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INTRAHOSPITAL/NOSOCOMIAL INFECTIONS

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Abstract. *Intrahospital, also known as nosocomial, infections are infections that patients acquire during their hospital stay, with the consideration that the patient did not have a confirmed infection upon admission. The frequency of intrahospital infections is a global concern, especially due to the emergence of multidrug-resistant pathogens. This literature review aims to determine the need for strict prevention measures for these infections. Several factors have been identified as associated with developing infections in the hospital environment. These include increased exposure to contaminated surfaces and contact with individuals during intrahospital transfers. In the context of intensive care units, invasive devices for example mechanical ventilators, central venous catheters, and urinary catheters have been identified as potential sources of nosocomial infections. Efforts to prevent and control intrahospital infections require implementing standardized processes and procedures. This includes the use of appropriate asepsis and antisepsis protocols. It is important to note that the frequency of intrahospital infections may vary in different hospital settings, and limited resources and infrastructure contribute to higher infection rates. Nosocomial infections can lead to a range of consequences. These include increased morbidity and mortality rates among patients, prolonged hospital stays, escalated healthcare costs due to the need for additional treatments and interventions, as well as complications and adverse effects on patients' health. Ultimately, these harmful effects reduce overall well-being and quality of life for affected individuals. Additionally, developing antibiotic resistance due to infections poses significant challenges to effective treatment. Nosocomial infections can also significantly impact healthcare institutions, including increased burden on healthcare providers, additional strain on resources, and the potential for damage to the institution's reputation. Therefore, prioritizing efforts to prevent and control intrahospital infections is crucial to mitigate these consequences and ensure safe and high-quality healthcare services.*

Key words*: intrahospital infections, resistant pathogens, prevention role, high-risk settings, intrahospital transfers*

Analysis and discussion

Intrahospital/nosocomial infections, also known as hospital-acquired infections (Hospital-acquired *infections/healthcare-associated infections-HAI*) represent a significant concern in healthcare institutions. These infections can be transmitted through contaminated surfaces and contact with individuals, making patients more vulnerable. Several studies have highlighted the association between intrahospital transfers and the development of these infections. Boncea et al. conducted a retrospective case-control study and found that each additional intrahospital transfer increased the odds of acquiring HAI by 9% [1]. In another study, Mitrofanova and Antsiferova discussed the problem of intrahospital infections in psychiatric hospitals, emphasizing the impact of these infections on the clinical course, diagnosis and treatment of the disease [2]. In addition, Guo et al. proposed optimal intrahospital transport protocols to reduce the risk of secondary viral transmission during transport, emphasizing the importance of following guidelines to prevent the spread of infection. The ongoing transmission of multidrug-resistant pathogens, such as *Klebsiella pneumoniae*, in healthcare facilities has also contributed to the prevalence of nosocomial infections [3,4].

Intrahospital transfers

Intrahospital transfers, especially in intensive care units, play a significant role in the spread of nosocomial infections. Research shows that healthcare-associated infections lead to longer hospital stays, and estimates indicate additional length of stay due to these infections even after infection control programs are in place, so the importance of strict infection control measures to mitigate their impact needs to be highlighted. Understanding the risks associated with intrahospital transfers is critical to preventing the transmission of infections within healthcare settings. Therefore, optimizing patient transfer protocols, ensuring appropriate hygiene practices, and implementing effective infection control strategies are essential to reduce the spread of nosocomial infections during intrahospital transfers [5,6].

Intrahospital transfers play a key role in patient care, but can also pose risks, as highlighted in various studies. Research shows that each additional intrahospital transfer increases the chance of developing a hospital-acquired infection (HAI) by 9%, highlighting the need to minimize unnecessary transfers to reduce pathogen transmission Strategies to improve the safety of intrahospital transport, especially for patients with suspected COVID-19 in outpatient settings, have been explored by developing virtual transfer pipelines and protocols to limit the spread of infection, ensuring patient and staff safety. These findings highlight the importance of well-organized and supervised transfers, taking into account factors such as equipment, staff safety, and appropriate routes to mitigate the risk of infection during patient transport within healthcare facilities [3,1].

In the healthcare field, there is a significant concern regarding intrahospital infections, meaning infections acquired by patients during hospitalization. The

etiology of these infections can be attributed to different microorganisms, which often show clinical manifestations within a time frame of 48 to 72 hours after admission. This global issue is further exacerbated by the emergence of multidrug-resistant pathogens, for example, *Klebsiella pneumonia*, a prominent cause of healthcare-associated infections worldwide.

Significant factors contributing to the development of hospital-acquired infections include increased exposure to contaminated surfaces and interactions with individuals during intrahospital transfers. Especially in intensive care units, the use of invasive medical equipment such as mechanical ventilators, central venous catheters, and urinary catheters has been identified as potential reservoirs for nosocomial infections. Mitigation of the frequency of intrahospital infections requires strict adherence to standardized processes and protocols, including meticulous disinfection practices and optimal use of disinfectants in all departments of health institutions. It is necessary to recognize that the prevalence of intrahospital infections can show differences in different health institutions, where the lack of available resources and infrastructure significantly contribute to increased infection rates [1,4].

Methodology

The methodology in the examined articles was diverse, and this showed the different aspects of these infections as a phenomenon in health care. In the framework of the scientific article entitled "*Infections intrahospitalarias en servicios de medicina interna y cirugía del Hospital Universitario de Neiva, 2012* ", the assessment of nosocomial infection indicators was carried out through a quantitative, observational and descriptive cross-sectional study of providing insight into the prevalence of such infections within certain hospital departments [7]. In contrast, in the research paper entitled "*Analysis of used disinfectants and antiseptics in correlation with the occurrence of nosocomial infections - Clinical Hospital Štip, Republic of Macedonia in the period 2007-2011*", there is a lack of explicit explanation regarding the methodologies used to measure nosocomial infection indicators, which represents a gap in the description of the methodology [8]. Similarly, in the scientific paper "*Infections intrahospitalarias a dispositivos invasivos en unidades de intensivos de un national hospital de Lima, Peru*", an assessment of nosocomial infections associated with invasive devices in intensive care units was performed using data from the Office of Epidemiology and Health environment in the period from 2010 to 2012, shedding light on the prevalence of such infections in critical environments [9]. In contrast, in the publication titled "*Persistent intrahospital transmission of multidrug-resistant Klebsiella pneumoniae and challenges for infection control*" there is also an absence of explicit delineation regarding the methodologies used to measure indicators of nosocomial infections, which warrants further clarification in the methodology section [4]. Finally, a scientific investigation entitled "*Association between intrahospital transfer and hospital-acquired infection in the elderly: a retrospective case-control study in a UK hospital network*" investigated the correlation between intrahospital transfers and the onset of hospital-acquired infections through a retrospective study. A case-control study using data extracted

from electronic health records and microbial cultures, offering valuable insights into the dynamics of infection transmission in healthcare settings, particularly among the elderly population [1].

Causative agents

The causative agents of healthcare-associated infections vary depending on the type of infection. Common pathogens causing catheter-related urinary tract infections include *Enterococcus, Staphylococcus aureus, Pseudomonas, Proteus, Klebsiella*, and *Candida* [9]. *Staphylococcus aureus,* coagulase-negative *Staphylococcus, Enterococcus, E. coli, Pseudomonas aeruginosa, Enterobacter* and *Klebsiella pneumoniae* are often implicated in surgical site infections [5]. In cases of hospital-acquired pneumonia and ventilator-associated pneumonia, *Staphylococcus aureus* and *Pseudomonas aeruginosa* are the commonly identified pathogens, with higher proportions of *E. coli* and *Klebsiella pneumoniae* in the pediatric population. In addition, a study conducted at a hospital in Peru revealed Staphylococcal coagulase as a frequently isolated agent in bloodstream infections associated with central venous catheters. These findings highlight the importance of targeted prevention strategies and vigilant infection control measures to combat HAIs effectively [9].

Klebsiella pneumoniae, E. coli and various other bacterial species are frequently identified in cases of nosocomial infections in internal medicine and surgical services, Gonzales noted [7]. Sofia P. claims in her research that the most common pathogens associated with nosocomial infections are predominantly gram-positive bacteria, with special emphasis on *Staphylococcus aureus*, which was proven in a study related to nosocomial infections [8].

Preventive measures

Preventive measures for infections include optimization of the use of disinfectants and antiseptics, regular microbiological tests and controls in health institutions [8]. Single-patient rooms can reduce pathogen transmission by minimizing person-to-person and person-to-surface contact, thereby reducing the risk of healthcare-associated infections [8]. The intrahospital transfer should be minimized to reduce exposure to contaminated surfaces, other patients, and healthcare workers, ultimately reducing the spread of infections. In addition, controlling a patient's initial risk of infection through detailed markers of disease severity and adjusting for disease severity can help prevent infections in healthcare settings. By implementing these strategies, healthcare facilities can effectively fight and reduce the occurrence of nosocomial infections, ensuring the safety of both patients and staff.

The importance of hand hygiene appears as a key factor in the prevention of hospital-acquired infections, as stated in 5 of the 9 papers included. Research has shown that nosocomial infections, which occur predominantly in hospital settings, are a significant concern due to their adverse effects on patient outcomes and financial

implications for health care, as pointed out by Sofija Petkovska [8]. In the context of healthcare settings, the act of transferring patients to a hospital setting is associated with escalating susceptibility to infection, highlighting the critical nature of minimizing unnecessary transfers to mitigate pathogen transmission, as discussed by Emanuel Esther Bonce [1]. The importance of intrahospital infections is emphasized in specialized psychiatric institutions, shedding light on the complexity and consequences of HAIs in different health institutions, as pointed out by Natalia N. Mitrofanova. Moreover, research focusing on nosocomial infections within internal medicine and surgical units highlights the economic and social consequences of HAIs, thus emphasizing the imperative nature of implementing effective infection control strategies, particularly including hand hygiene protocols, as articulated by Laura Gonzalez. The practice of proper hand hygiene is emerging as a fundamental element in the field of infection prevention, as highlighted in various research efforts dealing with different aspects of nosocomial infections and their management, for example by Omair Chincha.

Influence on the course of the underlying disease

The impact of infections on the clinical course of underlying diseases is significant and affects diagnosis, treatment, prognosis and outcomes. Nosocomial infections, especially in specialized psychiatric hospitals, represent a significant challenge globally, with a focus on psychiatric hospital wards in Penza, Russia, revealing the etiological structure and patterns of antibiotic resistance [2]. Proper prevention strategies, including the optimal use of disinfectants and antiseptics, are key to reducing the occurrence of hospital-acquired infections, as seen in a study conducted at the General Hospital in Strumica, Republic of Macedonia [8]. Nosocomial infections in the departments of internal medicine and surgery have economic, social and legal implications, emphasizing the importance of infection control measures in healthcare institutions [7]. In addition, the association of nosocomial infections with invasive devices highlights the need for strict infection control practices to mitigate risk [9].

In summary, nosocomial infections can lead to a spectrum of consequences, including increased rates of morbidity and mortality among patients. Such infections can prolong hospital stays and escalate healthcare costs due to the need for additional treatments and interventions. Moreover, nosocomial infections can cause complications and adverse health effects on patients, thus accelerating the deterioration of overall well-being and quality of life. In certain scenarios, nosocomial infections can contribute to the evolution of antibiotic resistance, thus complicating the effective treatment of infections. Moreover, the consequences of nosocomial infections extend to healthcare facilities, manifesting as an increased burden on healthcare workers, an increased strain on resources, and credible damage to the reputation of the facility.

The impact of intrahospital infections on the system of health institutions

Hospital-acquired infections have a significant impact on the reputation of medical institutions due to their association with compromised patient safety and quality of care [10,11,12]. These infections, which are often preventable with strict infection control practices, are considered by regulatory bodies to be "never events", so there is no justification for a hospital-acquired infection, as it reflects a breakdown in safety measures and leads to negative perceptions of hospital standards [13]. The federal government's preferred implementation of a system of rewards and penalties based on reported infection rates underscores the importance of transparency and accountability in the management of hospital-acquired infections, with penalties affecting an institution's financial position and public image. To maintain a positive reputation, hospitals must prioritize infection prevention strategies, such as comprehensive unit-based safety programs and effective monitoring, to demonstrate a commitment to patient well-being and quality care. Academic medical centers have been penalized for high rates of hospital-acquired infections. Underreporting of infections can also put you at risk of liability under the False Claims Act. Author Darden discusses the False Claims Act at length about the reporting requirements and responsibilities of hospital-acquired infections [14].

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INTRAHOSPITALNE/NOZOKOMIJALNE INFEKCIJE

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Sažetak. *Intrahospitalne infekcije, koje se nazivaju i nozokomijalne, su infekcije koje pacijenti stiču tokom boravka u bolnici, s tim da se uzima u obzir da pacijent potvrđeno nije imao infekciju na prijemu. Učestalost intrahospitalnih infekcija je pitanje globalne zabrinutosti, posebno zbog pojave patogena otpornih na više lijekova, kao što je Klebsiella pneumoniae. Cilj pregleda literature jeste utvrđivanje potrebe za strogim mjerama prevencije ovih infekcija. Više je faktora za koje je utvrđeno da su povezani sa razvojem infekcija u bolničkom okruženju. Uključuju povećanu izloženost kontaminiranim površinama i kontakte sa pojedincima tokom intrahospitalnih transfera. U kontekstu jedinica intenzivne njege, invazivni uređaji kao što su mehanički ventilatori, centralni venski kateteri i urinarni kateteri identifikovani su kao potencijalni izvori nozokomijalnih infekcija. Napori za sprečavanje i kontrolu intrahospitalnih infekcija zahtijevaju primjenu standardizovanih procesa i procedura. Ovo uključuje korišćenje odgovarajućih protokola asepse i antisepse. Važno je napomenuti da učestalost intrahospitalnih infekcija može varirati u različitim bolničkim okruženjima, a ograničeni resursi i infrastruktura doprinose većoj stopi infekcije. Nozokomijalne infekcije mogu dovesti do niza posljedica. To uključuje povećanu stopu morbiditeta i smrtnosti među pacijentima, produženi boravak u bolnici, eskalirane troškove zdravstvene zaštite zbog potrebe za dodatnim tretmanima i intervencijama, kao i komplikacije i štetne efekte na zdravlje pacijenata. Ovi štetni efekti na kraju dovode do smanjenja ukupnog blagostanja i kvaliteta života pogođenih pojedinaca. Dodatno, razvoj rezistencije na antibiotike kao rezultat infekcija predstavlja značajne izazove u efikasnom liječenju ovih infekcija. Nozokomijalne infekcije mogu imati i značajan uticaj na same zdravstvene ustanove - povećano opterećenje pružaoca zdravstvenih usluga, dodatno opterećenje resursa i potencijal za štetu reputaciji ustanove. Stoga je ključno dati prioritet naporima usmjerenim na sprečavanje i kontrolu intrabolničkih infekcija kako bi se ublažili ove posljedice i osigurali pružanje sigurnih i kvalitetnih zdravstvenih usluga.*

Ključne riječi: *intrahospitalne infekcije, rezistentni patogeni, uloga prevencje, mjesta visokog rizika, bolnički premještaji*