

STERI-7[®]

INFECTION CONTROL SOLUTIONS



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There are many different liquid disinfectants available under a variety of trade names. In general, these can be categorized as halogens, acids or alkalines, heavy metal salts, quaternary ammonium compounds, aldehydes, ketones, alcohols, amines, and dual actives. Unfortunately, the most effective disinfectants are often very aggressive (corrosive) and toxic. Some of the more common ones are discussed below:

Alcohols:

Ethyl or isopropyl alcohols in concentration of 70% to 90% are good general-use disinfectants. However, they evaporate fast and therefore have limited exposure time. They are less active against non-lipid viruses and ineffective against bacterial spores. Concentrations above 90% are less effective.

Formalin:

Formalin is 37% solution of formaldehyde in water. Dilution of formalin to 5% results in an effective disinfectant. Formaldehyde is a human carcinogen and creates respiratory problems at low levels of concentration.

Glutaraldehyde:

This compound although chemically related to formaldehyde, is more effective against all types of bacteria, fungi, and viruses. Vapours of glutaraldehydes are irritating to the eyes, nasal passages and upper respiratory tract. They should be used always in accordance with the instructions on the label and the appropriate personal protective equipment.

Phenol and Phenol Derivatives:

Phenol based disinfectants come in various concentrations ranging mostly from 5% to 10 %. These derivatives including phenol have an odour, which can be somewhat unpleasant. Phenol itself is toxic and appropriate personal protective equipment is necessary during application. The phenolic disinfectants are used frequently for disinfection of contaminated surfaces (e.g., walls, floors, bench tops). They effectively kill bacteria including Mycobacterium tuberculosis, fungi and lipid-containing viruses. They are not active against spores or non-lipid viruses.

Quaternary Ammonium Compounds (Quats):

Quats are cationic detergents with strong surface activity. They are acceptable for general-use disinfectants and are active against Gram-positive bacteria and lipid-containing viruses. They are less active against Gram-negative bacteria and are not active against non-lipid-containing viruses. Quats are easily inactivated by organic materials, anionic detergents or salts of metals found in water. If Quats are mixed with phenols, they are very effective disinfectants as well as cleaners. Quats are relatively non-toxic and can be used for decontamination of food equipment and for general cleaning.

Halogens (Chlorine and Iodine):

Chlorine-containing solutions have broad spectrum activity. Sodium hypochlorite is the most common base for chlorine disinfectants. Common household bleach (5% available chlorine) can be diluted 1/10 to 1/100 with water to yield a satisfactory disinfectant solution. Diluted solutions may be kept for extended periods if kept in a closed container and protected from light. However, it is recommended to use freshly prepared solutions for spill clean-up purposes. Chlorine-containing disinfectants are inactivated by excess organic materials. They are also strong oxidizers and very corrosive. Always use appropriate personal protective equipment when using these compounds. At high concentrations and extended contact time, hypochlorite solutions are considered cold sterilants since they inactivate bacterial spores.

Iodine has similar properties to chlorine. Iodophors (organically bound iodine) are recommended disinfectants. They are most often used as antiseptics and in surgical soaps and are relatively non-toxic to humans.

Dual Actives:

Steri-7 has a fast and broad spectrum activity and including spores. One of Steri-7's USP is its ability to clean and disinfect in one process. The dual actives give pathogens very little chance of becoming resistant to its properties. Steri-7 is not inactivated by organic loads or variation in working temperatures. Steri-7 has little or no odour and does not omit any fumes or vapours. Steri-7 is food safe, classed as non-toxic and Non-hazardous to the environment.

Most Resistant	Type of Microbe	Examples
	Bacterial Spores	<i>Bacillus subtilis</i>
		<i>Clostridium sporogenes</i>
	Mycobacteria	<i>Mycobacterium tuberculosis</i>
		<i>Mycobacterium bovis</i>
	Hydrophilic Viruses (non-liquid, non-enveloped)	<i>Coxsackievirus</i> <i>Rhinovirus</i>
	Fungi	<i>Cryptococcus sp.</i>
		<i>Candida sp.</i>
Vegetative Bacteria	<i>Streptococcus pneumoniae</i>	
	<i>Staphylococcus aureus</i>	
Less Resistant	Lipophilic Viruses (lipid containing, enveloped)	<i>Herpes Simplex</i>
		<i>Cytomegalovirus</i>

The Pathogens that are mentioned below are all gram negative bacteria which Steri-7 is effective against. The main commonality is all the pathogens are difficult to treat once contracted due to their resistance to antibiotics.

Acinetobacter baumannii

Acinetobacter baumannii is a species of pathogenic bacteria called aerobic gram-negative bacillus and is naturally sensitive to relatively few antibiotics. *A. baumannii* forms opportunistic infections. There have been many reports of *A. baumannii* infections among American soldiers wounded in Iraq. Multi-drug resistant *Acinetobacter baumannii* is abbreviated as **MDRAB**. Multidrug-resistant *Acinetobacter* is not a new phenomenon, but *A. baumannii* has always been inherently resistant to multiple antibiotics.

Acinetobacter enters into the body through open wounds, catheters, and breathing tubes. It usually infects those with compromised immune systems, such as the wounded, the elderly, children or those with immune diseases. Colonization poses no threat to people who aren't already ill, but colonized health care workers and hospital visitors can carry the bacteria into neighboring wards and other medical facilities. The number of nosocomial infections (hospital-acquired infections) caused by *A. baumannii* has increased in recent years.

The first military outbreaks of severe *A. Baumannii* infections occurred in April, 2003 in American soldiers returning from Iraq. Early reports attributed the infections to the Iraqi soil. Later testing demonstrated widespread contamination of field hospitals as the most plausible vector

Acinetobacter is frequently isolated in nosocomial infections and is especially prevalent in intensive care units, where both sporadic cases as well as epidemic and endemic occurrence is common. *A. baumannii* is a frequent cause of nosocomial pneumonia, especially of late-onset ventilator associated pneumonia. It can cause various other infections including skin and wound infections, bacteremia, and meningitis, but *A. lwoffii* is mostly responsible for the latter. *A. baumannii* can survive on the human skin or dry surfaces for weeks.

Since the start of the Iraq War, over 700 U.S. soldiers have been infected or colonized by *A. baumannii*. Four civilians undergoing treatment for serious illnesses at Walter Reed Army Medical Center in Washington, D.C., contracted *A. baumannii* infections and died. At Landstuhl Regional Medical Center, a U.S. military hospital in Germany, another civilian under treatment, a 63-year-old German woman, contracted the same strain of *A. baumannii* infecting troops in the facility and also died. These infections appear to have been hospital acquired.

Acinetobacter is a Gram-negative bacterium that is readily found throughout the environment including drinking and surface waters, soil, sewage and various types of foods. *Acinetobacter* is also commonly found as a harmless coloniser on the skin of healthy people and usually poses very few risks.

Acinetobacter infections acquired in the community are very rare and most strains found outside hospitals are sensitive to antibiotics. While *Acinetobacter* poses few risks to healthy individuals, a few species, particularly *Acinetobacter baumannii*, can

cause serious infections - mainly in very ill hospital patients. The most common *Acinetobacter* infections include pneumonia, bacteraemia (blood stream infection), wound infections, and urinary tract infections. 'Hospital-adapted' strains of *Acinetobacter* are sometimes resistant to antibiotics and are increasingly difficult to treat

Decontamination

- All infection control procedures should be reviewed and re-inforced or corrected, including hand decontamination, correct use of gloves, suctioning practices, and device usage. Some centres recommend the use of patient decontamination regimens using antiseptic preparations, such as chlorhexidine or triclosan, to reduce the bacterial loads on patients.
- Instruments or equipment (*eg* writing materials, sphygmomanometers, stethoscopes, lifting slings, and resuscitator bags) should be designated for affected patients. If possible, single-patient use items are to be preferred. Alternatively, such items should be decontaminated suitably before use on another patient. Special attention should be paid to ventilator circuits, suction catheters and humidifiers. A cluster of MRAB cases should trigger an audit and review of these measures and root cause analysis may also help identify and address the factors contributing to acquisition and transmission of infection in a hierarchical way.
- The area in which the patient was cared for should be cleaned after the patient's discharge according to the local disinfection policy (see below).
- Methods of cleaning should remove dirt without redistributing it, including the use of damp dusting, vacuum cleaners with high efficiency filters fitted to their exhausts and single-use, or thermally disinfectable, mops.
- Especial attention should be paid to horizontal surfaces and dust-collecting areas, bedclothes, curtain rails, beds, tables, ventilators, sinks, doorknobs, and telephones. Curtains should be changed as part of the terminal clean after an infected/colonised patient leaves. Where a curtain forms a common divider between two beds, it should be changed when one patient leaves. Easily decontaminated computer keyboards, for example those with flat sealed membranes, should be used. Electrical equipment that generates static need particular attention.
- *Acinetobacter* can contaminate stock items stored in a patient's room. Following a patient's departure, any such items in a room should be decontaminated adequately or disposed of. All unused disposable items such as packets of unopened gloves, needles etc, should be discarded. Stocks of these should thus be kept to the minimum needed for the care of that patient, so that wastage is minimised .
- The Infection Control Team should make a decision on whether a disinfectant is needed: chlorine-based agents (*eg* sodium dichloroisocyanurate) at 1,000

ppm available chlorine with a compatible anionic detergent if required should be recommended. In case of corrosion problems, 70% alcohol should be used.

- Pillows, duvets, mattress covers and mattresses should be similarly disinfected or discarded if damaged. Therapy beds need specialist cleaning (*eg* high quality thermal washing/disinfection). Special mattresses must be cleaned after patient use according to manufacturers' instructions.
- Where cases are continuing, rather than closing and emptying the affected units, infected/colonised patients can be cohorted in distinct areas with totally separate ancillary facilities such as sluices and cleaning equipment. Faced with this situation, we recommend that the cohorted area has its own nursing staff. We are aware that some hospitals have extended this cohorting to physiotherapists and medical staff. Where this is not possible, it is even more important that nursing staff enforce strict infection control discipline for all visiting staff.
- One should consider closing affected wards and performing thorough decontamination of the environment and all equipment once the final patient has left, as part of a terminal clean. MRAB can survive well in dust, much of which originates from patients' skin. Thus it is important to remove all dust as part of this terminal clean.
- This terminal clean should be co-ordinated by the Infection Control Team or link staff because, although easily accessible hard surfaces are cleaned by normal domestic staff, other items, such as electrical equipment, mattress and pillow covers and high surfaces such as air vents, will often require cleaning by other staff groups. Some Infection Control teams have noticed that outbreaks have tended to occur at times of staff pressure, particularly nursing and cleaning. The importance of adequate staffing needs to be an issue identified on the Trust risk register as appropriate.

Burkholderia cenocepacia

Burkholderia cenocepacia is a Gram-negative bacteria that is common in the environment and may cause disease in plants. It is an opportunistic pathogen and human infections are common in patients with cystic fibrosis and chronic granulomatous disease, and are often fatal. Originally defined as *B. cepacia*, the group has now been split into nine species, and *B. cenocepacia* is one of the most intensively-studied.

The proteobacteria are a major group of Gram-negative bacteria, including *Burkholderia*, *Escherichia coli*, *Salmonella*, and other Enterobacteriaceae, *Pseudomonas*, *Moraxella*, *Helicobacter*, *Stenotrophomonas*, *Bdellovibrio*, acetic acid bacteria, *Legionella* and alpha-proteobacteria as *Wolbachia* and many others. Other notable groups of Gram-negative bacteria include the cyanobacteria, spirochaetes, green sulfur and green non-sulfur bacteria.

Medically relevant Gram-negative cocci include three organisms, which cause a sexually transmitted disease (*Neisseria gonorrhoeae*), a meningitis (*Neisseria meningitidis*), and respiratory symptoms (*Moraxella catarrhalis*).

Medically relevant Gram-negative bacilli include a multitude of species. Some of them primarily cause respiratory problems (*Hemophilus influenzae*, *Klebsiella pneumoniae*, *Legionella pneumophila*, *Pseudomonas aeruginosa*), primarily urinary problems (*Escherichia coli*, *Proteus mirabilis*, *Enterobacter cloacae*, *Serratia marcescens*), and primarily gastrointestinal problems (*Helicobacter pylori*, *Salmonella enteritidis*, *Salmonella typhi*).

Gram negative bacteria associated with nosocomial infections include *Acinetobacter baumannii*, which cause bacteremia, secondary meningitis, and ventilator-associated pneumonia in intensive care units of hospital establishments.

Burkholderia cenocepacia

Scientific classification

Kingdom: Bacteria
Phylum: Proteobacteria
Class: Beta Proteobacteria
Order: Burkholderiales
Family: Burkholderiaceae
Genus: Burkholderia
Species: *B. cenocepacia*

Binomial name

Burkholderia cenocepacia

Extended-Spectrum Beta-Lactamases (ESBLs)

Extended-Spectrum Beta-Lactamases (ESBLs) are enzymes that can be produced by bacteria making them resistant to cephalosporins e.g. cefuroxime, cefotaxime and ceftazidime - which are the most widely used antibiotics in many hospitals.

ESBLs were first described in the mid-1980s and during the 1990s were mostly found in *Klebsiella* species, mostly in hospitals and often in intensive care units treating the most vulnerable patients. The HPA monitors trends in the numbers of bacteria producing these enzymes. Until recently, the numbers of patients affected remained small and the problem showed little sign of growing.

However, a new class of ESBL (called CTX-M enzymes) has emerged and these have been widely detected among *Escherichia coli* (*E. coli*) bacteria. These ESBL-producing *E. coli* are able to resist penicillins and cephalosporins and are found most often in urinary tract infections - though not simple cystitis. Of concern, they have been found in the community as well as in hospitals, but patients with 'community acquired' infections may have had previous contact with hospitals.

The HPA has an active research programme on ESBLs and investigates the enzymes, their genetics and the organisms that produce them.

Spread of ESBL producing GNRs can be controlled by good infection control practices (3, 5, 20), especially by good hand washing technique, although Lucet et al showed that stressing good hand washing practice was not sufficient to control transmission of ESBL producing strains. They combined education of staff with careful review of nursing care practices to minimize the risk of transmission (20). Other experts are advocating the role of antibiotic manipulation and restriction to control ESBL outbreaks.

***Ralstonia* spp**

Ralstonia species are gram-negative bacilli that grow well in moist environments and are an infrequent cause of colonization and infection in humans. Although ubiquitous in the environment, the organism is rarely found in hospitals. *Ralstonia* spp. has traditionally exhibited low virulence in humans but has been implicated in several nosocomial outbreaks involving contaminated solutions.

Health-care facilities must adhere to strict infection-control practices while administering respiratory therapy to prevent transmission of organisms such as *Ralstonia* spp. that thrive in warm, moist environments

Stenotrophomonas maltophilia

Stenotrophomonas maltophilia is an aerobic, nonfermentative, Gram-negative bacterium which cause uncommon but difficult to treat infections in humans. Initially classified as *Pseudomonas maltophilia*, *S. maltophilia* was also grouped in the genus *Xanthomonas* before eventually becoming the type species of the genus *Stenotrophomonas* in 1993.

S. maltophilia are slightly smaller (0.7-1.8 x 0.4-0.7 μm) than other members of the genus. They are motile due to polar flagella and grow well on MacConkey agar producing pigmented colonies. *S. maltophilia* are catalase positive, oxidase negative (which distinguishes them from most other members of the genus) and have a positive reaction for extracellular DNase.

S. maltophilia is ubiquitous in aqueous environments, soil and plants, including water, urine, or respiratory secretions; it has also been used in biotechnology applications. In immunocompromised patients, *S. maltophilia* can lead to nosocomial infections

S. maltophilia frequently colonizes breathing tubes such as endotracheal or tracheostomy tubes, the respiratory tract and indwelling urinary catheters. Infection is usually facilitated by the presence of prosthetic material (plastic or metal), and the most effective treatment is removal of the prosthetic material (usually a central venous catheter or similar device). The growth of *S. maltophilia* in microbiological cultures of respiratory or urinary specimens is therefore sometimes difficult to interpret and not a proof of infection. If, however, it is grown from sites which would be normally sterile (e.g., blood), then it usually represents true infection.

In immunocompetent individuals, *S. maltophilia* is a relatively unusual cause of pneumonia, urinary tract infection, or blood stream infection; in immunocompromised patients, however, *S. maltophilia* is a growing source of latent pulmonary infections. *S. maltophilia* colonization rates in individuals with cystic fibrosis have been increasing.

In UK in 2006 there were about 1000 recorded cases with 300 fatalities (30%).

S. maltophilia is naturally resistant to many broad-spectrum antibiotics (including all carbapenems) and is thus often difficult to eradicate. Many strains of *S. maltophilia* are sensitive to co-trimoxazole and ticarcillin, though resistance has been increasing. It is not usually sensitive to piperacillin, and sensitivity to ceftazidime is variable

- Because *S. maltophilia* is a common nosocomial colonizer in patients and medical fluids, the recovery of *S. maltophilia* should be considered nonpathogenic unless proven otherwise.

- If *S maltophilia* is recovered from several patients in the same area, sections of an ICU or ward can become the focus of further spread within the hospital setting.
- **Effective infection control measures can minimize or limit the spread of this and other organisms in the ICU.**
- Appropriate isolation procedures, rather than antimicrobial therapy, should be used to control the spread of *S maltophilia*.
- Medical personnel, including medical students, housekeeping staff, attending physicians, nursing personnel, and respiratory therapists, are potential carriers of the organism from patient to patient.

Infection	Predisposing Factor
Catheter-associated bacteriuria	Indwelling urinary catheters
Intravenous line infections	Central intravenous catheters
Pseudobacteremia	Contamination of blood during collection/processing of blood cultures
Primary bacteremia	Arterial monitoring devices