

# Nosocomial Infections



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# Definition

**Also called “hospital acquired infection” can be defined as: An infection acquired in hospital by a patient who was admitted for a reason other than that infection.**

**Also can be define: the 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. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility.**

# **Frequency of infection**

- **Nosocomial infections occur worldwide and affect both developed and resource-poor countries.**
- **Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients.**
- **They are a significant burden both for the patient and for public health.**

- The most frequent nosocomial infections are infections of surgical wounds, urinary tract infections and lower respiratory tract infections.
- The WHO study, and others, has also shown that the highest prevalence of nosocomial infections occurs in intensive care units and in acute surgical and orthopedic wards.
- Infection rates are higher among patients with increased susceptibility because of old age, underlying disease, or chemotherapy.

# **Factors influencing the development of nosocomial infections**

## **A- The microbial agent**

- **The patient is exposed to a variety of microorganisms during hospitalization. Contact between the patient and a microorganism does not by itself necessarily result in the development of clinical disease**
- **The likelihood of exposure leading to infection depends partly on the characteristics of the microorganisms, including**
  - \*Resistance to antimicrobial agents**
  - \*Intrinsic virulence**
  - \*Amount of infective material.**

- Many different **bacteria, viruses, fungi and parasites** may cause nosocomial infections.
- 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**).
- Some organisms may be **acquired from an inanimate object or substances** recently contaminated from **another human source** (**environmental 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** like:  
(Staphylococcus aureus, coagulase-negative staphylococci, enterococci, Enterobacteriaceae).

## **B- Patient susceptibility**

**Important patient factors influencing acquisition of infection include**

- 1- Age: infancy and old age are associated with a decreased resistance to infection.**
  
- 2- Immune status:**
  - **patients with acquired immunodeficiency syndrome (AIDS) have an increased susceptibility to infections with opportunistic pathogens.**
  - **Immunosuppressive drugs or irradiation may also lower resistance to infection**
  
- 3- Chronic diseases: Patients with chronic disease such as malignant tumours  
leukaemia  
diabetes mellitus  
renal failure are more affected than other**

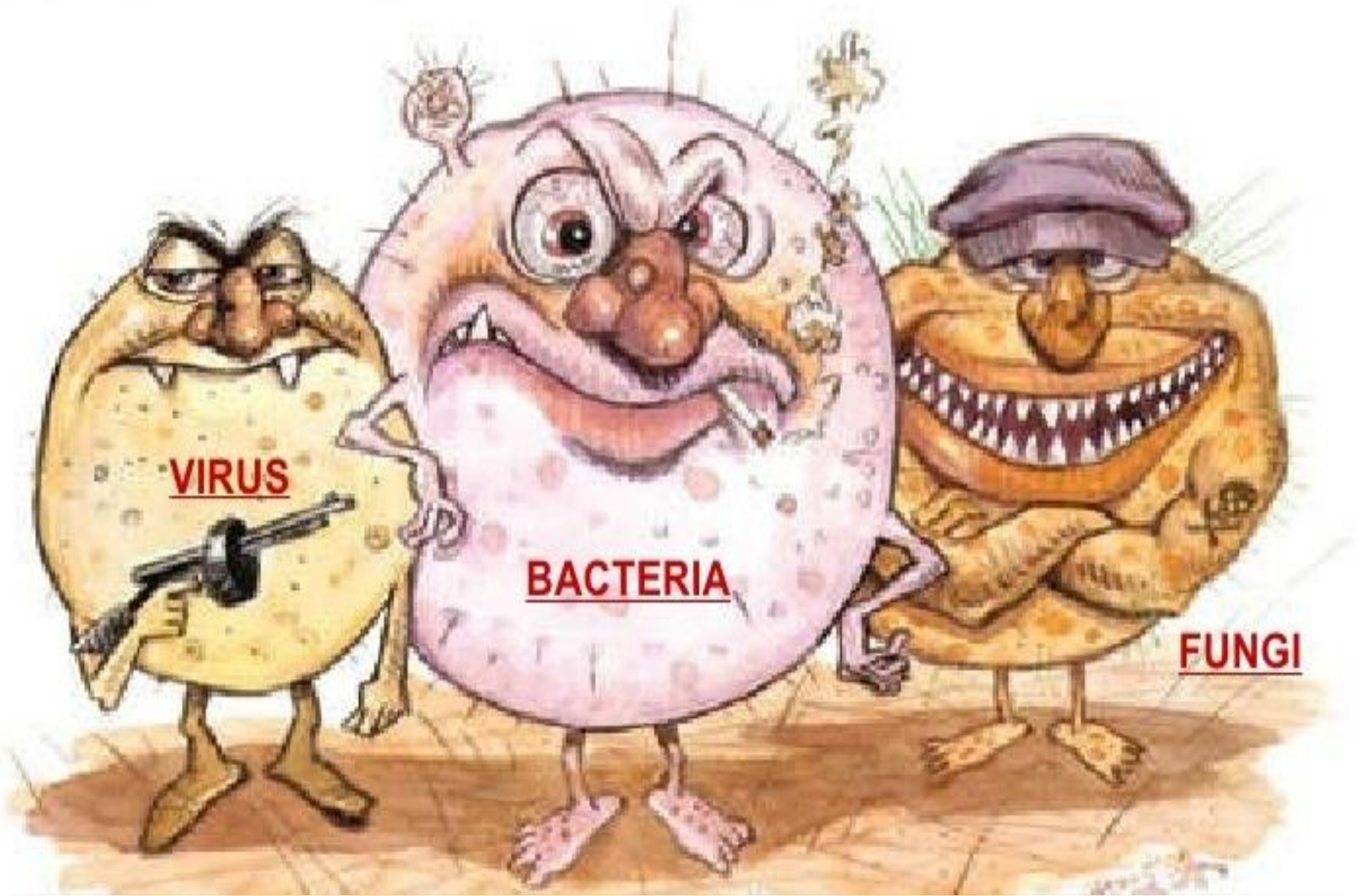
## C- Environmental factors

- Health care settings are an environment where both **infected persons** and **persons at increased risk of infection** congregate.
- Patients with infections or **carriers of pathogenic microorganisms** admitted to hospital are potential sources of infection to the patients and staff.
- Patients who become infected in the hospital are a further source of infection.
- 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.



## D- Bacterial resistance

- Many patients receive antimicrobial drugs. Through selection and exchange of genetic resistance elements, antibiotics promote the emergence of multi drugresistant strains of bacteria
- Microorganisms in the normal human flora sensitive to the given drug are suppressed, while resistant strains persist and may become endemic in the hospital.



**Microorganisms cause nosocomial infection**

# 1- Bacteria

These are the most common nosocomial pathogens. A distinction may be made between

## A- Commensal bacteria

- found in normal flora of healthy humans.
- These have a significant protective role by preventing colonization by pathogenic microorganisms.
- Some commensally bacteria may cause infection if the natural host is compromised immune response.
- For example, cutaneous coagulase-negative staphylococci cause intravascular line infection and intestinal *Escherichia coli* are the most common cause of urinary infection.

## **B- Pathogenic bacteria:**

**have greater virulence**, and cause infections (sporadic or epidemic) regardless of host status. For example:

### **1- Anaerobic Gram-positive rods**

(e.g. Clostridium) cause gangrene.

### **2- Gram-positive bacteria:**

*Staphylococcus aureus* (cutaneous bacteria that colonize the skin and nose of both hospital staff and patients) cause a wide variety of **lung, bone, heart and bloodstream** infections and are frequently **resistant to antibiotics**.

### **3- Gram-negative bacteria:**

**Enterobacteriaceae (e.g. Escherichia coli, Proteus, Klebsiella, Enterobacter, Serratia marcescens), may colonize sites when the host defenses are compromised (catheter insertion, bladder catheter, cannula insertion) and cause serious infections (surgical site, lung, bacteraemia, peritoneum infection). They may also be highly resistant.**

### **4- Gram-negative organisms**

**such as Pseudomonas spp. are often isolated in water and damp areas. They may colonize the digestive tract of hospitalized patients.**

## 2- Viruses

There is the possibility of nosocomial transmission of many viruses, including:

- **Hepatitis B and C viruses (transfusions, dialysis, injections, endoscopy)**
- **Respiratory syncytial virus (RSV), rotavirus, and enteroviruses (transmitted by hand-to-mouth contact and via the faecal-oral route).**
- **Other viruses such as cytomegalovirus, HIV, Ebola, influenza viruses, herpes simplex virus, and varicella-zoster virus, may also be transmitted.**

### 3- Parasites and fungi

- Some parasites (e.g. *Giardia lamblia*) are transmitted easily among adults or children.
- Many fungi and other parasites are opportunistic organisms and cause infections during extended antibiotic treatment and severe immunosuppression (*Candida albicans*, *Aspergillus spp.*, *Cryptococcus neoformans*, *Cryptosporidium*).
- These are a major cause of systemic infections among immunocompromised patients.
- Environmental contamination by airborne organisms such as *Aspergillus spp.* which originate in **dust and soil** is also a concern, especially during hospital construction.

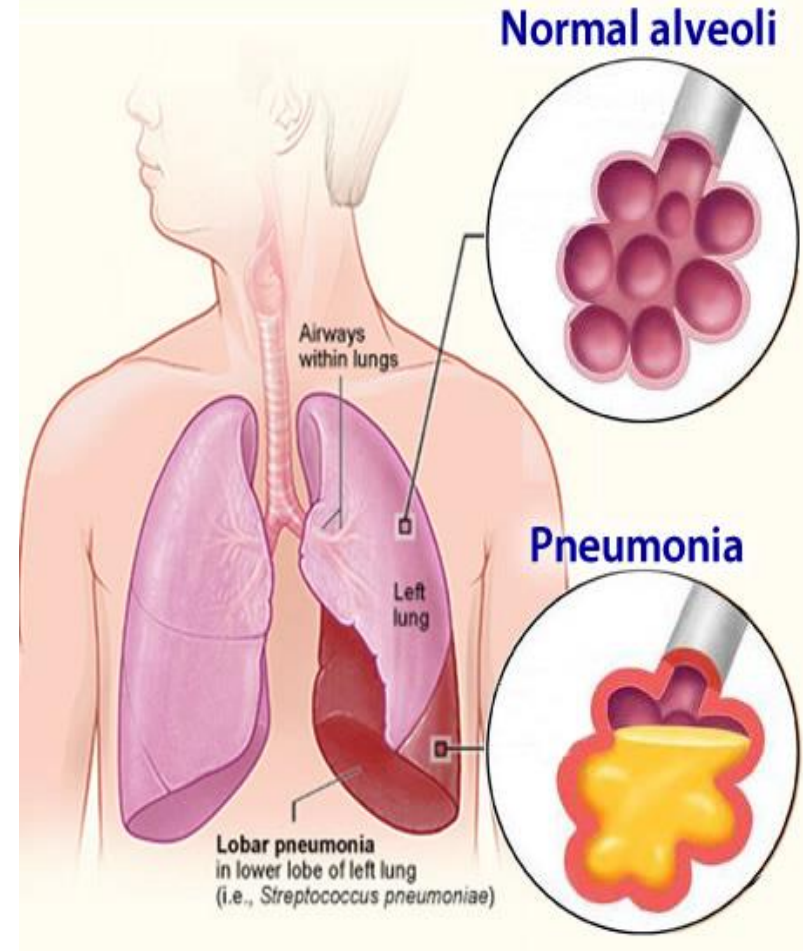
Bacteria	fungi	viruses	parasites
<p><i>Clostridium</i></p> <p><i>Staphylococcus spp.</i></p> <p><i>Escherichia coli</i></p> <p><i>Proteus</i></p> <p><i>Klebsiella spp.</i></p> <p><i>Enterobacter sp</i></p> <p><i>Pseudomonas spp</i></p>	<p><i>Candida albicans</i></p> <p><i>Aspergillus spp</i></p> <p><i>Cryptococcus</i></p> <p><i>Cryptosporidium</i></p>	<p><i>Respiratory syncytial viruses</i></p> <p><i>Rotaviruses</i></p> <p><i>Enteroviruses</i></p> <p><i>Cytomegalovirus</i></p> <p><i>HIV</i></p> <p><i>Ebola</i></p> <p><i>Influenza</i></p> <p><i>Herpes simplex</i></p> <p><i>Varicella-zoster virus</i></p>	<p><i>Giardia lamblia</i></p> <p><i>Entamoeba histolytica</i></p>



# Nosocomial infection sites

## 1- Nosocomial pneumonia

- The most important are patients on ventilators in intensive care units, where the rate of pneumonia is 3% per day.
- Microorganisms colonize the stomach, upper airway and bronchi, and cause infection in the lungs (pneumonia):





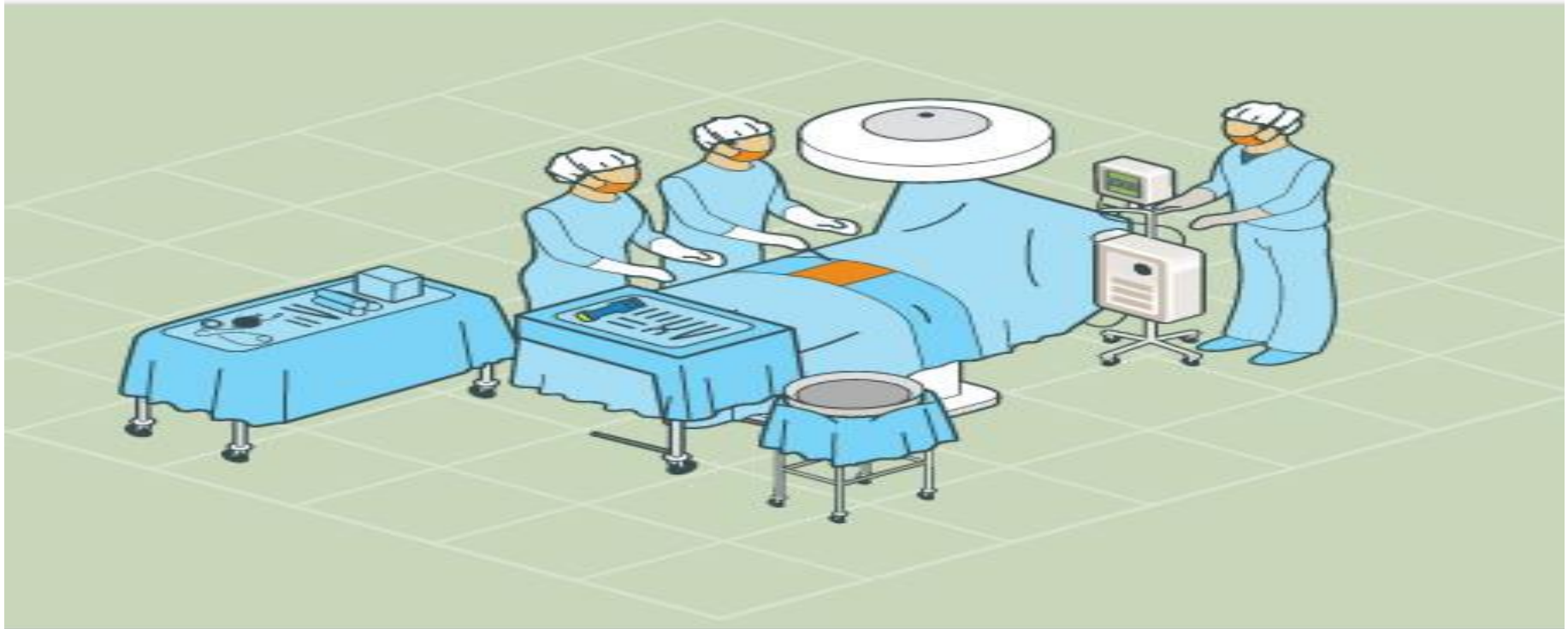
## 2- Urinary infections

- This is the most common nosocomial infection; 80% of infections are associated with the use of an indwelling **bladder catheter**
- Urinary infections are associated with less morbidity than other nosocomial infections, but can occasionally lead to bacteraemia and death



### 3- 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**



## 4- Nosocomial bacteraemia

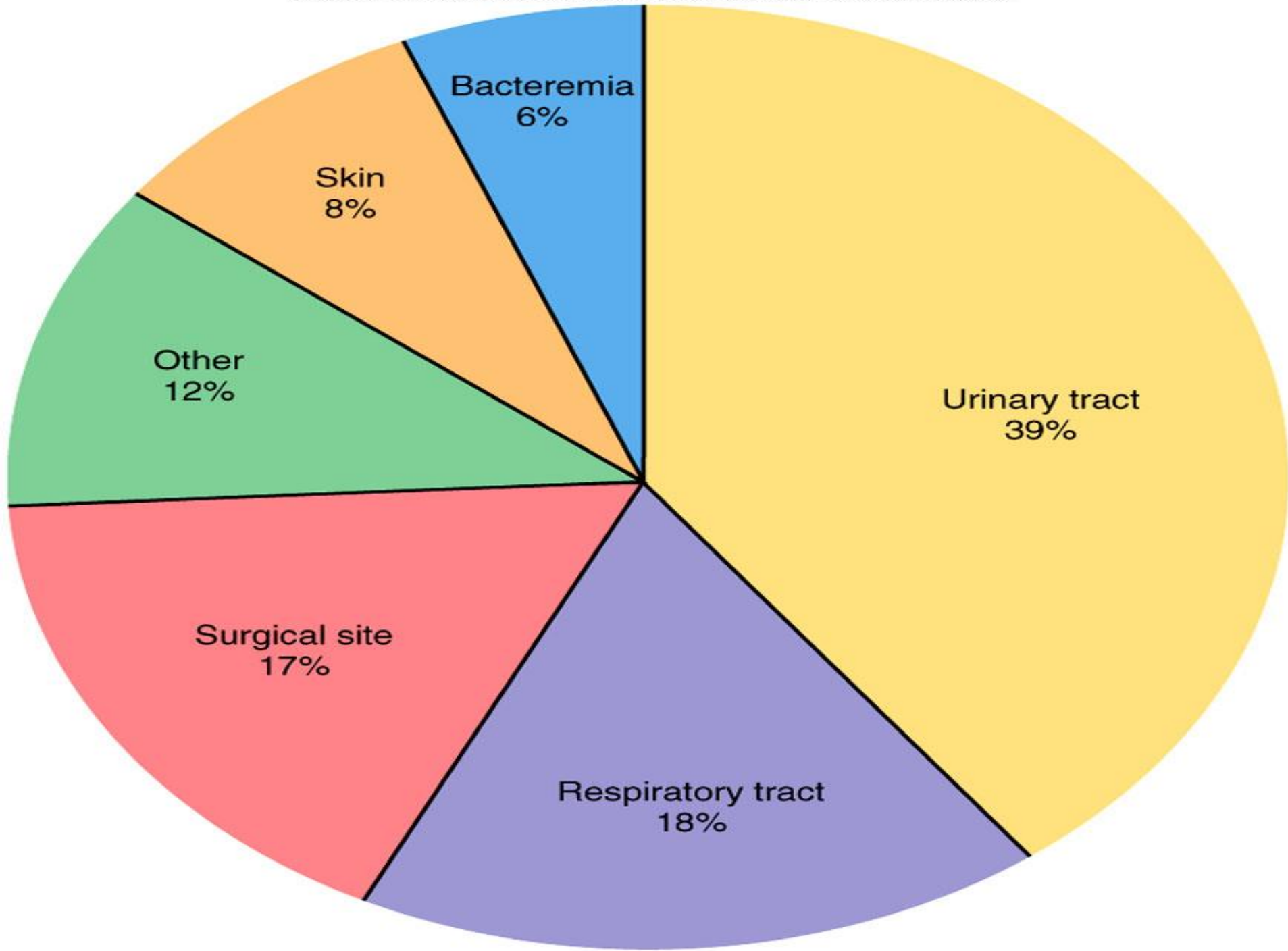
- These infections represent a small proportion of nosocomial infections (approximately 5%) but case fatality rates are high — more than 50% for some microorganisms.
- The incidence is increasing, particularly for certain organisms such as multiresistant coagulase-negative *Staphylococcus* and *Candida* spp.
- Infection may occur at the skin entry site of **the intravascular device, or in the subcutaneous path of the catheter** (tunnel infection).

## 5- Other nosocomial infections

These are the four most frequent and important nosocomial infections, but there are many other potential sites of infection.

For example:

- Skin and soft tissue infections: open sores (ulcers, burns and bedsores) encourage bacterial colonization and may lead to systemic infection.
- Gastroenteritis is the most common nosocomial infection in children, where rotavirus is a chief pathogen: Clostridium difficile is the major cause of nosocomial gastroenteritis in adults in developed countries.
- Sinusitis and other enteric infections, infections of the eye and conjunctiva.
- Endometritis and other infections of the reproductive organs following childbirth.



# Simplified criteria for surveillance of nosocomial infection

Types of nosocomial infection	Simplified criteria
Surgical site infection	Any purulent discharge, abscess, or spreading cellulitis at the surgical site during the month after the operation
Urinary infection	Positive urine culture (1 or 2 species) with at least 10 <sup>5</sup> bacteria/ml, with or without clinical symptoms
Respiratory infection	Respiratory symptoms with at least two of the following signs appearing during hospitalization: <ul style="list-style-type: none"> <li>— cough</li> <li>— purulent sputum</li> <li>— new infiltrate on chest radiograph consistent with infection</li> </ul>
Vascular catheter infection	Inflammation, lymphangitis or infection purulent discharge at the insertion site of the catheter
Septicaemia\ bacteraemia	Fever or rigours and at least one positive blood culture

# **Sources and transmission of nosocomial infection**

- 1- Skin**
- 2- Nasal tract**
- 3- Air**
- 4- Stool**
- 5- Clothes**
- 6- Workers and staff**
- 7- Pathogenic discharges and clinical sample of patients**
- 8- Water cycle of hospital**
- 9- All used instrument**
- 10- Operating room environment**



# Mode of transmission of nosocomial infection

There are three mode for transmission

- 1- **Direct contamination from the doctor and his staff**
- 2- **Contamination from air**
- 3- **Contamination from contaminated surgical tools.**



# Duration of transmission

- 1- If the infection appeared within 7 days of operation and deep, this means the contamination occurred inside the operation period.**
- 2- If the infection appeared after 7 days of operation and superficial, this means the contamination occurred outside the operation period.**

## **Problems affecting nosocomial infection**

- Resistant of microorganism to drug and chemicals**
- State of patients**
- Dose of drugs used for treatment.**

# Role of the nursing staff

Implementation of patient care practices *for infection control is the role of the nursing staff*. Nurses should be familiar with practices to prevent the occurrence and spread of infection, and maintain appropriate practices for all patients throughout the duration of their hospital stay.

## The senior nursing administrator is responsible for

- participating in the Infection Control Committee
- promoting the development and improvement of nursing techniques
- developing training programmes for members of the nursing staff
- supervising the implementation of techniques for the prevention of infections in specialized areas such as the operating suite, the intensive care unit, the maternity unit and newborns

# The nurse in charge of a ward is responsible for

- maintaining hygiene
- monitoring aseptic techniques, including hand washing and use of isolation
- reporting promptly to the attending physician any evidence of infection in patients under the nurse's care
- initiating patient isolation and ordering culture specimens from any patient showing signs of a communicable disease, when the physician is not immediately available
- limiting patient exposure to infections from visitors, hospital staff, other patients, or equipment used for diagnosis or treatment
- maintaining a safe and adequate supply of ward equipment, drugs and patient care supplies.

**The nurse in charge of infection control is a member of the infection control team and responsible for:**

- **Identifying nosocomial infections**
- **Investigation of the type of infection and infecting organism**
- **Participating in training of personnel**
- **Surveillance of hospital infections**
- **Participating in outbreak investigation**
- **Ensuring compliance with local and national regulations**
- **Liaison with public health and with other facilities where appropriate**
- **providing expert consultative advice to staff health and other appropriate hospital programmes in matters relating to transmission of infections.**