STERILIZATION AND DISINFECTION

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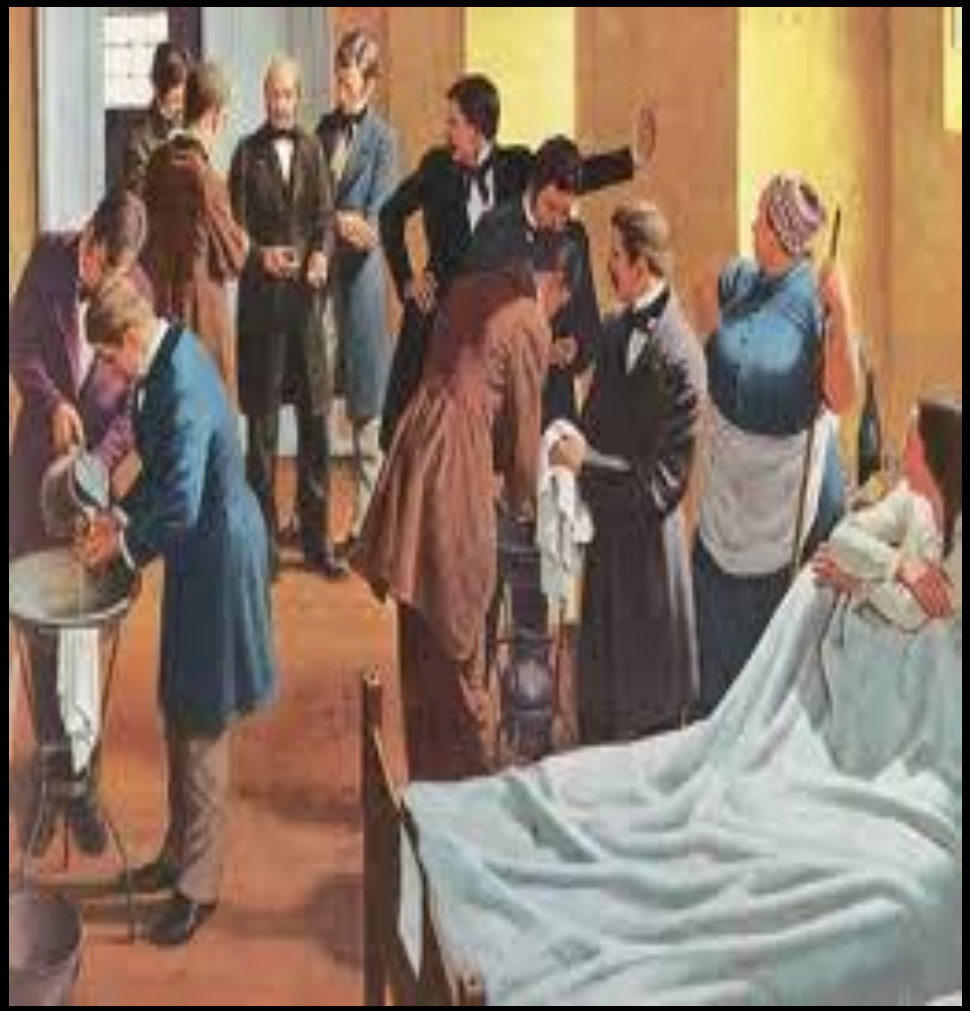
INFECTIOUS DISEASES AND CLINICAL MICROBIOLOGY

History

- Heating, salting, drying in the sun
- Infected wounds in the middle ages: the use of mercury
- Phenol, wine, vinegar, chlorine : antiseptic
- Robert Boyle fermentation/ disease relationship (1663)
- Nicolas Appert production of canned (1810)
- Pasteur pasteurization and flame (1850)



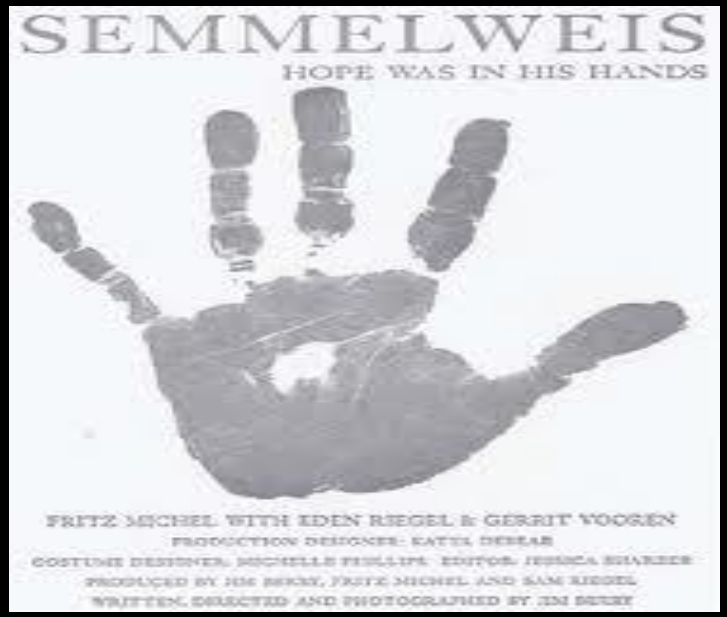

IGNAZ PHILIPP SEMMELWEIS
1818
1865
S
1.50
REPUBLIK OSTERREICH

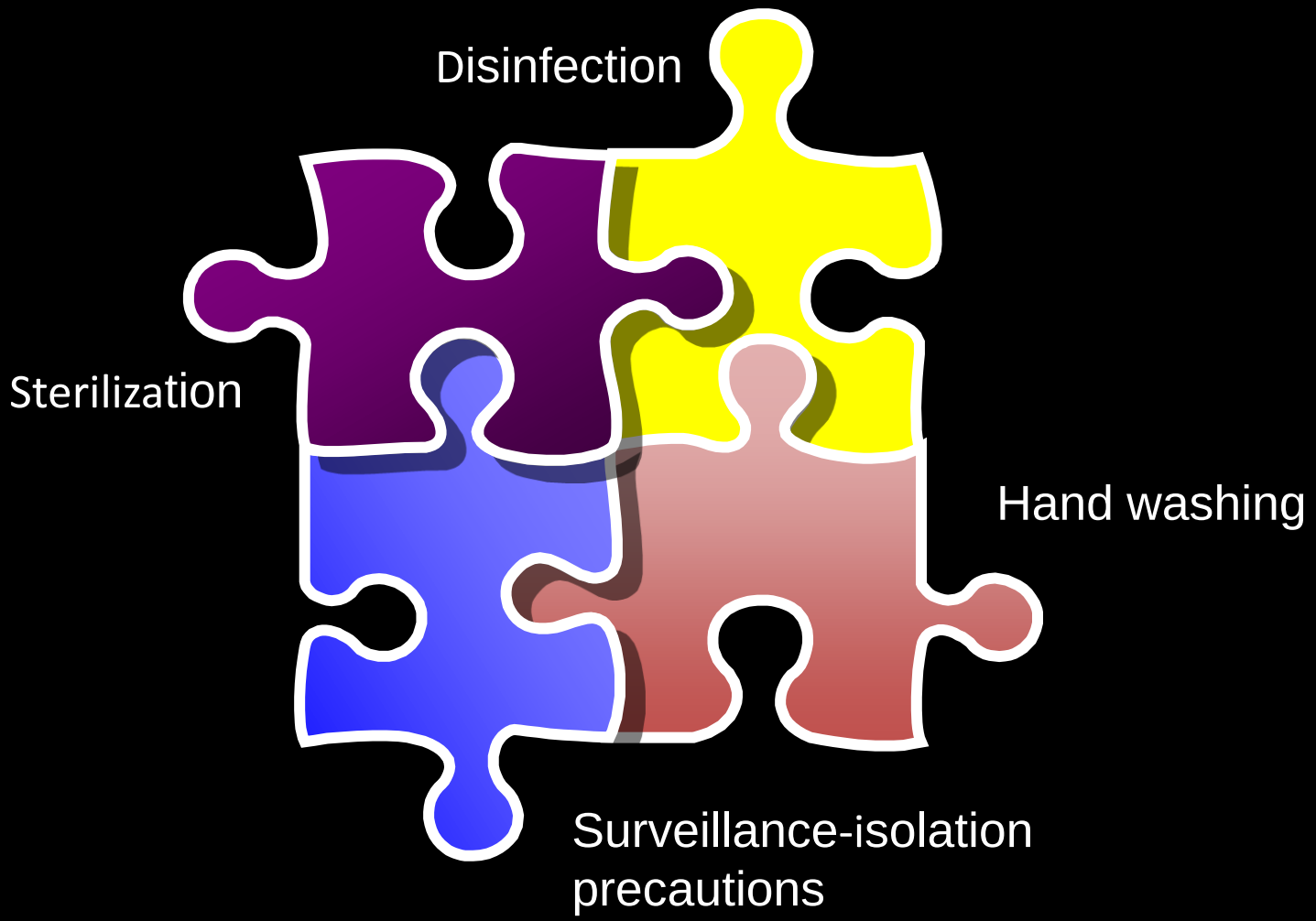
Semmelweis Wien Medical Faculty

- Transport of microorganisms from autopsy room to the ward : first scientist

Semmelweis Wien Medical Faculty

- Hand Washing: The main behaviour in the clinics today




Disinfection
Sterilization
Hand washing
Surveillance-isolation precautions


STERIL
ALAN
TEMIZ
ALAN
KIRLI ALAN

Introduction

- Microorganisms are the agents of
  - Contamination
  - Infection
  - Decay

- Hence it becomes necessary to remove them from materials and areas.

Introduction

- In mid 18 century Lister developed

  Aseptic Techniques to prevent contamination of surgical wounds.
- Prior to this development:

  Nosocomial infections caused death in >10% of surgeries

  Up to 25% mothers delivering in hospitals died due to infection

Definitions

STERILIZATION is the total elimination of all microorganisms including spores

- Typically the last things to die are the highly heat- and chemical-resistant bacterial endospores
- Instruments used for invasive procedures must be sterilized prior to use
- Moist heat or steam, radiation, chemicals (e.g., glutaraldehyde), and ethylene oxide (a gas) are employed for sterilization
- Sterilization by autoclaving, which uses moist heat, is used in most hospital and microbiology laboratory settings

Definitions

DISINFECTION is the elimination of pathogens, except spores, from inanimate objects

- Disinfectants are chemical solutions used to clean inanimate objects

  (physical processes, e.g., UV radiation, may also be employed to effect disinfection)

- Germicides are chemicals that can be applied to both animate (living) and inanimate objects for the purpose of eliminating pathogens

- Antiseptics are formulated for application to living tissue

Definitions

- **SEPSİS :**

  Comes from Greek for decay or putrid. Indicates bacterial contamination.
- ASEPSİS :

  Absence of significant contamination on inanimate surfaces
- ANTİSEPSİS :

  Reduction or Inhibition of microbes found on living tissue

Definitions

- **Aseptic techniques** are used to prevent contamination of surgical instruments, medical personnel, and the patient during surgery.
- Aseptic techniques are also used to prevent bacterial contamination in food industry.

Definitions

- BACTERİOSTATIC AGENT :

An agent that inhibits the growth of bacteria, but does not necessarily kill them.

- BACTERICIDE AGENT :

An agent that kills bacteria. Most do not kill Endospores

- SPOROCIDE AGENT :

An agent that kills spores

Definitions

- SANITIZATION : Lowering of microbial counts to prevent transmission in public setting (e.g., restaurants & public rest rooms)

- DEGERMING : Mechanical removal of microbes, e.g., from hands with washing

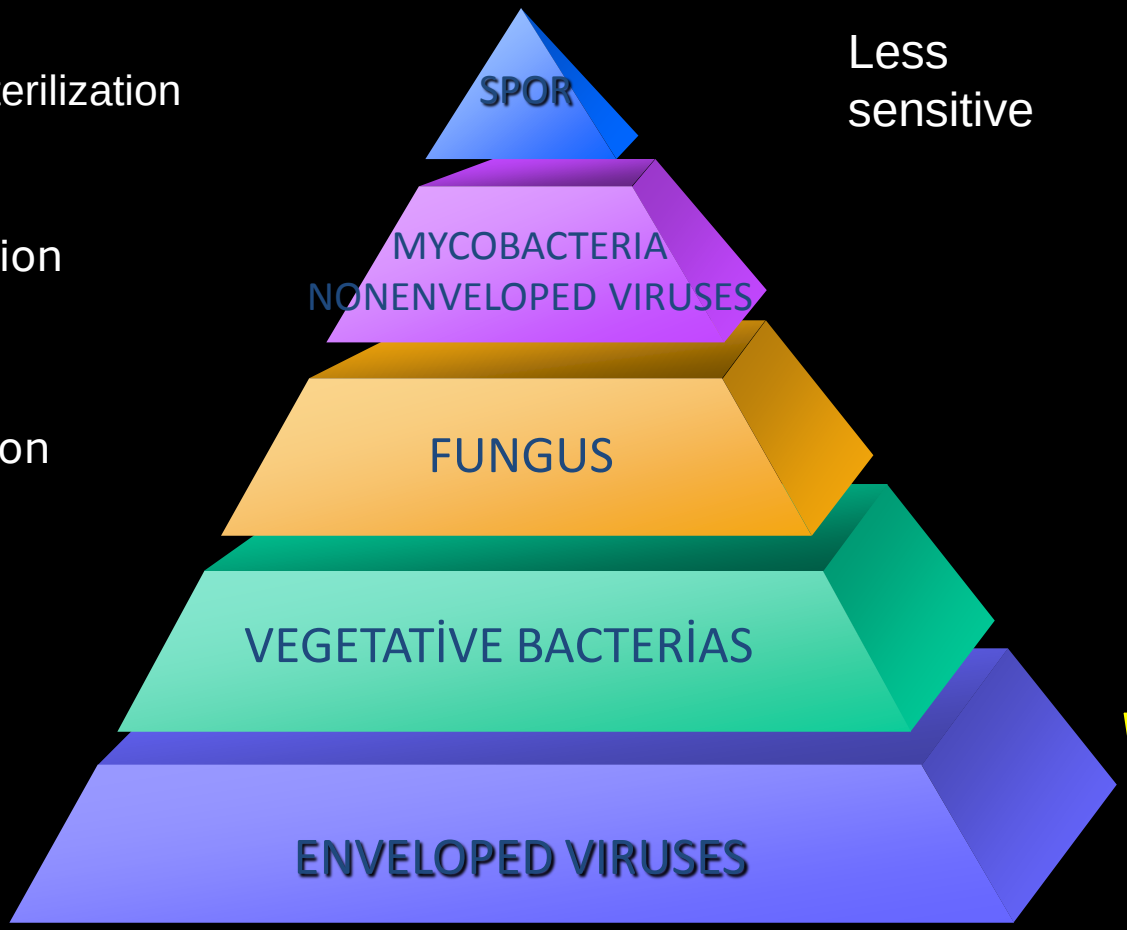
Sterilization+specific procedure

Sterilization - Chemical sterilization

High level disinfection

Mid level disinfection

Low level disinfection



SPAULDİNG classifications (1960)

- Medical and surgical equipments can be divided 3 group : depends on the make an infection capability
  - CRITICAL
  - SEMICRITICAL
  - NONCRITICAL

SPAULDİNG classifications

- Critical devices : Penetration to the steril tissues, must be sterilized

- Critical objects which enter normally
  - Sterile tissue
  - Vascular system
  - Blood flows

SPAULDİNG classifications

- Semicritical devices : objects that touch mucous membranes or skin
- Devices is not intact with steril tissue
- Sterilization preferred
- A disinfection process (High level disinfection-HLD) that kills all microorganisms but HLD alternative

SPAULDİNG classifications

- Noncritical devices: object that touch only intact skin

- Low level disinfection (LLD) enough

Critical objects

Processing Critical Objects

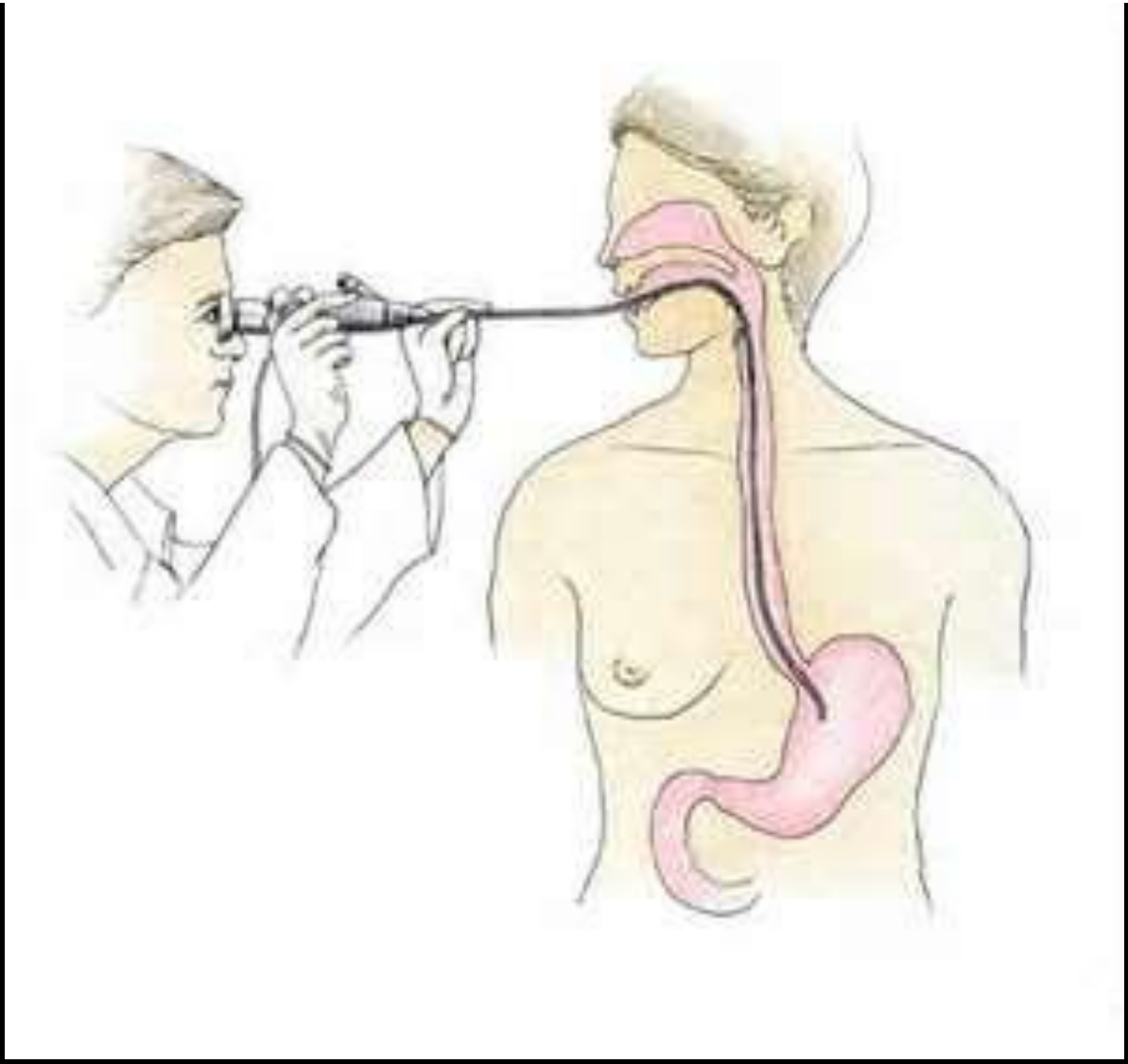
- Classification : enter sterile tissue
- Object : must sterilizied
- Level germicidal action: kill all m.o. and spores
- Examples : surgical instruments and devices cardiac catheters, implants, etc
- Method : Steam, ETO,Hydrogen peroxide plasma, chemical sterilization

Chemical sterilization of critical objects

- Glutaralaldehyde (≥ 2.0 %)
- Hydrogen peroxide-HP (7.5.%)
- Peracetic acid-PA (0.2.%)
- HP(1%) and PA (0.08%)
- HP (7.5%) and Phenol (1.93%)

- Exposure time per manufacturers recommendations

Semicritical objects



Processing semicritical objects

- Classification : Contact with mucous membranes or skin that is not intact
- Object: Free of all microorganisms
- Level germicidal action: Kill all microorgnisms except high numbers of bacterial spores
- Examples: Respiratory-anesthesia equipment, GI endoscopes,thermomether,etc
- Method: Steriization or high level disinfection

HLD of semicritical objects

- Glutaralaldehyde ≥ 2 %
- Ortho-phthalaldehyde 0.55%
- Hydrogen peroxide 7.5 %
- HP and peracetic acid 7.5% - 0.23%
- Hypochlorite 650-675 ppm
- Glutaralaldehyde and phenol 1.21% - 1.93%

Noncritical objects

Processing noncritical objects

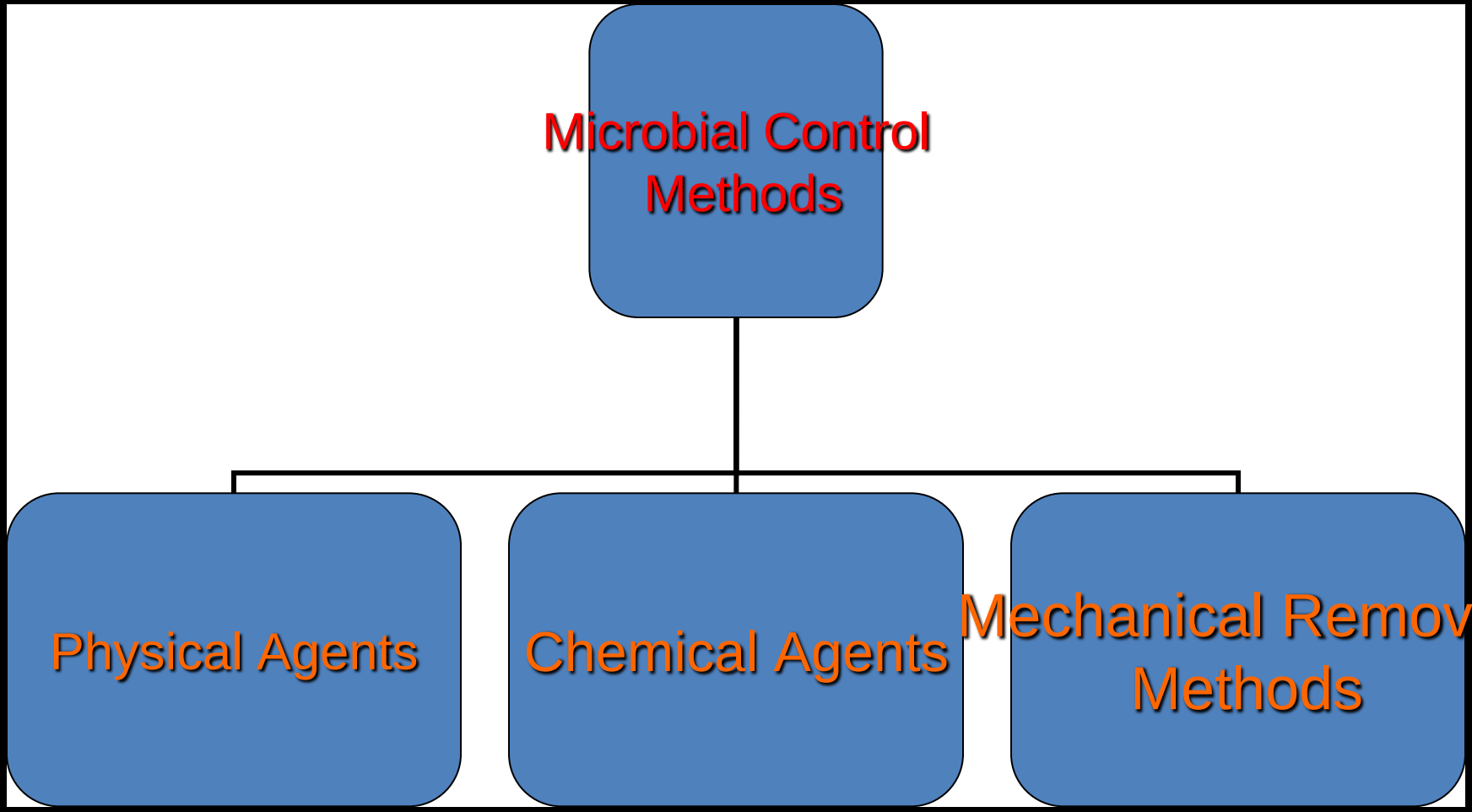
- Classification: will not come in contact with mucous membranes and skin
- Object: can be expected to be contaminated with some organisms
- Level germicidal action: kill vegetative bacteria, fungi and viruses
- Examples: bedpans,bed, EKG leads, walls,floors,etc
- Method : low level disinfection

Low level disinfection for noncritical objects

- Ethyl or isopropyl alcohol 70-09 %
- Chlorine 100 ppm
- Phenol ud
- Iodophor ud
- Quaternary ammonium ud

- Ud: manufacturers recommended use dilution

Methods of sterilization



Physical Agents

Heat

Dry

- Incineration
- Dry Oven

Moist

- Steam Under Pressure
- **Sterilization**
- Boiling Water/Hot Water Pasteurization
- **Disinfection**

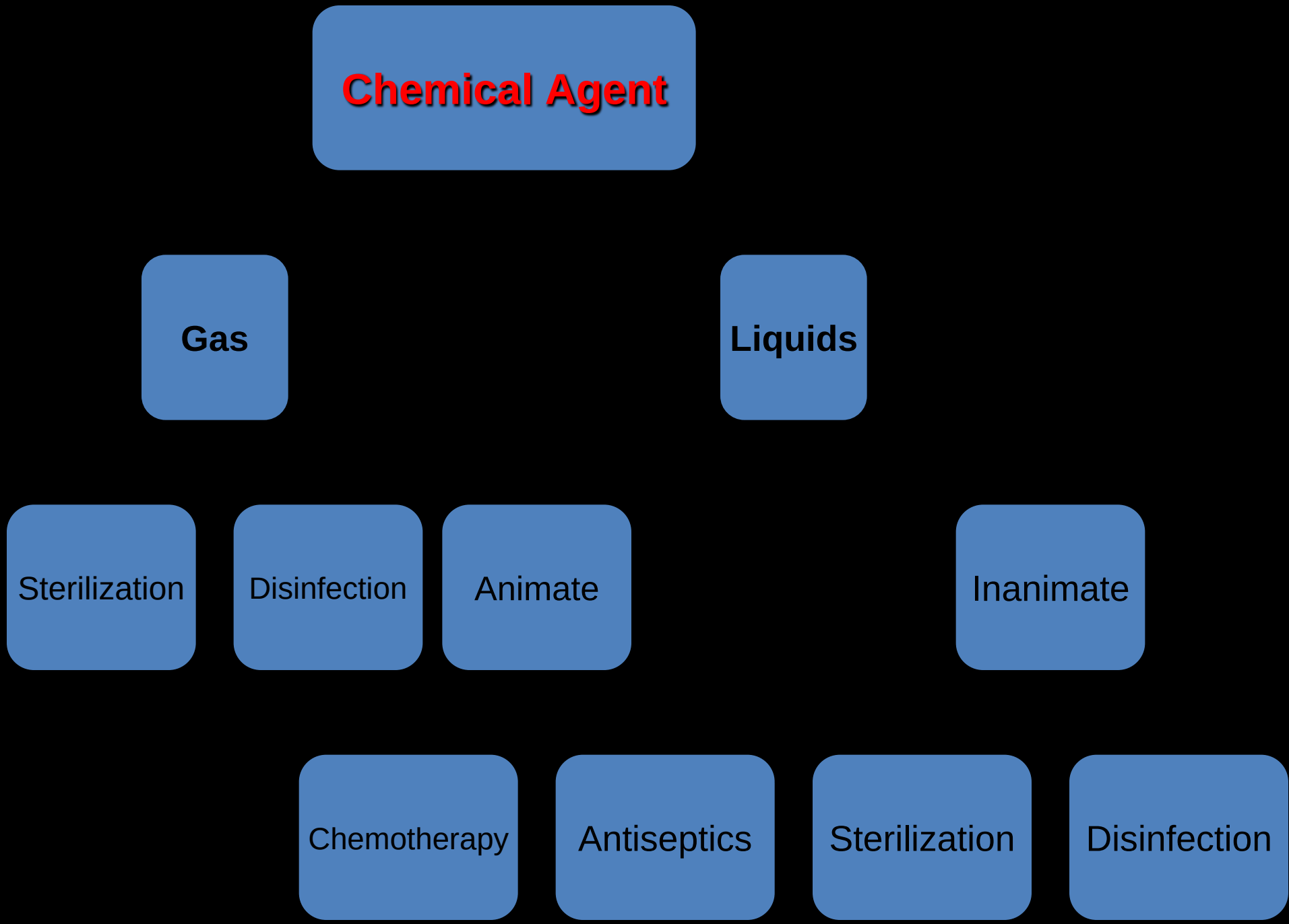
Radiation

Ionizing

- X Ray, Cathode, Gamma
- Sterilization

Non Ionizing

- UV
- Disinfection


Chemical Agent
Gas
Liquids
Sterilization
Disinfection
Animate
Inanimate
Chemotherapy
Antiseptics
Sterilization
Disinfection

Mechanical Removal Methods

Filtration

Air

Liquids

Disinfection

Sterilization

Sterilization

- Steam sterilizatin
- Dry heat sterilization
- Gas sterilization
  - Ethylene Oxide
  - Formaldehyde
  - Gas plasma
  - Ozon
  - Chlorindioxide
- Radiation
- Liguid chemical sterilization

Contaminated equpiments-concept of sterilization

- **Decontamination**
- **Transportation to the Sterilization unit**
- **washing, rinsing, Packaging**
- **Make sterilazition**
- **Sterilization protection**

- **Records must be kept under the each phase**

Steam sterilization

- Advantages
  - Non-toxic, Cycle easy to control and monitor
  - Inexpensive, Rapidly microbicidal
  - Least affected by organic/inorganic soils
  - Rapid cycle time
  - Penetrates medical packing, device lumens
- Disadvantages
  - Deleterious for heat labile instruments
  - Potential for burns

Steam sterilization

HEAT (C)	PRESSURE (PSİ)	TIME (MİN)
121	15	15
126	20	10
132	27	4
134	30	3
FOR PRİONS 134 C 18 MİNUTE REQUİRE		

Dry Heat Sterilization

- Works under the high heat
- At 140 degree 4 hour,
- At 160 degree 2.5 hour,
- At 170 degree 1 hour,
- At 180 degree 30 minute need for sterilization period

- Is not preferred nowadays

Sterilization with chemical agent

- If equipment is not resistance to the high heat, sterilization can make with chemical agent
- In this method, germicidal effect depends on the nucleic acid alkalinization.
- Etihyleneoxide (EO), Formaldehyde

Sterilization with chemical agent

- Etihyleneoxide (EO) a gas
  - Flammable
  - Explosive
  - Toxic
  - Carcinogenic
- Before using must wait 3-14 days
- Can be use implant sterilization

Sterilization with chemical agent

- Formaldehyde a gas
  - Toxic
  - Carcinogenic
- Is not suitable for implant devices

- Does not have permission in Canada and USA

Sterilization with chemical agent

- In this method (gas plasma) does not need heat and moisture
- Cold and dry sterilization
- Sensitive materials (optical,electronic devices) can make sterilizied

Sterilization with chemical agent

- Hydrogen peroxide (HP)
  - Steel
  - Aluminum
  - Titanium
  - Ceramics
  - Plastic
  - Glass materials for suitable to use

Sterilization with liquid chemical agent

- Dipped into the liquid to the method of sterilization
- Can not protect the sterility of the material after the procedure
- Thats way not use routinely

Sterilizitaion with liquid chemical agent

Chemical agent	time	heat
Glutaraldehyde (% > 2.0)	10 hour	20-25°C
Hidrogen peroxide-HP (% 7.5)	5 hour	20-25°C
Peracetik acid-PA (% 0.2)	12 min	50-56°C
HP (1.0%) + PA (% 0.08)	8 hour	20°C
HP (7.5%) + PA (% 0.23)	180min	20° C
HP (8.3%) + PA (% 7)	5 hour	25°C
Glut (% 1.12) + Phenol (%1.93)	12 hour	25°C
Glut (% 3.4) + Isopropanol (% 26)	10 hour	- 20° C

Sterilization control methods

- Maintenance and calibration should be done on a regular basis
- Devices, heat, pressure and time indicators reflect the correct measurements
- Temperature, pressure, gas concentration and the time given to these graphs

Sterilization control methods

- Applied to two types of indicators are used to test the validity of the sterilization
- Chemical indicators / Biological indicators
- If there is a change in the expected conversion of sterilization indicator to understand that the Company has requested.

Chemical indikators

- ISO standards are divided into six classes according to their usage according to their capacities and evaluation.
  CLASS 1-PROCESS INDICATOR
  CLASS 2-SPECIAL TEST indicator
  CLASS 3-ONE PARAMETER INDICATORS
  CLASS 4-MULTI-PARAMETER INDICATORS
  CLASS 5-Integrator
  CLASS 6-Emulator

Chemical indicators

- 1- Process indicator: Package up indicator. History tells us that the sterilization process of the material. Adhesive tapes or labels can use
- 2 - Special test indicators: Bowie-Dick type test packs are used
- 3 - Single-parameter indicators: Sterilization process indicates that a particular variable to the desired value has been reached.

Chemical indicators

- 4 - Multi-parameter indicators: Two or more critical variable to show the achievement of the desired values
- 5 - Integrator: Sterilization process checks all critical variables
  - Is equivalent to the effectiveness of biological indicators.

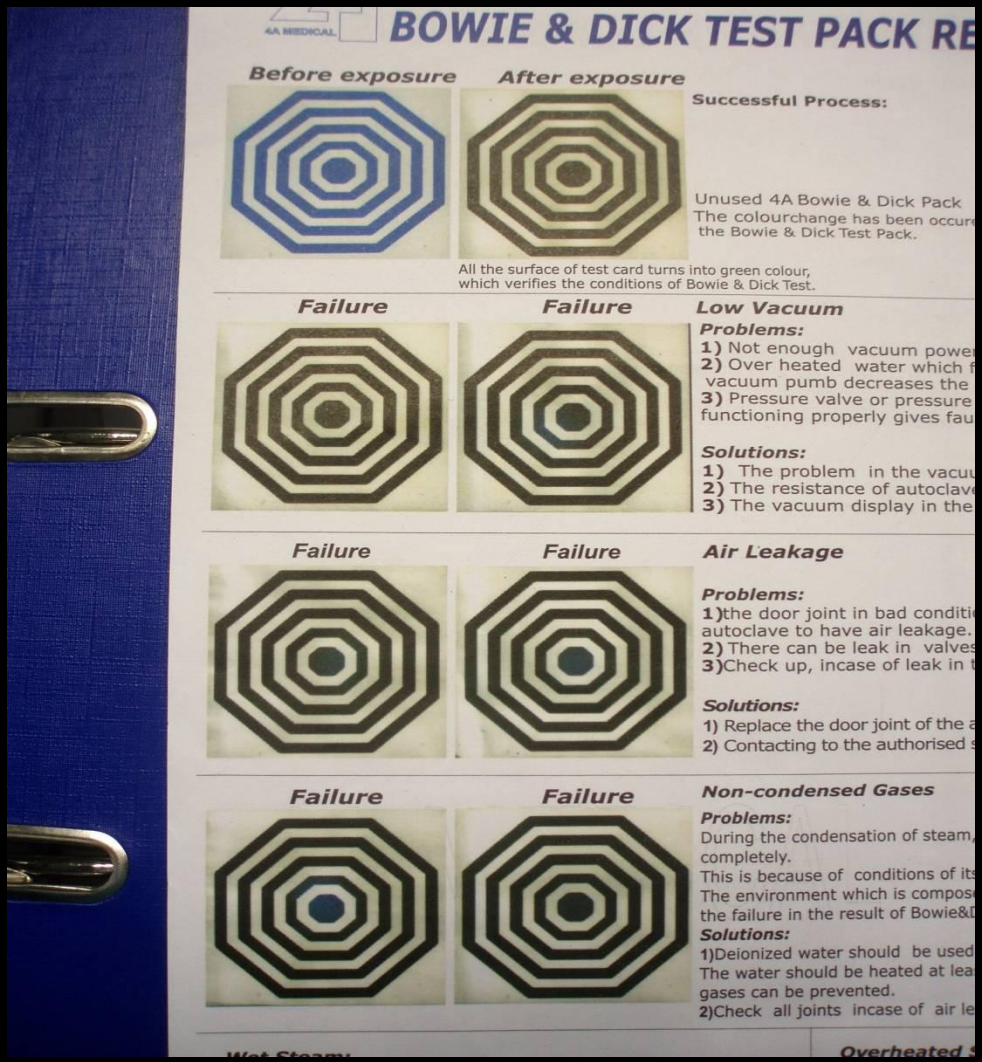
Chemical indicators

- 6 - Emulator (control cycle indicator): Method is set to the values that are critical to the achievement of the device helps to control all the variables

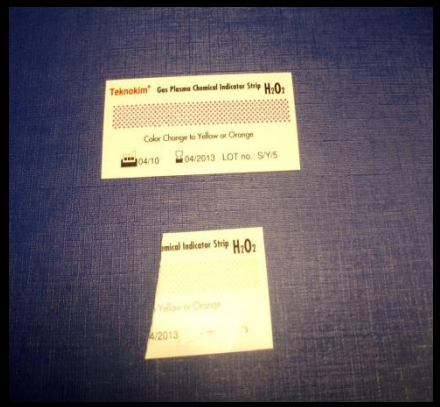
Chemical indicators

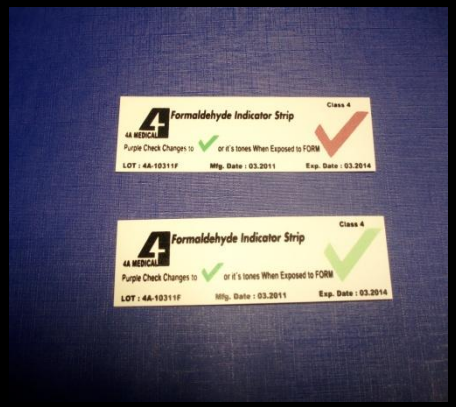
- The effectiveness of the vacuum system used to control the steam saturation and Bowie-Dick test should be done every day before the first operation

Sterilization control



Sterilization control





Chemical indicators

- Process set sterilizer include class 1 indicator on each package
- If you are prompted single-parameter indicators in package (class 3) can be used
- ESSENTIAL STERILIZATION CONTROL: For each load sterilizer include indicator of at least one ISO grade 4.5 or 6
- This indicators are evaluated by placing all materials in the load can be controlled

Chemical indicators

- The use of chemical indicator is important to select the correct parameters

- If 121 C to 134 C sterilizer indicator is left in a set, or vice versa, the results are interpreted incorrectly.

Biologic indicators

- Measures microbicidal effectiveness of the sterilization process
- Contain a certain number of bacteria spores
- Steam sterilization:
  Bacillus stearothermophilus
- Dry heat, EO, gas plasma sterilization
  Bacillus subtilis is used
- After the procedure, control is made by culture of bacteria spores

Biologic indicators

- Pressure steam sterilization
  Those with graphic print feature once a week,
  Used every day if is not have graphic feature
  To be implanted materials should be used in each conversion
- EO sterilization used for each conversion
  Cabin volume <300 liters and 2,
  > 300 liters, at least 3
  use of biological indicators.

Biologic indicators

- Biological indicators of sterilization by using quality should be checked
  - After repairs
  - Packaging material change
  - Package size changes

Biologic indicators

- The disadvantage of biological indicators requires 48 hours after the procedure for the control of spore culture method

- The evaluation by the method of measuring the enzymatic activity of bacteria spores results can be obtained in 4 hours.

Biologic indicators

Sterilization record

- Protocol number
- Applied method of sterilization
- The selected program
- Load the content
- Critical variables measuring records
- The official name / surname

- These registration forms must be kept for 5 years

Protection of steril materials

- Only health staff to the entry into room
- When you enter the store clean apron,bonnet, hand washing
- Which are protected from dust and insects
- Protect from sunlight
- Not Dust-binding surfaces
- Easy to clean the floor
- Room temperature: 22-24 C
- Humidity: 35-70% level

Unsuitableness materials

- Packaged with not suitable materials and methods
- Package integrity is corrupted
- Non-related information on the sterilization
- Stained, wet materials
- Improper storage conditions
- When the humid after autoclaves
- Contacting contaminated surfaces
- MATERIALS ARE NOT ACCEPT STERİLE

Disinfection

- The removal of unwanted microorganisms from media
- Less effective than sterilization
- Bacterial spores can not disappear from media
- Is performed using heat or chemicals

Disinfection with heat

- Hot water (pasteurization), a simple, harmless, highly effective
- Plasma fraction preparations for about 6 hours at 60 ° C, vaccine and sera may be used
- 4 log reduction in microbial load endoscope washing with hot water is provided.

Disinfection with heat

- Washing with hot water and detergent washing machines are used widely
- After disinfection, the instruments must be stored in suitable conditions
- The biggest disadvantage of thermal disinfection is not have standardization of safe control methods

Disinfection with heat

Thermal Disinfection heat and time	
Heat of surface (°C)	Disinfection time (min.)
≥ 80	2
75	10
70	15

Disinfection with chemical agent

- Used in many places within the hospital environment
- The efficacy of disinfection
  - Disinfectants used in external ambient conditions (pH, humidity, ambient temperature, water hardness)
  - Material that will be disinfected
  - Germicidal activity
  - Concentrations of use
  - Operating time DETERMINED

Disinfection with chemical agent

- Disinfectants
  - Is inactivated by organic matter
  - There is no penetration properties
  - Affect the surface they come into contact

Disinfection with chemical agent

- External ambient conditions
  - Chlorinated compounds are negatively affected by the increase of heat
  - At Alkaline pH; glutaraldehyde, quaternary ammonium compounds enhancing the effect of , phenolic compounds, hypochloride, iodine effect decreases
  - Hard water; disinfectant inactivates and leaves on the material permanent precipitates

Disinfection

- Laparoscope-arthroscope-cystoscope
- Must be sterile when they enter the sterile space
- Between High-level disinfection and sterilization , there is no significant difference of infection
- After disinfection, should be rinse with sterile water

Disinfection

- Semi-critical instruments
  - Flexible Endoscopes
  - Laryngoscopes
  - EndotraCheal tubesA
  - nesthesia equipment
  - Pulmonary circulation equipment
  - Nasal and vaginal speculum and vaginal probes
  - Nebulizer cups, some ophthalmic instruments
  - Ear Syringe hose
  - Thermometers
  - hydrotherapy tanks

Disinfection

- Endoscopes
  Heat sensitive endoscopes should be sterile or high-level disinfection
- Flexible endoscopes are contaminated with bacteria, according to entered the cavity (10^5-10^9 cfu / mL)
- Clear up the equipments reduce the bacterial load (log 4-6)
- Completely removed by cleaning with HIV virus contaminated endoscopes are shown

Disinfection

- Endocavitary probes
  - Echocardiography, vaginal / rectal probes
  - In addition to high-level disinfection, guidelines recommends that using condom or probe wrapper for each patient
  - Condoms are more secure than probe wrapper in terms of perforation
    leakage, 1.7% condom, 8.3% coating

Disinfection / Glutaralaldehyde

- ADVANTAGES
- Does not corrosion of metals
- Effective in the presence of organic material
- Many materials required 10 hours for sterilization

- DİSADVANTAGES
- Very irritant to mucous membranes and the skin
- After reconstitution, short shelf half-life (14-30 days)
- Expensive
- Re-used solutions, the concentration should be monitored

Disinfection / ortho-fhytoaldehyde (OPA)

- Mechanism of action
  - Rapid-acting high-level disinfectant
  - 0.55% contains 1.2 benzendikarboxialdehyte
  - An alkylating agent
  - Continued effectiveness of acid and alkali environment (pH 3-9)

Disinfection / ortho-fhytoaldehyde (OPA)

- According to glutaraldehyde mikobacterisidal activity begins earlier and stronger (6 min; 6x log^9 decrease)
- OPA is effective to the Gluteraldehide-resistant mycobacteria
- 0.5% OPA is not sporicidal, if pH increased sporicidal effect can be seen

Disinfection / ortho-fhytoaldehyde (OPA)

- There is FDA-approved only for HLD
- High-level disinfection contact time of 12 min at 20 ° C is sufficient to
- Material compatibility is good
- When prepared solutions effectiveness of 14 days

Disinfection / ortho-fhytoaldehyde (OPA)

- If swallowed, irritation of the digestive tract
- If contact with the skin, paint gray color
- Contact with eyes; itching, tearing and redness
- Long-term or repeated skin contact resulted with dermatitis
- Irritation of the respiratory system
- Expensive

Disinfection

- Test strips should be used for the pursuit of MEC
- After the useful life test strips should not be used (note date test strips is opened)
- The testing frequency, which depends on the often used solutions (daily use; should be tested at least once every day)
- Results must be recorded

Semicritical equipments

- Stethoscopes
- Sphygomanometer cuff
- Bed linen
- ECG electrodes
- Urine pan
- Food containers

Disinfection / protection of contamination

- Carrier containers must be cleaned, before re using safely
- After opening a sterile solution should not be considered as no longer sterile
- The expiration date must be on each product should be carefully monitored

Precautions

- Disinfection of critical and semi-critical devices never use low-level disinfectants
- Do not use HLD for cleaning noncritical materials and enviroment
- Use the recommended concentrations and contact time
- Disinfectant sometimes it can be toxic to the user ,always take safety precautions