Epidemiology of Nosocomial Infections

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Intro

- Nosocomial infections are a major concern for the global health safety of both patients and healthcare workers.
- They also referred to as healthcare-associated infections (HAI), are infections acquired during the process of receiving health care that was not present during the time of admission.
- These infections are not related to the main cause of hospital admission and may occur even after the patient has been discharged from the hospital.

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Epidemiology and Risk Factors of Nosocomial Infection in Hospitalized Children and Adults: A Review

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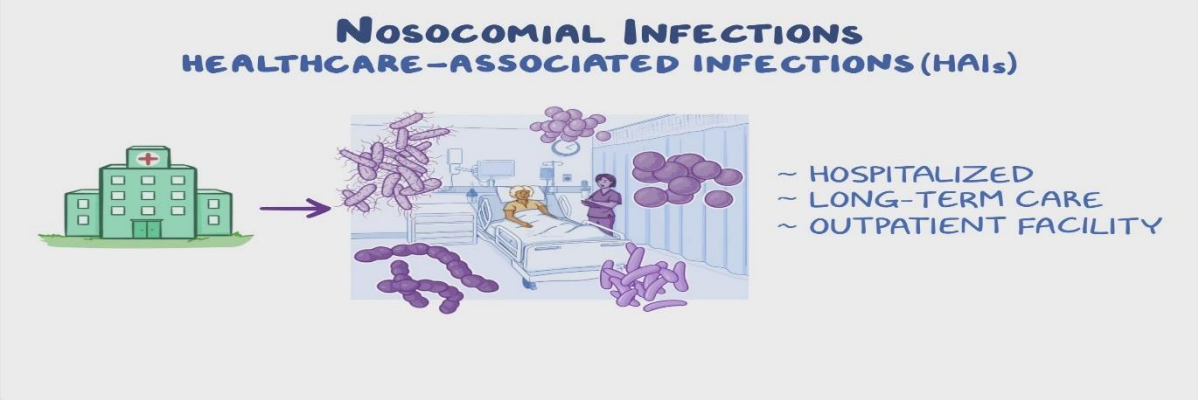
Intro *(Cont'd)*

- Although some of these infections can be treated easily, others may more seriously affect a patient's health, increasing length of their hospital stay and hospital costs, and causing considerable distress to these patients.
- Nosocomial infections are a potential risk to the patients, staff, and community as well.
- Due to poor surveillance systems, there is minimal information on the burden of healthcare-associated infections.

Types

- The most frequently reported types of healthcare-associated infections
  - Respiratory tract infections
  - Surgical site infections
  - Urinary tract infections
  - Bloodstream infections
  - Gastro-intestinal infections, with Clostridium difficile infections representing almost half of the gastro-intestinal infections



- The five most common hospital-acquired infections in the United States, which include urinary tract infection, pneumonia, catheter sepsis, surgical wound infection, and infection caused by the bacterium Clostridium difficile, are estimated to cost the healthcare system in the United States $10 billion annually.

- Cost of treatment in one patient:
  - CRBSI: $45,000
  - VAP: $40,000
  - Clostridium difficile infection:$11,000

- According to European Centre for Disease Prevention and Control more than 3.5 million cases of HAI are estimated to occur in the European Union and European Economic Area each year
  - leading to more than 90 thousand deaths and corresponding to approximately 2.5 million disability adjusted life years (DALYs)
  - a burden estimated to exceed the cumulative burden of other infections including influenza and tuberculosis in the EU/EEA

- HAIs constitute 71% of cases of infections with antibiotic-resistant bacteria, including bacteria resistant to last-resort antibiotics, such as CREs.

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- Intensive care patients represent a concerning healthcare category due to their fragilities and infection predisposition.
- An essential role is to prevent infections by monitoring the patients during their recovery.
  - surveillance programs must be encouraged as the prior infection control strategy
- At the same time, once an infection has occurred, it is vital to promptly provide a concrete plan for patient intervention.

THE URGENCY OF A FAST-TRACK PROTOCOL IN INTENSIVE CARE SETTINGS

ICU patient (with fragilities and risk factors)

Clinical scores and **laboratory biomarkers** fortify the infection suspicion

Surveillance data suggest potential MDR microorganisms infection and/or dissemination

Acute symptoms and/or imaging signs

Clinicians select a **fast-track protocol** for a specific patient

Rapid aetiological agent **identification and antimicrobial susceptibility testing**

Laboratory personnel aim to apply all the **advanced rapid technologies** to provide preliminary microbiological data

antibiotics

MDPI

Review

Bacterial Infections in Intensive Care Units: Epidemiological and Microbiological Aspects

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- a descriptive cross-sectional study that was conducted on 112,316 patients from eight hospitals in Qom City in 2018.
- Information were collected via the national nosocomial infections surveillance system of Iran and patients' medical records
- Results
  - The prevalence of nosocomial infections in patients hospitalized in the hospitals of Qom city was 0.8%.
  - The highest and lowest prevalence of nosocomial infections were reported in neonatal intensive care units (11%) and pediatric intensive care units (1.1%), respectively.
  - The most common type of nosocomial infection in hospitalized patients was UTI (27.7%) and the least common type was SSI (8.3%).
  - Acinetobacter and Escherichia coli were the highest bacterial strains in infections.

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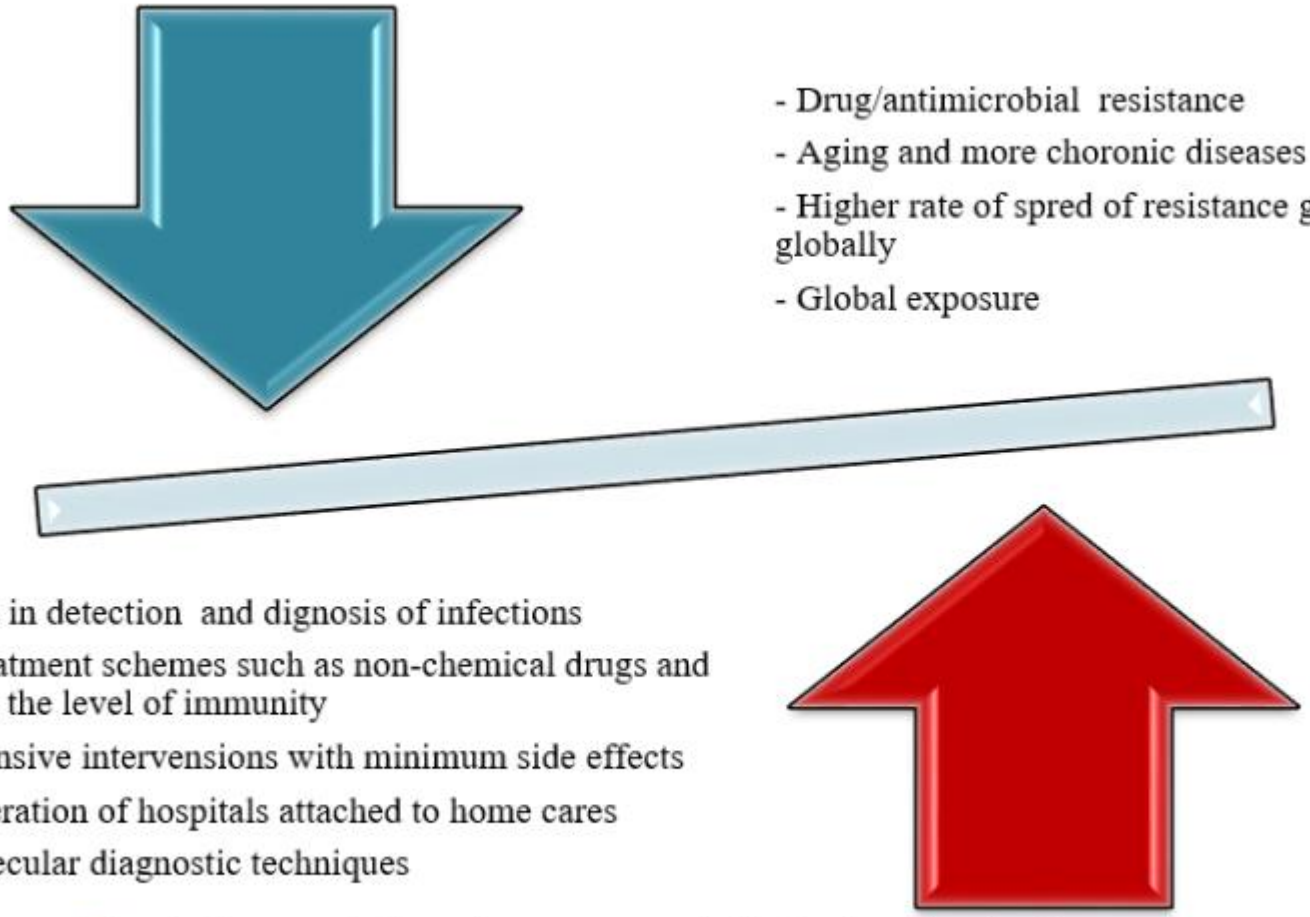

Fig. 1: Factors influencing nosocomial infections in the future

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View Point

The Future of Nosocomial Infections

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Nosocomial Bacterial Infections: Epidemiology, Source, and Antibiotic Resistance

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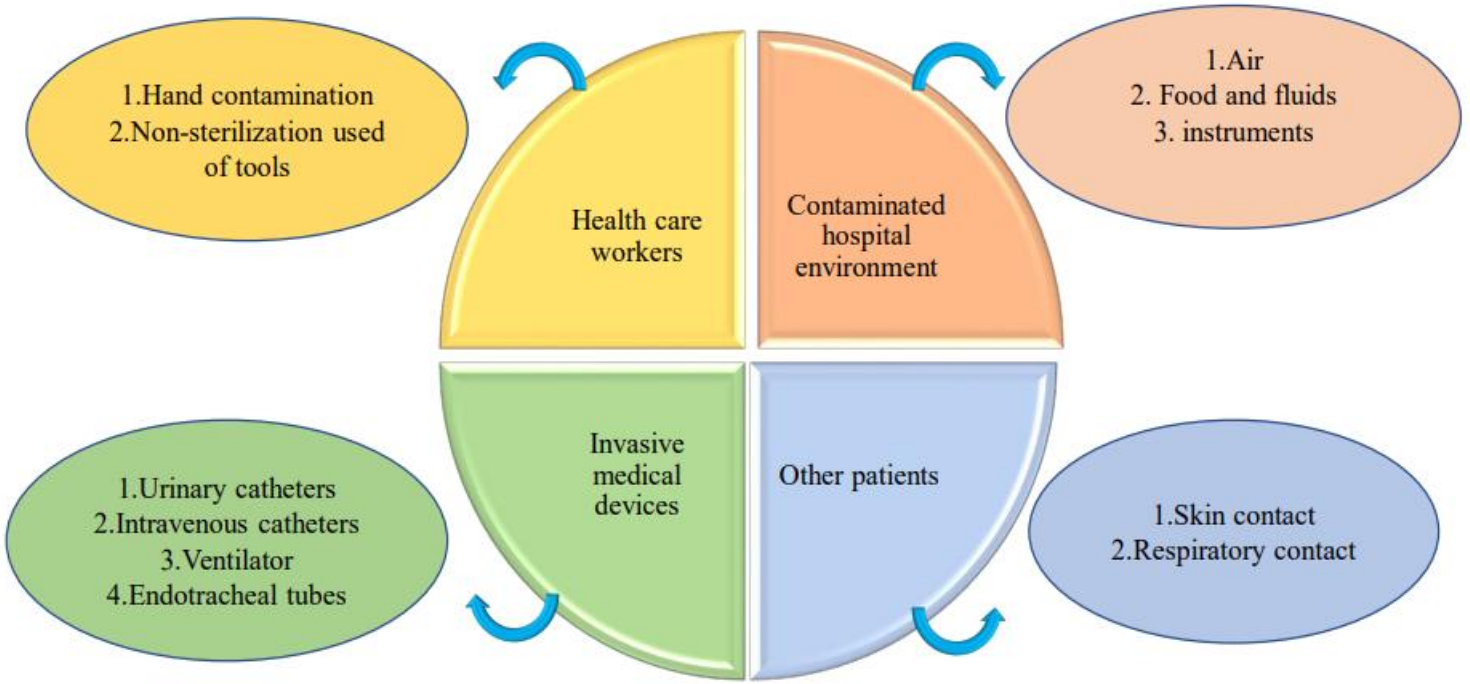

Figure 1. Some Important Transmission Sources of Hospital Infections

Table 1. A Summary of Nosocomial Infections in Several Different Studies

The Most Common Hospital Infections	Common Pathogens	Important Results	References
Pneumonia, UTI, bloodstream infections, gastrointestinal infections, SSI, clinical sepsis	*C. difficile* (16.9%), *K. pneumoniae* (11.9%), *E. coli* (8.5%), *S. aureus* (6.8%), and *S. maltophilia* (6.8%)	Approximately, 60% of *Enterobacteriaceae* demonstrated antimicrobial resistance to third-generation Cephalosporins. The use of urinary catheters and other medical devices was an important risk factor.	95
UTI, Bloodstream infections	*E. coli* (32.4%), *P. aeruginosa* (11.7%), and *Klebsiella* species (17%)	Ampicillin-resistant *E. coli* was found in 23.9% of cases, comprising 73.8% of all *E. coli* isolated from UTIs. There were no instances of carbapenem resistance in *E. coli*, but *Klebsiella* species exhibited resistance to Carbapenems (6.25%) , Quinolones (40.6%), and Ceftriaxone (59.4%), respectively.	97
Pneumonia, bloodstream infections, UTI, SSI	MRSA (22.2%), *P. aeruginosa* (22.6%), and *Acinetobacter* species (11.9%)	Trauma, long-term hospital stay, and tracheotomy were significant risk factors for hospital-acquired infections.	98
Respiratory system infections	*Acinetobacter* species (31.5%) *Klebsiella* spp. (25.3%), *P. aeruginosa* (13.2%), *S. aureus* (10%), and *E. coli* (7.4%)	The highest resistance rate was observed against Ciprofloxacin (61.8%), followed by Imipenem (50.3%).	99
UTI, respiratory tract infection	*Acinetobacter species, P. aeruginosa, E. coli,* and *K. pneumoniae*	*Acinetobacter* species and *P. aeruginosa* were identified as the most antibiotic-resistant pathogens. Imipenem and Piperacillin/tazobactam exhibited the highest activity against gram-negative bacilli and resistance to Ciprofloxacin.	100

Note. UTI: Urinary tract infection; SSI: Surgical site infections; *C. difficile: Clostridium difficile; K. pneumonia: Klebsiella pneumonia; E. coli: Escherichia coli; S. aureus: Staphylococcus aureus; S. maltophilia: Stenotrophomonas maltophilia; P. aeruginosa: Pseudomonas aeruginosa;* MRSA: Methicillin-resistant *S. aureus*.

Table 2. Details of Some Natural Products as New Therapeutic Strategies for Resistant Strains

Natural Products	Efficiency	References
Geranial, neral, 1,8-cineole, camphene, β phellandrene	High efficacy against Gram-negative MDR pathogens such as carbapenem- and polymyxin-resistant *K. pneumoniae*	89
Saponins, Bromo-polyphenols obtained from Cassia fistula bar	Effective against MDR *E. coli* isolated from Ganga River water, milk, and chicken meat	89
Phenylalanine β-naphthylamide	Efflux pump inhibitor	89
Flavonoids and polyphenols obtained from aerial parts of the Vernonia plant	Antibacterial action against *E. coli, K. pneumoniae, P. aeruginosa,* and *S. aureus*	103
Pleuromutilin and its derivatives such as valnemulin, tiamulin, azamulin, and retapamulin	Antibacterial action against the MRSA	104

Note. MDR: Multidrug-resistant; *K. pneumonia: Klebsiella pneumonia; E. coli: Escherichia coli; P. aeruginosa: Pseudomonas aeruginosa; S. aureus: Staphylococcus aureus;* MRSA: Methicillin-resistant *S. aureus.*

Table 3. Details of Nanoparticles as New Therapeutic Strategies for Resistant Strains

Nanoparticles	Efficiency	Reference
ZnO NPs prepared from ripe fruits	Antibacterial action against resistant UTI pathogens such as *S. aureus*	89
SeNP	Antibacterial action against Gram-positive resistant pathogens such as *S. aureus* and MRSA	105
Aloe Vera-conjugated NPs	Antibacterial activity against resistant Gram-positive strains (*S. aureus*) and Gram-negative strains such as *E. coli, A. baumannii,* and *P. aeruginosa*	106
Iron oxide NPs	Antibacterial effect on the growth mechanism and membrane activity of *E. coli* strains	107

Note. NPs: Nanoparticles; ZnO NPs: Zinc oxide nanoparticles; UTI: Urinary tract infection; *S. aureus: Staphylococcus aureus*; SeNP: Selenium nanoparticle; MRSA: Methicillin-resistant *S. aureus*; *A. baumannii*: *Acinetobacter baumannii.*

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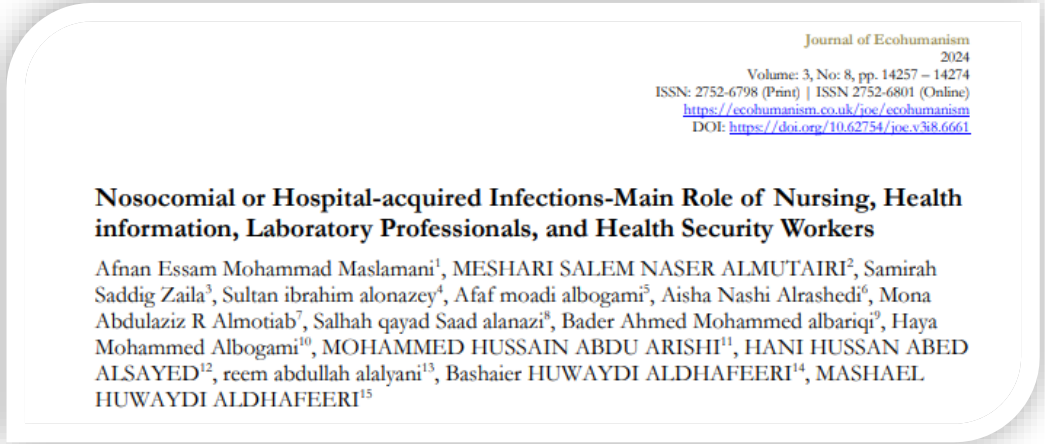
- Strategies for HAI Prevention and Control
  - Enhanced Hand Hygiene Compliance
  - Antimicrobial Stewardship Programs
  - Environmental Disinfection
  - Vaccination Programs (healthcare workers and high-risk patients)
  - Surveillance and Rapid Response
  - Patient Cohorting and Isolation



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Nosocomial or Hospital-acquired Infections-Main Role of Nursing, Health information, Laboratory Professionals, and Health Security Workers

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Summary

- The rate of HAIs and the number of publications in this regard has risen in recent years.
- The HAIs rate and the most common micro-organism are different in various regions.
- Information extracted from researches can help decision makers establish preventive strategies and implement effective and reliable plans.
- More focus needs to be dedicated to the prevention of HAI and AMR, through the application of available recommendations and guidelines.
- The high rates of HAI and bacterial resistance emphasize the ongoing need for continued efforts to control them.

Thank You