Sterilization & Disinfection Chemical Agents

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Sterilization & Disinfection

- Definitions
- Bacterial Cell Death
- General characteristics
- Types of Chemical Agents
- Comparisons

Definitions

- Sterilization
  - Complete Destruction of ALL microbes
- Disinfection
  - Killing of pathogens on inanimate objects
  - physical or chemical
- Antiseptic
  - A chemical agent for disinfection of living tissue
  - External skin, mouth vagina

Definitions

- Bacteriocide
- kill microbes
- also germicide, fungicide, virucide
- Bacteriostatic
- Prevents or stops microbial growth
- also fungistatic, virustatic
- Aseptic(Asepsis)
- Prevent contamination of person or object by microbes

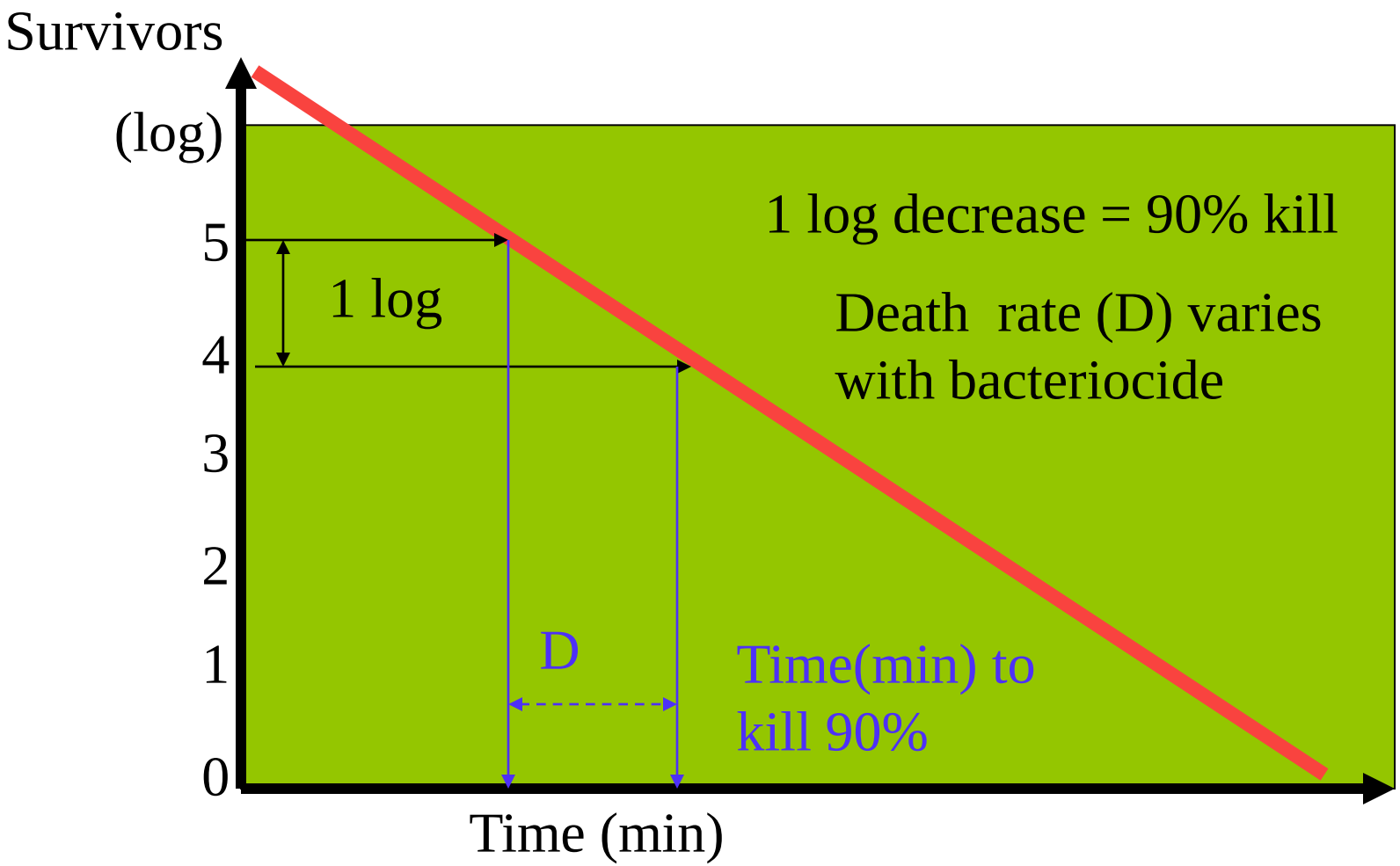
Definitions

- Sanitize
- Removal of pathogens from inanimate objects
- Mechanical or chemical cleaning
- need not sterilize of disinfect
- Contamination
- Presence of living microbes on object

Definitions

- Infection
- Presence of living multiplying microbes in host tissues
- often pathogenic
- Preservation
- Prevention of spoilage
- Control of Contamination
- Bacteriostatic

Bacterial Cell Death



Chemical agents

- Wide variety in susceptibility
- Growing cells more susceptible than resting cells or spores
- Gram +ve more susceptible than Gram -ve
- *Mycobacterium* (TB) more resistant
- Hepatitis virus very resistant

General Rule for Disinfection

- Clean then disinfect
  - organic matter inactivates many chemicals
- Use at recommended strength
  - Undiluted NOT always best
  - 70% alcohol better than 100% alcohol
- Prevent contamination of disinfectant
- Prepare fresh
  - deterioration after prolonged storage

Types of Chemical Agents

- Phenols
- Halogens
- Metal ions
- Alcohols
- Detergents
- Alkylating agents
- Ethylene Oxide
- Hydrogen peroxide

When in doubt about efficiency of a disinfectant

Get a laboratory test

Phenols

- **Mechanism of action**
- **Rupture the cell membrane**
- **Denature enzymes (protein)**
- **Effective in presence of organic matter**
- **blood, pus, feces, vomitus**
- **Good environmental disinfectants**

Phenols (examples)

- Phenol
- corrosive to skin
- smell
- 1% effective disinfectant

Cresols

- Methyl phenol
- Phenyl-phenol (“Lysol”)

Chlorinated phenols

- Hexachlorophene
  - Effective against Gm +ve
  - absorbed through skin
  - Toxic to infants if used often
- Pentachlorophenol
  - more toxic than above

Halogens

- Cholorine
- Iodine

Iodine

- Applications
  - Skin antiseptic
  - Environmental disinfectant
- Mode of Action
  - Iodination of Tyrosine

Iodine (cont)

- Prepare fresh
- Dark brown - active
- Straw Yellow - inactive
- Clean area first
- organic matter reduces activity

Iodine Formulations

- Tincture iodine I_2 in ethanol
- Aqueous iodine I_2 in NaI/KI
- Iodophors (organic)
- I_2 in nonionic detergent
- Wesocdyne
- Generally 75 ppm
- Mycobacterium 450 ppm
- Iodoform
- I_2 chemically combined

Chlorine

- Bacteriocide, fungicidal, virucidal
- 2-10 ppm
- Applications
  - disinfection of water, sewage etc
- Mode of Action
- Oxidizes proteins
- Features
- corrosive
- smells

Chlorine/formulations

Chlorine gas

Poisonous

forms HOCl (hypochlorous acid) in water

Applications

water supplies

swimming pools

sewage effluent

- Inorganic chlorine
  - Bleach NaOCl
  - hypochlorite $Ca(0Cl)_2$
  - chloramine
- effective against
  - Hepatitis
  - HIV

Metal Ions

- Silver
  - 1% $AgNO_3$ eye drops
  - gonnorrheal neaonatal opthalmitis
- Mercury
  - Hg Cl_2 Skin antiseptic
  - Mercurochrome
- Copper, zinc
  - fungicide, algacide
  - pressure treated wood

Alcohols

- Ethanol
- 70-75% in water best
- absolute less effective
- Isopropanol
- kills *Mycobacterium*

"Tincture of … " alcohol used as the solvent for other ingredient

Detergents

- Sanitize
- soaps
- neutral detergents
- Disinfect
- Anionic detergents
- Cationic detergents
- More effective with phenol
- Surface active

DO NOT MIX

Anionic Detergents

- -ve charge
- salts of long chain alkyl or aryl sulphonates

Cationic Detergents

- +ve charge
- ina
- eg cotton fibres
- effective at low concentrations
- Quaternary ammonium compounds
  - Benzalkonium chloride
  - eg "Zephiran"

Not effective for *Pseudomonas*

Chlorohexidine

- "Hibitane"
- 4% gluconate
- Emulsion used as a scrub
- Topical application for minor skin infections
- inefficient at high concentrations
- Mode of action
- cell membrane
- denatures protein
- not affected by organic matter

Alkylating Agents

- Cross link proteins, nucleic acids
- $-NH_2$, -OH,-SH,-COOH
- Formaldehyde
- Glutaraldehyde
- Beta-priopiolactone
- Ethylene oxide

Formaldehyde

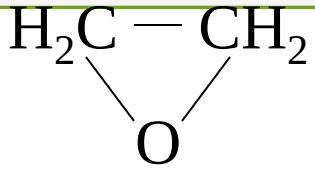
- HCHO
- Toxic
- Irritant
- Gas - fumigant
- Solutions- protein vaccines
- tetanus diptheria

Glutaraldehyde

- 2% glutaraldehyde pH 8
- Exposure time
- 5 min bactericidal
- 10 min kills *Mycobacterium*, Heptatitis virus
- 10 hr sterilizes
- Applications
- Lensed instruments, tubing, scalpels, inhalators

Beta-propiolactone

- Carcinogenic
- Unstable
- degrades but leaves no residue
- Applications- sera, vaccines



Ethylene Oxide

- Sterilizes heat sensitive or chemcial sensitive objects
- Flammable, explosive carcinogenic
- Gas sterilizing autoclave
- 3-4 hr, 60 °C, high pressure
- 24 hr room temperature to dissipate gas
- use with CO2 or FREON to reduce explosions

Pregnant women should not be exposed!!

Hydrogen Peroxide

- Oxidizing agent
- Disinfectant -6%
  - Bactericidal
  - Fungicidal
  - Virucidal
- Prepare fresh

Kill curves of various antiseptics