Research Article

Hospital-acquired infections and antibiotic use in a geriatric hospital: a point prevalence study

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Abstract

Background: Healthcare-Associated Infections (HAIs) are the most common healthcare-associated complications, particularly in elderly patients. The aim of this study is to describe the prevalence of HAIs and associated risk factors in the IRCCS INRCA of Ancona.

Methods: A cross-sectional study has been carried out. Data has been collected in accordance with the European Centre for Disease Prevention and Control (ECDC) Point Prevalence Survey 2022-2023 (PPS3) protocol in the IRCCS INRCA of Ancona in November 2022.

Results: Out of the 128 patients included in our study, 75.0% were over 78 years old and 9.1% presented an active HAI on the day of the survey. The prevalence of HAIs varied based on the length of the hospital stay (OR 1.1, CI 95% 1.05 - 1.17, $p < 0.001$) and hospitalization > 7 days (OR 5.9, CI 95% 1.2 - 28.7, $p = 0.02$).

Conclusion: It is clear from our findings that HAIs are associated with advanced patient age, prolonged hospital stay, and use of medical devices, especially in those patients that, due to their clinical situation, are more vulnerable. Although some of these infections can easily be treated, it is important to develop effective infection control strategies thanks to antimicrobial stewardship programs.

Background

Healthcare-Associated Infections (HAIs) are the most common healthcare-associated complications. These infections considerably increase the costs of healthcare and are detrimental to patients' health [1].

The Centre for Disease Control and Prevention (CDC) identifies that nearly 1.7 million hospitalized patients each year acquire HAIs while being treated for other health problems and that more than 98,000 of these patients (1 in 17) die as a result of these infections [1].

According to the European Centre for Disease Prevention and Control (ECDC) which analyzed a total of 310,755 patients in 1,209 hospitals from 28 European Countries, 6.5% of patients were affected by an HAI and a total of 8.9 million estimated episodes per year [2].

Enterobacteriaceae, Acinetobacter baannii, Pseudomonas aeruginosa, Staphylococcus aureus, Clostridium difficile and enterococci were the most frequently isolated microorganisms in European Hospitals [2]. Antibiotics are one of the most prescribed drug classes, yet the incidence of inappropriate antibiotic prescription (molecule, duration, or dosage) remains high [3]. Their incorrect use leads to the progressive selection of multidrug-resistant microorganisms

with an epidemiological and economic impact, exacerbated by the rapid loss of efficacy of an increasing number of antibiotics and the reduced development of new antibiotic molecules over the past decade [4,5].

The World Health Organization Health Organization (WHO) considers this problem one of the three most important public health threats of the 21st century, along with the climate crisis and the trend toward vaccine rejection [6].

Italians aged ≥ 65 years in 2021 constituted 23.5% of the Italian population, but by 2050 it is estimated that this proportion will increase to 34.9% [7]. As patients age, the phenomenon of immunosenescence leads to increased risk of morbidity and mortality secondary to infectious disease processes due to a decline in both quantitative and qualitative immune function [8]. The aim of this study is to describe the prevalence of HAIs and associated risk factors and the use of antibiotics in the IRCCS INRCA Italian National Research Centers on Ageing of Ancona.

Methods

The study was conducted in November 2022 in the IRCCS INRCA of Ancona, according to the Point Prevalence Survey 3 protocol proposed by the ECDC. All patients admitted to the wards at or before 8 a.m. and not discharged at the time of the survey have been included.

Data collection for each department was completed in a single day, using the electronic medical record.

An active healthcare-associated infection (associated with acute care hospital stay) present on the day of the survey is defined as an active infection is active if signs and symptoms of the infection are present on the survey date or signs and symptoms were present in the past and the patient is (still) receiving treatment for that infection on the survey date. The presence of symptoms and signs should be verified until the start of the treatment in order to determine whether the treated infection matches one of the case definitions of healthcare-associated infection and the onset of symptoms was on Day 3 or later (day of admission = Day 1) of the current admission; or the patient presents with an infection but has been readmitted fewer than 48 hours after a previous discharge or transfer from a healthcare facility; or the patient has been admitted (or develops symptoms within two days) with an infection that meets the case definition of an active surgical site infection (SSI), i.e. the SSI occurred within 30 days of the operation (or in the case of surgery involving an implant, was a deep or organ/space SSI that developed within 90 days of the operation) and the patient either has symptoms that meet the case definition and/or is on antimicrobial treatment for that infection; or the patient has been admitted (or develops symptoms within two days) with *C. difficile* infection fewer than 28 days after a previous discharge or transfer from a healthcare facility; or an invasive device was placed on Day

1 or Day 2, resulting in an HAI before Day 3; or onset of symptoms on Day 1 or Day 2 in a newborn; or the patient was diagnosed with COVID-19 and the onset of symptoms (or first positive test if asymptomatic) was on Day 3 or later (day of admission = Day 1) of the current admission or the patient has COVID-19 on admission (or onset before Day 3) and was (re-)admitted fewer than 48 hours after a stay of more than seven days in the same or another healthcare facility [9] In total, 132 cases were analyzed and four patients were excluded from the study because the HAIs were related to another care facility [10].

The survey protocol was approved by the ethics committee of the Università degli Studi di Torino (Prot. No. 0421518 of 29/07/2022).

Any information relating to a patient participating in the surveillance was collected and treated in pseudonymized form, while the research results are made available through scientific publications anonymously, carefully, and rigorously avoiding any detail that could in some way allow third parties to trace their identity. Furthermore, the data is retained in compliance with current legislation on the processing of personal data (EU Regulation No. 2016/679, D.lgs.196/2003 amended by D.lgs.101/2018) by the Data Controller identified in the Istituto Superiore di Sanità (ISS).

Results

Of the 128 patients included, 56.3% (72) were female, 75.0% (96) were over 78 years old and 9.1% (12) had a Healthcare-Acquired Infection on the day of the survey.

The area of care with the most infections is the medical area where 53.9% are located, followed by the surgical area (25.0%) and post-acute care (21.1%) Table 1.

Table 1: Characteristics of patients enrolled at the time of the survey.

	All patients (n = 128)		With HAI (n = 12)		Without HAI (n = 116)	
Gender						
Male	57	44.5%	4	33.3%	53	55.7%
Female	71	55.5%	8	66.7%	63	54.3%
Age						
0-77	32	25.0%	1	8.3%	31	26.7%
78-84	28	21.9%	2	16.7%	26	22.4%
85-89	34	26.6%	3	25.0%	31	26.7%
> 89	34	26.6%	6	50.0%	28	24.1%
Field						
Medicine	69	53.9%	6	50.0%	63	54.3%
Surgery	32	25.0%	4	33.3%	28	24.1%
Post-Acute Care	27	21.1%	2	16.7%	25	21.6%
Devices						
CVC	16	12.5%	1	8.3%	15	12.9%
Urinary catheter	66	51.6%	9	33.3%	57	49.1%
Surgery						
NHSN	6	4.7%	1	8.3%	5	4.3%
Minimally invasive	26	20.3%	4	33.3%	22	19.0%
Hospitalization, median	7	(4-14)	20	(17-32)	7	(4-12)

At univariate analysis (Student's t, Mann-Whitney), three characteristics were identified that show a statistically significant difference between the groups of patients with HAI and without ($p < 0.1$): age of the patient, presence of urinary catheter and length of hospital stay (from time of admission to time of detection).

A multivariate analysis (logistic regression) was then conducted to calculate the odds ratio (OR) and confidence interval (CI), using the factors noted: duration of hospitalization (OR 1.1, CI95% 1.05 - 1.17, $p < 0.001$) and hospitalization > 7 days (OR 5.9, CI 95% 1.2 - 28.7, $p = 0.02$) Table 2.

Urinary tract infections ($n = 4$) were the most frequent HAIs, of which one was sustained by *Morganella Morganii* and another one by *Klebsiella Pneumoniae Carbapenemase* (KPC), followed by three SARS-CoV-2 infections (25.0% of HAI), two pneumoniae (16.7% of HAIs), two skin and soft tissue infections (16.7% of HAI), of which one sustained by *Escherichia Coli* and one *Clostridium Difficile* gastrointestinal infection (8.3% of HAI) Table 3.

Almost half of the patients (45.3%) were on antibiotics on the day of the survey but in 10.3% of cases, the reason for treatment was not motivated in the clinical chart. Surgery prophylaxis accounted for 17.2% of antibiotic therapies and in half of these cases it lasted for at least two days.

The most widely administered class of antibiotics is third-generation cephalosporins, followed by carbapenems and penicillins with isoniazid Figure 1.

Table 2: Length of hospital stay of patients with HAI.

Length of hospital stay	Patients with HAI			
	n	OR	CI95%	*p*
≤ 7 days	2	-	-	-
> 7 days	10	5.9	1.2 - 28.7	0.02
Total	12			

Table 3: Prevalence distribution of major HAI by location.

Types of infection	*n*	% of HAI
UTIs	4	33.3
Pneumoniae	2	16.7
Skin and soft tissue Infections	2	16.7
Gastrointestinal Infections	1	8.3
COVID19 Infections	3	25.0
Total	12	
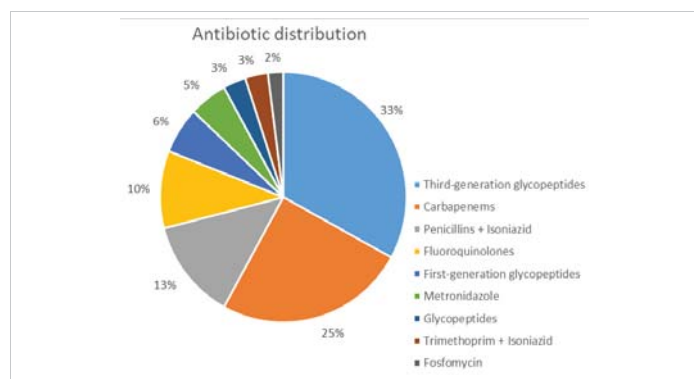
Figure 1: Prevalence distribution of major classes of antibiotics.

Conclusion

Our findings show that the most relevant risk factors for HAIs are advanced patient age, prolonged hospital stay, and use of medical devices, as already documented in previous studies [11,12].

In particular, a hospital stays longer than 7 days represents the element most strongly associated with HAIs (OR 5.9; *p = 0.02*).

It is clear that it is not always possible to reduce the length of hospitalization (e.g., post-acute care, rehabilitation) and this is particularly true for elderly patients, like those of our study sample; however, there is room for improvement.

HAIs prevalence studies are very useful Hospital Hygiene tools that should be performed periodically, in conjunction with a laboratory monitoring system of multiresistant/alert microorganisms and an antimicrobial stewardship program [13].

Moreover, making HAIs data publicly available is fundamental to enhancing the knowledge of microorganisms' circulation and their patterns of resistance so that actions can be taken [14].

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