

# Antiseptics and disinfectants

# Definition of terms

- **Antiseptic** = agent that causes destruction or inhibition of growth of micro organisms (bacteria, viruses, fungi) on living surfaces such as skin & mucous membranes.
- **Disinfectant** = agent that causes destruction or inhibition of growth of microorganisms (bacteria, viruses, fungi) on non living surfaces (instruments, equipments, pieces of furniture, rooms, etc).
- Spores are (usually) not destroyed !!!

## Definition of terms (continued)

- **Antisepsis** = use of chemical solutions for disinfection (prefix: "anti" = against) e.g. removal of transient microorganisms from the skin and a reduction in the resident flora
- **Asepsis** = absence of infectious microorganisms (prefix: "a" = absence)
- **Aseptic techniques** - aimed at minimising infection e.g.
  - The use of sterile instruments
  - The use of a gloved no touch technique

## Properties of antiseptics/disinfectants

1. Microbicidal activity
2. Non staining & good odour
3. Active against all pathogens
4. Active in presence of pus, blood & exudates
5. Rapid acting
6. Non irritating to tissues / non corrosive
7. Non absorbable
8. Non sensitizing/

## Mechanisms of action

**disrupt cellular structures and/or processes e.g.**

- Oxidation of bacterial protoplasm
  - $H_2O_2$  Halogens, potassium permanganate
- Coagulation (denaturation) of proteins
  - Phenols, chlorhexidine, alcohols, aldehydes
- increasing permeability of bacterial cell membrane
  - Cetrимide, soaps

# Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary ammonium compounds
- Alcohols
- Aldehydes
- Acids
- Metals
- Dyes

## Depending on concentration:

Some chemicals can act either as antiseptics or as disinfectants e.g.

- **Phenol** solution 0.2% = antiseptic; 1% = disinfectant

# Phenol & derivatives

## Phenol

- Earliest use (19th century), reference standard
- mechanism: denaturation of bacterial proteins
- Uses: disinfection of urine/faeces/pus contaminated surfaces/areas
- Extremely irritating, corrosive



# Phenol & derivatives

## **Cresol**

- Methyl derivative of phenol, less damaging to tissues than phenol
- 3-10 times more active
- used for disinfection of utensils, excreta & for washing hands

## Phenol & derivatives

### **Chloroxylenol (Dettol)**

- Does not coagulate proteins
- Non corrosive, Non irritating to skin
- Commercial 4.8 % solution used for surgical antisepsis
- Skin cream and soap: 0.8%
- Mouth wash 1%

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# Oxidizing agents

## **Peroxides:**

- short-acting germicidal effect through release of nascent oxygen, which irreversibly alters microbial proteins
- little or no action on bacterial spores
- nascent oxygen rendered inactive when it combines with organic matter

## **e.g. Hydrogen peroxide** solution (3%)

- releases oxygen in contact with catalase on wound surfaces and mucous membranes; effervescent action mechanically helps remove pus and cellular debris from wounds and is valuable for cleaning infected tissue

# Oxidizing agents

## Peracetic acid

- broad antimicrobial spectrum (like hydrogen peroxide) + greater lipid solubility
- effective against bacteria, yeasts, fungi, and viruses (0.001–0.003%)
- **sporicidal at 0.25–0.5%**
- Solutions of 0.2% peracetic acid applied to compresses are effective at reducing microbial populations in severely contaminated wounds

# Oxidizing agents

- **Potassium permanganate:**
  - broad antimicrobial properties,
  - effective algicide (0.01%) and virulicide (1%) for disinfection, but concentrations  $>1:10,000$  tend to irritate tissues
  - Old solutions turn chocolate brown and lose their activity
  - stains tissues and clothing brown (disadvantage)

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# Halogens & halogen containing compounds

**Iodine tinctures:** 2% iodine + 2.4% sodium iodide (NaI) in 50% ethanol; it is used as a skin disinfectant. Strong iodine tincture contains 7% iodine and 5% potassium iodide (KI) dissolved in 95% ethanol; it is more potent but also more irritating than tincture of iodine.

**Iodine solutions:** 2% iodine + 2.4% NaI dissolved in aqueous solution; it is used as a nonirritant antiseptic on wounds and abrasions. Strong iodine solution (Lugol's solution) contains 5% iodine and 10% KI in aqueous solution.



# Halogens & halogen containing compounds

- Chlorine** - potent germicidal effect against most bacteria, viruses, protozoa, and fungi at a concentration of 0.1 ppm, but much higher concentrations are required in the presence of organic matter
- Alkaline pH ionizes chlorine and decreases its activity by reducing its penetrability.
  - irritant to the skin and mucous membranes
  - widely used to disinfect water supplies and inanimate objects (eg, utensils, bottles, pipelines)
  - sodium hypochlorite solutions (bleach) 2–5% can be used as a disinfectant, and a more diluted form (0.5%) can be used for irrigating suppurating wounds, but it dissolves blood clots and delays clotting
  - Root canal therapy in dentistry

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# Biguanides

## **Chlorhexidine**

- Acts by disrupting bacterial cell membrane & denaturation of bacterial proteins
- Non irritant, more active against Gram + bacteria
- Used in for surgical scrub, neonatal bath, mouth wash & general skin antiseptic
- Most widely used antiseptic in dentistry 0.12-0.2% oral rinse or 0.5 -1 % tooth paste

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# Quaternary ammonium compounds

**Detergents:** destroy bacteria, fungi & viruses by altering permeability of cell membrane

- Efficiently remove dirt and grease
- Widely used as antiseptics & disinfectants for surgical instruments, gloves etc

**Soaps:** Anionic detergents

- Weak antiseptics with cleansing action
- Washing with soap and warm water - one of the most effective methods of preventing disease transmission

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# Alcohols

## **Ethanol**

- Antiseptic, cleansing agent at 40-90%
- Act by precipitation of bacterial proteins
- Irritant, should not be applied on mucous membranes, ulcers, open wounds

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- Alcohols
- **Aldehydes**
- Acids
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# Aldehydes - Formaldehyde

Also used as sterilization agents!

- Used for fumigation
- 37 % aqueous solution (formalin)
- denaturates proteins
- Used for preserving dead tissues
- Use as antiseptic restricted due to bad odour & irritation
- Glutaraldehyde is a better sterilizing agent

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# Acids

## **Boric acid**

- weak antiseptic , bacteriostatic
- used for mouth wash, irrigation eyes, glossitis
- Adverse effect: vomiting, abdominal pain on systemic absorption

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# Metals: metallic salts

## **Silver:**

- Silver ions precipitate proteins + interfere with essential metabolic activities of microbial cells
- 0.1% aqueous silver solution – bactericidal but irritating
- 0.01% solution – bacteriostatic
- 0.5% solution - sometimes applied as a dressing on burns to reduce infection

Colloidal silver compounds – slowly releasing silver ions

- more sustained bacteriostatic effect
- non-irritant
- mild antiseptics, also used in ophthalmic preparations

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# Dyes

## **Gentian violet** (Crystal violet)

- topical antiseptic; commonly used for:
- Marking the skin for surgery preparation and allergy testing
- Effective against *Candida albicans* and related infections such as thrush, yeast infections, tinea, etc.
- In resource limited settings, gentian violet is used to manage burn wounds, inflammation of the umbilical cord stump (omphalitis) in neonates, oral candidiasis, mouth ulcers