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Original Article

Frequency of Healthcare-Associated Infections in the Elderly Patient Hospitalized

Aria Rahmani [1], Alireza Namazi Shabestari [2], Maryam Sadeh [3], Reza Bidaki [4], Saeidreza Jamalimoghadamsiahkli [5], Zahra Vahabi [*2]

1. Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, Tehran, Iran
2. Department of Geriatric Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
3. Department of Laboratory Sciences, School of Paramedicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
4. Research Center of Addiction and Behavioral Sciences , Diabetes Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
5. Ziaeian Hospital, Tehran University of Medical Sciences, Tehran, Iran

[*] **Corresponding Author:** Department of Geriatric Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran. **Tel:** +982155425785 **, Email address**: Vahab1357@gmail.com

ABSTRACT

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Introduction: Healthcare- Associated Infections (HAI) are known to be one of the most important health issues in developed and developing countries. The most common infections include central line-associated bloodstream infections, catheter-associated urinary tract infections, ventilator-associated pneumonia and surgical site infection. The aim of this study was to investigate the incidence of nosocomial infections in the elderly patients.

Methods: In this cross-sectional study, 1279 patients were 60 years of age or older. Patients who had been admitted for more than 48 hours in the hospital and had no signs of infection at the time of admission, were entered into the study. It was evaluated four most common HAI, according to CDC include bacteremia, central line-associated blood stream infections, urinary tract infections, and ventilator-associated pneumonia. Infections may also occur at surgery sites, known as surgical site infections. The Chi-square and T- test or analysis of variance was used for data analysis.

Results: Of the total patients, 93 (7.3%) developed HAI at duration admission. The highest rate of infection was bacteremia, which was 48.4 % and then urinary tract infection 21.5%. The prevalence of HAI among patients with cardiovascular diseases was relatively higher than underlying diseases. The frequency of length of hospital stay was significant in patients > 7 days with 68.8% in the HAI group.

Conclusion: Our findings showed that patients with cardiovascular, renal and pulmonary disease are more susceptible to HAIs. Due to the increased length of hospital stay increases the risk of infection, it is recommended to discharge patients as soon as possible.

Keywords: Infections, Hospitalized, Health care, Patients, Aged

Introduction

Healthcare-associated infections (HAI), also known as nosocomial infections, are acquired after hospitalization in hospitals and healthcare service unit are not related to the primary disease of hospitalized patients. Nowadays, HAI as a crucial public health problem cause complications such as higher morbidity and mortality rate, a significant increase in the admission time, and treatment costs (1, 2). HAIs were previously named nosocomial infections, but since today a considerable amount of the given patient care

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is outpatient, the term nosocomial has changed to healthcare-associated (2).

HAIs are divided into four main types: central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), surgical site infection (SSI), and ventilator-associated pneumonia (VAP) (3). CLABSIs, the most common type of HAI, happen when the microorganisms enter the bloodstream via a central venous catheter (CVC). Mechanism of entry can be either intra or extra luminal. SSIs occur at the surgical site after surgery. They can be limited to the skin or involve the proximate tissue and internal organs or implanted devices. Urinary catheters, as widely used closed urine drainage systems, are mainly responsible for UTIs. Transmission routes of UTIs are either intra luminal through contamination of the collection bag or extra luminal through microorganism's movement from outside of the urinary catheter (4). Cases of pneumonia are the second commonest HAI and mostly associated with endotracheal intubation and mechanical ventilation, which is a common treatment modality for patients with respiratory failure in the intensive care unit (ICU) (4-6). Significant burden and unfavorable discharge outcomes of healthcare related infection with different risk factors has been detected in a longitudinal study (7). The average prevalence of HAI in 4 Latin American countries was 11.5%, with Venezuela having the highest prevalence with 17.79% and Brazil having the lowest with 7.1% (8). The prevalence of HAIs in Iran as previous data is 1.3–10% (9-11).

Older adults are more susceptible to acquiring HAIs with higher mortality in contrast to younger patients. They are more vulnerable to HAIs due to their low immune function. HAIs highly indicate outcome measures in acute hospital care. Therefore, prevention and careful management of HAIs directly affects patient mortality (12). Pneumonia, influenza, and bacteremia have been listed as the most common causes of mortality in the elderly infections. Therefore, highly specific studies on the prevalence, risk factors, complications, and increase the awareness of physicians and infectious disease specialists of various infections in the elderly population are suggested (13, 14). Recent studies have suggested various strategies to prevent the transmission of bacterial infections in different wards of the hospital, as well as strategies for developing antimicrobial stewardship programs. Also quality management and resources to guarantee work structure, such as hygiene care, health professionals and staff are recommended (3, 15).

Although previous studies have kept HAI prevalence under surveillance, there are limited data available specific to the elderly population in Iran. In this survey, It was assessed the prevalence of HAIs and associated factors by reviewing the records of patients referred to Ziaian Hospital in Tehran during the first 6 months of 2019 who spent 48 hours from the time of admission and had no symptoms of infection at that time.

Methods

Participants and procedure

This cross-sectional study was conducted from March 21st, 2018, to September 22nd, 2018, at Tehran University of Medical Sciences, Ziaeian Hospital.

The study included 1279 patients above 60 years old with the mean age of 73.26 (SD = 8.85, highest = 99). The Ziaeian hospital is a 142-bed facility consists of CCU, ICU and internal medicine, geriatric, hemodialysis, obstetrics and gynecology, general surgery, and pediatric wards.

All information was collected from patients' records achieved of infection quality control unit. About selected file records, all cases above 60 years who were admitted more than 48 hours were included, and those with a diagnosed infection 48 hours after admission, which was not related to the primary complaint and diagnosis of the patient, were categorized as HAI patients. Data from demographic form was considered such as age, sex, duration of hospitalization (from admission to leaving the hospital). The past medical illness or underlying disease, including any cardiovascular, endocrine, pulmonary, neurologic, hematologic, nephrology and substance misuse and cigarettes were considered. According to the expert of the Hospital Infections Committee, all the data recorded in the patients' files were obtained according to the following protocols. Pneumonia was been diagnosed in patients with or without mechanical ventilation who presented with cough, fever (> 38 Celsius), and dyspnea and was confirmed by CT-scan, chest X-ray read by an internal medicine specialist or radiologist or a sputum culture as guideline (16). Urinary tract infection (UTI) was been diagnosed by dysuria, frequency, urgency, low-grade fever (< 38 Celsius), and hematuria. It was been confirmed by urine analysis and culture with colony formation of > 105 (17). Surgical site infections were been diagnosed by purulent discharge, erythema, prolonged healing, fever, pain and tenderness, swelling, and warmness of the surgical site and were confirmed by clinical evidence and examination of the surgical site by the attending physician as guideline (18). Bacteremia was been diagnosed by chills and fever, decreased level of consciousness, tachycardia, and tachypnea and was confirmed by blood culture (19). All the diagnoses were consulted with related infectious disease specialist if necessary. Devices suspected of causing infection (venous and urinary catheter and endotracheal tube) and their days of usage have also been recorded in all the patients.

Data analysis

The collected data were entered into SPSS software version 22.0 (SPSS Inc., Chicago, III., USA). Chi-square test was used to investigate the causes of hospitalization with nosocomial infections. T-test or analysis of variance was used to investigation the duration of hospitalization with nosocomial infections. $P < 0.05$ was considered as significant.

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Ethical consideration

After approving the plan and obtaining permission from the Research Council of Tehran University and the hospital archives unit to review the files and assure the units that patients 'information was confidential, information was collected from patients' files. The survey is documented by code 23507 in research committee Tehran University of Medical Sciences (TUMS).

Results

The study included 1279 patients above 60 years old with the mean age of 73.26 (SD = 8.85, highest = 99) from geriatrics, internal medicine (44.9%), ICU (5.5%), CCU (19.6%) and general surgery (30%) wards. Of those patients, 48.4% (620) male, and 51.6% (659) were female. The patients with a history of smoking were 9.2% and 5.1% of substance misuse. Also, patients over 60 years of age were hospitalized for a total of 8281 days during this study period, with an average of 6.5 days. Of all the patients included, 93 of them (7.3%) developed HAI during admission. According to Table 1, there was no significant difference between the gender group of the patients and the risk of HAI (p = 0.7). The highest frequency of the length of hospital stay was 4-7 days (43%) and in HAI group was significantly (p = 0.0001) higher in the group of 7 > days (68.8%). The most common underlying disease was cardiovascular diseases, with 1073 of cases (83.9%), and the least common was cancer (2.3%), and the prevalence of HAI among patients with cardiovascular diseases was relatively higher than others (Table 1).

Regarding the ward of admission, 47.3% of Internal Medicine/ Geriatric Wards patients were diagnosed with HAI, about 2 times more compared to the ICU wards. While the HAI rate was much less in CCU and general surgery ward (p = 0.0001).

Our results (Figure 1) also revealed bacteremia (bloodstream infections) as the leading cause of HAI in this hospital (3.5% of all patients and 45 (48.4%) of all the HAIs). Ten of 45 cases of bacteremia were caused by angio-catheterization. Twenty patients (21.5 %) developed UTI, 13 of which had a urinary catheter. Eighteen (19.3%) of patients (1.4% of all patients) were diagnosed with pneumonia which endotracheal tube was inserted for 9 of them for mechanical ventilator support. Other causes of HAI included 10 (10.8%) cases of SSI.

Our study showed that, the mean length of stay in hospital was 6 and a half days but in patients with healthcare-associated infections it was 15.1 days.

Some of patients (51.6%) with nosocomial infections had negative blood culture and the most common bacteria isolated from blood culture of patients with HAI were Staphylococcus coagulase negative (20.4%) followed by Klebsiella Pneumonia (15.1%), Enterococcs spp. (5.4%), Ecoli (3.2%), Staphylococcus Aureus (2.1%) and Pseudomonas Aeruginosa (2.1%). Urine culture for patients with HAI were most frequently infected by Enterococcs spp. (8.6%) and the lowest frequency of Pseudomonas Aeruginosa (2.1%) (Table 2).

Table 1. Frequency of variables in hospitalized elderly patients and patients with HAI

Variables	Patients (%) N = 1279	Patient with HAI (%) N = 93 (7.3%)	p-value
Sex			
Male	620 (48.4)	44 (47.3)	0.7
Female	659 (51.6)	49 (52.7)	
Length of hospital stay			
< 4 days	324 (25.3)	0	0.000
4-7 days	550 (43)	29 (31.2)	
> 7 days	405 (31.7)	64 (68.8)	
History of smoking use			
Substance misuse	65 (5.1)	21 (22.6)	0.2
Cigarette smoking	118 (9.2)	30 (32.2)	0.2
Background Underlying			
Cardio Vascular Disease	1073 (83.9)	67 (72)	0.001
Gastro Intestinal Disease	93 (7.3)	7 (7.5)	0.9
Renal Disease	212 (16.5)	18 (19.4)	0.4
Endocrine Disease	141 (11)	35 (37.6)	0.000
Cancer	30 (2.3)	7 (7.5)	0.001
Pulmonary Disease	155 (12.1)	13 (14)	0.5
Ward of admission			
Internal Medicine/ Geriatric Wards	575 (44.9)	44 (47.3)	0.000
ICU	70 (5.5)	22 (23.7)	
CCU	250 (19.6)	14 (15.1)	
Surgery	384 (30)	13 (14)	

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Table 2. Distribution of bacterial isolated from positive blood and urine culture in patients with HAI

Isolated Bacteria	Urine culture (%)	Blood culture (%)
Klebsiella pneumoniae	5 (5.4)	14 (15.1)
Enterococcus spp.	8 (8.6)	5 (5.4)
E. coli	5 (5.4)	3 (3.2)
Pseudomonas aeruginosa	2 (2.1)	2 (2.1)
Staphylococcus aureus	0	2 (2.1)
Staphylococcus coagulase negative	0	19 (20.4)
Negative result	73 (78.5)	48 (51.6)
Total	93 (100)	93 (100)

Discussion

Infectious diseases are one of the major concern in Iranian healthcare system. Knowledge and education to health providers and hospital policy makers can decrease risk of nosocomial infections. But, we need estimate condition of HAI and get basic information about its details.

Out of 1279 hospitalized patients, 7.3% (93) had HAI. Our results showed that HAI is not associated with sex. Smoking and substance misuse increase HAI fourfold and more than threefold, respectively. In similar studies the prevalence of HAI infection in China and Mexico was 3.3% and 6.4%, respectively (14, 20). In a study conducted in Iran (Shiraz in 2008-2009), the rate of nosocomial infections was reported to be 9.4% and the highest infection was related to bloodstream infections (2.5%), followed by surgical site infections (2.4%), UTI (1.4%) and pneumonia (1.3%) (11).

In this study about admitted elderly and infections, the most common underlying disease was cardiovascular diseases, with 83.9% of cases, and the least common was cancer (2.3%), and the prevalence of HAI among patients with Cardio Vascular Disease (CVD) was relatively higher than others. It shows that CVD is an important risk factor about HAI. Therefore, this matter should consider about CVD patients in related wards. Major risk factors independently related with HAIs were diabetes mellitus, immunosuppression, body temperature, surgery duration, reoperation, cephalosporin prescription, duration of exposure to central venous catheter, ICU admission, mechanical ventilation and ICU maintaining (21).

The results of an epidemiologic study from Iran showed that most reported HAIs were associated with surgical site infections from the surgical ward (22). In this study, Internal Medicine/ Geriatric wards had a high prevalence of HAI but surgery and CCU ward had less prevalence HAI rather than others. It may be related to better protection, sterilization and care in these wards in this hospital. In other study in 2001 and 2005, most cases of HAI were related to ICUs and burn wards (23, 24).

In another study, HAI risk was increased by 5% after each day of hospital stay (25). This finding was likewise in our study in this way, in elderly patients with a length of hospital stay of more than 7 days showed a significant increase in the risk of HAI.

In this study, bacteremia (48.8%) was the most common HAI followed by UTI (21.5%), Pneumonia (19.3%) and SSI (10.8%) respectively. In a retrospective cohort study by Zhao, 60,332 elderly patients of 60 years of age or older have been studied. The five most common HAIs have been reported lower respiratory tract infection (42.7%), UTI (14.7%), bacteremia (14.4%), antibiotic-associated diarrhea (6.4%), and SSI (3.6%) respectively. Furthermore, the five most common HAI pathogens were noted Candida Albicans, Klebsiella Pneumonia, Acinetobacter Baumannnii, Escherichia Coli, and Pseudomonas Aeruginosa. Among device associated HAIs, the higher rate was attributed to a higher rate of underlying diseases and unusual medical procedures (26). In a study conducted by Solis-Hernandez et al. it was found that HAIs and mortality rate were more frequent in the geriatrics predominately with to ventilator-associated pneumonia and Gram-negative microorganisms (27).

In a retrospective study in China on 3370 geriatric patients, nosocomial infections decreased from 3.3% to 1.15% due to improved nutritional conditions. The authors state that improving patients' nutritional status is effective in reducing NI risks. In this study before prevention strategy, the most NIs were pneumonia 63.15% and UTI 31.58% (20).

Blood culture was two times more likely to be negative in patients with HAI, but more prevalent HAI were by Staphylococcus Coagulase negative and the least were Staphylococcus Aureus and Pseudomonas Aeruginosa.

In a study at Kenyatta National Hospital in Kenia country in intensive care unit, the most frequently isolated bacteria were Pseudomonas. Aeruginosa, Klebsiella, Citrobacter, Staphylococcus Aureus, Streptococcus Pneumoniae, Acinetobacter and E.coli, that separated from tracheal secretion, urine, blood and pus swabs (28).

It might underestimate the HAI prevalence because loss of follow up post-discharge patients' surveillance. The notable finding of the current study is the pathogens lab out, Staphylococcus Coagulase negative.

In a study in Mexico, 18469 patients were included (108555 hospital days stay). Nearly, 79.6% of HAI were infected non-elderly range and 20.3% elderly patients. More infection rates for VAP, secondary bacteremia, and catheter related UTI were noted for geriatrics as a higher frequency of positive cultures for Gram-negative bacteria, particularly Klebsiella and fungal infections ($P > 0.05$) (14).

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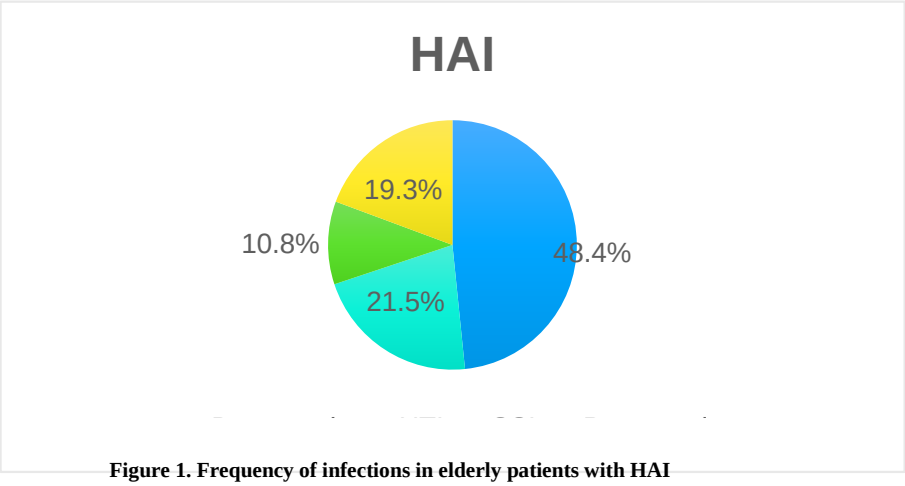

Figure 1. Frequency of infections in elderly patients with HAI
***UTI: Urinary tract infection, SSI: Surgical site infection,**

The our results was shown that the significant differences in the reported data globally are due to various reporting systems or data gathering, different hospital conditions, and especially under-reporting the HAI data. It is best to our knowledge that since each day of admission increases the risk of HAI, patients should be discharged as soon as possible.

Since our study was retrospective cross-sectional, some of the risk factors of HAI have not been thoroughly investigated. We recommend adding a HAI form to patients' files for further studies. However, our study was conducted at a general hospital, and further studies at a hemato-oncology subspecialty hospital are recommended. Since prevalence of healthcare associated infections increases by 1.13% per day, it is recommended to discharge patients as soon as possible.

It is recommended to policy makers and health providers for respect hygiene issue like, skin preparation, hand washing, dressing changes, devices disinfection, prophylactic antimicrobial prescription as needed, training and monitoring staff competency, decrease hospital stay, optimal site catheter selection.

Conclusion

Our findings showed that patients with endocrine, cardiovascular disease and renal disease are more susceptible to HAIs. Bacteremia is more prevalent infection, too. Due to the increased length of hospital stay increases the risk of infection, it is recommended to discharge patients as soon as possible

Study limitations

This study was performed in only one center for 6 months and its findings cannot be extended to all elderly patients. Also, the lack of use of drug susceptibility data of various microorganisms was a limitation of the work.

Conflict of interests

The authors declare that they have no conflict of interest.

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Authors' contributions

ZV, SJ and AR designed the study. ZV, AR involved in data collection. AR, AN wrote the article. MS and RB edited and revised it, participated in results analysis and improve discussion section and submitted it.

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