

Introduction to Microbiology



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Bacterial Death

- Defined as failing to give rise to colonies on media, hence setup (e.g type of media) is important.
- An exponential decrease in microbial survivors takes place, and varies with the killing agent.

$$S = S_0 e^{-kt}$$

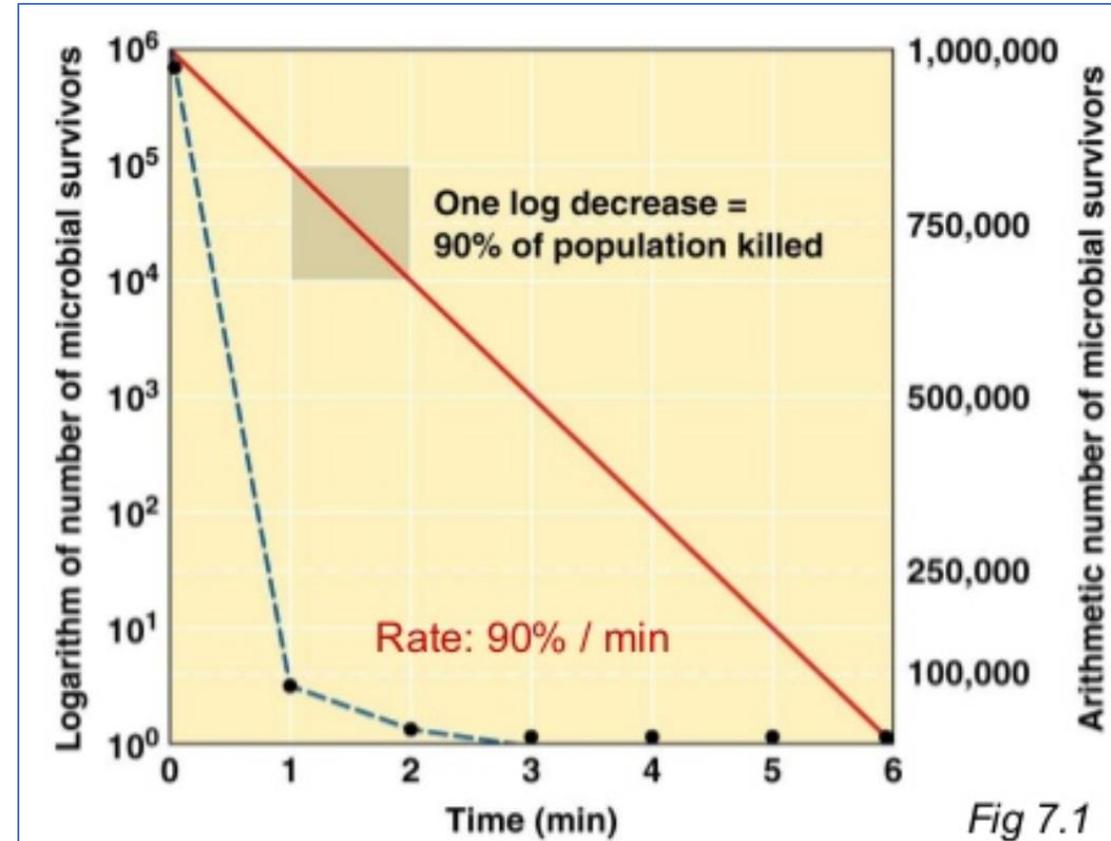


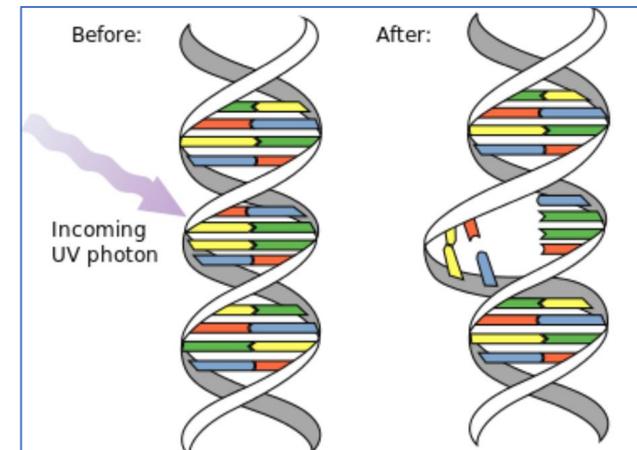
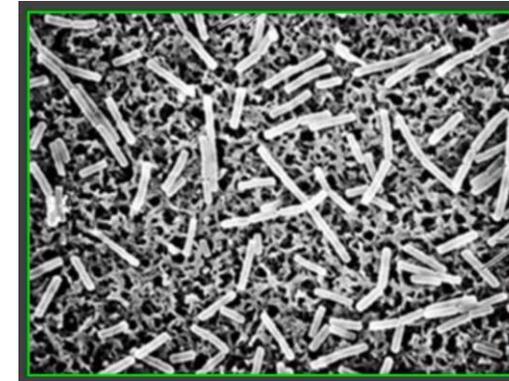
Fig 7.1

Antimicrobial agents / definitions

- Sterilization: To make free from any viable organism, conveys an absolute meaning
- Disinfection: To reduce bioburden on a surface for an appropriate to use level, bacterial spores and highly resistant microbes can survive.
- Cleaning (removal of organic and inorganic material from objects mechanically, done before sterilization or disinfection).
- Bacteriostatic (reversible inactivation of an organism)
- Bactericidal (irreversible inactivation of an organism)

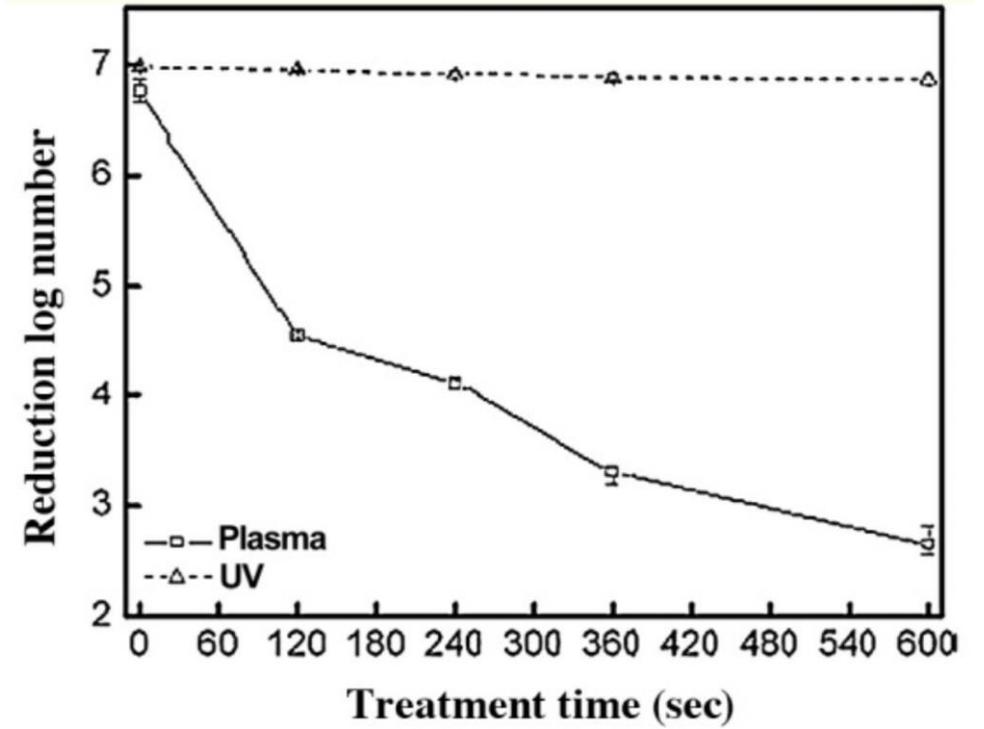
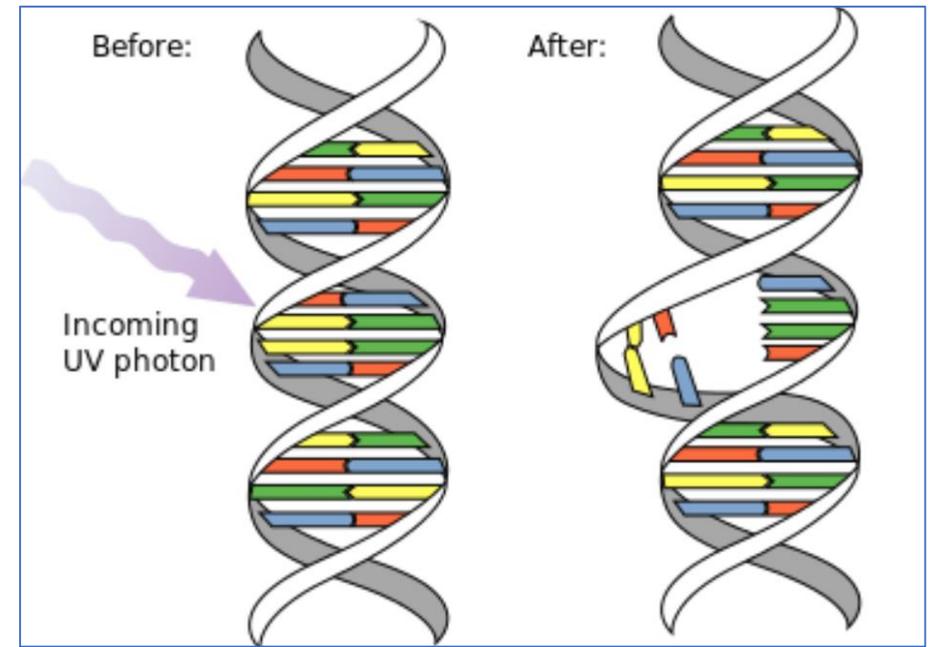
Sterilization

- Autoclaves use pressurized saturated steam at 121 °C (249 °F) for around 15–20 minutes.
- Filters with a pore size of 0.2 μM retain most microbes
- Chemicals like hydrogen peroxide in higher concentrations (10-30%) and and Glutaraldehyde with long contact times (3-12 hours).



Sterilization

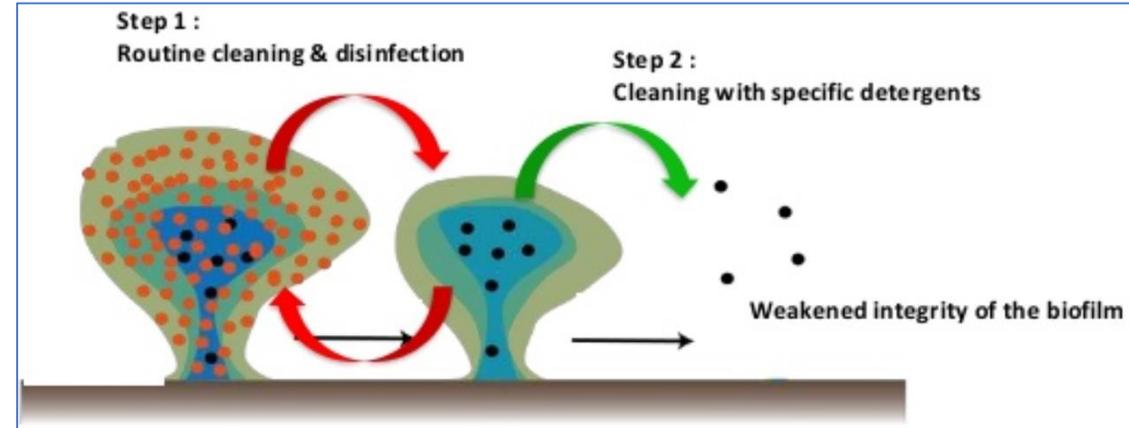
- UV radiation damage DNA by crosslinking adjacent pyrimidines while ionizing radiation (e.g. gamma radiation) cause strand breaks. Gamma radiation has better penetration into material.
- Gas plasma or vapor phase sterilization for heat sensitive equipment (e.g hydrogen peroxide and peracetic acid in vapor form).



Agents	Bacteria	Mycobacteria	Bacterial Spores	Fungi	Viruses
Disinfectants					
Alcohol	+	+	–	+	+/-
Hydrogen peroxide	+	+	+/-	+	+
Phenolics	+	+	–	+	+/-
Chlorine	+	+	+/-	+	+
Iodophors	+	+/-	–	+	+
Glutaraldehyde	+	+	+	+	+
Quaternary ammonium compounds	+/-	–	–	+/-	+/-
Antiseptic Agents					
Alcohol	+	+	–	+	+
Iodophors	+	+	–	+	+
Chlorhexidine	+	+	–	+	+
Parachlorometaxyleneol	+/-	+/-	–	+	+/-
Triclosan	+	+/-	–	+/-	+

“ Factors that affect the efficacy of both disinfection and sterilization include:

- prior cleaning of the object;
- organic and inorganic load present;
- type and level of microbial contamination;
- concentration of and exposure time to the germicide;
- physical nature of the object (e.g., crevices, hinges, and lumens);
- presence of biofilms;
- temperature and pH of the disinfection process”



Antimicrobial agents / definitions

- Septic :presence of pathogenic microbes in living tissues or associated fluids. (e.g. septic shock)
- Antiseptic : destroys or inhibits the growth of microorganisms in or on living tissue or fluid, e.g. (Alcohol, Iodine, Chlorhexidine).
- Aseptic : describing a technique free of microorganisms. (e.g. in surgery)
- Preservation: The prevention of multiplication of microorganisms in formulated products



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Phenolics	+	+	–	+	+/-
Chlorine	+	+	+/-	+	+
Iodophors	+	+/-	–	+	+
Glutaraldehyde	+	+	+	+	+
Quaternary ammonium compounds	+/-	–	–	+/-	+/-
Antiseptic Agents					
Alcohol	+	+	–	+	+
Iodophors	+	+	–	+	+
Chlorhexidine	+	+	–	+	+
Parachlorometaxyleneol	+/-	+/-	–	+	+/-
Triclosan	+	+/-	–	+/-	+

Antimicrobial agents / Mechanism of action

- Denaturation of proteins (e.g. heat destroys tertiary structures of proteins)
- Oxidation damage interferes with most biological processes of the cell. (e.g. Hydrogen peroxide interferes with some enzymes)
- DNA damage. (e.g. UV and ionizing radiation)
- Cell membrane and cell wall disruption. (e.g. Alcohol dissolves membrane lipids)

Further reading:

- Murray - Medical Microbiology 8th Edition
Section 1: Introduction
Chapter 3: Sterilization, disinfection and antisepsis
- Jawetz, Melnick & Adelberg's Medical Microbiology, 26th edition-
Section 1: Fundamentals of Microbiology-
Chapter 4: The Growth, Survival, and death of Microorganisms

Sterility in the OR

- Millions of surgical procedures and thousands of surgical site infections
- The goal of aseptic techniques is to prevent the transfer of microorganisms into the surgical wound.
- Only be there if needed.
- Any surface commonly touched should be disinfected. All surgical equipment is sterile.



Ignaz Semmelweis, Savior of mothers

