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FACTORS ASSOCIATED WITH HOSPITAL-ACQUIRED INFECTIONS AT THE HOSPITAL FOR REHABILITATION - PROFESSIONAL DISEASES

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ABSTRACT

Objective: To determine the hospital-acquired infection (HAI) rate and associated factors at the Hospital for Rehabilitation - Professional Diseases in 2025.

Methods: A retrospective cross-sectional study was conducted on 869 inpatient medical records from January 2025 to June 2025. HAIs were identified according to the Ministry of Health guideline (Decision No. 3916/QĐ-BYT). Frequencies and percentages were used for descriptive statistics. Chi-square and Fisher's exact tests were applied for inferential analysis ($p < 0.05$).

Results: The HAI rate was 4.14%. HAIs occurred predominantly in the respiratory tract, with Klebsiella spp. being the most common pathogen. Factors significantly associated with HAIs included the presence of chronic diseases, longer length of hospital stay, undergoing invasive procedures, and increased risk with a higher number of invasive procedures. Associated invasive procedures comprised peripheral venous catheterization, central venous catheterization, urinary catheterization, mechanical ventilation, tracheostomy, endotracheal intubation, and nasogastric tube placement.

Conclusion: The HAI rate was relatively low; however, HAIs were mainly respiratory and were strongly associated with chronic comorbidities, prolonged hospitalization, and invasive interventions. Infection control efforts should prioritize high-risk patients and strengthen the care and monitoring of invasive devices.

Keywords: Hospital-acquired infection, associated factors, rehabilitation, hospital.

1. INTRODUCTION

Hospital-acquired infections (HAIs) are among the major challenges to patient safety worldwide[1,2]. HAIs increase the burden of disease, prolong hospital stay, and raise treatment costs, thereby placing additional pressure on healthcare systems[2,3]. Considerable evidence shows that HAIs not only affect treatment outcomes but are also closely associated with length of hospital stay; therefore, HAI control is a core priority in hospital quality management[2,3]. In rehabilitation specialty hospitals, the risk of HAIs is even more noteworthy because patients often require prolonged inpatient treatment, depend heavily on caregiving, and are more likely to undergo invasive interventions during daily rehabilitation practice[4,5]. When HAIs occur, they not only worsen the underlying medical condition but may also interrupt rehabilitation therapy, delay functional improvement, and adversely affect overall treatment effectiveness. Studies conducted in rehabilitation settings and among patients undergoing neurological rehabilitation have highlighted the detrimental impact of infections on functional outcomes and treatment duration[4,5].

In Vietnam, several studies have described the current situation and factors associated with HAIs in a number of hospitals and clinical departments, particularly intensive care units[6–9]. The Ministry of Health has also issued infection prevention and control guidelines under Decision No. 3916/QĐ-BYT (2017) as a basis for standardizing practice.[10] However, data on factors associated with HAIs in rehabilitation settings remain limited, although this patient group has distinct risk characteristics. Therefore, this study was conducted to determine the prevalence of HAIs and associated factors at the Hospital for Rehabilitation - Professional Diseases. Based on the findings, appropriate infection prevention and control measures may be proposed, thereby contributing to improved patient safety and enhanced effectiveness of treatment, care, and rehabilitation.

2. MATERIALS AND METHODS

2.1. Study design

A retrospective cross-sectional study.

2.2. Setting

The study was conducted at the Hospital for Rehabilitation - Professional Diseases from January 2025 to June 2025.

2.3. Participants

All medical records of inpatients treated at the Hospital

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for Rehabilitation - Professional Diseases during the study period that met the following criteria were included:

- ***Inclusion criteria:*** Medical records of patients admitted for inpatient treatment at the Hospital for Rehabilitation – Professional Diseases during the study period, with sufficient clinical and paraclinical information for determining HAI status according to the definition of the Vietnam Ministry of Health.

- ***Exclusion criteria:*** Medical records of patients with evidence of infection within ≤48 hours of admission, according to the definition of the Vietnam Ministry of Health (i.e., community-acquired infection or infection acquired at another hospital); medical records of patients who were transferred to another hospital or died within ≤48 hours after admission; and records with insufficient information for determining HAI status.

2.4. Sample size and sampling method

The sample size was calculated using the formula for estimating a proportion:

$$n = Z^2_{1-\alpha/2} \frac{p(1-p)}{d^2}$$

N is the sample size; Z = 1.96 for a 95% confidence interval.

We used p = 0.043 (the HAI rate reported at Ha Dong General Hospital in 2020 by Nguyen Xuan Thiem et al.) [9] and d = 0.02.

Based on the above formula, the required number of inpatient medical records was 396; in practice, 869 medical records met the eligibility criteria.

2.5. Variables

General characteristics: sex, age group, chronic disease status, and length of hospital stay;

Hospital-acquired infection variables: HAI status, type of HAI, and causative pathogens;

Invasive procedure variables: peripheral venous catheter, central venous catheter, urinary catheterization, mechanical ventilation, CPAP, tracheostomy, endotracheal intubation, nasogastric tube, and other drainage devices;

Surgical variables: surgery and surgical classification.

2.6. Data collection

The data collection tool was developed based on the HAI surveillance form issued by the Hospital for Rehabilitation - Professional Diseases in 2022, as well as guidance documents from the World Health Organization and the Ministry of Health (Decision No. 3916/QĐ-BYT dated August 28, 2017, on surveillance of hospital-acquired infections in healthcare facilities)[10].

Data were collected retrospectively from medical records. The investigator extracted information from the records, including general characteristics, HAI-related characteristics, invasive procedure-related characteristics, and surgical characteristics. HAI cases were identified according to the case definition provided in the Ministry of Health guidelines (Decision No. 3916/QĐ-BYT, 2017), based on clinical signs, paraclinical findings, and the diagnostic conclusions recorded by the treating physicians in the medical records. For cases of infection transferred from another facility or community-acquired infection present on admission, HAI was diagnosed at the study hospital only when the patient had completed treatment for the infection present at admission and had negative microbiological results before developing a new episode of infection, or when the patient was receiving treatment according to an antibiotic susceptibility test but showed no improvement and a different pathogen was isolated, or when an infection developed in another organ system that was not a secondary bloodstream infection. After collection, the data were checked for completeness and logical consistency before data entry and analysis.

2.7. Data analysis

After collection, the data were entered into Excel 2016 and subsequently analyzed statistically using SPSS version 20.0. Frequencies and percentages were used for descriptive statistics. The chi-square test and Fisher's exact test were used for inferential statistics.

2.8. Ethical considerations

The study was conducted in accordance with the ethical regulations for biomedical research of the Ethics Committee of the Hospital for Rehabilitation - Professional Diseases.

3. RESULTS

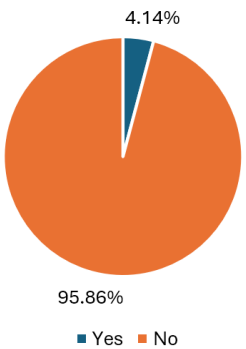

Figure 1. Rate of hospital-acquired infections

The study found that the rate of HAIs at the Hospital for Rehabilitation - Professional Diseases was 4.14% (36/869).

Table 1. Characteristics of hospital-acquired infections

N = 36	n	%
Type of HAIs		
Respiratory tract infection	25	69.44
Urinary tract infection	10	27.78
Skin and soft tissue infection	1	2.78
Causative pathogens		
Klebsiella spp.	12	33.33
Pseudomonas aeruginosa	5	13.89
Acinetobacter spp.	5	13.89
Enterobacter spp.	4	11.10
Escherichia spp.	3	8.33
Pseudomonas spp.	2	5.56
Aeromonas spp.	1	2.78
Escherichia coli	1	2.78
Proteus mirabilis	1	2.78
Providencia spp.	1	2.78
Serratia spp.	1	2.78

Table 1 shows that most HAIs were respiratory tract infections (69.44%). The most commonly identified pathogen was Klebsiella spp., accounting for 33.33%.

Table 2. Association between hospital-acquired infections and the general characteristics of the study participants (N = 869)

General characteristics	Total; n (%)	Hospital-acquired infections; n (%)		p
		Yes	No	
Sex				
Male	531 (61.10)	17 (47.22)	514 (61.70)	0.080*
Female	338 (38.90)	19 (52.78)	319 (38.30)	
Age group				
<30 years	43 (4.95)	2 (5.56)	41 (4.92)	0.340*
30 to under 45 years	187 (21.52)	6 (16.67)	181 (21.73)	
45 to under 60 years	279 (32.11)	8 (22.22)	271 (32.53)	
≥ 60 years	360 (41.42)	20 (55.56)	340 (40.82)	
Chronic disease status				
No	231 (26.58)	2 (5.56)	229 (27.49)	0.006*
Yes	638 (73.42)	34 (94.44)	604 (72.51)	
Length of hospital stay				
0 – 3 days	104 (11.97)	1 (2.78)	103 (12.36)	< 0.001**
4 – 7 days	177 (20.37)	2 (5.56)	175 (21.01)	
8 – 11 days	201 (23.13)	3 (8.33)	198 (23.77)	
≥ 12 days	387 (44.53)	30 (83.33)	357 (42.86)	

**: Chi-square test; **: Fisher's exact test*

The results in table 2 show that most patients were male, aged 60 years and older, had underlying chronic diseases, and generally experienced prolonged hospital stays (≥ 12 days). Chronic disease status and length of hospital stay were found to be significantly associated with HAIs ($p < 0.05$).

Table 3. Association between hospital-acquired infections and invasive procedure characteristics of the study participants (N = 869)

Invasive procedure characteristics	Total; n(%)	Hospital-acquired infections; n (%)		p
		Yes	No	
Invasive procedures				
No	222 (25.55)	3 (25.55)	219 (26.29)	0.030*
Yes	647 (74.45)	33 (74.45)	614 (73.71)	
Peripheral venous catheter				
No	462 (53.61)	8 (22.22)	454 (54.50)	< 0.001*
Yes	407 (46.84)	28 (77.78)	379 (45.50)	
Central venous catheter				
No	765 (88.03)	26 (72.22)	739 (88.72)	0.020**
Yes	104 (11.97)	10 (27.78)	94 (11.28)	
Urinary catheterization				
No	465 (53.51)	12 (33.33)	453 (54.38)	0.040*
Yes	404 (46.49)	24 (66.67)	380 (45.62)	
Mechanical ventilation				
No	750 (86.31)	26 (72.22)	724 (86.91)	0.030**
Yes	119 (13.69)	10 (27.78)	109 (13.09)	
CPAP				
No	794 (91.37)	33 (91.67)	761 (91.36)	1.000**
Yes	75 (8.63)	3 (8.33)	72 (8.64)	
Tracheostomy				
No	700 (80.55)	21 (58.33)	679 (81.51)	0,001*
Yes	169 (19.45)	15 (41.67)	154 (18.49)	
Endotracheal intubation				
No	733 (84.35)	26 (72.22)	707 (84.87)	0.040*
Yes	136 (15.65)	10 (27.78)	126 (15.13)	

Invasive procedure characteristics	Total; n(%)	Hospital-acquired infections; n (%)		p
		Yes	No	
Nasogastric tube				
No	575 (66.17)	17 (47.22)	558 (66.99)	0.020*
Yes	294 (33.83)	19 (52.78)	275 (33.01)	
Other drainage devices				
No	833 (95.86)	33 (95.86)	800 (96.04)	0.190**
Yes	36 (4.14)	3 (8.33)	33 (3.96)	
Number of invasive procedures				
0	222 (25.54)	2 (5.56)	220 (26.41)	0.008*
1	287 (33.03)	10 (27.78)	277 (33.25)	
More than 2	360 (41.43)	24 (66.67)	336 (40.34)	

**: Chi-square test; **: Fisher's exact test*

Table 3 shows that HAIs were more frequently recorded in the group undergoing invasive procedures than in the non-intervention group (p = 0.03). Most invasive procedures were significantly associated with HAIs, except for CPAP (p = 1.000) and other drainage procedures (p = 0.190). The number of invasive procedures was also found to be associated with HAIs (p = 0.008).

Table 4. Association between hospital-acquired infections and surgical characteristics of the study participants (N = 869)

Surgical characteristics n (%)	Total; n (%)	Hospital-acquired infections;		p*
		Yes	No	
Surgery				
Không	748 (86.08)	30 (83.33)	718 (86.19)	0.630
Có	121 (13.92)	6 (16.67)	115 (13.81)	
Surgical classification				
Clean	28 (23.14)	1 (16.67)	27 (23.48)	0.770
Clean - Contaminated	24 (19.83)	1 (16.67)	23 (20.00)	
Contaminated	34 (28.10)	1 (16.67)	33 (28.70)	
Dirty	35 (28.93)	3 (50.00)	32 (27.83)	

**: Chi-square test*

Table 4 shows that there were no statistically significant differences between HAIs and surgery or surgical classification (p > 0.05).

4. DISCUSSION

Our study found an HAI rate of 4.14%, suggesting a relatively low HAI burden. This result was lower than that reported in a study conducted at Military Hospital 110, but was comparable to that of a hospital in China.[4,6] This similarity may be explained by the distinctive "risk balance" of the rehabilitation care model. Patients in rehabilitation settings often have prolonged hospital stays, impaired mobility, and require assistance with basic care, all of which increase the risk of infection. On the other hand, compared with intensive care or acute care settings, rehabilitation hospitals generally involve fewer major surgical procedures and less continuous use of invasive interventions; therefore, the infection pressure associated with such procedures tends to be lower, keeping the overall HAI rate within the range of approximately 3 – 5%.[4] In addition, rehabilitation environments involve frequent close contact and shared use of rehabilitation equipment, meaning that the risk of cross-transmission depends heavily on hand hygiene and adherence to protocols, consistent with the view that the hospital environment and healthcare workers may act as vehicles of transmission when infection control is suboptimal. Routine surveillance and targeted interventions related to care devices, hand hygiene, equipment disinfection, and rehabilitation spaces should be maintained to reduce HAIs.

Respiratory tract infections and Klebsiella spp. were the predominant characteristics of HAIs identified in our study. This finding differs from that reported by Tang Xuan Hai in 2024.[7] The difference may be attributable to variations in the patient population and in pathogen detection methods. In pediatric hospitals, the spectrum of respiratory pathogens often includes a higher proportion of viruses, and rapid testing for viral pathogens is more widely implemented; therefore, the etiological pattern may be more virus-dominant. In contrast, in our study, etiological identification was more likely based primarily on bacterial culture of respiratory specimens, making Gram-negative bacilli such as *Klebsiella* spp. more likely to emerge as the most frequently documented pathogens. In addition, the microbiological epidemiology of each facility, previous antibiotic exposure, and institutional policies on antibiotic use and infection prevention and control may also create different selective pressures, thereby altering the predominant pathogens across studies.

Our findings showed that HAIs were significantly associated with the presence of comorbid chronic diseases and length of hospital stay (p < 0.05), suggesting that these factors may be related to the occurrence of HAIs in hospitalized patients. This finding is generally consistent with previous studies.[2,8,9] One possible explanation is that patients with chronic diseases often have reduced physiological reserve, impaired immune function, poor nutritional status, and limited mobility, which may make them more susceptible to hospital-associated pathogens. In addition, these patients may be more likely to undergo invasive procedures and have more frequent contact with healthcare staff, which could increase opportunities for exposure. Regarding length of hospital stay, one possible explanation is the cumulative exposure to the hospital environment over time; however, this association may also partly reflect underlying disease severity.[3] It is also possible that the relationship is bidirectional: prolonged hospitalization may be

associated with a greater likelihood of HAIs, while HAIs themselves may also be associated with longer hospital stay.[3] Therefore, although causal inferences cannot be drawn from the present study, chronic diseases and length of hospital stay may be considered factors associated with HAIs, and these characteristics may be useful for identifying patients who require closer monitoring and appropriate infection prevention and control measures during hospitalization.

In our study, HAIs were significantly associated with the use of invasive procedures – including peripheral venous catheterization, central venous catheterization, urinary catheterization, mechanical ventilation, tracheostomy, endotracheal intubation, and nasogastric tube placement – as well as with a greater number of invasive procedures. This finding is consistent with several previous domestic studies.[8,9] Internationally, a systematic review of HAIs in adults also reported that endotracheal intubation, urinary catheterization, central venous catheterization, mechanical ventilation, tracheostomy, and nasogastric tube use were commonly associated with HAIs.[1] One possible explanation is that patients requiring invasive devices often have greater functional impairment, higher dependence on care, and more complex clinical conditions; therefore, invasive procedures may reflect not only technical interventions themselves but also broader clinical vulnerability and intensity of care. Many patients may be in the post-acute phase of illness (e.g., stroke, trauma, severe debilitation) and may continue to experience dysphagia, impaired cough and sputum clearance, reduced mobility, and limited self-care ability; accordingly, devices such as tracheostomy tubes, endotracheal tubes, nasogastric tubes, and urinary catheters may still need to be maintained. Although the intensity of intervention may be lower than in acute care settings, the observed association may be related to cumulative exposure over time, because these devices are often retained for prolonged periods, care procedures are repeated daily, and close contact with healthcare staff continues throughout long-term rehabilitation and nursing care. The consistency between our findings and previous studies may therefore reflect a broader pattern in which a greater number of invasive procedures is associated with higher care dependency and more frequent care-related manipulations, which may in turn be related to the occurrence of HAIs. Although causal inferences cannot be drawn from the present study, these findings suggest that patients undergoing invasive procedures may require closer monitoring and appropriate infection prevention and control measures, particularly in rehabilitation settings where device duration and care contact may be prolonged.

5. CONCLUSION

The overall burden of hospital-acquired infections was relatively low. These infections were not evenly distributed across patient groups, but tended to occur more frequently among patients with chronic diseases, prolonged hospital stay, and invasive procedures. Infection prevention and control measures may therefore be considered with greater focus on patients with these characteristics, through enhanced surveillance, appropriate indication of procedures, strict adherence to aseptic principles, close care and monitoring, and early removal of invasive devices when no longer necessary.

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