SECTION : 3 HOSPITAL INFECTION CONTROL

Ch: 21. Healthcare-associated Infections

ESSAY
(Nil)

SHORT ESSAYS

1. Write the functions of HICC (Hospital Infection Control Committee). Add a note on antimicrobial stewardship (July 2023)

Ans:-

- Supervises the implementation of the hospital infection control program

Functions:-

- HAI surveillance –
  1.CA-UTI
  2. CLABSI
  3. VAP
  4. SSI
- Develops a system - identifying, reporting, analysing, investigating, and controlling
- Antimicrobial stewardship program (AMSP)
- Policies - Reviews and updates on policies and guidelines
- Education - for healthcare workers
  Staff health - Monitors employee health
- Outbreak management
- Communicates and cooperates with other departments
- Reviews risks associated
- HICC meetings - shall meet regularly not less than once a month

Antimicrobial stewardship program (AMSP)

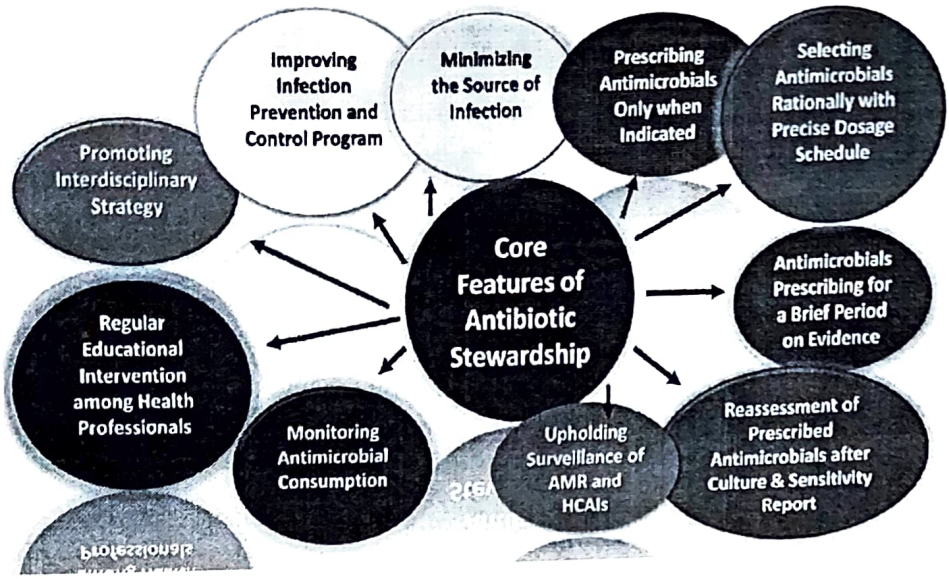
- use of the right antimicrobial agent, for the right patient, at the right time, with the right dose, route, and frequency, causing the least harm to the patient and future patients

need of AMSP -

- Antimicrobial Resistance (AMR)
- Misuse and Over-use of Antimicrobials
- Widespread Use of Antimicrobials in Other Sectors
- Poor Antimicrobial Research

Implementation-

- Administrative Support (Leadership)
- Formulating AMS Team
- Infrastructure Support
- Framing Antimicrobial Policy
- Implementing AMS Strategies - Front End Strategy & Back End Strategy
- Education and Training


Core Features of Antibiotic Stewardship
Improving Infection Prevention and Control Program
Minimizing the Source of Infection
Prescribing Antimicrobials Only when Indicated
Selecting Antimicrobials Rationally with Precise Dosage Schedule
Promoting Interdisciplinary Strategy
Antimicrobials Prescribing for a Brief Period on Evidence
Regular Educational Intervention among Health Professionals
Monitoring Antimicrobial Consumption
Upholding Surveillance of AMR and HCAIs
Reassessment of Prescribed Antimicrobials after Culture & Sensitivity Report

SHORT ANSWERS

1. Acinetobacter baumannii (March 2014)

- Most pathogenic species of genus Acinetobacter.
- They are saprophytic bacilli
- Hospital environment is heavily contaminated with these organisms
- One among the ESKAPE pathogens causing Hospital acquired infections
- Unhygienic practices in hospitals and warm hospital environment promote colonization.
- Acineotobacter baumannii are multidrug resistant

Virulence factors:-

- 1)OmpA;Outer membrane protein A -mediates adhesion ,invasion and cytotoxicity
- 2)LPS
- 3)Ability to form biofilm

Note – ESKAPE pathogens

- Enterococcus faecium
- Staphylococcus aureus
- Klebsiella pneumoniae
- Acinetobacter baumannii
- Pseudomonas aeruginosa
- Enterobacter species

2. Healthcare associated infections – definition, major types, four micro-organisms transmitted through contact (January 2023)

Ans:

Definition

- infections acquired in the hospital by a patient admitted for a reason other than the infection in context
- the infection should not be present or incubating at the time of admission
- the symptoms should appear at least after 48 hours of admission

Major types-

- Catheter-associated urinary tract infection (CAUTI)
    - Catheter-associated UTI (CAUTI)
    - Catheter-associated asymptomatic bacteriuria (CA-ASB)

  } Device Associated Infections
- Catheter-related bloodstream infection (CRBSI)
- Ventilator-associated pneumonia (VAP)
- Surgical site infection (SSI)

Organisms transmitted through contact-

- MRSA (Methicillin resistant S. aureus)
- CRE (carbapenem resistant Enterobacteriaceae)
- VRE (vancomycin resistant enterococci)
- Acinetobacter
- Pseudomonas
- adenovirus, gonococcus,
- scabies
- rotavirus, cholera, C. difficile
- hepatitis viruses - HAV and HEV

OBJECTIVE TYPE QUESTIONS

1. List two common bacterial causes of healthcare acquired pneumonia.(February 2022)

Ans:-

Early-onset VAP	Late-onset VAP
• Pneumococcus • H. influenzae • methicillin susceptible S. aureus	• P. aeruginosa • Acinetobacter baumannii • E.coli • Klebsiella

Ch: 22. Major Healthcare-associated Infection Types

ESSAY.

(Nil)

SHORT ESSAYS

1. Describe the major Hospital Acquired Infections (HAI) types. Add a note on standard precautions (July 2022)

Ans:-

Major types-

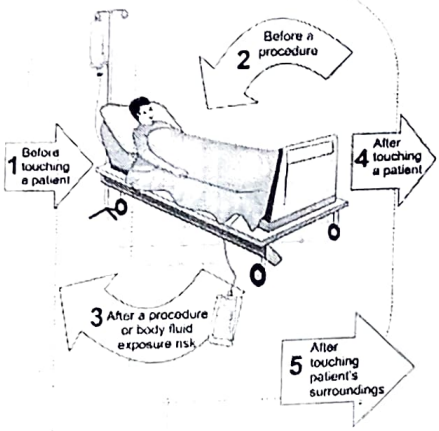
- Catheter-associated urinary tract infection (CAUTI)
  - Catheter-associated UTI (CAUTI)
  - Catheter-associated asymptomatic bacteriuria (CA-ASB)

  } Device Associated Infections
- Catheter-related bloodstream infection (CRBSI)
- Ventilator-associated pneumonia (VAP)
- Surgical site infection (SSI)

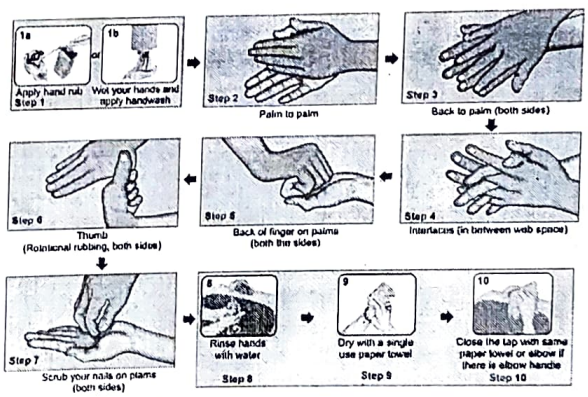
Standard precautions:-

Indication - handling all patients, specimens and sharps.

- Hand hygiene: Wash hands promptly after contact with infective material Use no touch technique wherever possible
- Personal protective equipment (PPE)
- All biomedical waste including sharp should be segregated and disposed appropriately
- Clean up spills of infective material promptly
- Ensure that all patient-care items such as instruments, devices and linens are disinfected before reuse
- Environmental cleaning of surface and floor
- Safe use and disposal of sharp
- Respiratory hygiene and cough etiquette



5 moments of hand hygiene



Steps of hand hygiene

SHORT ANSWERS

1. Hospital acquired infections (February 2015)

Ans:-

Definition-

- infections acquired in the hospital by a patient admitted for a reason other than the infection in context
- the infection should not be present or incubating at the time of admission
- the symptoms should appear at least after 48 hours of admission

Major types-

- Catheter-associated urinary tract infection (CAUTI)
  - Catheter-associated UTI (CAUTI)
  - Catheter-associated asymptomatic bacteriuria (CA-ASB)

  } Device Associated Infections
- Catheter-related bloodstream infection (CRBSI)
- Ventilator-associated pneumonia (VAP)
- Surgical site infection (SSI)

	CAUTI / CA-ASB	CRBSI	VAP	SSI
organisms	E. coli Klebsiella Pseudomonas Acinetobacter Enterococcus Proteus Providencia Morganella	Klebsiella Enterobacter Pseudomonas CoNS S. aureus Candida	Pneumococcus H. influenzae MSSA P. aeruginosa Acinetobacter baumannii E.coli Klebsiella MRSA	S. aureus coagulase negative staphylococci E.coli Klebsiella Enterococcus Pseudomonas Acinetobacter
Risk factors	•Long-term •Latex catheter •Female gender •Old age •Diabetes mellitus •Failure in adherence to aseptic technique	•Longer duration •Femoral vein CL •Non-tunnelled Catheters •Multi-lumen CLs •Emergency insertion •Immunodeficiency •Poor hand hygiene	•Long duration •Nasogastric tube Tracheostomy •Patients with coma •Immobilization •Improper asepsis •contaminated environment	•Age >60 years •Improper surgical Scrub •Malnutrition •diabetes •Inadequate skin antisepsis •Immunosuppression •Bacterial virulence •Inadequate ventilation
Laboratory Diagnosis	•Catheterized or history of recent catheterization within 48 hours •Presence of at least one signs or symptoms of UTI •$\geq 10^3$ CFU/mL: in symptomatic patients •$\geq 10^5$ CFU/mL: in asymptomatic patients.	•Presence of fever, chills, rigor, or hypotension after the insertion of CL •signs of catheter site infection •Simultaneous blood culture from CL and PL - differential time to positivity ≥2 hrs	•CPIS* score >6 •Gram staining – high number of bacterias •Culture – •$\geq 10^5$ CFU/mL for endotracheal aspirate •$\geq 10^4$ CFU/mL for BAL •$\geq 10^3$ CFU /mL for PSB •X-ray or CT chest – infiltration /	•Superficial - skin and subcutaneous levelwithin 30 days regardless of the type of surgery •Deep - muscle and facial level within 30 days for all surgeries except for breast, cardiac and implant surgeries (90 days) •Organ space - level of organ space site within 30 days for all surgeries except

			consolidation / cavitation	breast, cardiac and implant surgeries (90 days)
Management	•removal of catheter •appropriate antimicrobial therapy	•Systematic antimicrobial therapy •Antibiotic lock therapy	•combination of antimicrobial agents active against S. aureus, Pseudomonas and other gram-negative bacilli •based on local antimicrobial resistance pattern of the hospital	•suture removal •incision and drainage •adjunctive systemic antimicrobial therapy

OBJECTIVE TYPE QUESTIONS
(Nil)

Ch: 23. Sterilization and Disinfection

ESSAY

1.Define sterilization and disinfection. Name the best method of heat sterillization temperature's employed and holding periods. Describe the working of above instrument and its applications in hospital and lab. What are the sterilization controls used? (February 2018)

Ans: -

- Sterilization is a process by which all living microorganisms including viable spores, are either destroyed or removed from an article, surface or medium.
- Disinfection is a process that destroys or removes most if not all pathogenic organisms but may or may not destroy bacterial spores.

Best method: -

- Autoclave / Steam sterilizer
- functions like a pressure cooker
- Cycle duration varies (3 to 18 min) depending on the sterillization temperature (121°C–135°C)
- most common - 121°C for 15 min at a pressure of 15 pounds (lbs) per square inch (psi).
- This principle is employed in the action of moist heat sterilization by autoclave.

Mechanism of action:

- Moist heat destroys microorganisms by irreversible coagulation, denaturation of enzymes and structural proteins.

Components of steam sterilizer:

- Pressure chamber
- Lid
- Cylinder
- Electrical heater

Three phases of sterilization include

(i) Conditioning phase – After water boils, air inside the chamber is completely displaced by steam.

(ii) Exposure phase – Holding period is counted from this point (15 minutes)

(iii) Exhaust phase – Electrical heater is switched off and steam sterilizer is allowed to cool till it reaches atmospheric temperature.

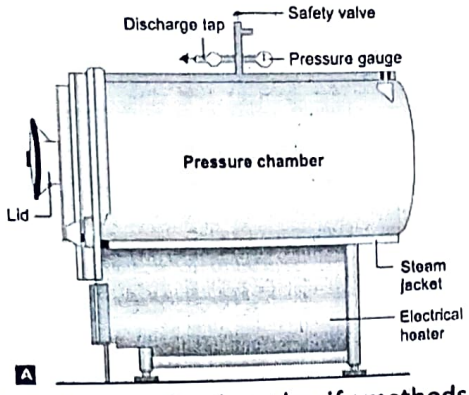
Conditions required – 1. Duration of cycle – 15 minutes
2.Sterilization temperature – 121 degree Celsius
3.Pressure - 15 psi

Uses – Most commonly employed method of moist sterilization for all critical and semi critical items that are heat & moisture resistant, Culture media preparation, Biomedical wastes

Advantages – low cost, fast, non-toxic

Sterilization control –

Biological indicator: spores of Geobacillus stearothermophilus
Chemical indicator: External pack control, Bowie-dick test, Internal pack control
Physical indicator: Digital display



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2. Define sterilization ,classify methods of sterilization. Describe in detail about moist methods below 100 and above 100 C (May 2021)

Ans:-

- Sterilization is a process by which all living microorganisms including viable spores, are either destroyed or removed from an article, surface or medium.

It is classified into-

- Physical methods
  - Heat based - steam sterilizer/autoclave and dry heat sterilizer/hot air oven.
  - Filtration
  - Radiation : ionizing and non-ionizing
  - Incineration
  - Microwave
- Chemical methods
  - Ethylene oxide sterilizer
  - Plasma sterilizer

➢ Moist method above 100 degrees Celsius

- Autoclave / Steam sterilizer
- functions like a pressure cooker
- Cycle duration varies (3 to 18 min) depending on the sterilization temperature (121°C–135°C)
- most common - 121°C for 15 min at a pressure of 15 pounds (lbs) per square inch (psi).
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3.Pressure - 15 psi

Uses – Most commonly employed method of moist sterilization for all critical and semi critical items that are heat & moisture resistant, Culture media preparation, Biomedical wastes

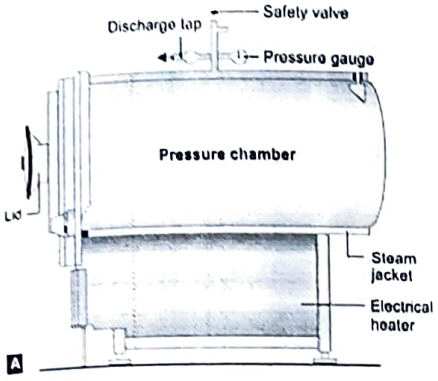
Advantages – low cost, fast, non-toxic

Sterilization control –

Biological indicator: spores of Geobacillus stearothermophilus

Chemical indicator: External pack control, Bowie-dick test, Internal pack control

Physical indicator: Digital display



- Moist method below 100 degrees Celsius -boiling, steaming
  - Boiling of the items in water for 15 minutes will kill most of the vegetative organisms .
  - Steaming – when the autoclave is used without closing the pressure valve, temperature does not rise beyond 100 degree Celsius. This technique is employed for disinfecting those items which cannot tolerate the higher temperatures in autoclave.

SHORT ESSAYS

1.Moist heat sterilization technique – Autoclave (September 2013)

Ans:-

Autoclave:-

- functions like a pressure cooker
- Cycle duration varies (3 to 18 min) depending on the sterilization temperature (121°C–135°C)
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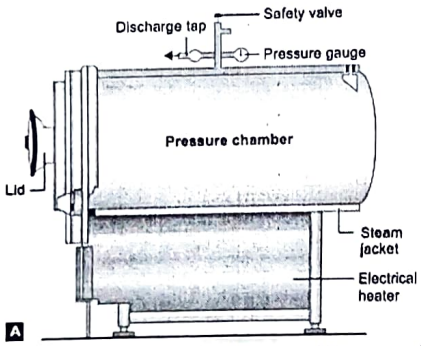

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2.Discuss about autoclave and its uses (March 2014)

- functions like a pressure cooker
- Cycle duration varies (3 to 18 min) depending on the sterilization temperature (121°C–135°C)
- most common - 121°C for 15 min at a pressure of 15 pounds (lbs) per square inch (psi).
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Advantages – low cost, fast, non-toxic
Sterilization control –
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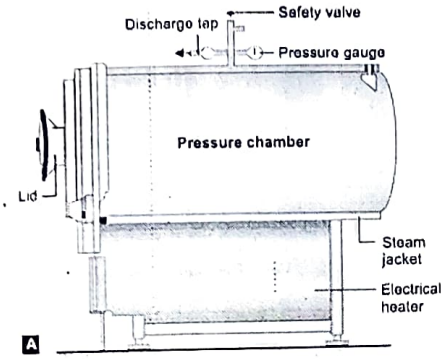


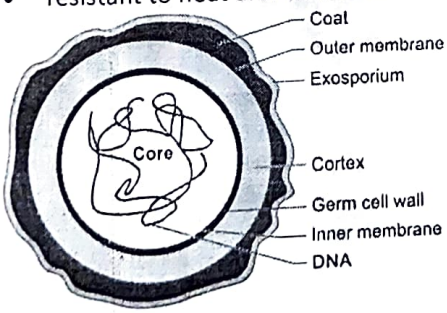
Uses

- All critical and semi-critical items - surgical instruments, anesthetic equipment, dental instruments, implanted medical devices and surgical drapes and linen.
- sterilizing culture media.

3. Bacterial spore and methods for its disinfection (July 2018)

Ans:-

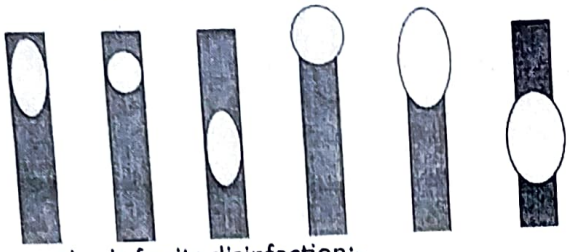
- During highly unfavorable environmental conditions under depletion of essential nutrients, bacteria form a resistant, resting (or dormant) stage called as "Spore".
- four layers (out – in) Exosporium → Coat → Cortex → Cambium.
- Sporulation / sporogenesis - process of formation of spores from the vegetative state
- in a nutrient rich medium → active vegetative cells.
- resistant to heat and disinfectant → calcium and dipicolinic acid into the spore cortex



Classification: -

- Position - central /terminal/ subterminal

- Shape - oval / spherical
- diameter - bulging /non-bulging.



methods for its disinfection:-

HIGH-LEVEL DISINFECTANTs (HLD)-

They combine with nucleic acids, proteins and inactivate them, probably by cross-linking and alkylating the molecules.

- Glutaraldehyde
- Ortho-phthalaldehyde (0.55%)
- Formaldehyde
- Peracetic Acid
- Hydrogen Peroxide (H2 O2)

4. Hot air oven (February 2021)

Ans:-

- dry heat sterilizer
- used for materials like glassware, powders, petroleum products.
- has a sterilization chamber - electrically heated
- has a fan or a motor - adequate and even distribution of hot air in the chamber.
- Principle: - Hot air oven acts by oxidation of cell constituents by dry heat.
- Temperature can range from 150° C -170° C.
- Advantages: - It is nontoxic, Eco-friendly method. Low operating cost. Penetrates well into the materials, and is noncorrosive to metals
- Disadvantages: - High temperature which can damage and is not suited for many delicate materials.
- Sterilization control: - Spores of bacillus atropheus is used a s biological indicator.

5. Ethylene oxide and plasma sterilization (July 2022)

Ans:-

	Ethylene oxide (ETO)	Plasma sterilization
Mechanism	causes alkylation of cell components such as cell proteins, DNA and RNA	H2 O2 breaks into free radicals such as hydroxyl (OH–) and hydroperoxyl (HO2) which initiate microbicidal action
Steps	1.Preconditioning: air is removed from the vacuum is created. In the optimum physical conditions 2.Sterilization: ETO is allowed to enter the chamber. The four essential parameters that influence the effectiveness of ETO sterilization are—gas concentration, temperature, relative humidity, and exposure time. 3.Degassing : extensive aeration of	1. chamber is evacuated 2. injection of chemical sterilant hydrogen peroxide (H2 O2) 3. an electrical field is applied to the chamber to create a gas plasma 4. H2 O2 breaks into free radicals such as hydroxyl (OH–) and hydroperoxyl (HO2) which initiate microbicidal action 5. excess gas is removed Duration- 75/52/24 minutes

	the sterilized materials for 8–12 hours are necessary to remove residual ETO.	
Uses	Heart-lung machine components Sutures, catheters and stents Respirators and dental equipment Devices with electronic components Assembled complex devices Multi-lumen tubings, etc	sterilization of materials and devices that cannot tolerate high temperature and humidity - some plastics electrical devices arthroscope micro and vascular instruments spine sets laparoscope
Control	Spores of Bacillus atrophaeus	Spores of Bacillus stearothermophilus

6.Enumerate various methods of moist heat sterilisation. Add a note on laboratory Autoclave.(July 2023)

Ans:-

Methods of moist heat sterilization

- Steam sterilizer / Autoclave – kills microorganisms and spores.
- Pasteurization
- Inspissation
- Boiling Kills microorganisms but not spores.
- Steaming
- Tyndallization / Intermittent sterilization

Autoclave-

- functions similar to a pressure cooker
- Cycle duration varies (3 to 18 min) depending on the sterilization temperature (121°C–135°C)
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Conditions required – 1. Duration of cycle – 15 minutes
2.Sterilization temperature – 121 degree Celsius
3.Pressure - 15 psi

Biomedical waste treatment particularly sharps are done by autoclave

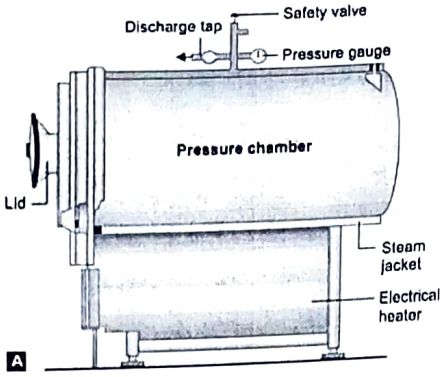
Advantages – low cost, fast, non-toxic

Sterilization control –

Biological indicator: spores of Geobacillus stearothermophilus

Chemical indicator: External pack control, Bowie-dick test, Internal pack control

Physical indicator: Digital display



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Uses

- All critical and semi-critical items - surgical instruments, anesthetic equipment, dental instruments, implanted medical devices and surgical drapes and linen.
- sterilizing culture media.

SHORT ANSWERS

1.Method of moist heat sterilization (April 2013)

Ans:-

- Steam sterilizer / Autoclave – kills microorganisms and spores.
- Pasteurization
- Inspissation
- Boiling Kills microorganisms but not spores.
- Steaming
- Tyndallization / Intermittent sterilization

2.Sterilization using dry heat (September 2014)

Dry heat sterilizer / Hot air oven is used for materials that might be damaged by moist heat or that are impenetrable to the moist heat like glasswares, powders, petroleum products etc. Dry heat acts by oxidation of cell constituents. Dry heat sterilizer has a sterilization chamber, which is electrically heated. It has also got a fan or a motor to ensure adequate and even distribution of hot air in the chamber. It is non-toxic and does not harm the environment. Not expensive and non-corrosive for metals.

3.Pasteurization (September 2015)

- heat-based method of sterilization (Intermediate level disinfection)
- developed by Louis Pasteur
- This technique is used for destroying the food spoiling microorganisms in milk and fruit juice and thereby extending their shelf life.
- In hospitals, pasteurization is used to to disinfect the respiratory and anesthesia equipment by immersing in hot water (70^0 C for 30 minutes)

Methods: -

72°C for 15-20 sec followed by rapid cooling to 13°C or lower – FLASH METHOD

Moist heat at 63° C for 30 minutes – HOLDER METHOD

149° C for 0.5 seconds – ULTRA HIGH TEMPERATURE METHOD

4. Tyndallisation (February 2016)

- heat based method used to sterilise delicate media containing serum, gelatine, egg etc.
- by heating them at 100 degree celsius for 20 minutes on 3 successive days with overnight resting period
- incubation at 37 C during resting period allows germination of spores into vegetative form which are killed in next day heating

uses :-

- It main use is for destroying the endospore from the food products or nutrient media.
- Mainly useful for sterilization of media containing heat labile ingredients such as sugar, milk, gelatin
- It is suitable for sterilizing items which does not sustain high pressure and temperature of autoclave

5. Gaseous disinfectant (February 2017,July 2019)

- Ethylene oxide – widely used gaseous chemical sterilant in CSSD.
  It has broad microbicidal action including spores, causes alkylation of cell components.
- Halogens– Iodine and chlorine have antimicrobial activity
- Hydrogen peroxide vapor
- Chlorine dioxide
- Ozone

6. Radiation as a sterilization method (February 2018)

- Radiation can be ionizing or non ionizing

- Ionizing radiation
  - Include cobalt 60 gamma rays, electron accelerators
  - It is a low temperature sterilization method: COLD STERILISATION
  - Causes ionization of molecules leading to breakage of DNA
  - Efficacy is tested by Bacillus pumilus
- Non-ionizing radiation
  - Infrared radiation
  - Ultraviolet radiation – causes destruction of nucleic acid through induction of thymine dimers. Disinfection of drinking water, titanium implants, contact lenses are disinfected by UV radiation

7.Phenol co -efficient (July 2018)

- It is a measure of the bactericidal activity of a chemical compound in relation to phenol
- The number obtained by dividing the degree of dilution of test disinfectant by the degree of dilution of phenol in a certain span of time
- Coefficient > 1 → for given dilution, the test disinfectant is more powerful and can kill germs better than phenol.
- Coefficient <1, → for the given dilution, phenol is better at controlling germs.

8. Name 4 items sterilized by autoclave? (2 marks) (February 2019)

Ans: -

- Surgical instruments
- Anaesthetic equipment
- Dental instruments
- Implanted medical devices
- Surgical drapes and linens
- culture media preparation

9. Clinical applications of autoclave (February 2020)

Ans: -

- All critical and semi-critical items - surgical instruments, anesthetic equipment, dental instruments, implanted medical devices and surgical drapes and linen.
- sterilizing culture media.
- Biomedical waste treatment particularly sharps are done by autoclave.

10. Sporicidal disinfectants? (May 2021)

Ans: -

- Sporicidal disinfectants are high level disinfectants which can kill bacterial spores when used in high concentrations.
- Aldehydes - glutaraldehyde, orthopthaldehyde, formaldehydes
- Peracetic acid and hydrogen peroxide

OBJECTIVE TYPE QUESTIONS

1. Name 2 sporicidal disinfectants (February 2022)

Ans: -

- Glutaraldehyde
- Peracetic acid

2. Biological control for autoclave(July 2022)

Ans:-

- Spores of Geobacillus stearothermophilus

3. Name the disinfectant (with %) to be used for a large spill.(January 2023)

Ans:-

- 1:10 dilution of 5% hypochlorite (5000 ppm) i.e. 0.5%

Ch: 24. Biomedical Waste Management

ESSAY

(Nil)

SHORT ESSAYS

1. Describe various modes of biomedical waste disposal with examples. Add a note on treatment of waste disposal? (February 2022)

Ans:

a) Incineration: It is a high temperature dry oxidation process. Reduces organic and combustible wastes to inorganic incombustible matter and results in a very significant reduction of waste- volume and weight. This process is usually selected for disposal of wastes that cannot be recycled, reused or disposed of in a landfill

b) Chemical disinfection: Chemicals are added to wastes to kill microorganisms in the wastes. Chemical disinfection is most suitable in treating the liquid waste such as blood, urine, stools or hospital sewage.

c) Wet thermal treatment: Steam disinfection of shredded infectious waste and is based on exposure of wastes to high pressure steam.

d) Microwave irradiation: Most microorganisms are destroyed by the action of microwaving at a frequency about 2450 MHz. The water contained within the waste is rapidly heated by the microwaves produced and the infectious components are destroyed by heat conduction.

e) Land disposal: Sanitary landfills are utilized for dumping wastes and enable geological isolation of wastes from the environment, appropriate engineering preparation before the site is ready to accept waste

f) Inertization: Process of inertization involves mixing waste with cement and other substances to minimize the risk of toxic substances contained within it percolating into ground water.

g) Shredder: wastes are deshaped into smaller pieces so as to make the wastes unrecognizable

h) Hydroclaving : Low temperature steam sterilizer involving steam treatment with fragmentation and drying of waste

i) Plasma pyrolysis : Uses ionized gas in the plasma state to convert electrical energy to temperature of several thousand degrees using plasma arc torches or electrodes.

SHORT ANSWERS

1.Incineration (March 2014)

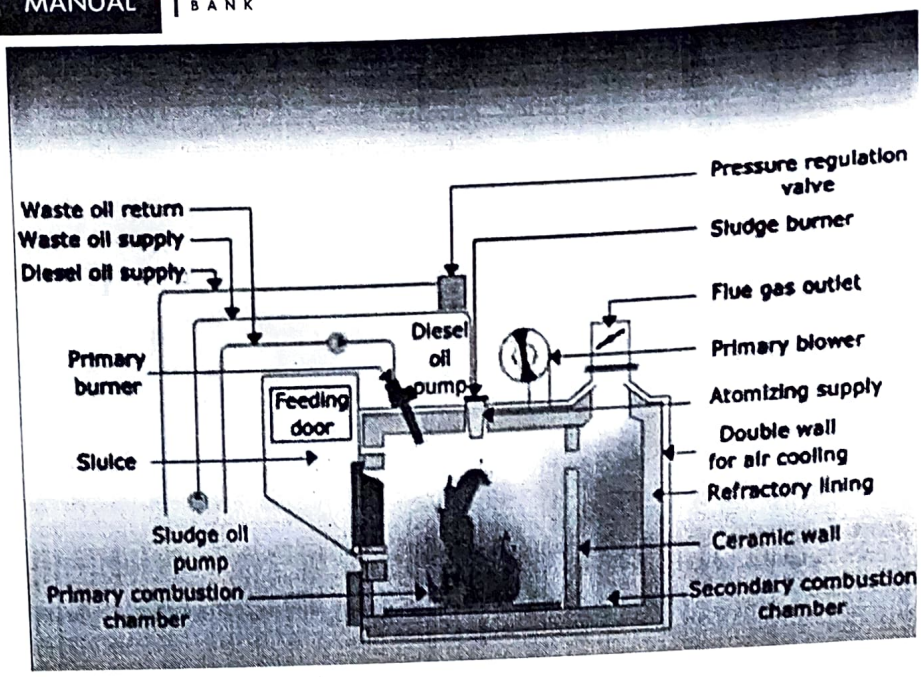
ideal method of choice of disposal of Biomedical wastes which cannot be reused, recycled or can be disposed in a landfill

Incineration is a high temperature dry oxidation process that reduces organic and combustible waste into non-organic incombustible matter.

Types of incinerators:-

- Rotary Kiln Incinerator
- Fluidized Bed Incinerator
- Moving Grate Incinerator
- Multiple Hearth Incinerator
- Liquid Injection Incinerator
- Catalytic combustion chamber
- Waste-Gas Flare Incinerator
- Fixed Grate/ Direct-Flame Incinerator

Parts of incinerator-



OBJECTIVE TYPE QUESTIONS

25. Needle Stick Injury

ESSAY: *Nil*
SHORT ESSAYS: *Nil*
SHORT ANSWERS: *Nil*
OBJECTIVE TYPE QUESTIONS: *Nil*

26. Antimicrobial Stewardship

ESSAY: *Nil*
SHORT ESSAYS: *Nil*
SHORT ANSWERS: *Nil*
OBJECTIVE TYPE QUESTIONS: *Nil*

27. Environmental Surveillance (Bacteriology of Water, Air and Surface)

ESSAY: *Nil*
SHORT ESSAYS: *Nil*

SHORT ANSWERS

1. Presumptive coliform counting (February 2015 , February 2022)

- preliminary screening method
- detect the presence of coliform bacteria in water samples
- Coliform bacteria are a group of microorganisms commonly found in the environment, including the intestines of humans and animals.
- The presumptive coliform testing is often based on the detection of gas production (CO_2) from the fermentation of lactose, a sugar present in the medium.
- One common method for this purpose is the Most Probable Number (MPN) method

inoculating water samples into a series of lactose-containing tubes or wells
↓
incubated at 35-37°C for period of 24-48 hours
↓
tubes are examined for the presence of gas

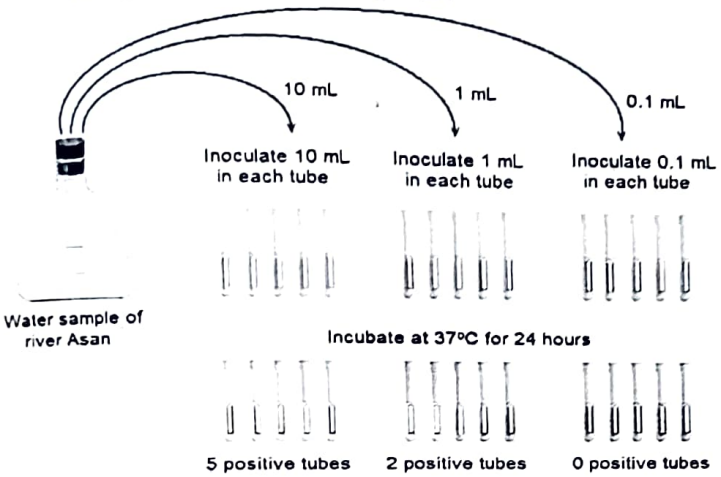
↓

gas is detected

↓

presence of coliform bacteria

- This test only provides a presumptive indication of coliform contamination
- Does not specifically identify the type of coliform bacteria present.
- To confirm the presence and identify the specific species - confirmed lactose fermentation test and biochemical tests or PCR



OBJECTIVE TYPE QUESTIONS

(Nil)