

B.Sc. (H) Microbiology
SEC , Sem I

Agents of respiratory infection

- **Viruses:** influenza, measles (rubeola), chickenpox (herpes varicella-zoster) and rhinoviruses (colds); Hantavirus (from a rodent; mouse)
- **Bacteria:** *Legionella* spp. (Legionnaire's disease and pontiac Fever), tuberculosis and other mycobacteria (*Mycobacterium* spp.), anthrax (*Bacillus anthracis*), and brucellosis (*Brucella* spp.)
- **Fungi:**
 - causing diseases like histoplasmosis, cryptococcosis, blastomycosis, coccidioidomycosis, and aspergillosis
 - May produce secondary metabolites, VOCs, mycotoxins
- **Protozoans:**
 - *Pneumocystis carinii* pneumonia; prevalent in immunodeficient hosts such as AIDS patients.
 - *Acanthamoeba encephalitis*; Primary Amoebic Meningoencephalitis (PAM)

Reservoirs of Airborne Microbes

- Wide range, overall, depends on the microbe
 - humans,
 - animal,
 - soil
 - dust
 - water
 - air

Amplifiers:

- Places where microorganisms multiply or proliferate.
- Most reservoirs are potential amplifiers.

Airborne microbes and their Reservoir

Viruses:

Mostly humans but some animals

Some rodent viruses are significant: ex: Lassa Fever Virus and Hantavirus.

Bacteria:

**Humans (TB & staphylococci),
other animals (Brucella and Anthrax),
water (*Legionella*)
soil (Clostridia)**

Fungi:

soil and birds (*Cryptococcus* and *Histoplasma*)
dead plant material
wet surfaces (wood and other building materials)
indoor air (mycotic air pollution)
stagnant water for the opportunistic fungi (*Aspergillus* sp.)

Disseminators

- Devices causing microbes to enter airborne state or be aerosolized; often the reservoir or amplifier.
- Any device able to produce droplets and aerosols:
 - Humans and other animals: coughs and sneezes
 - Mechanical ventilation systems
 - Nebulizers and vaporizers
 - Toilets (by flushing)
 - Showers, whirlpools baths, Jacuzzi, etc.
 - Wet or moist, colonized surfaces (wet walls and other structures in buildings)
 - Environments that are dry and from which small particles can become airborne by scouring or other mechanisms:
 - Vacuuming or walking on carpets and rugs
 - Excavation of contaminated soil
 - Demolition of buildings

Factors Influencing Airborne Infection

1. Aerosol factors
2. Microbe factors
3. Host factors

Aerosol Factors

- **Particle size;** <5 um in diameter, "droplet nuclei" from coughing & sneezing
 - Deposition site: depends on particle size and hygroscopicity
 - Chemical composition of the aerosol particle
- **Sunlight:** UV inactivates the microbes
- **Relative humidity (RH); dessication**
- **Temperature:** generally greater inactivation at higher temperature
- Factors influencing **air movement:** winds, currents, mechanical air handlers, etc.
- **Seasonal factors:** precipitation, air currents, pollen sources, etc.
- **Air pollution:**
 - chemicals inactivating airborne microbes (OAF= Open Air Factor)
 - enhancing their ability to cause infection in a host

Microbes Factor

- Size of microbe and of aerosol particle
 - influences air transport
 - influences deposition site: in environment and in host
- Composition:
 - lipids, proteins (structural, enzymes), amino acids, etc.
 - enveloped and non-enveloped viruses respond differently to air pollution
- **Protective forms:**
 - spores
 - cysts
 - growth phase
 - moisture content

Host Factors

- Allergies, asthma
- Respiratory disease
- Immunosuppressed (patients)
- Contact lens wearers

Classification of Bioaerosols on viability

- While all bioaerosols are biological in origin,
- Can be categorized into : **viable** and **non-viable**.
- **Non-viable** bioaerosols are **not currently alive** and, therefore, **cannot multiply**. Eg: aerosolized pollen, animal dander and saliva, and insect excreta are all forms of non-viable bioaerosols.
- **Viable** bioaerosols are **living** organisms that demonstrate microbiological activity and have the **potential to multiply**. These include airborne bacteria, fungi, and viruses, of which bacteria and fungal spores are the two most prevalent bioaerosols present.

Airborne microorganisms

- Airborne particles are a major cause of respiratory ailments of humans, causing allergies, asthma, and pathogenic infections of the respiratory tract. They are a major concern in food and pharma industries. Airborne fungal spores are also important agents of plant disease, and the means for dissemination of many common saprotrophic (saprophytic) fungi.
- Examples of important respiratory diseases of humans (health impact)
- The roles of airborne spores in crop diseases (environmental impact)
- Significance in food and pharma industries & operation theatres etc.

Health effects

- Exposures to bioaerosols in the occupational and residential indoor environments are associated with a wide range of health effects with major public health impact, including:
 - infectious diseases (Pathogenic- has to be viable),
 - acute toxic effects,
 - allergies
 - cancer
- Respiratory symptoms and lung function impairment are the most widely studied and probably among the most important bioaerosol-associated health effects
- Potential Health effects such as skin and neurological conditions and birth effects are underexplored.

- The more extreme health effects include the resulting illnesses due to pathogenic bioaerosols.
- Sources of pathogenic bioaerosols include humans, animal houses, wastewater treatment plants, and biosolids storage units.

types

- Viruses
- Bacteria
- Fungi
- Protozoan