* Antiseptic, Disinfectant and Ectoparasiticides. *

Antiseptic and Disinfectants

Antiseptic : Agents used on living surface (skin, mouth)
Disinfectants : Agent used for inanimated object (instruments, privies, water supply)
Germicides : Cover both category of Drugs.
Sterilization : Complete killing of all form of micro-organism, including spores.
Disinfection : Reduction in the number of viable pathogenic microbes to the level that they do not pose a risk to individual with normal host defence.

Thus in ordinary usage, disinfectants do not eliminate all microbes. 'Sanitization' (used for inanimate surface or environment), 'Decontamination' also have similar ~~con~~ connotation.

A Good antiseptic / disinfectant should be (Ideal Properties) :

① Chemically stable
② Cheap
③ Non-staining with agreeable colour and odour.
④ Cidal and non merely static, destroying spores as well.
⑤ Active against all pathogen (Bacteria, fungi, Virus, Protozoa)
⑥ Able to spread through organic film and enter folds and crevices.
⑦ Active even in presence of blood, pus, exudates and excreta.

A Disinfectant in addit^{n} should not corrode or rust instrument. and be easily washable.

An Antiseptic in addition should be
① Rapid in action and exert sustained protection.
② Non-irritating to tissues, should not delay healing.
③ Non-sensitizing (no allergy)
④ Non-absorable or produce minimum toxicity if absorbed
⑤ Compatible with soap and other detergent.

Mechanism of action of Germicides :

(a) Oxidation of bacterial protoplasm
(b) Denaturation of Bacterial protein including enzymes.
(c) Detergent like action increasing permeability of Bacterial membrane

Potency : of Germicides is generally expressed by its phenol coefficient or Rideal Walker coefficient.

Factors which modify activity of Germicides :

→ Temperature and pH
→ Period of contact with the micro-organism
→ Nature of microbes involve
→ Size of innoculeum
→ Presence of blood, pus, and other organic matter.

Classification of Antiseptic and Disinfectant :

1] Phenol Derivatives : Phenol, Cresol, Chloroxylenol, Hexachlorophene
2] Oxidizing Agent : Pot. Permanganate, Hydrogen peroxide, Benzoyl peroxide
3] Halogens : Iodine, Iodophores, Chlorine, Chlorophores.
4] Biguanide : Chlorohexidine
5] Quaternary ammonium (cationic) : Cetrimide, Benzalkonium Chloride, Dequalinium Chloride.
6] Soaps : of Sod. and Pot.
7] Alcohol : Ethanol and Isopropanol
8] Aldehyde : Formaldehyde and Glutaraldehyde.
9] Acids : Boric acid
10] Metallic salts : Silver nitrate, silver sulfadiazine, zinc sulphate, Calamine & Zinc oxide.
11] Dyes : Gentian violet, Acriflavin, Proflavin
12] Furan Derivative : Nitrofurazone, (Nitrofurantoin — Urinary Infection), (Furazolidone — Intestinal Infection)

1] Phenols :

Phenol (Carbolic acid) :

→ Acts by disrupting bacterial membrane and denaturing bacterial proteins
→ Relatively weak agent (Bacteriostatic at 0.2% & cidal at > 1%, poor action on bacterial spore)
→ Is protoplasmic poison, injuring microbes and cell tissue, at high concen. it cause skin burns & is caustics.
→ Organic matter deminished its action slightly which alkines and soaps do so profoundly (carbolic soaps are not more germicidal than soap itself.)
→ Used as antiseptic
→ As cheap so used as disinfectant for urine, faeces, pus, sputum of patient.
→ Sometime used as antipruritis because of its mild local anaesthetic actions.

Cresol : Methyl phenol
more active (3-10 times) less tissue damage ; disinfect utensils, excreta and for washing hands
→ Lysol is 50% soap emulsion of cresol

Chloroxylenol :

→ Phenol coefficient 70
→ Does not coagulate protein
→ Non corrosive, non irritative to intact skin
→ efficacy reduced by organic matter
→ Poorly water soluble

Hexachlorophene :

→ Acts by Inhibiting bacterial enzymes and at high concentration causing bacterial lysis
→ Odourless, non-irritating and does not cause strain.
→ Activity is reduced by organic matter but not by soap.
→ Commonly used in soaps and other cleaning antiseptics for surgical scrub & patient's skin.
→ Narrow spectrum kill gram +ve & not gram -ve & bacterial spores.
→ Action is slow but persistent due to decomposition on skin as film, not removed by water
→ Produce brain damage (specially in neonatal)

2] Oxidizing agents :

Potassium Permanganate:

→ Occur as purple crystal, Highly water soluble, liberate Oxygen which Oxidizes bacterial protoplasm
→ 1:4000 – 1:10000 solution (Condy's lotion) used for gargling, douching, irrigating cavities, urethra, and wound.
→ Action is rather slow
→ High conc. cause burn & blisters
→ Used to disinfect water (ponds and well); for stomach wash after alkaloidal poising (except atropine & cocaine, not efficiently oxidize)
→ Promote rusting; not good for surgical instrument.

Hydrogen Peroxide :

→ Liberate nacent Oxygen which Oxidize necrotic matter and bacteria
→ 3% sol° produce 10 volume of oxygen
→ Catalase present in tissue speed decomposition resulting in foaming Help in loosening & removing slough, ear wax, etc
→ loses potency on keeping

Benzoyl Peroxide :

→ Specifically active against *Propionibacterium acnes*.
→ Used on acne vulgaris

3] Halogens :

Iodine :

→ Rapid acting broad spectrum (Virus, Bacteria, fungus) microbicidal agent
→ Acts by iodinating and oxidizing microbial protoplasm.
→ Organic matter retard but does not abolish its germicidal action.
→ Iodine Crystal are corrosive, strong solut° (> 5%) cause burning and blistering of skin.
→ Tincture iodine (2% in alcohol) used on cuts, for degerming skin before surgery & to treat ring Worm.
→ Mandel's paint (1.25 %. iodine dissolve with the help of Pot. Iodide forming soluble I_3^- ions) applied on sore throat.
→ non staining Iodine ointment (Iodex 4%.) is popular as antiseptic & counter irritant.

Iodophores :

→ Are soluble complexes of iodine with large molecular organic compounds that serve as carrier – release free iodine slowly.
→ Povidone (Polyvinylpyrrolidone) iodine :

- Non-irritting, Non-toxic, non-staining, exert prolonged germidical action.
- Treated area can be bandaged without risk of blistering.
- Used on boils, furunculosis, burns, otitis externa, ulcers, tinea, monilial / trichomonal / non specific vaginitis & for surgical scrubbing, disinfection of endoscopes and instrument.

Chlorine :

→ Highly reactive element, rapid acting potent germicide, 0.1-0.25 ppm kill most pathogens (not *M. tuberculosis*) in 30 sec.
→ Degerming action soon exhausted, and is lacks substantivity.
→ Used to disinfect urban water supply.
→ chlorine is more active in acidic & neutral medium.

Chlorophores :

→ Compounds that release Hypochlorous acid (HOCl). Because of ease of Handling, used in preference to gaseous chlorine.

(i) Chlorinated lime (Bleaching powder):

→ On exposure, it decomposes releasing 30 - 35 % W/W chlorine.

→ Is used as disinfectant for drinking water, swimming pool, and sanitizer for privies, etc.

(ii) Sodium Hypochlorite solution :

→ Contain 4 - 6 % sodium Hypochlorite

→ Powerful disinfectant used in dairies for milk cans, other iquipments and for infant feeding bottles.

→ Unstable, too irritant to be used as antiseptic, except for root canal therapy in dentistry.

4 Biguanide :

Chlorohexidine :

→ Powerful, non-irritating cationic antiseptic that disrupts bacterial cells.

→ Secondary action is denaturation of microbial protein.

→ Relatively more active against gram +ve.

→ Used for surgical scrub, neonatal bath, mouthwash, obstetrics and as general skin antiseptics.

→ Most widely employed antiseptic in dentistry.

→ 0.12 - 0.2 % oral rinse or 0.5 - 1 % toothpaste, highly active in preventing / treating gingivitis.

→ Repeated application cause brownish discolouration of teeth.

5 Quaternary Ammonium (cationic) Antiseptic.

→ Detergent

→ cidal to bacteria, fungi & viruses

→ many gram -ve bacteria (especially Pseudomonas), M. tuberculosis and bacterial spores are relatively resistant

→ Acts by altering permeability of cell membrane and denaturating of bacterial proteins.

→ Soaps being anionic neutralize their action.

→ While Alcohol potentiates

→ Non-irritating & mild keratolytics.

→ Pus, debris and porous materials like cotton polyethylene reduce their activity.

Cetrimide :

→ Is a soapy powder with a faint fishy odour.

→ Has good cleansing action, efficiently removing dirt, grease, tar and congealed blood from road side accident wounds.

→ Alone or combination with Chlorohexidine, it is one of the most popular hospital antiseptic and disinfectant for surgical instruments, utensils, bath, etc.

Benzalkonium Chloride :

→ Highly soluble in water and Alcohol.

→ A 1:1000 soln is used for sterile storage of instruments

→ 1 in 5000 or 1 in 10,000 for douches or irrigation, etc.

Dequalinium Chloride :

→ Has used in gum paints and lozenges.

6] Soaps :

→ Anionic detergents with weak antiseptic action.
→ Affect only gram +ve bacteria
→ Usefulness primarily in cleansing action
→ Washing with soap and warm water, most effective method of preventing transmission of infection by removing of diluting pathogenic bacteria.

7] Alcohols :

Ethanol :

→ Effective antiseptic and cleansing agent at 40 – 90% conc.
→ Rapidity of action increased with conc. 70%. and decreases above 90%
→ Acts by precipitating bacterial proteins.
→ Low concentration enhance the antiseptic activity of iodine and chlorohexidine when used as solvent for these.
→ Is an irritant and should not use on mucous membrane, delicate skin (scrotum), ~~Ulcer~~ ulcers, etc.
→ On open wound it produces a burning sensation, injured surface and form a coagulum under which bacteria could grow.
→ Poor disinfectant for instruments, does not kill spores & promotes rusting.

Isopropanol :

→ Less volatile
→ Can be used in place of ethanol

8] Aldehydes :

Formaldehydes :

→ is Pungent gas
→ Sometime used as Fumigation.
→ 37% aqueous solution called Formalin is diluted to 4% & used for hardening and preserving dead tissues.
→ It denaturates protein and is a general protoplasmic poison but acts slowly.
→ Broad spectrum germicides, but used as antiseptic is restricted by its irritating nature & pungent odour.
→ Occasionally employed to disinfect instrument and excreta.
→ who handle formalin can develop eczematoid reaction.

Glutaraldehyde :

→ Less volatile, less pungent, less irritating
→ better than formalin, but need to be activated by alkalization of the solution.
→ Exert Broad spectrum activity against bacteria, fungi & viruses.
→ Organic matter do not inactivate it.
→ 2% solutn, used to disinfect surgical instrument, but prolonged contact is needed.

9] Acids :

Boric acid :

→ Only Bacteriostatic and very weak antiseptic.
→ Non-irritant even to delicate structures; saturated aqueous solution (4%) have been used for irrigating eyes and as mouthwash, douche, etc.
→ Systemic absorption cause vomiting, abdominal pain, diarrhoea, visual disturbance and kidney damage.
→ Hence its use for irrigating bladder, large wound and as ointment on exclusive burnt areas, liberal use of the powder for infants is not recommended.

10] Metallic Salts :

Silver Compounds :

→ Are astrigents and caustic.
→ react with SH, COOH, PO_4 and NH_2 group of protein.

(i) Silver nitrate
→ Rapidly kill microbes
→ action persists for long periods because of slow release of Ag^+ ions from silver proteinate formed by interaction with tissue proteins.
→ Tissue get stained black due to decomposition of reduced silver.
→ Silver nitrate touch is used for hypertrophied tonsilitis and aphthous ulcers.
→ Highly active against gonococci

(ii) Silver sulfadiazines
→ Highly active against Pseudomonas
→ Used on Burns

Zinc Salts :

→ Astringent & mild antiseptic.

(i) Silver sulfate :
→ Highly water soluble
→ 0.1 – 1% is used for eye wash & in ear/eye droops.
→ Applied to skin, decreases perspiration.
→ White lotion contain 4% each zinc sulfate and sulfated potash used for acne & impetigo.

(ii) Calamine and Zinc oxide :
→ Insoluble
→ Being mild Antiseptic; are popular Dermal protectives and adsorbants.

Zinc Phosphide :
→ toxic
→ Used as rat poison

11] Dyes :

Gentian Voilet (Crystal voilet)

→ Rosaniline dye active against staphylococci, other gram +ve bacteria and fungi but gram –ve bacteria & mycobacteria are insensitive
→ Aqueous or alcoholic solution (0.5–1%) used on furunculosis, bedsores, chronic ulcers, infected eczema, thrush, Vincent's angina, ringworm, etc
→ Become unpopular due to deep staining.

Acriflavin and Proflavin :

→ There are orange-yellow acridine dyes active against gram +ve bacteria and gonococci.
→ efficacy not reduced by organic matter
→ efficacy enhanced in alkaline medium.
→ Less efficacy on exposure to light in solution form
→ Non-irritating; do not retard healing; particularly suitable for chronic ulcer & wounds.
→ Bandage impregnate with acriflavin – vaselin is used for burn dressing.

Methylene Blue :

→ Occur as dark greenish, crystalline powder with a metallic lustre.
→ Is Hygroscopic and soluble in water.

12] Furan Derivative :

Nitrofurazone (Nitrofural) :

→ Cidal to both gram –ve & +ve, aerobic and anaerobic
→ Activity reduce by serum.
→ Act by inhibiting enzymes necessary for carbohydrate metabolism in bacteria
→ Highly efficacious in burns, skin graft

Ectoparasiticides

→ Drugs used to kill parasites that lives on body surface.
→ Pediculosis (Lice - wingless insect) (Pediculus capitis - head ; Pediculus corporis - body ; Pediculus pubis - pubic region)
→ Scabies
→ Drug Used are ① Permetrin ② Lindane ③ Benzyl Benzoate ④ Crotamiton ⑤ Sulfur ⑥ Dicophane ⑦ Ivermectin.

1] Permethrin :

→ Broad spectrum, potent pyrethoid insecticide
→ currently most efficious, most convienient dry for scabies, Lice
→ Cause neurological paralysis in insect., probably by delaying depolarization.
→ Toxicity is very low ; 40-400 times lower than Rndane.
→ Permethrin persist on skin for days
→ Systemic absorbtion is minimal
→ Nearly 100% cure rate for scabies & Pediculosis.
→ Single application is needed in most cases.
→ Resistance to permethrin - very low
→ effective in lindance non-responsive cases.
→ 1st choice for scabies & pediculosis

2] Lindane (Gamma benzene hexachloride, BHC)

→ Broad spectrum insecticides
→ Penetrate through their chitinous cover and affect the nervous system.
→ Highly effective in treating headlice (67-92% cure) and scabies (84-92% cure) by single treatment
→ efficacy is lower than permethrin
→ Lice, mite can develop resistance
→ Combining with benzyl benzoate preclude resistance and improve cure rate to nearly 100%

Disadvantages of Lindane

→ Highly lipid solube can absorbed through skin (especially from oily vehicles and in small children)
→ Can produce systemic toxicity - CNS stimulation, convulsions, vertigo & cardiac arrhythmias.
→ Can induce CYP isoenzymes in liver & affect metabolism of many drugs.
→ Avoid in infants, young children & during pregnancy

3] Benzyl Benzoate :

→ Oily liquid with faint aromatic smell
→ Popular for treatment of Scabies
→ Emulsion is applied all over except Face & neck.
→ 76%-100% cure rate in scabies
→ Minimally absorbed through skin
→ Systemic absorbtion is low, toxicity is low.
→ but neurologically symptoms occur in Childrens hence contraindicated in them.
→ Skin irritation is common ; Contact dermatitis is possible
→ Also use for pediculosis.
→ 2nd line drug for scabies
→ Combination with lindane is highly effective.

4] Crotamiton :

→ Effective scabicide, pediculocide and antipruritic.
→ but produce low cure rate (60-88%)
→ Best result – 5 days application in childrens
→ less prone to cause skin irritation
→ low systemic toxicity despite absorbed through the skin.
→ Because of low efficacy & repeat application, it is 2nd line drug

5] Sulfur :

→ Oldest scabicide, weak pediculocide, antiseptic, fungicides & keratolytic.
→ Slowly reduced to H_2S and oxidized do SO_2 and pentathionic acid ; latter dissolve the cuticle of itch mite & kill it.

Disadvantages :

ⓐ Treatment is messy.
ⓑ Produce bad odour – socially unacceptable
ⓒ Repeated application are required

6] Dicophane DDT :

→ Popular insecticides for mosquitoes, flies and other pests.
→ Penentrate through exoskeleton and acts as a neurotoxin for the anthopods.
→ When oily vehicles are used, significant amount may be absorbed through skin & cause rashes, muscle weakness, tremor.
→ High dose produce BHC like convulsion.
→ Get stored in body fat and induces microsomal enzymes.
→ Combination with benzyl benzoate is more effective.
→ Rarely used

7] Ivermectin :

→ Antihelmintic drug
→ found highly effective in scabies and pediculosis
→ Orally administered drug for ectoparasitosis
→ Cured upto 91 - 100% patients of scabies.
→ AIDS patient with scabies also respond.
→ Most cases of head / body lice have been successfully treated.
→ Well tolerated with few / if any side effect.
→ Not given to children < 5 year, pregnant & lactating women
→ limited use has been made in scabies & pediculosis because of availability of efficacious topical agents.