



OVERVIEW OF HOSPITAL-ACQUIRED INFECTIONS

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Abstract:

Background: Hospital-acquired infections (HAIs), known as nosocomial infections, are a significant global concern. They manifest within 48 hours of a patient's admission to a healthcare facility. These infections, not present at admission, burden patients, healthcare systems, and communities substantially.

Aim: to understand the types and causes of hospital-acquired infection and how to prevent and control it.

Methods: This is a comprehensive review of hospital-acquired infections (HAIs). PubMed and Google Scholar were the databases used for the search process from 2005 to 2021. The terms used in the search were Hospital-acquired infections (HAIs), Pathogens, Types, and Prevention.

Conclusion: HAIs comprise various diseases instigated by pathogens, frequently resulting in complications and mortality. The Susceptibility to HAIs is elevated in individuals with chronic disease and those undergoing invasive medical interventions and procedures. Mitigating HAIs demands a proactive and well-coordinated approach from all parties engaged in healthcare provision to ensure patient safety and alleviate the impact of HAIs on healthcare infrastructures.

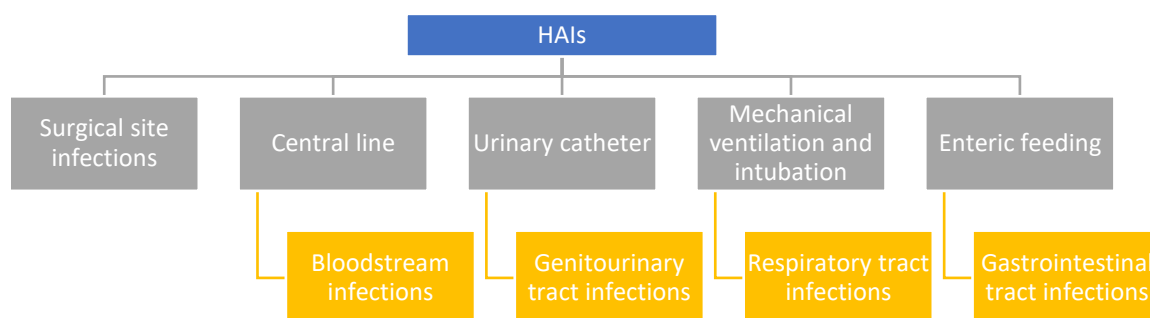
Keywords: Hospital-acquired infections (HAIs), Pathogen, Types, Prevention.

Introduction:

Hospital-acquired infections (HAIs), or nosocomial infections, are infections that individuals acquire during their treatment or while residing in a healthcare facility, typically manifesting within 48 hours after the patient's admission. These specific infections are characterized by the absence of their presence or incubation process at the time of the patient's entry into the healthcare institution. Moreover, they are not linked to the primary cause of the patient's hospitalization. This phenomenon is prevalent on a global scale across numerous nations. In the United States, instances of hospital-

acquired conditions (HACs) reached 48,771 in 2016, resulting in an additional cost exceeding 2 billion dollars, equating significantly to 41,000 dollars per patient affected by HACs (1). The impact of infections acquired in healthcare facilities goes far beyond its effects on individual patients, reaching out to influence entire communities and healthcare systems. This highlights the essential importance of implementing comprehensive and strong prevention strategies and effective surveillance measures to effectively reduce and control the occurrence of these infections and their associated consequences.

Figure (1): Most common Causes of HAI and type



Causes of Infections:

HAIs refer to various illnesses contracted within the healthcare environment, encompassing a wide spectrum of disease types and causes [Figure 1]. Among the most prevalent categories are surgical site infections, genitourinary tract infections, gastrointestinal tract infections, central line-associated bloodstream infections (CLABSI), respiratory tract infections (RTIs) like hospital-acquired pneumonia (HAP), and ventilator-associated pneumonia (VAP) (2). Thus, these infections have a significant impact on patient health outcomes, leading to adverse effects, increased financial burdens on healthcare facilities, and higher death rates among affected individuals. It is well-documented that the occurrence of HAIs spans a wide range, from 6.1% to as high as 44%, with many pathogenic microorganisms, such as *Klebsiella pneumoniae*, commonly identified as causative agents. Moreover, HAIs have been closely linked to the development of complications such as acute kidney injury, sepsis, and, ultimately, increased mortality rates in affected individuals. On the other hand, infections acquired within a community setting exhibit distinguishable characteristics from those acquired in healthcare facilities, particularly noting a higher prevalence of RTIs and genitourinary tract infections. A comprehensive investigation of antibiotic resistance between HAIs and community-acquired Urinary Tract Infections (UTIs) revealed a noteworthy disparity. The research highlighted that uropathogenic identified in patients receiving care in hospital settings demonstrated elevated levels of resistance towards specific antibiotics, such as Trimethoprim/sulfamethoxazole and Imipenem when juxtaposed with individuals in community settings. Furthermore, the study unveiled a pattern of consistent resistance rates towards Nitrofurantoin among the community patients (3). Moreover, it has been observed that patients admitted to hospitals in Taiwan due to COVID-19 have been identified as being susceptible to contracting various types of infections, such as bacterial, viral, fungal, and atypical infections while undergoing treatment, which in turn have been linked to higher rates of mortality and extended durations of hospitalization.

Risk Factors:

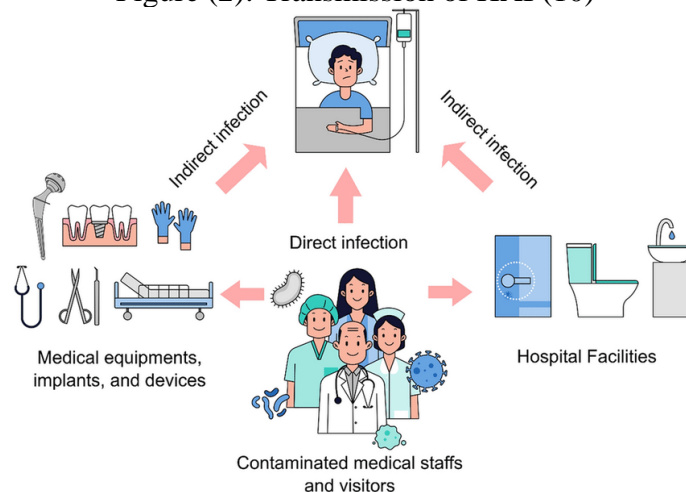
Risk factors contributing to HAIs are multifaceted, including patient-specific characteristics and the performance of invasive medical procedures. These procedures, such as catheterization, surgical interventions, and invasive devices like ventilators, urinary catheters, and central venous lines, create entry points for pathogens(4). Moreover, Chronic conditions such as diabetes, cardiovascular disease, chronic kidney disease, and chronic obstructive pulmonary disease demonstrate heightened

susceptibility to HAIs. Patients with chronic illnesses often have compromised immune systems, making them more susceptible to infections acquired during hospitalization. Furthermore, the treatment of chronic illnesses within hospital settings can give rise to unintended repercussions, including adverse drug responses, complexities in medication schedules, and non-compliance, consequently elevating the likelihood of infections(5). Previous study demonstrated Several factors have been identified in patients diagnosed with systemic lupus erythematosus (SLE) that cause increased susceptibility to nosocomial infections. These factors include but are not limited to recent utilization of immunosuppressants, undergoing central venous catheterization, and elevated levels of C-reactive protein (6). In addition, Environmental factors play a crucial role in the transmission and dissemination of HAIs, which pose a significant threat to patient safety and public health within healthcare settings. The presence of inadequate cleaning practices and contaminated surfaces within hospital environments creates conducive reservoirs for the proliferation and persistence of various pathogenic bacteria, contributing to the increased risk of HAIs. Many research studies have investigated the prevalence and distribution of common pathogens such as *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, and *Salmonella* spp. on different surfaces within hospital facilities. Among these pathogens, some strains have been identified to display resistance to multiple antimicrobial agents, further complicating infection control and treatment strategies in healthcare settings. Specifically, surfaces frequently touched by healthcare workers, patients, and visitors, such as door handles and cistern levers, have been identified as hotspots for microbial contamination, with high pathogenic bacteria detected on these fomites. This highlights the critical importance of implementing and adhering to rigorous disinfection and sanitation protocols to mitigate the risk of HAIs and prevent the transmission of multidrug-resistant organisms within healthcare facilities (7). It is imperative to recognize and understand the impact of these variables to effectively manage and reduce the risk of nosocomial infections in individuals with chronic disease.

Transmission:

The transmission of HAIs can be done through various routes, encompassing contact, airborne, vector-borne, and common vehicle transmissions. The pathogens that are commonly responsible for causing HAIs, such as *Streptococcus* species, *Acinetobacter* species, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, among several others, have the potential to be disseminated through both direct and indirect contact, airborne transmission, and even through the air itself [Figure2] (8). Besides, it is important to consider that opportunistic pathogens, which are accountable for causing HAIs, can be spread through the air, albeit to a certain extent, thereby presenting a significant peril to individuals with compromised immune systems (9).

Figure (2): Transmission of HAI (10)



How to Prevent HAIs:

Preventing HAIs is paramount in ensuring patient safety and decreasing morbidity and mortality rates within healthcare settings. It is imperative to highlight that implementing preventive strategies such as rigorous surveillance protocols and robust quality monitoring systems is paramount in mitigating the burden of HAIs within healthcare settings (4). Various measures, such as stringent adherence to hand hygiene protocols, utilization of effective sterilization techniques, and strict compliance with infection control guidelines, play a pivotal and crucial role in preventing HAIs. Particularly noteworthy is the critical nature of implementing comprehensive infection prevention protocols, especially in times of global health crises like the ongoing COVID-19 pandemic, as this is vital in mitigating the spread of nosocomial infections. Previous study unequivocally demonstrated that fostering a culture of safety within healthcare facilities, including adopting specialized care bundles tailored to combat different types of infections, can markedly contribute to reducing HAIs. Furthermore, the proper management of healthcare waste, maintenance of high standards of environmental sanitation, and the promotion of effective hand hygiene practices among medical personnel are indispensable strategies in eradicating pathogenic microorganisms and minimizing the associated risks of HAIs. It is imperative to underscore the significance of adhering to established standard infection control practices, as advocated by reputable entities such as the World Health Organization and the Centers for Disease Control and Prevention, as this adherence is paramount in achieving a substantial decrease in the incidence of a diverse array of HAIs (11). Also, Preventing HAIs requires implementing multifaceted strategies to mitigate the risk of transmission and acquisition of infections within healthcare settings. These strategies encompass a range of interventions, including but not limited to the vigilant monitoring of antibiotic resistance patterns, meticulous tracking of physician prescribing behaviors, and establishing a robust culture of safety that prioritizes adherence to evidence-based guidelines and best practices. By proactively addressing these key areas, healthcare facilities can effectively reduce the occurrence of failures in care processes, thereby enhancing patient safety and improving overall healthcare quality. Additionally, cooperation between healthcare professionals, specifically physicians and nurses, and quality teams is vital in ensuring optimal patient outcomes and safety within healthcare settings. This collaboration is especially crucial in performing procedures like the prompt removal of central venous catheters and Foley catheters since these actions are recognized to greatly decrease the chance of HAIs (12). Moreover, Tactics such as the enforcement of correct decontamination procedures, the maintenance of ideal staffing levels, and the utilization of catheters coated with antimicrobial agents have been verified through empirical studies to produce notable reductions in the frequency of nosocomial infections within healthcare institutions (13). Overall, the comprehensive implementation of a multi-modal strategy encompassing a diverse array of interventions, including meticulous hand hygiene practices, judicious employment of antimicrobial agents through stewardship programs, and the thorough application of infection control protocols customized to cater to the unique characteristics and needs of distinct patient cohorts is paramount in the successful mitigation and prevention of HAIs.

Surveillance and Reporting:

Following and documenting HAIs are critical in recognizing the size of the problem and indicating guidance for preventive measures. It is necessary to closely oversee HAIs to gain insights into their prevalence within healthcare settings and to inform the development of effective strategies to reduce their occurrence. Various surveillance methodologies are available for this purpose, including the definition of hospital-onset adult sepsis event (HO-ASE) established by the Centers for Disease Control and Prevention (CDC). This approach is designed to identify cases of severe nosocomial infections that may go unnoticed by the current systems for reporting HAIs, thereby enhancing the overall effectiveness of surveillance efforts (14). Besides, Surveillance criteria across different nations tend to exhibit variability, thus influencing the documented incidence rates of infections such as hospital-acquired urinary tract infections (HAUTI). The surveillance phase is critical for detecting widespread HAIs like urinary tract infections, respiratory tract infections, surgical site infections, and bloodstream infections, primarily caused by pathogens such as *Clostridium difficile* and various drug-

resistant bacteria. It is imperative to underscore that meticulous surveillance practices are essential to ensure the accurate collection, dissemination, and utilization of data about HAIs, thereby facilitating enhancements in infection control protocols within the premises of healthcare establishments (15). In addition, Hospitals employ cutting-edge surveillance mechanisms, as evidenced by the utilization of real-time nosocomial infection surveillance systems (RT-NISSs), to diligently oversee and manage the transmission of HAIs with a notable degree of efficacy. The deployment of such systems facilitates the organized gathering of precise and reliable data about HAIs, thereby contributing significantly to the execution of targeted prevention and control initiatives aimed at curtailing the incidence of such infections within healthcare settings. Using RT-NISSs has demonstrated a propensity to substantially enhance the precision associated with identifying cases involving multidrug-resistant organisms (MDRO), thereby bolstering the overall sensitivity, specificity, and predictive capability of the surveillance systems in place (16). Furthermore, using algorithms within hospital information systems is crucial in efficiently identifying patients who have contracted HAIs. This utilization results in a notable enhancement in detection rates compared to the traditional manual surveillance methods commonly employed in healthcare settings. Also, Obstacles in precisely documenting HAIs come from a range of complexities ingrained in the healthcare system. These challenges encompass a wide array of issues, such as discrepancies in reported rates stemming from inherent limitations within the reporting systems utilized by healthcare facilities. Moreover, the lack of seamless cooperation among healthcare staff further compounds the difficulties in achieving precise and reliable reporting of HAIs. Additionally, Barriers, such as the lack of accessibility to crucial clinical information and the inadequacy in knowledge dissemination among infection control nurses, are significant impediments that obstruct the process of conducting precise and thorough surveillance (17). Furthermore, it is imperative to emphasize the enhancement of collaboration among healthcare personnel, the expansion of expertise among infection control nurses, and the advancement of hospital information systems as pivotal measures to bolster the precision of reporting on HAIs. These strategies are designed to elevate the precision of data collection and analysis, with the ultimate goal of fortifying patient safety through the efficient identification and prevention of HAIs.

Education program to prevent HAI:

Patient education programs currently in place are undeniably critical in the endeavor to prevent HAIs. Many research projects have emphasized patient education's vital role in augmenting infection prevention measures within healthcare settings. Moreover, research has revealed that specialized training sessions have a considerable impact on boosting the knowledge levels of medical students, thereby confirming the effectiveness of educational strategies in preventing HAIs (18). Moreover, Hospital leaders and staff display a profound comprehension and acknowledgment of the significance linked to patient education, especially concentrating on vital subjects like catheter-associated urinary tract infections (CAUTIs) and central-line-associated bloodstream infections (CLABSI). They underscore the necessity for implementing uniform and standardized methodologies to impart information and knowledge to patients efficiently and effectively (19). Likewise, a suggestion has been put forth to establish specialized rooms within hospital settings solely dedicated to patient education, with the primary goal of catering to a wide range of educational requirements, elevating levels of patient contentment, and ultimately advancing the overall standard of healthcare services. This proposal underscores the significance of implementing individually customized educational initiatives for patients, recognizing the pivotal role such programs play in ensuring comprehensive and effective healthcare delivery (20). Structured teaching programs have demonstrated a notable ability to enhance the knowledge levels among student nurses, providing clear evidence of the beneficial effects of educational interventions in preventing HAIs (21). Besides, the successful execution of various strategic initiatives such as antimicrobial stewardship, promotion of hand hygiene, and education of patients necessitates a fundamental transformation in the prevailing culture within individual hospitals, demanding a comprehensive reorientation of attitudes and practices towards healthcare delivery. This cultural metamorphosis must extend beyond the confines of the local hospital setting to encompass a wide spectrum of collaborative efforts within the healthcare

sector, involving multiple stakeholders and interdisciplinary teams working in unison toward achieving common goals and objectives (22). By incorporating patients in educational efforts aimed at boosting awareness of infection prevention measures, supplying conveniently accessible resources like hand sanitizers, and advocating for adherence to recommended practices, healthcare providers possess the potential to greatly affect the reduction in infection rates in healthcare settings and enhance patient outcomes. Additionally, it is crucial to mention that national efforts like the STRIVE initiative not only act as proof of the increasing acknowledgment of evidence-based infection prevention measures in healthcare facilities but also highlight the vital importance of team participation, leadership engagement, and patient and family involvement in the collective drive to reduce the incidence of HAIs (23). Besides, Executing thorough educational schemes, as shown by the example of Methicillin-Resistant *Staphylococcus Aureus* (MRSA) prevention, is doubtful to greatly enhance the knowledge and practical competencies of nurses, thus not emphasizing the effectiveness of focused training sessions in reducing the prevalence of healthcare-related infections. The execution of comprehensive educational initiatives can produce significant advantages in equipping healthcare professionals with the necessary expertise and competencies to combat infectious diseases effectively within healthcare settings (22).

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