ANNEXURE A

6

Environmental cleaning, waste management and decontamination of medical devices

Objectives

When you have completed this chapter you should:

- Understand the importance of the environment in infection transmission
- Be familiar with common methods of environmental disinfection
- Know the difference between routine cleaning and terminal cleaning
- Be familiar with recommended healthcare waste management practices
- Understand the difference between cleaning and decontamination
- Understand the difference between decontamination, disinfection and sterilization
- Understand the difference between disinfectants and antiseptics
- Be aware of the risks associated with inadequate decontamination of medical devices
- Be familiar with common methods of decontamination
- Know which medical devices require decontamination.

Environmental cleaning

6-1 What is cleaning?

Cleaning (in the healthcare setting) refers to the removal of visible dirt, dust and debris. Cleaning alone results in large reductions in environmental contamination, including the removal of many pathogens.

6-2 What is the role of the environment in infection transmission?

A clean patient environment contributes to prevention of healthcare-associated infection. Cleaning in healthcare facilities aims to remove visible dirt and dust, reducing levels of harmful micro-organisms in the patients' surroundings. Dust contains skin scales and micro-organisms, which can be spread in the environment and air by sweeping or dry dusting.

A clean patient environment contributes to prevention of healthcare-associated infection.

6-3 How often should healthcare facilities be cleaned?

Most areas of a healthcare facility will require at least daily cleaning. Other specialised clinical areas may require twice daily (outpatient areas) or more frequent cleaning (operating theatres).

6-4 Which cleaning methods should be used?

Any cleaning method that generates movement of dust, e.g. sweeping or dry dusting, should not be used. Damp dusting of surface and mopping of floors are the preferred method as these techniques do not generate dust movement. The routine use of disinfectants for all clinical areas is unnecessary and strongly discouraged as it contributes to the development of antimicrobial resistance.

6-5 What cleaning equipment is required?

- Cleaning cloths: these should ideally be colour coded to distinguish cloths used for "clean" areas from those used for highly contaminated areas, e.g. toilets, baths and isolation areas. Where a colour coding system is used, it is important to ensure that all staff is aware of which equipment may be used for cleaning which areas.
- Cleaning buckets/carts: should be cleaned daily or whenever heavily soiled.
- Mops: flat mops are preferred to the "spaghetti" mop type. Mopping water and detergent solution should be changed frequently. Proper storage of mops is important so that they can be allowed to dry thoroughly and without cross-contamination of the mop heads.
- Floor polishers: where these are used the machines should be emptied and cleaned daily.
- Storage area: each clinical area should have a dedicated cleaning store/closet. It is important to ensure that all equipment is stored dry, and inspected for damage prior to use.

6-6 What general principles apply to cleaning of healthcare facilities?

- A cleaning programme should be in place (including cleaning protocols, regular staff training and monitoring of adequacy of cleaning)
- A standard, institution-approved detergent should be used in all areas (unless otherwise specified by the IPC practitioner)
- The manufacturer's instructions regarding dilution of cleaning solutions should always be followed
- Surfaces must be allowed to dry completely (as damp areas encourage growth of micro-organisms)
- A cleaning plan should be devised for each clinical area, working from areas of least contamination to areas of most contamination, e.g. from administrative areas to toilets to isolation rooms.
- All surfaces should be easy to clean, compatible with hospital detergents

and disinfectants, smooth and nonporous.
- All carpets should be removed as these are very difficult to clean.

6-7 Which tasks should be given to the domestic or household staff?

The cleaning tasks assigned to the domestic staff may vary between institutions, but in most instances include the following:

- Cleaning of clinical areas and surrounding administrative areas
- Removal of waste and replacement of waste containers
- Removal of linen, replenishing stocks of fresh linen
- Replacement of hand decontamination solution
- Cleaning of ward-based washer-disinfectors
- Cleaning of non-clinical equipment.

It is, however, critical to establish who is responsible for cleaning what (between domestic and nursing staff) to ensure there are no items or areas that are overlooked.

6-8 What personal protective equipment should be used by cleaning staff?

For routine environmental cleaning staff should wear:

- Domestic rubber gloves that reach to at least mid-arm to protect the workers from exposure to chemicals and organic material. These gloves are re-usable but should be inspected for tears or leaks before each use. Rubber gloves that are re-used must be cleaned with detergent and allowed to dry before moving on to clean the next clinical area. Cleaning staff should not use the examination gloves provided for healthcare workers. If working with potentially dangerous chemicals, then heavy-duty rubber gloves are preferred.
- Plastic aprons should be worn during any activity that may result in splashes.
- If entering a room where transmission-based precautions are in place, the domestic staff should be made aware of the risk and instructed to put on the required personal protective equipment.
- Ideally all domestic staff should also be immunised against tetanus and hepatitis B as they are frequently exposed to sharps.

6-9 Which areas are frequently touched in the healthcare setting?

Items such as door handles, light switches, patient monitors and medical equipment buttons/knobs are frequently touched by healthcare workers and patients. These are high-risk surfaces for cross-transmission because they hold the micro-organisms that are transferred from people's hands. Domestic staff should be specifically alerted to give extra attention to these frequently touched surfaces during their routine cleaning.

Frequently touched surfaces are a high risk for cross-transmission because they hold the pathogens that are transferred from people's hands.

6-10 What is the difference between routine cleaning and terminal cleaning?

Routine cleaning is the standard, everyday procedure for cleaning of clinical areas, including mopping of floors, damp dusting of surfaces with detergent, etc. Terminal cleaning is performed when a patient with a transmissible illness is discharged (usually for isolation rooms), e.g. MRSA and other drug-resistant bacteria, tuberculosis, *Clostridium difficile*. The terminal cleaning process requires:

- Removal and discarding of all unused consumables and personal protective equipment (PPE) from the room
- Removal and laundering of all linen
- Removal and safe disposal of all waste
- Washing of all surfaces with detergent (including walls to a height of 2 metres)
- Wiping of all surfaces with an appropriate disinfectant (including bed frame, mattress and pillows). The IPC practitioner should be asked to advise on an appropriate disinfectant (usually alcohol-based or chlorine-based disinfectants at an appropriate strength or dilution). Remember that chlorine can be corrosive (causing damage to metal surfaces).
- Allowing all surfaces to dry before admission of a new patient.

Terminal cleaning is required when a patient with a transmissible illness is discharged (usually from an isolation room).

6-11 How should blood spills be managed?

The following principles should be applied:

- All blood spillages should be immediately cleaned up using domestic gloves
- Glass and solids should be removed using a brush and pan, and discarded in a sharps container or if too large, wrapped in newspaper before safely disposing
- The remaining fluids should be blotted using as many paper towels as needed; these should be discarded in the clinical waste
- Water and detergent should be used to remove all visible blood
- The area should be wiped over with a chlorine-based solution (at a concentration of 10 000 parts per million) and allowed to dry.

All healthcare facilities require a written, easily understandable and accessible standard operating procedure (SOP) for managing blood spills.

Waste management

6-12 What is clinical waste?

This is generally defined as waste from a healthcare facility that may contain hazardous pathogens. Examples include:

- Any material contaminated with patient blood or bloody body fluids (e.g. wound exudate, pus)
- Other body fluids (cerebrospinal fluid, amniotic fluid, semen, vaginal secretions).

Other special types of waste are generated from healthcare facilities including expired medication, chemicals and oils. These are also potentially hazardous and require a programme for disposal, separate from management of clinical and general waste.

Clinical waste is waste that may contain hazardous pathogens; non-clinical healthcare waste includes general rubbish, expired medications and chemicals.

6-13 What is waste management?

Waste management is the handling and safe disposal of infectious and non-infectious waste. The aims of waste management are to ensure safe and environmentally friendly destruction or reprocessing of healthcare waste.

6-14 What legislation and recommendations exist for waste management?

Most countries have legislation governing the disposal of healthcare waste. Ultimately the head of each healthcare facility is responsible for ensuring that proper policies and processes are in place for waste management. Each facility or group of facilities should have a designated waste manager responsible for implementation of the waste policy and procedures for protection of staff working with waste. Compliance monitoring for waste management is usually performed by the IPC practitioner. Training in healthcare waste management is required for all facility staff, including clinical staff, domestic staff, porters, radiographers, pharmacists and other allied health professionals.

The healthcare facility manager is responsible for ensuring that proper waste management policies and processes are in place.

6-15 What is waste segregation?

This is simply the separation of healthcare-associated waste at source into clinical (infectious waste) or non-clinical (domestic) waste. Waste segregation takes place at the point of generation (source) into different (colour-coded) plastic bags or containers for disposal. Separation of waste at source (i.e. at ward or clinic room level) saves time, cost and eliminates the risk attached with sorting medical waste. Many healthcare facilities use colour-coded waste bags and posters/signs to indicate to healthcare workers and visitors where the disposal of different types of waste must take place. For example, red bags for clinical waste and black or clear bags for non-clinical waste and general rubbish. Sharps are disposed of at source in robust solid containers to avoid accidental injuries.

Waste segregation is the separation of healthcare-associated waste into clinical (infectious waste) or non-clinical (domestic) waste.

Waste segregation		
Healthcare waste should be segregated at source (point of generation)		
Category	**Recommended colour coding**	**Examples of items**
Anatomical tissues and clinical waste Any material which is visibly contaminated with blood or body fluid or infectious agents	RED  CLINICAL WASTE	Placentae, human limbs and tissue, excision products, used bandages and dressings, urinary catheter and drainage bags*, intravenous administration sets, abdominal swabs, theatre dressings Infectious disease isolation area: gloves and aprons, linen savers with blood or body fluids
Sharps Sharp objects that are contaminated with blood or body fluids	YELLOW  SHARPS	Hypodermic needles, stilets, vials, syringes containing blood or body fluids, insertion ends of intravenous administration sets, trochars, cannulae, rigid guidewires
Non-clinical waste Generated by patients but not contaminated with blood or body fluids	BLACK  NON-CLINICAL	Items used by patients but not contaminated with blood or body fluids, e.g. used gloves, linen savers, tissues, paper towels, packaging or wrapping from sterile items or processed items, babies' nappies, sanitary towels
Paper and packaging Packaging or wrapping, office and administration		Office paper, wrapping paper from SSD, surgical masks, overshoes, surgical disposable caps and gowns
SSD equipment Used single items sent to SSD for sterilization or high-level disinfection	CLEAR  FOR STERILIZATION	Surgical instruments, vaginal speculae, respiratory equipment, masks, etc.
Storage of patient articles	CLEAR  STORAGE	Storage of patient articles
*IV fluid and wound drainage bags containing residual fluid should be emptied in the sluice room.		

***Figure 6-1:** Waste segregation*

(Adapted from *Infection Prevention and Control Manual*, Tygerberg Academic Hospital, Cape Town, South Africa, 2012)

6-16 What is sharps management?

This is the risk management programme (part of standard precautions) that is implemented to reduce the risk of sharps (or needlestick) injuries. The following recommendations apply to waste management of sharps:

- Puncture-proof containers should be used.
- Sharps containers should be securely wall-mounted or fixed to procedure trolleys.
- All sharps containers should be labelled with the date and location.
- Sharps containers should be removed when filled to the indicated two-thirds full mark.
- Sharps containers should be securely closed and transported to a safe storage area until collected for final destruction.

6-17 How should medical waste be transported?

When removing waste from clinical areas, the domestic staff should ensure that:

- The waste containers have been properly sealed (i.e. by sealing waste boxes with tape, closing the lids of sharps containers securely, or by placing soiled linen in leak-proof bags).
- The waste boxes and sharps containers are labelled correctly with the date, institution name and name of the clinical area where the waste was generated.
- A waste cart or trolley that is leak-proof and clean is available to remove the waste.
- The domestic staff should wear appropriate personal protective equipment (PPE), e.g. heavy duty gloves, apron and closed shoes.

6-18 How should medical waste be stored?

Medical waste is often stored in a holding area in the wards/clinical area, until collected by the domestic staff for disposal. This area should be kept clean, dry, well-ventilated and secured. Depending on the clinical area concerned, waste may need to be collected as often as twice daily. Collected waste from the clinical areas is then transported to the facility's wasteholding area, to await collection for final disposal at an incineration or waste destruction site. Similar to the requirements mentioned above, this wasteholding area should be securely locked, clean, dry, well ventilated and free from pests/rodents. The area should be inspected by IPC staff intermittently.

6-19 How should medical waste be disposed of?

There are several different methods available for destruction and disposal of medical waste. Non-clinical waste (e.g. paper towels, rubbish) is usually buried at a local municipal dumpsite or landfill. Clinical waste and sharps are ideally destroyed by incineration. This is the best way to ensure that there is no remaining risk for needlestick injury and no viable micro-organisms. The heat generated by this process is often "re-cycled" to generate steam or

produce heat for the healthcare facility. Other newer technologies for waste disposal are available for example microwave or heat sterilization, and shredding. If third parties are used for waste disposal, the facility must draw up contracts for this purpose. In parts of Africa, leftover food and/or kitchen waste are disposed of in compost heaps, which in turn produce compost for fertilising food crops.

Decontamination of medical devices

6-20 What is decontamination?

Decontamination is the process followed to ensure that re-usable medical devices are safe to use on the next patient. Examples are the decontamination of a vaginal speculum between patients or the decontamination of surgical instruments between operations.

Decontamination is a process that ensures that medical devices are safe to use on another patient.

6-21 Why is decontamination required?

Decontamination is required to destroy and remove micro-organisms before a medical device or piece of equipment is used on another patient. Micro-organisms can be transferred to patients (through direct or indirect contact with inadequately decontaminated devices/ equipment) resulting in healthcare-associated infection.

6-22 Which steps form part of the decontamination process?

Decontamination includes some or all of the following steps:

- Cleaning (physical removal of organic material including micro-organisms)
- Disinfection (killing or destruction of most but not all disease-producing micro-organisms)
- Sterilization (destruction of all micro-organisms).

The decontamination process involves cleaning, disinfection and/or sterilization.

6-23 How difficult is it to kill different types of micro-organisms?

Different micro-organisms have differing levels of susceptibility to destruction. Some, like viruses, most bacteria and fungi are relatively easy to kill. Others, like mycobacteria (TB) and spores (*Clostridium difficile*) are relatively resistant to killing. That is why it is important to know which micro-organisms need to be destroyed when selecting the appropriate method for decontaminating a particular device.

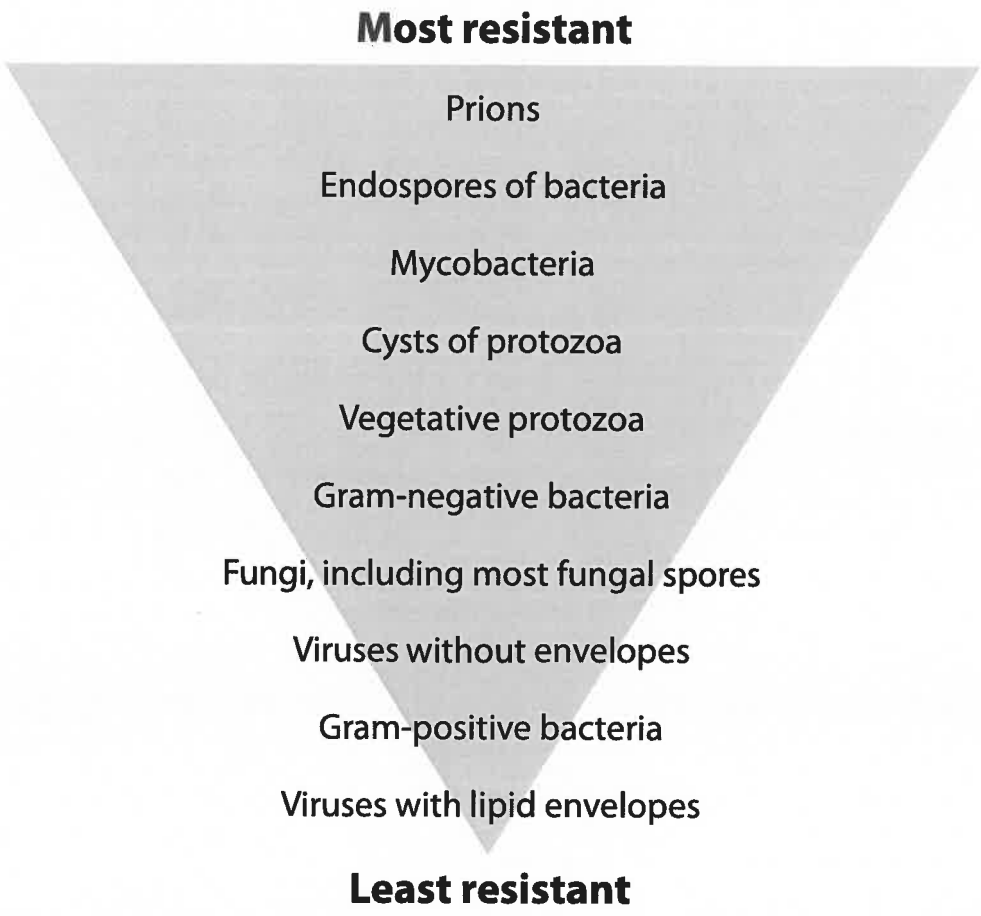

***Figure 6-2:** Most resistant to least resistant micro-organisms*

6-24 Which medical devices should be decontaminated?

Any medical device or piece of equipment that comes into direct contact with a patient or patient's body fluids, can potentially be contaminated with micro-organisms. For example blood pressure cuffs, thermometers and saturation probes all pose a risk of infection transmission if not adequately decontaminated between patients.

6-25 How does one decide on the level of decontamination required?

The method of decontamination is determined by the level of risk for infection transmission. For example, devices that will be in contact with the patient's bloodstream or sterile tissue/sterile body cavities must be sterilized. Items that will only be in contact with intact skin, can undergo low-level disinfection, which should remove most pathogens. The Spaulding classification gives guidance on how to determine the type of decontamination processes required.

The appropriate method of decontamination for a particular medical device is determined by the level of risk for infection transmission.

Instrument category	Examples	Process
Critical: enters directly into the bloodstream, sterile tissue or cavities	Surgical instruments, needles, intravenous catheters	**Sterilization:** no micro-organisms left, including spores
Semi-critical: contact with intact mucous membranes	Endoscopes, laryngoscopes, airway tubes, resuscitation masks and bags	**High-level disinfection:** no vegetative forms of bacteria left, few spores acceptable
Non-critical: Touches only intact skin	Blood pressure cuffs, stethoscopes, cervical collars, thermometers	**Low-level disinfection:** most pathogens removed

The Spaulding classification

6-26 Which medical devices can be decontaminated on the ward?

Using the Spaulding classification as outlined above, non-critical devices and instruments can be decontaminated at ward level. This would include the cleaning and disinfection of commonly used items such as thermometers and stethoscopes. Other commonly used items such as urine jugs and bedpans are often cleaned at ward level. Cleaning of these items can be manual or automated. Staff responsible for manual cleaning should be provided with personal protective equipment including heavy-duty gloves, plastic aprons, and eye protection. The use of an automated washer-disinfector is ideal, as this minimises handling of bedpans/urinals, saves time and achieves better disinfection than manual methods.

Non-critical devices and instruments can be safely decontaminated at ward level.

Items or site	Preferred method of decontamination	Alternative methods/comments
Airways and endotracheal tubes	Single-use disposable	
Ambu bags	Send to SSD for heat disinfection.	Ethylene oxide
Ampoules	Wipe with 70% isopropyl alcohol and allow to dry before opening.	DO NOT immerse in disinfectant.
Baths	Clean with detergent and non-abrasive cream cleaner. Rinse and dry.	For infected patients, as opposite and wipe over with chlorine-based agent after cleaning. Do not soak.
Beds and cots	Wipe with warm water and detergent to remove all visible signs of dirt. Allow to dry.	Disinfection not necessary.

Items or site	Preferred method of decontamination	Alternative methods/comments
Bed lockers	Wipe with warm water and detergent. Dry.	Clean inside locker once patient has been discharged.
Bedpans and urinals	Wear non-sterile gloves. Empty contents directly into ward washer disinfector (80 °C × 1 min). Inspect for cleanliness after removal. Store inverted to dry.	Macerators: papier-mâché bedpans and urinals Manual cleaning: wear gloves, empty bedpan into sluice and rinse. Clean thoroughly with a nylon scrubbing brush and detergent. Rinse. Invert to dry. NEVER SOAK BEDPANS.
Blankets and bed covers	Change after each patient has been discharged or when visibly soiled. Send to laundry to wash at 80 °C.	Do not allow bedding from home. These may be infected with bed bugs or carry scabies.
Bowls (patient wash)	Wash with detergent, rinse and store inverted to dry.	Modern ward washer disinfectors can also wash bowls.
Commodes	Wash seat daily with detergent and hot water and dry with disposable paper towel. Wipe the commode seat with a large alcohol wipe after each use.	If visibly contaminated, remove soil with tissue. Wash with warm water and detergent. Dry. For enteric diseases, wipe the commode with hypochlorite (1000 parts per million) after each use.
Computer and keyboards	Damp dust daily. Wipe keyboard carefully to remove visible dirt.	Use a keyboard cover which is changed frequently.
Crockery and cutlery	Wash at 80 °C in dishwasher. Manual cleaning: wear gloves and hand wash in detergent and hot water (60 °C), rinse and dry.	Wear domestic gloves for manual cleaning. Infected patients: unless as instructed by IPC team treat as routine. Disposable crockery is rarely indicated, e.g. rabies.
Curtains	Change curtains frequently. Isolation room curtains (infectious cases) should be changed with each terminal clean.	Blinds, both vertical and horizontal, are difficult to clean and wash regularly.
Dressing trolleys	Remove all items daily and wipe surface with warm water and detergent. Dry. Wipe over with 70–80% ethanol alcohol. Discard all previous contents of open jars and bottles. Replace with unopened containers.	If open jars are used, keep the volume small so that the containers can be heat disinfected when empty. DO NOT TOP UP OPEN DISINFECTANT CONTAINERS.

Items or site	Preferred method of decontamination	Alternative methods/comments
Endotracheal suction catheters	Disposable. Can be used for 24 hours on the same patient. Flush with sterile water after each use. Bowl is washed and dried after each suction and filled with sterile water only before use.	Decontaminate hands thoroughly before carrying out suction. Do not share suction catheters between patients. DO NOT RECYLCLE SUCTION CATHETERS.
Feeding bottles (baby)	Heat sterilized in SSD	Wash thoroughly. Rinse and soak in fresh hypochlorite solution (125 ppm available chlorine) for 30 minutes. Remove, rinse and dry.
Humidifiers	Empty daily and heat disinfect after each patient use. Clean with warm water and detergent. Dry. Fill with sterile water only.	
Infant incubators	Wash all removable parts and clean thoroughly with detergent. Dry with paper towel.	Infected: after cleaning, wipe over with 70% ethanol alcohol or hypochlorite (125 ppm). Leave incubator to stand for six hours (aeration).
Laryngoscope blades	Wash blade with detergent, rinse and dry. Wipe over with alcohol.	
Mattresses	Use a water impermeable cover. Clean with warm water and detergent. Dry thoroughly. Never admit patients to soiled, stained or damaged mattresses.	Major source of cross-infection. Replace torn mattress covers immediately. Wet mattresses should be discarded.
Scissors	Wipe over with 70% alcohol before and after each use.	
Thermometer (oral)	Wash and dry after each patient use. Wipe with 70% alcohol and store dry.	NEVER soak thermometers in disinfectant.
Ultrasound probe	Disinfect with 70% isopropyl alcohol between each patient use. Intravaginal: cover probe with a condom for each patient.	

Items or site	Preferred method of decontamination	Alternative methods/comments
Ventilators	These are complex and should be cleaned and disinfected according to the manufacturer's instructions. Sometimes there are technicians in the healthcare facility who do the maintenance.	Remove tubing and send to SSD for heat disinfection (80 °C × 3 min) or chemical disinfection. Clean all inspiratory and expiratory connections. Change both sets of filters. Check efficiency of air movement. Reassemble. Clean the outside of the ventilator. Register in logbook.
Wash basins	Clean with warm water and detergent. Disinfectants are not recommended.	
X-ray equipment	Damp dust only.	Wipe with 70% alcohol if disinfection required.
Table adapted from S Mehtar, *Understanding Infection Prevention and Control*, Juta, 2010.		

6-27 Why is prior cleaning of devices and instruments needed?

Cleaning is the first step towards disinfection, sterilization and making medical devices safe for re-use. Proper cleaning alone will remove approximately 80–90% of microbial contamination. It is vital that the cleaning process removes **all visible** organic matter such as blood, dirt or tissue. This then ensures effective disinfection or sterilization by allowing penetration of disinfectants and steam respectively.

Cleaning is the first step towards making medical devices safe for re-use, and will remove approximately 80–90% of microbial contamination.

6-28 What is the correct method of cleaning?

For medical devices and instruments that can be safely immersed in water, the following steps apply:

- Wear domestic gloves, aprons and visors to protect your mucous membranes
- Fill a sink or tub with warm water
- Add detergent according to the manufacturer's instructions
- If applicable, disassemble the instrument fully
- Hold the item below the surface of the water
- Using a soft nylon brush, clean all surfaces, grooves and hinges of the instrument
- Inspect the instrument thoroughly to ensure all visible organic material is removed
- Prepare the item for disinfection or sterilization as needed.

6-29 What is the role of disinfection?

Disinfection is the killing or destruction of most pathogens, and is applied to inanimate (non-living) surfaces or instruments. This process will not kill all pathogens (especially spore-forming pathogens), but reduces the level of contamination to one that is not harmful. Microbial killing by disinfection can be achieved using chemicals, heat or both.

The use of heat for either disinfection or sterilization is the preferred method for making items safe for re-use. However, for heat-sensitive items (endoscopes/ electrical equipment) or surfaces (mattress covers, worktops, etc.), chemical disinfection is an acceptable alternative.

6-30 What are the advantages and disadvantages of using disinfectants?

Disinfectants are generally inexpensive, have rapid action, can be used for processing at the point of use and are suitable for decontamination of heat-sensitive items. The negative aspects of disinfectants are that they are less effective than heat, require rinsing of items, may enhance antimicrobial resistance, may be harmful to the environment and can cause allergic reactions.

Disinfectants are cheap, act rapidly and can be used on heat-sensitive items, but are less effective than heat and can cause allergic reactions.

6-31 Why is it not acceptable or effective to soak instruments in disinfectants?

The following concepts about soaking are very important:

- No device or instrument can be effectively disinfected or sterilized unless it has been thoroughly cleaned.
- Soaking used medical devices in disinfectants is a waste because most disinfectants cannot penetrate organic matter.
- The act of soaking gives healthcare workers a false sense of security, whereas in fact the device or instrument has usually not been adequately decontaminated.

Soaking used medical devices in disinfectants is a waste because most disinfectants cannot penetrate organic matter.

6-32 Which disinfectants are most commonly used in low-resource settings?

Alcohol and chlorine-based disinfectants are the most widely available. Depending on the concentration used (see below), these chemical disinfectants can achieve low to intermediate level disinfection. Chlorine may not be suitable for all types of disinfection, as it can be corrosive (causing damage to metal surfaces). Others types of disinfectants available include quaternary ammonium compounds (QACs) and phenolics. For semi-critical items like

endoscopes, high-level disinfection is needed using aldehydes, peracetic acid or OPA.

Alcohol and chlorine-based disinfectants are the most widely used agents in low-resource settings.

Chlorine-releasing agents: use concentrations	
	Parts per million available chlorine
Blood spillage (HIV, HBV, HCV)	10 000
Pre-cleaned surfaces, cleaning equipment	1 000
Catering and infant feeding equipment	125
Drinking water	1

6-33 What is the difference between disinfectants and antiseptics?

Disinfectants are used for killing pathogens on inanimate surfaces or instruments. Antiseptics are chemicals used to kill pathogens on live tissue, for example alcohol hand-rub, chlorhexidine gluconate and povidone iodine for skin preparation prior to surgery.

Disinfectants kill pathogens on inanimate surfaces/instruments and antiseptics kill pathogens on live tissue/skin.

6-34 What legislation and recommendations exist for medical decontamination?

Any medical device or instrument that is re-usable should have a specified process for its decontamination, for example a standard operating procedure for re-processing of used vaginal speculae. Wherever possible, decontamination of devices/instruments should be performed in a dedicated sterile services department. This ensures that the items are handled by staff with the required skills, equipment and procedures to deliver safe medical devices. Most countries have legislation governing Patient and Occupational Health and Safety. In more developed settings, all decontamination processes require validation (a form of proof that the process was carried out to accepted standards).

Any re-usable medical device or instrument should have a specified process for decontamination. Wherever possible, decontamination should be performed in a dedicated sterile services department.

6-35 Which items or instruments should not be decontaminated?

Any item that is designated by the manufacturer as single-use, or any item that cannot be thoroughly cleaned, e.g. hypodermic needles and syringes, should be discarded after use.

Any item designated by the manufacturer as single-use should be discarded after use, because the risk of infection transmission after inadequate reprocessing is high.

The role of the sterile services department (SSD)

6-36 Which items should be sent to the sterile services department for decontamination?

Ideally all critical and semi-critical items (see Spaulding classification under 6-25) should be decontaminated in the SSD. In certain instances, where items are needed urgently for re-use on other patients, decontamination may be carried out at point of care. In such circumstances it is even more important to ensure quality management and proper oversight of the decontamination process. Examples would include cleaning and high-level disinfection of bronchoscopes or endoscopes at point of care.

All critical and semi-critical items should be decontaminated in a sterile services department (SSD).

6-37 What is the flow of items for decontamination through the sterile services department?

The SSD should be designed and laid out so as to streamline movement of items and to prevent contamination of processed, sterile items by "dirty" items arriving in the "wash room", cleaning area. Items and instruments for decontamination follow a specific flow or process through the SSD:

- Collection of used devices and instruments from wards, theatres, outpatients
- Disassembly of instruments
- Cleaning
- Disinfection
- Check that items are still functional
- Preparation and packaging of items for sterilization
- Sterilization of instruments, theatre trays and packs
- Storage of items and packs
- Dispatch and delivery of sterile items and packs to point of use.

6-38 What protective equipment and measures are required for staff in the sterile services department?

SSD staff should wear uniforms that cover their arms and neck area, to minimise skin contact with chemical products. Closed shoes should be worn. Industrial gloves and aprons are indicated for staff working in the "dirty" areas or wash room. Eye protection may be needed where staff are rinsing items or using water jets through hollow bore instruments. All SSD staff should have received a full course of hepatitis B immunisation and 5-yearly tetanus boosters. Occupational health and safety training and access to an occupational health service is mandatory.

SSD staff require proper protective clothing/equipment, as well as hepatitis B and tetanus immunisations.

6-39 What form of sterilization is used in most sterile services departments?

The most widely used method for the final step in decontamination of heat-stable items is steam sterilization. Steam is a reliable, non-toxic and cost-effective method of sterilization. The machines used for steam sterilization are known as autoclaves, and can be downward displacement (gravity) or high-vacuum autoclaves. Items to be autoclaved must be wrapped in materials (cloth or paper) that allow penetration of steam. There are several validation methods used to ensure that the sterilization process is effective. Biological indicators measure the effectiveness of the autoclave in killing bacterial spores. Chemical indicators are used to verify that the items have been exposed to heat (e.g. autoclave tape) and that steam has penetrated the packs (e.g. the "Bowie Dick" test). Records of validation testing should be kept in SSD in a logbook for at least five years. There is a variety of other methods of sterilization including flash sterilizers, dry-heat sterilization, irradiation, ethylene oxide and hydrogen peroxide gas plasma.

Steam (autoclaving) is a reliable, non-toxic and cost-effective method of sterilization.

6-40 Where should decontamination of specialised equipment be performed?

Endoscopy procedures are often performed in dedicated procedure rooms, with requirement of a rapid turnaround time for processing of equipment. For this reason, decontamination of endoscopes usually occurs at point of care. Several outbreaks and infections from poorly decontaminated endoscopes have been documented worldwide. Several pathogens can be transmitted by endoscopes including blood-borne viruses, gastro-intestinal bacteria and in some countries, intestinal parasites.

Reprocessing is the process followed to make a piece of shared equipment safe to use on the next patient. Endoscope reprocessing is a highly technical procedure and should only be undertaken by appropriately trained staff. The steps in endoscope reprocessing include: thorough cleaning of all channels, chemical disinfection, rinsing, drying and storage. Most endoscopes are heat-sensitive so cannot be autoclaved or heat sterilized. It is critical to follow the manufacturer's recommendations at every stage of the decontamination process. As the risk for cross-infection is high, users must ensure cleaning and high-level disinfection of endoscopes are tightly regulated (validated) and monitored.

Case study 1

A patient who has undergone a hernia repair presents to the outpatient's department (OPD) after 14 days with a deep wound infection. The surgeon realises that this is the fifth case over the past eight weeks with an infected hernia repair. There is nothing out of the ordinary except that the operating theatre has been overloaded with work

and has started decontaminating some surgical trays on site instead of sending them to the sterile services department (SSD) for reprocessing.

1. What are the possible reasons for deep-seated wound infections in these patients?

The operating theatre is not designed to reprocess a large number of surgical devices and only has equipment for reprocessing emergency instruments. Operating staff have not been adequately trained to clean and sterilize medical devices. They do not understand the validation process and how to deal with incorrect reprocessing cycles. There may not be adequate storage areas for the sterile packs.

2. What should the IPC team investigating this outbreak look for?

- Check the management of the patient including the antibiotic prophylaxis regimen – has it changed?
- Observe the reprocessing procedures to ensure these are correct. This information can be found in the registers and logbooks which ought to be present for each piece of equipment.
- Look to see if the medical devices have been soaked prior to cleaning; this increases the risk of antimicrobial resistance and is not recommended.
- The team should look for evidence of appropriate sterilization such as process indicators which should be present in the patient notes and also in the register.
- Make sure that the sterile packs remain sterile until they are ready for use.
- Review the early wound dressing practices on the ward.

3. What can be done to rectify the situation?

Move the sterilization of surgical devices back to the SSD as soon as possible. If this is not possible, train the operating theatre staff to clean and reprocess surgical devices correctly. The reprocessing equipment must have validation systems in place to check each step of the cycle and there must be a visible record of each kept for a minimum of five years.

Case study 2

A young enthusiastic surgeon goes to a conference and comes back with a very sophisticated state of the art flexible hepatoscope (a type of endoscope). As an IPC practitioner you are asked to work out a way of reprocessing this item.

1. How are you going to deal with this endoscope? What processes will you put in place to make sure it is safe for re-use?

Find out more about the endoscope, contact the manufacturer and get the necessary guidelines on cleaning and disinfection. Since it is an expensive and delicate piece of equipment, the exact cleaning and disinfection method must be obtained from the manufacturer. Then set up a standard operating procedure (SOP) which

includes absolutely every step and where possible validation of each step. Train the staff who will be dedicated to handle this device so that they are confident to deal with it and will recognise any shortfalls in the decontamination process. If none of this is possible, arrange for the manufacturer to recommend a private contractor who knows how to reprocess this equipment.

2. What are the risks of using a poorly disinfected hepatoscope?

Consider blood-borne viruses, commonly HIV, hepatitis B and C but also other viruses that might affect the liver. In some countries parasitic diseases such as *Echinococcus granulosis*, liver fluke and others can be a problem. Healthcare-associated pathogens especially *Pseudomonas*, *Acinetobacter*, *Staphylococcus aureus* and *enterococci* must be considered. All these have to be dealt with in a clear and confident manner to make sure the equipment is safe to re-use.

3. What is the ideal method for reprocessing flexible fibre-optics and delicate endoscopes?

The device can be dealt with by low temperature chemical disinfection methods, but never a sterilizer which reaches above 90 degrees. It has to be thoroughly cleaned; making sure each channel (including the biopsy channel) has been cleaned. The final stage would be to disinfect with the appropriate chemical as per manufacturer's recommendations. Automated systems for reprocessing are preferable to manual ones but both can be equally effective if the endoscope is exposed for the correct time and thoroughly rinsed after exposure to chemicals.

Case study 3

You walk into a healthcare facility and are met with a strong smell of a disinfectant in the outpatient's department (OPD). It was discovered that the cleaners were using hypochlorite for routine cleaning of the environment including the floors and all surfaces including the bedpans, because of "all the germs in the hospital" and because "we have been doing it for years".

1. Is it necessary to use a disinfectant in the environment for routine cleaning?

No, by simply cleaning with warm water and detergent, 80-90% of organic matter will be removed and so will most pathogens. If the surfaces are visibly clean, then they are clean. No disinfectant is required for routine cleaning; only for terminal cleaning.

2. What is the impact of hypochlorite on the floors and surfaces?

Hypochlorite is highly corrosive to metal and other materials, and therefore should not be used in these situations. It is also non-biodegradable and can lead to enhanced antimicrobial resistance. It is inactivated by organic matter and so becomes ineffectual in the presence of it.

3. What are the indications for using disinfectant in the environment?

There are very clear indications for the use of hypochlorite such as terminal cleaning after a *Clostridium difficile* infection or spillage of blood (wiped over after cleaning up).

Case study 4

The Department of Health is contacted after several patients at a dental practice are diagnosed with hepatitis C infection. Further testing of all dental practice patients reveals that 53 people have contracted hepatitis C (all shown to be the same strain). The dentist's rooms are visited by an IPC practitioner to review the on-site decontamination and sterilization procedures and equipment.

1. What should the IPC practitioner be looking for?

She should perform a risk assessment to identify possible means by which blood-borne viruses could be transmitted. The following specific areas and procedures should be assessed:

- The availability of standard operating procedures (SOP) for decontamination/sterilization
- The availability and use of personal protective equipment (PPE)
- Evidence that single-use items are being re-used, e.g. needles, syringes
- The facilities available for cleaning equipment
- The condition of the dental equipment itself
- The maintenance logbook of the bench-top sterilizer
- The area where sterile equipment is stored prior to use
- The adequacy of staff training in decontamination and sterilization.

2. The IPC practitioner finds that some of the dental instruments are rusty and that the sterilizer has not been serviced in more than five years. Why are these findings significant?

It is not possible to adequately disinfect or sterilize rusty equipment. Any item that has rust on it should be condemned and replaced. It is essential that all critical medical equipment (like sterilizers) be maintained regularly, at least annually. This should be documented in a service logbook so that the facility has a record.

3. On further enquiry, the IPC practitioner establishes that the dental nurse has never been formally trained on how to decontaminate and sterilize dental equipment. Why is training required?

Inadequately decontaminated equipment can transmit blood-borne viruses and bacterial pathogens. Patients undergoing procedures with unsterile equipment are at very high risk of infection. Decontamination and sterilization procedures can be complicated and staff may be unfamiliar with the proper technique. Induction and regular in-service training are needed, especially if new instruments or new sterilization equipment is purchased.