Update in
Anaesthesia

Originally published in Update in Anaesthesia, edition 7 (1997)

Decontamination Procedures for Medical Equipment

Roger Skilton
Correspondence Email: Bruce.McCormick@rdeft.nhs.uk

Summary

Decontamination of medical equipment involves the destruction or removal of any organisms present in order to prevent them infecting other patients or hospital staff.

Decontamination reduces the risks of cross infection and helps to maintain the useful life of equipment. It is important in the overall control of hospital acquired infection.

INTRODUCTION

Microbes (bacteria and viruses) can be carried from one person to another on the surface of any equipment that is shared between them unless it is decontaminated between use. They can also be carried on the skin surface which is why handwashing between examining patients is important. Microbes gain access to the body, through open wounds, inhalation of infected secretions or by close contact with mucous membranes. The process by which microbes are passed from one infected person, to cause infection in another, is known as 'cross-infection'.

Cleaning, disinfection and sterilisation are all procedures that are used in the decontamination process.

DEFINITIONS

Cleaning is the process that removes contaminants including dust, soil, large numbers of micro-organisms and organic matter (e.g. blood, vomit). It is an essential prerequisite to disinfection and sterilisation. It also removes the organic matter on which micro-organisms might subsequently thrive.

Disinfection is a process used to reduce the number of micro-organisms but not usually bacterial spores. The process does not necessarily kill or remove all micro-organisms, but reduces their number to a level which is not harmful to health.

Sterilisation removes or destroys all forms of microbial life including bacterial spores. Each instrument or piece of medical equipment which comes into contact with a patient is a potential source of infection. These are divided into 3 groups of risk, described in Table 1.

TECHNIQUES OF DISINFECTION AND STERILISATION

Before equipment is to be disinfected or sterilised, it should be thoroughly cleaned to remove any visible dirt or secretions. This involves washing with water and detergent (soap). Protective clothing (an apron, gloves and a facemask) should be worn.

Disinfection is best achieved by moist heat such as boiling in water (100°C for 10 minutes at sea level) which kills all organisms except for a few bacterial spores. It is important to remember that the temperature at which water boils decreases with altitude and a longer boiling time will be required. For example, at 4000m above sea level where boiling occurs at 86°C a minimum of 20 minutes is required for disinfection. It is important to note that boiling equipment items in water will not achieve sterilisation.

Disinfection can also be achieved by using chemicals which however may themselves be toxic when allowed contact with skin or are inhaled. They can also be corrosive and flammable so that protective clothing (gloves, apron and a facemask) should be worn. Chemical disinfectants may be supplied ready to use or may need accurate dilution to provide an appropriate solution. It must be remembered that disinfectants

Table 1. *Level of risk*

High risk items	Items come into close contact with a break in the skin or mucous membranes or are introduced into a normally sterile body area. e.g. surgical instruments, needles, urinary and other catheters. ***Sterilisation** is required for this group.*
Intermediate risk items	Items come into close contact with mucous membrane or are items contaminated with particularly virulent or readily transmissible organisms. e.g. Items of respiratory equipment including laryngoscope blades, endotracheal and tracheostomy tubes, oropharyngeal and nasal airways. ***Disinfection** is required for this group.*
Low risk	Items only come into contact with normal intact skin. e.g. stethoscopes or washing bowls. ***Cleaning and drying** is usually adequate for this group.*

R Skilton
Consultant Anaesthetist
York District Hospital
York YO31 8HE
UK

can decay and lose activity. Decay is more rapid at high temperatures and can be accelerated by the presence of impurities. All disinfectants take time to work.

RANGE OF ACTIVITY OF DISINFECTANTS

Gram positive bacteria (e.g. Staphylococci), are more sensitive than gram negative bacteria (e.g. Pseudomonas). Mycobacteria and spores are relatively resistant. Enveloped viruses (e.g. HIV) are killed by most disinfectants but non-enveloped viruses (e.g. Coxsackie) tend to be more resistant.

Spores

Fungal spores are easily killed by disinfectants. Other bacterial spores (e.g. Clostridia) are resistant to most disinfectants in common use.

Tubercle bacteria

These pathogens are more resistant to chemical disinfectants than other bacteria. They can be killed by exposure to 2% alkaline Glutaraldehyde solution (Cidex) for 60 minutes.

Viruses

Hepatitis B virus (HBV) and Human Immunodeficiency Virus (HIV) are inactivated by Cidex in 1 - 2 minutes, although to ensure adequate penetration, soiled items should be placed in a 2% glutaraldehyde solution for 30 minutes. Exposure to 70% alcohol solution for 10 minutes is also effective. Viruses causing Rabies, Lassa fever and other haemorrhagic fevers are also killed by Cidex.

CHEMICAL DISINFECTANT SOLUTIONS

Clear Soluble Phenolics (e.g. Stercol & Hycolin) are good for killing most bacteria including TB. They have limitied activity against viruses.

Hypochlorites (e.g. Presept and Milton)

These agents have a wide range of activity against bacteria, fungi, viruses and bacterial spores. They may be used for decontaminating any area with blood spillage. They are corrosive to metals and must be applied at the correct concentration. They are inactivated by organic matter and decay on storage.

Alcohols (e.g. methanol, ethanol and isopropanolol)

Alcohols have good activity against bacteria & viruses. They should only be used after all the visible surface dirt has been removed from the area to be disinfected.

Aldehydes (e.g. glutaraldehyde and formaldehyde)

These agents are active against bacteria, viruses and fungi. They have a slow action against tubercle bacilli and are irritant to skin and eyes.

STERILISATION

This can be achieved by steam, steam and formaldehyde, hot air, ethylene oxide or irradiation. Autoclaving is the commonest method, using steam under pressure and is the most reliable way to sterilise instruments. A temperature of 134°C for 3 minutes or 121°C for 15 minutes is recommended.

Formaldehyde is irritant to the eyes, respiratory tract and skin. It can also be absorbed by some materials and subsequently slowly released with potentially hazardous results. Hot air sterilisation takes a long time and items must be able to withstand temperatures of at least 160°C for periods of 2 hours or more.

Ethylene oxide is a colourless gas which is toxic to inhale. It is effective against all organisms and does not damage equipment. The operating cycle ranges from 2 - 24 hours so the turnaround time is prolonged and it is a relatively expensive process.

Sterilisation by irradiation is an industrial process and particularly suited to the sterilisation of large batches of products. Irradiation can cause serious deterioration of materials and is therefore not a suitable method for the resterilisation of equipment items.

SUMMARY OF DECONTAMINATION PROCEDURES

Respiratory equipment

Sterilisation is unnecessary since spore-bearing organisms are not a cause of respiratory infection. Infection hazards can be reduced by lowering the amount of condensation in a circuit by means of heat-moisture exchangers, moisture traps and by the regular cleaning and drying of valves and circuits.

Many hospitals do not have access to disposable **ventilator circuits** and therefore with mechanical ventilators the internal circuit can often be autoclaved. The external (or patient) circuit and humidifiers may be disinfected in a washing machine at a temperature of at least 71°C for 3 minutes. The external circuit should be changed every 48 hour or between patients. Heated water humidifiers should be cleaned, dried and refilled with sterile water every 48-72 hours. If nebulisers are used they should be rinsed in alcohol after cleaning every 48 hours.

Anaesthetic face masks should be washed and cleaned after each use. Where resources allow single use disposable masks are now recommended.

Laryngoscope blades should be washed after use and disinfected either chemically by soaking in 70% alcohol for 10 minutes, or by thermal means such as boiling in water at 100°C for 5 mins.

Endotracheal tubes intended for single use can be re-used if they are cleaned and disinfected. Thermal methods are likely to cause material damage but following cleaning, chemical disinfection can be provided by immersing tubes in a solution of 70% alcohol for 10 minutes. The tubes should then be allowed to dry before use. 2% glutaraldehyde is not suitable as it may be absorbed by the plastic and is too irritant.

Suction catheters are not easy to clean but provided they are free of visible soiling they may be disinfected using 70% alcohol as described earlier and allowed to dry before use.

Instruments such as needles and cannulae (including spinal and epidural needles) are reused in many resource-poor settings, where the supplies of new equipment are severely stretched. These must be sterilised after thorough cleaning. In many situations autoclaving is the most practical technique.