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ORIGINAL ARTICLE

The influence of hospital-acquired infections on length of stay and mortality in an internal medicine unit: a retrospective study

A influência das infecções hospitalares na duração da internação e na mortalidade em uma unidade de clínica médica: um estudo retrospectivo

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ABSTRACT

Introduction: Hospitalization is essential for treating various conditions but involves risks such as hospital-acquired infections (HAIs), which increase morbidity, mortality, and healthcare costs. **Objective:** To analyze the relationship between length of stay in an internal medicine ward and the occurrence of infectious complications. **Methodology:** This is a retrospective study based on the analysis of 437 patient records from March 2023 to November 2024 in a tertiary public hospital in Fortaleza, Brazil. Sociodemographic data, final diagnoses, length of stay, and occurrence of HAIs were evaluated. Statistical analysis was conducted using Jamovi® software with a 5% significance level. **Results:** The average age was 51 years, with 53.3% female patients. The mean hospital stay was 21.67 days. HAIs occurred in 32.4% of patients, especially among the elderly (40.1%) and males. Infected patients had longer hospital stays (31.67 vs. 16.85 days; p<0.001) and higher mortality rates (23.2% vs. 1%). The most frequent complications were respiratory infections, followed by skin and bloodstream infections. HAIs were also associated with pressure injuries, delirium, and hyperglycemia. **Conclusion:** HAIs significantly increase hospital stay duration and mortality, highlighting the urgent need for effective prevention and control strategies to improve patient outcomes and optimize healthcare resources.

Keywords: Hospital infections. Hospitalization. Patient Safety. Duration of Therapy.

RESUMO

Introdução: A hospitalização é fundamental para tratar diversas condições, mas envolve riscos, como as infecções relacionadas à assistência à saúde (IRAS), que aumentam a morbidade, mortalidade e os custos hospitalares. **Objetivo:** Analisar a relação entre o tempo de internação em uma enfermaria de clínica médica e a ocorrência de complicações infecciosas. **Metodologia:** Estudo retrospectivo, com análise de 437 prontuários de pacientes internados entre março de 2023 e novembro de 2024 em um hospital público terciário de Fortaleza, Ceará. Foram avaliadas variáveis sociodemográficas, diagnósticos, tempo de internação e ocorrência de IRAS. A análise estatística foi realizada no software Jamovi®, com significância de 5%. **Resultados:** A média de idade foi de 51 anos, com 53,3% de mulheres. O tempo médio de internação foi de 21,67 dias. IRAS ocorreram em 32,4% dos pacientes, principalmente entre idosos (40,1%) e homens. Pacientes infectados apresentaram maior tempo de internação (31,67 vs. 16,85 dias; p<0,001) e mortalidade (23,2% vs. 1%). As complicações mais comuns foram respiratórias, seguidas por infecções de pele e corrente sanguínea, além de associação com lesões por pressão, delirium e hiperglicemia. **Conclusão:** As IRAS aumentam significativamente o tempo de internação e a mortalidade, exigindo medidas preventivas eficazes para melhorar os desfechos e otimizar recursos hospitalares.

Palavras-chave: Infecção Hospitalar. Hospitalização. Segurança do paciente. Duração da Terapia.

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INTRODUCTION

Hospitalization, while essential for managing acute and chronic illnesses, is not without risks. Patients frequently experience complications unrelated to their primary condition, but rather as unintended consequences of medical care itself.[1] These complications can significantly extend hospital stays, increase healthcare costs, and lead to adverse outcomes, including functional decline, organ dysfunction, and even mortality. Among these complications, hospital-acquired infections (HAIs) represent one of the most prevalent and serious concerns, posing a major challenge to patient safety and healthcare systems worldwide.[2]

HAIs are a critical public health issue, particularly in low- and middle-income countries, where their incidence is disproportionately higher due to resource constraints and infrastructural limitations.[3] These infections typically manifest 48 to 72 hours after hospital admission and are strongly associated with prolonged hospitalization, increased antimicrobial resistance, and excessive healthcare expenditures.[4] Beyond the economic burden, HAIs contribute to higher morbidity and mortality rates, often complicating the course of illness and worsening patient prognosis. Furthermore, these infections have a profound psychosocial impact, affecting the quality of life of both patients and their families.

In Brazil, updated data on the prevalence, etiology, and risk factors for HAIs in intensive care units (ICUs) are still limited. A multicentre point prevalence study, conducted in 2016 in 28 adult ICUs from both university and non-university hospitals in Minas Gerais, aimed to provide an up-to-date overview of HAIs, identifying the most frequent types—such as pneumonia and bloodstream infection—and the main pathogens involved, with emphasis on non-fermenting Gram-negative bacteria.[5]

Certain populations are particularly vulnerable to HAIs, including elderly patients, immunosuppressed individuals, and those with chronic diseases or requiring invasive medical interventions. Older adults, in particular, face an elevated risk due to age-related immune decline (immunosenescence) and functional impairments that increase their susceptibility to infections.[5] Additionally, patients with complex medical conditions often experience prolonged hospital stays, not only due to clinical instability but also because of administrative and social barriers to discharge.[6]

Among the various hospital departments, Internal Medicine units play a pivotal role in managing patients with diverse and often severe medical conditions. These wards frequently accommodate individuals at high risk of prolonged hospitalization and infectious complications due to their underlying health status and need for continuous medical interventions. Given this scenario, a thorough assessment of the prevalence of HAIs and their impact on hospital length of stay is crucial for guiding effective infection prevention strategies and optimizing patient outcomes.

By analyzing the relationship between infectious complications and hospitalization duration, this study aims to provide evidence-based insights that can support the development of targeted interventions, ultimately reducing morbidity, mortality, and healthcare-associated costs.

OBJECTIVES AND METHODOLOGY

Study design

This was a retrospective observational study conducted in the internal medicine ward of a tertiary public hospital in Fortaleza, Ceará, Brazil. The ward has 34 beds for both male and female patients and functions as a teaching unit for medical students and residents specializing in internal medicine. The study included patients aged 15 years or older who were admitted between March 2023 and November 2024 and completed their entire hospital stay under the care of the internal medicine team, with discharge or death occurring by November 30, 2024. Patients transferred to other units or specialties during hospitalization, as well as those who died in the intensive care unit (ICU), were excluded.

Eligibility criteria

Hospital-acquired infection (HAI) was defined as any infection diagnosed at least 48 hours after admission, according to the criteria of the institutional Infection Control Committee, in accordance with the Brazilian National Health Surveillance Agency (ANVISA) guidelines.[7] Healthcare-associated pneumonia (HAP) was diagnosed based on clinical findings—such as fever, leukocytosis or leukopenia, purulent respiratory secretions, and worsening oxygenation—along with radiological evidence of a new or progressive pulmonary infiltrate, with or without microbiological confirmation from respiratory samples. Bloodstream infection (BSI) was defined as a positive blood culture for a recognized pathogen not related to infection at another site, in a patient with compatible clinical signs (fever, hypotension, chills); for common skin contaminants, at least two positive blood cultures for the same microorganism were required. Catheter-associated urinary tract infection (CAUTI) was diagnosed based on a urine culture showing $\geq 10^5$ CFU/mL of up to two microorganisms, associated with symptoms such as dysuria, urgency, frequency, fever, suprapubic pain, or flank pain.

Outcomes

The primary outcomes were length of stay (LOS) and in-hospital mortality. The secondary outcomes were the occurrence of pressure injuries, delirium, and hospital-acquired hyperglycemia.

Data collection and statistical analysis

Data were obtained individually from electronic medical records through the hospital's information system, including variables such as age, sex, patient origin, final diagnosis, presence of infectious complications, and LOS. Data were recorded in Microsoft Excel 2017® spreadsheets for statistical processing.

Continuous variables were assessed for normality using the Shapiro–Wilk test. Normally distributed variables were expressed as mean ± standard deviation (SD) with 95% confidence intervals (CI) and compared using Student's *t*-test, whereas non-normally distributed variables were expressed as median and interquartile range (IQR) and compared using the Mann–Whitney U test. Categorical variables were analyzed using the Chi-square test or Fisher's exact test, as appropriate. Multivariate logistic regression was used to determine independent predictors of in-hospital mortality, adjusting for HAI, age, sex, neoplasia, and immunosuppression. The effect of HAI on LOS was estimated using a log-linear model (ordinary least squares regression on ln[LOS]) adjusted for the same covariates. Results were reported as adjusted odds ratios (aOR) with 95% CI or as percentage change with 95% CI. Statistical significance was set at $p < 0.05$ for two-tailed tests.

This research was submitted to the Brazilian national research ethics platform and approved by the hospital's Research Ethics Committee under CAAE No. 86190325.5.0000.5041, in accordance with national ethical guidelines for research involving human subjects.

Ethics

The study was registered in the Brazilian national research ethics platform and approved by the hospital's Research Ethics Committee (CAAE No. 86190325.5.0000.5041), in accordance with national regulations for research involving human subjects.

RESULTS

During the study period, a total of 437 hospitalizations were analyzed, comprising 233 females (53.3%) and 204 males (46.7%). Patient age ranged from 15 to 95 years, with a mean of 51 years (SD ± 19.6). The overall mean length of stay (LOS) was 21.7 days, varying from 1 to 176 days. Short admissions of up to 7 days accounted for 21.7% of cases, whereas 38.9% remained hospitalized for 8–20 days, and 39.4% exceeded 20 days (Table 1). Elderly patients were particularly vulnerable, presenting the highest burden of hospital-acquired infections (HAIs), with a prevalence of 40.1%.

The most frequent discharge diagnoses included digestive system diseases (19.4%), neoplasms (13.5%), infectious and parasitic diseases (12.6%), and pancytopenia (10.5%), while 37.1% of admissions were grouped under miscellaneous conditions (Table 2).

HAIs were documented in 142 patients (32.4%), with a slightly higher prevalence among males (52.8%). Infected patients exhibited a significantly prolonged LOS (mean 31.7 days) compared to non-infected patients (mean 16.9 days; $p < 0.001$). Moreover, the mean age of patients with HAIs was higher than the overall average (56.8 vs. 51 years).

Table 1. Sociodemographic characteristics and hospital length of stay of the study population (N=437).

Variable	Min–Max	N (%)	Mean ± SD (95% CI)
Female	-	233 (53.3%)	-
Male	-	204 (46.7%)	-
Age (years)	15–95	-	51.0 ± 19.6 (49.51–53.19)
Total LOS (days)	1–176	437 (100%)	21.67 ± 19.85
LOS 0–7 days	-	95 (21.7%)	-
LOS 8–20 days	-	170 (38.9%)	-
LOS >20 days	-	172 (39.4%)	-

Note: standard deviation (SD); confidence intervals (CI); length of stay (LOS).

Table 2. Most frequent primary diagnoses among hospitalized patients.

Diagnosis	N	%
Digestive system diseases	85	19.4
Neoplasms	59	13.5
Infectious and parasitic diseases	55	12.6
Pancytopenia	46	10.5
Dermatological diseases	30	6.9
Other	162	37.1

A total of 36 deaths were recorded, corresponding to a case-fatality rate of 8.2%. Deceased patients were significantly older than survivors (62.4 vs. 50.3 years; $p < 0.001$). Mortality was markedly higher among patients with HAIs (23.2%) compared with those without infection (1.0%; Table 3). Neoplasms were the most common diagnosis among deceased patients (33%), consistent with the hospital's profile as a non-emergency, non-interventional cardiology facility.

HAIs were also strongly associated with major in-hospital complications. Patients with infection had substantially higher risks of pressure injury (26.8% vs. 1.4%; OR 26.67, $p < 0.001$), delirium (38.0% vs. 2.7%; OR 25.33, $p < 0.001$), and hyperglycemia (35.2% vs. 11.9%; OR 4.05, $p < 0.001$).

In multivariate logistic regression, HAIs emerged as the strongest independent predictor of mortality after adjusting for age, sex, neoplasia, and immunosuppression (Table 4). The adjusted odds ratio for HAI was 29.49 (95% CI 8.53–101.99, $p = 9.05 \times 10^{-8}$). Additional predictors included advanced age (aOR 1.03 per year, 95% CI 1.01–1.06, $p = 0.0138$) and neoplasia (aOR 3.80, 95% CI 1.56–9.27, $p = 0.00329$). Male sex showed a protective trend (aOR 0.45, $p = 0.0589$), while immunosuppression was not significantly associated with outcomes ($p = 0.999$). The model demonstrated good explanatory capacity ($N = 436$, pseudo-$R^2 = 0.315$).

Similarly, in a log-linear model adjusted for the same covariates, HAIs were associated with a 68.7% increase in LOS (95% CI 40.0%–103.3%, $p = 7.11 \times 10^{-8}$) (Table 5).

Taken together, these findings underscore the profound impact of HAIs on clinical outcomes, contributing to prolonged hospitalization, higher mortality, and a greater burden of complications. The results highlight the critical need for effective infection control strategies and targeted interventions for elderly and high-risk populations.

Table 3. Association between hospital-acquired infections and outcomes.

Outcome	HAI N (%)	No HAI N (%)	OR	95% CI	p-value
Mortality	33 (23.2)	3 (1.0)	29.57	-	<0.001
Pressure injury	38 (26.8)	4 (1.4)	26.67	-	<0.001
Delirium	54 (38.0)	8 (2.7)	25.33	-	<0.001
Hyperglycemia	50 (35.2)	35 (11.9)	4.05	-	<0.001

Note: hospital-acquired infection (HAI); odds ratios (OR); confidence intervals (CI).

Table 4. Multivariate logistic regression for in-hospital mortality.

Predictor	Adjusted OR	95% CI (Lower)	95% CI (Upper)	p-value
HAI (yes)	29.49	8.53	101.99	9.05e-08
Age (years)	1.03	1.01	1.06	0.0138
Male sex	0.45	0.20	1.03	0.0589
Neoplasia	3.80	1.56	9.27	0.00329
Immunosuppression	0.00	0.00	∞	0.999

Note: hospital-acquired infection (HAI); odds ratios (OR); confidence intervals (CI).

Table 5. Adjusted effect of HAI on length of stay (log-linear model).

Predictor	% Change in LOS	95% CI	p-value
HAI (yes)	68.7% longer	40.0% to 103.3%	7.11e-08

Note: hospital-acquired infection (HAI);length of stay (LOS); confidence intervals (CI).

DISCUSSION

The prevalence of hospital-acquired infection (HAI) in this study was 32.4%, significantly higher than that reported in other institutions in the same region (8–14%) and above the average recorded in the Americas (9.6%). Patients with HAIs had a mean length of stay (LOS) of 31.67 days, approximately 15 days longer than those without infection (16.85 days; $p < 0.001$), demonstrating the direct impact of these complications on hospitalization duration. Mortality was also markedly higher among infected patients (23.2% vs. 1.0% in non-infected patients), confirming the role of HAIs as a major predictor of adverse outcomes.

These findings are consistent with national and international studies linking HAIs to prolonged hospitalizations and increased mortality risk.[8,9] In the present study, pneumonia was the most prevalent HAI, in line with literature indicating that respiratory infections are the leading type in both internal medicine wards and intensive care units. The higher prevalence of HAIs in elderly patients (40.1%) exceeds previously reported rates (17–24%) and may be attributed to immunosenescence, a process in which aging leads to a decline in immune function, increasing susceptibility to infections and their complications. The predominance in male patients, also observed here, has been reported in other studies and may relate to physiological and behavioral differences.[9,10]

Beyond longer LOS and higher mortality, HAIs were associated with worse clinical outcomes, including increased rates of pressure injury (26.8% vs. 1.4%), delirium (38% vs. 2.7%), and hospital-acquired hyperglycemia (35.2% vs. 11.9%). These results reinforce the role of HAIs as markers of clinical severity and the need for intensified care.[11]

The mortality profile, with a predominance of cancer patients (33%), reflects the institutional characteristics, as the hospital lacks emergency services and interventional cardiology support, and is not a referral center for acute cardiovascular cases. Nationally, cardiovascular diseases are the leading cause of death, followed by infectious diseases and neoplasms, underscoring the specificity of our findings.

Although this study did not directly assess the economic impact of HAIs, international data indicate that infected patients may incur hospital costs up to eight times higher, mainly due to prolonged antimicrobial use and additional laboratory testing. This aspect is particularly relevant in public healthcare institutions, where resources are limited.

Pneumonia was the most prevalent HAI in this study, aligning with national and international data indicating that respiratory infections are the most common in both medical wards and intensive care units. In some regions, such as Africa and Southeast Asia, wound infections predominate due to a higher prevalence of such conditions, whereas in the Americas, gastrointestinal infections are the leading cause, followed by pneumonia.

The mortality analysis revealed that most deaths in this study occurred among patients with neoplasms, accounting for 33% of cases. This finding reflects the local hospital reality, as the facility lacks emergency services and interventional cardiology support, making it a non-referral center for acute cardiovascular cases. In contrast, national statistics indicate that cardiovascular diseases are the leading cause of death, followed by infectious diseases and neoplasms. Among patients with HAIs, the mortality rate was 23.2%, consistent with previously reported figures, which range from 7% to 64%, depending on patient characteristics and infection severity.[1]

Study limitations include its retrospective design, which depends on the quality and completeness of electronic medical records, and the absence of data on deaths occurring in the ICU, which could provide a more comprehensive assessment of hospital mortality. Additionally, the analysis was restricted to a single institution, which may limit generalizability.

The findings contribute to a better understanding of the relationship between hospital length of stay, HAIs, and mortality in internal medicine wards. However, some limitations should be acknowledged, particularly the lack of data on deaths occurring in the ICU, which could have provided a more comprehensive analysis of hospital mortality. Nonetheless, the results reinforce the need for robust infection prevention and control strategies, especially for vulnerable populations such as older adults and cancer patients.

CONCLUSION

This study highlights the relationship between hospital length of stay, hospital-acquired infections, and mortality, emphasizing the alarmingly high prevalence of HAIs, particularly among elderly patients. The observed infection rates exceeded global averages, significantly contributing to prolonged hospital stays.

The identification of respiratory infections as the most common HAIs and the high mortality rate among patients underscore the urgency of implementing effective infection prevention and control measures. Therefore, it is essential to develop and enforce robust protocols to reduce the incidence of HAIs, mitigate their impact on hospital stays, and improve patient outcomes.

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