

عفونت‌های بیمارستانی

دکتر لیدا محفوظی

متخصص بیماری‌های عفونی

استادیار دانشگاه علوم پزشکی گیلان

مقدمه

- Hundreds of millions of patients are affected by health care-associated infections worldwide each year, leading to significant **mortality and financial losses for health systems.**
- Of every **100** hospitalized patients at any given time,
 - **7** in developed and
 - **10** in developing countries
- will acquire at least one health care-associated infection.

The **endemic burden** of health care-associated infection is significantly higher in **low- and middle-income** than in high-income countries, in particular in patients admitted to **intensive care units** and in **neonates**.

urinary tract infection is the most frequent health care-associated infection in high-income countries,

surgical site infection is the leading infection in settings with limited resources, affecting up to one-third of operated patients

up to nine times higher than in developed countries.

In high-income countries, approximately 30% of patients in (ICU) are affected by at least one health care-associated infection.

In low- and middle-income countries the frequency of ICU-acquired infection is at least 2-3 fold higher

device-associated infection up to 13 times higher than in the USA.

Newborns are at higher risk of acquiring health care-associated infection in developing countries, with infection rates **three to 20 times** higher than in high-income countries.

تعريف

- Hospital-acquired infections, or healthcare-associated infections (HAI), are nosocomially acquired infections **not present or might be incubating at the time of admission.**
- These infections are acquired after hospitalization and manifest **48 hours after admission to the hospital**

Health care-associated infections, or “nosocomial” and “hospital” infections, affect patients in a **hospital** or **other health-care facility**, and are not present or incubating at the time of admission.

They also include infections acquired by patients in the hospital or facility but

- ***appearing after discharge,**

and

- ***occupational infections among staff.**

HAI infections include

- *central line-associated bloodstream infections (CLABSI)
- *catheter-associated urinary tract infections (CAUTI)
- *surgical site infections (SSI)
- *Hospital-acquired Pneumonia (HAP)
- *Ventilator-associated Pneumonia (VAP)
- * *Clostridium difficile* infections (CDI)

The impact of hospital-acquired infections is seen not just at an individual patient level, but also at the community level as they have been linked to **multidrug-resistant infections.**

Identifying patients with risk factors for hospital-acquired infections and multidrug-resistant infections is very important in the prevention and minimization of these infections.

The risk for hospital-acquired infections is dependent on

*the **infection control** practices at the facility,

*the patient's **immune status**,

* the **prevalence of the various pathogens** within the community.

The risk factors for HAI include :

- immunosuppression
- older age
- length of stay in the hospital
- multiple underlying comorbidities
- frequent visits to healthcare facilities
- mechanical ventilatory support
- recent invasive procedures
- indwelling devices
- and stay in an intensive care unit (ICU)

Receipt of intravenous antibiotics within the last 90 days is one of the major risk factors for developing antimicrobial resistance to multiple drugs.

hospitalizations play a major role in the management of acute illnesses,
but they also enhance the risk of susceptible patients for multiple nosocomial and often antimicrobial-resistant pathogens.

These pathogens can be acquired from :

- *other patients,
- *hospital staff,
- *or the hospital facility.

The risk is higher among patients in ICU.

In a point prevalence study that included 231,459 patients across 947 hospitals concluded that about 19.5% of patients in ICU had at least one HAI.

epidemiology

At any given time, the prevalence of health care-associated infection in developed countries varies between **3.5% and 12%**.

The European Centre for Disease Prevention and Control reports an average prevalence of **7.1%** in European countries.

The estimated incidence rate in (USA) was **4.5%** in 2002, corresponding to 9.3 infections per 1 000 patient-days and 1.7 million affected patients.

According to a recent European multicentre study, the proportion of infected patients in **ICU** can be as high as **51%**; most of these are health care associated.

Approximately **30%** of patients in ICUs are affected by at least one episode of health care-associated infection.

The longer patients stay in an ICU, the more at risk they become of acquiring an infection.

On average, the **cumulative incidence of infection** in adult high-risk patients is **17.0 episodes per 1000 patient days**.

High frequency of infection is associated with the use of invasive devices, in particular central lines, urinary catheters, and ventilators.

Health care-associated infections in low- and middle-income countries

Limited data, often of low quality, are available from low- and middle-income countries.

recent analysis by WHO found that health care-associated infections are more frequent in resource-limited settings than in developed countries.

At any given time, the prevalence of health care-associated infection varies between 5.7% and 19.1% in low- and middle-income countries.

Average prevalence is significantly higher in high- than in low-quality studies (15.5% vs 8.5%, respectively).

The proportion of patients with ICU-acquired infection ranged from 4.4% to 88.9% with a frequency of overall infections as high as 42.7 episodes per 1000 patientdays.

This is almost three times higher than in high-income countries.

in some developing countries, the frequency of infections associated with the use of central lines and ventilators and other invasive devices can be up to 19 times higher than those reported from Germany and the USA.

Newborns are also at higher risk, with infection rates in developing countries 3-20 times higher than in high-income countries.

Among hospital-born babies in developing countries, health care-associated infections are responsible for **4% to 56% of all causes of death** in the neonatal period, and 75% in South-East Asia and Sub-Saharan Africa.

Surgical site infection is the leading infection in the general patient population in countries with **limited resources**, affecting up to **two third** of operated patients and with a frequency up to nine times higher than in developed countries.

The infections (in descending order) include:

- **Pneumonia (21.8%),**
- **surgical site infections (21.8%),**
- **gastrointestinal infections (17.1%),**
- **urinary tract infections or UTIs (12.9%),**
- **and primary bloodstream infection (9.9%, and include Catheter-associated bloodstream infections).**

Among the pathogens causing HAI,
***C. difficile* (12.1%)** is the leading pathogen
and is closely followed by :

Staphylococcus aureus (10.7%),
Klebsiella (9.9%), and
Escherichia coli (9.3%).

Skin and surgical site infections are usually caused
by *Staphylococcus aureus* and sometimes include
Methicillin-resistant *staphylococcus aureus*
(MRSA).

The SENIC study (Study on Efficacy of Nosocomial Infection Control) pointed out the possibility of reducing infections by **a third** by combining **infection tracking and infection control programs**.

The implementation of robust infection surveillance and prevention practices has resulted in some success in the prevention of HAI.

According to the CDC, the rates of **CLABSI** have decreased by 46% between 2008 to 2013

What factors put patients at risk of infection in health-care settings?

Several factors can cause health care-associated infections. Some of these factors are present regardless of the resources available:

- ☐ **prolonged and inappropriate use of invasive devices and antibiotics;**
- ☐ **high-risk and sophisticated procedures;**
 - ☐ **immuno-suppression and other severe underlying patient conditions;**
- ☐ **insufficient application of standard and isolation precautions.**

Some determinants are more specific to settings with limited resources:

- ❑ inadequate environmental hygienic conditions and waste disposal;
- ❑ poor infrastructure;
- ❑ insufficient equipment;
- ❑ understaffing;
- ❑ overcrowding;
- ❑ poor knowledge and application of basic infection control measures;
- ❑ lack of procedure;
- ❑ lack of knowledge of injection and blood transfusion safety;
- ❑ absence of local and national guidelines and policies.

Pathophysiology

Transmission of pathogens in a health care environment is complex and can occur through:

- direct contact with the healthcare workers
- or the surrounding contaminated environment.

- Risk factors for the development of CDI

- recent antibiotic use
- gastric acid suppressants
- nonselective non-steroidal anti-inflammatory drugs (NSAIDs)
- some comorbidities

- Risk factors for SSI include both:
 - patient factors
 - such as age, diabetes, obesity, nutritional status, colonization, co-existing infections,
 - and operative factors
 - such as duration of the procedure, skin antisepsis, surgical technique, antimicrobial prophylaxis.
- Some pathogens possess a tendency to colonize in areas with warmth and moisture.
- These areas located in the inguinal and perineal region, axilla, and trunk.
- Certain bacteria and fungi thrive in such environments.

- Some of the proposed mechanisms of CAUTI are
 - intraluminal colonization,
 - retrograde intraluminal ascent,
 - extraluminal peri urethral spread,
 - and biofilms adherent to the urinary catheters.
- Some organisms, such as *Pseudomonas* species and *Proteus* species, can form tough biofilms around catheters.
- Sometimes, these pathogens produce enzymes that inactivate the antimicrobial agents, making it harder to treat these infections.

- Mechanisms of infection in central line-associated bloodstream

- colonization,
- biofilm formation,
- extraluminal migration.
- The femoral site is associated with an increased risk of infections and should be avoided if possible.
- Staphylococcus aureus and Staphylococcus epidermidis are common organisms associated with biofilm formation on catheters.

Coagulase-negative staphylococci (CoNS), commonly found in **skin flora**, is a common cause of colonization of central lines and thereby central line-associated bloodstream infections.

- Multidrug-resistant (MDR) pathogens a significant cause of infections in hospitals, particularly in the ICU
- Infections with MDR organisms increase the length of stay (LOS), mortality indicators, and costs of care.
- MDR pathogens are resistant to at least one antibiotic from three different classes or with different mechanisms of action

- **MDR organisms** are often suspected of HAP and VAP.
- The use of intravenous antibiotics within the past 90 days is an important risk factor for MDR infections.
- **Other risk factors for MDR VAP include:**
 - the presence of **septic shock** at the time of VAP onset
 - **duration** of hospitalization,
 - **Acute respiratory distress** syndrome,
 - **acute renal replacement** therapy before the onset of VAP

History and Physical

- Obtaining details in history and performing a physical examination is important in determining whether the infection was acquired before admission or whether it is a hospital-acquired infection.
- Important pieces of history, such as subjective fever, chills, and night sweats, may indicate that the infection was not hospital-acquired

Common infectious symptoms

fever, chills, altered mental status, productive cough, shortness of breath, palpitations, abdominal pain, flank pain, suprapubic pain, polyuria, dysuria, and diarrhea.

Vital signs can reflect signs of systemic inflammatory response or sepsis. These include hypothermia or hyperthermia, tachypnea, tachycardia, and hypotension.

Examination of external devices such as tracheostomies, endotracheal tubes, foley catheters, intravascular lines, insulin pumps, and pacemakers/defibrillators is essential.

Supplementing the examination of external devices is the information on the location and placement of the device (duration and setting).

Central lines placed hastily during emergencies need to be **re-evaluated** and possibly replaced within **24 hours to 48 hours**, especially in the context of aseptic conditions during placement of the line or a new fever during hospitalization.

Central venous catheters are considered the primary source of hospital-acquired bloodstream infections.

The other sources of bloodstream infections are **catheter-associated urinary tract infections** and **ventilator-associated Pneumonia**.

The surgical sites and breaches in skin integrity should be examined daily for any signs of evolving infection.

Thorough and serial examinations go a long way in identifying brewing infections in early phases, containing the infections, and minimizing complications.

Careful examination of abdomen and stool samples is often needed in evaluation for clostridium difficile infection

Evaluation

- Laboratory testing complements the history and clinical examination in elucidating the possible source of infection and revealing evidence of organ dysfunction.
- Serum levels of lactic acid, liver transaminases, prothrombin time, blood urea nitrogen (BUN), and serum creatinine can support clinical findings of hypoperfusion.
- Other important lab findings include low or elevated white cell counts, elevated bands, thrombocytopenia, hypoglycemia, hyperglycemia, and reduced mixed venous blood saturation.
- Obtaining samples for cultures before initiation of antibiotics is vital in early identification of the pathogen and the antimicrobial susceptibility pattern.

- Both the pathogen and the antibiotic susceptibility help narrow down from broad-spectrum antibiotics to specific agents targeted towards the pathogens.
- Investigations that do not alter clinical decision making or the clinical course not recommended.
- If the pretest probability is high for a HAI such as ventilator-associated pneumonia/ VAP, then tests such as C-reactive protein (CRP) and procalcitonin are not indicated.
- For patients with HAP/ VAP, recent IDSA guidelines recommend noninvasive sampling with tracheal aspirates that shown to have non-inferior yield when compared to invasive samplings such as quantitative tracheal lavage or bronchoscopy

Outcomes

- Healthcare-associated infections increase the length of stay, health care costs, and mortality.
- Each year the top 5 healthcare-associated infections result in about \$9.8 billion costs, with surgical site infections leading the pack.
- Healthcare costs are known to occur in every medical and surgical department, including the ICU.
- with more awareness and better guidelines, both sepsis and central line infections are declining.
- Best practices have now been established in most hospitals for the insertion of central lines and wound care.
- All members in all disciplines of the interprofessional healthcare team must have involvement in this process

What is the impact of health care-associated infections?

health care-associated infections create additional suffering

And a high cost for patients and their families.

Infections prolong hospital stays, create long-term disability, increase resistance to antimicrobials, represent a massive additional financial burden for health systems, generate high costs for patients and their family, and cause unnecessary deaths.



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