Section 5- Thermal and Chemical Disinfection

Thermal and chemical disinfection overview

A disinfection process is one that is intended to significantly reduce the number of pathogenic microorganisms on instruments by removing and/or killing them. Bacterial spores are not necessarily killed by disinfection, however their numbers may be reduced as a result of the cleaning process.

Disinfection may be high level, intermediate level or low level (refer to ‘Equipment reprocessing: cleaning, disinfection and sterilization’). The level of disinfection required is governed by the intended use of the item, namely in a ‘non-critical’, ‘semi-critical’ or ‘critical’ site (refer to ‘Spaulding’s classification’).

High level disinfection of previously cleaned instruments and equipment will produce items with very low likelihood of any pathogenic microorganisms remaining.

Disinfection: key points

- disinfection may involve chemical or thermal means. Thermal disinfection, where items can withstand it, is always preferable to chemical disinfection
- disinfection by any process is not appropriate where sterilization is necessary, i.e.: instruments or equipment used in invasive procedures (‘critical’ sites)
- where sterilization is possible, sterilization is preferable to high level disinfection
- disinfection is preceded by thorough mechanical or manual cleaning
- the method of disinfection chosen must be compatible with the particular equipment and suitable for the intended use of the equipment

Efficacy of disinfection

The efficacy of disinfection depends on:

- the number of microorganisms present on items to be disinfected
- biocidal action of the disinfectant or disinfection process (chemical concentration, pH, temperature, water quality, humidity)
- effective contact between the biocidal agent and the microorganisms (presence of crevices, lumens, hinges)
- biocidal agents and apparatus being appropriate for the item(s) being disinfected

Consider the manufacturer’s directions for use, and the material safety data sheet for each disinfectant regarding the need for fume extraction. This is usually achieved using a fume extraction hood or by use of a recalculating fume cabinet using an activated charcoal filter.
Thermal disinfection

Thermal disinfection achieves high level disinfection when surfaces are in contact with heated water for an appropriate length of time. Shorter times are required at higher temperatures than at lower temperatures. Draft International standards will precipitate changes to conditions required for disinfection by thermal means using circulating hot water in a mechanical cleaning machine. AS 4187 will include the following instrument surface temperatures and times for washer/disinfectors:

- 70°C for 100 minutes, or
- 75°C for 30 minutes, or
- 80°C for 10 minutes, or
- 90°C for 1 minute

Indications for use

Thermal disinfection is recommended for reprocessing of:

- anaesthetic equipment and apparatus
- laundering (eg linen, mop heads)
- eating and drinking utensils including infant feeding equipment

Methods of thermal disinfection

- washer/disinfector machines are designed for cleaning instruments and utensils, complex equipment, such as anaesthetic breathing circuits, and laboratory glassware
- some washer/disinfectors clean baskets of instruments by impingement (forced spraying) from fixed or rotating arms in a closed chamber. This is a batch process
- continuous process washer/disinfectors provide a continuous process of washing and (usually) disinfection during which articles on a moving belt proceed through a series of chambers. The 'indexing' washer achieves complete isolation of each sequential stage, and can be programmed so that different loads receive different treatments. The different treatments may involve different degrees of thermal disinfection

A typical washer/disinfector cycle includes the following stages:

- cold water rinse
- warm water wash, with cleaning agent
- hot water rinse, with disinfection (eg 80-85°C for 2 minutes, or other intended conditions)
- drying by radiant heat or hot air
Flexible endoscopic instruments are particularly difficult to clean and disinfect, and easy to
damage because of their intricate design and delicate materials. Gastroenterological
Nurses College of Australia Inc (GENSA) published Infection control in Endoscopy (2nd
edition, 2003) guidelines which includes comprehensive instructions for the cleaning,
disinfection and testing requirements for endoscopic reprocessing. These guidelines form
the basis for practice within Queensland Health facilities and can be located via the
CHRISP website at

Chemical disinfection

Chemical disinfection is the application of a liquid chemical agent to eliminate the majority
of pathogenic microorganisms, with the exception of bacterial spores, on inanimate objects
or surfaces. Chemical disinfectants:

- may be inactivated in the presence of organic matter; thorough cleaning of the
  item must occur prior to contact with chemical disinfectants for the agent to be
effective
- must be suitable for the intended use of the equipment (i.e.: choice of
  disinfectant and process depends on whether low, intermediate or high level
disinfection is indicated)
- must be compatible with the particular equipment
- must be used in the appropriate concentration, and have sufficient contact with
  all surfaces of the item for an appropriate length of time.

Examples of use in health care settings

- endoscopic equipment (where unable to be sterilized)
- disinfection of environmental surfaces (where indicated)
- disinfection of ‘non-critical’ equipment
- disinfection of intravenous access devices/’ports’, medication vials
- preservation of specimens

Alcohol

Alcohols (ethyl and isopropyl alcohol) are rapidly bactericidal, tuberculocidal, fungicidal
and virucidal, but not sporicidal. They denature protein through dehydration. The optimum
concentration is 60-90% by volume. Alcohol is used to:

- disinfect the surface of ampoules/vials prior to access
- disinfect cleaned surfaces (following initial clean with detergent and water) eg
trolleys, counter tops, laboratory benches where required
- disinfect surfaces of some equipment eg stethoscope diaphragm, resuscitation
  manikins
- assist in the drying of some equipment surfaces
- disinfect skin prior to invasive procedures (refer to ‘skin antisepsis’)
Comments:
- evaporates at room temperature. The concentration of alcohol diminishes as it evaporates and the action may be bacteriostatic at concentrations below 50%
- flammable at concentrations recommended for disinfection; precautions are required to prevent accidental ignition; unsuitable for use in operating rooms
- inactivated by organic material; prior cleaning is required
- inexpensive and readily available
- there is no residual activity after the alcohol has completely evaporated
- generally unsuitable for application to mucous membranes
- damages materials such as rubber, plastics. The lens cement of optical equipment is weakened by disinfection with alcoholic solutions.

Chlorine (sodium hypochlorite)

Sodium hypochlorite has broad spectrum antimicrobial activity; however it is inactivated in the presence of organic matter. It is used for the treatment of water, disinfection of laundry items, dental appliances and clean environmental surfaces.

Comments:
- sodium hypochlorite is inactivated by organic material; prior cleaning is required for chlorine compounds to be effective
- low concentrations of sodium hypochlorite are effective and rapidly disinfect clean surfaces
- hypochlorite solutions may bleach and damage the texture of fabrics and corrode or damage materials eg stainless steel instruments and utensils
- solutions are unstable; are to be prepared fresh for use and to be used within 24 hours
- requires direct contact with surfaces (unsuitable for channels/crevices etc) for up to a maximum of 10 minutes
- affected by temperature and water pH
- concentration of chlorine-based disinfectants refers to available chlorine, which is a measure of oxidising power. The available chlorine content of a concentrated solution is expressed as percent w/v or, part per million (ppm). One percent corresponds to 10,000 ppm available chlorine

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<td>10,000ppm</td>
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<tr>
<td>Household bleach*</td>
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<tr>
<td>Milton**</td>
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</table>

*Household bleach (5%+ sodium hypochlorite) = 50,000 ppm available chlorine
**Milton (1% sodium hypochlorite) = 10,000 ppm available chlorine

Formaldehyde

The liquid form is bactericidal, tuberculocidal, fungicidal, virucidal and sporicidal. However, its carcinogenic properties limit its use. The aqueous solution (Formalin) contains 37-40% w/v formaldehyde. Formaldehyde is classified as a high level disinfectant and is chiefly used to preserve anatomical specimens.
**Comments:**
- Vapour is extremely irritating to the eyes and respiratory tract at low concentrations (1-5 ppm) which can also be detected by smell.
- Care must be taken to avoid contact between any free source of free chlorine, including chlorine disinfectants, and formaldehyde eg in histopathology laboratories and mortuaries.

**Glutaraldehyde**

Glutaraldehyde is a liquid disinfectant recommended for the purposes of high level disinfection of heat-sensitive endoscopic instruments (refer GENSA Infection Control Guidelines).

**Comments:**
- Refer to manufacturers directions for use of CIDEX™ and AIDAL™ as these products differ in relation to activation, duration of use and monitoring of in-use concentration.
- Care must be taken to avoid the introduction of organic material or excess water by unclean or wet instruments which will reduce the concentration of glutaraldehyde.
- Aldehydes fix protein to instrument surfaces; meticulous cleaning must occur prior to immersion.
- Workplace health and safety issues are well-documented.

**Indications for use of glutaraldehyde**

There are two fundamental issues important to the use of glutaraldehyde, and both must be addressed by users:
- Whether sterility is required for the instruments/equipment being processed, as distinct from high level disinfection; and
- Whether there is adequate workplace protection available for people who are using glutaraldehyde.

**Glutaraldehyde as a sterilizing agent**

It is technically possible to achieve sterilization by immersing items in glutaraldehyde, however, this requires many hours to accomplish and is not a practical means for achieving sterilization. Users need to consult manufacturers’ data on this point. Glutaraldehyde is more commonly used for short immersion times to produce high level disinfection.

Items requiring sterility (eg arthroscopes, hysteroscopes, laparoscopes and their accessories, cystoscopes and all other instruments entering normally sterile locations in the body) must have been processed by a recognised sterilization method. Steam sterilization, or one of the three low temperature sterilization methods are suitable to achieve this end.
Glutaraldehyde as a disinfecting agent

In cases where sterility is unnecessary and thermal disinfection is inappropriate (a good example is the reprocessing of gastrointestinal flexible endoscopes), high level disinfection using a TGA registered instrument grade liquid chemical disinfectant is indicated.

**NOTE:** The strong and appropriate recommendation (from a number of sources) is for instruments to be meticulously cleaned prior to immersion in the disinfectant. They are then rinsed free of residual glutaraldehyde (using water of known microbiological quality) after disinfection to protect both patient and staff from contact with the irritant and hazardous active agent of the disinfectant solution.

**NOTE:** Temperature requirements and other factors affecting the efficacy of glutaraldehyde should be reviewed prior to use. Consider manufacturer's directions.

Efficacy of glutaraldehyde

The Therapeutic Goods Administration (TGA) governs the marketing in Australia of all therapeutic goods including liquid sterilants and ‘instrument grade disinfectants’, such as glutaraldehyde. At the present time no new glutaraldehyde preparations are allowed to be marketed without TGA registration involving evaluation of their efficacy, adequacy of labeling, and assurance of Good Manufacturing Practice in their manufacture. Continued marketing of glutaraldehyde preparations which were on the Australian market prior to 1 January 1998 is occurring with ‘sponsoring’ firms already having submitted applications for retrospective registration. Through this process of TGA registration users can now be assured of the efficacy of glutaraldehyde preparations on the Australian market.

Soaking times/immersion times

The issue of soaking times for instruments being disinfected in glutaraldehyde is somewhat controversial. Many factors influence successful disinfection. The time for which an instrument is soaked in glutaraldehyde is but one factor, and is inversely governed by the temperature and concentration of the disinfectant solution. However the relationships are not linear.

Differences in recommended soaking times are seen between different manufacturers of glutaraldehyde disinfectants as well as between professional organisations representing users of the disinfectant. AS 4187 recommends that users consider manufacturers’ recommendations (requiring users to note the instructions for the particular glutaraldehyde preparation in use).

The infection control literature recommends a soaking time of 20 minutes for all endoscopic equipment undergoing high level disinfection, following careful cleaning, to satisfy the time requirements for inactivation of mycobacteria (Alvarado and Reichelderfer, APIC Guidelines for infection prevention and control in flexible endoscopy. AJIC 2000;28:138-155). The GENSA Guidelines for Infection Control in Endoscopy (1999) recommend a soaking time of 10 minutes for endoscope disinfection following a meticulous and repeatable regime of cleaning, with the exception of bronchoscopes, which require a soaking time of 20 minutes to inactivate mycobacteria.
Regardless of the soaking duration chosen, users must ensure that all equipment is meticulously cleaned prior to immersion and that the solution is in contact with all surfaces of each instrument during immersion, avoiding air bubbles trapped inside lumens.

**Glutaraldehyde concentration**

Whether glutaraldehyde preparations are acid or alkali based, the recommended in-use concentration of each preparation is an important point for effectiveness as a disinfectant. In order to achieve a nominal in-use concentration, manufacturers design their chemical formulation so that the concentration commences at an elevated level. As the concentration of active glutaraldehyde decreases over time, it remains above the minimal effective concentration up until the manufacturers recommended date of discard. Other factors will shorten the time that a solution can be used, as concentration will be affected by evaporation, dilution and carry-over.

‘Evaporation’ is simply the loss of glutaraldehyde from the solution through the process of conversion to a gaseous state and subsequent release into the air above the solution. This is the major factor requiring proper ventilation of any area in which glutaraldehyde is used.

‘Dilution’ is the reduction of the concentration of glutaraldehyde in the disinfectant solution due to the presence of droplets of water adhering to instruments following the final rinse of the cleaning stage. These droplets lower the concentration of glutaraldehyde in the disinfectant solution by a small amount by increasing the ratio of water to active ingredient.

‘Carry over’ is the gradual loss of disinfectant solution due to adherence of some of the solution to the surfaces of each instrument as instruments are removed from the solution. This residual material is toxic and must be rinsed off the instrument(s) after disinfection.

It follows that with evaporation, dilution and carry over, there is for each situation a point in time after commencement of use at which the concentration of glutaraldehyde is no longer reliable for disinfection and the solution must be replaced. This ‘end point’ will vary according to the type and number of instruments being immersed, as well as the number of days that have elapsed since use of the solution commenced. To avoid this potentially serious situation occurring, users must follow procedures involving monitoring of liquid concentration and replacement of the disinfectant with fresh solution at a frequency based on the results of concentration monitoring.

With relatively small numbers of instruments being processed, safe usage for as long as four weeks is possible with some brands of glutaraldehyde solution. Common practices used to avoid the ‘end point’ even being approached are to replace glutaraldehyde solutions on a weekly basis, or even daily in known high usage situations. Solutions are also discarded on a daily basis after use if the disinfectant is not stored in its in-use receptacle, as Workplace Health and Safety regulations prohibit recanting of solutions.
Monitoring glutaraldehyde concentration

Determining the replacement frequency requires measurement of in-use concentration. Monitoring strips (‘dip in the solution’ type) are available from the various suppliers of glutaraldehyde preparations. However, the strips need to be chosen to be compatible with the particular chemical formulation of the preparation in use. Chemical analysis of sample(s) of the solution in a laboratory is the only alternative to monitoring strips. Whilst laboratory analysis is more accurate than the available monitoring strips, the accuracy afforded by use of properly chosen strips is adequate for most purposes. Laboratory monitoring does provide a method for checking the accuracy of the monitoring strips where this is questioned.

Workplace health and safety issues

The workplace health and safety issues associated with use of glutaraldehyde disinfectants are significant as evidenced by the number of documented cases of skin and/or respiratory sensitisation reported by personnel involved in their handling or use. Staff wearing contact lenses who work in settings where glutaraldehyde is used should consult an ophthalmologist regarding the suitability of their lenses. Such staff may experience eye irritation or find that lenses become discoloured due to impregnation with glutaraldehyde. The issues are covered in detail in a report prepared in 1994 under the National Industrial Chemicals Notification and Assessment Scheme.

Glutaraldehyde is classified as a hazardous substance when its concentration is greater than 0.1% w/w, according to the National Occupational Health and Safety Commission’s Approved Criteria for classifying hazardous substances. If a substance is classified as a hazardous substance, then its use is regulated by Part 13 of the Workplace Health and Safety Regulation 1997. This requires that a worker is not exposed to more than the maximum allowable exposure standard relevant to that substance. In the case of glutaraldehyde this is the airborne concentration in the worker’s breathing zone, and workers need to be aware that maximum exposure limits exist. The Regulation governs all of the exposure standards, labelling, surveillance, personal protective equipment, training, management of spills, record keeping relevant to both employers and employees, and readers of this section are referred to it for further information.

In relation to employers’ responsibilities to protect workers from exposure to hazardous substances, the Division of Workplace Health and Safety has prepared a useful ‘Case Study’ that demonstrates the steps an employer must take to comply with the Regulation as it applies to a facility using glutaraldehyde for disinfection. It follows that there may be requirements for monitoring and health surveillance if the risk assessment process described in the Case Study indicates a significant risk.

For advice on these issues, contact the Division of Workplace Health and Safety on telephone Freecall 1800 177 717.
Ventilation and air quality monitoring

All areas where glutaraldehyde is used should be properly ventilated. This may be by means of controlled air flow that exhausts to atmosphere or by purpose designed recirculating fume cabinets with activated charcoal chemical vapour absorbent filters. If recirculating fume cabinets are being considered, their ability to maintain adequately low levels of glutaraldehyde vapour in the breathing zone of operator(s) needs to be assured prior to installation. There is also a need for the activated charcoal cartridge within a recirculating fume cabinet to be regularly replaced. The frequency of its replacement needs to have been specifically determined based on the amount of usage of the fume cabinet and the level of control of atmospheric glutaraldehyde required.

Where ventilation is unable to control the operator’s exposure to glutaraldehyde from inhalation, personal protective equipment such as a respirator may be necessary. Whichever ventilation method is used, an assessment by a skilled occupational hygienist who is able to measure the concentration of glutaraldehyde vapour in the operator’s normal breathing zone is necessary when an installation is first completed (or if it has never been tested before). Testing involves setting up equipment capable of sampling air in the breathing zone and the taking of a number of 15 minute samples in various locations.

To discuss and/or have this testing performed, contact Public Health Services Laboratories, Queensland Health, at Coopers Plains, Tel: (07) 3274 9106, Fax: (07) 3274 9177, or the Safety in Mines Testing and Research Station (SIMTARS), Redbank, Tel: (07) 3810 6336; Fax: (07) 3810 6388. These specialists provide a written report covering the results measured as well as recommendations about workplace health and safety issues observed at the time of testing in the facility. The cost of having this on-site analysis done will vary depending on factors such as location, number of sites, number of samples needing to be taken, and travel and accommodation costs (if applicable).

At the time of preparation of this section, the average cost for testing for a survey in the Brisbane area was $700 - $1000. This covers collection of samples, laboratory analysis, and written report containing results, observations and recommendations. Where testing is done for Queensland Health facilities by Centre for Public Health Services Laboratories' personnel, only travel and accommodation costs will have to be met. It would be best for individual facilities or Health Services Districts to seek a quotation. Some savings could possibly be made by way of a number of facilities in a geographical area arranging for testing at the same time.

Costs of this testing can be significant but repeated testing is only needed when there is a variation in the equipment, layout or ventilation system or an employee believes they are being exposed. Due to the limited number of testing personnel available in Queensland and the impracticality of frequent repeat testing, a policy of testing once only (provided there is no subsequent change in the process or the ventilation installation) is regarded as adequate monitoring of this issue. Some facilities may decide to have more frequent monitoring performed, but this is not required if there has been no change.

Monitoring of the reliable operation of ventilation systems, knowledge of the effectiveness of recirculating fume cabinets and/or observance of the recommended regimen for replacement of activated charcoal filters (where used) assures the continuing minimisation of hazard to workers due to glutaraldehyde vapour in the breathing space.
Personal protective equipment

Gloves of material impermeable to glutaraldehyde, full facial shield and water proof gowns or aprons are necessary for personal protection wherever glutaraldehyde preparations are used. Also, careful design of the area where disinfection is being performed and the procedures used will minimise the likelihood of skin exposure to glutaraldehyde.

Glove materials may be nitrile or latex with nitrile having more resistance to glutaraldehyde ‘break through’. The use of single-use gloves (changed with each procedure) avoids many of the problems of ‘break through’. Users of latex gloves need to be aware that the time for glutaraldehyde ‘break through’ may vary widely but is usually greater than one hour. Glutaraldehyde also ‘breaks through’ nitrile glove material following repeated use without washing residual disinfectant off gloves prior to storage between procedures.

The ‘sleeve length’ of gloves influences the risk of exposure to glutaraldehyde as well as the work practices aimed at minimising the risk of skin contact along the arms or wrists.

A suitable ‘spill kit’, designed for appropriate action in the case of a spillage of glutaraldehyde, is advisable. One supplier of spill kits suitable for spills up to 15 litres is Endomed Pty Ltd, 1/18 Paisley Drive, Lawnton, 4501, Telephone (07) 3881 1883.

Continued use of glutaraldehyde: difficult in-use situations

Difficulties in bringing under control the workplace health and safety issues relating to protection of health care worker(s) from exposure to glutaraldehyde as a hazardous substance may preclude its use in some situations. Employer responsibilities towards employees may lead to a decision in some situations to eliminate glutaraldehyde from a facility. In addition, practical issues precluding the use of glutaraldehyde where sterility is required may result in a decision to avoid its use in some situations.

These difficulties have created the impression that a state-wide or national ‘ban’ on the use of glutaraldehyde is imminent. This is not the case. Safe use of glutaraldehyde is technically and practically feasible, and in view of this Queensland Health has no plan to generally limit its use in facilities over which it has jurisdiction.

Eliminating the use of glutaraldehyde for sterilization purposes

Where surgical procedures are invasive, instruments must be sterile. In previous years glutaraldehyde has been widely used for processing heat sensitive invasive equipment but it is now a Queensland Health risk management priority that use of glutaraldehyde for this purpose be eliminated. The following points should be considered for action to eliminate the use of glutaraldehyde:

- increase available inventory of heat sensitive instruments, particularly rigid endoscopes
- replace older design instruments by newer design steam sterilizable ones and use steam sterilization
- install low temperature sterilization equipment appropriate for the instruments in use
- organise better shared use of expensive instrument inventory belonging to the District
- manage operating theatre case lists in a way that optimises use of the available instruments in association with their sterile processing requirements
Ortho-phthalaldehyde (OPA)

Ortho-phthalaldehyde (OPA) is an instrument grade liquid disinfectant recommended for the purposes of high level disinfection of heat sensitive instruments. The increased level of microbial activity of ‘OPA’ lends itself to shorter disinfection immersion times than other available high level chemical disinfectants.

‘OPA’ (0.55%) is a high level disinfectant suitable for reprocessing clean, heat sensitive, semi-critical medical and dental devices. It does not sterilize devices; items requiring sterilization should undergo an appropriate, biologically monitored sterilization process.

The minimum effective concentration (MEC) of ‘OPA’ is 0.3%. The solution may be reused for a maximum of 14 days, and should be monitored using Solution Test Strips to ensure that the MEC is above 0.3% during this time. No activation of the product is required. Once opened, the shelf life of the unused portion can be stored in the original sealed container for up to 75 days prior to use. Prior to disposal, the solution must be inactivated using Glycine. The product is designed to be used in both manual (bucket and tray) systems as well as automated endoscope reprocessors. The manufacturer’s instructions should be consulted.

Thorough cleaning of instruments, including all lumens, prior to immersion should involve the use of a near neutral, low-foaming and easily rinsed detergent. Any residual contamination reduces the effectiveness of ‘OPA’. The item is to undergo cleaning and drying prior to immersion in ‘OPA’, immersed completely for at least 10 minutes at 20°C (room temperature), and rinsed according to manufacturer's instructions. Tests have shown that ‘OPA’ is a more rapid tuberculocidal agent than other high level chemical disinfectants; this is achieved following immersion of a thoroughly cleaned instrument for 10 minutes.

Comments:
- stable over a wide pH range
- does not fix proteinaceous material to instruments
- is compatible with a wide range of instrument models and materials
- does not require activation
- non-irritating to personnel
- stains skin and surfaces
- costly in comparison to glutaraldehyde

Workplace health and safety

Direct contact with ‘OPA’ may cause irritation to eyes and skin, and temporary staining of the skin. Repeated contact may cause sensitisation. Personal protective equipment (eg gloves with sleeve length to protect arms or wrists made of latex, nitrile, butyl rubber or synthetic copolymer; full face shield; fluid resistant gowns) should be used in concordance with AS 4187 requirements.

‘OPA’ vapours may cause respiratory and eye irritation. The agent should be used in a well-ventilated area in closed containers with tight-fitting lids. Local exhaust hoods may be required if the area is not adequately ventilated.
Peroxygen biocide

The one available peroxygen disinfectant (Virkon™) may be used on environmental surfaces; however surface disinfection is not routinely required in health care settings.

Phenolics

Phenolics are classified as low level disinfectants. They are absorbed by porous materials, and the residual disinfectant may cause tissue irritation. Phenolics are bactericidal, virucidal, fungicidal and tuberculocidal.

Comments:
- mainly used for environmental disinfection of non-porous surfaces, such as laboratory surfaces
- not for routine hospital use

Quaternary ammonium compounds

Suitable for low-level disinfection of clean surfaces; not recommended for routine use in health care facilities. Cement, synthetic rubbers and aluminium may be damaged by quaternary ammonium compounds, especially if an anti-rust compound has been added to the solution. Inactivated in the presence of organic matter.

Purchasing chemical disinfectants

The following is a list of actions and principles to assist in rationalising the range of chemical disinfectants being purchased for use in individual facilities:

Formulate a policy for the selection and application of chemical disinfectants in the health care facility

Determine the overall use of disinfectants through a comprehensive survey of all departments and prepare a list of currently purchased products and the purposes for which they are used. The concentration in use should also be noted.

Use the list as a basis for eliminating the use of disinfectants when:
- sterilization is required
- disinfection by hot water or steam can be carried out
- the use of an antimicrobial agent is unnecessary

Develop policies for which chemical disinfectants are required (applications and in-use concentration) for disinfection of hospital equipment, for example
- phenolic disinfectant in discard jars in bacteriological laboratories
- glutaraldehyde or OPA used for disinfection of endoscopic instruments
- disinfection of the hospital environment
Disinfectants for cleaning

It has been demonstrated by Ayliffe et al (1967) and other investigators that the benefit of including an antibacterial agent in the cleaning solution is restricted to the short period of wet contact. Residual disinfectant, which may remain on the floor, is inactive in the dry state and does not retard the rate or decrease the level of re-contamination in areas where uncontrolled movement of people and equipment occurs. Sodium hypochlorite is recommended where disinfection is required following cleaning of blood spills (refer ‘blood spill cleaning procedure’), and alcohol (eg isopropyl alcohol-impregnated wipes) may be used on clean trolley tops and similar surfaces that have been physically cleaned.

Other significant issues for disinfectant purchasing

- disinfectants should have TGA approval
- the successful implementation of a disinfection policy depends on the provision of information to the staff throughout the hospital
- the responsibility for preparing dilutions should be centralised and placed under the supervision of a pharmacist
- the solutions that are distributed to wards and departments should be ready for use and clearly labelled to identify the type of disinfectant
- the selection of a type or brand should be based on compatibility with materials with which it may come in contact during use, the risk of harm to the user or the articles treated, the intended purpose of the disinfection process, and cost-effectiveness

Endoscopic instruments and their accessories

Fibre-optic endoscopic instruments can be divided into rigid endoscopes (laparoscopic instruments) and flexible endoscopes. There are significant processing and usage differences between rigid and flexible endoscopes.

However, both rigid and flexible endoscopes (and their accessories) require meticulous cleaning prior to undergoing the appropriate sterilization, or high level disinfection, process.

Rigid endoscopes are categorised as ‘critical’ items (refer to ‘Spaulding’s classification’), and must be sterilized between uses. Flexible endoscopes are categorised as either ‘critical’ or ‘semi-critical’ in relation to the nature of their use. Those classified as ‘critical’ must be sterilized. In the case of ‘semi-critical’ flexible endoscopes, sterilization is preferred but not mandatory. Where sterilization of ‘semi-critical’ flexible endoscopes is not possible, high level chemical disinfection is required.

Both rigid and flexible endoscopes can be sterilized by low temperature processes, although some methods may be unsuitable for some flexible endoscopes. Many rigid endoscopes can also withstand steam sterilization. Endoscopes with no attached lenses, fibre-optic light carriers or cables, and suitable accessories, may be sterilized by steam (refer to ‘steam sterilization’ and ‘low temperature sterilization processes’). In all instances, the instrument manufacturer’s instructions as to the preferred method of sterilization should be followed.
A wide range of accessories is available for both invasive and non-invasive endoscopes, including forceps, laparoscopic scissors, diathermy, snares, sphincterotomy knives, and lasers. Accessories used in conjunction with rigid and flexible endoscopes should be treated as ‘critical’ items and sterilized.

**Summary of processing requirements**

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* method dependent on location of sterilizing machinery and need for wrapped product (wrapped is preferred)
♦ method dependent on instrument type, materials and facilities – consult instrument manufacturer

**Rigid endoscopes**

Invasive (‘critical’) endoscopes are mainly laparoscopes, and rigid instruments with no operating channel. According to AS 4187, arthroscopes and laparoscopes which are inserted into sterile body cavities shall be sterile. Rigid endoscopes are classified as ‘critical’ (refer ‘Spaulding’s classification’) and must be sterilized. Although high level disinfection has been used in the past, it is now considered inadequate.

**Sterilization of rigid endoscopes**

Sterilization of invasive devices attains a higher standard of infection control than high level disinfection can achieve, is more thoroughly controlled, and cycle times are comparable with immersion in disinfectants.

Low temperature sterilization methods (ethylene oxide, peracetic acid or hydrogen peroxide plasma sterilization processes) or steam sterilization may be used for rigid endoscopes. Low temperature methods are preferable as they may reduce instrument damage caused by repeated exposure to steam (even when the instrument is steam compatible). Refer to ‘steam sterilization’ and ‘low temperature sterilization processes’.

Laparoscopes and accessory instrumentation shall be dismantled, cleaned (specially designed ultrasonic irrigators are available to assist cleaning), dried thoroughly and then reassembled prior to sterilization.
Flexible endoscopes

Flexible endoscopes can be classified according to Spaulding’s classification as ‘critical’ (e.g. invasive) instruments that penetrate the skin or are inserted into a sterile cavity, or as ‘semi-critical’ (e.g. non-invasive) items that are in contact with intact mucous membranes. However, even in cases where items are not classified as ‘critical’, sterilization is preferable to high level disinfection.

Sterilization of flexible endoscopes

Steam sterilization is unsuitable for flexible endoscopes because they are unable to tolerate temperatures greater than 60°C. Low temperature sterilization methods are required when sterilization of flexible endoscopes is required (i.e.: flexible endoscopes categorised as ‘critical’) and, where sterilization is desired (i.e.: flexible endoscopes categorised as ‘semi-critical’) but not mandatory.

Low temperature systems such as ethylene oxide, and peracetic acid sterilization systems may be used to sterilize flexible endoscopes. However, the hydrogen peroxide plasma sterilization process is not commonly used for reprocessing flexible endoscopes due to the following technical problems:

- very long narrow lumens and those closed at one end are unsuitable for sterilization using the hydrogen peroxide plasma process
- process compatible packaging must be used
- biological indicators are required for routine monitoring with lengthy incubation periods
- entire cycle takes 75 minutes, making hydrogen peroxide plasma impractical for routine processing of most gastroenterological endoscopes

High level disinfection of flexible endoscopes

Non-invasive or ‘semi-critical’ items may either be sterilized or high level disinfected, however sterilization is the preferred method whenever possible. In the case of bronchoscopes that are high-level disinfected, care must be taken to observe the contact time required to inactivate Mycobacterium tuberculosis.

High level disinfection is a suitable process for non-invasive (‘semi-critical’) endoscopes such as gastroscopes, duodenoscopes, sigmoidoscopes, proctoscopes, colonoscopes, bronchoscopes, and laryngoscopes.
Reprocessing of anaesthetic and respiratory equipment

Most anaesthetic machines and breathing systems are contaminated to a minor degree with microorganisms. Equipment that is in direct contact with the patient (breathing circuits and masks) becomes more heavily contaminated.

All anaesthetic equipment that comes into contact with a patient’s body fluids (including saliva) must be changed, cleaned and thermally disinfected before use on another patient. This includes equipment that has come into indirect contact with the anaesthetist’s hands, which may be contaminated with blood, saliva or other body fluid. Additionally, unused items introduced into the anaesthetic work-field should be regarded as dirty and reprocessed. Attachment 3 outlines recommended processing information for anaesthetic and respiratory equipment.

To protect staff from aerosols generated during manual cleaning processes, preference should be given to the use of washer/disinfectors for the washing, disinfecting, rinsing and drying of respiratory apparatus. Most units automatically process through pre-wash, disinfection, rinse and drying cycles.

Anaesthetic equipment: cleaning methods

Thorough cleaning of all instruments and equipment is an essential prerequisite in disinfection and sterilization processes:

- all systems must be disassembled completely to allow unrestricted contact of all parts with the cleaning and disinfection process
- measuring instruments and pressure gauges must be processed separately according to the recommendations of the manufacturer
- lumens of non-disposable endotracheal tubes, airways, facemasks, laryngeal masks, anaesthetic breathing circuits and cobs connectors are to be placed over the appropriate nozzle/water jet on the washer/disinfector to ensure proper cleaning and rinsing
- the manufacturer’s instructions for cleaning and reprocessing of anaesthetic equipment should be followed
- mechanical washer/disinfectors must not be overloaded

The cleaning of external surfaces of anaesthetic machines and associated equipment should occur on a regular basis; the use of detergent and water is sufficient. The internal components do not require routine cleaning and disinfection.

Anaesthetic equipment: disinfection requirements

Anaesthetic respiratory equipment is classified as ‘semi-critical’ (refer to ‘Spaulding’s classification’) and requires thermal disinfection for reprocessing. Sterilization of anaesthetic and ventilator equipment is generally unnecessary.

Water temperatures for thermal disinfection

Rinse water temperature shall be between 80°C and 86°C (>80°C). Refer to ‘Water temperature for thermal disinfection’.

Monitoring of washer/disinfectors

The requirement for routine microbiological monitoring of washer/disinfectors is unwarranted, as there are no current standards to determine if the washer/disinfector is microbiologically safe. Washer/disinfectors and instruments should be visually inspected and cycle parameters monitored to determine if the machine is functioning correctly:

- perform visual inspection and documentation of time at temperature. Instruments and equipment should be free from detergent and rinse additive residues
- presence of chemical residue (if the washing machine is functioning as designed with temperature, detergent, wash and rinse pressure all at the correct levels, there will be virtually no chemical residue left on instruments)

Standardized test devices are available for testing the effectiveness of wash processes. These tests are based on a visual indication of soil removal effectiveness.

Perform regular thermocouple testing of disinfection temperatures:

- rinsing 40°C to 50°C;
- washing 50°C to 60°C;
- disinfecting 80°C to 95°C, for up to 10 minutes

Drying

Drying reduces the risk of contamination during inspection and assembly of instruments:

- drying cabinets should be used for drying anaesthetic equipment. Drying cabinet operating temperatures shall be within the range 65°C to 75°C
- on completion of the cycle, the items shall be removed and placed in the anaesthetic apparatus drying machine (if drying cycle not installed). Tubing and other items with lumens shall be placed over appropriate connectors to ensure hot air dries all surfaces. Drying facilities may be available within the washer/disinfector

Single use items

- use single use sachets of lubricant for insertion into the patient’s airway
- avoid using multi-dose vials. Such vials should always be accessed with a clean needle and syringe and dedicated for single patient use only

Soaking or ‘cold sterilization’

Soaking or ‘cold sterilization’ (immersion of the different items in solutions containing disinfectants eg aldehydes) has a relatively high failure rate due to dosing errors, insufficient contact time (air trapping) as well as disadvantages of toxicity, skin irritation and allergy, and environmental concerns.
Management of patients with confirmed or suspected pulmonary tuberculosis

Ideally, elective operative procedures on patients who have pulmonary tuberculosis should be delayed until the patient is no longer infectious. However, if operative procedures must be performed, they should be done, if possible in operating rooms that have anterooms and staff must observe airborne precautions (refer to ‘additional precautions’).

For operating rooms with anterooms, the doors to the operating room should be closed, and traffic into and out of the room should be minimal to reduce the frequency with which the door opens and closes.

- a bacterial filter should be placed as close as possible to the patient to help reduce the risk of contamination of the anaesthetic equipment (ventilator and CO₂ absorbers) and prevent the discharge of tubercle bacilli into the ambient air
- preference may be given to a disposable anaesthetic breathing circuit with appropriate filters
- detergent and water is sufficient for environmental cleaning