



Hospital-acquired Infections - Trends Across Europe

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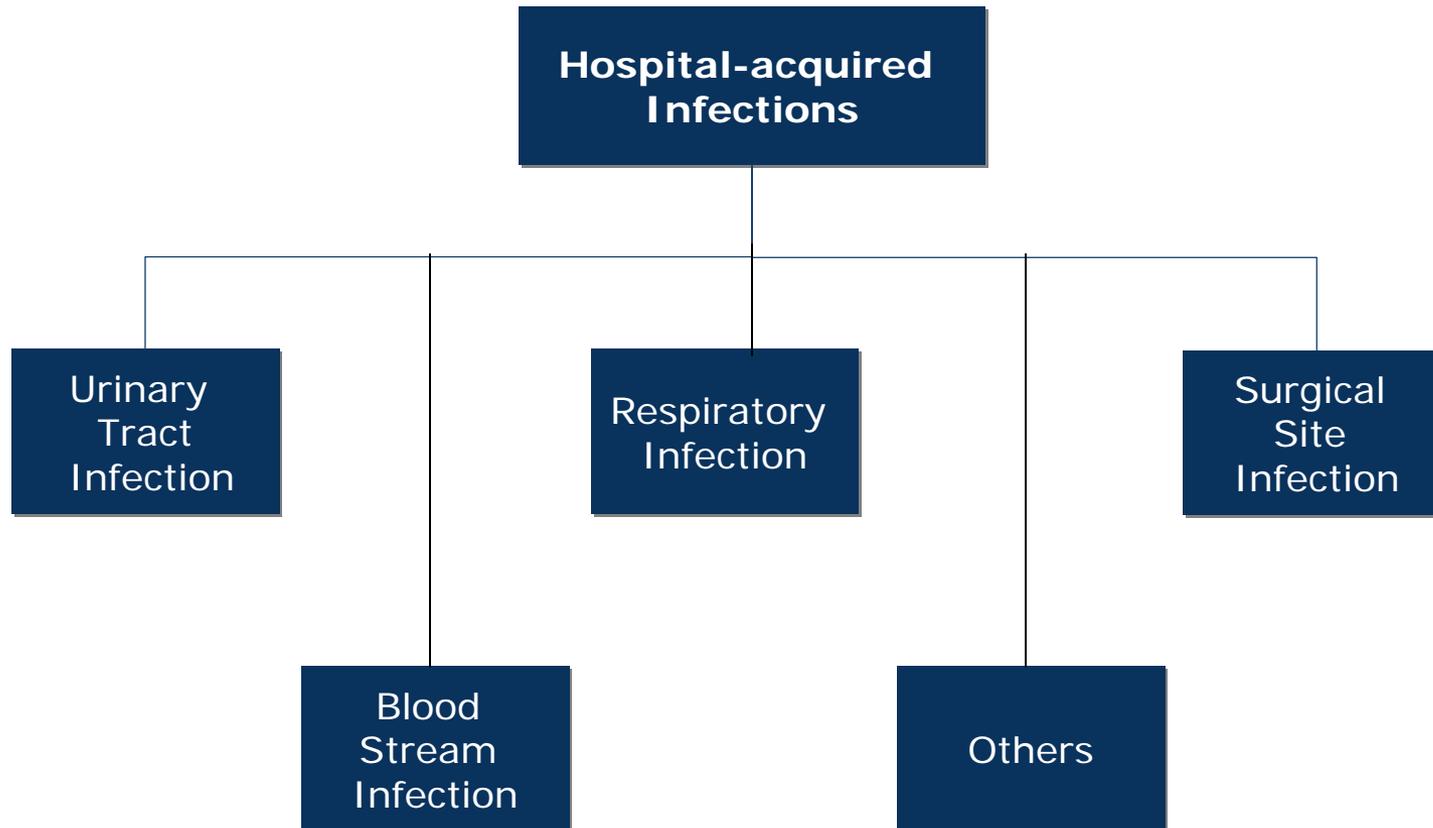
Introduction to Hospital-acquired Infections



Hospital-acquired Infections: An Introduction

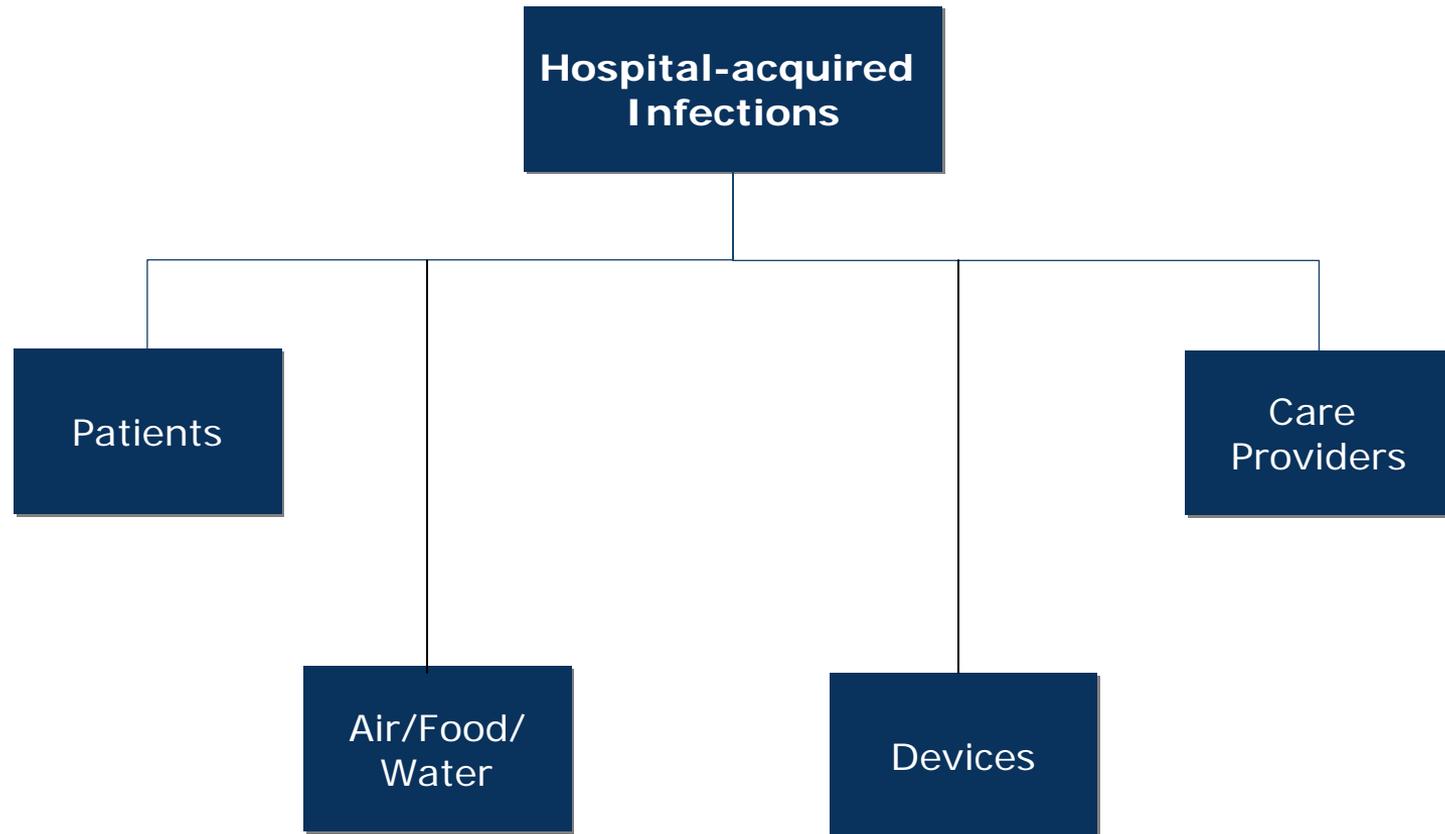
- Hospital-acquired infection (HAI) or nosocomial infection is a term coined to define an infection acquired in hospital by a patient, who was admitted for a reason other than that infection, and in whom the infection was not present or incubating at the time of admission. These infections also include those that surface after being discharged from hospital.
- The term 'healthcare associated infection' is defined as any infectious agent acquired either as a consequence of a person's treatment by healthcare providers or by healthcare workers in the course of their duties. These healthcare associated infections are often identified in a hospital setting, but can also be associated with healthcare services delivered in the community.
- These infections lead to increases in duration of hospital stay and costs, and cause a range of symptoms, from minor discomfort to prolonged or permanent disability, and in some cases death. Patients who are at the highest risk of acquiring an infection are the old, very young and patients with weakened immune systems.
- Infections caused may be due to bacteria or other microorganisms. It may spread through air, food, blood, contact and so on.

Hospital-acquired Infections Classification



Note: Others include gastrointestinal infections and so on

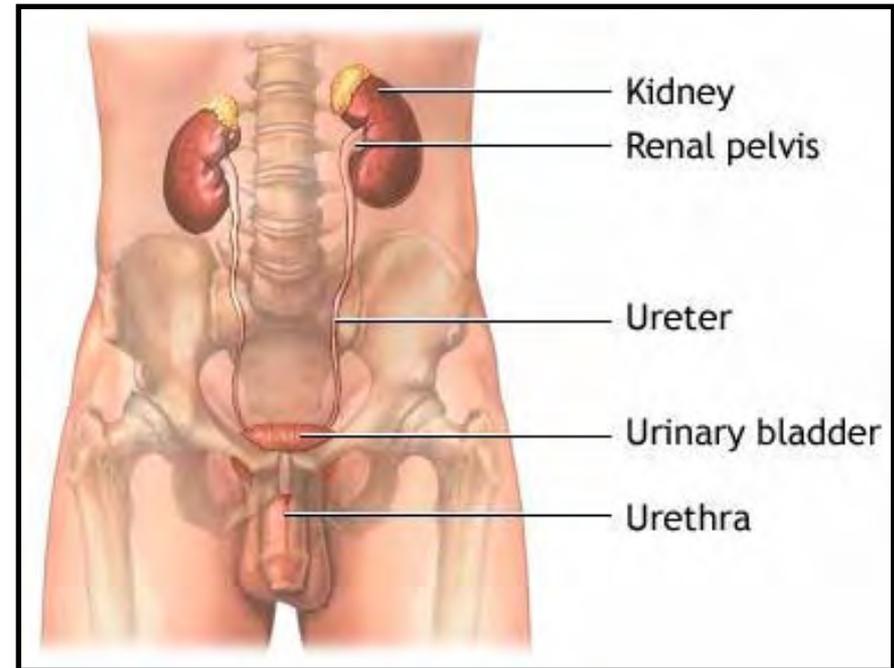
Hospital-acquired Infections – Mode of Transmission



Urinary Tract Infections

- Urinary tract infection (UTI) is a bacterial infection that affects any part of the urinary tract. It is further classified as:
 - **Urethritis:** Infection affecting the urethra
 - **Cystitis:** Infection affecting the bladder
 - **Pyelonephritis:** Infection affecting kidneys through ureter
- The main causative agent is *Escherichia coli* (*E.coli*). Microorganisms called *Chlamydia* and *Mycoplasma* also cause UTI, but these infections are limited to the urethra and reproductive system. Unlike *E. coli*, *Chlamydia* and *Mycoplasma* may be sexually transmitted, and infections require treatment of both partners.
- The extended use of catheters, microbial colonization of the drainage bag are some of the causes of UTI in patients.
- There have been risks of acquiring UTI after colonoscopy, extracorporeal lithotrities and so on.

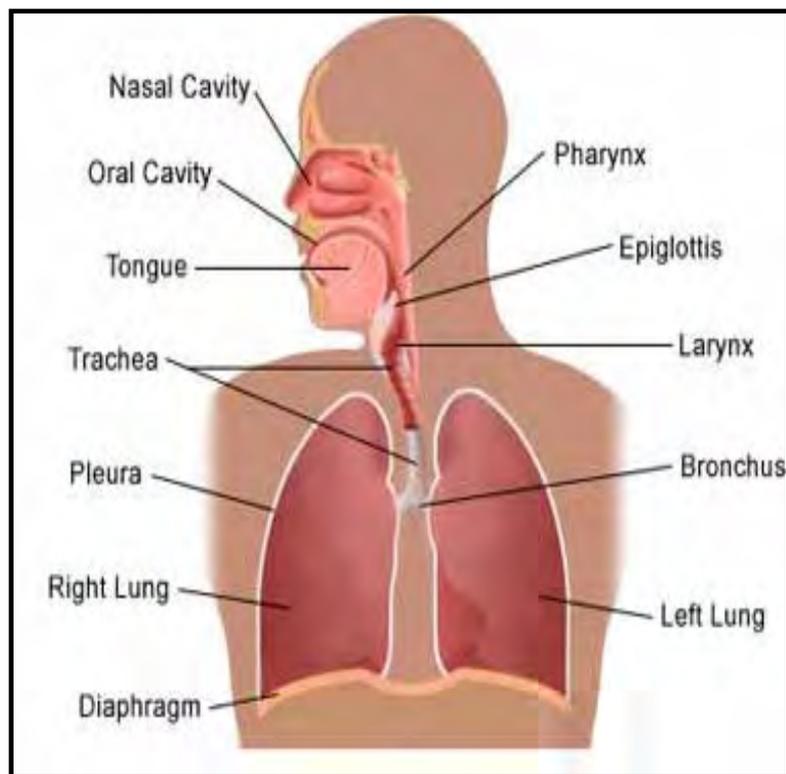
Urinary Systems



Respiratory Infections

- Bacteria and other microorganisms are easily introduced into the throat during treatment procedures and cause respiratory infections. The microorganisms can spread to the patient from contaminated equipment or from the hands of healthcare workers, through mechanical ventilation, suctioning of material from the throat and mouth. The infected microorganisms spread to the throat from the mouth and nose and colonize there. Then it can aspirate to the lungs spread the infection thus causing pneumonia. Pneumonia is the second most common type of hospital-acquired infection.
- Hemophilus influenza, streptococcus pneumonia, staphylococcus aureus, enterobacteriaceae, respiratory viruses, fungi, candida spp and aspergillus's spp are a few of the microorganisms causing respiratory infections.
- Respiratory infections are the most common cause of death among nosocomial infections, while in the intensive care unit (ICU) it is the primary cause of death.
- The use of ventilators and contaminated respiratory devices may spread the infection to the patients. Hospital stay is generally one to two weeks longer than for other patients.

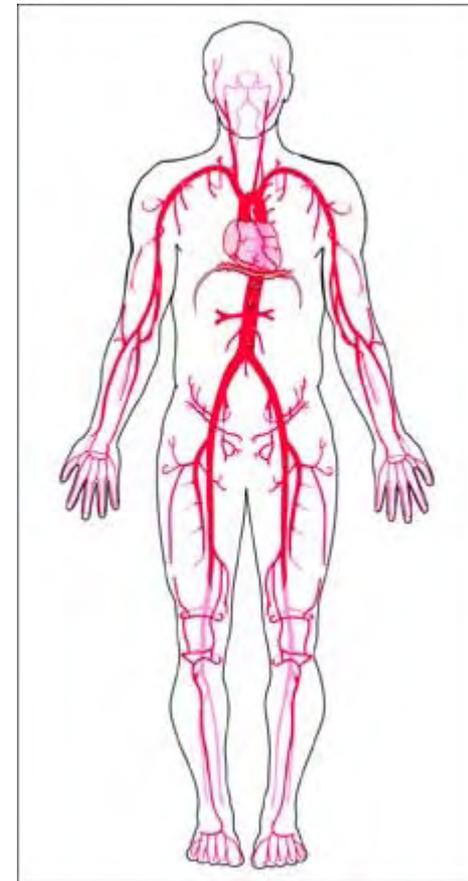
Respiratory Systems



Blood Stream Infections

- Bloodstream infection (BSI) is an invasion of bacteria into the blood. It may be caused through a wound or an infection, or through a surgical procedure or an injection or through catheterization.
- A few of the microorganisms causing BSI include Coagulase-negative Staph *S. aureus*, Enterococci, *Candida* spp, *E. coli*, *Klebsiella* spp, *Pseudomonas aeruginosa*, *Enterobacter* spp, *Serratia* spp, *Acinetobacter* spp.
- BSIs are a leading cause of mortality due to nosocomial infections.
- The risk factors for nosocomial BSIs vary due to heavy microbial colonization of the skin at the site of insertion, duration of placement, contamination of the catheters or other insertion devices.
- The risk of BSI is highest when the patient is admitted to the ICUs than in other types of wards.
- The major causes of BSI include catheters, dental procedures, urinary tract infections, intravenous drug use, colorectal cancer and a few other surgeries.

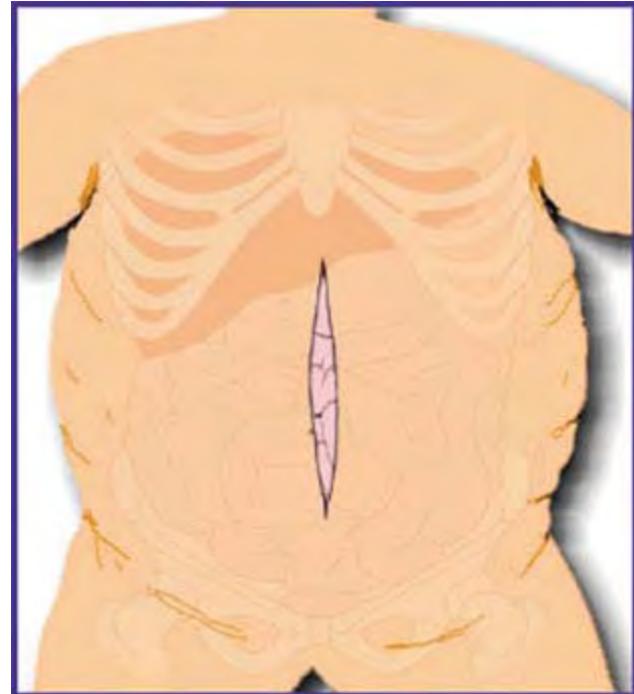
Circulatory System



Surgical Site Infections

- The infections developed at the surgical site are known as surgical site infections (SSIs).
- These are infections of the tissues and organs exposed by the surgeon during an invasive procedure.
- SSIs are classified further into three groups, namely superficial incisional, deep incisional and organ-space SSIs based on the site and the extent of infection.
- Superficial incisional SSIs involve only the skin or subcutaneous tissue around the incision.
- Deep incisional SSIs are related to the procedure and involve deep soft tissues, such as the fascia and muscles.
- Weak immune system, poor blood supply and diseases can increase the risk of infection in the patients.

Surgical Site



Other Infections

- Other infection in hospital setting include:
 - Skin and Soft Tissue Infections: The infection of ulcer, burns and deep wounds like bed sores are good area for bacterial colonization, hence the risk of infection is high in weakened immune system in patients in the hospital.
 - Gastroenteritis: It is inflammation of the gastrointestinal tract, involving both the stomach and the small intestine resulting in acute diarrhoea. At least 50 per cent of cases of gastroenteritis are due to food borne illness caused by norovirus, while another 20 per cent of cases, are due to rotavirus.
 - Ophthalmic infections: eye ailments that are caused by bacterial, viral, or other microbiological agents. They include conjunctivitis, Keratitis, Corneal Ulcer etc.
 - Reproductive infection: It includes endometritis and infection of reproductive organs after childbirth.

Other Infections



Hospital-acquired Infections

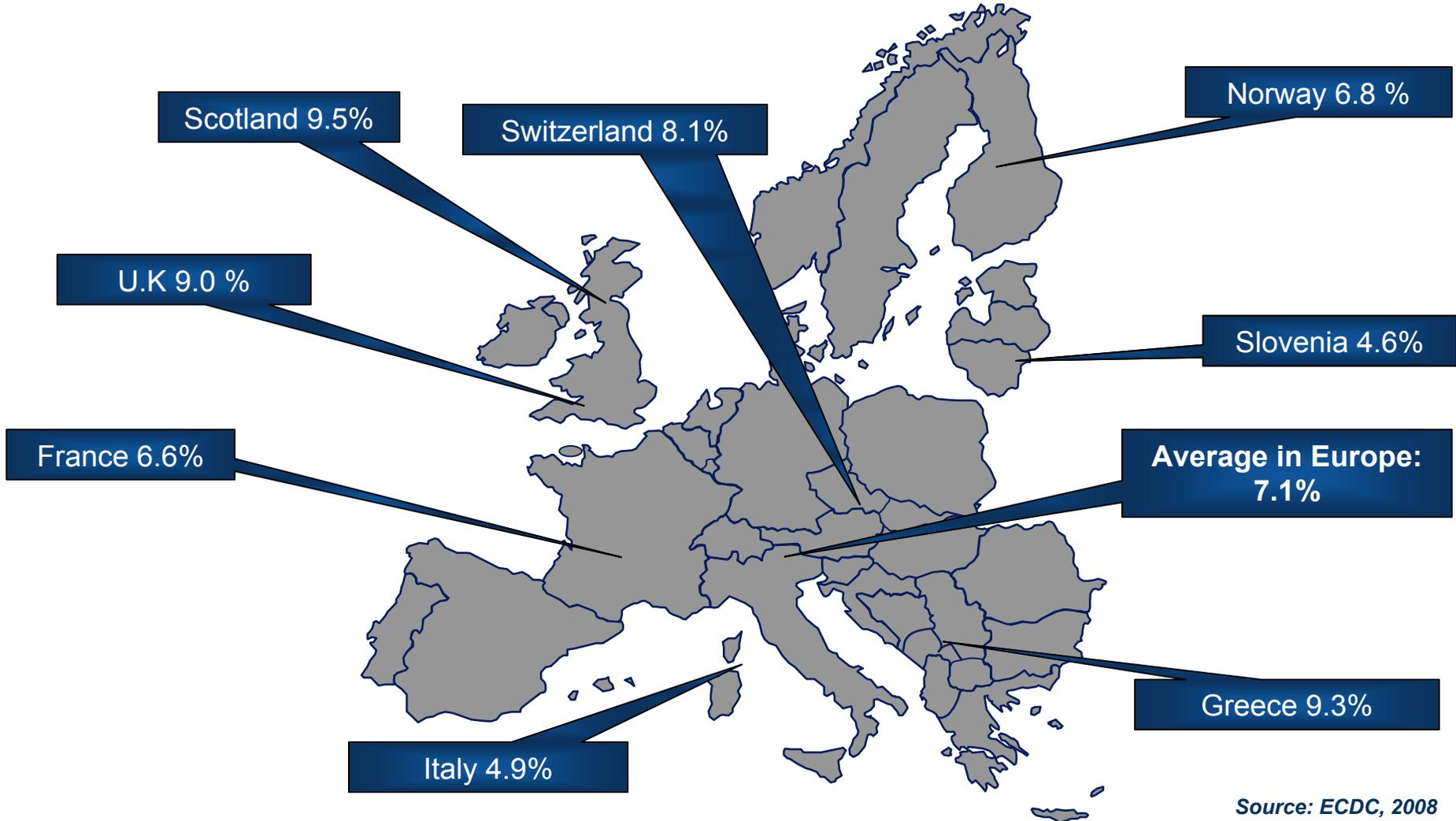


Hospital-acquired Infections (HAI) – Overview

- Around 1.4 million patients per day are affected by hospital-acquired infections (HAI) throughout the world.
- According to the European Commission, there are approximately 4.1 million healthcare associated infections and 50,000 attributable deaths in the European Union each year.
- In 2009, the mean HAI prevalence was around 7.1 per cent, while the incidence was only 5.1 per cent. This reveals that despite initiative taken to reduce the incidence of new infection, the inability to treat the existing ones completely has added to the burden of the health expenditure in Europe.
- According to European Centre for Disease Prevention and Control (ECDC), the burden on healthcare systems is immense, resulting in an additional 16.0 million days of hospital stay per year. Assuming the average daily cost of a hospital stay to be €334.0, the total annual healthcare cost for the EU-27 can be estimated at €7.00 billion. However, this value does not include the indirect costs linked to loss of income, or the intangible costs associated with physical and emotional suffering.
- The most frequent infections are urinary tract infections (UTIs), followed by respiratory tract infections, infections post- surgery, bloodstream infections (BSIs) and others.
- In developed countries, HAI concerns 5.0 per cent to 15.0 per cent of hospitalised patients and can affect 9.0 per cent to 37.0 per cent of those admitted to intensive care units (ICUs).
- In Europe, an estimated five million HAI at least occur in acute care hospitals annually, contributing to 135,000 deaths and representing around 25.0 million extra days of hospital stay and a corresponding economic burden of €13.00 billion to €24.00 billion.

Prevalence of HAI in Europe

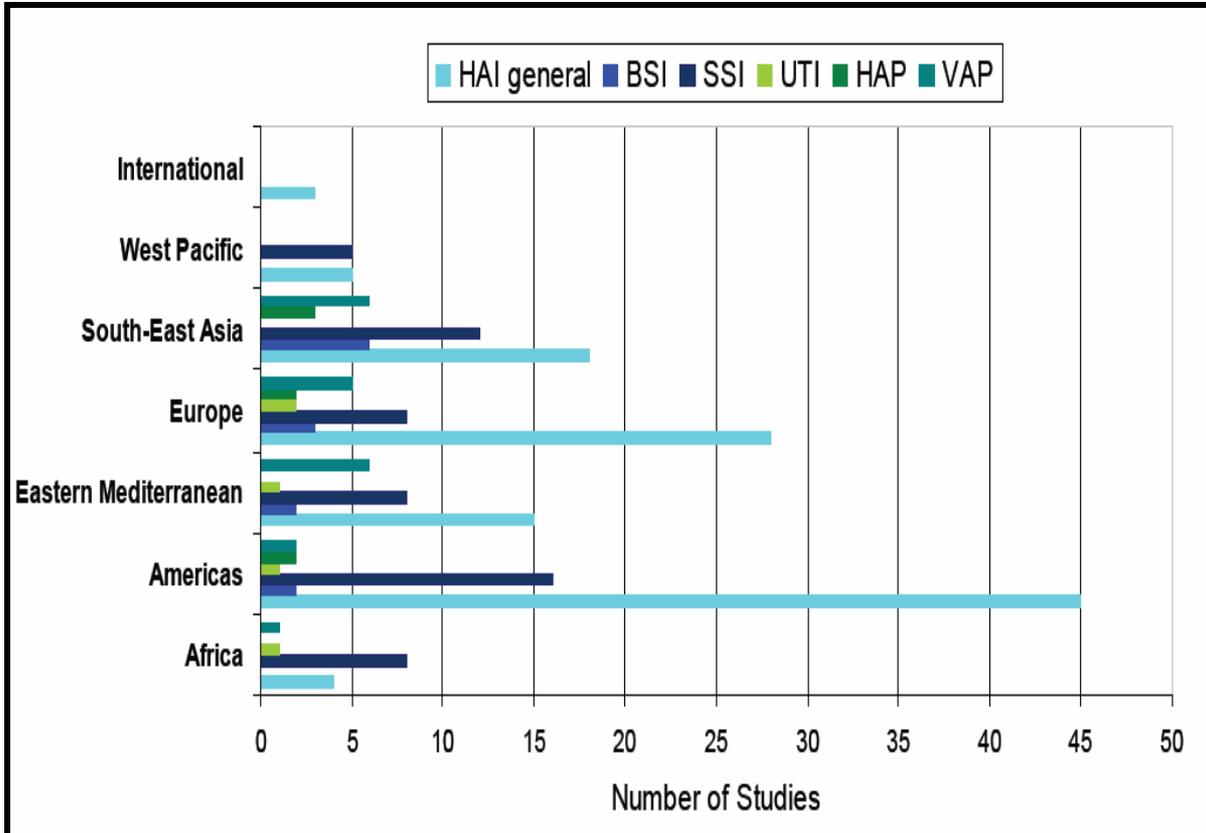
Hospital-acquired Infections: Prevalence of HAI (Europe), 2008



Source: ECDC, 2008

Distribution of HAI Surveillance Studies across Geography

Hospital-acquired Infections: Studies Conducted by Type of Infection (World), 2008

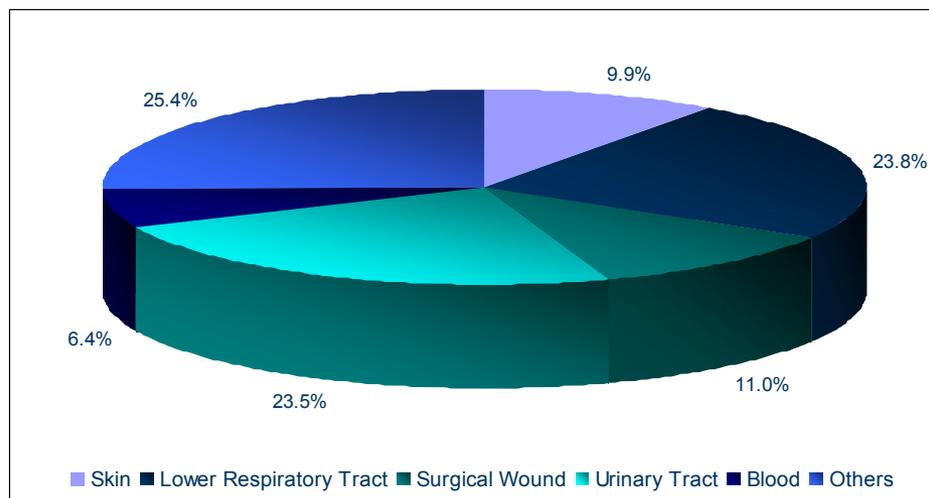


- The importance of HAI surveillance is not completely understood in the European region, as the number of studies performed are relatively less in comparison to other regions in the world.
- It is more important to have infection-centric studies to understand and develop protocols to prepare better prevention strategies.
- The need to have ward-based studies have also become important, as the risk of infection varies in ICU versus normal wards.

Source: WHO

Hospital-acquired Infections – Trends

Hospital-acquired Infections: Per cent Split by Type (Europe), 2008



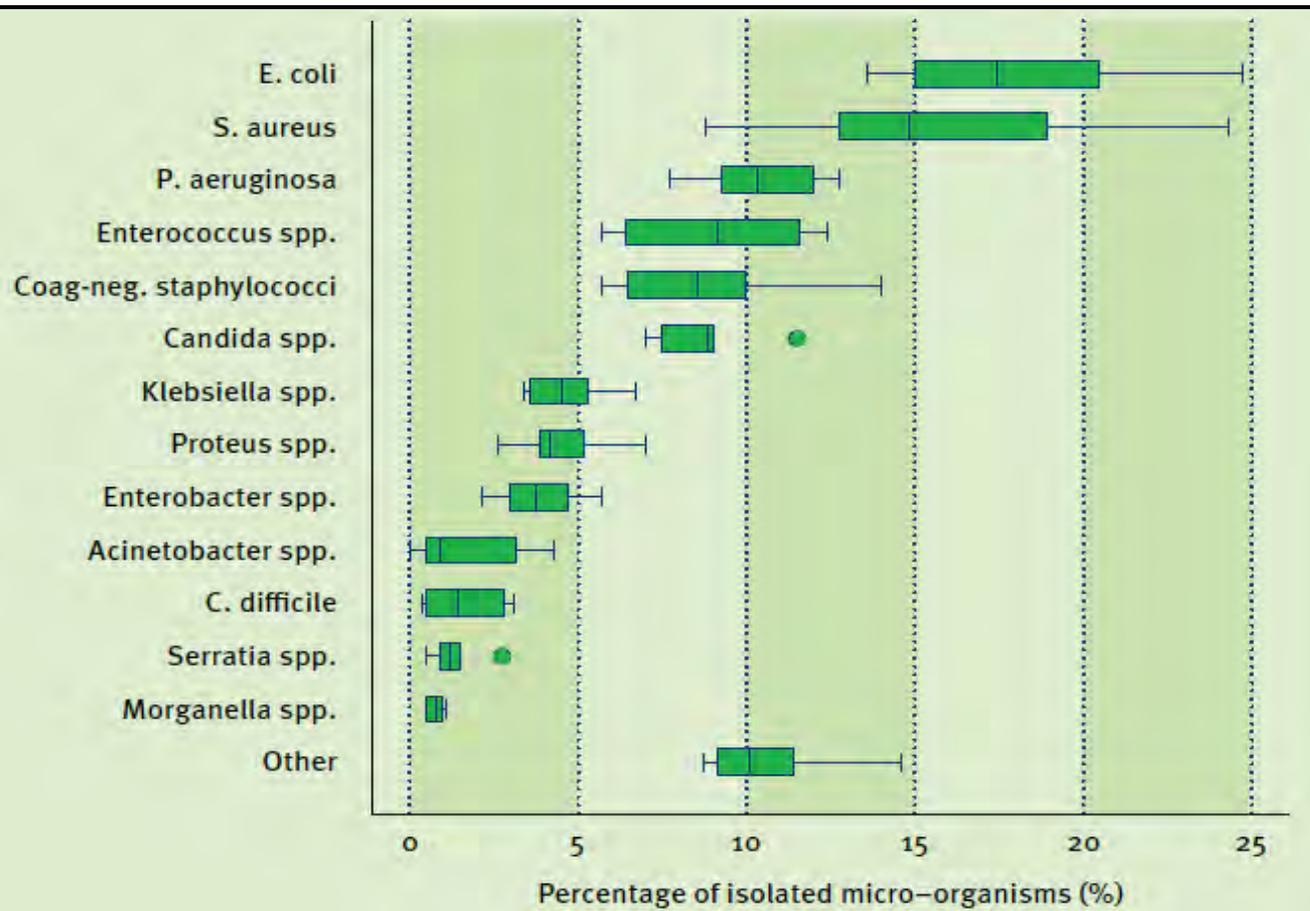
Source: ECDC Report, 2008

According to studies conducted by ECDC in 2008:

- The average rate of prevalence of HAI in Europe was 7.1%.
- There were approximately 4,131,000 affected patients.
- There were approximately 4,544,100 episodes of HAI every year.
- HAI lead to 16.0 million extra days of hospital stay in Europe.
- Mortality due to healthcare associated infection was high and almost attributed to 37,000 deaths.
- The impact of nosocomial infection on the EU member States' economy was high as well. It accounted for about €7.0 billion per year (including direct costs only).

Microorganisms Isolated

Hospital-acquired Infections: Relative Frequency of Microorganisms Isolated (Europe), 2008



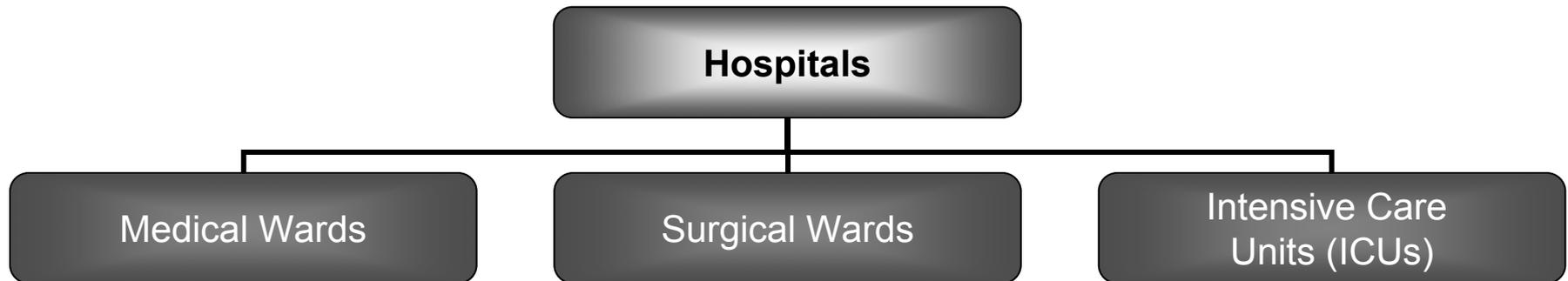
- The risk of HAIs from different kinds of microorganisms varies in hospitals.
- The risk of HAI due to S.aureus and E.coli are the highest, closely followed by P.aeruginosa and Enterococci spp.
- Though the graph reveals the percentage of isolated micro-organisms, it directly relates to the risk of infection possible in hospitals by these organisms.

Source: ECDC, 2008

Hospital and Infections

- The hospital is a huge set-up, where the risk of infection is high.
- The care providers are equally exposed to risk of infection as patients. However, due to reduced immunity in patients, the prevalence is higher among them.
- The risk of infection for patients increases due to these reasons:
 - Weak immune system
 - Longer duration of stay in hospital
 - Longer duration usage of catheter
 - Longer duration of usage of ventilators
- The nature of infection and place of stay in hospital also attribute to the type of infection.
- The risk of ventilator related respiratory infections and device related BSIs are higher in ICUs than in general wards, as the usage of these products vary drastically according to the place of care (though determined by need primarily).

Hospital-acquired Infections – Analysis Based on Wards



- Medical wards have patients of mixed morbidities and diseases. The patients might be shifted from various departments like emergency, ICUs etc, and hence infection is not necessarily acquired here. The risk of infections in these wards include UTIs, BSIs and respiratory infections predominantly.
- Surgical wards have the highest risk of surgical site infections (SSIs), ventilator infections and devices related infections such as UTI due to catheters and BSI due to other invasive devices. The risk of infection in these wards is not just attributed to prolonged use of these devices. However, as the environment is not completely hygienic, there could be microbial colonization in the devices and hence risk of infection.
- The intensive and critical care centers have the highest risk of nosocomial infections, due to weakened immune system and other ailments.

Hospital-acquired Infections – Analysis Based on Intensive Care Units

- ICUs have critically ill patients needing constant care and monitoring. However, ICU patients have five to ten times higher possibilities of acquiring nosocomial infections than other hospital patients. Device-associated infections are the most common causative factors among ICU inpatients. An inpatient ICU is a designated unit, where there is appropriate equipment and specialised staff to provide continuous care, according to the particular medical needs of a defined and limited class of critically ill patients.
- A device-associated infection is an infection in a patient with a device such as central line, ventilator, or indwelling urinary catheter, arterial lines etc that was in use within the 48-hour period before onset of infection. If the interval since discontinuation of the device is longer than 48 hours, there must be compelling evidence that infection was associated with device use.. The presence of an invasive device automatically increases the risk of infection because it provides an easy access for bacteria in a clean site.
- According to Axel et al, approximately 15.0 per cent of nosocomial infections on ICUs are the result of patient-to-patient transmissions of the causative organisms. Ventilator-associated pneumonia (VAP) is the most common infection followed by surgical site infection, catheter-related bloodstream infection, urinary tract infection etc.
- ICU patients suffer increasingly than other patients from weakened immune system due to disease processes, trauma, interruption of normal defense mechanisms, malnutrition due to inability to eat and inability to ambulate. This further adds burden to the risk of infection.

Hospital-acquired Infections – Analysis Based on Intensive Care Units (Contd...)

Urinary Tract Infections

- There is an increased usage of catheters in ICU because of the severity of illness. Hence, the risk of UTIs is higher with prolonged use of catheters.

Intravascular Infections

- The number of lines a patient may have for monitoring or nutrition increases the risk of line-related infections. Lack of adherence to recommendations regarding insertions, line care, access and tubing changes increase the risk of infections.

Nosocomial Pneumonia

- The use of ventilators can increase the risk of pneumonia (device-related infections). However, following the established protocol for head-of-bed (HOB) elevation, tubing changes and suctioning practices can help indirectly in reducing the risk of infection.

Surgical Site Infections

- SSIs can become a mammoth problem for ICU patients as they have more drains than the general patients. In addition, as these patients usually cannot ambulate as early, the risks of complications increase.

Antimicrobial Use

- Because of the increase in invasive devices and procedures, patients are on antibiotics for longer duration. This prolonged exposure to antibiotics have increased the incidence of antibiotic resistance, hence reducing infections becomes even more of a concern.

Analysis Based on Types of Hospital-acquired Infections

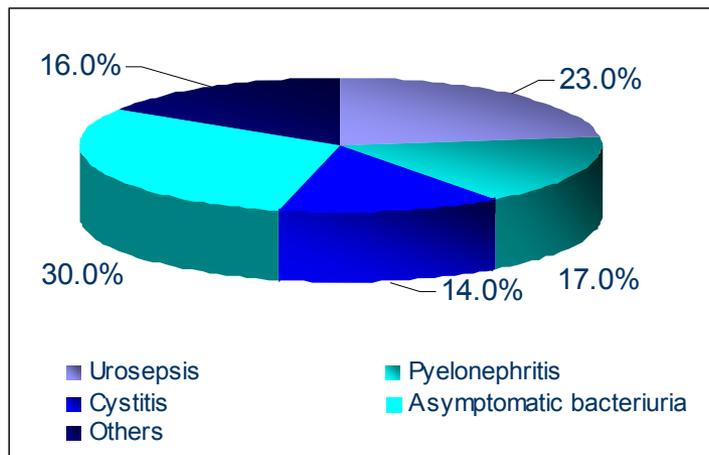


Urinary Tract Infections – Overview

- Urinary tract infections (UTIs) are the most common type of HAI in Europe, accounting for more than 30.0 per cent of infections. More than 90 per cent all these UTIs are caused by instrumentation of the urinary tract.
- According to Pan European Prevalence (PEP) study, the prevalence of nosocomial urinary tract infections (NAUTIs) was 10.0 per cent.
- Catheter-associated urinary tract infection (CAUTI) has been associated with increased morbidity, mortality, hospital cost and length of stay.
- It has been estimated from various studies that nearly 25.0 per cent of the hospitalised patients require urinary catheter at some point of time.
- Although UTI is not associated with all catheters usages, the risk of developing bacteraemia in catheterised patients is 5.0 per cent per day of catheterisation in short term use. About 20.0 per cent of bacteraemia results in catheter-related UTIs. For long-term catheterisation (more than 30 days), even with proper care, the risk of infection is high.
- From various other studies, it is revealed that approximately 2.5 per cent of hospital patients acquire UTI.
- In the hospital, the intensive care unit (ICU) has the highest prevalence of UTI with 8.0 per cent to 21.0 per cent of nosocomial infections; more than 95 per cent of ICU cases are associated with the presence of an indwelling urinary catheter.
- The risk of infections increases with every additional day of catheter usage.

Urinary Tract Infections

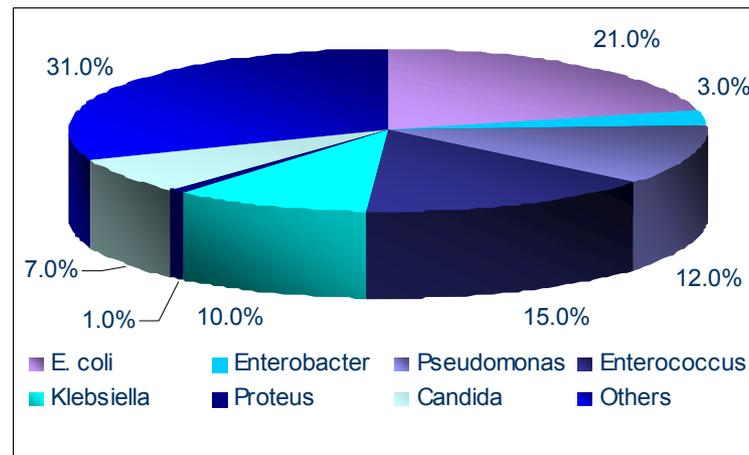
Hospital-acquired UTI: Per cent Split by Type (Europe), 2007



Source: PEP Study

- A survey was conducted to study the prevalence of NAUTI per day in 93 hospitals with a total of 6,033 patients.
- The prevalence of NAUTI was as high as 12.0 per cent in the same.
- The risk factors like previous infections, urinary tract obstructions, urinary stones and antibiotic therapy also have influence on the pathogen causing NAUTI.
- The risk of infection from various pathogens has an impact on the type of UTI based on the mode of intervention and duration of catheter usage.

Hospital-acquired UTI: Per cent Split in Risk of Infection by Pathogens (Europe), 2007



Source: PEP Study

Hospital-acquired UTI: Risk of Infection by Pathogens (Europe), 2007

Pathogen	Risk of Infection
<i>E. coli</i>	Increased catheter duration
<i>Candida sp.</i>	Laparoscopic intervention
<i>Enterococcus sp.</i>	Endoscopic intervention
<i>Proteus sp.</i>	Using suprapubic catheter

Source: PEP Study

Catheter Associated Urinary Tract Infections (CAUTI)

- Catheter associated urinary tract infection (CAUTI) is one of the most common forms of UTI in healthcare system. About 75.0 per cent to 80 per cent of all nosocomial UTIs are due to insertion of catheters. The hospital stay increases by five to six days on an average due to CAUTI.
- The incidence of CAUTI was higher in the first seven days of catheters being in situ. Similarly, the risk of CAUTI was higher in women than in men according to a study conducted by Health Protection Scotland Agency.
- In terms of care centers, the risk of CAUTI was highest in long-term care setting, where elderly population, community patients, psychiatric patients are treated. The need for catheterisation is high here, hence the rate of infection is high as well.
- In primary care and acute care settings, the risk of CAUTI is high in the latter than in the former. According to a study by Health Protection Scotland, the incidence of CAUTI in primary care setting was 1.2 per cent, while it was 5.7 per cent in acute care divisions.

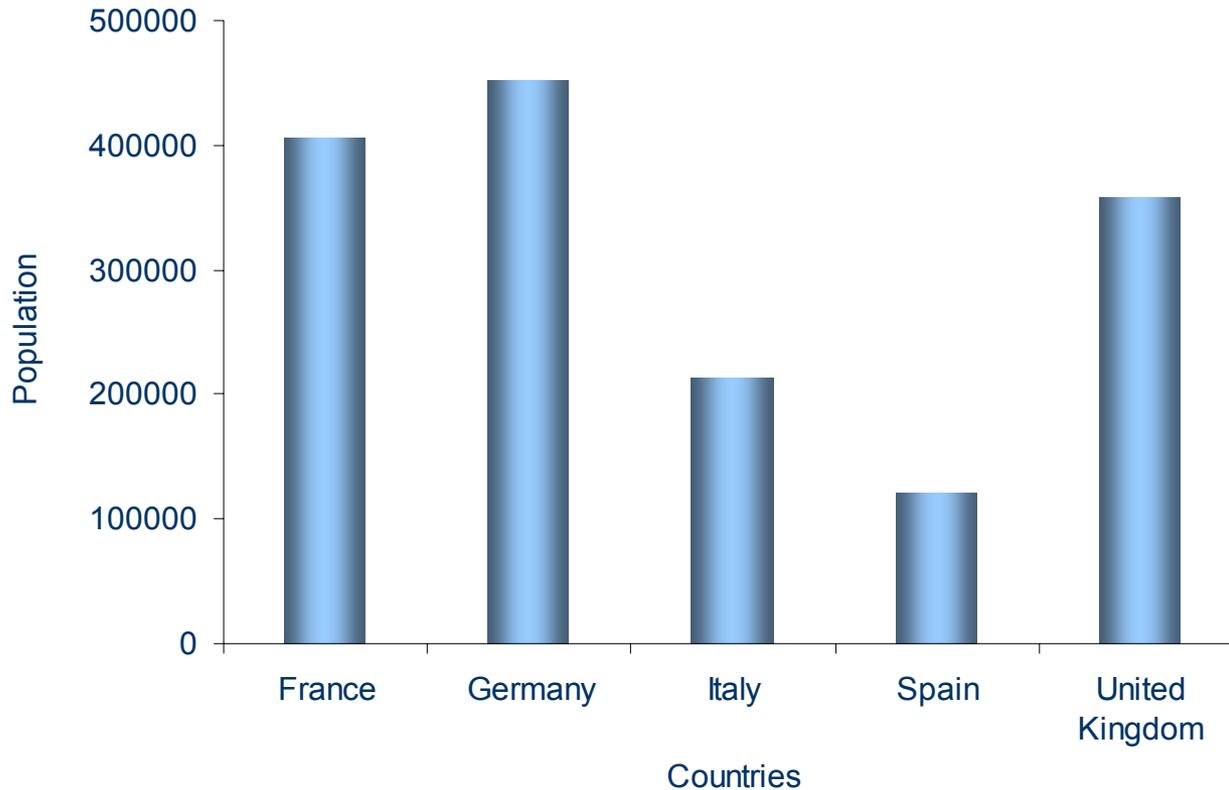
CAUTI: Pathogens Causing CAUTI Ranked in Order of Risk of Infection (Europe), 2009

Pathogen	Rank
<i>Escherichia coli</i>	1
<i>Candida</i> species	2
<i>Enterococcus</i> species	3
<i>Pseudomonas aeruginosa</i>	4
<i>Klebsiella pneumoniae</i>	5
<i>Enterobacter</i> species	6
Coagulase-negative staphylococci	7
<i>Staphylococcus aureus</i>	8
<i>Acinetobacter baumannii</i>	9
<i>Klebsiella oxytoca</i>	10

Source: Centers for Disease Control and Prevention (CDC)

Hospital-acquired Urinary Tract Infections

Hospital-acquired UTI: Patient Population (Europe), 2009



- This is the estimated population suffering due to Urinary tract infections acquired in hospitals across the five regions.
- These populations are in relation to the number of catheterizations days, use of catheters across various wards in hospitals in respective countries.

Source: Frost & Sullivan

Pneumonia Infections



Hospital-acquired Pneumonia Infections

- Hospital-acquired pneumonia (HAP) is a respiratory infection acquired in the hospital and affects 0.5 per cent to 1.7 per cent of patients in Europe. The duration of hospital stay extends by seven to nine days, and it has high mortality rates. The type of HAP acquired with mechanical ventilation are called as ventilator associated pneumonia (VAP). In patients with VAP, the mortality rate varies between 20.0 per cent and 55.0 per cent, and it increases to 76.0 per cent, if infection is caused by multidrug-resistant pathogens.
- The risk factors for acquiring nosocomial pneumonia (NP) include mechanical ventilation, elderly, neonates, severe underlying disease, immunodeficiency, cardiopulmonary disease, or recent thoraco-abdominal surgery. Various pathogens that infect the respiratory tract and cause nosocomial pneumonia are bacterial pneumonia, Legionnaires' disease, pulmonary aspergillosis, Mycobacterium tuberculosis and viral pneumonia such as Respiratory Syncytial Virus (RSV) and influenza.
- The incidence of NP in ventilated patients was ten times higher than non-ventilated patients. The incidence varies from 9.0 per cent to 70.0 per cent for patients on ventilators. It is a major threat to the recovery of patients, and is highest in ICU-acquired infections in mechanically ventilated patients.
- The major three conditions which increases the risk of occurrence of pneumonia include:
 - Significant impairment of host defenses
 - Introduction of a sufficient-size inoculum to overwhelm the host's lower respiratory tract defenses
 - Introduction of highly virulent organisms into the lower respiratory tract
- NP is classified as early-onset that occurs during the first four days of infection and late-onset beyond four days.

Hospital-acquired Pneumonia Infections – Risk Factors

- The major risk of infection from NP is mechanical intubations.
- The factors that increase the risk of colonization of the oropharynx and stomach are:
 - Administration of antibiotics
 - Admission to ICU
 - Underlying chronic lung disease
- The factors favouring aspiration into the respiratory tract or reflux from GI tract are:
 - Supine position
 - Depressed consciousness
 - Endotracheal intubation
 - Immobilisation
 - Surgery of head/neck/thorax/upper abdomen

Hospital-acquired Pneumonia: Classification of Pathogens Based on the Onset of Pneumonia (Europe), 2009

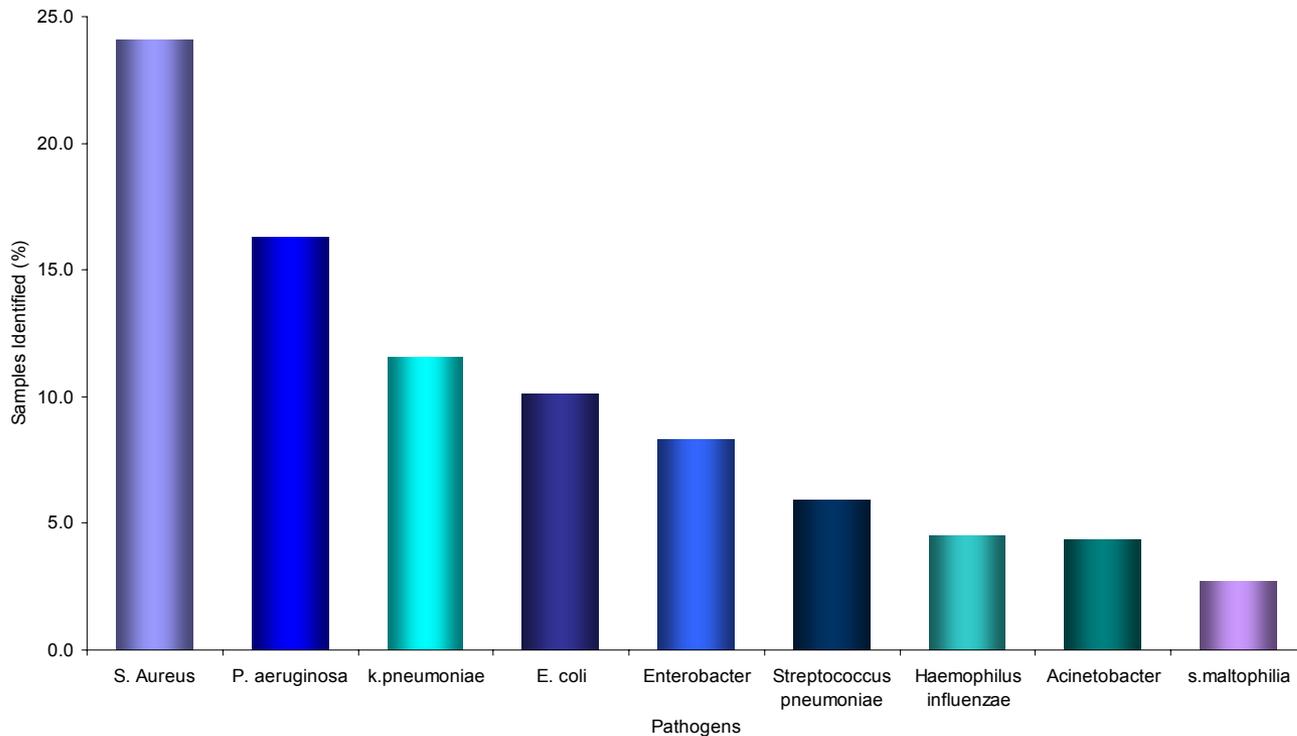
Pathogen	NP
<i>Enterobacter</i>	Late-onset
<i>P. aeruginosa</i>	Late-onset
<i>Acinetobacter</i>	Late-onset
MRSA	Late-onset
S. Aureus	Early-onset
<i>Streptococcus pneumoniae</i>	Early-onset
<i>Haemophilus influenzae</i>	Early-onset

Source: WHO

Hospital-acquired Pneumonia Infections in ICUs

- The use of mechanical ventilators are the highest in ICUs. With the patient's immune systems being weak, the risk of infections is high. With prolonged stay in ICU, the risk increases as well.

Hospital-acquired Pneumonia: Per cent of Contribution by Nine Most Frequently Identified Pathogens from Patient Samples (Europe), 2009



- In a study by Gastmeier et al, based on data from 308 ICUs from the German National Nosocomial Infection Surveillance System, 11,285 cases of NP were used for analysis. In this study, 11.6 per cent had no detectable pathogens. For the remaining, an average of 1.5 pathogens per pneumonia case was recorded.
- The most frequent pathogen identified in the NP patient samples were S.aureus and 26.5% of these were due to MRSA pathogens.

Source: Gastmeier et al.

Hospital-acquired Pneumonia Infections in ICUs (Contd...)

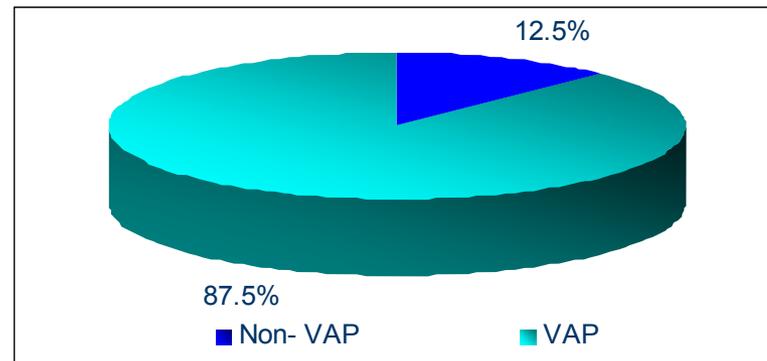
- In a study by Gastmeier et al in ICUs the number of pneumonia cases considered to be ventilator associated was as high as 87.5 per cent. The overall VAP rate was 7.5 cases per 1,000 ventilator days.
- The risk of late onset was much higher than early onset.

Hospital-acquired Pneumonia: Per cent of Cases Distributed Based on Onset Days (Europe), 2009

Days	Cases (%)	Days	Cases (%)
1-4	19.8	>4	80.2
1-5	29.0	>5	71.0
1-7	45.4	>7	54.6

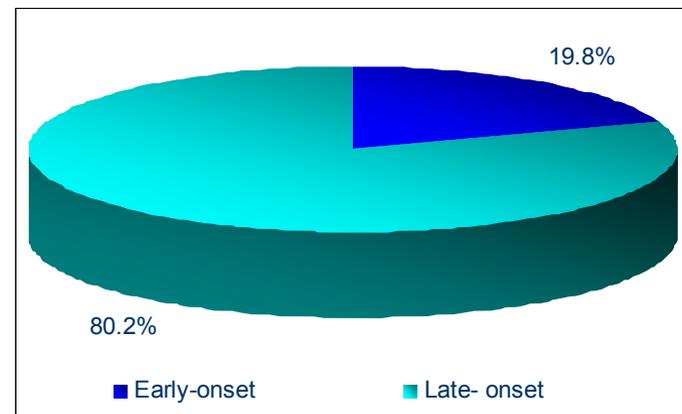
Source: Gastmeier et al.

Hospital-acquired Pneumonia: Per cent Split Based on Type of Infection in ICUs (Europe), 2009



Source: Gastmeier et al.

Hospital-acquired Pneumonia: Per cent Split Based on Onset of Infection in ICUs (Europe), 2009



Source: Gastmeier et al.

Hospital-acquired Pneumonia Infections in ICUs and Drug Resistance

Hospital-acquired Pneumonia: Relative Risks of Pneumonia with Particular Pathogens Based on Onset (Europe), 2009

Pathogen	1-7 days	7 days
<i>S. aureus</i>	26.9	21.7
<i>P. aeruginosa</i>	11.9	19.9
<i>K. pneumoniae</i>	11.1	12.0
<i>E. coli</i>	10.6	9.6
<i>S. pneumoniae</i>	8.3	4.0
<i>Enterobacter</i> spp.	7.5	9.0
<i>Haemophilus</i> spp.	6.7	2.7
<i>Acinetobacter</i> spp.	3.2	5.4
<i>S. maltophilia</i>	1.4	3.8

- The risk of acquiring Hospital-acquired Pneumonia is high post seven days and varies based on the pathogen causing the infection. The risk increases with antibiotic resistant pathogens.
- The risk of mortality due to VAP increases to 76.0 per cent with multi drug resistant (MDR) pathogens.
- In a 2009 study in Belgium by Depuydt et al, MDR pathogens were responsible for 27.0 per cent of the VAP episodes.
- MRSA was responsible for 6 per cent of the VAP and extended-spectrum β -lactamase producing Gram-negative Enterobacteriaceae (ESBL) in 15.0 per cent of VAP.

Source: Gastmeier et al.

Surgical Site Infections



Surgical Site Infections (SSIs)

- An estimated 234.0 million major operations are performed around the world each year.
- According to WHO, major complications are reported to occur in 3.0 per cent to 16.0 per cent of inpatient surgical procedures, with permanent disability or death rates of approximately 0.4 per cent to 0.8 per cent.
- SSIs are an important cause of healthcare associated infections. They are classified into incisional, organ, or other organs and spaces manipulated during an operation; incisional infections are further divided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue-muscle and fascia). They account for 15.9 per cent of all HAI.
- SSIs have serious consequences for patients affected, as they have been estimated to at least double the length of hospital stay and result in pain, suffering and possible further surgery as well. The risk of SSI is that it has a risk of readmission due to worsening of infection and further complications, which mounts the burden.

Surgical Site Infections: Risk of Infection Based on Wound Types (Europe), 2009

Wounds	Risk of Infection (%)
Clean	2.0
Clean-contaminated	4.0-10.0
Contaminated	10.0
Dirty	25.0

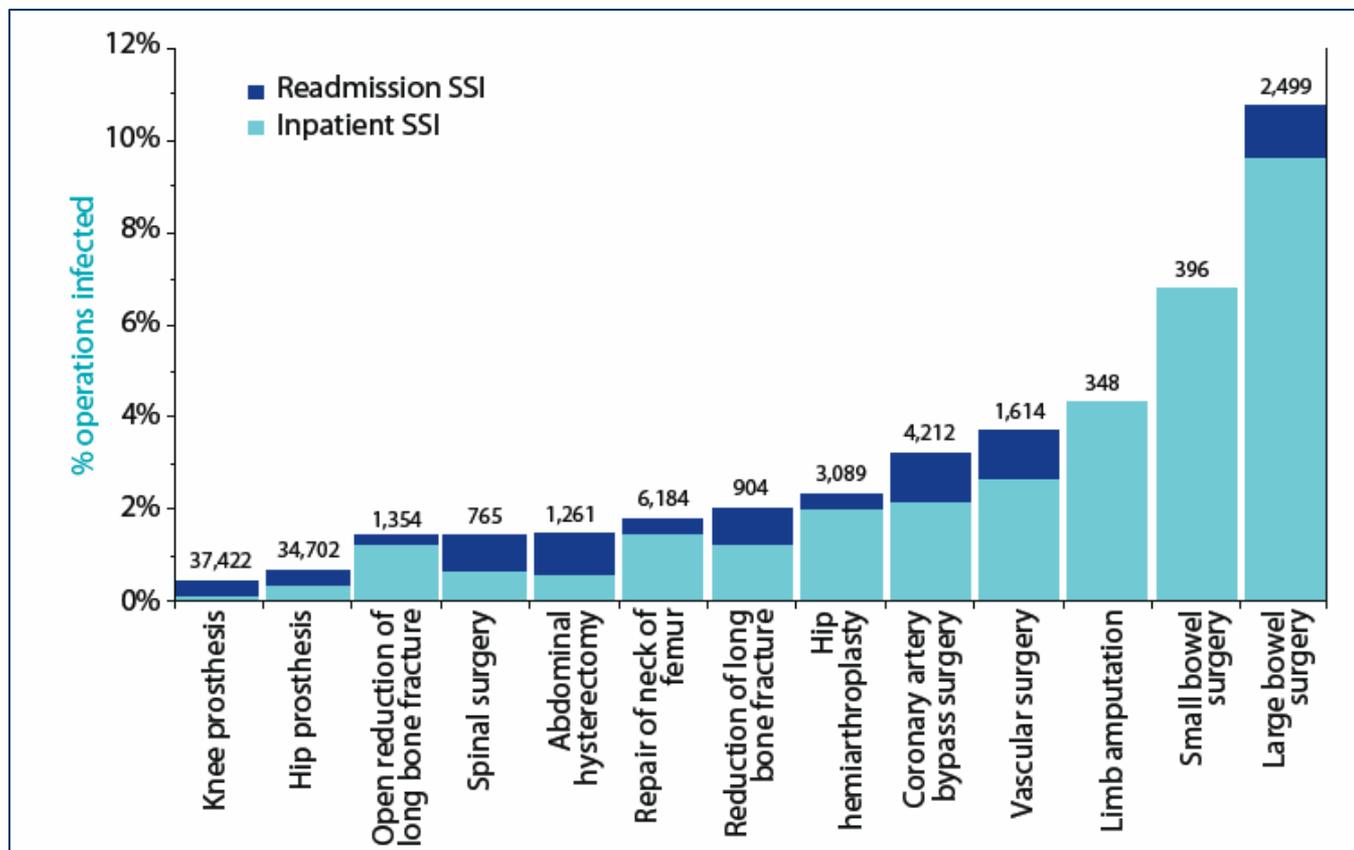
Source: WHO

The risk factors for SSI include:

- Patient related factors like diabetes, smoking, poor nutrition and so on.
- Environment factors like contaminated instruments, air and so on.
- Surgical procedure like skin classification, complexity of surgery, stress on the wound among others.

Surgical Site Infections (SSIs) (Contd...)

Surgical Site Infections: Incidence of SSI by Surgical Category with Number of Operations Mentioned (UK), 2009

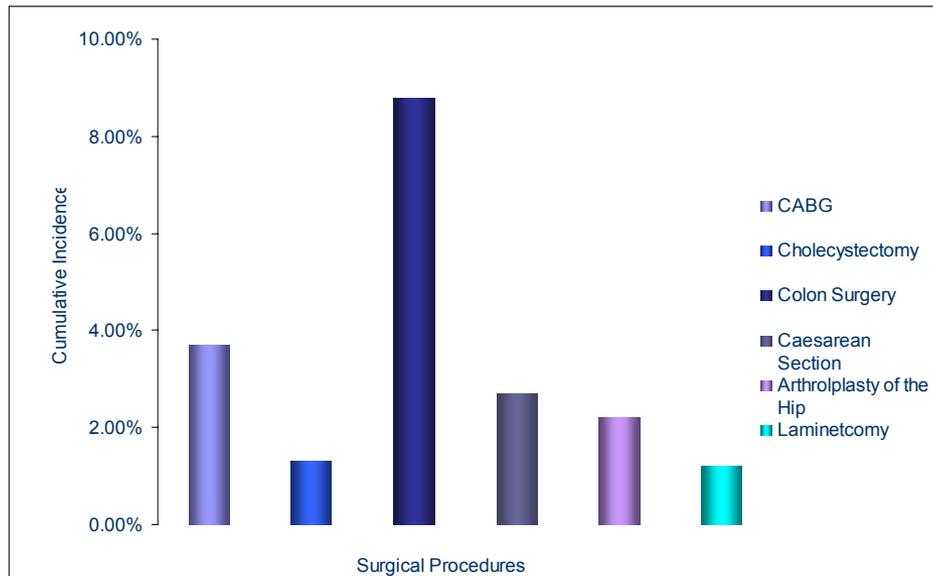


Source: HPA

- The risk of surgical site infection varies with each surgery.
- Bowel surgery, and limb surgery have had the highest risk of SSIs.
- The risk of readmission due to SSI increases when the duration of stay in hospitals post surgery is less than three days.

Surgical Site Infections in Select Surgical Procedures

Surgical Site Infections: Incidence of SSI in Select Surgical Procedures (Europe), 2007



- The risk of SSI increases with large surgeries.
- In varied large surgeries, the risk of infection also increase with higher duration of surgery and the nature of the surgery, other than the other normal risk factors for SSI.

Source: HELICS, 2007

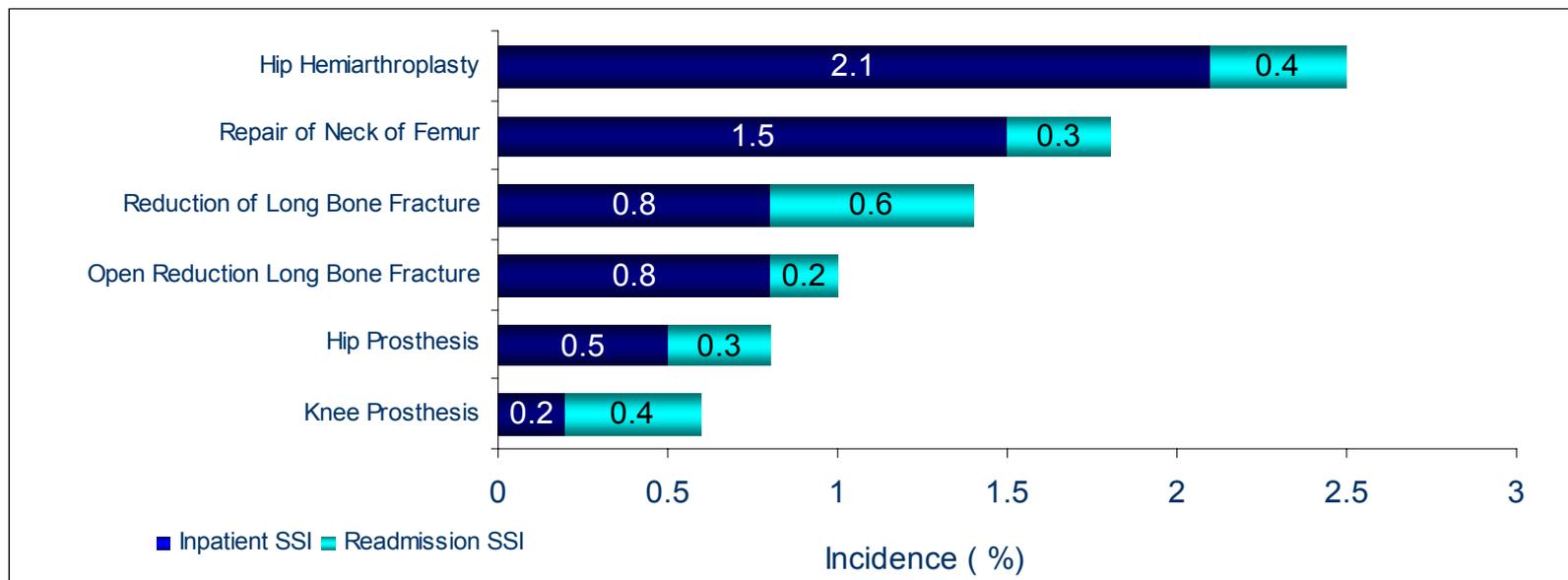
Surgical Site Infections: Per cent Distribution of Pathogens Isolated in Select Surgical Procedures (Europe), 2007

Pathogen	CABG (%)	Chol (%)	Colo (%)	Csec (%)	Hip artho (%)	Lam (%)
S. aureus	31.6	11.6	11.9	28.9	44.3	33.3
Enterobacter species	5.1	6.3	5.0	0.8	2.6	33.3
E. Coli	5.6	24.1	22.8	14.0	3.2	33.3
Klebsiella species	2.4	8.0	3.9	1.7	0.9	0.0
Acinetobacter spp	0.5	3.6	0.7	0.0	1.4	0.0
P. aeruginos	2.7	2.7	6.4	1.7	4.6	0.0

Source: HELICS, 2007

Surgical Site Infections in Orthopaedic Surgery

Surgical Site Infections: Incidence of SSI in In-patients and Patients Readmitted Based on Type of Surgery (Europe), 2008

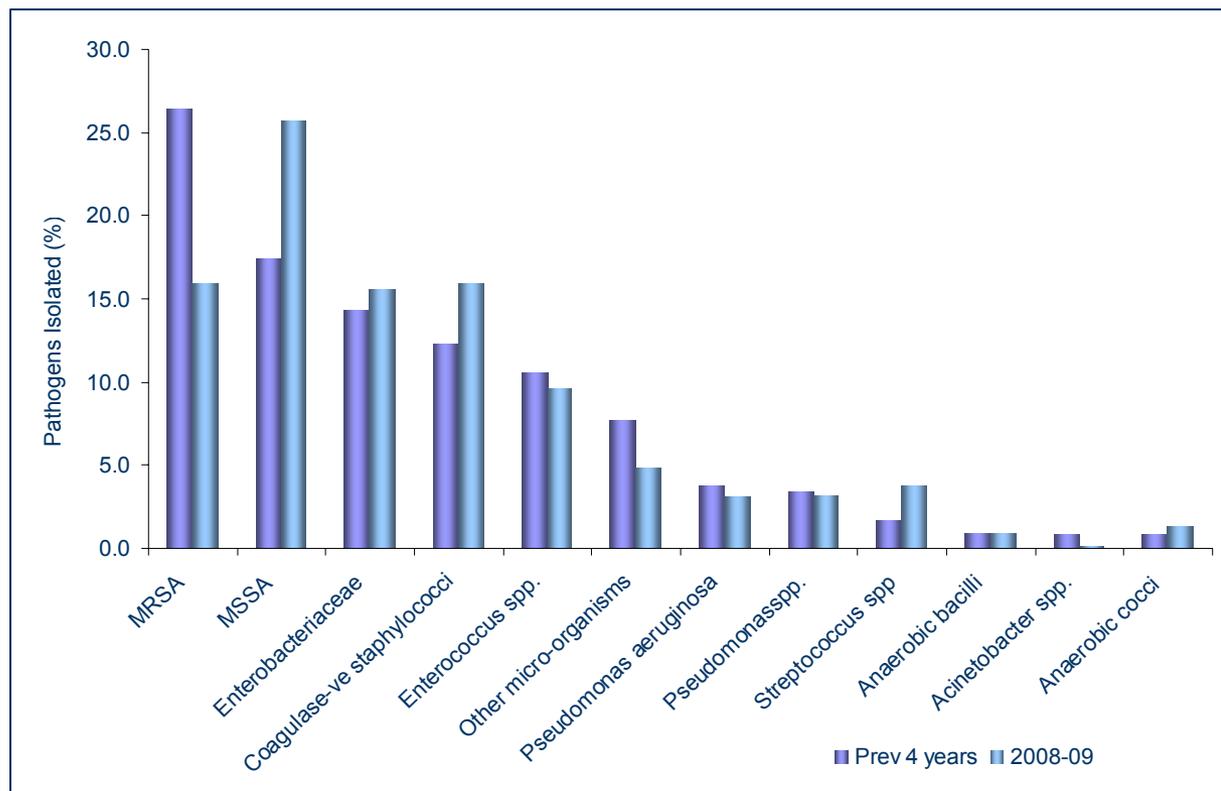


Source: HPA

- In another report by Eichholz et al, the risk of post operative SSI in decompressive procedures was less than 1.0 per cent and higher than 10.0 per cent in instrumented fusion.
- Minimally invasive spinal surgery techniques may reduce postoperative wound infections as much as 10-fold compared with other large, modern series of open spinal surgery.

Surgical Site Infections in Orthopaedic Surgery (Contd...)

Surgical Site Infections: Per cent of Pathogens Isolated from SSI (Europe), 2005-2009



Source: HPA

- The number of pathogens isolated directly links to incidence of infection.
- The chart reveals that there has been a drastic decrease in the number of MRSA pathogens isolated.
- This shows that there has been success in initiatives taken to curb MRSA pandemic. However, there has been an increase in MSSA and Enterococci infections.

Bloodstream Infections



Bloodstream Infections (BSI)

- Blood stream infections (BSIs) are a leading cause of infections in critically ill patients. When bacteria enter the bloodstream through a wound or an infection, or through a surgical procedure or an injection, it is classified as BSI.
- They are further classified as primary BSI and secondary BSI. Primary BSI is a condition where the pathogen is isolated in the absence of infection at another site. Secondary BSI is a condition where pathogen is isolated from the blood, when there are infections at other sites like UTI.
- There has been increasing trend of primary BSI due to increase in infections with gram negative bacteria and fungi. The risk of polymicrobial BSI has been high traditionally. The risk factors for BSI include other infections, prolonged stay in hospitals, catheter insertion for long duration, blood transfusion, infusion, wound infection, trauma, weakened immune system and so on.
- The mortality rate due to BSI is high and ranges between 20.0 per cent and 40.0 percent in hospital environment. The risk of BSI and increase in mortality has directly increased blood culturing. It has increased from 289 blood cultures/1000 in 1985 to 720/1000 in 2006.
- BSIs are an indisputable cause of morbidity and mortality. These infections may originate in the community setting among healthy individuals or among patients actively receiving healthcare as on dialysis, chemotherapy, and so on. However, the largest numbers of BSI are nosocomial. Despite incidence rates of nosocomial BSI being highest in ICUs, the greatest number of cases occur in non-ICU settings. Many of the incidence of BSI are catheter related. Application of simple principles of intravenous catheter placement and maintenance can markedly reduce nosocomial BSI. Although treatment of BSI can be difficult, the greatest challenge is preventing these infections.

Bloodstream Infections (Contd...)

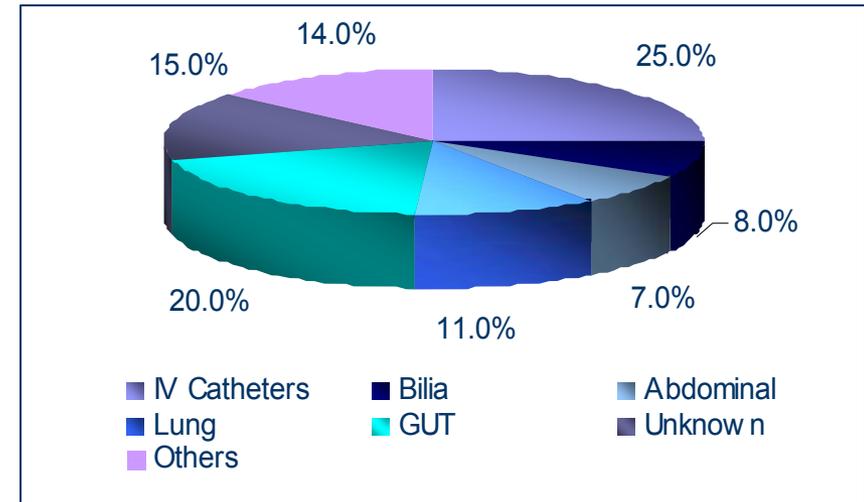
- The major problems with BSI are, the infection can be caused by multiple pathogens and site of origin for them may vary.
- Catheters have been the largest threat to the spread of BSIs. Incidentally, the risk of infection varies with different types of catheters.

Bloodstream Infections: Number of Organisms in Polymicrobial Infectious Episodes (Europe), 2008

Number of Pathogens	Prevalence (%)
Two	86.5
Three	11.8
Four	1.4
Five	0.2
More than Five	0.0

Source: HPA

Bloodstream Infections: Per cent Split of BSI Based on Site of Origin (Europe), 2008



Source: ISCHEMO

- According to Health Protection Agency (HPA) database, the risk of polymicrobial infection has been increasing and accounted for almost 8.8 per cent of BSIs.
- Further analysis to polymicrobial isolates revealed that risk of two pathogen infections was highest.

Catheter-related Bloodstream Infections (CR-BSIs)

- Intravascular catheters are indispensable in hospitals, particularly in ICUs. These catheters provide necessary vascular access, but their use puts patients at risk of BSI. The incidence of CR-BSI varies considerably by the type of catheter, frequency of catheter manipulation, and patient-related factors like underlying disease and acuity of illness.
- The risk of BSI is low with peripheral venous catheters in comparison to the central venous catheters (CVC).
- Approximately 90.0 per cent of the CR-BSI occur with CVC.
- CRBSI is associated with both increased ICU stay and mortality.
- CR-BSIs have been estimated to occur in 3.0 per cent to 7.0 per cent of catheters used.

Bloodstream Infections: Common BSI Pathogens

Common BSI Pathogens
<i>Staphylococcus aureus</i>
<i>Candida</i> spp.
<i>Enterococcus</i> spp.
<i>Corynebacterium</i> spp.
<i>Escherichia coli</i>
<i>Pseudomonas aeruginosa</i>

Source: HPA

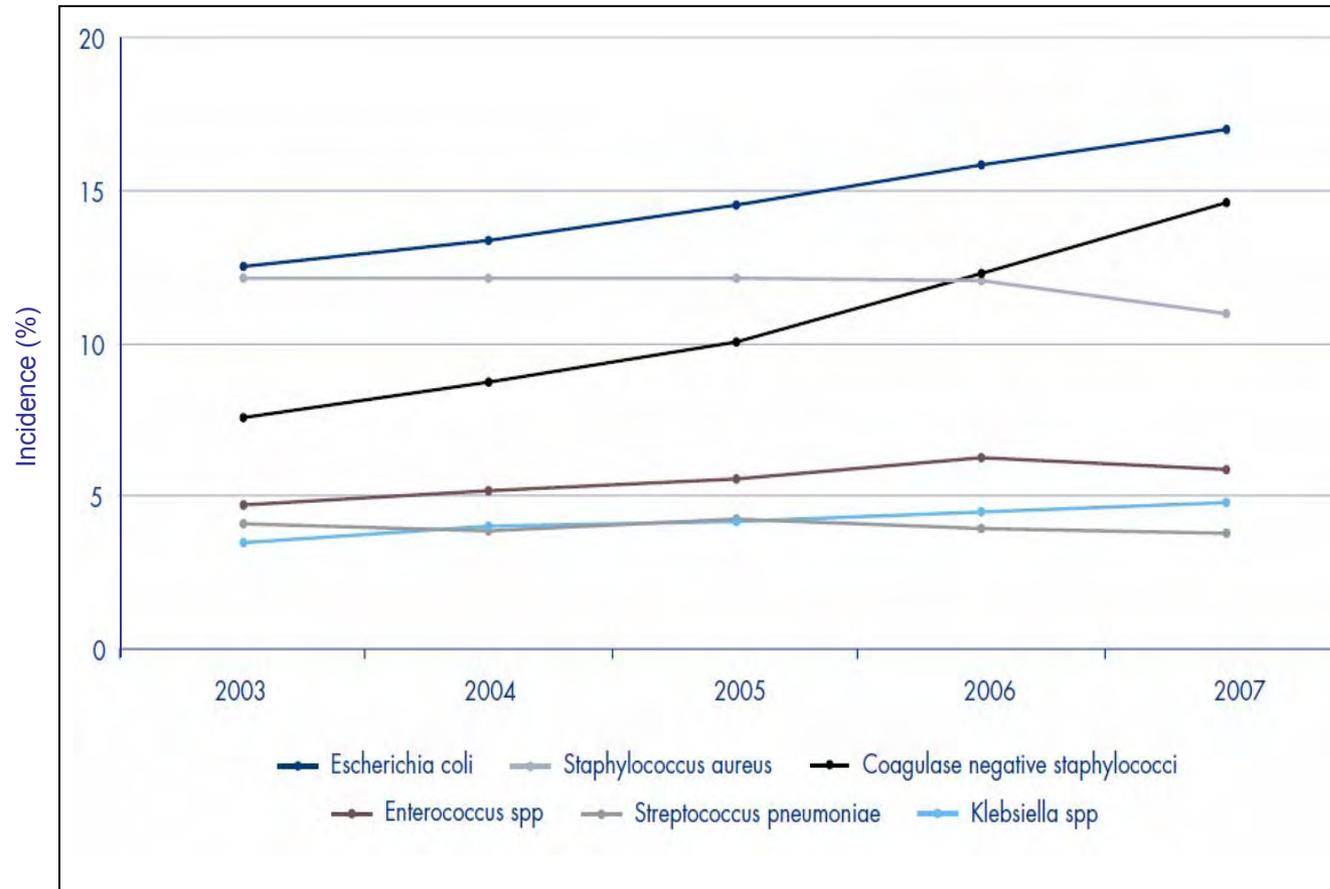
Bloodstream Infections: Incidence of Device-related BSI

Device	Incidence (%)
Peripheral:	
Venous	<0.2
Arterial	1.0
CVC:	
General purpose	3.0
Pulmonary artery	1.0
Haemodialysis	10.0

Source: HPA

Bloodstream Infections

Blood Stream Infections: Trends in Pathogens Causing BSI (UK), 2003-2007



Source: HPA

- ICU-acquired BSIs occurred on an average in 3.4 per cent (mean of ICU cumulative incidences 3.4 per cent, median 2.5 per cent) of patients staying more than two days in the ICU.
- The incidence varied from 1.3 per cent in patients without intubations to 18.6 per cent in patients who were intubated for two weeks or more.
- There has been a decrease in BSIs caused by S.aureus, Enterococci and S.pneumoniae, while there has been an increasing trend in other types of pathogens causing BSI.

MRSA in Bloodstream Infections

Bloodstream Infections: Incidence of MRSA per 100,000 Patient Days (Europe), 2008

Country	MRSA Incidence/100,000 Patient Days
Belgium	3.0
The Netherlands	0.2
Luxembourg	1.3
France	9.0
Italy	5.7
Spain	7.2
Germany	0.6
Norway	0.4
Finland	0.7
Sweden	0.3
The United Kingdom	8.7

- MRSA is one of the largest threat in hospitals causing most of the infections with increasing risk of BSI.
- There has been a declining trend in infections caused due to MRSA in Europe over the years, particularly BSI, due to the various initiatives taken by the governments across countries.

Source: HPA

Antimicrobial Resistance



Introduction

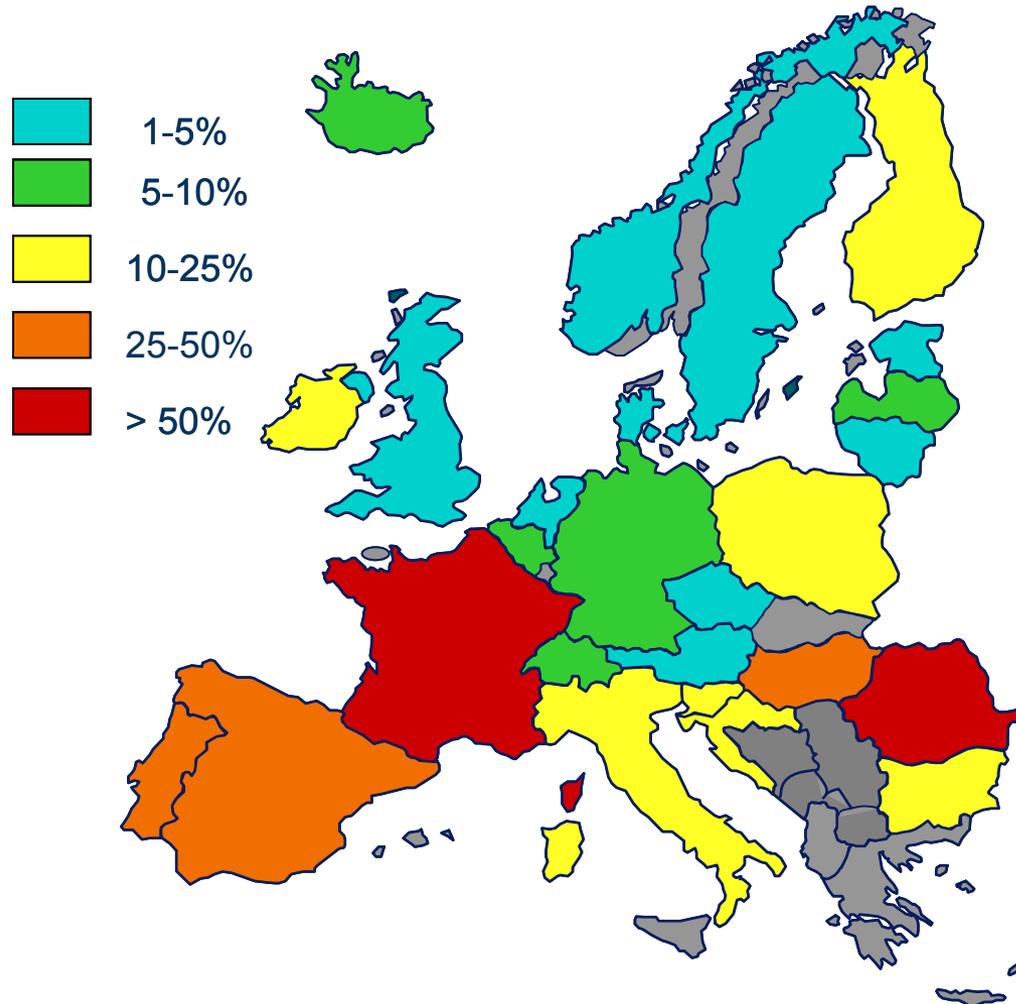
- Antimicrobial agents (antibiotics and related medicinal drugs) have substantially reduced the threat posed by infectious diseases for many years. However, at present, with the emergence and spread of microbes that are resistant to antibiotics, the usage of antibiotics has been threatened. Microbial resistance is emerging and evident in many bacterial infections, which contribute to most human disease such as diarrhoeal diseases, respiratory tract infections, meningitis, sexually transmitted infections and hospital-acquired infections.
- Some important examples include penicillin-resistant *Streptococcus pneumoniae*, vancomycin-resistant enterococci, methicillin-resistant *Staphylococcus aureus*, multi-resistant salmonellae and multi-resistant *Mycobacterium tuberculosis*.

List of Antibiotic Resistant Pathogens

<i>Streptococcus pneumoniae</i> , Penicillin-R (PNSP)	<i>Enterococcus faecalis</i> , Aminoglycoside-R
<i>S. pneumoniae</i> , Erythromycin-R	<i>Klebsiella pneumoniae</i> , Third-generation cephalosporin-R
<i>Escherichia coli</i> , Aminopenicillin-R	<i>K. pneumoniae</i> , Carbapenem-R
<i>E. coli</i> , Third-generation cephalosporin-R	<i>K. pneumoniae</i> , Aminoglycoside-R
<i>E. coli</i> , Aminoglycoside-R	<i>K. pneumoniae</i> , Fluoroquinolone-R
<i>P. aeruginosa</i> , Fluoroquinolone-R	Vancomycin-resistant <i>Staphylococcus aureus</i> (VRSA);
Vancomycin-resistant enterococci (VRE);	Carbapenem-resistant Enterobacteriaceae;
Carbapenem-resistant <i>Pseudomonas aeruginosa</i> ;	Carbapenem-resistant <i>Acinetobacter spp.</i> ;
<i>E. coli</i> , Fluoroquinolone-R	<i>Pseudomonas aeruginosa</i> , Piperacillin- or Pip.-Tazobactam-R
<i>Staphylococcus aureus</i> , Methicillin-R	<i>P. aeruginosa</i> , Ceftazidime-R

Streptococcus pneumoniae

Streptococcus pneumoniae: Proportion of Invasive Isolates with Resistance to Penicillin (Europe), 2008

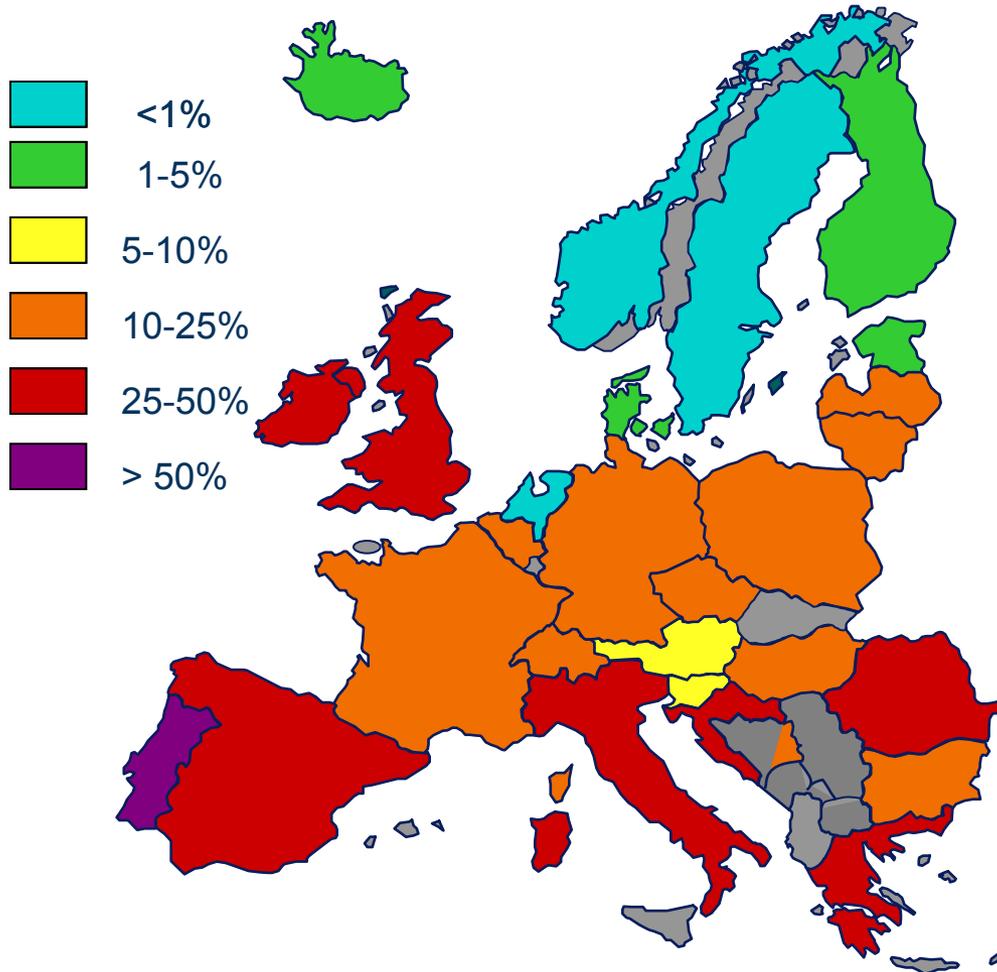


Source: ECDC, 2008

- *Streptococcus pneumoniae* is a common cause for upper airway infections like sinusitis, pneumonia, BSIs and meningitis.
- These pathogens generally have resistance to penicillin and erythromycin. For erythromycin resistance *S. pneumoniae*, the prevalence was more 25.0-50.0% in France, Italy while it varies between 5.0-10.0% in U.K and Germany.
- With regards to isolates dual resistance to penicillin and erythromycin, there was a decrease witnessed in France and Belgium, while it increased in Ireland, Hungary and Turkey.
- Among the low-endemic countries, the United Kingdom and Switzerland showed a significantly increasing trend towards dual resistance.

Staphylococcus aureus

Staphylococcus aureus: Proportion of Invasive Isolates with Resistance to Oxacillin (MRSA) (Europe), 2008

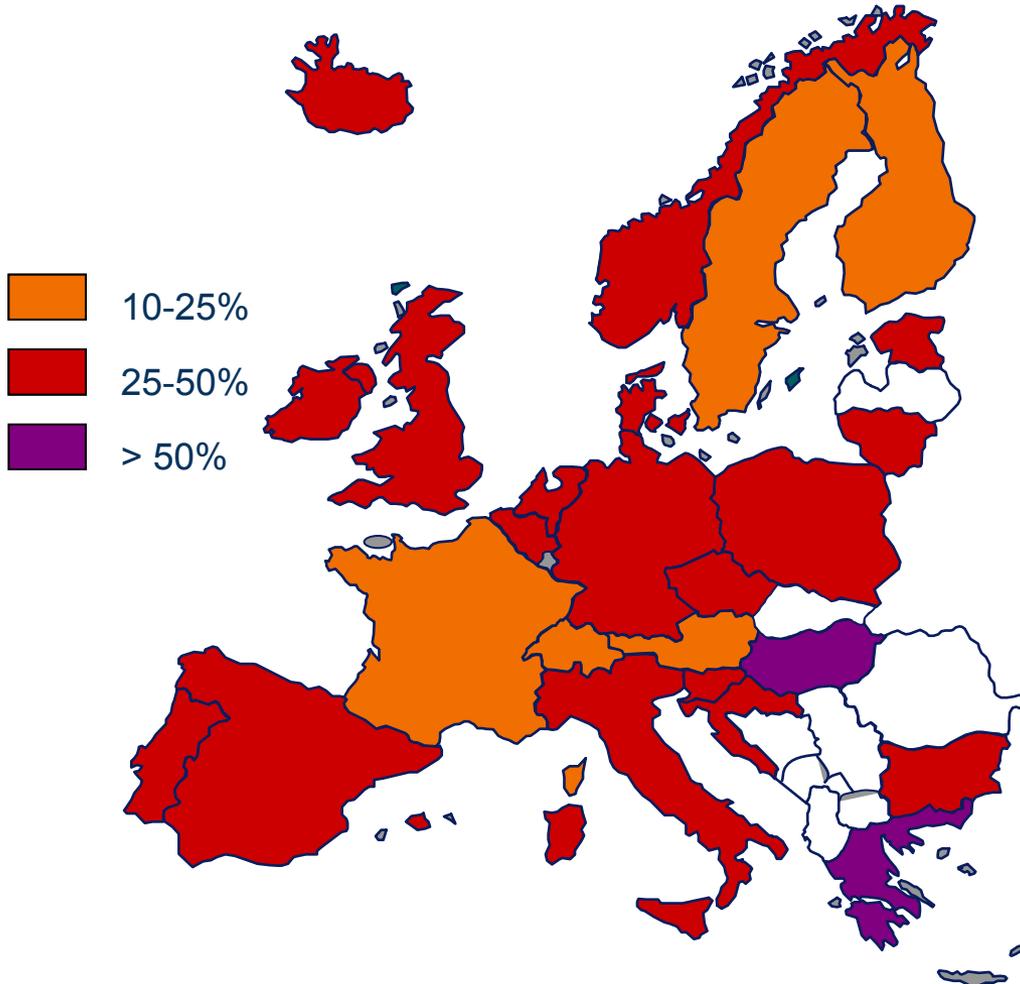


- Staphylococcus aureus is a gram-positive bacterium that colonizes the skin of about 30.0 per cent of healthy humans. Its methicillin-resistant S. aureus (MRSA) is the most important cause of antibiotic resistant healthcare-associated infections worldwide.
- There have been new developments in drug resistance of S.aureus pathogens. This relates to a potentially new strain of Staphylococcus aureus, which could be vancomycin resistant.
- There has been a decrease in the overall MRSA episodes reported in hospitals in Europe. In the United Kingdom, according to HPA, there has been a 59.0 per cent decrease in MRSA episode reported in the last four years.
- The proportion of S. aureus isolates that showed intermediate resistance to vancomycin (VISA) was very low in Europe. Overall, it represented less than 0.1 per cent of S. aureus bloodstream isolates reported to EARSS.

Source: ECDC, 2008

Enterococci

Enterococcus faecalis: Proportion of Invasive Isolates with Resistance to Aminoglycosides (Europe), 2008



- Enterococci belong to the resident flora of the gastrointestinal tract of humans. Under normal circumstances they are harmless commensals, but they cause invasive diseases when the relationship with the host is disrupted.
- Almost 80 per cent of the Enterococci infections in humans are caused by *Enterococcus faecalis* and the rest by *Enterococcus faecium*.
- Enterococci are resistant to a broad range of antibiotics including cephalosporins, penicillins, sulphonamides and low concentrations of aminoglycosides. They are mostly present in bloodstream infections.
- The average proportion of *Enterococcus faecium* isolates that showed resistance to vancomycin was below 8.0 per cent in the Europe. There was a large inter-country variation, from less than 1.0 per cent in 14.0 countries to more than 25.0 per cent in Ireland, Greece and Portugal, with very few significant variations.

Source: ECDC, 2008

Economic Burden of Infections Due to Antibiotic-Resistant Bacteria

Hospital Acquired Infections: Economic Burden of Infections due to Antibiotic-resistant Bacteria (Europe), 2008

Antibiotic-resistant Bacteria	Additional Inpatient Hospital Costs (EUR)	Additional Outpatient Costs (EUR)	Productivity Losses due to Absence from Work (EUR)	Productivity Losses due to Patients Who Died from their Infection (EUR)	Total Costs (EUR)
Antibiotic-resistant Gram - positive Bacteria	424 700 000	5 500 000	91 100 000	145 600 000	666 900 000
Antibiotic-resistant Gram – positive Bacteria	503 100 000	4 500 000	59 300 000	300 300 000	867 200 000
Total	927 800 000	10 000 000	150 400 000	445 900 000	1 534 100 000

Source: ECDC

Geographic Analysis



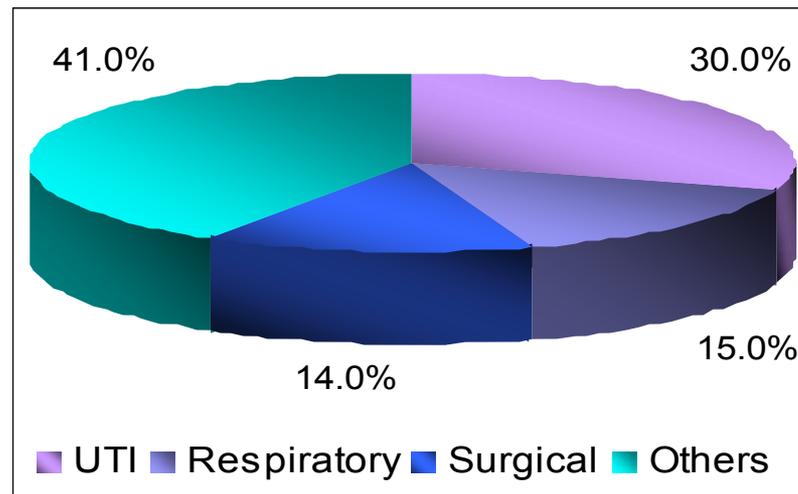


- The importance of nosocomial infection prevention has been well identified and necessary steps have been adopted to improve the existing prevention measures.
- According to the national survey conducted in 2006, among 2,337 health facilities, representing 95 per cent of hospital beds and 358,467 patients on the day of the survey, 17 820 patients were infected. This showed that the prevalence of nosocomial infection in France was as high as 4.97 per cent. However, it decreased by 12.0 per cent from 2001 to 2006.
- With the success of 2005-2008 nosocomial infection control program, the government launched the "National Programme for Prevention of Nosocomial Infections in 2009-2012." This programme is a continuation of the 2005-2008 program. It is organized around six national guidelines, with variations across regions, to improve quality and safety of care.
- The dashboard of nosocomial infections was created by the French Government to encourage all health facilities to measure their actions and their results in the field of fight against nosocomial infections.
- The dashboard provides information about surveillance, infection episodes among others.



- According to reports between 2005 and 2008, nearly 75 per cent of healthcare facilities in France had doubled their annual usage of alcohol-based disinfectants (used for hand hygiene).
- By 2008, all the healthcare facilities performing surgical procedures had organised the surveillance of surgical site infections (SSIs). The awareness in this sector has been very high. In 2005, only 60.3 per cent of the healthcare facilities with surgical activities had surveillance system organised; however, this increased to 84.5 per cent in 2007.
- The need for control of antibiotic resistance pathogen has also been well realized. In 2009, all the healthcare facilities had committees to monitor the antibiotic consumption. In 2007, about 83.8 per cent of health facilities had a committee to monitor proper use of antibiotics. In 2007, about 66.0 per cent of institutions had defined a Memorandum of first-line antibiotics, and 96.2 per cent of establishments with a surgical activity had developed surgical antibiotic prophylaxis protocols.

Hospital-acquired Infections: Per cent of Split by Type (France), 2006



Source: Frost & Sullivan

- In the last two years, the French Government had allocated nearly €46.0 million for the prevention of nosocomial infections. In 2008, 16 studies and research projects had been funded by the Ministry of Health, for about €780 000.

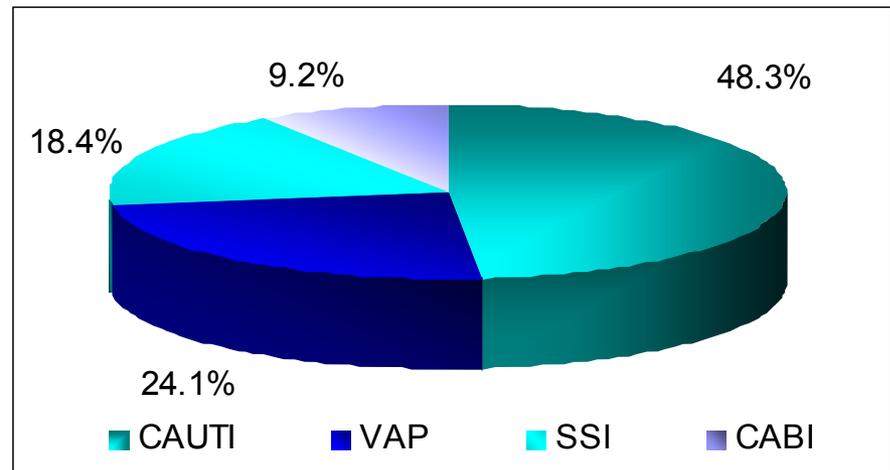


- The six key directions are promoting a shared culture of quality and safety care, optimising the collection and use of surveillance data, anticipating and detecting the emergence of pathogens with epidemic potential, maintaining the user at the centre of device, improving the organisation of prevention of infections associated with care and promoting research on healthcare associated infections.
- The target objectives to be achieved by 2012 across healthcare facilities are:
 - The incidence of bacteremia associated with central venous catheters (CVC) in resuscitation should be less than 1/1000 days of exposure to venous catheters central.
 - The incidence of SSIs for 100 acts, for patients with low-risk elective surgery should decrease by 30.0 per cent. Targeted interventions are the wall hernia, cholecystectomy, orthopedic prosthetic surgery, caesarean, breast surgery, peripheral veins and coronary bypass surgery.
 - The incidence of blood exposure to personal healthcare facilities must drop by 20.0 per cent per 100 admissions.
 - The incidence of MRSA per 1000 days of hospitalisation should decrease by 20.0 per cent and the proportion of strains of Enterococcus faecium resistant to glycopeptides has to remain below 2 per cent over the national territory.



- Nosocomial infection is huge burden to the German healthcare system. There are around 16.0 million admissions in German hospitals, thus the risk of nosocomial infection is significantly high.
- In Germany, the "Krankenhaus-Infektions-Surveillance-System"(KISS), was initiated in 1997. It is a nationwide nosocomial infection surveillance system to create a database for hospital infections throughout Germany. The surveillance is further divided into:
 - ICU surveillance component ("ITS-KISS")
 - Surgical patient surveillance component ("OP-KISS")
 - Neonatal ICU component ("NEO-KISS")

Hospital-acquired Infections: Per cent of Split by Type (Germany), 2009



Source: RKI

- According to Robert Koch Institute (RKI), there are around 500,000 nosocomial infections occurring every year in Germany. It also revealed that the inpatient stay in ICU increases by five days due to nosocomial infection.



Hospital-acquired Infections: Pathogens Causing Infections and Related Details (Germany), 2008

Pathogen	Frequent Cause of Nosocomial Infection	Frequency on Hands	Persistence on Hands
Staphylococcus aureus	Surgical site infection, pneumonia, sepsis	10-78%	≥150 minutes
Pseudomonas spp.	Lower respiratory tract infection	1-25%	30-180 minutes
Escherichia coli	Urinary tract infection	Unknown	6-90 minutes
Yeasts including Candida spp.	Lower respiratory tract infection, urinary tract infection, sepsis	23-81%	1 hour
Rotavirus	Viral gastroenteritis, particularly in children	20-79%	Up to 4 hours
Clostridium difficile	Antibiotic-associated diarrhea	15-49%	Unknown

- In Germany, the Clean Hands Campaign (“Aktion saubere Hände”) was launched by the Federal Ministry of Health in January 2008. By June 2009, 550 hospitals had signed up to the campaign, including two-thirds of the university hospitals. The goal was to establish hand disinfection as a decisive quality parameter anchored firmly in clinical routine.
- The rate of nosocomial infections can be reduced up to 40.0 per cent by improved compliance in hand disinfection.

Source: *Dtsch Arztebl Int*



- In 2006, "Prevention and control of infections in health care organizations and social health - INF-OSS project" was initiated to enable a stable coordination between regions to harmonise tools for monitoring and infection control. This was funded by National Centre for Prevention and Disease Control – CCM Ministry of Health.
- According to Italian Society of Infectious and Tropical Diseases (SIMIT) nosocomial infections was prevalent in 5.0 to 10.0% of hospitalized patients in Italy.
- Interestingly blood stream infections accounted for 10.0-15.0% of nosocomial infections and was directly associated with mortality rate of 15.0%. Vascular catheters were responsible for most cases of nosocomial BSIs. Sepsis related to vascular catheters were the most easily preventable nosocomial infection.
- The urinary tract infection (UTI) were the most common nosocomial infection, accounting for up to 40.0-45.0% of cases. UTIs contributed only 10.0-15.0% of longer hospitalization and additional costs unlike other infections where the prolonged stays and additional costs involved were much higher. The majority of nosocomial UTI was associated with invasive urological manoeuvres or placement of catheters in the bladder.

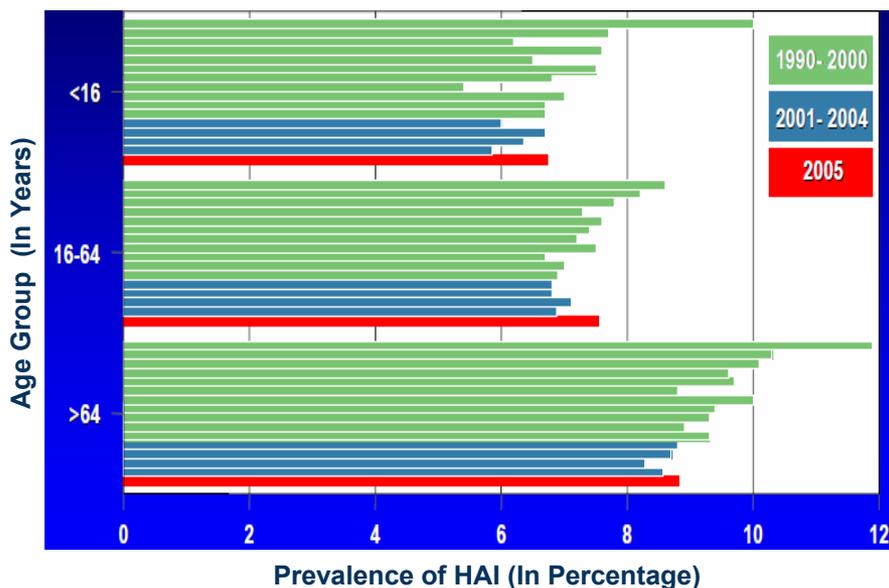


- The surgical site infections represented only 20.0 to 30.0% of nosocomial infections, but contributed up to 57.0% of additional days of hospitalization and 42.0% of additional costs. It is difficult to determine the true incidence of surgical site infection because the average infection has an incubation period of 5-7 days beyond the period of hospital stay. As a huge percent of the procedures are currently performed as outpatient surgeries, it further increases the complexity in tracking the prevalence of infections. It is interesting to note that almost 2.0-5.0% of patients operated have the risk of acquiring surgical site infection in Italy.
- Nosocomial pneumonia accounted for 15.0- 20.0% of the nosocomial infections in Italy. It is the most frequent cause of infection in intensive care units but is considered to be the second most frequent cause of infections in the totality of nosocomial infections. It is responsible for more than 20.0% of the additional days of hospitalization and almost 40.0% of additional costs. The overall mortality rate in fact varies between 20.0% and 70.0%.



- According to a study in Spain, in the last few years the adverse events related to hospitals ranged between 4.0 to 17.0%, where 50.0 percent of them could have been prevented.
- As adverse events cause 31.4% of extended stays and are responsible for 25.0% of the readmissions, the impact is huge on the hospital expenditure.

Hospital-acquired Infections: Prevalence if HAI across Age Groups (Spain), 1990-2005



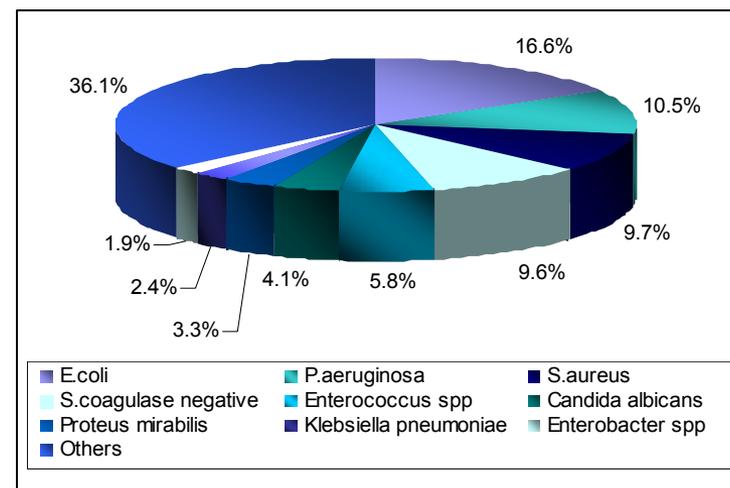
Source: Ministry of Health, Spain

Hospital-acquired Infections: Percentage Split of Adverse Events (AE) by Type (Spain), 2008

Problem Nature	Total %	Avoidable %
Procedure- related	25.0	31.7
Nosocomial Infection related	25.3	56.6
Medication related	37.4	34.8
Related to the care provided	7.6	56.0
Diagnosis related	2.7	84.2
Other	1.8	33.4

Source: Ministry of Health, Spain

Hospital-acquired Infections: Percentage split of Pathogens Causing HAI (Spain), 2005

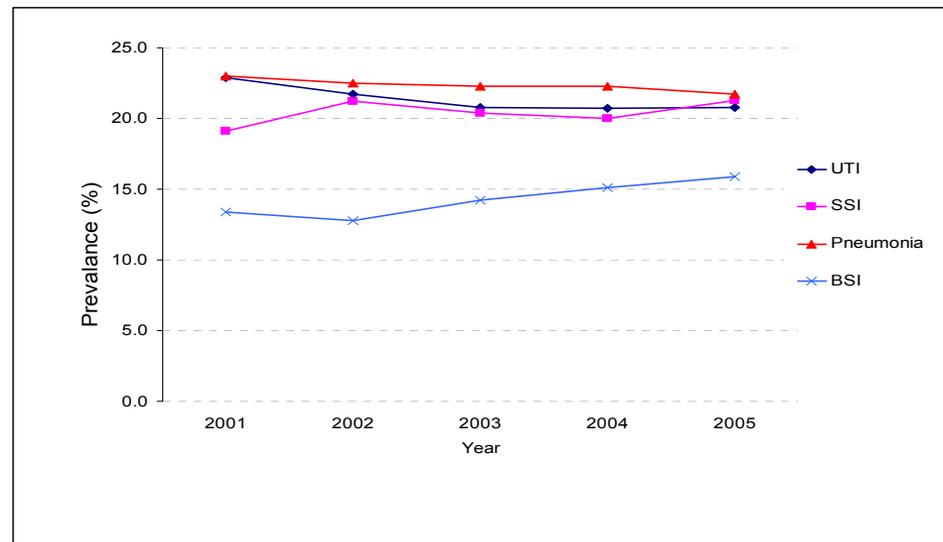


Source: Ministry of Health, Spain

Spain (Contd...)

- According to the EPINE study, the prevalence of Hospital-acquired infection in 2009 was 6.8%. Interestingly the prevalence of VAP was 7.10% in hospitals, BSI was 6.1%.
- The prevalence of infections in Pediatrics was 6.73% and 8.11% in patients having undergone surgery.
- The risk of infection also varied according to size of the hospitals. The prevalence was 6.41% in Small hospitals, while 7.77 % in medium sized hospitals and 9.31% in major hospitals.
- In this study where 4692 HAI patients were studied, UTI accounted for 22.1%, Hospital-acquired respiratory infections accounted for 20.93% and surgical site infections accounted for 20.16%.

Hospital-acquired Infections: Prevalence by Type in Percentage (Spain), 2001-2005



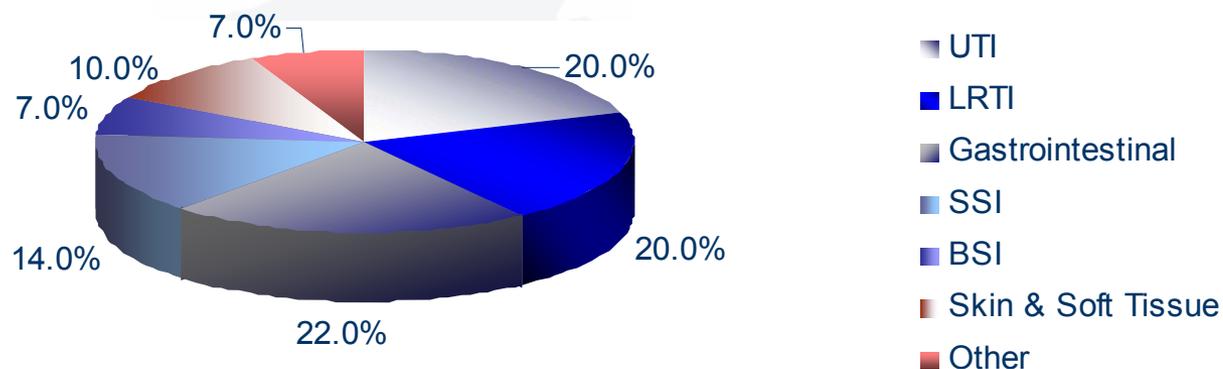
Source: Ministry of Health, Spain

The United Kingdom



- According to the National Audit Office report of 2009, a prevalence survey found that 8 per cent of patients had nosocomial infections. The risk of obtaining a healthcare associated infection increases with age. The prevalence of infections in people under 35 was 3.2 per cent; between the ages of 35 and 64 it was 6.4 per cent; between the ages of 65 and 84 it was 8.3 per cent and for people over 85 it rose to 9.8 per cent.
- Incidentally, about 44 per cent of the BSIs are associated with invasive devices of which two-thirds is due to intravenous access devices.
- With UTI, 80.0 per cent of them were associated with urinary catheters.
- About 70.0 per cent of healthcare associated gastrointestinal infections were caused by *C. difficile*.
- About 50.0 per cent of SSIs were caused by *S.aureus*.

Hospital-acquired Infections: Per cent Split by Type (UK), 2009



Source: HPA



- The estimated cost of caring for people that acquire a healthcare associated infection is over £1.0 billion per year for NHS hospitals. However, the Department's productivity calculator estimated that each avoidable healthcare associated infection cost the NHS £4,300.
- The Department of Health committed to make the control and prevention of healthcare associated infections a top priority. The Health Act 2006 introduced new legislation on prevention and control of healthcare associated infections. Until March 2009, compliance was regulated through a statutory inspection regime operated by the Healthcare Commission. From April 2009, this responsibility passed to the new Care Quality Commission.
- For 2007-08, the average bed occupancies (Source: Information Centre), were 85.3 per cent, and for Elderly Care, a high risk group for healthcare associated infection, the same was 90.8 per cent. Average bed occupancy levels in 26.0 per cent of trusts are over 90.0 per cent. Bed occupancy levels in the United Kingdom are high by international standards.
- Most trusts do not report data on healthcare associated infections, other than MRSA BSIs and *C. difficile*, to their board. The 2008 Code of Practice expects NHS trusts to undertake local surveillance on other healthcare associated infections and to adopt measures for their control and prevention.
- The Health Act 2006 introduced a target to reduce one specific infection, namely MRSA BSI, across all NHS acute hospital and acute foundation trusts by 50 per cent by 2008. By end of March 2008, the NHS had achieved a 57.0 per cent reduction in MRSA BSIs against the 50.0 per cent national target.

The United Kingdom (Contd...)



- Reports of *C. difficile* in the over 65 years age group peaked in 2006. In October 2007, a target was set for a 30.0 per cent reduction in the number of cases of *C. difficile* reported in 2010-11 against a 2007-08 baseline. However, since 2007 there has been a 41.0 per cent reduction.
- There has also been a reduction in SSIs. The overall orthopaedic SSI rate has also fallen from 1.44 per cent in 2004 to 0.6 per cent in 2008.
- There are no national surveillance systems on some of the most common healthcare associated infections, for example UTIs, pneumonia and skin infections. However, the Health Protection Agency receives data and reports back annually to trusts on all BSIs under its voluntary surveillance scheme.
- Since April 2004, the Department and its arm's length bodies spent £120.0 million, comprising £57.0 million on national initiatives to tackle healthcare associated infections and a one-off allocation of £63.0 million for the "deep clean" in 2007-08. From 2003 to 2009, the NHS saved between £45.0 million and £59.0 million in treatment costs by reducing the incidence of MRSA BSIs. From 2006 to 2008, it saved between £97.0 million and £204.0 million in treatment costs by reducing *C. difficile* infections.
- To control antibiotic resistance, the tracking of hospital antibiotic prescribing patterns is of high importance. However, the progress in enhancing the tracking has been limited, largely because of delays in developing electronic prescribing.

Initiatives and Impact in the United Kingdom

Hospital-acquired Infections: Objectives, Costs and Benefits of Various Initiatives (UK), 2009

Project	Objective	Costs	Benefits
Modern Matrons	Improve clinical care Standards and provide clean environment for care	At least £56 million per annum – Infection control is 30 per cent of their workload	Helped in increased usage of disinfectants, sterilisation and disinfection equipment
Clean Your Hands Campaign	Improve the availability of alcohol hand rub at patient care and increase compliance with hand hygiene and its auditing	£2.5 million	Increase in usage of hand disinfectants
The Deep Clean (2008)	Improvements in cleanliness and patient confidence, tackle healthcare associated infections and ensure patient safety	£62.6 million	Increase in usage of disinfection equipment
MRSA Screening (from April 2009)	Reduction of spread of MRSA colonisation from patients in the community into the hospital	Approximately £130.0 Million per annum from 2010-11	Increase in usage of diagnostics sets

Source: HPA

About Frost & Sullivan



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- **The Growth Consulting Company**
 - Founded in 1961, Frost & Sullivan has over **45 years** of assisting clients with their decision-making and growth issues
 - Over 1,700 Growth Consultants and Industry Analysts across 32 global locations
 - Over 10,000 clients worldwide - emerging companies, the global 1000 and the investment community
 - Developers of the **Growth Excellence Matrix** – industry leading growth positioning tool for corporate executives
 - Developers of **T.E.A.M. Methodology**, proprietary process to ensure that clients receive a 360° perspective of technology, markets and growth opportunities
 - Three core services: **Growth Partnership Services, Growth Consulting** and **Career Best Practices**

What Makes Us Unique

• Exclusively Focused on Growth

Global thought leader exclusively focused on addressing client growth strategies and plans – Team actively engaged in researching and developing of growth models that enable clients to achieve aggressive growth objectives.

• Industry Breadth

Cover the broad spectrum of industries and technologies to provide clients with the ability to look outside the box and discover new and innovative ideas.

• Global Perspective

32 global offices ensure that clients receive a global coverage/perspective based on regional expertise.

• 360° Perspective

Proprietary T.E.A.M.TM Methodology integrates all 6 critical research methodologies to significantly enhance the accuracy of decision making and lower the risk of implementing growth strategies.

• Growth Monitoring

Continuously monitor changing technology, markets and economics and proactively address clients growth initiatives and position.

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T.E.A.M. Methodology

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In-depth qualitative and quantitative research focused on timely and critical global, regional, and country specific trends, including the political, demographic, and socioeconomic landscapes.

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Insightful strategies, networking opportunities, and best practices that can be applied for enhanced market growth; interactions between the client, peers, and Frost & Sullivan representatives that result in added value and effectiveness.

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