




Sterilization, Disinfection, and Antisepsis

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Definitons

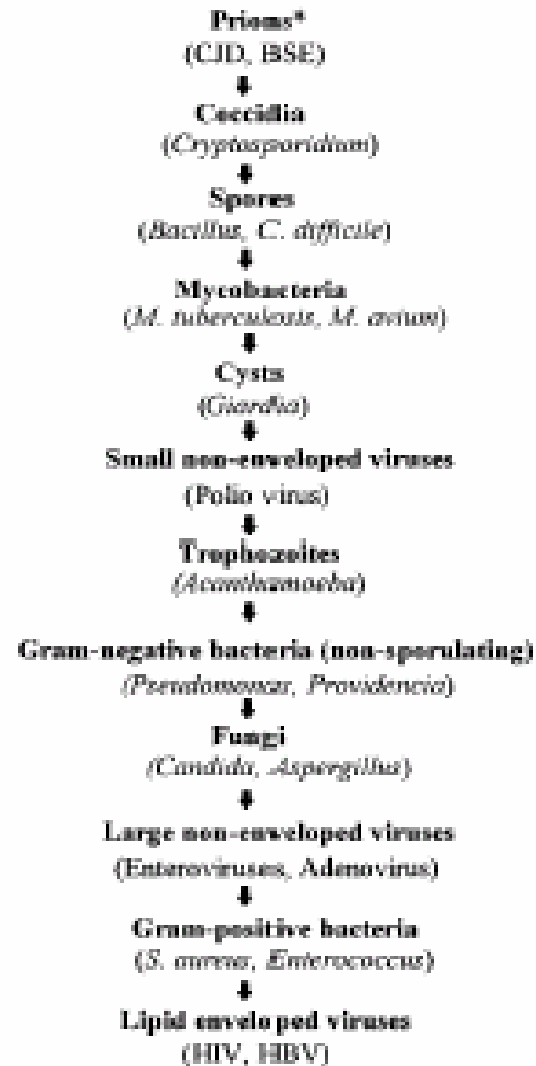
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- Sterilization-use of physical procedures or chemical agents to destroy all microbial forms including bacterial spores, mycobacteria, nonenveloped viruses and fungi
 - Pasteurization:heating of materials to 60°C for 30 minutes or 71°C for 30 sec.
 - Disinfection- use of physical procedures or chemical agents to destroy most microbial forms; bacterial spores and relatively resistant organisms may viable
 - Disinfectants:high-, intermediate-, low-level agents



Definitons

- Antisepsis-use of chemical agents on skin or other living tissue to inhibit or eliminate microbes; no sporicidal action is implied
- Germicide- chemical agent capable of killing microbes; spores may survive
- Sporicide- germicide capable of killing bacterial spores
- Sanitation-Process by which microbial contamination on inanimate surfaces is reduced to a safe level

Descending order of resistance to antiseptics and disinfectants





Sterilization methods

- **Physical**
- **Gas vapor**
- **Chemical sterilants**

Sterilization methods

Physical sterilants

- **Steam under pressure**
 - 121 °C or 132 °C for various time intervals
- **Dry heat**
 - 1 h at 171 °C, 2 h at 160 °C, 16 h at 121 °C
- **Filtration**
 - 0.22- to 0.45 μm pore size
 - HEPA(high efficiency particulate air) filters
 - Air control systems for removing particles(microorganisms)

Sterilization methods

Physical sterilants

- **UV radiation**

- Variable exposure to 254 nm wavelength
- Have low penetrability; direct exposure is required
- It causes skin erythema and conjunctivitis

- **Ionizing radiation**

- Variable exposure to microwave or gamma radiation

Sterilization methods

Gas vapor sterilants

■ Ethylene oxide

- 450 to 1200 mg/L at 29 °C to 65 °C for 2 to 5 hr
- Highly efficient, but extremely toxic

■ Formaldehyde vapor

2% to 5% at 60° to 80 °C

Carcinogenic!

■ Hydrogen peroxide vapor

- 30 % at 55° to 60 °C

■ Plasma gas

- Highly ionized hydrogen peroxide gas

■ Chlorine dioxide gas

- Variable; lack of toxicity

Sterilization methods

Chemical sterilants

- **Gluteraldehyde**
 - 2%
- **Peracetic acid**
 - an oxidizing agent
 - 0.2%
 - Has excellent activity
 - The end products are nontoxic
- **Beta-propiolactone**

Disinfection



- Disinfection process have been categorized as high level (\cong sterilization), intermediate level (spore forms can survive) and low level (many microbes can remain viable)
- High level disinfection: certain type of endoscopes, surgical instruments with plastic or other instruments that can not be autoclaved
- Intermediate level: flexible fiberoptic endoscopes, laryngoscopes, vaginal specula, anesthesia breathing circuits...
- Low-level: blood culture cuffs, electrocardiogram electrodes, stethoscopes

The effectiveness of disinfectants is influenced

by:



- The nature of the item to be disinfected
- Number and resilience of the contaminating organism/s
- Amount of organic material present (which can inactivate the disinfectant)
- Type and concentration of disinfectant
- Duration and temperature of exposure

Methods of disinfection

Method	Concentration(level of activity)
Heat	
Moist heat	75 ° to 100 °C for 30 min(high)
Liquid	
Gluteraldehyde	2%(high)
Hydrogen peroxide	3 % to 25% (high)
Formaldehyde	3% to 8% (high/intermediate)
Chlorine dioxide	Variable(high)
Peracetic acid	Variable(high)

Methods of disinfection

Method	Concentration(level of activity)
Liquid	
Chlorine compounds	100 to 1000 ppm of free chlorine (high)
Alcohol(ethyl, isopropil)	70% to 90% (intermediate)
Phenolic compounds	0.4% to 5%(intermediate/low)
Quaternary ammonium compounds(QAC)	0.1% to 1.6 %(low)



The uses of common disinfectants

- **Hand hygiene body surfaces**
 - Chlorhexidine
 - Isopropyl alcohol
 - Povidone iodine
 - Allergy risk
- **Medical equipment**
 - Gluteraldehyde
 - Respiratory irritant
- **Hospital, clinical environment**
 - Pheolic compounds
 - Avoid skin contact
 - Hypochlorite
 - Corrosive to metal



Antisepsis

- Antiseptic agents are used to reduce the number of microbes on skin surfaces
- These compounds are selected for their safety and efficacy


Antiseptic agents

Antiseptic agent	Concentration
Alcohol(ethyl, isopropyl)	70% to 90%
Iodophors	1 to 2 mg of free iodine/L 1% to 2% available iodine
Chlorhexidine	0.5% to 4%
Parachlorometaxyleneol	0.5% to 3.75%
Triclosan	0.3% to 2%

Germicidal properties of disinfectants and antiseptic agents

Agents	Bacteria	Myco- bacteria	spores	fungi	viruses
<u>Disinfectants</u>					
Alcohol	+	+	-	+	+/-
Hydrogen peroxide	+	+	+	+	+
Formaldehyde	+	+	+	+	+
Phenolics	+	+	-	-	+
Chlorine	+	+	+/-	+/-	+
Iodophors	+	+/-	-	-	+/-
Gluteraldehyde	+	+	+	+	+
QAC	+	-	-	-	+/-

Germicidal properties of disinfectants and antiseptic agents

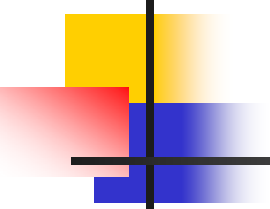


Agents	Bacteria	Myco-bacteria	spores	fungi	viruses
<u><i>Antiseptic agents</i></u>					
Alcohol	+	+	-	+	+
Iodophors	+	+	-	+	+
Chlorhexidine	+	+	-	+/-	+
Parachlorometaxylenol	+/-	+/-	-	+	-
Triclosan	+	+/-	-	-	?

The mechanisms of antibacterial action of antiseptics and disinfectant

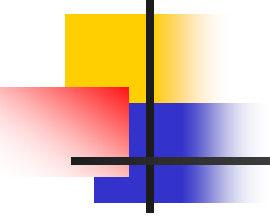
Target	antiseptics or disinfectant	mechanisms of action
Cell envelope(cell wall, outer membrane)	Glutaraldehyde EDTA, other permeabilizers	Cross-linking of proteins, Gram-negative bacteria: removal of Mg ²⁺ , release of some LPS
Cytoplasmic (inner) membrane	QACs Chlorhexidine	Generalized membrane damage involving phospholipid bilayers Low concentrations affect membrane integrity, high concentrations cause congealing of cytoplasm

The mechanisms of antibacterial action of antiseptics and disinfectant



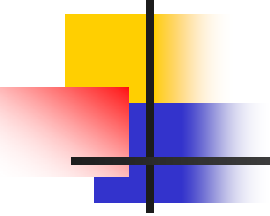
Target	antiseptics or disinfectant	mechanisms of action
Cytoplasmic (inner) membrane	Diamines PHMB, alexidine Phenols	Induction of leakage of amino acids Phase separation and domain formation of membrane lipids Leakage; some cause uncoupling

The mechanisms of antibacterial action of antiseptics and disinfectant



Target	antiseptics or disinfectant	mechanisms of action
Cross-linking of macromolecules	Formaldehyde Glutaraldehyde	Cross-linking of proteins, RNA, and DNA Cross-linking of proteins in cell envelope and elsewhere in the cell
DNA intercalation	Acridines	Intercalation of an acridine molecule between two layers of base pairs in DNA

The mechanisms of antibacterial action of antiseptics and disinfectant



Target	antiseptics or disinfectant	mechanisms of action
Interaction with thiol groups	Silver compounds	Membrane-bound enzymes (interaction with thiol groups)
Effects on DNA	Halogens Hydrogen peroxide, silver ions	Inhibition of DNA synthesis DNA strand breakage

The mechanisms of antibacterial action of antiseptics and disinfectant

Target	antiseptics or disinfectant	mechanisms of action
Oxidizing agents	Halogens Peroxygens	Oxidation of thiol groups to disulfides, sulfoxides, or disulfoxides Hydrogen peroxide: activity due to from formation of free hydroxy radicals (OH), which oxidize thiol groups in enzymes and proteins; PAA: disruption of thiol groups in proteins and enzymes