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HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL PRESCRIBING PATTERNS IN TWO ACUTE CARE HOSPITAL CENTERS

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ABSTRACT

Introduction: Healthcare-associated infections (HAIs) and antimicrobial resistance (AMR) pose major threats to patient safety worldwide. This study aimed to determine the prevalence and distribution of HAIs, as well as to characterize clinical profiles and risk factors in two acute-care hospital centers in Albania.

Methodology: A multicenter, cross-sectional Point Prevalence Survey (PPS) was conducted, applying the standardized protocol of the European Centre for Disease Prevention and Control (ECDC, Version 6.1). The sample included 648 patients admitted to the "Mother Teresa" University Hospital Center (MTUHC, n=511) and the Durrës Regional Hospital (RHD, n=137). Modified Poisson regression was used to identify independent predictors of HAIs, calculating adjusted prevalence ratios (aPR) with 95% confidence intervals (CI).

Results: The overall prevalence of HAIs was 6.3% (95% CI: 4.4–8.1%), with a higher rate at the tertiary level (MTUHC: 6.7%) compared to the regional level (RHD: 5.1%). Pneumonia was the most frequent infection (41.5%), followed by surgical site infections (26.8%) and urinary tract infections (19.5%). The rate of microbiological confirmation was critically low, occurring in only 14.6% of clinically identified cases. Multivariate analysis confirmed that a hospital stay of 8–14 days (aPR=2.9, 95% CI: 1.12–7.5, p=0.03), a hospital stay of ≥ 3 weeks (aPR=5.4, 95% CI: 2.1–13.8, p<0.001), presence of a central vascular catheter (aPR=2.1, 95% CI: 1.1–4.3, p=0.010), urinary catheter catheter (aPR=3.8, 95% CI: 1.9–7.5, p=0.002) and intubation (aPR=2.6, 95% CI: 1.1–6.5, p=0.03) were the primary independent predictors of HAIs. Stratified analysis showed that the effects of these risk factors remain homogeneous and are not significantly modified by the type of hospital (p > 0.05).

Conclusions: This pilot study provides baseline evidence regarding the epidemiological burden of HAIs in Albania. The findings highlight an urgent need to strengthen diagnostic laboratory capacities and to implement rigorous active surveillance and antimicrobial stewardship programs at all levels of hospital care.

KEYWORDS: Hospital-acquired infections; Point Prevalence Survey; Poisson regression; Central vascular catheter; Albania.

1. INTRODUCTION

In recent times, healthcare-associated infections (HAIs) persist in their position as a major menace to patient safety. These infections tend to lead to increased morbidity and mortality, as well as longer duration of hospitalisation, in addition to generating excessive healthcare expenditure (1, 2). Moreover, the significance of HAIs extends beyond the infection episode itself. Treatment typically increases antimicrobial exposure, while repeated or unnecessary therapies create selective pressure that drives antimicrobial resistance (AMR) (1).

The evidence base demonstrates the extent of the HAI burden, as well as the impact of AMR. According to Suetens et al. (2018), European point prevalence surveys conducted between 2016 and 2017 estimated that approximately 6.5% of patients in acute care hospitals had an HAI on any given day, corresponding to a total of 4.5 million episodes. Furthermore, antimicrobial resistance was observed in nearly one-third of the selected bacterial isolates (3). Additionally, a multitude of studies have demonstrated significant variations in HAI prevalence across various hospital settings. A study conducted in Lombardy revealed that 10.1% of patients exhibited at least one healthcare-associated infection (HAI). The most prevalent types of HAI included bloodstream infections, urinary tract infections, lower respiratory tract infections, and surgical site infections (4).

In the Piedmont region, the prevalence of Healthcare-Associated Infection (HAI) was 8.0% across a network of 42 hospitals (5), while a study in four hospitals in Kazakhstan reported a prevalence of 3.8%, with nearly half of the detected infections being recorded in intensive care units (6). Surveys conducted in Singapore and Fiji have further demonstrated that the distribution of respiratory tract infections is contingent on the patient population under study, as well as on exposure to medical devices, clinical speciality, and diagnostic infrastructure (7,8). Across a range of settings, patients at the highest risk of healthcare-associated infections (HAIs) are consistently those receiving the most complex care. Intensive care admission, advanced age, severe comorbidities, major surgical interventions, and the use of urinary catheters, central venous catheters, or mechanical ventilation have been shown to be consistently associated with higher prevalence rates (4,5).

This finding is of considerable epidemiological significance. The study posits that institutional prevalence is indicative not only of infection control performance but also of referral patterns, disease severity, procedural intensity, length of hospital stays, and the thoroughness with which infections are investigated and documented. The findings indicate that infection prevention and control, and antimicrobial stewardship, should be considered as integral components of a comprehensive patient safety strategy. Consequently, ongoing surveillance of HAI and AMR occurrence remains imperative, as traditional surveillance methods are resource-intensive and frequently restricted to specific wards, pathogens, devices, or types of infections.

Conversely, point prevalence surveys (PPS) have been posited as a practical alternative, offering a standardised, cross-sectional (snapshot) measure of active healthcare-associated infections (HAIs) and antimicrobial prescribing across the entire institution (4-8). The utilisation of common case definitions and standardised data structures is instrumental in facilitating comparisons between wards and hospitals, the identification of areas exhibiting elevated risk, and the establishment of a baseline for the evaluation of interventions pertaining to infection prevention and control (IPC) and antimicrobial stewardship (AMS).

The implementation of these strategies at national and regional levels, spanning a range of health systems, including those of Belgium, Italy, Singapore, Kazakhstan, and Japan, as well as in resource-constrained settings, serves as a testament to their efficacy (4,6,7,9-11). However, a point prevalence survey (PPS) reflects the situation at a specific moment in time (a "snapshot") rather than an assessment of incidence; its interpretation must account for differences in case mix, length of stay, diagnostic capabilities, and study methodology. The execution of repeated surveys has been demonstrated to serve the purpose of reinforcing local conclusions by revealing the persistence of observed patterns. Furthermore, inter-centre comparisons have been shown to highlight organisational differences that might otherwise remain unidentified in a broad, aggregated assessment (12,13). In the context of this study, the objective was to ascertain the prevalence and distribution of healthcare-associated infections (HAIs), and to characterise antimicrobial prescribing patterns at two acute care hospitals. The study utilised a standardised point prevalence survey approach.

2. METHODS

2.1 Study design and setting

We conducted this multicentre, cross-sectional point-prevalence study at the Mother Teresa University Hospital Centre (MTUHC) and the Durrës Regional Hospital (RHD), two acute care institutions in Albania. MTUHC functions as a tertiary patient care centre, treating a wide range of conditions for patients from across the country. In contrast, RHD serves as a regional centre, managing various diseases for patients within the Durrës district. The total number of beds included in the study across both hospitals was 954 (714 beds at MTUHC and 240 beds at RHD). During the study period, 648 patients were present: 511 at MTUHC and 137 at RHD. The study procedures, case definitions and data structure were based on version 6.1 of the European Centre for Disease Prevention and Control (ECDC) protocol for point-prevalence surveys of healthcare-associated infections and antimicrobial use in European acute care hospitals (14).

The survey was conducted on a single calendar day, with each participating ward being surveyed on that same day. In instances where data collection across an institution necessitated a greater timeframe than a single day, individual wards were surveyed within the same predetermined study period. It was ensured that no ward was surveyed more than once. While the sampling frame focused primarily on wards expected to feature high relative risks of invasive infections, intensive use of devices, or high volumes of antimicrobial prescribing, a broader selection of lower-risk elective units (e.g., Ophthalmology, Rheumatology) was intentionally retained. This inclusive approach was adopted to avoid cross-sectional under-representation, maintain the structural integrity of a comprehensive institution-wide Point Prevalence Survey (PPS), and provide a valid internal baseline for risk comparison across highly heterogeneous clinical specialties. The identical eligibility criteria and data collection procedures were implemented at both centres to enable valid centre-level comparisons. The following table provides a comprehensive list of the wards included in both hospitals, with the tertiary hospital (MTUHC) featuring a significantly higher number of wards compared to the regional hospital in Durrës. The following units were incorporated into the predetermined sampling framework (Table 1).

Table 1. Wards were included in the predefined sampling frame

No.	MTUHC	No.	RHD
1	Cardiology Intensive Care Unit	1	General Surgery
2	Hematology	2	ENT and Ophthalmic Surgery
3	Gastrohepatology	3	Orthopaedics
4	Nephrology	4	Obstetrics
5	Internal Medicine and Hypertension	5	Gynaecology
6	Cardiac Surgery and Intensive Care	6	General Medicine
7	Vascular Surgery	7	Neurology
8	General Surgery	8	Paediatrics
9	Urology	9	Paediatric Intensive Care Unit

10	Digestive Surgery	10	General Intensive Care Unit
11	Burns and Plastic Surgery with Intensive Care		
12	Oncology		
13	Otorhinolaryngology		
14	Ophthalmology		
15	Anaesthesia and Resuscitation		
16	General Paediatrics		
17	Intensive Care Unit		
18	Paediatric Oncohaematology		
19	Paediatric Pneumo-Allergology		
20	Paediatric Nephrology		
21	Paediatric Surgery		
22	Neurosurgical Intensive Care Unit		

2.2 Study population and eligibility criteria

The study population included patients who were hospitalised in the wards enumerated in Table 1 on the designated date. In accordance with the enrollment procedure delineated in the ECDC PPS protocol (14), the present study encompassed all patients admitted to each of the designated wards at or prior to 08:00 who were present in the ward at the time of study conduction. Patients admitted after the commencement of the study in a given ward, or those who had been discharged or transferred prior to the initiation of the study in that specific ward, were excluded from the study. A temporary absence from a ward for the purposes of a diagnostic or therapeutic procedure was not considered to constitute an exclusion, provided that the patient had been officially admitted to that ward. It is imperative to note that each eligible patient was counted only once.

2.3 Data collection and quality assurance

The collection of data was undertaken using a standardised ECDC PPS form (14). This form facilitated the collection of data at the hospital, ward, and patient levels. The hospital and ward level variables encompassed the type of service, bed capacity and occupancy, specific infection prevention structures, antimicrobial stewardship arrangements, and other organisational indicators available according to Protocol 6.1. Patient-level information was extracted from medical records, medication charts, microbiological examination reports, and any other clinical documentation available on the day the study was conducted. The patient data set included demographic and clinical characteristics, including admission date, recent surgical interventions, disease severity, and the presence of peripheral or central vascular catheters, urinary catheters, intubation, or other pertinent invasive devices. Additionally, the data set documented active invasive infection, antimicrobial treatment, microbiological findings, and available antimicrobial susceptibility results. The data collection team comprised specialised professional staff, including infection control microbiologists, laboratory technicians and personnel responsible for managing hospital infection control at the two hospitals in question. Prior to analysis, the completed forms were meticulously examined for completeness, internal consistency, the presence of duplicate patient records, chronological discrepancies, and the alignment between recorded diagnoses, antimicrobial indications, and microbiological findings. The corrections were made exclusively through reference to the source data, and were meticulously documented in the study database.

2.4 Definitions and outcome measures

The classification of an infection as active was dependent on the fulfilment of the relevant ECDC case definition on the date of the survey, or the receipt of treatment for an infection that had previously met the case definition during the current admission. The type of infection and the anatomical site were coded according to the ECDC hierarchy. The collection of microbiological testing data, the identification of isolated microorganisms, and the documentation of antimicrobial resistance were exclusively recorded for validated laboratory results. The primary outcome for healthcare-associated infections (HAIs) was the proportion of eligible patients with at least one active HAI. The number and distribution of individual HAI episodes were assessed separately, as a patient could have more than one infection. Antimicrobial use was defined as the receipt of at least one systemic antimicrobial agent at the time of the study, or the receipt of a surgical prophylactic dose within the timeframe specified by the ECDC protocol. The categorisation of antibacterial agents was conducted in accordance with the World Health Organization's (WHO) Access, Watch, and Reserve classification, where relevant. The primary outcome for antimicrobial use was defined as the proportion of eligible patients receiving at least one antimicrobial agent. For the purpose of descriptive analyses, the total number of registered agents was employed as the denominator.

2.5 Statistical Analysis

The statistical software SPSS, version 26.0, was utilised to perform the analyses. The variables were presented in terms of frequency, percentage, and mean with standard deviation. The prevalence of HAIs was calculated by dividing the number of patients with at least one active HAI by the total number of patients included in the study. The primary prevalence estimates were accompanied by exact 95% binomial confidence intervals. In order to ensure a high methodological validity, the data processing for this multicentre cross-sectional pilot study (PPS) progressed from conventional univariate and bivariate analyses to advanced multivariate modelling. Initial

bivariate analysis for categorical variables was performed using Pearson's Chi-square test or Fisher's Exact Test when the expected cell counts in the contingency table were less than five. In instances where continuous variables exhibited a non-normal distribution (for instance, the length of hospital stay), the non-parametric Mann-Whitney U test was employed for the purpose of comparison. In view of the fact that the prevalence of the primary outcome (presence of an HAI) is not a very rare event in point prevalence survey (PPS) studies, a modified Poisson regression analysis was used. This analysis allows for the direct calculation of adjusted prevalence ratios (aPR), along with their corresponding 95% confidence intervals (95% CI), with two-sided P-values < 0.05 considered statistically significant.

2.6 Ethical Considerations

The study protocol was developed in accordance with the "National Program for the Prevention and Control of Hospital-Acquired Infections." The protocol was reviewed and approved by the head of the Institute of Public Health [Institutional Review Board, approval no. 321, 22 March 2022] and by the governing authorities of the two hospitals participating in the study. The requirement for individual informed consent was not met, as patient-level data were extracted from medical records, in accordance with institutional authorization. It is important to note that the data collected for the study were based on the PPS (Point Prevalence Survey) protocol. The identification of patients was managed through the utilisation of coding, and access to the data was restricted to authorised personnel only. The results were reported in an aggregated format to ensure confidentiality, in full compliance with national data protection requirements and the ethical principles governing research involving human participants.

3. RESULTS

3.1 Hospitals included in the study and general data

The present study included two hospitals, one serving as a national-level tertiary centre (MTUHC) and the other as a regional-level secondary centre (RHD), thereby offering an insightful comparison between the two distinct types of hospital management. In accordance with the standard protocol of the Public Health Service (PHS), wards demonstrating a higher risk of healthcare-associated infections (HAIs) or a higher utilisation of antimicrobials were included in both hospitals. The mean length of stay was 7.5 days across both hospitals, 8.2 days at the MTUHC and 5.2 days at the RHD. The consumption and utilisation of alcohol-based hand rubs serve as significant indicators of hospital hygiene. An analysis of data from the hospitals indicates a consumption rate of 8.1 liters per 1,000 patient-days. Specifically, the MTUHC recorded 6.6 liters per 1,000 patient-days, while the RHD recorded 19.5 liters per 1,000 patient-days. A fundamental component of the organisational structure of hospital infection control and the management of antimicrobial resistance is the presence of a dedicated hospital infection control unit and an infection control committee. It is notable that MTUHC is the only institution that has infection control units and an infection control committee, whereas RHD has only an infection control committee. However, the organisation and planning of their work, as well as the transparency of their decision-making, are inadequate.

3.2 Patients included in the study

A total of 648 patients were enrolled in the study, comprising 511 patients from MTUHC and 137 patients from RHD. The mean age of all patients was 50.4 years (± 25.6 SD), specifically 49.8 years (± 26.0 SD) for MTUHC and 52.4 years (± 24.2 SD) for RHD. The overall female-to-male ratio is 302/346 = 0.87 (with a higher number of males overall. The length of hospital stay (in days) exhibited significant variations between the two centres, with an overall mean stay of 7.5 ± 6.4 days for the entire sample. Patients at the MTUHC hospital exhibited a prolonged mean duration of stay, with an average of 8.2 ± 6.6 days, as 16.4% of these patients (n = 84) necessitated hospitalisation for a period exceeding three weeks. In contrast, patients at the RHD hospital exhibited a reduced length of stay, with a mean of 5.2 ± 4.8 days, since more than half of them (51.8%, n = 71) were treated and discharged within 1 to 3 days.

With regard to surgical interventions, it was established that 24% of patients had undergone a procedure prior to their hospital admission. The McCabe classification was utilised to categorise the patients, and the observations revealed that 76% of the patients did not have a fatal illness, 5.4% had a rapidly fatal illness, and 16.8% had a fatal illness. It was noted that for 0.9% of the patients, this classification was not reported, as it was not completed by the interviewers, who did not feel able to make such a classification. In the course of the evaluation process aimed at ascertaining the presence of a catheter, it was determined that 83.8% of the patient population exhibited the presence of a peripheral vascular catheter. Furthermore, 21.6% were found to have a urinary catheter, 5.6% had a central catheter, and a mere 1.7% were intubated. Table 2 summarises patients' characteristics according to their respective hospital.

Table 2. Patient characteristics by hospital

Variables/Categories	MTUHC		RHD		Total	
	N	% tot	N	% tot	N	% tot
Age groups						

<1-year old	21	4.1%	3	2.2%	24	3.7%
1-4 years old	31	6.1%	5	3.6%	36	5.6%
5-14 years old	48	9.4%	3	2.2%	51	7.9%
15-24 years old	11	2.2%	7	5.1%	18	2.8%
25-34 years old	22	4.3%	21	15.3%	43	6.6%
35-44 years old	24	4.7%	8	5.8%	32	4.9%
45-54 years old	58	11.4%	18	13.1%	76	11.7%
55-64 years old	118	23.1%	18	13.1%	136	21.0%
65-74 years old	102	20.0%	24	17.5%	126	19.4%
75-84 years old	68	13.3%	25	18.2%	93	14.4%
>=85 years old	8	1.6%	5	3.6%	13	2.0%
Gender						
Female	221	43.2%	81	59.1%	302	46.6%
Male	290	56.8%	56	40.9%	346	53.4%
Days of stay (7)						
1-3 days	174	34.1%	71	51.8%	245	37.8%
4-7 days	132	25.8%	40	29.2%	172	26.5%
8-14 days	121	23.7%	19	13.9%	140	21.6%
>=3 weeks	84	16.4%	7	5.1%	91	14.0%
Surgery upon admission						
No surgery	389	76.1%	102	74.5%	491	75.8%
NHSN surgery	114	22.3%	27	19.7%	141	21.8%
Non-NHSN/minimal surgery	8	1.6%	8	5.8%	16	2.5%
McCabe score						
Non-fatal disease	386	75.5%	112	81.8%	498	76.9%
Fatal disease	102	20.0%	7	5.1%	109	16.8%
Rapidly fatal disease	17	3.3%	18	13.1%	35	5.4%
Missing/Unknown	6	1.2%	0	0.0%	6	0.9%
Central vascular catheter	36	7.0%	0	0.0%	36	5.6%
Peripheral vascular catheter	424	83.0%	119	86.9%	543	83.8%
Urinary catheter	129	25.2%	11	8.0%	140	21.6%
Intubation	10	2.0%	1	0.7%	11	1.7%

**Note: Hospitals are to be categorized into Mother Teresa University Hospital Center (MTUHC) and Durrës Regional Hospital (RHD); A patient may have multiple catheters*

3.3 Healthcare-associated infections

On the day this study was conducted, 6.3% (95% CI 4.4–8.1%) of patients were identified as having at least one healthcare-associated infection. The prevalence of healthcare-associated infections exhibited variation between the two hospitals: at MTUHC, the prevalence was 6.7% (95% CI 4.5–8.8%), while at RHD hospital, it was 5.1% (95% CI 1.4–8.7%). Among the 41 subjects who had a healthcare-associated infection, 87.8% (36/41) had only one such infection, 9.76% (4/41) had two, and 2.44% (1/41) had three (Figure 1).

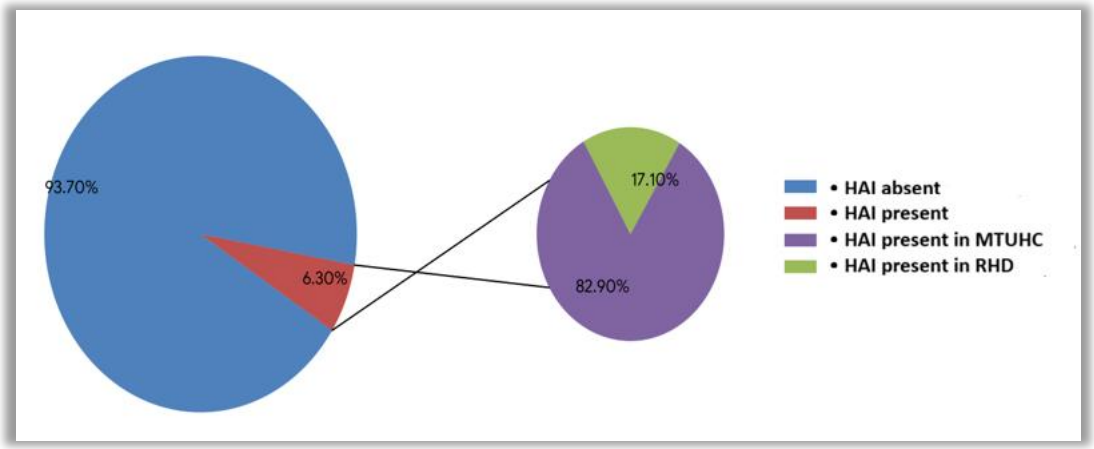


Figure 1. Prevalence of HAIs and its distribution among the two hospital centers

The following table presents the burden of healthcare-associated infections (HAIs) by ward. A statistical analysis of the data indicates that the Surgery ward accounts for the highest number of patients who tested positive for an HAI, representing 46.34% (19/41) of cases. This is followed by the Intensive Care (Reanimation) ward, with a positivity rate of 26.83% (11/41), while the General Medicine ward accounts for 21.95% (9/41) of cases. As demonstrated in table 3, other wards, including Paediatrics and Gynecology, account for 2.44% (1/41) of the cases.

Table 3. Distribution of HAIs by ward and type of infection encountered

	Number of patients with HAI	Percentage of patients with HAI
Wards		
Gynecology/Obstetrics	1	2.44
Intensive Care	11	26.83
Pediatrics	1	2.44
General Medicine	9	21.95
Surgery	19	46.34
Type of infection encountered		
Pneumonia/ Other lower respiratory tract infections	17	41.5%
Surgical wound infection	11	26.82%
Urinary tract infections	8	19.5%
Bloodstream infection	2	4.88%
Catheter-associated infection (with/without BSI)	1	2.44%
Cardiovascular system infections	0	0.0%
Gastrointestinal tract infection	2	4.88%
Skin and soft tissue infections	0	0.0%
Bone and joint infections	0	0.0%
Central nervous system infection	0	0.0%
Eye, ear, nose, and mouth infection	0	0.0%
Reproductive system infections	0	0.0%
Systemic infections	0	0.0%

A more thorough examination of the study's findings indicates that pneumonia accounts for the highest proportion, constituting 41.5% (17/41) of the cases. This is followed by surgical site infections, which account for 26.82% (11/41), and urinary tract infections, which account for 19.5% (8/41).

3.4 Characteristics: Origin, time of infection onset, and association with the use of medical devices

The presence of an infection at the time of hospital admission was observed in 12 patients (29.3% of those with healthcare-associated infections HAIs). Of these, 9.76% (4 patients) acquired the infection at the same hospital

where they were admitted; 14.63% (6 patients) had an infection originating from a different hospital (i.e. they had been previously admitted elsewhere); and 2 patients (4.88%) had an infection of unknown origin at the time of admission (Table 4).

Table 4. Characteristics of HAIs: Origin and connection to catheters

Variables	Frequency of HAI (N)	Percentage of HAI (%)
Total number of patients with HAI	41	100.0%
Origin of HAI at admission:		
HAI present at admission	**12**	**29.3%**
Same hospital	4	9.76%
Another hospital	6	14.63%
Other/unknown origin	2	4.88%
HAI during the same hospital stay	**29**	**70.7%**
Days until the onset of the HAI (median) (29 cases)		
1-2 days	4	13.8%
3-4 days	6	20.7%
5-7 days	5	17.24%
8-14 days	7	24.13%
15-21 days	2	6.89%
>=3 weeks	5	17.24%
Device-associated infections:		
Pneumonia, total (17 cases)		
Intubation within 48 hours before onset of signs	1	5.9%
Not intubated	16	94.1%
Urinary tract infections, total (8 cases)		
Urinary catheter within 7 days before onset	4	50.0%
No urinary catheter	4	50.0%
Primary bloodstream infections		
Vascular catheter within 48 hours before onset of signs	2	100.0%

3.5 Microorganisms Isolated in HAIs

In the present study, out of the 41 cases of healthcare-associated infections (HAIs) that were identified, microbiological analysis to isolate the causative pathogen was performed in only 14.6% (6/41) of cases. In accordance with the findings derived from the laboratory, a total of eight microorganisms were isolated. Non-Enterobacteriaceae Gram-negative bacteria accounted for 12.5% (1/8) of the isolates, specifically identified as *Acinetobacter baumannii*. The largest proportion of isolated microorganisms belonged to the Enterobacteriaceae group (50%; 4/8), while 37.5% (3/8) were Gram-positive cocci (see Table 5). With regard to the nature of the infection, the highest number of isolates was associated with urinary tract infections, bloodstream infections, and surgical site infections; conversely, only one case of pneumonia or lower respiratory tract infection was recorded, with *Providencia spp*. identified as the causative agent. A total of five microorganisms were isolated from 41 identified healthcare-associated infections (HAIs) at the MTUHC hospital. Of these, one was a non-Enterobacteriaceae Gram-negative bacterium, three belonged to the Enterobacteriaceae group, and one was a Gram-positive coccus. In the RHD hospital, three cases were found to contain isolated microorganisms. Of these, two were non-Enterobacteriaceae Gram-negative bacteria, and one was a member of the Enterobacteriaceae group (Table 5).

3.6 Correlation between the presence of HAIs and risk factors

In a univariate analysis conducted on 648 patients, the overall prevalence of healthcare-associated infections (HAIs) was 6.3%, with the duration of hospital stay, the use of a central vascular catheter, and treatment in an intensive care or paediatric unit identified as key risk determinants. The risk of developing a nosocomial infection increased with the duration of the patient's hospital stay. The specialties with the highest risk of hospital-acquired infections were surgical intensive care and paediatric surgery. The findings of this study indicate that the risk of acquiring nosocomial infections is significantly higher in cases involving intensive interventions and prolonged hospital stays (Table 6).

Table 5. Microorganisms isolated in HAIs by type of infection

HAI/Microorganisms	Frequency of HAI (No/%)	Pneumonia/Other lower respiratory tract infections (No/%)	Surgical site infection (No/%)	Urinary tract infections (No/%)	Bloodstream infection (No/%)	Gastrointestinal tract infection (No/%)	Catheter-related infection with/without BSI (No/%)
HAIs present in patients	41 (100%)	17 (41.46%)	11 (26.83%)	8 (19.51%)	2 (4.88%)	2 (4.88%)	1 (2.44%)
HAIs with micro. confirmation	6 (100%)	1 (16.67%)	2 (33.33%)	2 (33.33%)	1 (16.67%)	0 (0.00%)	0 (0.00%)
Microorganisms identified*	8 (100%)	1 (12.50%)	4 (50.00%)	2 (25.00%)	1 (12.50%)	0 (0.00%)	0 (0.00%)
Gram-negative, non-Enterobacteriaceae	1 (12.50%)	0 (0.00%)	1 (25.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Acinetobacter baumannii	1 (12.50%)	0 (0.00%)	1 (25.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Enterobacteriaceae	4 (50.00%)	1 (100%)	1 (25.00%)	1 (50.00%)	1 (100%)	0 (0.00%)	0 (0.00%)
Enterobacter spp. (unspecified)	1 (12.50%)	0 (0.00%)	0 (0.00%)	1 (50.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Escherichia coli	1 (12.50%)	0 (0.00%)	1 (25.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Klebsiella pneumoniae	1 (12.50%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (100%)	0 (0.00%)	0 (0.00%)
Providencia spp.	1 (12.50%)	1 (100%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Gram-Positive Cocci	3 (37.50%)	0 (0.00%)	2 (50.00%)	1 (50.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Enterococcus faecalis	1 (12.50%)	0 (0.00%)	1 (25.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Staphylococcus aureus	1 (12.50%)	0 (0.00%)	1 (25.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Staphylococcus haemolyticus	1 (12.50%)	0 (0.00%)	0 (0.00%)	1 (50.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

**Note: 8 microorganisms were identified from 6 microbiological confirmations (2 additional microorganisms resulted from polymicrobial infections, where two types of bacteria were found in the same patient).*

Table 6. Correlations between HAIs and their predominant factors among hospitalized patients in both hospitals

Variables	Total Frequency	Total Percentage	Number of HAI	Percentage of HAI	Crude PR	CI 95%	*p*
All patients	648	100.0%	41	6.3%			
Age groups							
1-44 years old (reference)	180		9		ref		
<1year old	24	3.7%	2	8.3%	1.7	0.3-8.5	0.5
45-74 years old	338		22		1.3	0.5-2.9	0.5
75-84years old	93	14.4%	7	7.5%	1.5	0.5-4.3	0.4
>=85 years old	13	2.0%	1	7.7%	1.5	0.2-13.5	0.6
Male	346	53.4%	28	8.1%	1.9	1-3.8	0.05
Days of stay							
1-3days	245	37.8%	6	2.4%	ref		
4-7 days	172	26.5%	7	4.1%	1.7	0.5-5.1	0.3
8-14 days	140	21.6%	12	8.6%	3.7	1.3-10.1	0.01
>=3 weeks	91	14.0%	16	17.6%	8.5	3.2-22.3	**<0.001**
Surgery during admission							
No surgery	491	75.8%	28	5.7%	ref		
NHSN surgery	141	21.8%	12	8.5%	1.5	0.7-3.1	0.2
Non-NHSN/minimal surgery	16	2.5%	1	6.3%	1.1	0.1-8.6	0.9
McCabe score							
Non-fatal disease	498	76.9%	26	5.2%	ref		
Fatal disease	109	16.8%	11	10.1%	2	0.9-4.2	**0.05**
Rapidly fatal disease	35	5.4%	3	8.6%	1.7	0.5-5.9	0.4
Missing/Unknown	6	0.9%	1	16.7%	3.6	0.4-32.2	0.2
Invasive Device (730 device in total) *							
Peripheral vascular catheter	543	74.38%	7	1.29%	1.00	Reference	-
Central vascular catheter	36	4.93%	6	16.67%	15.3	4.5 – 48.4	**<0.0001**
Urinary catheter	140	19.18%	26	18.57%	17.4	7.3 – 41.2	**<0.0001**
Intubation	11	1.51%	2	18.18%	16.10	3.3 - 78.3	**0.001**
Patients / Speciality Consulted							
All specialties	648	100.0%	41	6.3%	ref		
General surgery	30	4.6%	3	10.0%	1.6	0.5-5.6	0.5
Digestive tract surgery	45	6.9%	4	8.9%	1.4	0.5-4.2	0.5
Orthopedics and trauma	10	1.5%	1	10.0%	1.6	0.2-13.3	0.6
Cardiac surgery	24	3.7%	3	12.5%	2.1	0.6-7.4	0.2
Neurosurgery	28	4.3%	2	7.1%	1.1	0.2-4.9	0.8

Pediatric surgery	18	2.8%	4	22.2%	4.2	1.3-13.4	**0.01**
Oncology	21	3.2%	1	5.3%	3.7	0.1-6.3	0.8
ENT (Otolaryngology)	6	0.9%	0	0.0%	1.1	0.06-20.3	0.9
Ophthalmology	11	1.7%	0	0.0%	0.6	0.03-10.9	0.7
Burns and plastic surgery	10	1.5%	0	0.0%	0.6	0.04-12.1	0.8
Urology	35	5.4%	1	2.9%	0.4	0.05-3.2	0.4
Vascular surgery	11	1.7%	0	0.0%	0.6	0.03-10.9	0.7
Internal medicine	53	8.2%	1	1.9%	0.2	0.03-2.1	0.2
Gastroenterology	13	2.0%	0	0.0%	0.5	0.03-9.2	0.6
Hepatology	25	3.9%	1	4.0%	0.6	0.08-4.6	0.6
Endocrinology	2	0.3%	0	0.0%	2.9	0.1-61.90	0.5
Nephrology	37	5.7%	3	8.1%	1.3	0.3-4.4	0.6
Hematology / BMT (Bone Marrow Transplant)	37	5.7%	3	8.1%	1.3	0.3-4.4	0.6
Neurology	20	3.1%	0	0.0%	0.3	0.02-6.0	0.5
Pulmonology	18	2.8%	1	5.6%	0.8	0.1-6.7	0.8
Rheumatology	5	0.8%	0	0.0%	1.3	0.07-24.4	0.8
Other (Neuro-ICU and Ophthalmology)	5	0.8%	0	0.0%	1.3	0.07-24.4	0.8
Pediatrics	83	12.8%	1	1.2%	0.1	0.02-1.3	0.09
Medical ICU	28	4.3%	1	3.6%	0.5	0.07-4.1	0.5
Surgical ICU	16	2.5%	6	37.5%	8.8	3.0-25.6	**0.0001**
Pediatric ICU	7	1.1%	2	28.6%	5.9	1.1-31.4	**0.03**
Mixed/polyvalent ICU	14	2.2%	2	14.3%	2.5	0.5-11.4	0.2
Specialized ICU	4	0.6%	0	0.0%	1.6	0.08-30.7	0.7
Obstetrics / Gynecology	25	3.9%	1	4.0%	0.6	0.08-4.6	0.6
Gynecology (incl. surgery)	7	1.1%	0	0.0%	0.9	0.05-17.3	0.9

**Note: The total number of invasive devices (N = 730) exceeds the total number of enrolled patients (N = 648) because individual patients could be exposed to multiple concurrent devices (A patient may have multiple catheters: e.g., carrying both a peripheral and a urinary catheter simultaneously).*

Multivariable analysis employing modified Poisson regression confirms that the duration of hospital stay and the use of invasive devices are the primary independent predictors of healthcare-associated infections (HAIs), after adjusting the model for age, hospital type, and disease severity (McCabe score). The male gender lost its statistical significance in the adjusted model (aPR = 1.5; 95% CI: 0.9–2.4; p = 0.11), suggesting that it does not act as an independent risk factor. The length of hospital stay exhibited a robust, progressive correlation with elevated risk, particularly for durations of ≥ 3 weeks, where the risk escalates substantially by a factor of 5.4 [95% CI: 2.1–13.8; p < 0.001]. With regard to the impact of invasive procedures on the risk of HAIs, the urinary catheter has been identified as the most significant clinical factor, with a reported adjusted risk increase of 3.8 [95% CI: 1.9–7.5; p = 0.002]. This is followed by intubation, which is associated with a 2.6-fold higher risk [95% CI: 1.1–6.5; p = 0.034], and then the central vascular catheter, which is linked to a 2.1-fold higher risk [95% CI: 1.1–4.3; p = 0.01] (Table 7).

Table 7. Bivariate Analysis and Modified Poisson Regression of Risk Factors for HAI

Variables/Risk Factors	HAI Prevalence (%)	Crude PR (95% CI)	p-value	Adjusted Prevalence Ratio (95% CI) *	p-value
Gender					
Female (Reference)	4.3%	1.0		1.0	
Male	8.1%	1.9 (1.0–3.8)	0.05	1.5 (0.9–2.4)	0.11
Hospital stay					
1-3 days (Reference)	2.4%	1.0		1.0	
4-7 days	4.1%	1.7 (0.5–5.1)	0.3	1.3 (0.5–3.2)	0.45
8-14 days	8.6%	3.7 (1.3–10.1)	0.01	2.9 (1.1–7.5)	0.03
≥ 3 weeks	17.6%	8.5 (3.2–22.3)	<0.001	5.4 (2.1–13.8)	<0.001
Peripheral Vascular Catheter					
No					
Yes (Reference)**	1.3%	1.0		1.0	
Central Vascular Catheter					
No (Reference)	4.5%	1.0		1.0	
Yes	12.9%	3.1 (1.6–5.9)	0.0001	2.1 (1.1–4.3)	0.01
Urinary Catheter					
No (Reference)		1.0		1.00	
Yes	18.5%	14.4 (6.4–32.5)	<0.001	3.8 (1.9–7.5)	0.002
Intubation					
No (Reference)		1.0		1.0	-
Yes	18.2%	14.1 (3.3–60.3)	0.012	2.6 (1.1–6.5)	0.03

**Note: The multivariable regression model has been adjusted for patient age, participating hospital (MTUHC vs. RHD), and the McCabe score (a measure of disease severity). Multicollinearity values: maximum VIF = 1.42 (Tolerance > 0.70). Model goodness-of-fit: Deviance/DF = 1.04. **Kateteri periferik është vendosur si reference.*

A stratified analysis and an assessment of the interaction term by hospital type (see Table 8) demonstrate that the adjusted risk for healthcare-associated infections (HAIs) – associated with length of stay and the use of invasive devices – remains largely consistent, without being statistically significantly modified by the level of healthcare (tertiary vs. regional). Although patients who have been hospitalised for a minimum of three weeks demonstrate a risk that is approximately three times higher at the tertiary centre (MTUHC: aPR = 6.1; 95% CI: 2.4–15.5) in comparison to the regional hospital (RHD: aPR = 2.1; 95% CI: 0.5–11.9), the p-value for the interaction (p = 0.24) confirms that this variation does not reach statistical significance. A similar trend is observed for invasive clinical procedures: central vascular catheters (MTUHC: aPR = 2.1 vs. RHD: aPR = 1.6; p-interaction = 0.72) and intubation (MTUHC: aPR = 2.9 vs. RHD: aPR = 1.9; p-interaction = 0.61). These show higher relative risks in the tertiary setting, which is likely due to the greater complexity of cases in intensive care units. However, interaction tests indicate that this difference is not statistically significant. Conversely, urinary catheterisation presents a higher relative risk in the regional hospital (RHD: aPR = 4.1; 95% CI: 1.2–13.5) than in the tertiary hospital (MTUHC: aPR = 1.8; 95% CI: 0.9–3.8). However, the interaction term was not found to be significant (p = 0.31). Taken together, these findings indicate that the type of hospital does not act as an effect modifier for the primary risk factors. This suggests that HAI prevention and control strategies such as protocols for catheter hygiene and the management of catheter duration should be applied with the same level of rigour and the same standards across both tiers of the hospital system (Table 8).

Table 8. Stratified Analysis and Interaction Term (Interaction Analysis) by Hospital Typology

Exposure Factor	MTUHC (Tertiary) Adjusted Prevalence Ratio (95% CI)	RHD (Regional) Adjusted Prevalence Ratio (95% CI)	Interaction Adjusted Prevalence Ratio (95% CI)	p-value ((Interaction)
Hospital stay 8–14 days	3.2 (1.2–8.7)	1.8 (0.4–8.1)	1.7 (0.3–8.8)	0.51
Hospital stay ≥ 3 weeks	6.1 (2.4–15.5)	2.1 (0.4–11.9)	2.8 (0.5–16.9)	0.24
Central Vascular Catheter (Yes)	2.1 (1.1–4.3)	1.6 (0.4–6.0)	1.3 (0.3–5.8)	0.72
Urinary Catheter (Yes)	1.8 (0.9–3.8)	4.1 (1.2–13.5)	0.44 (0.1–2.2)	0.31
Intubation (Yes)	2.9 (1.1–7.6)	1.9 (0.5–7.8)	1.5 (0.3–8.4)	0.61

3. DISCUSSION

This point-prevalence survey (PPS), conducted at the Mother Teresa University Hospital Center (MTUHC) and the Durrës Regional Hospital (RHD), provides detailed information regarding the burden of healthcare-associated infections (HAIs) in Albania. The present study found the overall prevalence of HAIs to be 6.3% (95% CI: 4.4–8.1%), reflecting a persistent epidemiological burden. The burden of the disease exhibited variation according to the level of hospital care, with a percentage of 6.7% (95% CI: 4.5–8.8%) observed at the national tertiary centre (MTUHC), in comparison to 5.1% (95% CI: 1.4–8.7%) recorded at the secondary-level regional hospital (RHD). The findings of this study are consistent with the global literature on the subject, which indicates that the prevalence of healthcare-associated infections (HAIs) is determined not only by the performance of infection prevention and control (IPC) programmes, but also by patient complexity, the intensity of invasive procedures, clinical referrals, and the length of hospital stay (15–17).

4.1 Comparison of Global HAI Prevalence with the Region and the World

A comparison of the 6.3% HAI prevalence found in this study with research conducted in various European countries reveals that this figure is close to the European average reported by Suetens et al. (2018) (3). Their point prevalence survey (PPS) of healthcare-associated infections, conducted on specific days during 2016 and 2017 in acute care hospitals, estimated that approximately 6.5% of patients had at least one such infection (19, 20). In contrast, the present finding is lower than that of a study by Antonelli et al. (2024) in Italy, where a PPS in the Lombardy region showed that 10.1% of patients had at least one HAI (4). In addition, Russotto et al. (2025) reported a prevalence of 8.0% across a network of 42 acute care hospitals (5). While the discrepancy between our study and the aforementioned research is not substantial, it may be attributed to a higher index of clinical suspicion, as well as more advanced capabilities for investigating and documenting infections within the Italian healthcare system, compared to the healthcare institutions examined in our country. However, in other countries, lower HAI prevalence rates have been reported compared to those observed in the two hospitals under scrutiny. For instance, a study conducted by Semenova et al. (2024) in Kazakhstan found a 3.8% prevalence across four acute-care hospitals (6). Nevertheless, the most recent national data from Kazakhstan indicate an increase in prevalence, demonstrating that developing healthcare systems often face initial under-reporting of cases, whether due to strict surveillance criteria or a lack of available resources (19).

Researchers have emphasised that the distribution of infections is contingent upon factors such as exposure to medical devices, clinical specialty, and the diagnostic infrastructure of the institutions under analysis (5,7). In this case, the heterogeneity between MTUHC and RHD is indicative of this. The tertiary hospital admits the most severe cases from across the country, characterised by a longer average length of stay (8.2 ± 6.6 days) and a higher proportion of patients with chronic conditions or critical illnesses, compared to RHD (5.2 ± 4.8 days), where more than half of the patients are discharged within 1 to 3 days.

4.2 Analysis of Risk Factors, Hospital Wards, and Invasive Devices

The study revealed that a significant proportion of healthcare-associated infection (HAI) cases were concentrated in specific wards, namely Surgery (46.35%, 19 out of 41 cases) and Resuscitation/Intensive Care (26.82%, 11 out of 41 cases). This phenomenon is consistent with global trends, wherein patients requiring the most intricate care are observed to be disproportionately susceptible to nosocomial infections (20–22). As demonstrated in the study conducted by Semenova et al. (2024) (6), almost 50% of all identified infections were recorded in intensive care units (ICUs). In addition, other studies have confirmed that admission to intensive care, the performance of major surgical interventions, and the presence of urinary catheters, central vascular catheters, or mechanical ventilation are consistently associated with a higher prevalence of infections (4, 5). Our analysis of risk factors indicated that the length of hospital stay is of great significance, as the risk of an HAI occurring increases dramatically with the number of days spent in the hospital. In the present study, patients with a length of stay ranging from 8–14 days exhibited a crude PR of 3.7 (95% confidence interval [CI]: 1.3–10.1, $p = 0.01$), while those with a stay of 3 weeks or longer demonstrated a crude PR of 8.5 (95% CI: 3.2–22.3, $p < 0.001$), in comparison to the reference group consisting of patients with stays of 1–3 days. This finding is corroborated by the methodological guidelines published by the ECDC (2022) (14), which substantiates the notion that an extended hospitalisation period

engenders an augmented ecological exposure to nosocomial pathogens. With regard to the utilisation of invasive devices, the employment of a central vascular catheter (corresponding to a crude PR of 15.3; 95% CI: 4.5-48.4, p <0.0001), urinary catheter and intubation exhibited significant associations that are consistent with the observations reported by Costantino et al. (2026). The aforementioned researchers observed that the deployment of medical devices functions as both an indicator of clinical severity and a modifiable conduit for the transmission of infection (12). Moreover, this phenomenon has been observed in recent data from repeated point prevalence surveys (PPS) conducted by Costantino et al. (2026), as even conventional medical wards (such as General Medicine, which accounted for 21.95% of HAI cases in our study) where patients require increasingly complex care can carry a significant risk of HAIs; this challenges the traditional assumption that surveillance should focus primarily on surgical or intensive care units (12).

4.3 Anatomical Structure of Infections and Specific Profiles

In this study, pneumonia was the most prevalent infection, accounting for 41.5% (17/41) of cases, followed by surgical site infections and urinary tract infections, at 26.82% (11/41) and 19.5% (8/41) of cases, respectively. This distribution is indicative of a particular profile for our nation, wherein respiratory infections manifest as the predominant cause of hospital-acquired morbidity. In contrast to the study by Antonelli et al. (2024) (4), the point prevalence survey (PPS) in that study shows a more balanced distribution among bloodstream infections (BSI), urinary tract infections (UTI), lower respiratory tract infections, and surgical site infections (SSI) a finding that differs from our own, which indicate a disproportionate burden of pneumonia. It is particularly noteworthy that, among the 17 patients in our study who developed pneumonia, 94.1% had not undergone prior intubation, and only 5.9% had been intubated within 48 hours prior to the onset of symptoms.

The finding, that a significant proportion of cases of pneumonia are non-ventilator-associated (NVAP), is of critical significance and should be viewed with concern. While a such a dense cluster of respiratory infections in conventional wards might initially raise suspicion of an nosocomial outbreak of undetermined origin, or of diagnostic misclassification (e.g. overlapping community-acquired infections) it is necessary to consider several contextual factors. Firstly, recent international surveillance has highlighted that NVAP accounts for a substantial, frequently underreported burden of HAIs outside the ICU, often driven by microaspiration, immobility, and gaps in basic nursing care. Secondly, given the study's critically low microbiological confirmation rate (14.6%), it is evident that these cases were predominantly identified through clinical and radiological criteria. Consequently, a secondary diagnostic overestimation due to empirical over-reporting by clinicians cannot be entirely ruled out. In order to differentiate sporadic NVAP clusters from potential community-to-hospital outbreaks or true institutional outbreaks, future active, prospective surveillance paired with mandatory biosampling is strictly required. With regard to urinary tract infections, the occurrence of such infections in 50% of patients who had a urinary catheter in place for seven days prior to the onset of symptoms aligns perfectly with international literature, in which catheterisation remains the primary modifiable risk factor (23).

4.4 The Microbiological Diagnostic Deficit

A critical aspect of our study pertains to the low rate of microbiological confirmation. Out of 41 cases clinically identified as healthcare-associated infections (HAIs), microbiological analysis to isolate the causative pathogen was performed and yielded valid results in only 14.6% (6/41) of cases. The very low rate of microbiological confirmation is linked to the administration of antibiotics prior to the collection of cultures. This finding suggests that in over 85% of cases, clinicians manage hospital-acquired infections on an empirical basis. This diagnostic gap is notably more pronounced in this region than in other countries. For instance, in Italy, microbiological investigation was reported for 64% of HAI cases, despite significant challenges regarding resistance among the isolated organisms (4). Alothman et al. (2020) observe in the Middle East that the limitations in the completeness and consistency of susceptibility reporting pose a significant obstacle, yet sampling rates remain higher (24). In settings with restricted laboratory access, surveillance definitions that are overly reliant on laboratory data frequently underestimate the true burden of HAIs, emphasising the necessity to augment diagnostic capacity within hospital environments (8, 25). 8 microorganisms were identified from 6 microbiological confirmations were 2 additional microorganisms resulted from polymicrobial infections, where two types of bacteria were found in the same patient. Of the 8 microorganisms isolated in this study, 50% (4/8) belonged to the Enterobacteriaceae family (*Escherichia coli, Klebsiella pneumoniae, Providencia spp*), 37.5% (3/8) were Gram-positive cocci (*Staphylococcus aureus, Enterococcus faecalis, Staphylococcus haemolyticus*), and 12.5% (1/8) consisted of the *non-Enterobacteriaceae* Gram-negative bacterium *Acinetobacter baumannii*. In the study by Semenova et al. (2024), *Pseudomonas aeruginosa* and *Acinetobacter baumannii* were the most frequently identified pathogens (6). In a study conducted by Cai et al. (2017), unspecified clinical sepsis and pneumonia, accounting for 25.5% and 24.8% of cases, respectively, were the most common healthcare-associated infections (HAIs), with *Staphylococcus aureus* (12.9%) and *Pseudomonas aeruginosa* (11.5%) being the most common pathogens implicated in these infections (7). Meanwhile, a recent study by Costantino et al. (2026) reported that the cases included in the research involved deep surgical site infections and catheter-related bloodstream infections, primarily caused by Gram-negative bacteria such as *Acinetobacter baumannii, Escherichia coli*, and *Klebsiella pneumoniae* or *by Staphylococcus aureus*. Gram-positive isolates consisted mainly of coagulase-negative staphylococci and *Enterococcus faecalis*, alongside *Clostridioides difficile* and invasive candidiasis (12). Although the rate of microbiological confirmation was low, which limits the monitoring of all healthcare-

associated infection (HAI) cases, it remains essential to ensure the continuous monitoring of these cases, as well as the assessment of all factors contributing to HAIs within hospital settings.

5. STUDY LIMITATIONS

It is important to note that this study is subject to certain methodological limitations, which should be considered during the interpretation of its results. Firstly, the cross-sectional design, specifically a Point Prevalence Survey (PPS), provides only a 'snapshot' or static view of the situation at a single point in time. This limits the ability to establish a direct causal link between risk factors and the development of healthcare-associated infections (HAIs). Secondly, the purposive (a priori) selection of high-risk wards and the exclusion of other departments within the participating hospitals limit the extrapolation of these data to the national level. Thirdly, the low rate of microbiological testing (14.6%) may have resulted in an underestimation of cases that meet the strict laboratory-based definitions set by the ECDC, as greater reliance was placed on clinical criteria. Additionally, this heavy reliance on clinical markers might have introduced a degree of diagnostic misclassification, particularly regarding non-ventilator-associated pneumonia cases, which could not be bacteriologically verified as distinct from community-acquired etiologies. Notwithstanding, this pilot study provides a robust and standardised basis for the establishment of active surveillance systems and rigorous antimicrobial stewardship programmes in Albania.

6. CONCLUSION

The present multicentre study provides a critical, standardised assessment of the epidemiological burden of healthcare-acquired infections (HAIs) and their associated factors within the Albanian hospital system. The overall prevalence of 6.3% is largely consistent with the average reported by European Union countries, thus highlighting an ongoing and persistent challenge to patient safety. Utilising sophisticated statistical modelling techniques, the study reveals that the risk of HAIs is not uniformly distributed; rather, it is disproportionately concentrated among patients with prolonged hospital stays (particularly those exceeding two weeks) and those undergoing invasive procedures, such as the use of central vascular catheters. The absence of a statistically significant interaction between the type of institution (tertiary versus regional) and these risk factors suggests that the biological and environmental dynamics of infection transmission remain consistent across settings. This finding underscores the necessity for universal prevention standards.

The most critical finding, which has significant clinical implications, is the pronounced deficit in microbiological confirmation, as more than 85% of infections are managed on a purely empirical basis. This practice has the potential to compromise the accuracy of epidemiological surveillance and to augment the risk of the selection of multidrug-resistant bacterial clones under the selective pressure of antimicrobials. Moreover, the preponderance of non-ventilator-associated pneumonia (non-VAP) in conventional hospital wards calls into question the long-standing assumption that surveillance should be focused exclusively on intensive care units. A transition from reactive, empirical strategies to a proactive system necessitates the prioritisation of investments in the expansion of diagnostic laboratory capacity, the standardisation of respiratory hygiene protocols, and the establishment of functional antimicrobial stewardship committees on a national scale.

7. RECOMMENDATIONS

In order to optimise the prevention of healthcare-associated infections (HAIs) and antimicrobial resistance in healthcare settings, the following measures should be taken:

- The establishment of infection prevention and control programmes at both the national and hospital levels is imperative. These should include recommendations regarding organisational and structural arrangements, diagnostic and therapeutic procedures (such as antimicrobial stewardship), resource requirements, surveillance objectives, training, and patient information.
- The development of guidelines for the prevention and control of HAIs and antimicrobial resistance at both the national and hospital levels is imperative.
- It is imperative to enhance continuous surveillance at the central level and beyond.
- It is imperative to enhance infection prevention and control measures among staff members. This should include the provision of relevant training.
- It is imperative to enhance the quality of the information provided to patients, thereby fostering their engagement in adhering to infection prevention and control measures.
- It is imperative to provide sustained assistance to enhance the laboratory's capacity for conducting diagnostic tests for healthcare-associated infections (HAIs).

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