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Microbiology

Doctor 2017 | Medicine | JU

◉ Sheet ○ Slides

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Bacterial Death

Death of any living organism can be defined as an **irreversible inactivation** of it, so it does not **grow** nor **reproduce** anymore.

To confirm the death of bacteria:

We grow it on a **suitable media** *(agar plate for example)* and see if it **forms colonies** or **not** so then we can confirm whether the bacteria is **alive or dead** originally**.**

Note: *The setup (media) must be of* ***suitable conditions*** *to the bacteria we are studying, because if it wasn't suitable the bacteria would be* ***dead*** *and we won't know if it was originally dead or not.*

Exponential decrease through bacterial death

As seen in the following graph, An exponential decrease in microbial survivors takes place and varies in degree according to **the killing agent.**

The **rate** of bacteria death is **90%** per every **minute**.

Note: *The curve is* ***not linear*** *because at some point the bacteria will* ***adapt*** *to the conditions applied by the killing agent.*

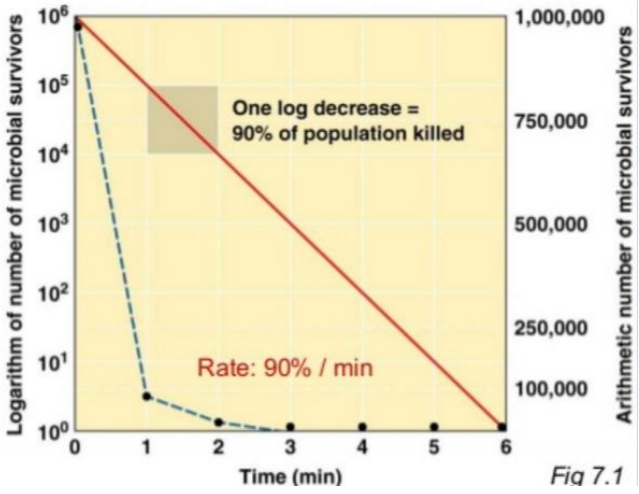


Fig 7.1

Formula of cell death

$$S = S_o * e^{-kt}$$

- **S** → Number of cells **survived after** using a killing agent
- **S°** → Number of cells **originally**
- **E** → Depends on the **type of the killing agent**

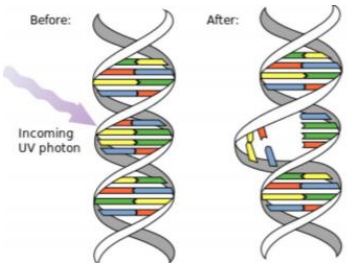
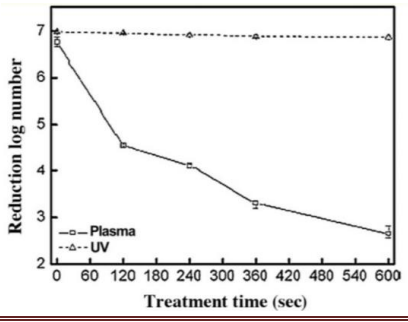
Antimicrobial Agents Definitions

1	**Sterilization**	A process to make an object **free from any living organism** on a surface.
2	**Disinfection**	Removal of **some microorganism** to get a surface that is appropriate to **use level**. It is **less effective** than sterilization. ***Note:*** *Some microorganisms **may persists** since they are **highly resistan**t microbes like **spores** and **prions**.*
3	**Cleaning**	Removal of **organic and inorganic materials** *(biofilm)* from objects mechanically with **water** or **fire** for example.

Bacteriostatic: It is the **reversible inactivating** of an organism process.
*Once we remove the agent the bacteria will **resume** its growth and replication.*

Bactericidal: It is the **irreversible inactivating** of an organism process.
*Even if we **remove** the agent the bacteria will still be **dead**.*

Sterilization Processes

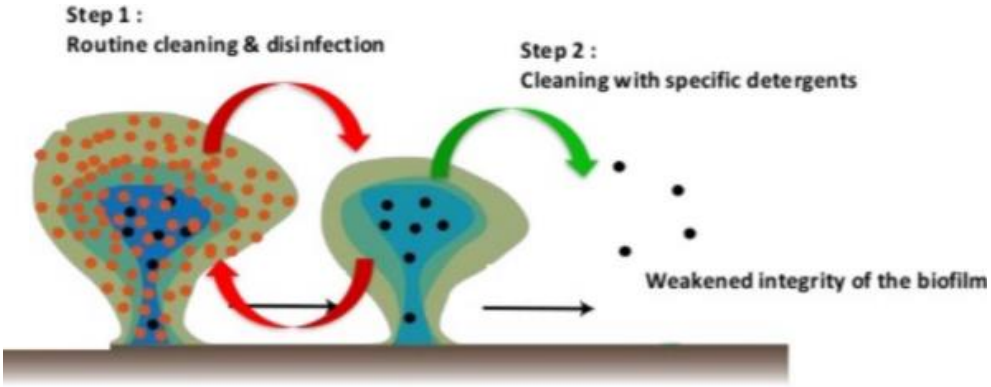
1	**Autoclaves**	They are **strong containers** that use **pressurized** and **saturated steams** at almost 121 C° for around 15-20 min. It's the most **efficient** way to kill microorganism using **heat and pressure.** 
2	**Filters**	With **pores** size of **0.2 µm** filters mostly, microorganisms will be **retained**.
3	**Chemicals**	**Hydrogen peroxide** is used in high concentrations (10%-30%). **Glutaraldehyde** is used with long contact times (3-12hr). ***Note:*** *Both when used at **lower concentration/time** may be considered **disinfectants** since they wont be as **effective** to be **considered** sterilizing agents.*
4	**Radiations**	**UV radiation** damages DNA by **crosslinking adjacent** pyrimidines. **Ionizing radiation** like **Gamma radiation** for example causes **strand breaks**  ***Note:*** *Gamma radiation has **better penetration into materials** than UV radiations.*
5	**Gas plasma /Vapor phase**	This process shows **high efficiency** in killing **spores**. **Example:** Hydrogen peroxide and Peracetic acid in **vapor form** *The graph shows that **Plasma** kills bacteria **better** than **UV*** 

Note: *Sterilization processes are used **depending on the objects' nature**, for example some objects' are **heat sensitive** therefore we cannot use **autoclaves**, so filters or gas plasma are considered **more suitable**.*

Factors that affect efficacy of both disinfection and sterilization:

1) **Prior cleaning**

   The presence of **biofilm** makes it harder for sterilizing agents and disinfectants to **penetrate** the bacteria and even sometimes **inactivates** the agents, so we have to **clean** the object before sterilizing/disinfecting to get rid of biofilms, that's why cleaning is **important**.



2) **Organic and inorganic load present**

   This **decreases** the **efficacy of action** for both disinfection and sterilization.

3) **Type and level of microbial contaminations.**

   Example: Prions, whom are **highly resistant.**

4) **Concentration of and exposure time to the germicide** *(killing agent)* as discussed before.

5) **Physical nature of objects**

   If they have **crevices, hinges or lumens**, its hard to **reach** them properly.

6) **Presence of biofilm**

7) **Temperature and pH of the disinfection process**

Antimicrobial Agents Definitions part 2

1	**Septic**	Is the presence of **pathogenic microbes** in **living tissues** or **associated fluids**. ***Note:*** *A* ***septic shock*** *is a serious medical condition that occurs when* ***living tissues*** *are* ***damaged*** *in response to* ***infection*** *by* ***microbes****.*
2	**Antiseptic**	**Destroys or inhibits** the **growth** of microorganisms in or on **living tissues** or fluids. They are similar to disinfectants, but they work on **living tissues** unlike disinfectants. ***Example:*** *Alcohol, Iodine and Chlorhexidine.* 
3	**Aseptic**	Is an adjective describing a **technique free of microorganisms** ***Example:*** *Surgery*
4	**Preservation**	Is the **prevention** of multiplication of microorganisms in formulated products using **preservatives**.

Mechanism of action of antimicrobial agents

1) **Denaturation of proteins**
   Heat destroys the **tertiary structure** which gives a protein its **function**.
2) **Oxidation damage** interferes with **most biological processes** of the cell *(membrane/DNA synthesis)*
   Example: Hydrogen peroxide interferes with **some enzymes** causing **biological** interferences.
3) **DNA damage**
   Example: UV and Ionizing radiation.
4) **Cell membrane and cell wall disruption**
   Example: Alcohol dissolves membrane lipids.

This table is only for further explanation of how each Antimicrobial agent affect different microorganism and others

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

+ → The microbe is **killed**

_ → The microbe is **not killed**

+/- → Means that the effect **depends** on the **concentrations/time** used.

Good Luck 😊