Antiseptics, Disinfectants, and Sterilants (Germicides)

This information is provided for the benefit of health-care workers who may not have access to the wide variety of products available in modern health care facilities of the West. It is hoped that the information provided here may be useful for identifying agents available locally at a reasonable price.

Antiseptics are substances that inhibit the growth of microorganisms, i.e., bacteria, yeasts, viruses, etc. The term typically refers to topical agents that are used on the skin, on mucus membranes like the eyes and mouth, and within the vagina, or urinary bladder. Antiseptics are used to clean the skin and wounds after injuries, to prepare the skin for surgery, for disinfecting the eyes, the mouth, the vagina and the urinary tract when indicated and for disinfecting instruments and solid supplies. As a rule, bacterial spores are the most resistant to antiseptics and disinfectants. Mycobacteria (e.g. tuberculosis) are next most resistant, followed by non-lipid viruses (e.g. polio), fungi (e.g. cryptococcus), vegetative bacteria (e.g. salmonella), and lipid viruses (e.g. HIV).

Disinfectants are used to disinfect objects and surfaces and are classified as high, medium, or low-level depending upon required strength. They kill nearly all microorganisms except bacterial spores.

Sterilants eliminate all microorganisms on objects and surfaces, including bacterial spores.

Chapter contents

A) Antiseptics
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1. Antiseptics commonly used today

The following agents are known for their ability to kill or reduce the number of disease causing germs on body surfaces, internally (oral, urinary tract, etc.), externally (on body surface) and on inanimate objects related to medical-surgical care:

2. Water

Water is the very best antiseptic, solvent, and cleansing agent. It has no equal. Water must be recognized as the first line of attack when considering the eradication of germs of all kinds from the living being, and the first line of defense when attempting to prevent complications of injury or contamination. It may be used as a rinse, a bath, a douche, an irrigant, with pressure as with a water pick, a scrubbing, or in a number of other ways.

A common truism often recited in the operating theater and applicable anywhere says, “Dilution is the solution to pollution.”
Obtaining asepsis with the use of water cannot generally be accomplished with a medicine dropper. Use plenty of pure, clean water.

Water does not need to be sterile to be an effective agent for antisepsis on external surfaces. When, however, it is used on wounds and for internal uses, sterile water should be used if at all possible. However, even clean, filtered water is better than no water at all.

Boiling is generally a satisfactory means of sterilizing water for use as a cleansing agent. However, it does not kill all types of organisms.

Most infectious agents are destroyed with pressure-cooking at 15 pounds per square inch pressure for 15 minutes duration.

3. Iodine compounds

Tincture of iodine, 2%–7% (iodine dissolved in alcohol) and povidone iodine compounds are the most effective antiseptics available. They are active against bacteria, fungus and yeasts, viruses, spores, and protozoan parasites. They also possess anticancer effects with direct contact.

Tincture is a very good agent, but it is drying to the skin and very irritating when applied to open sores.

Povidone iodine is an organic compound that does not irritate the skin significantly. It is not as potent as the tincture, but is still one of the most effective antiseptics available. It is safe if used wisely.

There is a 6-8% incidence of iodine sensitivity (allergy), with potential serious consequences if ignored.
Iodine can be absorbed from large raw surfaces areas, so must be used discretely (especially in children).

Iodine may interfere with thyroid function and thyroid laboratory study results.

Use during pregnancy or lactation should be very limited because of the effect of iodine on baby's thyroid.

Iodine does stain, but the stain can be removed with sodium thiosulfate solution.

4. Lavasept

Lavasept (Poly-hexa-methyl-biguanide PHMB) is a European antiseptic that is believed to be equivalent to povidone iodine, but without the risks of iodine. It may be useful for the same indications as iodine. It binds to tissue, making it longer acting. A 0.02% solution is used in eye surgery.

5. Alcohols

Isopropyl alcohol and ethanol are the most commonly used alcohols. Alcohols are much more effective when diluted with water to make a 70% solution. Alcohols kill microorganisms very rapidly. They do not destroy most viruses and endospores. Alcohols are excellent solvents, probably secondary only to water, and are often used as vehicles for chemicals used for asepsis (For example, tincture of iodine). Alcohols are very drying to living tissues and painful to use in open wounds.

Bottled alcoholic drinks are suitable for emergency use for cleaning and asepsis if medical quality alcohol is unavailable.
70%–90% ethyl alcohol with 0.5% glycerin solution is an effective hand disinfectant.

6. Vinegar

Vinegar is an excellent cleansing agent for both living tissues and inanimate objects. It is a good antiseptic, but slow in its action. Like honey, vinegar has many healing qualities.

1% solution is effective on surgical dressings to prevent infections.

0.25% solution is useful for catheterization and irrigation of the urinary bladder.

0.25%–1% solutions are effective for vaginal infections with Candida (yeast) and Trichomonas (They are also used as spermicidal agents—effectiveness uncertain).

7. Hydrogen peroxide

3%–6% solution (20% damages tissues) of Hydrogen peroxide is a good cleansing agent, assisted by its effervescence. It is not highly effective in killing infectious agents.

8. Boric acid

Boric acid is a naturally occurring, white powder found in California deserts and other places.

It is a mild acid. It is antiseptic, antifungal, and antiviral. Boric acid 2% solution is a safe and
fairly effective agent that may be used on mucus membranes (1 tablespoon/quart of water). It is useful as an eye wash, in vaginal suppositories, or as a douche for chronic yeast infections.

It is insecticidal, killing all kinds of insects, ants, termites, cockroaches, silverfish, water bugs, carpenter ants, crickets, slugs, bedbugs, fleas, etc. It is an excellent agent for environmental protection against all kinds of insects. It is also an excellent fire retardant (used in cellulose insulation, etc.) and wood preservative.

9. Methyl salicylate (wintergreen oil)

This is an older, but effective antiseptic.

10. Carbolic acid (phenol)

Phenol is bacteriostatic (inhibits bacterial growth) at 0.1%-1%. It is bacteriocidal (kills micro-organisms) at 1%-2%, and kills anthrax spores at 5% in 48 hours.

11. Cresol

**Cresylic acid** is germicidal, fungicidal, viracidal, and is effective against HIV (kills germs, fungus, and viruses).

Dilute solution useful for hot soaks in dirty wounds.

It is used as 2% solution for disinfecting inanimate objects.
12. Thymol

Thymol is a pre-modern phenol derived from horsemint and similar plants. It is an effective antiseptic and is commonly used in mouth washes.

13. Potassium permanganate (See Chapter VII, chapter 3, G)

14. Silver compounds

Silver Nitrate solution 0.25%–0.5%. Silver nitrate is not as strong as Mercuric Chloride, but is safe for delicate tissues of the eye and throat. Though it stains bedding and may be absorbed when used on large burns, silver nitrate is an effective treatment for burns and other wounds.

5% Silversulfadiazine cream is one of the most effective agents available for burns and chronic infections.

15. Antibiotic ointments

Neomycin, Bacitracin, Polysporin, and others are very useful for keeping superficial wounds free of infection and from drying out.

16. Mercury compounds

These are very effective antiseptics, but there is serious concern for mercurial toxicity. Mercuric chloride is a powerful antiseptic, but is irritating to delicate tissues.
17. Bleach

Sodium hypochlorite (and other hypochlorites) are used in pools and spas. They are oxidizing agents that inhibit, but are not potent killers of infectious agents.

Household bleach is a 3%–6% solution of sodium hypochlorite. Safe drinking water may be made by adding 2–4 drops per liter of water, or 1 liter of bleach in 4000 liters of water.

Dakin’s Solution, 0.5% solution is excellent for treating chronic infections, ulcers, etc. when applied as continuous wet or wet to dry dressings. It may be made by adding 3 oz. of 5.25% household bleach to 32 oz. water and ½ teaspoon baking soda—boil to sterilize.

B) Soap and detergents

These may have antiseptic agents added to them that give them antiseptic qualities, but soaps are not ordinarily effective antiseptics by themselves. Soaps and detergents are important agents for breaking up fatty or greasy substances, as wetting agents, etc., enhancing the cleansing effects of water. Soap and water are unexcelled for cleansing hands, instruments, and the environment to prevent complications and the spread of infectious disease.

1. Chlorhexidine

This is a less toxic derivative of phenol. It may be used in aqueous or isopropanol solution for hand washing. It has an immediate effect. It is better against gram-positive bacteria than gram-negative organisms. It has a good margin of safety when used for total body wash and when applied to mucus membranes—mouthwashes, etc.

2. Hexachlorophene
Is used primarily for scrubbing of hands.

3. Benzalkonium chloride

Quaternary ammonium or chloride compounds used as disinfectants 0.1%–0.2%

Benzalkonium chloride is used primarily for scrubbing hands and face and for cleaning instruments. It is used in low concentrations as a preservative in liquid medications. It is inactivated by soap and other organic compounds and is not effective unless these are completely rinsed off.

4. Triclosan

Triclosan is widely used in hospitals for cleansing and disinfecting skin of surgeons and patients.

C) Disinfectants

Active ingredients in many disinfectants include:

1. Household bleach

1 part bleach to 4 parts of water (1% solution) is effective against many bacteria and viruses and is a common disinfectant used in hospitals. (Note: because it is corrosive, it should be followed by ethanol disinfection.) (Note: Some authorities recommend 10% solution for decontamination in the presence of large amounts of organic material.) DO NOT mix with organic compounds, acids, hydrogen peroxide, or ammonia!
Diluted solutions of household bleach kills mold and destroys the ability of mold to produce an allergic response. It is also effective in neutralizing other types of household allergens such as dust mites and cockroaches. It is recommended as one of the primary agents for remediation of mold-contaminated buildings.

2. Formaldehyde

1%–8% provides low, medium, and high-level disinfectant qualities depending upon concentration. It is an effective antiseptic, but is toxic to the environment. Because its gas penetrates very well, it is most often used for fumigation.

3. Glutaraldehyde

In variable concentrations, it is a medium to high-level disinfectant.

4. 3-6% hydrogen peroxide

Is a medium to high-level disinfectant.

5. Iodophore mixtures

Iodophore mixtures (povidone iodine) providing 40 to 50 mg of free iodine are medium-level disinfectants.
6. 70% concentration of alcohols

These are medium-level disinfectants.

7. Paracetic acid

In variable concentrations, it is a medium-level disinfectant.

D) Sterilants

1. Sodium hypochlorite

1%–2% solution is a high-level sterilant.

2. Formaldehyde

1%–8% Formaldehyde is a low, medium, and high-level sterilant depending on strength.

3. Glutaraldehyde

At variable concentrations, it is a medium to high-level sterilant.
4. Hydrogen peroxide

6%–30% Hydrogen Peroxide is a medium to high-level sterilant.

5. Paracetic acid

This is a medium-level sterilant.

6. Ethylene oxide

Ethylene oxide is used for gas sterilization of instruments. It is very flammable and expensive. It is usually mixed with CO2 to reduce inflammability. Used for sterilizing surgical equipment that must be kept dry.