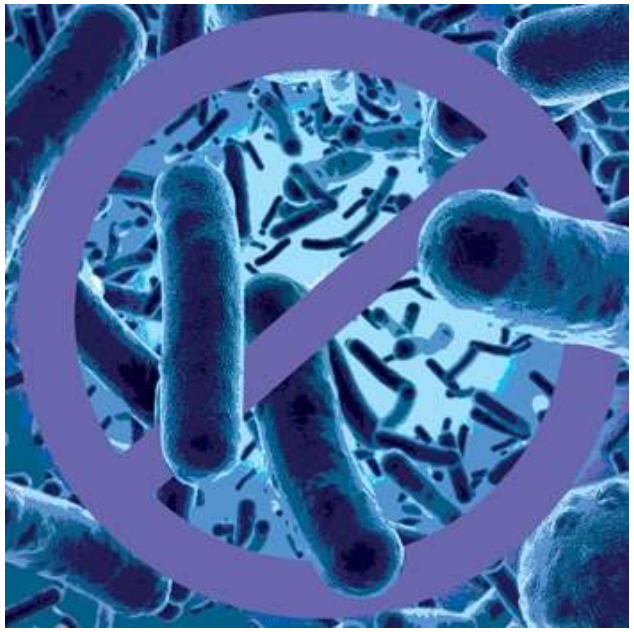
Sterilization & Disinfection



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Outline

- **Overview of disinfection and sterilization.**
- **Various methods.**
- **Important perspectives.**

Definitions

Sterilization: complete killing of all forms of microorganisms, including bacterial spores.

Disinfection: killing or removing of harmful vegetative microorganisms.

Antiseptic: disinfectant that can be safely used on living tissues.

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

History

- In 1862, **Louis Pasteur** developed pasteurization process.
- **Joseph Lister,**

  in 1867, used a carbolic solution spray on the wounds of his patients.
- **Charles Chamberland,**

  developed the first pressure steam sterilizer, or autoclave in 1876.

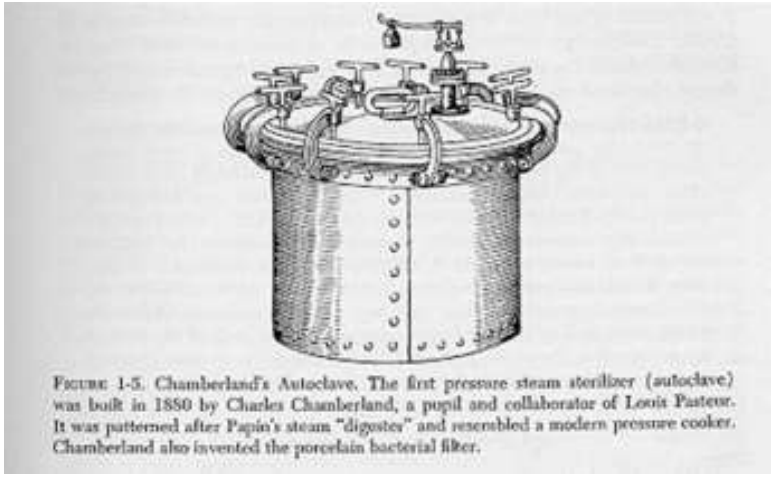


FIGURE 1-5. Chamberland's Autoclave. The first pressure steam sterilizer (autoclave) was built in 1880 by Charles Chamberland, a pupil and collaborator of Louis Pasteur. It was patterned after Papin's steam "digester" and resembled a modern pressure cooker. Chamberland also invented the porcelain bacterial filter.

Getting from here…

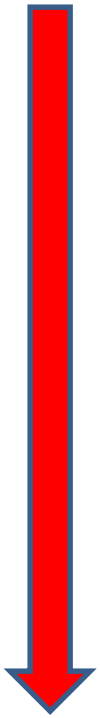
Back To Here:

Survival of Pathogens on Surfaces

Pathogen	Survival
MRSA	7 days – 7 months
VRE	5 days – 4 months
Acinetobacter	3 days -5 months
C. difficile (spores)	*5 months*
Norovirus	12 – 28 days
HIV	Minutes to hours
HBV	7 days
HCV	16 hours – 4 days

Order of resistance

Hardest to Kill



- *Prions*
- *Spores*
- *Mycobacteria*
- *Non-enveloped viruses*
- *Fungi*
- *Vegetative bacteria*
- *Enveloped viruses*

Easiest to Kill

Methods of sterilization and disinfection

PHYSICAL METHODS	CHEMICAL METHODS
•SUNLIGHT • DRYING • DRY HEAT • MOIST HEAT • FILTRATION • RADIATION • ULTRASONIC AND SONIC VIBRATIONS	•ALCOHOLS • ALDEHYDES • DYES • HALOGENS • PHENOLS • SURFACE-ACTIVE AGENTS • METALLIC SALTS • GASES

Choice of Method

- Method to be used will depend on:
  - Device's intended use
  - Risk of infection
  - Degree of soilage
- Process must not damage the device

Spaulding Classification

Device Classification

Device contacts sterile tissue or body sites, vascular system or the bloodstream

CRITICAL

Device contacts mucous membranes or non-intact / broken skin

SEMI-CRITICAL

Device contacts intact skin only

NON-CRITICAL

Minimum Disinfection Level Requirement

#

Sterilization

All viable microorganisms must be destroyed.

High Level Disinfection

All viable microorganisms must be destroyed, except bacterial spores.

Low Level Disinfection

Most vegetative bacteria and viruses destroyed, except bacterial spores, mycobacteria, fungi, or small non-lipid viruses.

Management of contaminated items

Contaminated reusable items should be:

- Handled as little as possible
- Staff should wear appropriate PPE
- Gross debris removed at point of use
- Soiled items removed immediately after use

It all starts with cleaning

Items can't be disinfected or sterilized unless they are properly cleaned.

Cleaning instruments

- Soak in enzymatic or non-enzymatic detergent
- Wear the appropriate PPE
- Keep instruments submerged in solution and scrub with brush
- Thoroughly rinse the instrument
- Allow instrument to dry

Automated cleaning

Types:

- Ultrasonic cleaner
- Instrument washer

Benefits:

- Improved efficacy
- Reduced employee exposure to splash and sharps

Disinfectants

Activity of disinfectants

- Contamination
- Concentration
- Temperature
- Time
- Range of action

High-Level Disinfectants

Germicide	Concentration
Glutaraldhyde (Cidex)	≥ 2.0%
Ortho-phthaladehyde (Cidex OPA)	0.55%
Hydrogen Peroxide* (Sporox)	7.5%
Hydrogen Peroxide and peracetic acid* (Peract)	1.0% / 0.08%
Hydrogen Peroxide and peracetic acid* (Endospore +)	7.5% / 0.23%
Hypochlorite (free chlorine)* (Sterilox ©)	650-675 ppm
Accelerated hydrogen peroxide (Resert XL)	2.0%
Peracetic Acid (Steris 20)	0.2%
Glutaraldehyde and Isopropanol (Aldahol III)	3.4% / 26%
Glutaraldehyde and phenol/phenate (Sporicidin)	1.21% / 1.93%

Liquid Disinfectants

Disinfectant Agent	Use Concentration
Ethyl or isopropyl alcohol	70% - 90%
Chlorine (bleach)	100 ppm
Phenolic	UD
Iodophor	UD
Quaternary ammonium compound (QUAT)	UD
Improved/Accelerated hydrogen peroxide	0.5%, 1.4%

Sterilization

Dry Heat Sterilisation

- Require hot-air ovens
- For glassware, metallic items, powders and oil/grease
- Time two hours at 160°C and one hour at 180°C
- Plastics, rubber, paper and cloth cannot be placed in them due to fire risk

Dry Heat Sterilisation

Advantages

- Can be used for powders, anhydrous oils
- Inexpensive
- No corrosive effect on instruments

Disadvantages

- High temperature damages some items
- Penetration of heat slow, uneven

Autoclave

Pressure (psi)	Temperature (°C)	Time (mins)
15	121	15
20	126	10
20	134	3

Types of autoclave

- Downward displacement
- Positive pressure displacement
- Negative pressure displacement
- Triple vacuum autoclave

Gravity Displacement Autoclaves

- Steam introduced to purge out air and build pressure
- Raise temperature normally to 121°C at 15 pounds/square inch and maintain it for 15-45 minutes
- For sterilising liquids and items in wraps that steam can penetrate

High-Vacuum Autoclaves

- Air is first vacuumed out and then steam introduced
- Faster and better penetration throughout the load
- Pressure and temperature higher; 134°C at about at 30 pounds/inch^2
- Processing time about three minutes
- Not suited for liquids due to need for vacuum

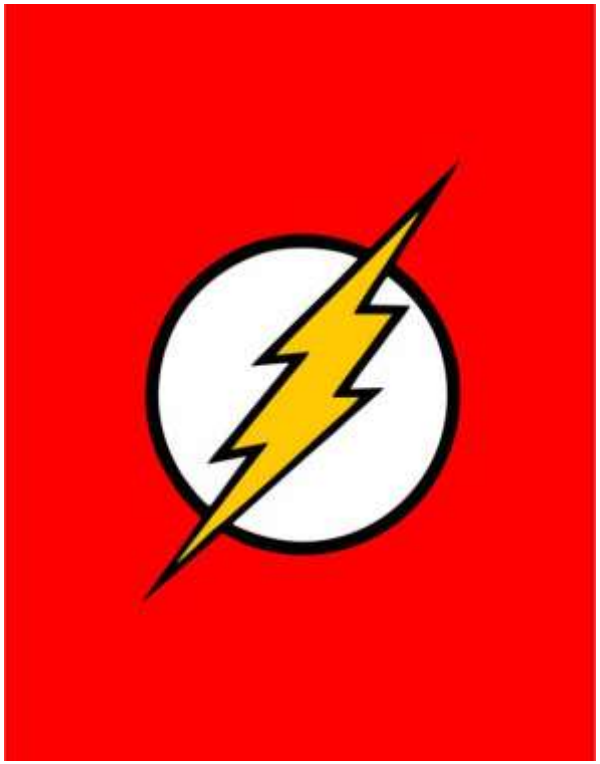
Low-Temperature Sterilization

- Mixture of steam (50-80°C) and formaldehyde vapour
- To process heat-resistant or heat-sensitive medical devices in specialised equipment
- Devices pre-cleaned and wrapped in standard material and processed in a three-hour cycle
- Cannot be used for liquids
- Formaldehyde must be purged/ neutralised well

Flash Sterilisation

Only to process a critical surgical item:
in an emergency
when accidentally contaminated, or
when other means of sterilisation unavailable

Never to be used for implantable items or to compensate for shortage of key instruments



Ethylene Oxide Gas Sterilisation

- Used for heat or moisture sensitive items
- Prevents normal cellular metabolism and replication

Multiple-load capable sterilizing cabinet

Hydrogen Peroxide Gas Plasma

- Highly reactive/charged particles from hydrogen peroxide generated under vacuum
- Can be used to sterilise heat- and moisture-sensitive items
  - Some plastics, electrical/electronic devices, and corrosion-susceptible metal alloys
- Special wrapping required

Fumigation

- For rooms contaminated with some pathogens
  - Such as MRSA and *Clostridium difficile*
- Release of hydrogen peroxide, chlorine dioxide gas or possibly ozone in sealed rooms
- Spore strips (biological indicators) placed strategically to monitor process
- Special equipment required
- Risk of damage to sensitive items

Pasteurisation and Boiling

- Semi-critical items can be pasteurised
  - 65-77°C, 30 min
  - Example: respiratory therapy equipment
- Must be retrieved carefully for safe transport and storage

Filtration

- Removal of microbes from air or heat-sensitive liquids
- Disinfectant-impregnated filters may inactivate trapped microorganisms
- Example: High-efficiency particulate air (HEPA) filters
- All filters must be checked for integrity and replaced as necessary

Ultraviolet (UV) Light

- UV lamps useful for chemical-free disinfection of air and water and also possibly for decontamination of environmental surfaces
- Broad-spectrum microbicidal action
- Require regular cleaning and periodic replacement

Microwaves

- Heating from rapid rotation of water molecules
- Limited use except for disinfecting soft contact lenses and urinary catheters for intermittent self-catheterisation
- May be used in emergencies to treat water for drinking or to ‘disinfect’ small water-immersible plastic or glass items

Wrapped or Packaged Instrument Sets in Autoclave

Item	Time	Temperature	Pressure	Notes
Small wrapped or packaged loads	15 minutes Add 5 min to allow for reaching parameters	270° F (132°C)	30 psi	Drying time 15-30 min No drying time – packs must be handled with sterile gloves

***Not recommended without use of minimum drying times**

Instrument wrap

- Should be square wrap with a 6 inch border around each side of the pan.
- Alternative wrap: 140-thread count, 100% cotton muslin.

Wet packs?

Cause	Solution
Over packed autoclave	Run smaller loads
Dehydrated wrap	Launder wrap after each use
Short drying time	Extend drying times
Stored on solid cool surface	Store on wire mesh shelving

Storage of Sterile Items

- A well-ventilated area that provides protection against dust, moisture, and temperature and humidity extremes.
- Sterile items should be stored so that packaging is not compromised.
- Label sterilized items with a load number that indicates the sterilizer used, the cycle or load number, the date of sterilization, and if applicable the expiration date.

Monitoring

Autoclave tape – external indicator

Chemical indicator – internal indicator

Indicators should be checked prior to using any item.
No color change – do not use and return for proper sterilization.

Biological monitors

METHOD OF STERILIZATION	BIOLOGICAL CONTROL
•**Hot Air Oven**	*Bacillus subtilis subsp. Niger* *Clostridium tetani*
• **Autoclave**	*Bacillus stearothermophilus*
•**Filtration**	*Serratia marcescens,* *Pseudomonas diminuta*
• **Ionizing Radiation**	*Bacillus pumilis*

Dental Surgery Perspective

Gigasept which contains succindialdehyde and dimethoxytetrahydrofuran are used for disinfection of plastic and rubber materials eg: dental chair

Asepsis of surgical theaters

Fumigation is done by two methods:

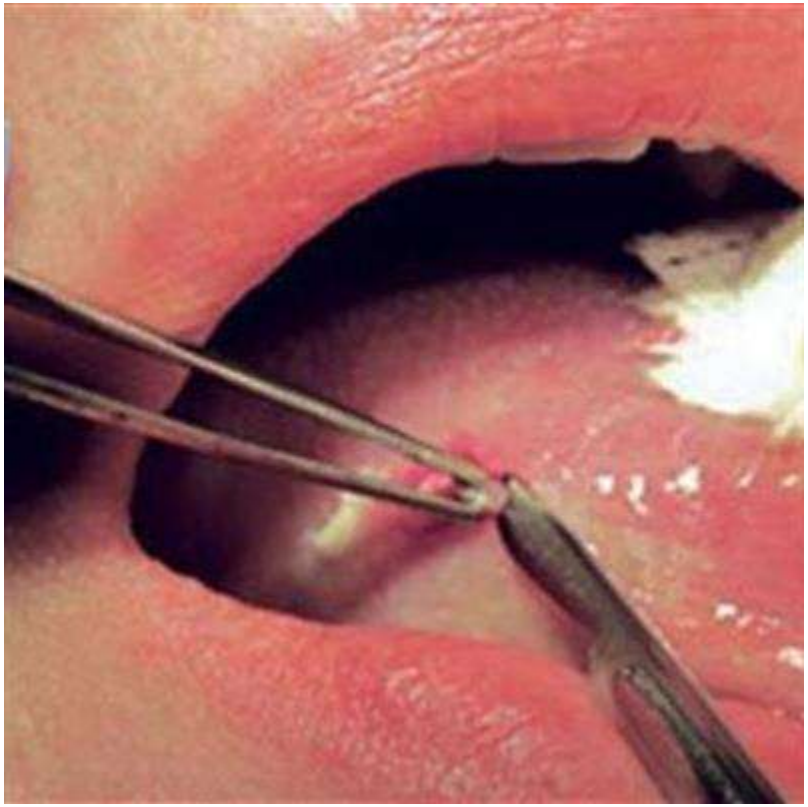
- Electric boiler method
- Potassium permanganate

BIOPSY SPECIMEN

Biopsy collection & transportation can also be a source of infection.

- It should be kept in sturdy containers with secure lid.
- Avoid contaminating the external surface of the container.
- Swab used for collecting micro-organisms should be

transferred slowly and carefully to the swab container



Impression Trays

Impression trays are sterilized as follows

- metallic - autoclave
- plastic – ethylene oxide

Disinfection of alginate impressions –

Methods

- - Spraying
- - Immersion
- Iodophors, sodium hypochlorite (1:10 concentration) ,
- phenols, formaldehyde, glutaraldehyde.

DENTAL CASTS

Spraying until wet or Immersing in a 1:10 dilution of sodium hypochlorite or an iodophor then rinse

Casts to be disinfected should be fully set (i.e. stored for at least 24 hours

ROTARY INSTRUMENTS - BURS

Diamond and carbide burs:
After use they are placed in 0.2% gluteraldehyde and sodium phenate (Eg. Sporicidin) for at least 10 minutes, cleaned with a bur brush or in an ultrasonic bath.
Sterilize in an autoclave or dry heat

Steel burs:
May get damaged by autoclaving. Can be sterilized by using a chemical vapor sterilizer or glass bead sterilizer at 2300C for 20-30 seconds.

INSTRUMENTS

Sharp instruments are ideally sterilized by :
conventional hot air oven

BUT NOT BY:
Boiling
Autoclave
2% glutaraldehyde

Blunt instruments are sterilized by
Autoclave

Sutures

Sutures are pre sterilized by gamma radiation

Sutures are re- sterilized by two recommended methods

1. Soak for a full 10 minutes completely immersed in

povidone iodine 10% solution, then rinse in sterile saline/water.

2. Ethylene Oxide – gas sterilisation.

ENDODONTIC INSTRUMENTS

- **Glass Bead or salt sterilizer**
- Gutta percha points are pre-sterilized.
- Contaminated points are sterilized by 5.25% sodium hypochlorite(1 min immersion).

Then rinse with hydrogen peroxide & dry it.

IMPLANTS

Pre sterilized with Gamma radiation

In case the implants needs to be re-sterilized conventional sterilization techniques are not satisfactory

Steam / Dry heat sterilization should not be used

Radio frequency glow discharge technique (RFGDT) or Plasma cleaning is used.

Take home points

Cleaning, disinfection, and sterilisation are the backbone of infection prevention and control

Proper cleaning is essential before any disinfection or sterilisation process

Take home points

Steam sterilisation is effective only when preceded by

Thorough pre-cleaning, proper packaging/loading, and careful monitoring of autoclaves.

Chemical disinfectants must be selected, used, and discarded to minimise harm.

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Questions ?