

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
وَبِهِ نَسْتَعِينُ

HANAN FOUDAH



Hospital Acquired Infection (HAI)

Introduction

Hospital-Acquired Infections (HAI) continue to be a source of great medical and economical strain for clinics and facilities across the world. A hospital-acquired infection— also called “nosocomial infection (NI) ” can be defined as:

- An infection acquired in hospital by a patient who was admitted for a reason other than that infection.
- An infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission.

Characteristic of HAI

For a HAI, the infection must occur:

- Up to 48 hours after hospital admission
- Up to 3 days after discharge
- Up to 30 days after an operation
- In a healthcare facility when someone was admitted for reasons other than the infection
- Ideally, it should be less than 1-2%

HAI Rate

Hospital Acquired Infection = i / d

Hospital Acquired Infection Rate = $(i / d) \times 100$

Where, i = Total Number of Hospital Infections

d = Total Number of Discharges (Including Deaths)

$$\text{Hospital Acquired Infection Rate} = \frac{\text{Total number of Hospital Infection in a given period}}{\text{Total number of discharges (Including deaths) during that given period}} \times 100$$

Frequency of HAI

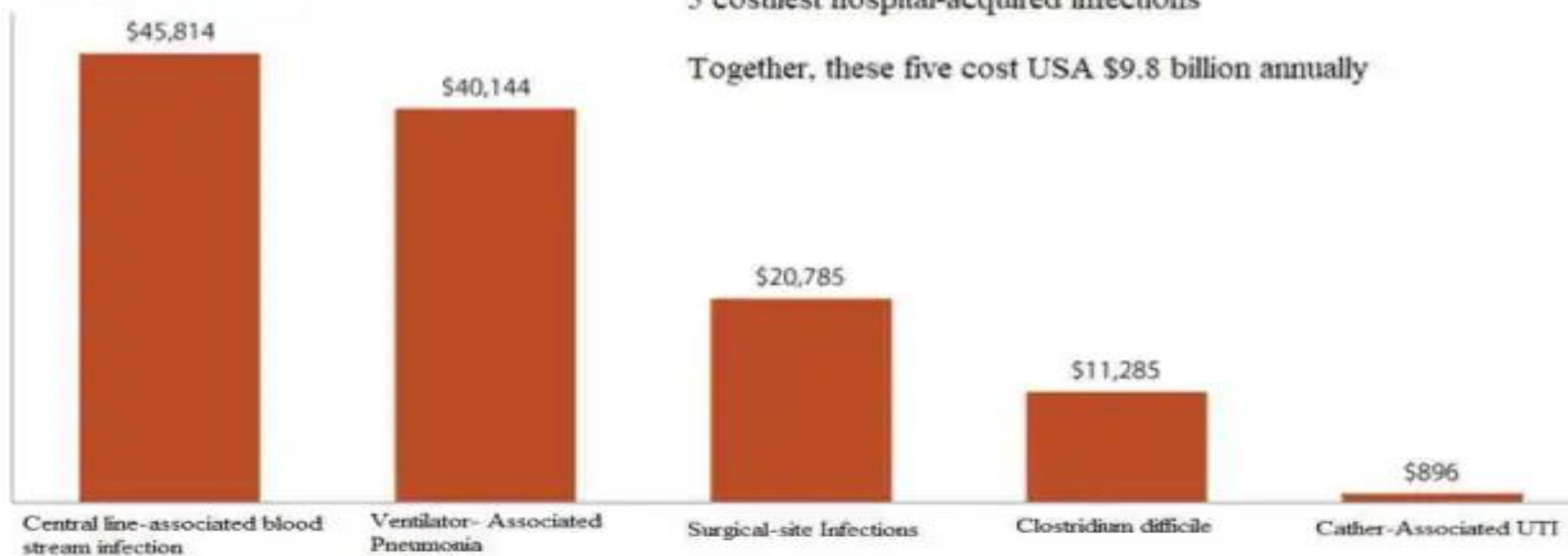
A prevalence survey conducted by WHO in 55 hospitals of 14 countries representing 4 WHO Regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections.

The highest frequencies of nosocomial infections were reported from hospitals in the Eastern Mediterranean and South-East Asia Regions (11.8 and 10.0% respectively).

Impact of nosocomial infections

- Hospital-acquired infections add to functional disability and emotional stress of the patient and may, in some cases, lead to disabling conditions that reduce the quality of life.
- The increased length of stay for infected patients is the greatest contributor to cost. One study showed that the overall increase in the duration of hospitalization for patients with surgical wound infections was 8.2 days.
- The increased use of drugs, the need for isolation, and the use of additional laboratory and other diagnostic studies also contribute to costs.
- Organisms causing nosocomial infections can be transmitted to the community through discharged patients, staff, and visitors.
- In severe cases (eg, Septicaemia), it may lead to death.

Average cost per case



5 costliest hospital-acquired infections

Together, these five cost USA \$9.8 billion annually

The Cost of HAIs (In USA)

The Center for Disease Control (CDC) estimates that there are *2 million cases of HAI per year*.

**ACCOUNT FOR ROUGHLY
TWO THIRDS OF ALL HAIs.**



central line-associated bloodstream infections
catheter-associated urinary tract infections
ventilator-associated pneumonia

Of these 2 million HAI cases, the CDC estimates *20,000 patients die* from HAI complications.

The cost of HAI (In UK)

- ▲ In 2007 approximately 9,000 people died with MRSA bloodstream infections or Clostridium difficile infections as the underlying cause or a contributory factor
- ▲ Department of Health estimated there were 300,000 HAIs in 2004
- ▲ Between 8 and 9% of patients acquire an infection while in UK health services care
- ▲ HAIs cost the NHS approx £1 billion per year
- ▲ The average cost of a single infection is approximately £3,000
- ▲ On average a patient spends 11 days longer in hospital if they acquire a HAI
- ▲ Department of Health estimates 15-30% of HAIs are preventable

Types of HAI (By Methods of Transmission)

Contact Transmission

- Direct Contact Transmission
- Indirect Contact Transmission

Droplet Transmission

Common Vehicle Transmission

Vector Borne Transmission

Blood borne spread

Self Infections and Cross infections

Common Causes
of Hospital Acquired Infection

Urinary bladder catheterization

Surgery and wound

Intravenous (IV) procedures

Biomedical waste

Lack of Awareness

Medical Devices

Lack of Hand-Wash Practices

Inappropriate House-Keeping

Inappropriate use of Antibiotics

Too much visitors (Over Crowding)

Potential causes contributing to the occurrence of HAI

Poor knowledge and application of basic infection control measures

Overcrowding

Inefficient implementation of policies and procedures across the hospital

Insufficient knowledge about blood transfusion safety

Needles stick injuries/blood and fluid exposure (mucocutaneous occupational exposures in health-care workers)

Inadequate environmental hygienic conditions and waste disposal

Poor hand hygiene practices adopted by the health-care workers

Factors contributing to health-care workers' poor adherence to hand hygiene

Lack of knowledge on guidelines/protocols

Busy/insufficient time

Sinks are inconveniently located/shortage of sinks

Lack of soap and paper towels

Understaffing/overstaffing

Lack of scientific information regarding the definitive impact of improved hand hygiene on health care-associated infection rate

Wearing gloves with a belief that glove use obviates the need for hand hygiene

Factors influencing the development of HAI

1. The microbial agent

- Contact between the patient and a microorganism.
- The likelihood of exposure leading to infection depends partly on the characteristics of the microorganisms, including resistance to antimicrobial agents, intrinsic virulence, and amount (inoculum) of infective material.
- Infections may be caused by a microorganism acquired from another
 - person in the hospital (cross-infection) or may be caused by the patient's own flora (endogenous infection).
- Most infections acquired in hospital today are caused by microorganisms which are common in the general population, in whom they cause no or milder disease than among hospital patients (*Staphylococcus aureus*, coagulase-negative staphylococci, enterococci, Enterobacteriaceae).

Organisms responsible for human infection

Organisms	Percentage
E.coli	20%
Staphylococcus aureus	11%
Other staphylococci	11%
Pseudomonas	9%
Klebsiella	9%
Proteus	8%
Others/Mixed	32%

Organisms commonly involved in HAI

Types of Infections	Organisms involved
UTI	E Coli, Proteus spp, Klebsiella spp, Pseudomonus Aeruginosa, Enterococcus spp, etc
RTI	H influenza, S. pneumoniae S. aureus Enterobacteriaceae virus, Fungus, eg, Candida and Aspergillus spp etc
Wound and Skin sepsis	S. aureus (MSSA), Methicillin Resistant S. aureus (MRSA), Staph pyogens, Coagulase negative Staphylococci, E. coli, Proteus spp etc
Blood Stream Infection (BSI)	S. aureus, MRSA, Enterococci, Coagulase negative S. aureus, Proteus spp, Klebsiella spp, Serretia spp, P. aeruginosa, fungi like Candida spp.
GIT Infection	C. difficile, Shigella spp, Salmonella spp, and viruses like Norovirus

2. Patient susceptibility

- Important patient factors influencing acquisition of infection include age, immune status, underlying disease, and diagnostic and therapeutic interventions.
- The extremes of life: Infancy and old age, are associated with a decreased resistance to infection.
- Patients with chronic disease such as severe anaemia, malignant tumours, leukaemia, diabetes mellitus, renal failure, or AIDS have an increased susceptibility to infections with opportunistic pathogens.
- Immunosuppressive drugs or irradiation may lower resistance to infection.
- Injuries to skin or mucous membranes bypass natural defence mechanisms.
- Malnutrition.
- Many modern diagnostic and therapeutic procedures, (eg, catheterization, intubation/ventilation and suction and surgical procedures, etc).

3. Environmental factors

- Health care settings are an environment where both infected persons and 'persons at increased risk of infection' congregate.
- Crowded conditions within the hospital, frequent transfers of patients from one unit to another, and concentration of patients highly susceptible to infection in one area (e.g. newborn infants, burn patients, intensive care) all contribute to the development of nosocomial infections.
- Microbial flora may contaminate objects, devices, and materials which subsequently contact susceptible body sites of patients.
- Lack of House-keeping services.
- Inappropriate building design and ventilation.

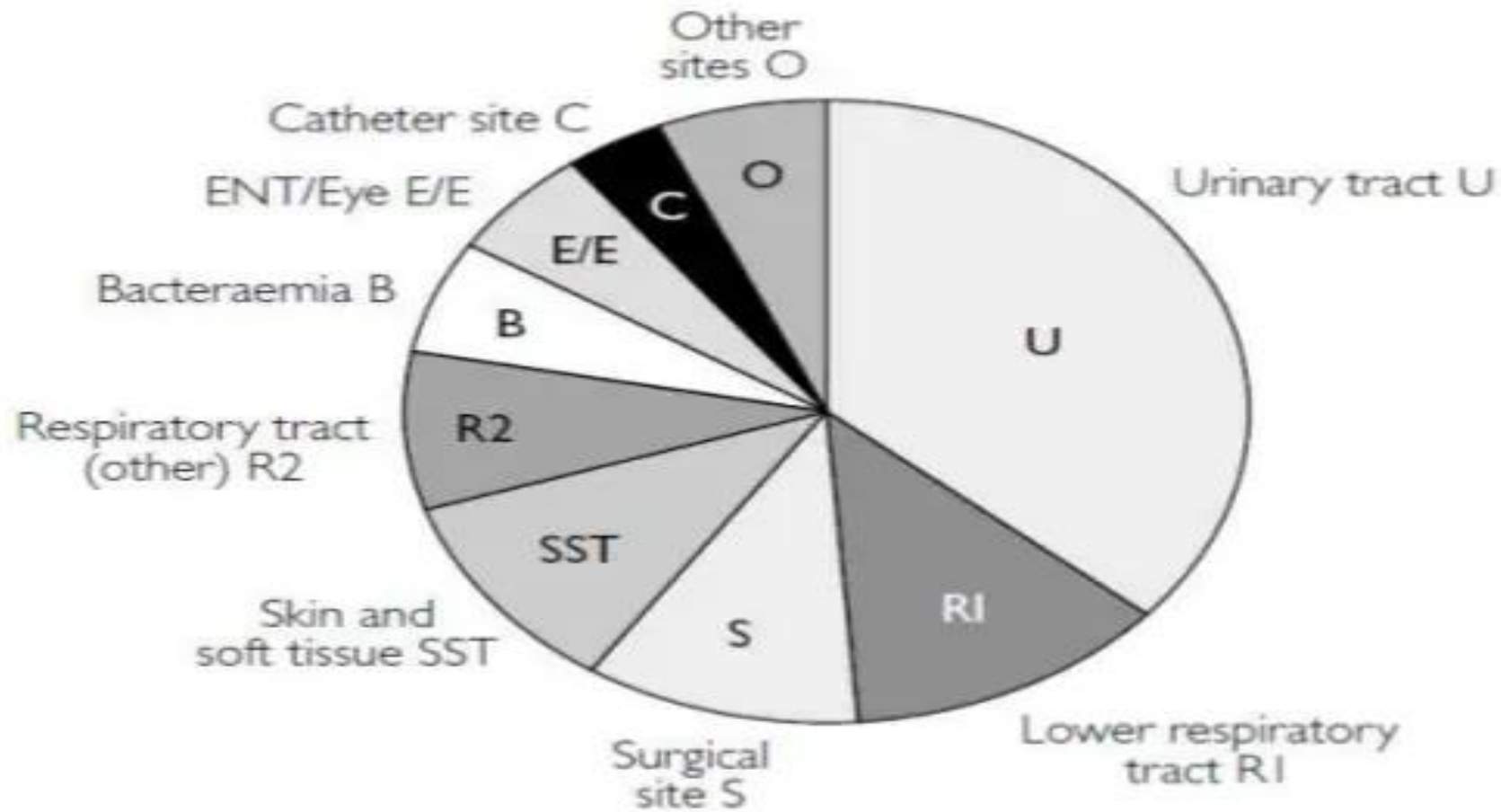
4. Bacterial resistance

- The widespread use of antimicrobials for therapy or prophylaxis (including topical) is the major determinant of resistance.
- Many strains of pneumococci, staphylococci, enterococci, and tuberculosis are currently resistant to most or all antimicrobials which were once effective.
- Multi-resistant *Klebsiella* and *Pseudomonas aeruginosa* are prevalent in many hospitals.

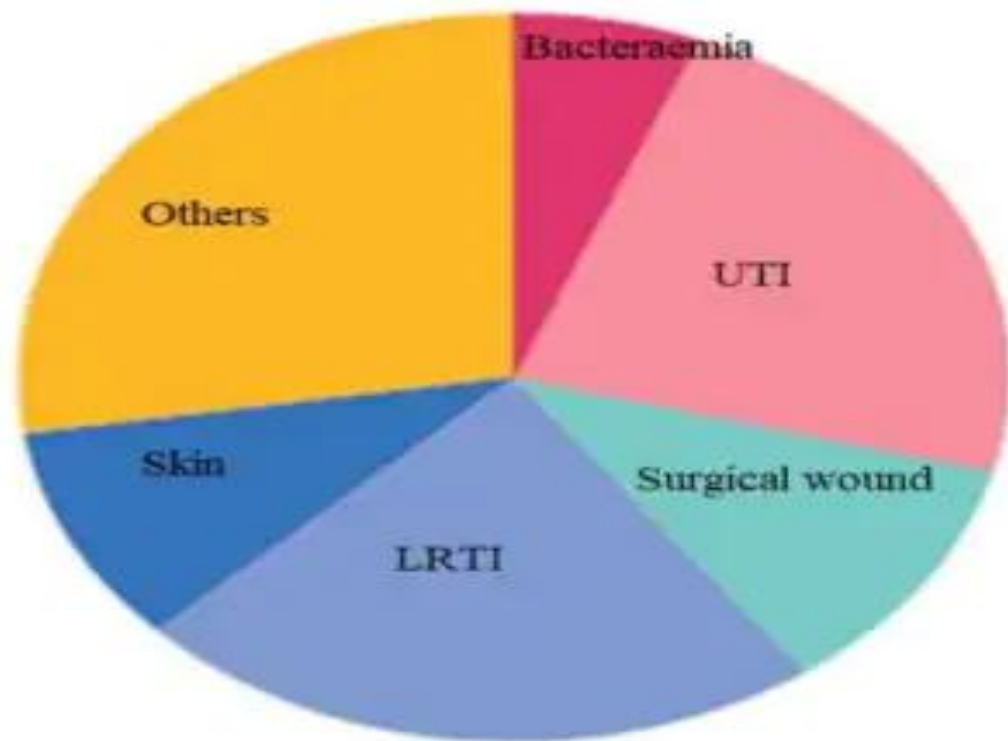
Antibiotic Resistant Organisms in HAI:

- MRSA: Methicillin Resistant *S. aureus*
- VRE: Vancomycin Resistant Enterococci
- ESBL: Extended Spectrum Beta-Lactamase Producing *E. coli*/
Klebsiella

Nosocomial infection sites



Prevalence of infection as per site



■ Bacteraemia	6.2%
■ UTI	23.2%
■ Surgical Wound	10.7%
■ LRTI	22.9%
■ Skin	9.6%
■ Other	27.4%

Urinary infections

- This is the most common nosocomial infection; 80% of infections are associated with the use of an indwelling bladder catheter.
- Infections are usually defined by microbiological criteria: positive quantitative urine culture ($\geq 10^5$ microorganisms/ml).
- The bacteria responsible arise from the gut flora, either normal (*Escherichia coli*) or acquired in hospital (multi-resistant *Klebsiella*).

Surgical site infections

- Surgical site infections are also frequent: the incidence varies from 0.5 to 15% depending on the type of operation and underlying patient status.
- The impact on hospital costs and postoperative length of stay (between 3 and 20 additional days) is considerable.
- The infecting microorganisms are variable, depending on:
 - Type and location of surgery,
 - Antimicrobials received by the patient.
 - Extent of contamination during the procedure (clean, clean-contaminated, contaminated, dirty),
 - Length of the operation
 - Patient's general condition
 - Quality of surgical technique
 - Presence of foreign bodies including drains
 - Virulence of the microorganisms, concomitant infection at other sites
 - Use of preoperative shaving, and
 - Experience of the surgical team

Nosocomial pneumonia (Respiratory tract)

- The most important are patients on ventilators in intensive care units, where the rate of pneumonia is 3% per day.
- High case fatality rate associated with ventilator-associated pneumonia; they are often endogenous (digestive system or nose and throat), but may be exogenous, often from contaminated respiratory equipment.
- Patients with seizures or decreased level of consciousness are at risk for nosocomial infection, even if not intubated.
- Viral bronchiolitis (respiratory syncytial virus, RSV) is common in children's units, and influenza and secondary bacterial pneumonia may occur in institutions for the elderly.
- With highly immuno-compromised patients, *Legionella* spp. And *Aspergillus* pneumonia may occur.
- In countries with a high prevalence of tuberculosis, particularly multi-resistant strains.

Nosocomial bacteraemia (Blood stream)

- Approximately 5%, but case-fatality rates are high — more than 50% for some microorganisms.
- Incidence is increasing, particularly for certain organisms such as multi-resistant coagulase-negative *Staphylococcus* and *Candida* spp.

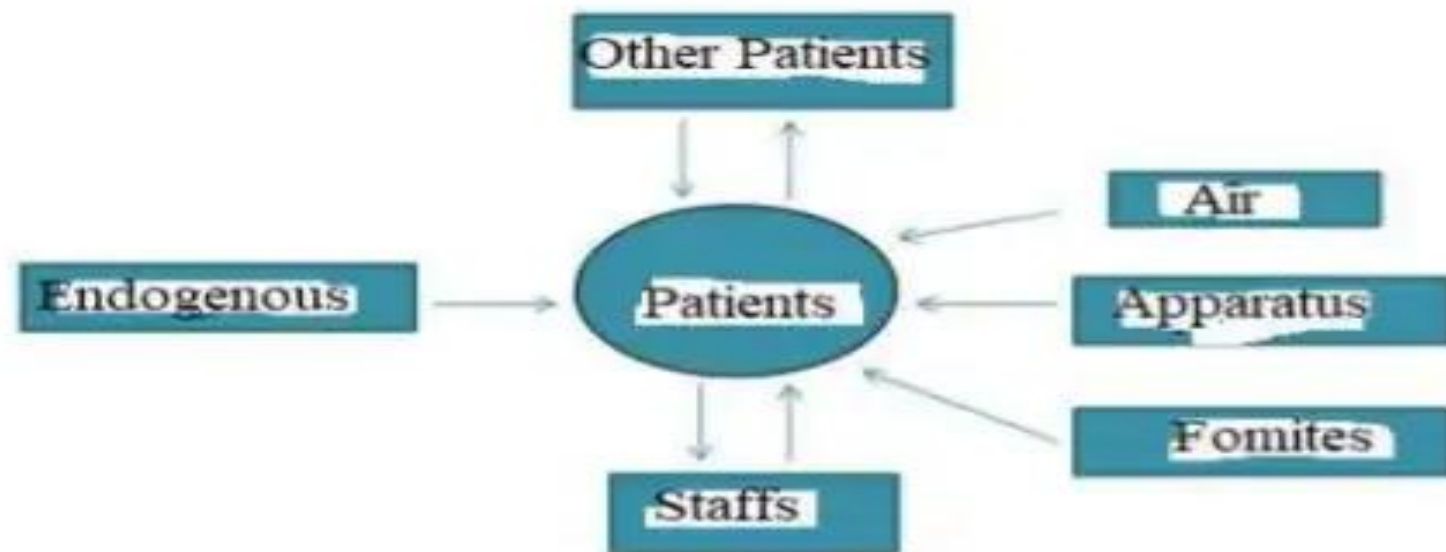
Other nosocomial infections (Skin and others)

- Skin and soft tissue infections: Open sores (ulcers, burns and bedsores)
- Gastroenteritis is the most common nosocomial infection in children, where rotavirus is a chief pathogen: *Clostridium difficile* is the major cause of nosocomia.
- Endometritis and other infections of the reproductive organs following childbirth.

HOSPITAL INFECTION – PRINCIPAL PATHOGENS

Bacteria	–	<i>Staphylococcus aureus</i> <i>Pseudomonas aeruginosa</i> <i>Streptococcus pyogenes</i> <i>Micrococcus</i> <i>Enterobacteriaceae</i> <i>Bacteroides</i> <i>Flavobacterium</i> species
Virus	–	Hepatitis B virus Cytomegalovirus Respiratory syncytial virus
Fungi	–	<i>Candida albicans</i> <i>Aspergillus</i> Saprophytic fungi
Parasite	–	<i>Sarcoptes Scabies</i>

Sources of Infection



HIGH INFECTION RISK AREAS IN THE HOSPITAL

Area	Predisposing factor	Type of infection
Intensive Care Unit	Patients with poor general resistance requiring intensive handling and instrumentation, mechanical ventilation, tracheostomy, catheterization and intravenous infusions.	Lower respiratory tract infection Urinary tract infection Local wound infection Infected drip sites Septicaemia
Burns Units	Lowered local resistance due to loss of skin and presence of necrotic tissue.	Superficial infection resulting in graft rejection Gram-negative septicaemia
Urological and Renal Dialysis Units	Catheterization, Peritoneal dialysis Use of kidney machines	Urinary tract infection, peritonitis, hepatitis
Premature Baby Unit	Poorly developed immune response	Skin infection, meningitis, septicaemia

Cancer Ward.
Operation Theatre.
Delivery Rooms.