

THE BASICS OF DECONTAMINATION

Objectives:

Review the basic factors that impact cleaning and decontamination of surgical devices.

Present the fundamentals of manual and automatic cleaning

Review various cleaning agents

Explain the advantages of a multi-step cleaning process

Understand cleaning technology challenges

Introduction:

The establishment of high quality, consistent decontamination practices is important for every healthcare facility. Exposure to contaminated instruments is risky for the healthcare worker, the patient and the community at large.

Decontamination is the process of rendering soiled medical devices safe for further handling and reprocessing. It includes the reduction of infectious organisms and other contaminants. The purpose of decontamination is to make devices safe for handling and prevent the transmission of disease.

OSHA defines decontamination as “the use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.” (29 CFR 1910.1030)

The first and most important step in decontamination is thorough cleaning and rinsing. AAMI defines cleaning as “the removal, usually with detergent and water, of adherent visible soil such as blood, protein substances and other debris, from the surfaces, crevices, serrations, joints, and lumens of instruments, devices, and equipment by a manual or mechanical process that prepares the items for safe handling and/or further decontamination.” (AAMI ST35)

Failure to properly clean a device after it is used on a patient may allow foreign material including microorganisms to interfere with the effectiveness of subsequent disinfection and sterilization.

Basic Factors of Cleaning and Decontamination:

Soiled medical devices furnish an environment for the growth of microorganisms. Thorough cleaning is absolutely essential to the effectiveness of subsequent processes.

There are a number of factors that determine the efficiency of the cleaning process, including the following:

- Type and amount of soil
- Quality of water
- Type of detergent
- Concentration of detergent
- Type of instrument or device
- Amount of time permitted for the detergent to act

Specifically, the efficiency of the cleaning process is influenced by many factors including the amount of blood and organic matter on the devices as well as the total number of instruments soiled and if blood has been permitted to dry on the instruments for a number of hours. It is crucial to keep instruments moist if they cannot be cleaned immediately.

Employee safety is an important concern. All staff handling contaminated devices must be properly trained and must wear personal protective equipment to protect from splashes and other means of contamination. Those in the decontamination area should wear the following PPE:

- Hair covering
- Eye protection
- Face mask
- Fluid resistant gown
- Utility gloves
- Skid resistant shoe covers

Contaminated devices should be contained from point of use to the decontamination area. Contaminated devices should be handled as little as possible to minimize potential exposure to employees, patients and the environment. Contaminated items should be contained during transport. Containers or carts must be marked with a biohazard label or secured in a red bag.

The design and location of the decontamination area should consider several factors to facilitate effective and efficient decontamination activities. The area should be physically separate from all other areas of the sterile processing department. Further, it should be accessible from a service corridor. Floors and walls should be sealed and protected from possible sources of contamination. The temperature should be controlled at a range of 20°C to 23°C or 68°F to 73° F to reduce the growth of microorganisms, and for the comfort of staff working in the decontamination area wearing personal protective attire. The ventilation system should be designed so that air flow patterns will not allow air contaminants to enter clean areas and allow for no less than 10 air exchanges per hour under negative pressure. Relative humidity should range from 30% to 60%.

The Fundamentals of Manual and Automatic Cleaning

Instruments must be cleaned as soon as possible after use, to avoid rusting or pitting, and to remove soil before it can dry and harden on surfaces and in the

serrations and crevices of the device. If stainless steel instruments are permitted to sit for hours before cleaning they may tarnish and plated instruments may show evidence of rusting. It is essential to remove all particles of tissue, blood, scale and accumulation of salts. All ratchets, box locks of instruments should be open and whenever possible devices should be disassembled for cleaning.

Procedures should be developed for all methods of decontamination of reusable items. The level of decontamination depends on the degree of infectivity, the necessary level of microbial kill, the characteristics of the device, and the degree of biohazard the device presents. The written recommendations of the device manufacturer should be reviewed and followed.

Reusable items may be cleaned by hand, by use of mechanical equipment, or a combination of the two methods. However, not all cleaning and decontamination procedures are appropriate for all types of devices. For example, some items cannot be immersed or may not tolerate high temperatures, i.e. scopes, cameras, power equipment. The cleaning method should be effective and not affect the functionality of the device. It is critical that the device manufacturer's written instructions for cleaning and decontamination be obtained and consistently followed.

Manual cleaning is often recommended for delicate or complex medical devices. For highly soiled items manual cleaning or soaking can facilitate the cleaning process and the outcome. For manual cleaning, active non-protein fixing cleaners with or without anti-microbial effect or cleaners with enzymes should be used. The cleaning solutions should be prepared on a daily basis. When there are high levels of contaminants, the cleaning solutions should be changed more frequently. If solutions are used too long, there are corrosion risks from contaminants, increased concentration of cleaning solution, and may result ineffective disinfection and sterilization.

Some concentrated cleaners come with a dispensing system whereby the correct dosage is automatically released at time of use. To prevent contaminant residues from drying on instruments, wet preparation at point of use is highly recommended. A thorough cleaning and rinsing is required, because blood, pus, or detergent residue may impede subsequent disinfection and sterilization. Manual cleaning with brushing contributes to improved outcome over static cleaning. However it is important to use the correct procedure and products.

The main reason for mechanical damage in manual cleaning is use of metal brushes, coarse scouring agents, too much force and the dropping or bumping of instruments. It is important to remember that items must be cleaned under the solution to avoid splashing and generation of aerosols.

Cleaning brushes are very important for manual cleaning and the removal of soil within cannulated devices. The correct size must be used for example to clean a lumen. Brushes used for cleaning must be decontaminated or discarded to remove

bio-filming organisms and prevent bio-film. Brushes must be decontaminated after each use.

Mechanical action is necessary for removal of most soils and microorganisms. An automated process should be used whenever possible. The use of mechanical equipment can improve cleaning effectiveness, increase productivity, and promote employee safety. Various types of mechanical cleaning equipment are available such as washer disinfectors, ultrasonic cleaners and cart washers, and the equipment should be selected to meet the health care facility's needs. Cleaning and disinfecting can best be standardized when using machine-based processes. As specified by international standards (prEN ISO 15883), only validated machine cleaning processes should be used.

An automatic washer that is highly effective for removing soil from hard to reach areas is ultrasonic. It creates waves that cause the solution to vibrate through the detergent bath. This action is called cavitation, a very rapid vibration that sets the molecules in the bath in rapid motion and causes them to implode. The resulting vacuum draws foreign matter including microorganisms from the cracks, crevices and hinges of medical devices.

When using automatic washers, the following procedures should be followed:

- All trays and holders need to be loaded correctly.

- Be sure that larger instruments do not obscure other instruments.

- Use appropriate cleaning and rinsing methods for cannulated devices.

- Arrange instruments to prevent damage through contact.

- Remove items immediately upon completion of the cycle to avoid residual moisture.

As a rule, thermal disinfection carried out with high temperatures and corresponding exposure time/contact time is the better choice over chemical disinfection. An automatic washer system with thermal disinfection incorporates the following steps:

- Pre-wash with cool tap water to remove coarse soil and foaming substances

- Cleaning with suitable detergent, i.e. enzymatic cleaner, for at least 5 minutes

- First rinse with demineralized water, if possible

- Second wash in hot water with a pH neutral or mild alkaline detergent (thermal disinfection)

- Second rinse

- Lubrication to achieve smooth action of working elements

- Final rinse with demineralized water to prevent spotting, stains, deposits and corrosion on surfaces and within channels of surgical instruments.

- Sufficient drying (steam-heat cycle)

Cleaning Agents

The selection of detergent in the cleaning process is not a simple matter. Surgical instruments are delicate easily damaged and susceptible to chemical attack. The

challenge is to select the correct detergent that provides excellent cleaning and minimal damage to the instrument surface.

Several cleaning agents are used for decontamination. These include water (the universal solvent) as well as detergents with and without enzymes. Detergents are cleaning agents that dislodge soil. Detergents work by lowering surface tension, dissolving or suspending small particles and keeping soils in suspension so that they can be washed or rinsed away.

Enzymes are catalysts that break down or digest large organic molecules. They work on a particular substance or substrate very much like a lock and key. They interact with and break down a particular molecule then move on and repeat the process. As they are very specific in their actions, it is advantageous to use a multi-enzymatic cleaner which acts on multiple substrates. For example, protease breaks down blood, mucous, feces and albumin; lipase breaks down fat such as bone marrow and adipose tissue; and amylase catalyzes starch.

Detergents used in the cleaning process should be compatible with the medical device to be cleaned. A neutral pH detergent or a slightly alkaline detergent is preferred over a caustic detergent. For example, detergents should not cause corrosion or promote electrolytic reactions. The pH level of a detergent is a crucial variable when decontaminating surgical devices. A pH of 7 is neutral. A detergent with a pH over 7 is alkaline. A detergent with a low pH (under 7) is acidic. A high alkaline detergent can cause alkaline streaking and a detergent that is acidic can cause corrosion.

Several high alkaline detergents are followed with a subsequent neutralizer or acid wash to neutralize the solution. PH neutral detergents do not require the addition of this product.

Multi-step Cleaning Process

Effective cleaning is a multi-step process. It relies on correct procedure and practices including pre-cleaning at point of use and thorough cleaning within the decontamination area. If not performed correctly, the entire decontamination process can be affected.

Staff must be trained and follow the required procedures and be knowledgeable of the various steps and potential pitfalls. For example, cold water or solutions at low temperature are preferable in the pre-cleaning step for rinsing or soaking protein from instrument surfaces to avoid coagulation. However, when cleaning, cool water may not activate the detergent, and water hotter than 43°C (109°F) may denature the protein in enzymatic cleaners. An enzymatic foam spray is preferable to liquids for transport as it inhibits spills and splashing, but a high foam product should never be used in automatic washers.

Replication in a stepwise process is necessary for the removal of soil. That is why various processes are used to clean surgical instruments. Thorough cleaning, and thermal disinfection renders a device safe for handling. Items should be disassembled for cleaning. Pre-cleaning with enzymes followed by thermal disinfection with a low foam detergent and thorough rinsing are the basic steps in instrument cleaning. Lipids are particularly hard to remove from surfaces. To remove fats from surfaces, staff may need to replicate the process using multiple enzyme cleaning steps.

Enzymes break down organic contaminants, but they do not destroy microorganisms. That is why cleaning is a multi-step process including thermal disinfection with an effective chelating detergent and mechanical action to remove soil and microorganisms.

A final inspection step must be performed to assure the cleanliness of the device. This inspection includes a visual check for the complete removal of debris and detergent residue.

Cleaning Technology Challenges

Removing soil and microorganisms from endoscopes, fiber optics and other cannulated devices can be particularly challenging and require time to properly process. Items such as catheters, needles, tubes, and minimally invasive endoscopic instruments have internal passageways that are hard to reach.

Hemostats have serrations and crevices that also create cleaning challenges. Blood or solutions can become dried and difficult to remove. Such items should be soaked in an enzymatic cleaner to reduce surface tension and brushed to remove soil from surfaces and channels.

Thermal disinfection is best accomplished with automated equipment including washer decontaminators, ultrasonic washers, endoscope reprocessors, and cart washers for case carts and transport vehicles.

New products offering technological improvements are constantly being developed and introduced in the marketplace. It is important for healthcare professionals to be aware and informed of the newest state of the art products and latest innovative technology designed to meet ever changing healthcare needs.

New tools are available to assess the effectiveness of a facility's decontamination process. Nonetheless always do a visual inspection and follow the device manufacturer's instructions for use.

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