic or poisonous, including cleaning products, disinfectants, expired drugs, laboratory reagents, cytotoxic drugs, and radioactive compounds.

Note: Although hazardous waste poses dangers, the focus of this booklet is on the disposal of sharps and potentially infectious medical waste.

Disposal of cytotoxic drugs and radioactive waste requires special consideration outside the scope of this booklet: if your facility uses these materials, consult local experts for guidance on appropriate handling and disposal.

Creating a waste-management plan

Every health facility—whether a large hospital, a doctor's office, or a small health post—should develop a written waste-management plan and should designate a staff member to coordinate the management of waste. The plan should clearly assign staff responsibilities that cover all of the steps needed for appropriate waste management.

There are four components to waste management:

1. **Sorting**: Separating waste by type at the place where it is generated
2. **Handling**: Collecting and transporting waste within the facility
3. **Interim storage**: Storing waste within the facility until it can be disposed of
4. **Final disposal**: Eliminating infectious waste, sharps, and hazardous chemical waste from the health facility

1. Sorting

Sharps and infectious or hazardous waste represent only a small percentage of the waste generated by a health care facility that must be handled specially 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 leads to large amounts of trash 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:

Sharps, nonsharps infectious waste, and nonsharps noninfectious waste should be put into the appropriate waste containers. To help the staff use containers correctly:

- Always keep separate containers in convenient places throughout the facility.
- Use colored plastic containers, painted drums, or easily readable labels to help distinguish between types of waste. For example, paint the containers used for nonsharps infectious waste yellow or red, or use yellow or red plastic bags, if available.
- Place sharps containers in convenient places so that staff do not have to walk across the room (or farther) carrying used sharps.

Sorting sharps

Needles and other sharps pose the greatest risk of injury, and regardless of whether they are contaminated, they should be disposed of in special sharps containers, such as heavy cardboard boxes, tin cans with lids, or plastic bottles. (For more information on the proper handling of sharps, see pages 33–34.)

2. 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. Wear appropriate protective clothing (e.g., a surgical mask, heavy utility gloves, a rubber/plastic apron, and boots), depending on the type of volume of waste being handled.

☛ Tips for Handling Waste:

- Handle waste as little as possible.
- Remove waste from operating theaters, procedure rooms, and sluice rooms while the containers are still partially empty—or at least once a day.
- Never put your hands into a container that holds medical waste.
- Do not collect infectious waste from client-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, clients, and visitors.

Emptying waste containers

Waste containers that are too full also present opportunities for accidents. Waste should be removed from operating theaters, 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 three-quarters full. (When sharps-disposal containers become too full, people may push sharps into the container, causing injury.)

3. Interim storage

If possible, final disposal of nonsharps infectious waste should take place immediately, but it is often more practical to store waste briefly in your facility before final disposal. Interim storage should be short-term—usually waste should be stored only for a few hours before disposal. Nonsharps infectious waste should never be stored in your facility for more than one or two days. During warmer times of year, do not stores such waste for more than 24 hours.

If it is necessary to store sharps and infectious waste on-site before final disposal: place waste in labeled, covered, leak-proof containers kept in a closed area that is minimally accessible to staff, clients, and visitors. As few people as possible should come into contact with stored medical waste.

Remember

Infectious waste and sharps pose serious health threats to the community. Never store such waste in open containers, and never throw waste into an open pile. All containers should have lids to prevent exposure to waste, spillage, or access by insects, rodents, and other animals.

4. Final disposal

Nonsharps noninfectious waste—like household trash—can be taken to the regular community waste-disposal point for final collection and disposal. This section discusses the final disposal of:

- Nonsharps infectious waste
- Liquid medical waste
- Sharps (whether contaminated or not)

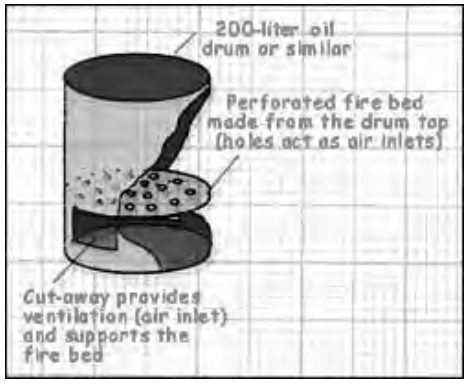
Nonsharps infectious waste

Always wear heavy utility gloves and shoes when handling or transporting medical waste of any kind. Solid nonsharps infectious waste should be disposed of on the premises if at all possible; this allows staff who understand the risks involved to supervise the disposal process. There are three options: burning, burying, and transporting to an off-site disposal site.

Burning. Burning is the best option, since high temperatures destroy microorganisms and reduce the amount of waste. Burning in an industrial incinerator is preferred, but if one is not available, a drum or brick incinerator can be used.

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 infectious waste. If your facility is large, it is more efficient to build or install an incinerator large enough to accommodate all of your facility's waste-disposal needs.



When using your drum incinerator:

- Choose a place that is downwind from the clinic to prevent smoke and odors from coming into the clinic.
- Make sure there are sufficient air inlets on the side of the 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 infectious waste. Use a regular community disposal site for nonsharps noninfectious waste. This will conserve both time and resources.
- Treat the ash as general waste. Bury or otherwise dispose of it in a designated area.

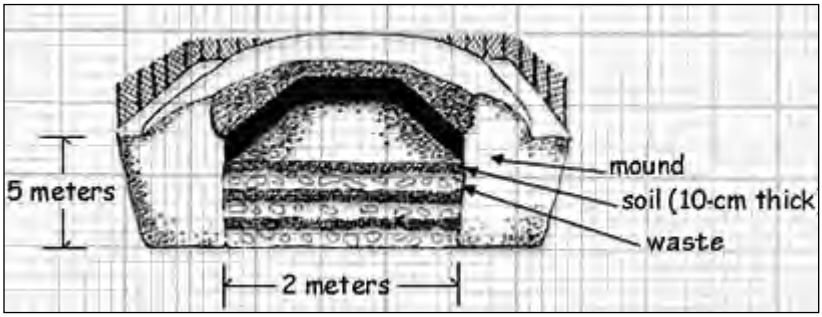
Follow similar guidelines when using a brick incinerator (which can be built by constructing an enclosed space with brick or concrete walls).

Some waste from health care facilities may not burn easily, especially if it is wet. Add kerosene to make the fire hot enough to burn all waste. Be sure to add the kerosene *before* starting the fire—adding kerosene after the fire has started might cause an explosion.

Burying. On-site burial is the next best option. To use burial, you must have space for a pit big enough for all the infectious waste (sharps and nonsharps) generated at the site. Line the pit with plastic, clay, or concrete, to prevent seepage. In addition, surround the pit with a fence or wall, and locate the pit within view of the facility to limit access to it and to prevent accidents and scavenging of waste.

Building and using a waste-burial pit.

- Choose an appropriate site that is at least 50 meters away from any water source to prevent contamination of the water source. The site should have proper drainage, be located downhill from any wells, be free of standing water, and be in an area that does not flood. The site should not be located on land that will be used for agriculture or development.



- Dig a pit 1 to 2 meters wide and 2 to 5 meters deep. The bottom of the pit should be 2 meters above the water table. Consult your local water engineer/water authority for information about the location of the water table.
- Fence in the area to keep out animals, scavengers, and children.
- Keep waste covered. Every time waste is added to the pit, cover it with a 10 to 30 cm layer of soil.
- Seal the pit. When the level of waste reaches to within 30 to 50 cm of the surface of the ground, fill the pit with dirt, seal it with concrete, and dig another pit.

Transporting. If neither burning nor burial on-site is possible, the waste must be transported for off-site disposal. If waste will be handled during transport by nonfacility staff (such as municipal trash removers), they must be educated about the cautions and risks regarding medical waste. Transport to an incinerator or designated burial site is suitable. Transport to an open community dump should be avoided. Open dumps increase the community's risk of exposure to infectious microorganisms because: 1) they facilitate the spread of infections by flies, rodents, and other animals that come in contact with waste; 2) people may easily come in contact with waste in open dump sites—for example, local children may play near the dump site; and 3) they encourage scavenging.

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, on others, or on the floor and other surfaces. Handle cleaning solutions and disinfectants such as glutaraldehyde in the same way as liquid medical waste:

- 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.
- Before pouring liquid waste down a sink, 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.
- Rinse the sink, drain, or toilet thoroughly with water to remove residual waste—again avoid splashing. Clean these areas with a disinfectant cleaning solution at the end of each day, or more frequently if heavily used or soiled.
- Decontaminate the container that held the liquid waste by filling it with or soaking it for 10 minutes in a 0.5% chlorine solution before washing.
- Wash your gloved hands after handling liquid waste before removing the gloves.

Sharps

Needlesticks and punctures involving sharps are the number-one cause of waste-related accidents for staff in health facilities. To reduce the risk of needlesticks, do not recap, bend, cut, or break needles or try to remove the needles from the syringe before disposal.

Although burning is the best way to dispose of medical waste, sharps are not destroyed by burning, except in large industrial incinerators. If an industrial incinerator is not available, sharps should be disposed of in a sharps pit (a metal drum buried in the earth or a concrete-lined pit). Sharps can be rendered harmless by placing needles, plastic syringes, and scalpel blades in a metal container and then, when the container is three-quarters full, pouring in fuel and igniting and burning it until the fire goes out on its own. When this is done, the plastic syringes will melt and, when cool, become a solid block of plastic, with the sharps embedded within the block. The block can then be buried in the type of burial pit used for nonsharps infectious waste. If it is not possible to bury all infectious waste on-site, sharps should be given priority for burial, since they pose the biggest risk of injury and infections.

Implementing and Managing an Infection Prevention Program

Success in implementing and maintaining appropriate infection prevention practices at a health care facility or other service setting requires knowledge of proper infection prevention practices, written plans and protocols, creativity, effective management skills, and contributions from all staff. When resources are limited, it is important to have an organized supply system, to ensure an adequate and reliable stock of essential materials and equipment.

Gaining support for infection prevention

To improve infection prevention practices at your facility or setting, you must first identify and bring together the key individuals who can help plan, implement, and support the recommended changes. The types of individuals will vary, depending on the size and type of facility or service setting; they may include administrators, service providers, central supply staff, housekeeping staff, laboratory technicians, and /or infection control committee members. In addition, if there is a community board, a representative of that board should be part of the group, to represent the clients' perspectives and to communicate the group's goals to the community.

Including all of these types of individuals is important for several reasons:

- Administrative support is crucial to improving infection prevention practices.
- Decisions about infection prevention practices reflect the consideration of a variety of factors, including available equipment, personnel, administrative support, and budget.
- People often resist change—even when it is desired—and this resistance can be a difficult barrier to overcome. Including all levels of staff will help staff feel invested in the process and more open to accepting change.

Once the group of key personnel is in place, they should receive a brief overview of the importance of good infection prevention and of the need to improve infection prevention practices. They should be informed about the process that might be undertaken to initiate and maintain improved infection prevention practices.

It is useful to have a written infection prevention plan that clearly defines roles and responsibilities for the actual infection prevention practices, for oversight to ensure appropriate practices are adhered to, and for assurance of the availability of needed supplies and equipment. It is also important to have written protocols that clearly outline how staff should carry out the various practices (e.g., hand washing, sterilization of instruments, client preparation for surgery, etc.). Protocols can be developed using the technical content in this booklet, taking into account the infection prevention practices that are necessary and practical, given the types of services provided and the location and resources available.

Assessing the current status of infection prevention practices

Before implementing a plan to improve infection prevention practices, you must carefully assess the practices currently being performed. This initial assessment will serve not only to identify areas for improvement, but also to supply baseline information against which to compare findings from subsequent assessments, so that you can evaluate the success of your efforts. As part of the assessment, review plans and protocols for infection prevention to see whether they are consistent with what is presented in this booklet. If not, they will need to be updated or developed (if your facility or service setting does not have one or both of them).

A good way to assess infection prevention practices is to observe staff in their daily work and compare their activities with infection prevention "standards," or ideal ways in which the practices should be performed, as have been described in this booklet. An Infection Prevention Assessment Survey is found in the Appendix (pages 90–93). To get a broad picture of infection prevention practices, it may be useful to observe different staff performing these practices at different times. If direct observation is not possible, you may be able to determine whether infection prevention practices are being performed properly by talking with staff and by touring the facility or observing service provision.

In assessing infection prevention practices, you will likely find that some practices were performed properly, some need to be improved, and still others need to be newly instituted. Protocol and practices that are consistent with those presented in this booklet should be reinforced; protocols and practices that are outdated, not practiced, or practiced improperly should be targeted for change.

Designing a plan to improve infection prevention practices

Identifying why the standards were not met

To select appropriate interventions for improving infection prevention practices, you must first determine the reasons why practices were performed improperly; this is critical to ensuring that the proposed intervention will actually address the cause of the problem. For example, if staff already know about the need to decontaminate used instruments and other items but do not have access to chlorine, arranging for training on decontamination will not improve their performance.

To identify the cause of problems that prevented a standard from being achieved, repeatedly ask "Why?" until the cause is determined. For example:

- Why are instruments and other items not being decontaminated immediately after use? Because there is no bucket with decontamination solution in the operating theater.
- Why? Because the cleaner does not make any solution.

- Why? Because there is no liquid or powdered bleach to use to make the solution.
- This is the cause of the problem.

Often, adequate infection prevention practices are not implemented because of one or more of the following reasons:
- Misunderstanding of the risk involved
- Lack of knowledge of appropriate practices
- Resistance to changing old habits
- Having inadequate supplies, equipment, and space for performing the appropriate practices

Prioritizing practices that need improvement

Implementing adequate infection prevention practices may be extremely difficult in resource-poor settings. Therefore, staff should prioritize those areas that are immediately most critical or can be most easily and quickly improved. Once these priority practices have been improved, staff can move on to the next set of practices needing the most immediate attention and can develop plans for achieving them, and so on, until all of the standards have been achieved.

In prioritizing what practices to improve, it is important to determine what problems are standing in the way. Problems that are within the power of management and staff to solve are likely to be easier to address and should be considered priorities. Those whose solution requires the intervention of a higher level of management, such as district, regional, or headquarters-level administrators, are likely to be more difficult to deal with and may be frustrating for administrators and staff. In such cases, the administrator can act as a liaison between the staff and higher-level management to help facilitate staff access to resources and communication of the problem to higher-level managers.

When prioritizing practices to address, consider the following:
- Are resources needed to improve infection prevention practices? If so, are they currently available, or is it possible to obtain them?
- If funds are required, will there be allowances in the budget?
- Do the current inappropriate practices affect most or many of the serviced provided?
- Will addressing these practice improve the quality of the service currently provided?
- Can improvements be made within the next six months?

Overcoming barriers to implementation

After identifying the reasons why appropriate infection prevention practices are not in place, you and the staff can develop a plan to overcome them. It is preferable to involve local staff—rather than district, regional, or national-level administrators—in this, because they are the ones who will be implementing the neces-

sary changes and understand which practices may or may not be possible or feasible to achieve on a daily basis. If it is necessary to involve higher-level administrators, the administrator can act as a liaison between local staff and higher-level administrators. Issues to consider include:

- A plan and protocols may need to be written or updated.
- Staff will need training if they misunderstand the risks involved in their work or lack knowledge of appropriate practices.
- Job descriptions should clearly state all staff members' roles and responsibilities.
- Staff should understand why they are asked to do something in a certain way, as they will be more likely to follow procedures when there is a good reason for doing them in a particular way and when they know what that reason is. In addition, this allows staff to apply procedures no matter what specific clinical care is being provided and to safely modify precautions based on the setting and situation. This is especially important in resource-poor settings, where supplies and equipment may be unavailable or stock-outs are frequent.
- All staff should have access to reference materials to consult when necessary. Special attention should be given to staff who are low-literate/illiterate and may need additional help in understanding the appropriate practices.
- Locally available resources should be identified, and staff should determine how to best use them in the face of limited funds, to ensure that the necessary supplies are available.
- It needs to be determined whether supplies are being used in ways that are most appropriate and cost-effective and, if not, how the money spent on them could be better used.

Implementing the necessary changes

Although supplies and equipment are necessary for performing infection prevention practices, the people make more of a difference than the materials. Well-trained, interested, and motivated staff—even those with limited supplies and equipment—are more likely to perform appropriate infection prevention practices than are poorly trained, unmotivated staff who work in a setting that has all the latest and most expensive equipment and supplies.

Likewise, administrative support is critical to motivating staff and ensuring that new practices continue to be performed. To show their commitment to and support for infection prevention, senior-level staff and supervisors should:

- Ensure that policies and procedures are in place
- Follow appropriate practices themselves
- Support others in their efforts to perform their duties in a safe manner, by emphasizing the importance of good infection prevention, the critical role that each staff member plays, and the rationale for performing the various procedures

- Help ensure that adequate resources (financial and human) and supplies are available
- Supervise staff in a manner that provides support, encouragement, and assistance

As you and the staff attempt to improve infection prevention practices, keep in mind the following:

- Change is a process, not an event that happens all at once.
- Do not try to change everything at once.
- Take small steps forward, and do not get discouraged if there are a few small steps backward.
- Help people work through and adjust to new practices.
- Do not give up.
- Start with yourself—do not expect other to do things you do not do yourself.

Monitoring and evaluating infection prevention practices

Once infection prevention practices have been implemented, they must be monitored and evaluated regularly to determine whether staff are continuing to perform them properly and to measure the overall success of staff efforts to improve practices. Monitoring and evaluation may take several forms.

Staff practices can be informally monitored on an ongoing basis through observation as they perform their daily routines. Staff can also provide informal monitoring by giving reminders and encouragement to their co-workers.

If training was provided, a follow-up evaluation should be scheduled to see how well the participants are using the new skills, to identify performance gaps that may still exist, and to plan for additional training or on-the-job reinforcement, if needed.

More formal approaches include an annual assessment by administrators using a survey tool (e.g., the Infection Prevention Assessment Survey, pages 90–93), preferably using the same tool that served as the basis for the plan to improve infection prevention. That way, it is easy to compare results with those of previous assessments.

To continue involving staff in efforts to improve infection prevention, it is useful to share with them the results of the previous and current assessments, so they can see what has changed. The staff can then discuss why they think certain practices improved, worsened, or are still not being implemented correctly, and they can problem-solve to find ways to change practices identified as needing improvement.

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Appendix: Infection Prevention Assessment Survey

For each of the standards listed below, check YES or NO, as appropriate, to indicate whether the standard was achieved. (If a particular standard is not applicable to the facility at which the survey is being conducted, check N/A.)

Use the Comments space after the standard to note details about why a standard has not been achieved or to note other information that may be useful in identifying or resolving inappropriate practices.

Hand Hygiene	**YES**	**NO**	**N/A**	**Comments**
1. Hands are cleansed when indicated.				
2. Alcohol-based handrubs are used for hand hygiene.				
3. Hands are washed with soap and running water when visibly soiled.				
4. Plans are made and supplies are available for times when running water is not available.				
Use of Gloves	**YES**	**NO**	**N/A**	**Comments**
5. Gloves are worn whenever contact with blood or other body fluids is anticipated.				
6. Utility gloves are worn when handling contaminated instruments and other items, handling medical or hazardous chemical waste and linens, performing housekeeping activities, and cleaning contaminated surfaces.				
Antiseptics and Disinfectants	**YES**	**NO**	**N/A**	**Comments**
7. Antiseptics are used only on the skin and mucous membranes.				
8. Disinfectants are used only for processing instruments and other items for reuse and for housekeeping activities.				
9. Antiseptics and disinfectants are handled in a manner that reduces the risk of contamination.				

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Aseptic Technique	**YES**	**NO**	**N/A**	**Comments**
10. Surgical hand preparation is performed before all surgical procedures.				
11. Sterile gloves are put on and removed in ways that do not contaminate the gloves or allow the wearer to touch the contaminated outside part of the gloves.				
12. The surgical site is not shaved routinely, only when absolutely necessary.				
13. The surgical/procedure site is prepared properly using an appropriate antiseptic solution.				
14. A sterile field is established and maintained during all surgical/clinical procedures.				
15. Traffic and activities are controlled and appropriate attire is worn in surgical/procedure areas.				
Use of and Disposal of Sharps	**YES**	**NO**	**N/A**	**Comments**
16. Hypodermic needles are not routinely recapped and are never bent or broken before disposal. Needles are not removed from syringes before disposal.				
17. Sharps are disposed of in puncture-resistant containers.				
18. Sharps containers are available wherever sharps are used. Containers are disposed of when they are three-quarters full.				
19. Unprotected sharp items are not passed directly from one person to another during surgical/clinical procedures.				
20. A new needle and syringe are used every time an injection is given or medication is withdrawn from a multidose vial.				
Processing Instruments and Other Items	**YES**	**NO**	**N/A**	**Comments**
21. "Clean" and "dirty" processing activities are performed in separate areas. When only one room is available for processing instruments and other items, it is arranged so that activities and objects flow in an organized fashion, from receiving used items to storing sterilized or high-level disinfected items.				
22. Instruments and other items are stored dry and are never left soaking indefinitely in solutions.				
23. Soiled linen is handled wearing utility gloves in a way that prevents exposure of the skin and mucous membranes to potentially contaminated material.				

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Decontamination	**YES**	**NO**	**N/A**	**Comments**
24. Instruments and other items are decontaminated by placing them in a 0.5% chlorine solution immediately after use and letting them soak for 10 minutes.				
Cleaning	**YES**	**NO**	**N/A**	**Comments**
25. Instruments and other items are thoroughly scrubbed using a soft brush and detergent and water and rinsed thoroughly with clean running water before sterilization or HLD.				
Sterilization	**YES**	**NO**	**N/A**	**Comments**
26. For steam sterilization, instruments and other items are packed in a way that allows steam to reach all surfaces.				
27. Appropriate parameters (time, temperature, pressure) for steam sterilization are followed.				
28. Appropriate parameters (temperature, time) for dry-heat sterilization are followed.				
29. Sterilization equipment is properly monitored and maintained.				
30. A properly prepared chemical solution, such as a product containing glutaraldehyde, is used for chemical sterilization.				
31. For chemical sterilization, instruments and other items are dry, opened or disassembled, and completely submerged in the solution.				
32. Instruments and other items are soaked in the chemical solution for the time listed in the manufacturer's instructions and are rinsed with sterile water.				
33. After any method of sterilization, instruments and other items are stored in a way that limits the risk of contamination.				
High-Level Disinfection (HLD)	**YES**	**NO**	**N/A**	**Comments**
34. For HLD by boiling, instruments and other items are opened or disassembled, completely submerged in water, and boiled for 20 minutes from the time when the water reaches a rolling boil.				
35. Appropriate and properly prepared disinfectant solutions are used for chemical HLD.				
36. For chemical HLD, instruments and other items are dry, opened or disassembled, and completely submerged in the solution.				

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High-Level Disinfection (HLD) continued	**YES**	**NO**	**N/A**	**Comments**
37. Instruments and other items are soaked in the chemical solution for 20 minutes and rinsed with boiled water.				
38. After any method of HLD, instruments and other items are stored in a way that limits the risk of contamination.				
Housekeeping	**YES**	**NO**	**N/A**	**Comments**
39. Non–client care areas are kept free of dust, dirt, and organic debris.				
40. Client care areas are dusted with a damp cloth each morning and cleaned with a disinfectant cleaning solution between clients and at the end of each clinic session or day.				
41. Once a week, the ceilings in operating theaters and procedure rooms are cleaned with a mop dampened with a disinfectant cleaning solution.				
42. Housekeeping equipment (mops, buckets, and cloths) is decontaminated, cleaned in detergent and water, rinsed in clean water, and allowed to dry before reuse.				
43. Fumigation and ultraviolet (UV) light are not used to disinfect operating theaters or other areas of the facility.				
Waste Disposal	**YES**	**NO**	**N/A**	**Comments**
44. Waste materials are separated into appropriate containers at the point at which they are generated.				
45. Sharps and nonsharps infectious waste are either burned or buried in a pit.				
46. The community is protected from possible exposure to medical waste.				
47. Liquid medical waste and hazardous chemical waste is poured down a drain or buried in a pit. (Cytogenic drugs and radioactive waste receive special handling.)				
48. Medical waste containers are cleaned with a disinfectant cleaning solution and rinsed with water daily, or more often, if visibly contaminated.				