Lec. 1 Medical Bacteriology for Environmental Health Sciences

Host-parasite Interactions

Infectious Diseases. These are caused by infectious agents which are bacteria, viruses, fungi, protozoa and helminths.

Parasite is a living organism (bacteria, viruses, fungi, protozoa, helminths) that lives in another organism, and receives shelter and nourishment. However, in medical science parasitology traditionally deals with animal parasites- protozoa and helminths.

Strict or obligate parasite is an organism that cannot live without a host. That is, they have no free-living existence. Examples: Treponema pallidum.

Facultative parasite is an organism that has both a free-living and a parasitic existence, e.g. *Clostridium species*, *Pseudomonas* species.

Pathogen. Pathogen is an organism which can cause disease.

Non-pathogen. An organism that does not cause disease. It may be a member of normal flora.

Opportunistic pathogen is an organism (non-pathogen, commensal or saprophyte) that can cause disease only in immunocompromised individuals that is having impaired resistance. Example : Atypical mycobacteria.

Saprophyte is an organism that lives on dead organic matter.

NORMAL FLORA (Commensals)

Microorganisms that is present on the skin and mucous membrane of normal (healthy) persons. One particular microorganism of the normal flora may be a nonpathogen, or opportunistic pathogen. Normal flora is of two types:

(1) Resident flora. These are microorganisms regularly present in the region at a given age, e.g. Viridans streptococci in mouth and throat, *Escherichia coli* in intestine,

(2) Transient flora. The microorganism is present only for hours to weeks, e.g. Streptococcus pyogenes in throat. Microorganisms of transient flora play no role when the normal resident flora remains intact.

But if the resident flora is disturbed than the microorganisms of transient flora may colonize and produce disease.

Beneficial Functions of Normal Flora. Examples:
(1) In mouth and lower bowel an invading pathogen may fail to compete for nutrients and receptor sites with normal flora,
(2) Some bacteria of the bowel produce antimicrobial substances,
(3) In new born, bacteria act as a powerful stimulus for the development of immune system,
(4) Bacteria of the gut can produce vitamin K.

Harmful Effects of Normal Flora. Clinical diseases by opportunist pathogen of normal flora arise under:
(1) when the organism leaves the normal site and localizes to another site, e.g. Escherichia coli in the urinary tract from gut,
(2) competitive advantage due to antibiotic therapy, e.g. colitis by Clostridium difficile,
(3) In immunocompromised individuals.

HOST
Host is the harbouring organism of a parasite.

INFECTION
Infection is the multiplication of an infectious agent within the body. Multiplication of pathogenic bacteria (e.g. Salmonella typhi) even if the person is asymptomatic is taken as an infection. Multiplication of bacteria of normal flora at its normal site is not an infection. However, if they multiply and cause disease it is an infection, e.g. Escherichia coli when causes diarrhoea.

An infection involves the following : (1) Source or reservoir of infectious agent, (2) Transmission of the infectious agent from the source to the host (3) Susceptible host- Portal or route of entry of the agent in the host, its localization, multiplication and finally host-parasite interactions which result in either (a) Destruction of the agent or, (b) Infectious disease.

Source (Reservoir) :
1. Human Source.
(a) Exogenous source : Patient or carrier,

(b) Endogenous source : The individual himself.

Carrier. A person with asymptomatic infection which can be transmitted to another susceptible person. An individual may be a carrier:
(a) in the incubation period (Incubatory carrier)
(b) during convalescence (convalescent carrier), e.g. typhoid fever, or
(c) for a prolonged period, e.g. typhoid fever.

2. Foods and Drinks
(a) Food :Any contaminated food, (b) Water contaminated with bacteria of typhoid fever, cholera, diarrhoea and dysentery,
(c) Milk contaminated with salmonella, M. bovis.

3. Animals : Zoonoses are diseases which are transmitted from infected animals to humans.
Bovine tuberculosis, brucellosis by Brucella abortus, Salmonella food poisoning, anthrax,
4. Soil. Tetanus, gas gangrene.

Modes of Transmission
1. **Water-borne,** e.g. cholera and other diarrhoeal diseases, enteric fever from contaminated water.

2. **Food-borne** (contaminated food) e.g. enteric fever, salmonella food poisoning.

3. **Air-borne** e.g. Droplets. During coughing, sneezing and talking: Diphtheria, tuberculosis.

4. **Dust-borne.** e.g. tuberculosis,

5. **Soil- Tetanus,** gas gangrene.

6. **Contaminated fomites** like beddings, clothings: Diphtheria, enteric fever, food poisoning.

7. **Direct contact-** STD like gonorrhoea, syphilis.

8. **Transplacental:** congenital syphilis.

Portal or Route of Entry
(1) Alimentary system by ingestion, (2) Respiratory system by inhalation, (3) Genitourinary system, (4) Skin due to trauma, bite of insects, (5) Placenta.

Self-infection and cross-infection

Self-infection is the infection that occurs from the patient's own flora. Examples : (i) infection of an wound of a patient by staphylococci carried by the individual in his nose, (2) coliforms and anaerobes released from his bowel during surgery.

Cross infection is the infection derived from other patients or healthy carriers by direct spread as droplets during talking, coughing, sneezing, by air-born dust, food, fluids etc. Cross-infection is common in hospitals.

Lab 1

Types of Biosafety Cabinets

Biosafety cabinets are used as the primary means of containment for working safely with infectious microorganisms. However, biosafety cabinets are only one part of an overall biosafety program, which requires consistent use of good microbiological practices.

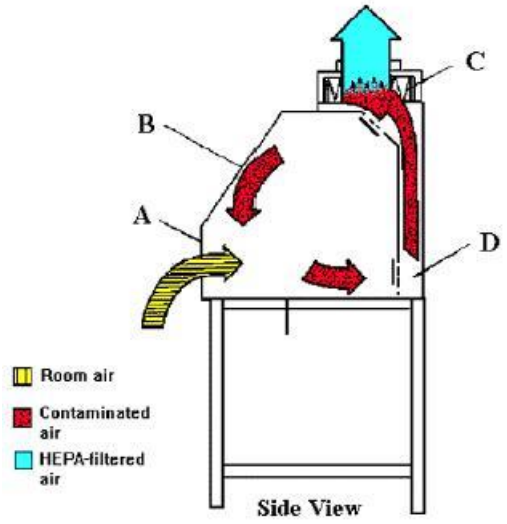
Biosafety cabinets are designed to prevent biological exposure to personnel and the environment and may also protect experimental material from being contaminated when appropriate practices and procedures are followed. Three kinds of biosafety cabinets, designated as Class I, II and III have been developed to meet varying research and clinical needs.

Biological safety cabinets use high efficiency particulate air (HEPA) filters in their exhaust and/or supply systems. These filtered cabinets are primarily designed to protect against exposure to particulates, including biological agents used in the cabinet. **Protection against exposure from fumes generated by radionuclides and toxic chemicals is only provided by Class II, Type B biosafety cabinets, which are ducted directly to the facility exhaust.**

The Class I Biosafety Cabinet

The Class I biosafety cabinet provides **personnel and environmental protection, but no product protection**. It has similar turbulent air flow as a chemical fume hood, but has a HEPA filter in the exhaust system to provide containment and environmental protection. **This older class of biosafety cabinet is rarely seen in microbiological laboratories.**

Class I Biosafety Cabinets

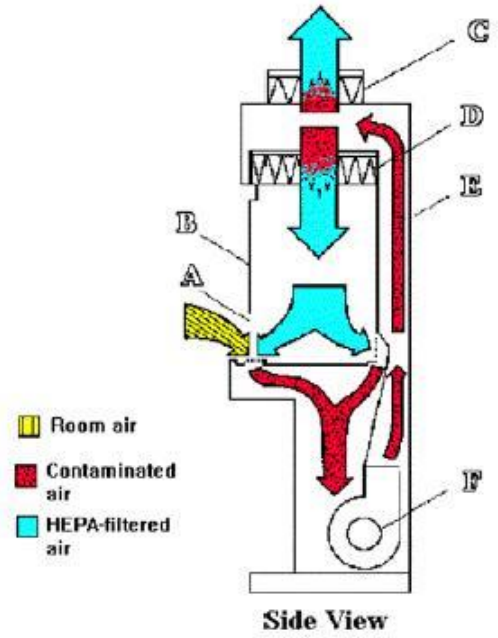


A. Front Opening
B. Sash
C. Exhaust HEPA
D. Exhaust plenum

The Class II Biosafety Cabinet

The Class II biosafety cabinet provides protection to the user, the experimental material and the environment. The Class II biological safety cabinet is the type most commonly used in microbiological laboratories. Air flow is drawn from the room around the operator into the front grille of the cabinet, which provides personnel protection. In addition, the downward laminar flow of HEPA-filtered air provides protection for experimental material inside the cabinet. Because cabinet air has passed through the exhaust HEPA filter, it is contaminant-free, providing environmental protection, and may be recirculated back into the laboratory (Class II Type A) or ducted out of the building (Class II Type B).

Class II Biosafety Cabinet

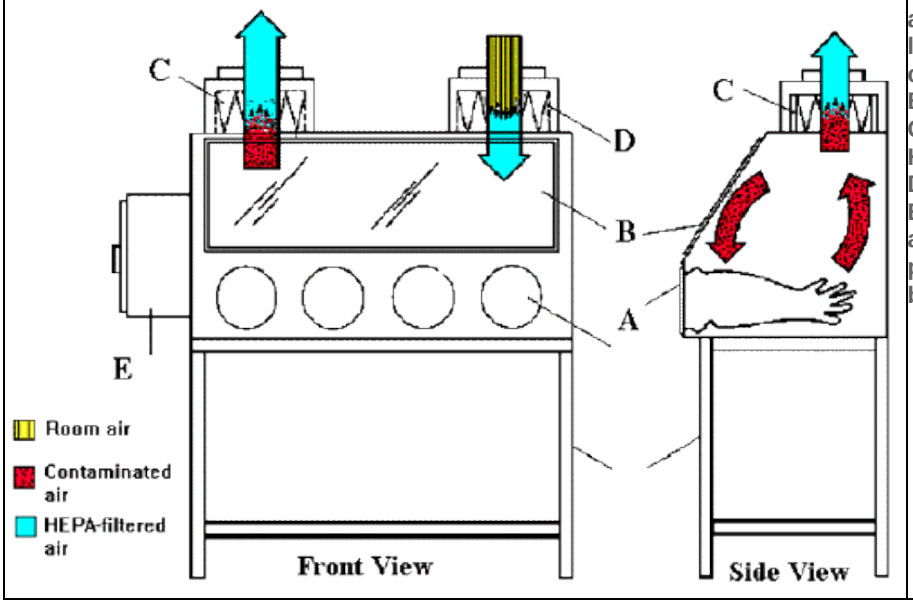


A. Front Opening
B. Sash
C. Exhaust HEPA filter
D. Supply HEPA filter
E. Rear plenum
F. Blower

The Class III Biosafety Cabinet

The Class III biological safety cabinet is most **suitable for work with biohazardous agents**. The Class III cabinet is completely enclosed, HEPA filter-ventilated cabinet fitted with glove ports and decontamination capabilities for entry and exit of material. It offers the highest degree of personnel and environmental protection from infectious aerosols.

Class III Biosafety Cabinet



A. Glove ports with O-ring for attaching arm-length gloves to cabinet
B. Sash
C. Exhaust HEPA
D. Supply HEPA
E. Double-ended autoclave or pass-through box
