

Trauma & Repair Nosocomial Infections & its Control

Professor Raheelah Amin
Chairperson

Department of Community Medicine

Module: Trauma & Repair (3rd year)

Learning objectives:

1. Describe the prevalence of nosocomial infections globally and specifically in Pakistan
2. Identify the causes of nosocomial infections in Pakistan
3. Enlist common nosocomial infections
4. Describe the importance of different modes of transmission for causation of the nosocomial infections
5. Explain the control & preventive measures for nosocomial infections

Definition:

A **nosocomial infection** is contracted because of an **infection** or toxin that exists in a certain location, such as a hospital.

Used interchangeably with the terms:

- **Health-care associated infections (HAIs)** and
- **Hospital-acquired infections.**

HAIs: What They Are?

Healthcare-acquired infections are infections that patients get while receiving treatment for medical or surgical conditions.

HAIs occur in all settings of care, including hospitals, surgical centers, ambulatory clinics, and long-term care facilities such as nursing homes and rehabilitation facilities.

HAIs

- These infections can occur during healthcare delivery for other diseases and even after the discharge of the patients. Additionally, they comprise occupational infections among the medical staff

Prevalence

- According to WHO estimates, approximately 15% of all hospitalized patients suffer from these infections
- Of every hundred hospitalized patients, seven in developed and ten in developing countries can acquire one of the healthcare associated infections

Prevalence

- According to Extended Prevalence of Infection in Intensive Care (EPIC II) study, the proportion of infected patients within the ICU are often as high as 51%
- Based on extensive studies in USA and Europe shows that HCAI incidence density ranged from 13.0 to 20.3 episodes per thousand patient-days

Who's At Risk?

- All hospitalized patients are susceptible.
- Some patients are at greater risk than others:
 - Young children,
 - The elderly, and
 - Persons with compromised immune systems are more likely to get an infection.
- Other risk factors are
 - Long hospital stays,
 - The use of indwelling catheters,
 - Failure of healthcare workers to wash their hands, and
 - Overuse of antibiotics.

- In American hospitals alone, the Centers for Disease Control (CDC) estimates that
- HAIs account for an estimated 1.7 million infections and 99,000 associated deaths each year. Of these infections:
 - 32 % of all healthcare-acquired infection are urinary tract infections
 - 22 % are surgical site infections
 - 15 % are pneumonia (lung infections)
 - 14 % are bloodstream infections

What's at Stake?

- Patients who acquire infections from surgery, they spend, on average, an additional 6.5 days in the hospital, are five times more likely to be readmitted after discharge and twice as likely to die
- Moreover, surgical patients who develop infections are 60 % more likely to require admission to a hospital's intensive care unit
- Surgical infections are believed to account for up to ten billion dollars annually in healthcare expenditures.

Burden of disease

- With increasing infections, there is an increase in prolonged hospital stay, long term disability, increased antimicrobial resistance, increase in socio-economic disturbance, and increased mortality rate.
- Sparse information exists on burden of nosocomial infections because of poorly developed surveillance systems and inexistent control methods.

2. Types of Nosocomial Infections

The most frequent types of infections include:

1. Central line-associated bloodstream infections (CLABSI)
2. Catheter-associated urinary tract infections (CAUTI)
3. Surgical site infections and ventilator-associated pneumonia (SSI)
4. Ventilator associated pneumonia (VAP)

A brief detail of these is:

2.1. Central line-associated bloodstream infections (CLABSI)

- deadly nosocomial infections with the death incidence rate of 12%–25%
- Catheters are placed in central line to provide fluid and medicines but prolonged use can cause serious bloodstream infections resulting in compromised health and increase in care cost
- There is a decrease of 46% in CLABSI from 2008 to 2013 in US hospitals

2.2. Catheter associated urinary tract infections (CAUTI)

- CAUTI is the most usual type of nosocomial infection globally
- CAUTIs are caused by endogenous native microflora of the patients.
- Catheters placed inside serves as a conduit for entry of bacteria whereas the imperfect drainage from catheter retains some volume of urine in the bladder providing stability to bacterial residence.
- CAUTI can develop to complications such as, orchitis, epididymitis and prostatitis in males, and pyelonephritis, cystitis and meningitis in all patients

2.3 Surgical site infections (SSI)

- SSIs are nosocomial infections that fall in 2%–5% of patients subjected to surgery.
- These are the second most common type of nosocomial infections mainly caused by *Staphylococcus aureus* resulting in prolonged hospitalization and risk of death
- The pathogens causing SSI arise from endogenous microflora of the patient.

2.4 Ventilator associated pneumonia (VAP)

- VAP is nosocomial pneumonia found in 9–27% of patients on mechanically assisted ventilator.
- It usually occurs within 48 h after tracheal intubation
- 86% of nosocomial pneumonia is associated with ventilation
- Fever, leucopenia, and bronchial sounds are common symptoms of VAP

3. Nosocomial Pathogens

- Pathogens responsible for nosocomial infections are bacteria, viruses and fungus parasites
- These microorganisms vary depending upon different patient populations, medical facilities and even difference in the environment in which the care is given

3.1. Bacteria

Some belong to natural flora of the patient and cause infection only when the immune system of the patient becomes prone to infections

- *Acinetobacter* is the genre of pathogenic bacteria responsible for infections occurring in ICUs. It is embedded in soil and water and accounts for 80% of reported infections
- *Bacteroides fragilis* is a commensal bacteria found in intestinal tract and colon. It causes infections when combined with other bacteria
- *Clostridium difficile* cause inflammation of colon leading to antibiotic-associated diarrhea and colitis, mainly due to elimination of beneficial bacteria with that of pathogenic. *C. difficile* is transmitted from an infected patient to others through healthcare staff via improper cleansed hands

3.1. Bacteria

- Enterobacteriaceae (carbapenem-resistance) cause infections if travel to other body parts from gut; where it is usually found. Enterobacteriaceae constitute Klebsiella species and *Escherichia coli*. Their high resistance towards Carbapenem causes the defense against them more difficult
- Methicillin-resistant *S. aureus* (MRSA) transmit through direct contact, open wounds and contaminated hands. It causes sepsis, pneumonia and SSI by travelling from organs or bloodstream. It is highly resistant towards antibiotics called beta-lactams

3.2. Viruses

- Usual monitoring revealed that 5% of all the nosocomial infections are because of viruses
- They can be transmitted through hand-mouth, respiratory route and fecal-oral route
- Hepatitis is the chronic disease caused by viruses. Healthcare delivery can transmit hepatitis viruses to both patients and workers.
- Hepatitis B and C are commonly transmitted through unsafe injection practices
- Other viruses include influenza, HIV, rotavirus, and herpes-simplex virus

3.3. Fungal parasites

- Fungal parasites act as opportunistic pathogens causing nosocomial infections in immune-compromised individuals
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- *Aspergillus* spp. can cause infections through environmental contamination
- *Candida albicans*, *Cryptococcus neoformans* are also responsible for infection during hospital stay
- *Candida* infections arise from patient's endogenous **microflora** while *Aspergillus* infections are caused by inhalation of **fungal spores** from contaminated air during construction or renovation of health care facility

According to the CDC

The most common **pathogens** that cause nosocomial infections are:

- Staphylococcus Aureus,
- Pseudomonas Aeruginosa, and
- E. coli

According to CDC

Some of the common nosocomial **infections** are:

1. **Urinary tract infections,**
2. **Respiratory pneumonia,**
3. **Surgical site wound infections,**
4. **Bacteremia,**
5. **Gastrointestinal and**
6. **Skin infections**

4. Epidemiology of nosocomial infections

- According to estimate reported of WHO, approximately 15% of all hospitalized patients suffer from these infections
- These infections are responsible for 4%–56% of all death causes in neonates, with incidence rate of 75% in South-East Asia and Sub-Saharan Africa
- The incidence is high enough in high income countries *i.e.* between 3.5% and 12% whereas it varies between 5.7% and 19.1% in middle and low income countries.
- The frequency of overall infections in low income countries is three times higher than in high income countries whereas this incidence is 3–20 times higher in neonates

5. Determinants

Risk factors determining nosocomial infections depends upon:

- **5.1. Environment:** Poor hygienic conditions and inadequate waste disposal from health care settings
- **5.2. Susceptibility :** Immunosuppression in the patients, prolonged stay in intensive care unit, and prolonged use of antibiotics.
- **5.3. Unawareness:** Improper use of injection techniques, poor knowledge of basic infection control measures, inappropriate use of invasive devices (catheters) and lack of control policies. In low income countries these risk factors are associated with poverty, lack of financial support, understaffed health care settings and inadequate supply of equipment

6. Reservoirs and transmission

6.1. Micro-flora of patient

- Can cause if they are transferred to tissue wound or surgical site. Gram negative bacteria in the digestive tract cause SSI after abdominal surgery.

6.2. Patient and staff

- through direct contacts with the patients (hands, saliva, other body fluids *etc.*) and by the staff through direct contact or other environmental sources (water, food, other body fluids).

6.3. Environment

- Pathogens living in the healthcare environment i.e. water, food, and equipments can be a source of transmission. Transmission to other patient makes one more reservoir for uninfected patient



7. Control & Preventive measures

7.1. Transmission from environment

7.2. Transmission from staff

7.3. Hospital waste management

7. Control & Preventive measures

7.1. Transmission from environment

- There must be policies to ensure the cleaning and use of cleaning agents on walls, floor, windows, beds, baths, toilets and other medical devices.
- Proper ventilated and fresh filtered air can eliminate airborne bacterial contamination.
- Regular check of filters and ventilation systems of general wards, operating theatres and ICUs must be maintained and documented.

7. Control & Preventive measures

7.1. Transmission from environment

- Infections attributed to water are due to failure of healthcare institutions to meet the standard criteria.
- Microbiological monitoring methods should be used for water analysis. Infected patients must be given separate baths.
- Improper food handling may cause food borne infections. The area should be cleaned and the quality of food should meet standard criteria

7. Control & Preventive measures

7.2. Transmission from staff

- It is the duty of healthcare professionals to take role in infection control.
- Personal hygiene is necessary for everyone so staff should maintain it.
- Hand decontamination is required with proper hand disinfectants after being in contact with infected patients.
- Safe injection practices and sterilized equipments should be used.
- Use of masks, gloves, head covers or a proper uniform is essential for healthcare delivery

7. Control & Preventive measures

7.3. Hospital waste management

- It act as a potential reservoir for pathogens that needs proper handling.
- 10–25% of the waste generated by healthcare facility is termed as hazardous.
- Infectious healthcare waste should be stored in the area with restricted approach.
- Waste containing high content of heavy metals and waste from surgeries, infected individuals, contaminated with blood and sputum and that of diagnostic laboratories must be disposed off separately.
- Healthcare staff and cleaners should be informed about hazards of the waste and it's proper management

8. Control program of nosocomial infections

8.1. Infection control programs

- Healthcare Institutes should devise control programs against these infections.
- Administration, workers and individuals admitted or visiting hospital must take into account such programs to play their role in prevention of infections.
- An efficient infection control program is shown in [Figure 1](#)

Standard precautions

- Hand hygiene
- Respiratory hygiene
- Personal protective equipment
- Injection safety
- Medication storage and handling
- Cleaning and disinfection (devices, environmental surfaces)
- Waste management

Transmission based precautions

- Contact precautions
- Droplet precautions
- Airborne precautions

Immunization/vaccination

Education and training of healthcare staff

9. Antimicrobial use and resistance

- Microbes are the organisms too small to be seen with the eyes, yet they are found everywhere on earth. Antimicrobial drugs are used against the microbes which are pathogenic towards living organisms. Antimicrobial resistance occurs when the microbes develop the ability to resist the effects of drugs; they are not killed and their growth does not stop.
- 9.1. Appropriate antimicrobial use
- 9.2. Antibiotic resistance
- 9.3. Antibiotic control policy

9. Antimicrobial use and resistance

9.1. Appropriate antimicrobial use

- After proper clinical diagnosis
- The selection of antimicrobials should be based upon the patient's tolerance in addition to the nature of disease and pathogen.
- The aim of antimicrobial therapy is to use a drug that is selectively active against most likely pathogen and least likely to cause resistance and adverse effects.
- Antimicrobial prophylaxis should be used when it is appropriate *i.e.* prior to surgery, to reduce postoperative incidence of surgical site infections.
- In case of immuno compromised patients, prolonged prophylaxis is used until immune markers are reinstated

9.2. Antibiotic resistance

- Drugs that were used to treat deadly diseases are now losing their impact due to emerging drug resistant microorganisms
- Self medication with antibiotics, incorrect dosage, prolonged use, lack of standards for healthcare workers and misuse in animal husbandry are the main factors responsible for increase in resistance
- Highly resistant bacteria such as MRSA or multidrug-resistant Gram-negative bacteria are the cause of high incidence rates of nosocomial infections worldwide

9.3. Antibiotic control policy

- The worldwide pandemic of antibiotic resistance shows that it is driven by **overuse** and **misuse** of antibiotics, which is a threat to prevent and cure the diseases.
- The development of new diagnostics and other tools is required in healthcare institutes to stay ahead of evolving resistance.
- Pharmacists should play their role of prescribing the right antibiotic when truly needed and
- Policymakers should foster cooperation and information among all stakeholders

Box 2: Practical methods for preventing nosocomial infection

- Hand washing: as often as possible. use of alcoholic hand spray. ...
- Stethoscope: cleaning with an alcohol swab at least daily.
- Gloves: supplement rather than replace hand washing.
- Intravenous catheter: thorough disinfection of skin before insertion.

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CDC Checklist for Core Elements of Hospital Antibiotic Stewardship Programs

The checklist (link below) is a companion to Core Elements of Hospital Antibiotic Stewardship Programs. This checklist should be used to systematically assess key elements and actions to ensure optimal antibiotic prescribing and limit overuse and misuse of antibiotics in hospitals. CDC recommends that all hospitals implement an Antibiotic Stewardship Program.

[Click here for checklist](#)

CDC - HAI Reduction and Implementation Tool Kits

The American Recovery and Reinvestment Act of 2009, Public Law 111-5 (ARRA), was signed into law on February 17, 2009. Within the Recovery Act, \$50 million was authorized to support states in the prevention and reduction of healthcare-associated infections. Many of these funds are being used to support activities outlined in the HHS Action Plan to Prevent Health Care-Associated Infections. This CDC site tracks states' efforts to meet the goals of the plan and the results can be located on the [CDC Healthcare-Associated Infections: Recovery Act site](#). CDC is assisting states in this process with implementation tool kits located at Premier's Safety Institute's [Healthcare-Associated Infection Web site](#).

- [CLABSI](#) (Catheter-related bloodstream infection)
- [C.diff](#) (Clostridium difficile infection)
- [CAUTI](#) (Catheter-related urinary tract infections)