Antiseptics & Disinfectants

By

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Antiseptics & Disinfectants

• The locally applied anti-infective agents that can kill pathogenic microorganisms (germs) are called germicides.

• There are two subtypes of germicides:

  • The Antiseptics are applied over living tissues like skin and mucous membranes and the Disinfectants are applied over the non-living materials.
  
  • The antiseptics, depending on their activity on the microorganisms, may be classified as either Bactericidal or bacteriostatic.
Uses of Antiseptics

• The antiseptics should be non-toxic to the living tissues.

• Antiseptics are generally used in cleansing of unbroken skin and wound surfaces after injury, burn and open wounds to minimize the chances of infection.

• Antiseptics are used specifically for preparation of skin surfaces prior to injections, catheterisation or surgical operations.
Uses of Antiseptics

• Antiseptics are intended for routine use as mouth wash for maintaining oral hygiene.

• Some commonly used antiseptics for skin cleaning includes chlorhexidine gluconate, iodine compounds like Povidone iodine and alcohol.

• Antiseptics are not used for internal use (cannot be ingested).
Disinfectants

• The disinfectants are the substances that prevent spreading of infection by destruction of harmful vegetative microbes or viruses.

• They have a rapid lethal action on all pathogenic microorganisms and their spores.

• They are primarily used for disinfection of surfaces of medical instruments and appliances, facilities, equipments, rooms and environments.

• Santisation is that procedure of Disinfection to minimise the microbial load or population in any inanimate surface acceptable for public health and hygiene.
Prevention of transmission of Infection

- The infection is commonly transmitted from person to person or from regions of high microbial load to the wound site by hands.
- Hands transmit germs (bacteria, fungi or virus) from fomites to the vital organs like eyes and to the respiratory and digestive systems.
- Mouth, nose and gut are the regions of high microbial load and your hand is the media of transmission of infection from these regions to the wound sites.
Prevention of transmission of Infection

• Washing with a soap (surfactant, having the property of partly dissolving in water and oily solvents) can remove all possible infectious agents from the skin.
• Washing with a soap and water is a better process to prevent from all kinds of infection.
• A proper hand washing practice can minimise transmission of infections.
Classification of antiseptic & disinfectants

• **1. Alcohols**: Ethanol, Isopropyl alcohol.
• **2. Aldehyde**: Formaldehyde and Glutaraldehyde.
• **4. Oxidizing agents**: Potassium permanganate, KMnO4; hydrogen peroxide, H2O2. Hydrogen peroxide is commonly used as disinfectant and antiseptic. The organic oxidizing agents like Carbamide peroxide and hydrous benzoyl peroxide are also used as antiseptic and disinfectants.
Classification of antiseptic & disinfectants

• **5. Quaternary ammonium Compounds**: Benzalkonium chloride, Benzethonium chloride, methylbenzethonium chloride are Cationic surfactants.

• Chlorhexidine gluconate is a Biguanides.

• **6. Halogen containing compounds**: Povidone–iodine is used as antiseptics. Halazone, Chlorazodin and Oxychlorosene sodium contain chlorine are used for disinfection of supply water.

• Elemental Iodine containing preparations such as Iodine tincture (2% iodine in 50% alcohol with sodium iodide) are used as antiseptics.

• **7. Dyes**: Gentian violet, Basic fuchsin, Methylene blue.

• **8. Aacriflavines**: proflavine
Alcohols

- Ethanol and 2-Propanol (Isopropyl alcohol) are the two most commonly used antiseptics.
- Alcohols dissolve lipids and denature proteins of the cell membrane and thereby kill the microorganisms, which is the main mechanism of action as antiseptic.
- Ethanol without qualification means anhydrous ethanol or absolute alcohol not less than 99.0 per cent w/w and not more than 100.0 per cent w/w at 15.56°C of C₂H₆O.
- The term alcohol, without qualification means 95 per cent ethanol.
- The length of carbon chain of primary alcohol determines its Vander Waal’s interaction and solubility in water.
- Increase carbon chain length increases Vander Waal’s interaction but decreases water solubility.
Alcohols

- Increase Vander Waal’s interaction increases microbial membrane penetration, so increases antimicrobial potency of alcohol.
- But Decrease in water solubility reduces antimicrobial potency.
- Branching of carbon chain decreases penetration through microbial membranes and so decreases antimicrobial activity.
- Antimicrobial activity of alcohols decrease in the order of primary > secondary > tertiary alcohol.
- The antimicrobial activity test is performed against cultures of *Staphylococcus aureus*. 
Alcohols

• **Denatured** alcohol is ethanol which is made unfit for use.
• **Completely denatured alcohol** is unsuitable for either external or internal use that contains methanol and benzene.
• **Especially denatured alcohol** contains one or more substances with ethanol to be used for a specialised purpose e.g. tincture of iodine and aftershave lotions.

**Ethanol (Ethyl alcohol)**

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\text{CH}_3\text{-CH}_2\text{-OH}
\]

**Isopropyl alcohol**

\[
\text{H}_3\text{C} - \text{CH} \text{CH}_3\text{OH}
\]
Aldehydes

- **Aldehyde**: Formaldehyde is used as an disinfectant.
- Formalin is a 37% formaldehyde w/v solution in water.
- Formaldehyde oxidises to formic acid and polymerises to paraformaldehyde (paraldehyde).
- Methanol is added to retard polymerisation to paraformaldehyde.
- Glutaraldehyde is used for sterilization of equipments that cannot be autoclaved.
Phenols

- Phenols are widely used as antiseptic and disinfectant.
- Phenols are aromatic compounds and may have different functional groups attached to the aromatic rings.
- The alkylated phenols and their halogenated derivatives such as cresols, Chlorocresols, Chloroxylenols, Resorcinol, Hexylresorcinol, and Hexachlorophene are most widely used antiseptic and disinfectants.
- Phenol derivatives are strong anti-microbial and can destroy vegetative bacteria, fungi and viruses.
Phenols, alkylated phenols and their halogenated derivatives

- Phenol
- Resorcinol
- Hexylresorcinol
- O-Cresol
- m- Cresol
- p- Cresol
- P-chlorocresol
- P-chloro-m-xylenol
- Hexachlorophene
Oxidizing agents

- Oxidizing agents: The inorganic compounds Potassium permanganate, KMnO4 and Hydrogen peroxide, H2O2, is commonly used as disinfectant and antiseptic in various purposes.

- The Carbamide peroxide and Hydrous Benzoyl peroxide are oxidizing agents, which are used as antiseptic and disinfectants.
The quaternary ammonium Compounds

- The quaternary ammonium Compounds (QAC) are cationic surfactants.
- Benzalkonium chloride, Benzethonium chloride, Methylbenzethonium chloride are the best examples of QACs used as antiseptic and disinfectants.
- Chlorhexidine gluconate is a Biguanides and not a QAC. But it has the similar physical chemical and anti-microbial properties like a QAC and behaves as a surfactant.
- It is commonly used for disinfection of skin and irrigation of wounds and for sanitisation.
- It cannot penetrate skin and mucous membrane and so conveniently used in mouth wash.
QACs

Benzalkonium chloride = $R=nC_{8}H_{17}$ to $C_{16}H_{33}$

Chlorhexidine gluconate
Halogen containing compounds

- Halogen containing compounds:
- Povidone iodine is used as antiseptics.
- Povidone iodine is available in various dosage forms and is potent antiseptic and disinfectant. The dosage forms are aerosols, ointments, surgical scrubs, antiseptic gauze pads, mouthwashes.
- Halazone, Chlorazodin and Oxychlorosene sodium contain chlorine and are used for disinfection of supply water.
- Elemental Iodine containing preparations such as Iodine tincture (2% iodine in 50% alcohol with sodium iodide) are used as antiseptics.
Dyes

• Dyes: The organic dyes have been in use as antiseptic earlier than the sulfonamides and antibiotics. The dyes still in use are Gentian violet, Basic fuchsin and Methylene blue.

• The gentian violet also known by Crystal violet is hexamethyl- p-rosaniline, which is used in various fungal and yeast infections.

• The basic fuchsin is a mixture of rosaniline and p-rosaniline chlorides is used in fungal infections like athlete's foot..

• The methylene blue is used as an antiseptic in the urinary infections.
Acriflavine

- Acriflavine derivatives: Proflavine
- Proflavine is chemically 3,6-Diaminoacridine.
- It is used as disinfectant against gram (+) ive, and fungal microbes.
- It is a hazardous compound, it can penetrate skin and affect nuclei.
- It intercalates DNA base pairs and cause mutation.
- It is carcinogenic.
Nitrofurans

• Nitrofurantoin: It is a hydrazone prepared from 5-nitro-2-furaldehyde and amoinohydantoin. It is used as antiseptic. It is used in urinary tract infection against gram (-)ive E. coli and some of the gram (+)ive bacteria.