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FACULTY OF NURSING

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Unit III Pharmacology of commonly used ANITISEPTICS, DISINFECTANTS AND INSECTICIDES

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Syllabus –

Unit III: Pharmacology of commonly used ANITISEPTICS, DISINFECTANTS AND INSECTICIDES

harmacology of commonly sed:

Antiseptics.

Disinfectants.

Insecticides.

Composition, action, dosage route, indications, contraindications, drug interactions, side effects, adverse, effects, toxicity & r of nurse.

ANITISEPTICS

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 microoorganisms (prefix: ”a” = absence)

Aseptic techniques - aimed at minimising infection e.g.

- The use of sterile instruments
- The use of a gloved no touch technique

istory of antiseptics

naz Semmelweis

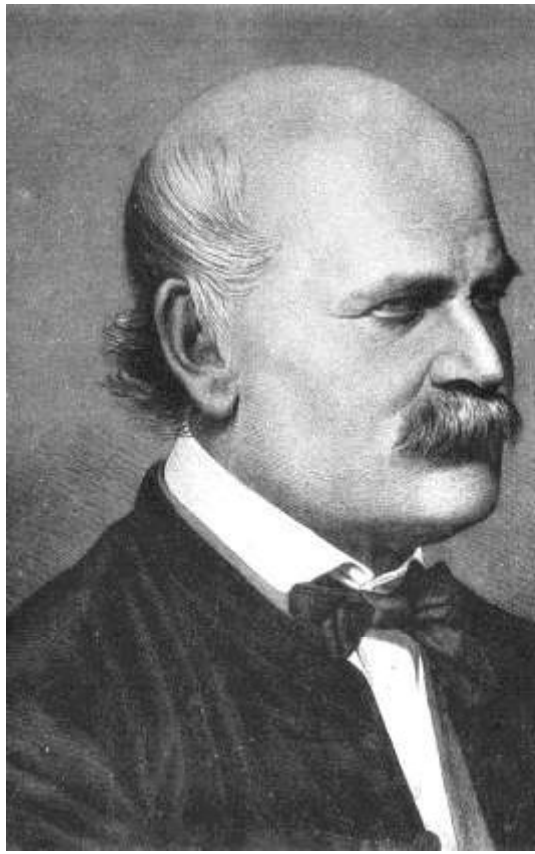
818 - 1865)

ungarian physician working in Vienna

ross contamination → high incidence of
leath after childbirth

He made doctors to wash hands in
chloride of lime before touching patients

Dramatically reduced incidence of
childhood fever.



History of antiseptics (continued)

Joseph Lister (1827 - 1912)

Brittish surgeon

carbolic acid (phenol) for hands

and wounds during operations

o maintain **aseptic conditions**

→ **aseptic surgery**

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_20_2, Halogens, potasium permanganate

Coagulation (denaturation) of proteins

- Phenols, chlorhexidine, alcohols, aldehydes

Increasing permeability of bacterial cell membrane

- Cetrimide, soaps.

Mnemonic: PHARMA GOD

Phenol derivatives.

Halogens.

Alcohols, Aldehydes, Acids.

urface antigens metallic salts
Metalls).

Miscellaneous.

Gases.

Oxidizing agents.

Dyes.

Classification

- **P**henol derivatives
- **O**xidizing agents
- **H**alogens
- Biguanides
- Quaternary amonium compou
- **A**lcohols
- Aldehydes
- Acids
- **S**urface antigens metallic salts (Metalls)
- **D**yes.
- **G**ases.
- **M**iscellaneous.

Depending on concentration:

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

henol 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

Cresol

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

Phenol & derivatives – contd

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% .

Classes

- Phenol derivatives
- **Oxidizing agents**
- Halogens
- Biguanides
- Quaternary amonium compounds
- Alcohols
- Aldehydes
- Acids
- Metalls
- Dyes.
- Gases.
- Miscellaneous.

Oxidizing agents

Peroxides:

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

e.g. Hydrogen peroxide solution (3%)

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

Oxidizing agents - contd

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 - contd

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)

Classes

- Phenol derivatives
- Oxidizing agents
- **Halogens**
- Biguanides
- Quaternary amonium compounds
- Alcohols
- Aldehydes
- Acids
- Metalls
- Dyes.
- Gases.
- Miscellaneous.

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 tinctur
contains 7% iodine and 5% potassium iodide (KI) dissolved i
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

lorine - Potent germicidal effect against most bacteria, viruses, rotozoa, and fungi at a concentration of 0.1 ppm, but much higher oncentrations are required in the presence of organic matter

lkaline pH ionizes chlorine and decreases its activity by reducing i enetrability.

ritant to the skin and mucous membranes

idely used to disinfect water supplies and inanimate objects (eg, tensils, bottles, pipelines)

odium hypochlorite solutions (bleach) 2–5% can be used as a isinfectant, and a more diluted form (0.5%) can be used for irrigati uppurating wounds, but it dissolves blood clots and delays clotting

oot canal therapy in dentistry

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- **Biguanides**
- Quaternary amonium compounds
- Alcohols
- Aldehydes
- Acids
- Metalls
- Dyes.
- Gases.
- Miscellaneous

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.

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- **Quaternary amonium compounds**
- Alcohols
- Aldehydes
- Acids
- Metalls
- Dyes.
- Gases
- Miscellaneous

Quaternary amonium compounds

ergents: destroy bacteria, fungi & viruses by altering
rmeability of cell membrane

fficiently remove dirt and grease

idely used as antiseptics & disinfectants for surgical instrumen
oves etc.

ps: Anionic detergents

eak antiseptics with cleansing action

ashing with soap and warm water - one of the most effective
ethods of preventing disease transmission

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compounds
- **Alcohols**
- Aldehydes
- Acids
- Metalls
- Dyes.
- Gases.
- Miscellaneous

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

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compounds
- Alcohols
- **Aldehydes**
- Acids
- Metalls
- Dyes.
- Gases
- Miscellaneous

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

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compounds
- Alcohols
- Aldehydes
- **Acids**
- Metalls
- Dyes.
- Gases.
- Miscellaneous

Acids

Boric acid

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

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compounds
- Alcohols
- Aldehydes
- Acids
- **Metalls**
- Dyes.
- Gases.
- Miscellaneous.

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

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compound
- Alcohols
- Aldehydes
- Acids
- Metalls
- **Dyes**
- Gases
- Miscellaneous.

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

ACRIFLAVINE :

- Active against gram +ve bacteria, gonococci
- Store in amber colored bottle.
- Nonirritant
- Use chronic ulcers and wounds

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compound
- Alcohols
- Aldehydes
- Acids
- Metalls
- Dyes
- **Gases**
- Miscellaneous

Ethylene Oxide

- Acts by alkylating proteins and nucleic acid.
- Highly inflammable and explosive.
- Used for sterilization of heart – lung machine, plastic equipment, sutures, dental equipment and cardiac catheters.
- Not used for fumigation as it is explosive.

Formaldehyde

- 40% solution is called formalin.
- Formaldehyde solution is used for disinfection of sputum, removal of warts, on palms and soles to treat hyperhidrosis, preservation of anatomical and pathological specimens.
- Formaldehyde gas used for fumigation of wards and OT's rarely for sterilization of heart instruments and gloves.
- In dentistry it is used to harden the residual pulp tissue.

Classes

- Phenol derivatives
- Oxidizing agents
- Halogens
- Biguanides
- Quaternary amonium compound
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- Aldehydes
- Acids
- Metalls
- Dyes
- Gases
- **Miscellaneous**

Nitrofurazone has bactericidal action on fungi. It is used topically for burns and ulcers.

DISINFECTANTS

Selection criteria of Disinfectants:

Disinfectant effectiveness depends on many factors. These include:

- Type of contaminating microorganism. Each disinfectant has uniq antimicrobial attributes.
- Degree of contamination. This determines the quality of disinfect required and time of exposure.
- Amount of proteinaceous material present. High protein based materials absorb and neutralize some chemical disinfectants.
- Presence of organic matter and other compounds such as soaps m neutralize some disinfectants.
- Chemical nature of disinfectant. It is important to understand the mode of action in order to select the appropriate disinfectant.

Concentration and quantity of disinfectant. It is important to choose th proper concentration and quantity of disinfectant that is best suited to each situation.

Contact time and temperature. Sufficient time and appropriate temperature must be allowed for action of the disinfectant and may depend on the degree of contamination and organic matter load.

Residual activity and effects on fabric and metal should be considered for specific situations.

Application temperature, pH and interactions with other compounds must be considered.

Toxicity to the environment and relative safety to people that may be exposed.

Cost.

LOW LEVEL DISINFECTANTS

Phenolic Disinfectants

Quaternary Ammonium Compounds: **C**ontain NH^{4+}. The labels often list a form of ammonium chloride (AC) such as alkyl aryl, benzyl, didecyl, dimethyl, ethylbenzyl, octyl or a combination thereof. Benzalconium chloride (BC) is a more tissue friendly **Quaternary Ammonium** than **Ammonium chloride** . **Quaternary Ammonium** disinfectants are effectiv against Gram + and Gram - bacteria, and enveloped viruses.

INTERMEDIATE LEVEL DISINFECTANTS

- Alcohols
- Hypochlorites
- Iodine And Iodophor Disinfectants

HIGH LEVEL DISINFECTANTS

Hydrogen Peroxide.

Gluteraldehyde.

Formaldehyde.

Ortho-phthalaldehyde.

Peracetic Acid.

Peracetic Acid and Hydrogen Peroxide.

Special Consideration for Creutzfeldt-Jakob Disease (CJD

Assignment - Creutzfeldt-Jakob Disease (CJD)

Special Consideration for Creutzfeldt-Jakob Disease (CJD).

- Contaminated instruments should be thoroughly cleaned to remove any organic material, immersed in a solution of sodium hydroxide[1N] (NaOH) or ½ strength bleach solutions (20000 ppm) for 1 hour, rinsed well, and then placed in a water bath and sterilized at 121°C for one hour. Hard surfaces should be cleaned to remove any visible soil, then flooded with [2N] NaOH or undiluted bleach (50000 ppm) for 1 hour, then mopped up and rinsed with water.
- Any personnel handling NaOH solution/ bleach solution must use appropriate PPE.

INSECTICIDES

(These are the part of pesticides.)

Classification of pesticides

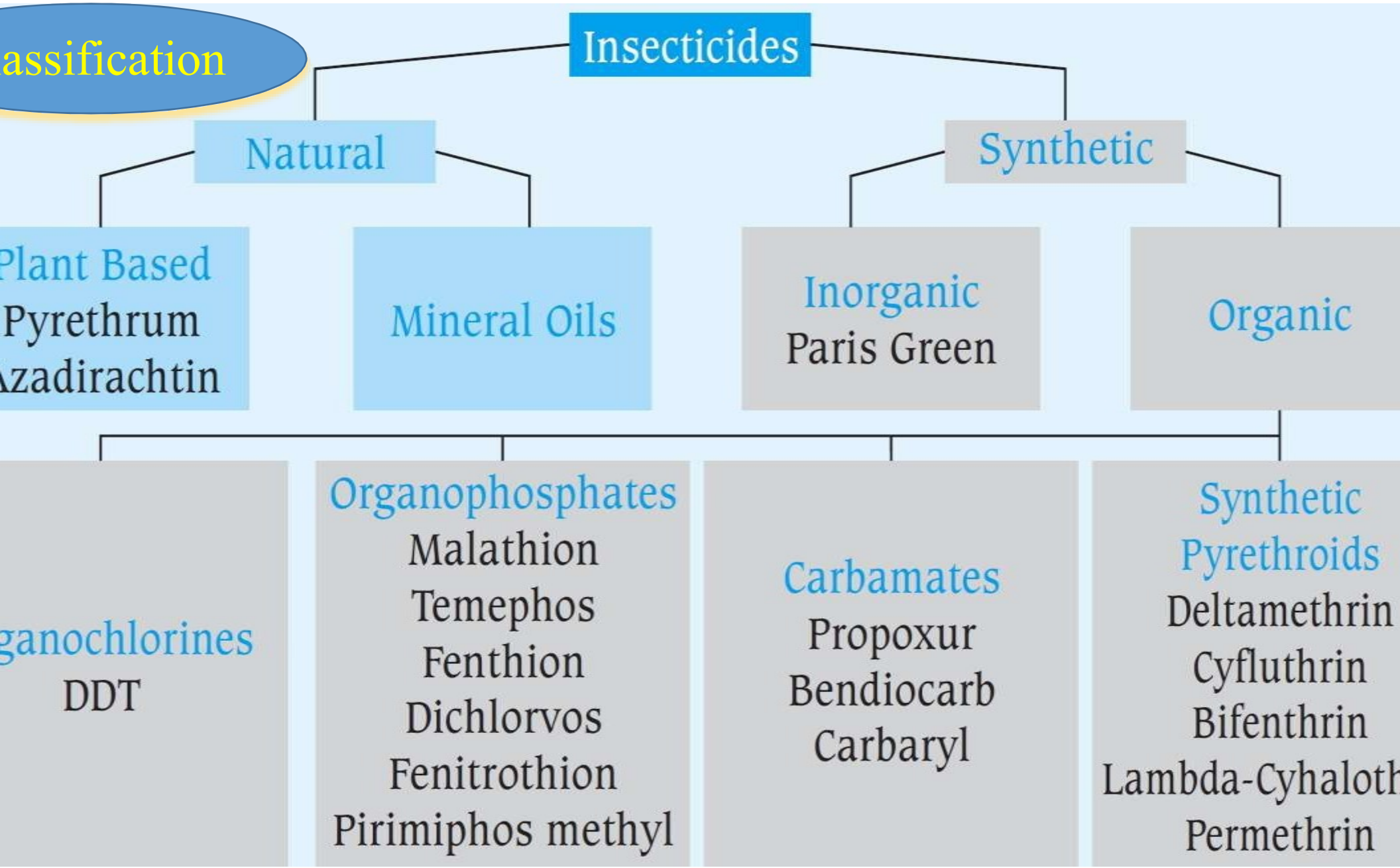
hese are organic or inorganic compound obtain from natural roducts, Depending upon the purpose for which the pesticides re used, they are classified as follows:

nsecticides

erbicide
ungicides
odenticides
lgaecide
Molluscicides
Miticides
ematocides

INSECTICIDES - Definition

- Insecticides are the chemicals used to kill the insects.


assification
Insecticides
Natural
Synthetic
Plant Based
Pyrethrum
Azadirachtin
Mineral Oils
Inorganic
Paris Green
Organic
ganochlorines
DDT
Organophosphates
Malathion
Temephos
Fenthion
Dichlorvos
Fenitrothion
Pirimiphos methyl
Carbamates
Propoxur
Bendiocarb
Carbaryl
Synthetic Pyrethroids
Deltamethrin
Cyfluthrin
Bifenthrin
Lambda-Cyhaloth
Permethrin

Dichloro-diphenyl-trichloroethane (DDT) – *Organic Insecticides*

Group: Organochlorine Compound

Physical Appearance: White amorphous powder

Mode of Action: Contact poison-nervous system paralysis

Mode of application: residual spray.

Dosage of Application: 5% susp. / 100-200gm / sq ft

Effective against: Lice, Fleas, Ticks, Flies, Mosquitoes

Period of effectiveness: 18 months

Disadvantage: Persistence in living organisms like plants, human and some wild animals leading to ecosystem damage, insecticide resistance

BHC (Benzene Hexa-Chloride) – *Organic Insecticides.*

Group: Organochlorine Compounds

a) Technical HCH- 13-16% Gamma isomer

b) Pure HCH – 99% Gamma isomer (lindane)

Physical Appearance: White or chocolate coloured powder, musty smell

Mode of Action: Kills insects by direct contact and its vapour

Mode of application: 50% Emulsifiable Concentrate

Dosage of Application: 25 – 50 mg per sq.foot

Effective against: Lice, Fleas, Ticks, Flies,

Period of effectiveness: Residual action for 3 months

Abate (Temephos)

- Group: Organophosphorus compound
- Physical Appearance: Brown Viscous liquid
- Mode of Action: Contact poison
- Mode of application: 50% EC. Only insecticide approved for use in potable water
- Dosage of Application: 1ppm
- Effective against: Anopheles stephensi

Malathion – *Organophosphate Insecticides*

- Group: Organo- phosphorus compound
- Physical Appearance: Yellow or clear brown colored liquid
- Mode of Action: Contact Poison
- Mode of application:

a) Malathion Technical (95%) for use as space spray

b) 50% Water Dispersible Powder (WDP) & emulsifiable Concentrate (EC) for residual control

c) 90% dust for use against fleas and lice

- Dosage of Application: 2 g/m2 for Mosquitoes
- Effective against: mosquitoes, houseflies, cockroaches, bedbugs, lice

enthion (Baytex) – *Organophosphate Insecticides*

Group: Organo-prosphrous Compounds

Physical Appearance: Brown liquid, Smell of garlic

Mode of Action: Contact poison, larvicide (Oils suffocate and poison the aquatic stages of mosquito)

Mode of application: residual spray

Dosage of Application: 1 ppm

Effective against: Culex quinquefasciatus (non-potable water)

ouseflies

Disadvantage: Injurious to aquatic vegetation and fish if not properly used.

Mineral Oil (Mosquito larvicidal oil, Malariol) – *Mineral oils Insecticides:*

Group: Kerosene oil, diesel oil, petrol and crude engine oil

Physical Appearance: Colourless or muddy Oil

Mode of Action: Contact poison, Cuts off air supply

Mode of application: Spray on the surface of water

Dosage of Application: 40 – 90 liters / 10000 sq m

Effective against: Mosquito larvae

Period of effectiveness: To be applied once a week

Pyrethrum – *Plant based Insecticides*

Group: Natural Insecticides, plant extract

a) Flowers of chrysanthemum cinerariafolium

b) Active principles: pyrethrum 1 and 2,cinerins 1 and 2

Physical Appearance: Colorless liquid

Mode of Action: Contact poison

Mode and Dosage of application: 50 to 100 ml of pyrethrum solution in kerosene oil is sprayed per 100 m3 of space.

Effective against: Adult mosquito, other insects.

Period of effectiveness: instant, no residual action.

Paris Green – *Synthetic inorganic Insecticides*

Group: Inorganic, Larvicidal

Physical Appearance: Emerald green crystalline powder

Mode of Action: Stomach Poison

Mode and Dosage of application: Applied as 1% granules to water in which breeding occurs

Effective against: Anopheline larave,

Period of effectiveness: One week

Diazinon

Group: Organo phosphorus compound

Physical Appearance: Volatile liquid

Mode of Action: Fumigant action, Contact Poison

Mode of application: Fumigation

Dosage of Application: 20 – 40 % at dose of 100 mg/sq foot

Effective against: Flies, Mosquitos

Used in DDT resistance

Different Classification

CARBAMATE INSECTICIDES-carbaryl , Dimetan, Pyrolan, Zectran, carbofuran

Organophosphorus compounds

Malathion, Parathion, Diazinon

Botonical compounds- Pyrethrum, Limonoids, Rotenone

Ectoparaciticides –permethrin, lindane, Benzyl benzoate, Crotamiton, Sulfur

Permethrin

Broad spectrum causes neurological paralysis in insects.

100 % cure rate nearly

Single application needed in most cases.

Few patients experience itching ,burning.

first drug of choice for scabies & pediculosis.

Scabies: Apply all over the body except face & head . Wash after 8- 12 hrs.

Head louse: massage about 30 g in to scalp and wash after 10 min.

Lindane

Broad spectrum insecticide which kills lice and mites by penetrating their chitinous cover

Properties similar to permethrin.

Cure rate low & resistance seen.

Disadvantage: being lipid soluble CNS toxicity like vertigo , convulsions seen.

Application similar to permithrin.

combination with benzyl benzoate is more effective.

Benzyl benzoate

Oily liquid with aromatic smell.

Cure rate 76 – 100% ; second application required after 24 hrs.

Toxicity is low. Application similar to permethrin.

Use has declined due to skin irritation.

Contra indicated in children because of neurological symptoms & skin irritation.

combination with lindane highly effective.

Crotamiton

low cure rates

Better results if applied for 5 days in children

Less irritation and toxicity

May be preferred in children as second choice

Ivermectin

Anti helminthic drug which has been recently found effective against scabies & pediculosis.

A single 0.2 mg /kg (12mg in adults) has 91- 100 % cure rate.

Contra indicated in children < 5yrs , pregnant & lactating women.

Nursing Responsibilities:

- Nurse must know the time course of action of the specific agent because the various antiseptics and disinfectants require different durations of exposure to be effective.
- Washing with antiseptic by nurses, physician and others, who contact patients will do more to protect patients from infection than will application of antiseptics to patients themselves.
- For routine hand alcohol, antiseptics, hand scrubs, are preffered to soap and water.
- Wear personal protective equipment which include boots, aprons, gowns, gloves, masks, protective spectacles and caps.

contd.

Make sure the correct name of the solution is on the container each time refill it, do not top off antiseptic dispenses.

Do not store gauze or cotton wool in antiseptics, this promote contamination.

Nurse should establish a routine schedule for preparing new solutions and cleaning reusable containers.

Label reusable containers with date, each time they are washed dried and refilled.

All containers should have lids, which should be well tightened.

Nurse should keep in mind that concentrated antiseptic solutions should be stored in a cool, dark area, never store them in direct sunlight or excessive heat.

Smoking, eating, and drinking in chemical storage areas id strictly prohibited.

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THE END