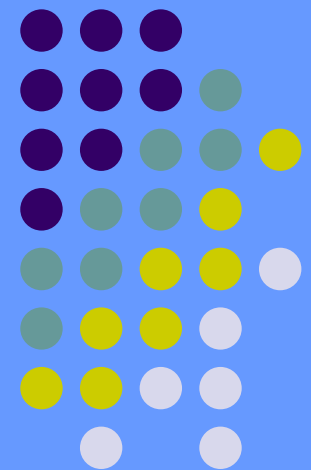


BASIC CONCEPTS OF INFECTION CONTROL

Cleaning, Disinfection and Sterilisation

International Federation of
Infection Control



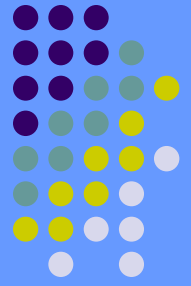


Workers' Protection

- Staff responsible for processing contaminated equipment should:
 - Receive adequate training
 - Wear appropriate protection
 - Gloves
 - Gowns or aprons, and
 - Splash protection (mask and goggles, or visor)
 - Receive adequate immunisations

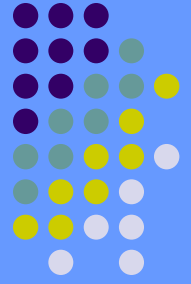


Why decontamination?



- To make the items safe for use in patients
- To protect the healthcare worker handling the items





Choice of Method

- The method chosen will depend on
 - the item's intended use
 - the risk of infection
 - the degree of soilage
- The decontamination process must not damage the device



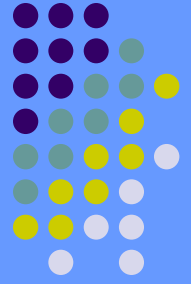
Single Use



Devices that cannot be properly cleaned and decontaminated (e.g., injection needles) must be 'single use' disposable and not re-processed



Classification of Infection Risk



- Infection risk from equipment or environment can be classified into three categories
 - High risk (critical items)
 - Intermediate risk (semi-critical items)
 - Low risk (non-critical items)





High Risk = Critical Items

- Items that enter sterile tissues, including body cavities and the vascular system
 - e.g., surgical instruments, intra-uterine devices, vascular catheters
- Must be cleaned and sterilised before use



Intermediate Risk = Semi-critical Items



- Items in contact with intact mucous membranes or broken skin
 - e.g., respiratory equipment, gastrointestinal endoscopes, vaginal instruments, thermometers
- Require cleaning followed by high-level disinfection



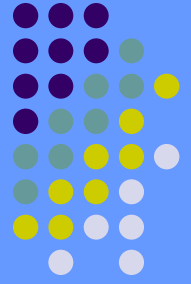
Low Risk = Non-critical Items



- Items in contact with normal skin
 - Bedpans
 - Blood pressure cuffs
 - Patient furniture
- Must be cleaned and dried



Sensitivity to Disinfection and Sterilisation



- Enveloped viruses
- Vegetative bacteria and fungi
- Fungal spores, non-enveloped viruses
- Mycobacteria
- Bacterial spores
- Prions



Harder to kill





Expected Reduction Levels for Microorganisms

- drying 10^{-1}
- cleaning with water 10^{-2}
- cleaning with detergent 10^{-3} to 10^{-4}
- disinfection 10^{-3} to 10^{-5}
- sterilization 10^{-6}

Babb JR, Bradley CR 1995

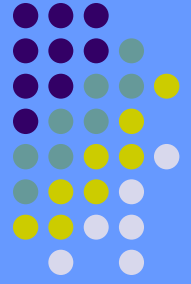




Cleaning

- Organic soil must be removed before disinfection and sterilisation
- Disassemble instruments soon after use to prevent drying of blood and secretions
- Processes:
 - Manual with water and neutral detergent
 - Washing machine with water and alkaline detergent
- Rinse after processing to remove chemicals and soil

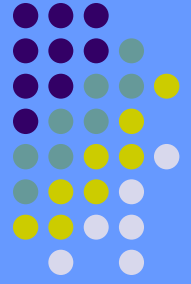




Disinfection

- Reduces the number of pathogenic microbes (except bacterial spores) to a level that is not harmful to human health
- Can be achieved by heat or chemicals

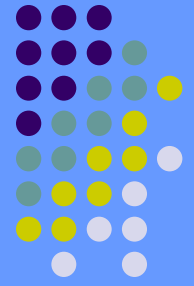




Thermal Disinfection

- Heat is preferable to chemicals
 - Washer (flusher) disinfectors include cleaning
 1. Rinsing phase to remove soil
 2. Disinfection phase 85° C for 15 min require electricity and water supply
 - Pasteurisation:
 - > 70° C for 30 min in water bath
 - Pre-cleaning necessary





Chemical Disinfection

- Effective chemical disinfectants are
 - intended to be toxic to living cells
 - harmful to the user
 - harmful to the environment if stable
 - expensive
- Use only when necessary
- Always read the label and follow instructions !



S = sensitive R = resistant M = moderately resistant



Procedure	herpes	Hep B	Gram +	Gram -	mycob
Heat 80°C	S	S	S	S	S
Alcohol	S	S	S	S	S
Chlorhexidine	S	R	S	S	R
Aldehydes	S	S	S	S	M
HClO ₂	S	S	S	S	S
Org acids	S	S	S	S	M
Phenols	R	R	S	S	M
Quat	S	R	S	R	R
Acridine	S	R	S	R	R



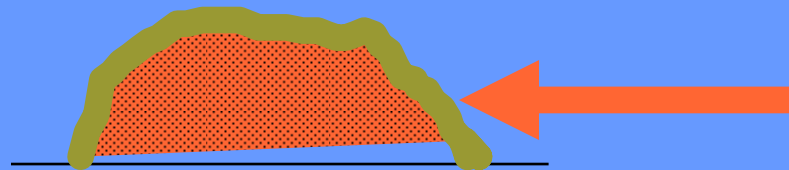
Disinfectants Can Encapsulate Infective Microorganisms



- Many disinfectants are less effective in carrier tests than in suspensions of organisms

Trapping

Mechanical cleaning needed



Chemical Disinfection of Objects



Organic acids

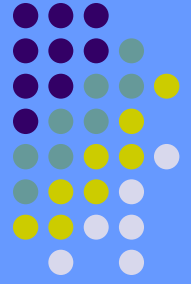
- Acetic acid (household use)
 - Oxidates, therefore corrosive

Formaldehyde, glutaraldehyde, etc.

- Fixating agent
- Rinsing with water may recontaminate the objects
- Allergen, carcinogen?



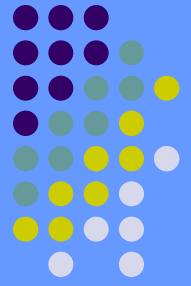
Chlorine Bleach HClO_2



- Effective against
 - bacteria
 - enveloped viruses
 - non-enveloped viruses
 - fungi
- Bleaching
- Corrosive
- Inactivated by organic material



Microbiological Monitoring of Disinfection



- Time-consuming
- Very difficult to standardize

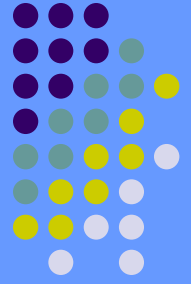
Better to focus on ensuring

- a validated product is used
- use in the right concentration

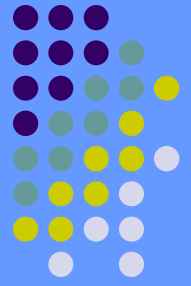


Storage

- Decontaminated items must be protected from contamination or damage during storage



How Sterilisation Started



Postoperative tetanus

- *Clostridium tetani*

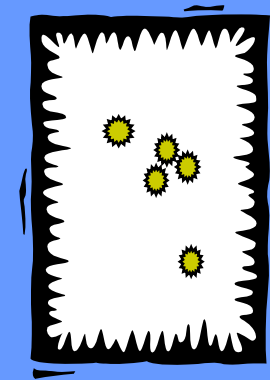
Gas gangrene

- *Clostridium perfringens*

Spore-forming anaerobic bacilli

Very low infective dose

Toxin production



Sterilisation and Sterility



- Sterility = the absence of all viable microorganisms including spores
- Sterilisation = the process by which sterility is achieved

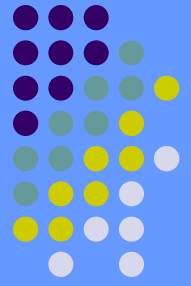


Sterility Assurance Level



- The purpose of any sterilizing treatment is to render an article completely free of any living microorganism
 - THIS CAN NEVER BE PROVED
- Sterility assurance level - SAL 10^{-6}
 - The probability of a non-sterile article is less than one in a million articles processed





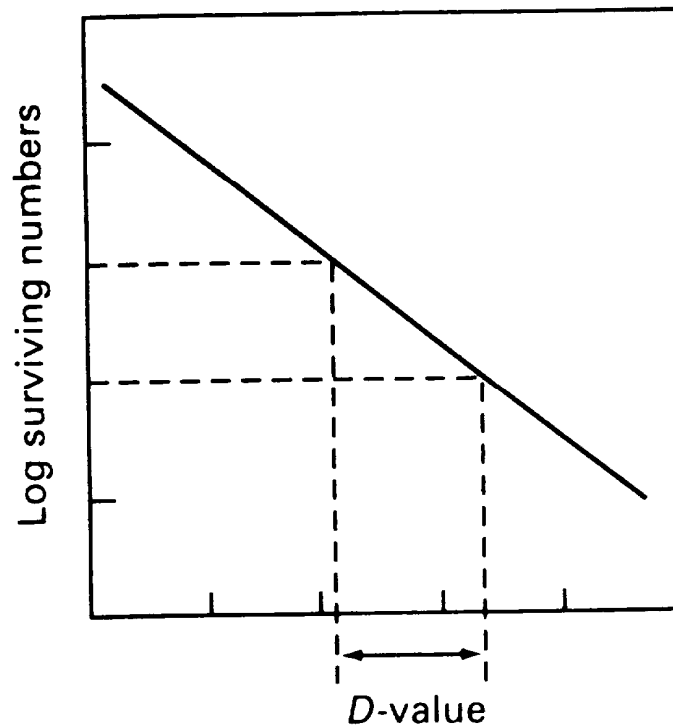
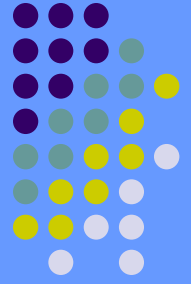
Sterilisation Methods

- Dry heat
- Steam
- Ethylene oxide
- Formaldehyde steam
- Radiation
- Plasma
- H_2O_2
- Aldehydes in aqueous solution



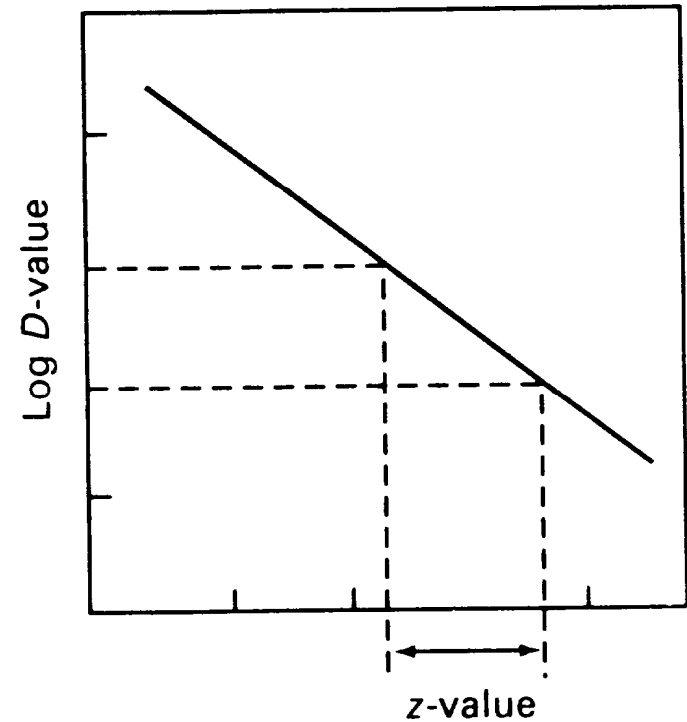
D-value

- The time in minutes at a particular temperature to reduce the viable population by 1 log₁₀



(a)

Time of heating (min)



(b)

Temperature of heating





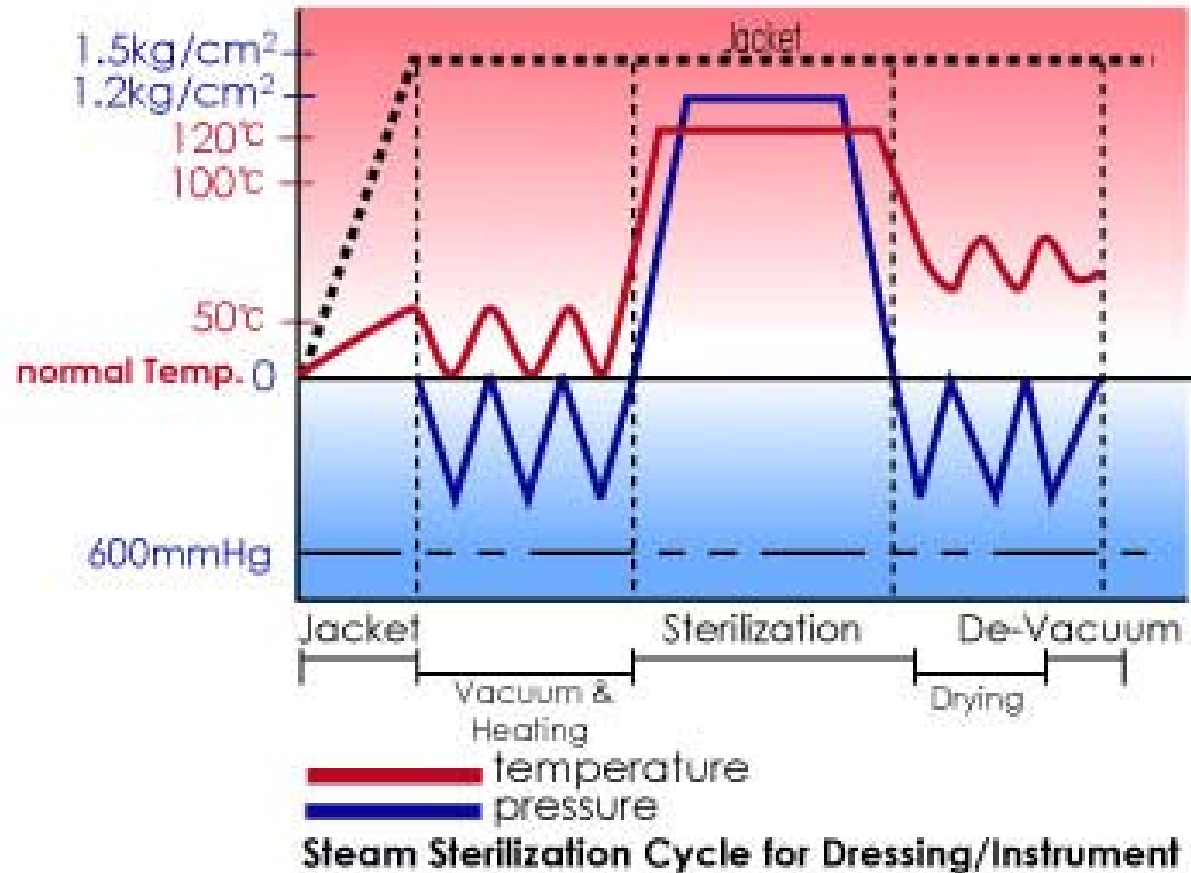
Dry Sterilisation

- Heat transport from a gas to cooler objects, usually glassware
- e.g., 180°C - 2 hours
 - Air is a poor conductor
 - Slow process, high temperature
 - Burns paper, cotton etc
 - Protein contamination prolongs sterilization time





Steam Vacuum Autoclave



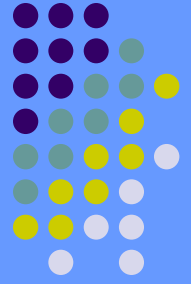


Steam Autoclave

- Heat is generated only on surfaces where steam can condense
- The autoclave load must be placed so that steam can reach all packages
- Leads to
 - degradation of DNA, RNA
 - inactivation of enzymes
 - membrane damage
 - protein coagulation



Steam Sterilisation of Textiles



- Air traps prevent steam penetration if poor prevacuum
- Condensate absorbed to fibres, risk of recontamination if humid



Ethylene Oxide

- Low cost
- Risk of cancer
- Aeration - 3 days necessary
- Common in low income countries, forbidden in high income countries



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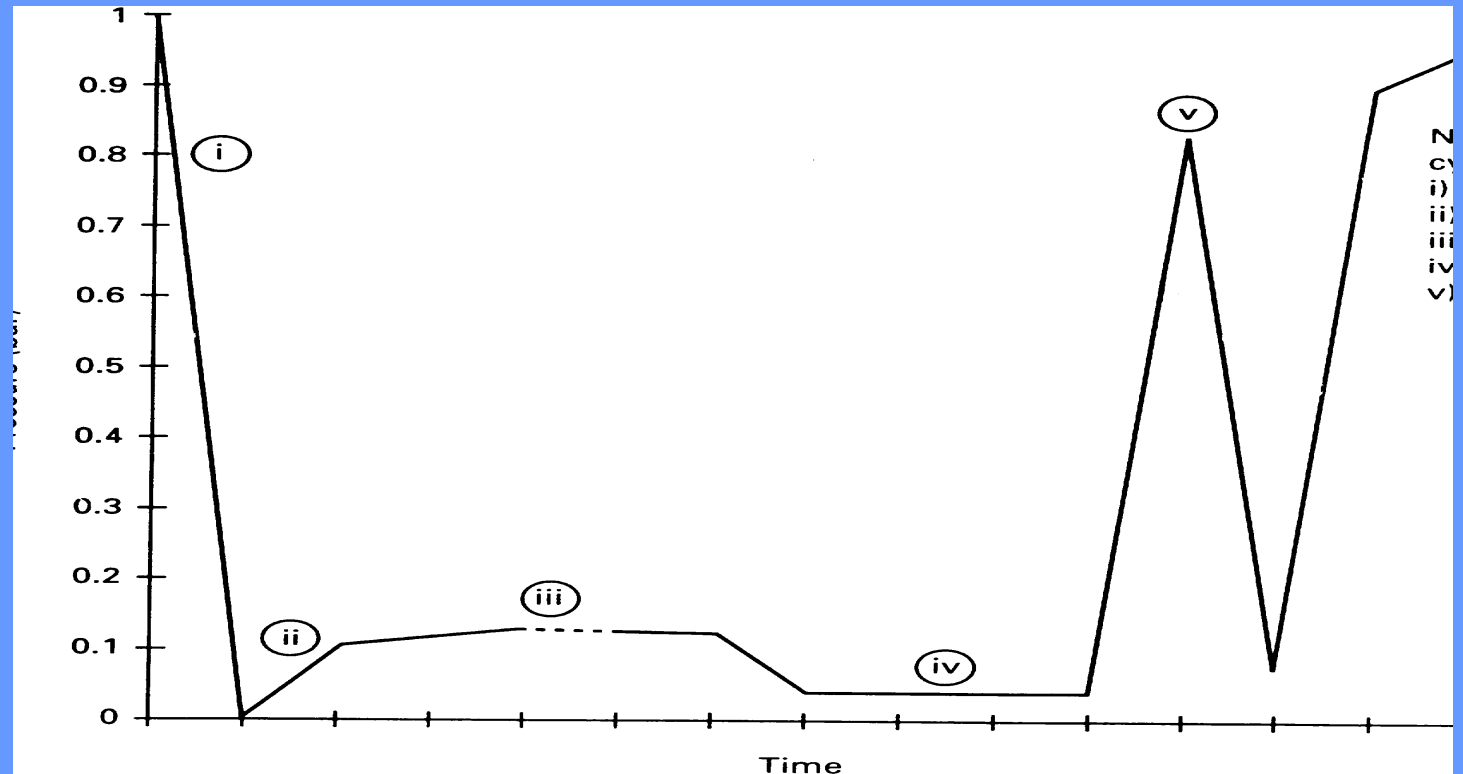


Plasma



$H_2O_2 \rightarrow$ free oxygen radicals

Interact with enzymes, DNA, RNA, cell membrane



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Plasma Problems

- Special packaging materials
- Poor penetration in narrow lumen
- Process impaired by rests of salts or proteins and by water
- High cost of equipment
- High process cost

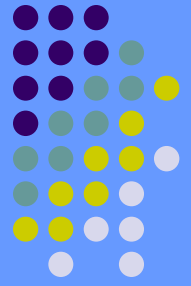


Process Control

- Sterilization processes have to be validated and controlled
- Reduction by 1 000 000 fold must be achieved
- *Presterilization values higher than 10^6 cannot be reduced to 0!*

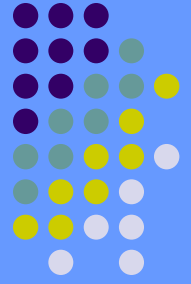


Process Monitoring of Sterilisation



- Time
- Temperature
- Pressure
- Steam hydration
- Integrating Process Indicators
 - Autoclave tape only shows if the package has been in an autoclave, not what happened there

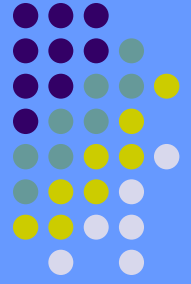




Packaging

- Use materials such as paper and/or polymers
 - Can be penetrated by steam and still keep the items sterile during storage
- Mark packages to identify their contents, date of sterilisation, and steriliser and load number
 - Helps to facilitate recall action and to aid in rotation of supplies





Sterilization of Heat-sensitive Objects

- ETO
- Formaldehyde/steam
- Plasma - H_2O_2
- Glutaraldehyde or succinaldehydes
- Ozone





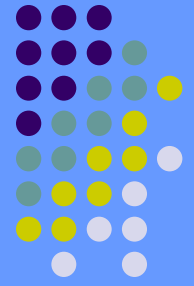
Re-processing



Five questions about the device need to be asked about the end status of the reprocessed device:

- Is it intact?
- Is it clean?
- Is it sterile?
- Is the process cost effective?
- Who takes the responsibility if anything goes wrong?

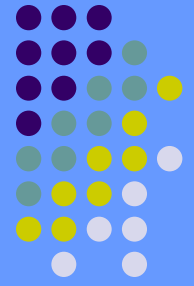




Key Points I

- The failure to disinfect or sterilize medical equipment properly may result in infection
- The level of decontamination required depends upon the intended use of the item
- Cleaning is essential before high level disinfection or sterilisation
- Chemical disinfection must be used when required by written policies





Key points II

- Thermal decontamination is safer and more effective than chemical
- Steam sterilisation is effective only when preceded by cleaning and carefully monitored
- Staff responsible for processing contaminated devices must be fully trained and wear protective apparel





References and Further Reading

- Infection Control Guidelines. Hand Washing, Cleaning, Disinfection and Sterilisation in Health Care. *Canada Comm Dis Report* 1198;24S8. www-phac-aspc.gc.ca
- Sterilisation, Disinfection and Cleaning of Medical Equipment: Guidance on Decontamination from the Microbiology Advisory Committee to the Department of Health (The MAC Manual). www.mhra.gov.uk





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