

Nosocomial infection & control

Infection developed in patients after admission to the hospital, which was neither present nor in the incubation period at the time of hospitalization.

They may become evident during patient's stay or after their discharge.

↑ Hospital associated infections

Epidemiological interaction

Incidence burden

5-10% in developed countries

10-30% in developing countries

Rate vary between countries, within same country, within the district and some time with the hospital itself .due to

- 1) Complex mix of the patients
- 2) Aggressive treatment
- 3) Local practices.

Risk factors

Consequences of nosocomial infection

Prolongation of hospital stay varies by site, greatest with pneumonia and wound infection.

Additional morbidity

Mortality increases; in order; LRI, UTI.

Long-term physical and neurological consequences

Direct patients cost increased-escalation of the cost of the care

Where do the microbes come from?

- 1) Patient's own flora
- 2) Cross infection from medical personnel
- 3) Cross infection from patient to patient

Hospital environment (inanimate objects): - Air - Water - Dust - IV fluids & catheters - Washbowls - Bedpans - Endoscopes - Ventilators & respiratory equipment

Sources of Infection

Endogenous:

- Patients own flora may invade patient's tissue during some surgical operations or instrumental manipulations
- Normal commensals of the skin, respiratory, GI, UG tract

Exogenous:

- From another patient / staff member / environment in the hospital
- Environmental sources: Inanimate objects, air, water, and food.
- Cross infection from: other patients, hospital staff (suffering from infections or asymptomatic carriers)

Microorganisms

Any pathogen, on occasion, can cause HAI

: major cause; Those that are able to survive in hospital environment & develop resistance to antibiotics & disinfectants

§ Commensal bacteria: found in the normal flora of healthy people.

Significant protective role; should be done by preventing colonization by pathogenic microorganisms. Some commensal bacteria may cause infection if the host is compromised. Eg: Staphylococcus epidermidis (cause of i.v. infections), Escherichia coli (cause of urinary infections).

Pathogenic bacteria: they have greater virulence, and cause infections (sporadic or epidemic) regardless of host status.

Bacteria: Gram-positive bacteria: • Staphylococcus aureus: bacteria that colonize the skin, nose and throat of patients and hospital staff. They cause a wide variety of lung, bone, heart and bloodstream infections and are frequently resistant to antibiotics.

In hospitals commonly 40-50% of S. aureus isolates are MRSA. • Staph epidermidis & Group D Streptococci • Streptococci: Streptococcus hemolyticus, Streptococcus Pyogenes • Clostridium tetani spores: survive in dust for very long time

Multidrug resistant *Staphylococcus aureus* (MRSA): colonize hospitals & cause Nosocomial infections. Thus, known as 'Hospital Staphylococci'

Gram-negative bacteria: In recent decades, enteric Gram negative bacilli → most important group of hospital pathogens •

Enterobacteriaceae: (*E. coli*, *Proteus*, *Klebsiella*, *Enterobacter*, *Serratia*) may colonize sites when the host defenses are compromised. They may also be highly antibiotic resistant • *Pseudomonas* spp: - often isolated in water and damp areas. They may colonize the digestive tract of hospitalized patients. - Ability to survive & multiply at low temp - Resistance towards antibiotics & disinfectants.

Viruses:

- HIV and Hepatitis B & C viruses: transmitted through blood & blood products
- Viral diarrhea & Chickenpox can be spread in hospitals • Cytomegalovirus, Herpes virus, Influenza, Enteroviruses & Arenaviruses can cause HAI

Fungi: • *Candida albicans*, *Aspergillus*, *Mucor* Protozoa: • *Entamoeba histolytica*, *Plasmodia*, *Toxoplasma gondii*, *Pneumocystis carinii*

Modes of Transmission of nosocomial infection

1. Contact: Most common route of transmission ↑ Hands or Clothing: - Hands of staff: important vehicle of spread - Contact of hands & clothing of attendants Eg: *Staphylococcus aureus*, *Streptococcus pyogenes* ↑

Inanimate objects: - Improper disinfection of Instruments: endoscope, bronchoscope, cystoscope Eg: *Pseudomonas aeruginosa*

2. Airborne: ↑

Droplets: - Droplets of Respiratory infections: transmitted by inhalation ↑ Dust: - Dust from bedding, floors, wound exudates & skin Eg: *Pseudomonas aeruginosa*, *Staphylococcus aureus* ↑ Aerosols: - Aerosols from nebulizers, humidifiers & AC Eg: *Legionella pneumophila*

3. Oral Route: - Hospital food may contain Antibiotic-resistant bacteria → may colonize intestine → can cause infections

4. Parenteral route: - Disposable syringes & needles - Certain infections may be transmitted by blood transfusion, tissue donation, contaminated blood products Eg: Hepatitis B, HIV

Common Nosocomial Infections ↑

UTI: Most common HAI (40% of Nosocomial infections) o Usually associated with catheterization or instrumentation of urethra, bladder or kidneys

Eg: *E. coli*, *Klebsiella*, *Proteus*, *Serratia*, and *Pseudomonas*, *Candida albicans* ↑

Pneumonia (Respiratory Infections): Leading cause of mortality in patients suffering from HAI

During aspiration in unconscious patients & pulmonary ventilation Eg: *Staph. aureus*, *Klebsiella*, *Enterobacter*, *Serratia*, *Proteus*, *Pseudomonas*, *Acinetobacter*, *Legionella*, *E. coli*.

Wound & skin sepsis:

Follow surgical procedure where causative agents are introduced into the tissue during operations

Higher in elderly patients

Manifest within a week of surgery

Non-surgical wounds due to burns, bed sores.

Eg: *Staph aureus*, *Pseudomonas aeruginosa*, *E. coli*, *Proteus*, *Enterococci* gastrointestinal infections:

Food poisoning due to *Salmonella*, *Shigella sonnei*, Enterotoxigenic manifestation due to *Staphylococcal* contamination of cooked food o Diarrhea due to *E. coli*

Bacteremia & Septicemia:

Bacterial invasion of bloodstream in various HAIs

Mostly caused by infected intravenous cannula

Gram-negative bacilli: common pathogens

Tetanus:

- Inadequate attention to aseptic precautions during surgery
- Use of contaminated dressings or improperly sterilized dressings
- Improper disinfection of site of intramuscular injection
- Inadequate care while cutting umbilical cord of new-born.

Diagnosis of HAIs may occur sporadically or as an outbreak

Diagnosis by routine bacteriological methods:

Direct smear examination Culture Sensitivity testing

Identification & elimination requires sampling from possible sources of infections such as hospital personnel, inanimate objects, water, air or food n Typing of isolate (phage, bacteriocin): may indicate a causal connection

Prevention and administration of antibiotic therapy: to the carrier staff or source patients to destroy the pathogenic agents and Proper sterilization & disinfection of inanimate objects. This helps to control the source of infection

Disinfection of excreta & infected material is necessary to control the exit point of infection

Regular washing of hands, disinfection of equipment & change of working cloths can control transmission.

Use of sterile dressings, surgical gloves & facemasks further contribute in control of nosocomial infection.

Pre-operative disinfection of patient's skin n Proper investigation of HAI & treatment of such cases

Hospital Infection Control Committee (HICC)

Every hospital must have an effective Hospital-acquired Infection Control Committee.

Responsible for the control of HAIs

ICC

The membership of the hospital ICC should reflect the spectrum of clinical services and administrative arrangements of the health care facility.

The committee should include:

1. Chief executive, or hospital administrator or Medical superintendent (Chairperson).
2. Clinical microbiologist (Infection control officer).
3. Infection Control Nurse (ICN).
4. Infectious Diseases Physician (if available)
5. Chief of nursing services.
6. Medical record officer (if available).
7. Representative from the major clinical specialties. 8. Additionally representatives of any other department (pharmacy, maintenance, housekeeping, etc) may be invited as necessary

Functions:

§ To formulate & update policies on matters related to hospital infections.

§ Review and approve surveillance and infection prevention program, emergence of drug resistance

§ Use of different antimicrobial agents.

§ Proper sterilization & disinfection procedures

§ To assess and promote improved practice at all levels of health facility.

§ To Obtain and manage critical bacteriological data and information, including surveillance data

To ensure appropriate staff training

§ Safety management

§ Development of policies for the prevention and control of infection

§ To develop its own infection control manual

§ Monitor and evaluate the performance of program

§ To recognize and investigating outbreaks of infections in the hospital and community

Hospital Infection Control

Reduce patient exposure to pathogens

- Reduce the number & virulence of nosocomial pathogens
- Use of aseptic technique during patient care
- Hand washing
- Proper isolation of patients known or suspected of harboring infectious diseases
- Whenever possible, avoid crowding wards
- Use gloves when necessary
- Wash hands immediately after glove removal and between patients
- Masks, Eye protection, Gown: Wear during activities likely to generate splashes or sprays
- Gowns: Protect skin and soiling of clothing

Sharps:

- Avoid recapping of needles
- Avoid removing needles from syringes by hand
- Place used sharps in puncture-resistant containers Ensure clean environment:
- Establish policies and procedures to prevent food and water contamination
- Establish a regular schedule of hospital cleaning with appropriate disinfectants in, for example, wards, operating theaters, and laundry
- Dispose of medical waste safely
- Needles and syringes should be incinerated
- Other infected waste can be incinerated or autoclaved for landfill disposal

Hand Hygiene is the single most effective intervention to reduce the cross transmission of Nosocomial infections

Hand washing:

must be "bacteriologically effective"

- Wash hands before any procedure in which gloves and forceps are necessary
- After contact with infected patient or one colonized with multi resistant bacteria
- After touching infective material
- Use soap and water (preferably disinfectant soap)

Standard safety measures to minimize the infection:

- 1) Assume that all specimens/ patients are potentially infectious for pathogens
- 2) All blood specimens or body fluids must be placed in leak-proof impervious bags for transportation to the laboratory
- 3) Use gloves while handling blood & body fluid specimens & other objects exposed to them.
- 4) If there are chances of spattering, use face masks and glasses
- 5) Wear laboratory coat or gowns while working in the laboratory, these should not be taken outside.
- 6) Never pipette by Mechanical pipetting should be used mouth devices.
- 7) Decontaminate laboratory work surfaces with appropriate disinfectant after the spillage of blood or other body fluids.
- 8) Limit use of needles & syringes to situations for which there are no other alternatives
- 9) All potentially contaminated materials of laboratory should be decontaminated before disposal or reprocessing
- 10) Always wash hands after completing laboratory work
- 11) Remove all protective clothing before leaving the laboratory.