

Impact of Clinical Factors on Nosocomial Infections and Bacterial Resistance in Resuscitation Settings in Abidjan, Côte d'Ivoire: Retrospective Cross-Sectional Study

Kouamé Koffi Isidore^{1,2}, Mobio N'kan Michael Patern^{1,2}, Bouh Kouesseu Judith^{1,2}, Konan Kouassi Jean^{1,2}, Coulibaly Klinna Theodore^{1,3}, Toure Walamitien Cyril^{1,2}, Sai Servais Sontia^{1,4}, Bable Koffi Suy^{1,2}, Kouakou Homawo José^{1,2}, Yapo Yapo Paul^{1,2}

¹Department of Anesthesia, Resuscitation, and Emergency Medicine, Felix Houphouët Boigny University, Abidjan, Ivory Coast; ²Anesthesia and Intensive Care Unit, Yopougon University Hospital Center, Abidjan, Ivory Coast; ³Anesthesia and Intensive Care Unit, Bingerville Mother and Child Hospital, Abidjan, Ivory Coast; ⁴Anesthesia and Intensive Care Unit, Treichville University Hospital Center, Abidjan, Ivory Coast

Correspondence: Kouamé Koffi Isidore, Email kouamedocinterne@gmail.com

Background: Nosocomial infections (NIs) are a key indicator of healthcare quality. This study aimed to identify the main determinants of NIs in the intensive care unit (ICU) of Yopougon University Hospital, providing updated local data to improve care quality and guide prevention strategies.

Methods: This was a retrospective, descriptive, and analytical cross-sectional study conducted over 11 months in the ICU.

Results: We recorded 55 NIs, representing 17.52% of ICU admissions. The male-to-female ratio was 1.80, with an average age of 42.00 ± 20.29 years. Hypertension (28.34%) and diabetes (8.92%) were the most common comorbidities. The leading causes for admission were consciousness disorders (18.47%), stroke (16.88%), and polytrauma (15.29%). Common invasive procedures included urinary catheter insertion (61.78%), mechanical ventilation (35.99%), venous catheter insertion (13.38%), and external ventricular drain (EVD) insertion (5.73%). Germs were identified in 17 cases (5.41% of NIs), with *Klebsiella* (29.41%), *Pseudomonas* (35.29%), and *Escherichia coli* (17.65%) being the most common. Other germs included *Staphylococcus aureus*, *Acinetobacter* spp. and *Enterobacter* spp. Antibacterial resistance was found in 64.70% of isolates. Factors independently associated with NIs were recent surgery (excluding immediate postoperative), obesity, EVD insertion, anemia, and prolonged hospitalization. Patients with hemodynamic instability or from the surgery department were less likely to develop NIs.

Conclusion: This study highlights risk factors such as comorbidities, invasive procedures, and bacterial resistance, emphasizing the need to strengthen hospital infrastructure, adopt prevention policies, and research antibiotic resistance. It stresses managing comorbidities, adhering to aseptic protocols, and involving the public in prevention efforts.

Keywords: impact, clinical factors, occurrence, nosocomial infections, bacterial resistance, intensive care

Introduction

Nosocomial infections (NIs), also known as healthcare-associated infections, are infections that occur after admission to a healthcare facility, typically after 48 hours of hospitalization. They include not only infections occurring during hospitalization but also those affecting healthcare personnel.¹ These infections pose a significant public health concern, particularly in low-income countries such as Côte d'Ivoire, where their incidence is particularly high.² Resuscitation services are particularly vulnerable to these infections because they often provide care to patients with severe illnesses and utilize invasive devices. The World Health Organization global report on infection control highlights that up to 30% of patients in intensive care units (ICUs) can develop NIs, with a 2 to 20 times higher incidence in low- and middle-income countries.³ In Europe, the incidence of NIs varies between 5% and 10%, with resuscitation services being among

the most affected, with rates reaching 30%.⁴ In Africa, although data remain limited, the prevalence of NIs varies considerably across countries and contexts. A systematic review estimated that the prevalence of health care-associated infections in Africa ranged from 1.6% to 90.2%, with an average of 15%.⁵ In Mali, a study conducted in the University Hospital Center (CHU) of Bamako reported a prevalence of NIs of 25% specifically in resuscitation services.⁶ In Côte d'Ivoire, there are no data in the literature on NIs during resuscitation.

To assess the quality of care in our healthcare facility, we identified the main determinants of NIs within the resuscitation service of the CHU of Yopougon. The objective was to provide up-to-date local data, which is essential for improving quality of care and effective prevention strategies in this vital sector of intensive care.

Methods

This cross-sectional retrospective study included descriptive and analytical data on 314 patients who received care in the resuscitation department of the CHU of Yopougon between February and December 2024. Sampling was non-probabilistic with comprehensive recruitment of all patients who met the inclusion criteria and received treatment during the study period. Data collection was carried out using a form that was previously validated by the main author and head of the department. The questionnaire was tested in a cohort of 30 patients to ensure its ease of use, reliability, and technical functionality. Pilot responses were not included in the final analyses. All patients admitted during the period with infectious syndrome after 48 hours of hospitalization were included in the study. Patients with infection at admission and those who died within 48 hours of admission were excluded from the study. The variables studied were sociodemographic data (age, sex), history and comorbidities (diabetes, diabetic wound, hypertension, cardiovascular disease, immunosuppression, surgery within the last 30 days excluding the immediate postoperative period, human immunodeficiency virus infection, cancer, corticotherapy, obesity, stroke, asthma), home department (emergency, surgery, general practice, other services), reasons for admission, management data, and microbiological data. In this descriptive study, the distribution of the different discrete variables in size and percentage was presented. Continuous variables were grouped into class, and the distribution of these classes was presented in numbers and percentages. The means, standard deviations, and extremes of these variables were specified. NI was diagnosed on the basis of fever after 48 hours of hospitalization, hyperleucocytosis with predominance of neutrophils, and high procalcitonin, with or without isolation of a germ. It was said to be of pulmonary origin in front of purulent secretions and radiological lesions. When the origin is urinary, it was evoked in front of turbid urine or a purulent urethral discharge in a patient who received urinary catheterization. For the analytical study, we performed a bivariate and then multivariate logistic regression analysis, as appropriate. The variables for the model were selected using the “top-down” method, starting with a global model that included all variables and then iteratively removing variables based on statistical criteria such as the p-value and AIC, to select the most relevant model. The model's goodness of fit was evaluated using the Hosmer-Lemeshow test to check if the fitted model matched the observed data. The likelihood ratio test was also used to compare the final model with alternative models. The handling of confounding variables was performed using multivariate logistic regression, where potential interactions between variables were tested to examine their influence on the final model. Additionally, collinearity analysis was conducted by calculating the variance inflation factor (VIF) to ensure that no variables included in the model were strongly correlated with each other, which could compromise the accuracy of the estimates. The selected model was the one with the highest likelihood ratio. The area under the ROC curve (AUROC) of the selected model was calculated with its 95% confidence interval (95% CI). The significance alpha threshold was set at 5%. All statistical analyses were performed using Stata 17 software (StataCorp LLC, College Station, TX, USA).

Ethical Considerations

Ethical approval was obtained by the Head of the Resuscitation Department of the CHU de Yopougon and the Medical Director of Health. Data collection was voluntary after informed consent was obtained by the patient or a trusted representative. Only the author had access to the data. The processing of data was confidential and anonymous. Our study complies with the Declaration of Helsinki.

Results

General Characteristics

A total of 314 patients were admitted during the study period including 202 men, with a sex ratio of 1.80 and an average age of 42.00 ± 20.29 years. Hypertension was the most common comorbidity, affecting 28.34% of patients. Patients were mainly from surgery (41.40%), followed by emergency rooms (30.25%) and general practice services (10.83%). The main reasons for admission were postoperative resuscitation (22.93%), impaired consciousness (18.47%) and stroke (16.88%). Apart from the routine placement of peripheral venous lines, the most common invasive procedures were urinary catheters (61.78%), mechanical ventilation (35.99%), and venous catheters (13.38%). Immunosuppressive therapy was administered to 35 patients, and anemia was observed in 21.34% of cases. Finally, 16.56% of patients were hospitalized for reasons other than their initial admission. The clinical parameters and patient management are listed in Table 1.

Nosocomial Infection

We recorded 55 cases of NI, which represented 17.52% of patients admitted during the study period. There were 38 cases of pneumonia (12.10%), 19 cases of urinary tract infection (6.05%), 7 cases of surgical wound infection (2.23%), 2 cases of catheter bacteremia (0.64%), 1 case of tracheotomy infection (0.32%), and 1 case of gynecological entrance sepsis (0.32%). We did not receive information on the source of NI for two cases.

Table 1 Clinical Profiles and Patient Management

Items	N (%)	Items	N (%)
Sociodemographic data		Reason for admission	
Sex		Polytrauma	48 (15.29)
Male	202 (64.33)	Hemodynamic instability	11 (3.50)
Female	112 (35.67)	Respiratory failure	35 (11.15)
Age		Trouble of consciousness	58 (18.47)
0–30	89 (28.34)	Stroke	53 (16.88)
30–60	162 (51.59)	Postoperative	72 (22.93)
60–90	63 (20.06)	Severe sepsis	5 (1.59)
Comorbidities/ history		State of convulsive disease	2 (0.64)
Diabetes	28 (8.92)	Eclampsia	2 (0.64)
Diabetic wound	1 (0.32)	Meningeal hemorrhage	2 (0.64)
HTA	89 (28.34)	Other reasons	45 (14.33)
Cardiovascular disease	2 (0.64)	Treatment data	
Immunosuppression	33 (10.51)	Peripheral route	314 (100)
Surgery < 30 days*	48 (15.29)	Mechanical ventilation	113 (35.99)
HIV	8 (2.55)	EVD	18 (5.73)
Cancer	7 (2.23)	Venous catheter	42 (13.38)
Corticosteroid	20 (6.37)	Urinary probe	194 (61.78)
Obesity	2 (0.64)	Drain de Redon	7 (2.23)
Stroke	2 (0.64)	Chest drain	3 (0.96)
Gastroduodenal ulcer	2 (0.64)	Tracheotomy	1 (0.32)
Asthma	2 (0.64)	Immunosuppressant	35 (11.15)
Original service		Evolution	
Emergency	95 (30.25)	Hypoprotidemia	9 (2.87)
Surgery	130 (41.40)	Anemia	67 (21.34)
General medicine	34 (10.83)	Extended hospitalization	52 (16.56)
Other services	54 (17.20)		

Notes: *Patient who underwent surgery less than 30 days ago.

Abbreviations: EVD, External ventricular drain; HIV, Human immunodeficiency virus; HTA, Hypertension.

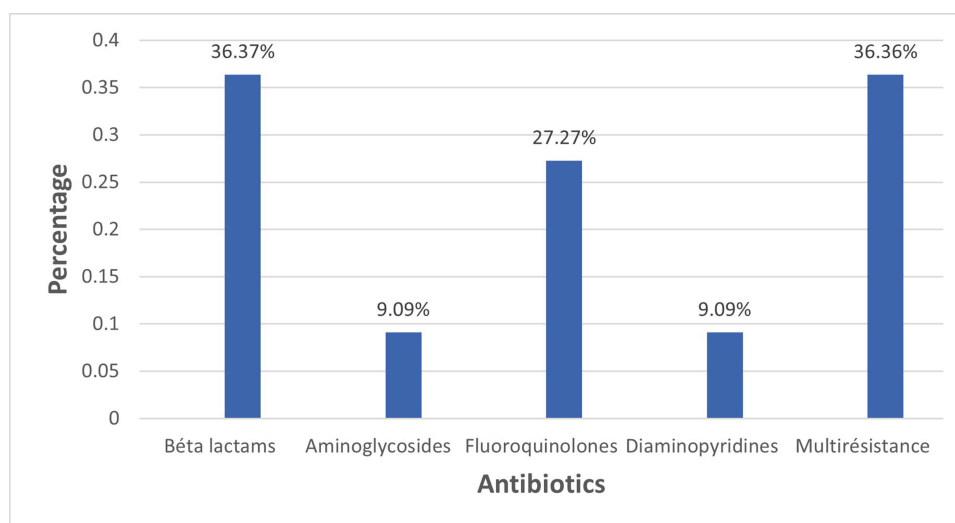


Figure 1 Antibiotic resistance profiles of isolated pathogens (n=11).

Microbiological Data

The germ was identified in 17 cases, or 5.41% of NIs. There were five cases of *Klebsiella* (29.41% of the isolated germs), six cases of *Pseudomonas* (35.29%), and three cases of *Escherichia* (17.65%). The other germs were *Staphylococcus aureus* sp, *Acinetobacter lamanii*, *A. baumannii*, *Enterobacter* sp, *Staphylococcus* sp, and coagulase-negative *Staphylococci*, each of which accounted for 5.88% of the identified germs. We recorded antibacterial resistance for 11 of the 17 isolates (64.70%). The resistance profiles are shown in [Figure 1](#)

Analytical Study

Factors independently associated with the occurrence of NI were recent surgery except in the immediate postoperative period, obesity, placement of the EVD, anemia, and prolonged hospitalization. Patients admitted for hemodynamic instability, as well as those coming from the surgery department, were less likely to develop nosocomial infections. These factors are listed in [Table 2](#).

Table 2 Factors Associated with Nosocomial Infection

Exposures	Nosocomial Infection		Total	Gross Coefficient (95% CI)	P	Adjusted Coefficient (95% CI)	p
	No	Yes					
Age							
0–30	74/259	15/55	89/314	I	Réf	I	Réf
30–60	131/259	31/55	162/314	0.15 (–0.52; 0.83)	0.655	0.02 (–0.06; 0.10)	0.583
>60	54/259	9/55	63/314	–0.20 (–1.09; 0.70)	0.669	–0.02 (–0.12; 0.08)	0.720
Sex							
Male	165/259	37/55	202/314	I	Réf	I	Réf
Female	86/259	20/55	112/314	–0.02 (–0.11; 0.06)	0.616	–0.03 (–0.11; 0.04)	0.375

(Continued)

Table 2 (Continued).

Exposures	Nosocomial Infection		Total	Gross Coefficient (95% CI)	P	Adjusted Coefficient (95% CI)	p
	No	Yes					
Comorbidities / Medical history							
Diabetes	22/259	6/55	28/314	0.04 (−0.10; 0.19)	0.569	0.14 (0.04; 0.24)	0.006
Diabetic wound	1/259	0/55	1/314	−0.18 (−0.92; 0.57)	0.645		
Hypertension	74/259	15/55	89/314	−0.01 (−0.10; 0.08)	0.847		
Cardiovascular disease	1/259	1/55	2/314	0.33 (−0.20; 0.85)	0.226		
Immunosuppression	26/259	7/55	33/314	0.04 (−0.10; 0.18)	0.556		
Recent surgery	30/259	18/55	48/314	0.23 (0.12; 0.35)	<0.001		
HIV	8/259	0/55	8/314	−0.18 (−0.45; 0.09)	0.187		
Cancer	7/259	0/55	7/314	−0.18 (−0.46; 0.11)	0.218	0.65 (0.21; 1.09)	0.004
Corticosteroid therapy	13/259	7/55	20/314	0.19 (0.01; 0.36)	0.033		
Obesity	0/259	2/55	2/314	0.83 (0.31; 1.35)	0.002		
Gastroduodena ulcer	2/259	0/55	2/314	−0.18 (−0.71; 0.35)	0.514		
Asthma	2/259	0/55	2/314	−0.18 (−0.71; 0.35)	0.514		
Originating service							
Emergency	67/259	28/55	95/314	0.17 (0.08; 0.26)	<0.001	−0.08 (−0.15; −0.01)	0.044
Surgery	120/259	13/55	133/314	−0.13 (−0.22; −0.05)	0.002		
General medicine	30/259	4/55	34/314	−0.06 (−0.20; 0.07)	0.351		
Other services	43/259	11/55	54/314	0.03 (−0.08; 0.15)	0.545		
Admission reason							
Polytrauma	32/259	16/55	48/314	0.19 (0.07; 0.30)	0.002	−0.19 (−0.39; −0.01)	0.048
Hemodynamic instability	11/259	0/55	11/314	−0.18 (−0.41; 0.05)	0.119		
Respiratory failure	30/259	5/55	35/314	−0.04 (−0.17; 0.10)	0.595		
Consciousness disorder	48/259	10/55	58/314	0.01 (−0.11; 0.10)	0.952		
Stroke	43/259	10/55	53/314	0.02 (−0.09; 0.13)	0.777		
Postoperative	65/259	7/55	72/314	−0.10 (−0.20; −0.01)	0.047		
Sepsis	3/259	2/55	5/314	0.23 (−0.11; 0.56)	0.183		
Status epilepticus	2/259	0/55	2/314	−0.18 (−0.71; 0.35)	0.514	0.23 (0.07; 0.39)	0.004
Eclampsia	1/259	1/55	2/314	0.33 (−0.20; 0.85)	0.226		
Meningeal hemorrhage	1/259	1/55	2/314	0.33 (−0.20; 0.85)	0.226		
Other reasons	38/259	7/55	45/314	−0.02 (−0.14; 0.10)	0.709		
Management data							
Mechanical ventilation	83/259	30/55	113/314	0.14 (0.05; 0.23)	0.001	0.23 (0.07; 0.39)	0.004
External ventricular drain	8/259	10/55	18/314	0.40 (0.23; 0.58)	<0.001		
Venous catheter	30/259	12/55	42/314	0.13 (0.01; 0.25)	0.042		
Urinary catheter	157/259	37/55	194/314	0.04 (−0.05; 0.13)	0.357		
Redon drain	6/259	1/55	7/314	−0.03 (−0.32; 0.25)	0.821		
Thoracic drain	3/259	0/55	3/314	−0.18 (−0.61; 0.26)	0.424		
Tracheotomy	0/259	1/55	1/314	0.83 (0.08; 1.57)	0.029		
Immunosuppressor	24/259	11/55	35/314	0.16 (0.02; 0.29)	0.021		
Evolution							
Hypoproteinemia	4/259	5/55	9/314	0.39 (0.14; 0.64)	0.002	0.19 (0.09; 0.28)	<0.001
Anemia	37/259	30/55	67/314	0.35 (0.25; 0.44)	<0.001		
Prolonged hospitalization	21/259	31/55	52/314	0.50 (0.41; 0.60)	<0.001		

Note: Zone ROC = 0.86 (0.80–0.92).

Abbreviations: CI, Confidence interval; HIV, Human immunodeficiency virus.

Discussion

Sociodemographic Data

Sociodemographic analysis of this study revealed a male predominance, with a sex ratio of 1.80, which is in agreement with the trends observed in the literature. Indeed, men are frequently overrepresented in resuscitation and surgery

services, a phenomenon that is often attributed to the epidemiology of traumatic pathologies and predisposition of men to engage in risky behaviors.⁷ The age profile of the patients revealed that the 30- to 60-year-old age group constituted the majority of patients (51.59%). This group is often associated with a wide range of underlying conditions, particularly comorbidities such as hypertension, diabetes, and cardiovascular disease.⁸ Although patients aged 60 to 90 represented 20.06% of the sample, this age group is likely more prone to NIs due to aging of the immune system and a higher prevalence of chronic comorbidities that compromise infection resistance.⁹

Comorbidities and History

The use of corticosteroids, which was administered to 6.37% of patients in this study, was an identified comorbidity. Other comorbidities included high blood pressure (28.34%), immunosuppression (10.51%), and diabetes (8.92%), which are well-established risk factors for NIs. These chronic conditions are often associated with a weakened immune system, making patients more vulnerable to infections. In addition, patients with hypertension and diabetes have vascular disturbances and impaired immune responses, factors that promote NIs.⁹

Service of Origin and Reason for Admission

Analysis of the original services revealed that the majority of patients were from surgical services (41.40%) and emergency rooms (30.25%). These results reflect typical admissions to ICUs, where patients are admitted either after major surgery or because of severe conditions requiring intensive care.¹⁰ Postoperative resuscitation (22.93%) was a major reason for admission, consistent with the literature, which has shown that invasive surgical procedures and postoperative management increase the risk of infectious complications.¹⁰ The frequency of consciousness disorders (18.47%) and strokes (16.88%) also highlights the fact that these patients are most often exposed to invasive treatments such as mechanical ventilation, which is a well-documented risk factor for NIs.

Data of the Support

Common invasive procedures in this study such as urinary catheterization (61.78%), mechanical ventilation (35.99%), and venous catheter insertion (13.38%) are known risk factors for NIs. Urinary catheters and mechanical ventilation are widely recognized as major risk factors for nosocomial urinary and respiratory infections, respectively.¹¹ In addition, the placement of EVDs (5.73%) and other invasive devices such as chest drains (0.96%) can also introduce germs into vulnerable sites and increase the risk of NIs.^{7,12} Immunosuppressive treatments (11.15%) are also a risk factor for NIs, as they weaken the immune system.

Nosocomial Infections

The rate of NIs observed in this study (17.52%) highlights the persistence of infections acquired in hospital despite the preventive measures in place. However, this rate remains relatively low compared to the many resuscitation units across Africa,⁷ possibly because this resuscitation facility was recently reopened after 5 years of closure for rehabilitation work. Pneumonia, which accounted for 12.10% of NIs in this study, was the most common NI, followed by urinary tract infections (6.05%). These results are similar to those of Merzougui et al,⁷ who reported a prevalence of nosocomial pneumonia followed by urinary infections in ICUs. Surgical wound infections (2.23%) and catheter-related infections (0.64%) were also common complications. This infection profile is characteristic of ICUs, where patients are often subjected to invasive interventions and prolonged monitoring.¹¹

Microbiological Data and Bacterial Resistance

Germs were identified in only 5.41% of cases; the isolated bacteria were mainly Gram-negative bacilli. This low identification rate could be attributed to the management of NIs by the patients themselves in a low-income country where universal health coverage is lacking. *Klebsiella* (29.41%) and *Pseudomonas* (35.29%) were the most frequently isolated bacteria, followed by *E. coli* (17.65%). These germs, which are common in respiratory and urinary infections, are frequently encountered in hospital settings.⁷ In addition, the presence of *Staphylococcus*, *Acinetobacter*, and other multidrug-resistant bacteria highlights the critical need for effective strategies to manage bacterial resistance and combat

NIs. This study revealed antibacterial resistance for 11 of the 17 isolated germs, or 64.70%. This resistance was particularly prevalent in *Klebsiella*, *Pseudomonas*, and *E. coli*, which complicates the treatment of infections, extends hospital stays, and increases mortality.⁵ Management of antibacterial resistance, particularly in ICUs, is essential to limit the spread of multidrug-resistant bacteria, which is primarily driven by the excessive use of antibiotics, lack of adequate resources and infrastructure, inadequate infection control practices, cross-transmission of resistant pathogens, as well as the presence of comorbidities and chronic diseases.⁵ These factors, combined with a lack of adherence to infection prevention standards, contribute to the spread of antibiotic-resistant bacteria in hospital environments.

Multivariate Analysis of Factors Associated with NIs

Multivariate analysis identified several independent factors associated with the occurrence of NIs, including recent surgery (not in the immediate postoperative period), obesity, EVD, anemia, and prolonged hospitalization. By contrast, Protective factors against nosocomial infection were hemodynamic instability and the originating service, specifically surgery.

EVDs are devices used to drain cerebrospinal fluid from the ventricles of the brain in cases of intracranial hypertension (ICH). Our analysis showed that the risk of NI was associated with the use of these drains, indicating that EVD drains, while essential for the management of patients with ICH, can be gateways to pathogens, especially when left in place for an extended period. Previous studies, such as that by Beer et al,¹² have shown that the installation of drains, although useful, can introduce bacteria into the surgical site, leading to nosocomial infections. This indicates that drainage management, including strict adherence to asepsis and sterility protocols, is crucial for preventing infections. Interventions such as reducing the drain length and regular monitoring can minimize the risk associated with surgical drains.¹² Recent surgical intervention outside of the immediate postoperative period is a significant factor in increasing the risk of NIs. This relationship is well documented in the literature, which shows that surgical procedures promote the development of infections due to the alteration of physical barriers in the body and the disruption of normal microbial flora. Indeed, even surgical interventions that are not immediately postoperative can result in bacterial colonization of surgical sites and implanted medical devices such as catheters, drains, and other instruments. The use of invasive medical devices, combined with inadequate sterilization practices, is a major factor in patient colonization by allowing microorganisms to enter and colonize the body, leading to infections.¹³ During surgical procedures, bacteria can be introduced into the body, often remaining on medical devices, increasing the risk of NIs. To prevent NIs, there must be strict adherence to aseptic practices, rigorous management of medical devices, and adherence to sterilization protocols.¹⁴ In a hospital setting, anemia is often associated with an increased risk of infection due to its impact on the immune system, underlining the importance of managing comorbidities in NIs. Patients with anemia have a reduced ability to fight infections, primarily due to the deficiency of red blood cells, which play a key role in oxygen transport and are essential for immune cell function.⁵ This association between anemia and NIs is well documented in the literature, where it has been reported that patients with low hemoglobin have a higher risk of infectious complications.¹⁵ Prolonged hospitalization is also a significant risk factor for NIs due to more frequent invasive procedures and increased overall exposure time to germs, leading to a higher likelihood of acquiring an infection.¹⁵ Razafindraibe et al¹⁵ showed that the longer the hospital stay, the higher the risk of NIs, possibly due to progressive impairment of the immune system as patients remain in hospital and the use of medical devices (eg, probes, catheters, drains). Obesity also significantly contributes to the occurrence of NIs through several interrelated mechanisms such as chronic systemic inflammation, which weakens the immune response and makes obese individuals more vulnerable to infections. In addition, medical interventions such as the insertion of catheters or drains can be complicated by abdominal fat, potentially leading to poorer asepsis and increased bacterial colonization.¹⁶ Obesity also disrupts wound healing, increasing the risk of postoperative infections. In addition, frequent comorbidities such as diabetes and hypertension exacerbate the risk of NIs by further weakening the immune system.¹⁵ Finally, obese individuals are more likely to develop pressure sores (also known as pressure ulcers), which are entry points for pathogens. Although counter-intuitive, surgery as a service of origin and hemodynamic instability are protective factors against NIs. Regarding surgery as the originating service, it is important to note that certain surgical procedures, especially those performed in specialized departments, benefit from rigorous preparation protocols and strict aseptic measures, thus helping to reduce the risk of infection. In addition, postoperative follow-up and care in dedicated surgery services can also reduce the risk of NI.

Hemodynamic instability may appear to be a risk factor; however, in reality, hemodynamic instability, when quickly corrected, can be a positive sign of treatment success, which reduces the length of stay in the ICU. However, given the small sample size of patients admitted for hemodynamic instability in this study, which is a limitation of this study, larger studies are needed to confirm this relationship more robustly and with greater statistical accuracy. Another limitation of this study was the low rate of germ identification, which may limit our understanding of the prevalence and resistance of pathogens in this particular environment.

Conclusion

In conclusion, this study highlights the risk and protective factors associated with NIs in resuscitation services. The results showed a high prevalence of comorbidities such as hypertension, diabetes, and immunosuppression, which contribute to the occurrence of NIs due to their impact on the immune system. Invasive procedures such as urinary catheters, mechanical ventilation, and the use of EVDs are also important risk factors. Multivariate analysis showed that recent surgery, obesity, anemia, EVD placement, and prolonged hospitalization were independently associated with an increased risk of NI. However, some protective factors were identified, such as surgery as the originating service and hemodynamic instability. Indeed, although hemodynamic instability is generally considered a risk factor, its rapid correction helps limit exposure to infection risks, thereby reducing the likelihood of complications. Finally, bacterial resistance remains a major issue, with a high rate of resistance among isolated germs, including *Klebsiella* and *Pseudomonas*, emphasizing the need for the strict management of NIs and antibacterial resistance in ICUs. To improve the situation, it is crucial that the government strengthen hospital infrastructure, implement infection prevention policies, and support research on antibiotic resistance. Healthcare workers, for their part, must strictly adhere to aseptic protocols, ensure continuing education, and effectively manage comorbidities and postoperative follow-up. Finally, the general public has an essential role to play by adopting appropriate hygiene practices, seeking prompt medical attention in the event of symptoms, and actively participating in prevention campaigns. These concerted efforts will reduce the risk of nosocomial infections and protect public health in a sustainable manner.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This work did not receive any domestic or external funding.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Apurba SS, Sandhya B. *Review of Microbiology & Immunology*. 6th ed. London: Jaypee Brother Medical Publishers Ltd; 2018.
2. Raoofi S, Pashazadeh Kan F, Rafiei S, et al. Global prevalence of nosocomial infection: a systematic review and meta-analysis. *PLoS One*. 2023;18(1):e0274248. doi:10.1371/journal.pone.0274248
3. World Health Organization (WHO). WHO launches first-ever global report on infection prevention and control. World Health Organization; Available from: <https://www.who.int/fr/news/item/06-05-2022-who-launches-first-ever-global-report-on-infection-prevention-and-control>. Accessed October 24, 2025.
4. European Centre for Disease Prevention and Control. *Incidence and Attributable Mortality of Healthcare-Associated Infections in Intensive Care Units in Europe, 2008-2012*. Stockholm: ECDC; 2018.
5. Bunduki GK, Masoamphambe E, Fox T, et al. Prevalence, risk factors, and antimicrobial resistance of endemic healthcare-associated infections in Africa: a systematic review and meta-analysis. *BMC Infect Dis*. 2024;24(1):158. doi:10.1186/s12879-024-09038-0
6. Beye SA, Maiga A, Cissoko Y, et al. Prevalence of nosocomial infections at the centre hospitalier universitaire du point G in Bamako, Mali. *Rev Mali Infect Microbiol*. 2024;19(1):45–49. doi:10.53597/remim.v19i1.2794

7. Merzougui L, Barhoumi T, Guizani T, et al. Nosocomial infections in resuscitation: annual incidence and clinical aspects at the polyvalente resuscitation service, Kairouan, Tunisia, 2014 [Nosocomial infections in the Intensive care unit: annual incidence rate and clinical aspects]. *Pan Afr Med J.* **2018**;30:143. doi:10.11604/pamj.2018.30.143.13824
8. Séré L, Tiéno H, Yanogo D, et al. Prevalence of diabetes and diabetes-related cardiovascular risk factors in a rural population in Burkina Faso [French only]. *Med Trop Sante Int.* **2021**;1(1):B1J8–7K63. doi:10.48327/B1J8-7K63
9. Saviteer SM, Samsa GP, Rutala WA. Nosocomial infections in the elderly. increased risk per hospital day. *Am J Med.* **1988**;84(4):661–666. doi:10.1016/0002-9343(88)90101-5
10. Diouf E, Leye PA, Bah MD, et al. Modalities of admission of patients in a resuscitation service in Africa and consequences on evolution. *Ann Fr Anesth Réanim.* **2014**;19(1).
11. Vidaković S, Raičević R, Grunauer M, et al. Risk factors for healthcare associated infections and in-hospital mortality in neurological intensive care unit in tertiary hospital in Belgrade, Serbia: a prospective cohort study. *Vojnosanit Pregl.* **2020**;775(10):1060–1066. doi:10.2298/VSP180422184V
12. Beer R, Pfausler B, Schmutzhard E. Management of nosocomial external ventricular drain-related ventriculomeningitis. *Neurocrit Care.* **2009**;10(3):363–367. doi:10.1007/s12028-008-9155-y
13. Malm D, Rolander B, Ebefors EM, et al. Reducing the prevalence of catheter-related infections by quality improvement: six-year follow-up study. *Open J Nurs.* **2016**;6(2):79–87.
14. Kubde D, Badge AK, Ugemuge S, et al. Importance of hospital infection control. *Cureus.* **2023**;15(12):e50931. doi:10.7759/cureus.50931
15. Razafindralaibe FAO, Rakotomavo FA, Ramarolahy ARN, et al. Factors determining the occurrence of nosocomial infections in patients with strokes admitted to intensive care. **2022**;14(1):56–59.
16. Huttunen R, Syrjänen J. Obesity and the risk and outcome of infection. *Int J Obes.* **2013**;37(3):333–340. doi:10.1038/ijo.2012.62

Infection and Drug Resistance

Publish your work in this journal

Infection and Drug Resistance is an international, peer-reviewed open-access journal that focuses on the optimal treatment of infection (bacterial, fungal and viral) and the development and institution of preventive strategies to minimize the development and spread of resistance. The journal is specifically concerned with the epidemiology of antibiotic resistance and the mechanisms of resistance development and diffusion in both hospitals and the community. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/infection-and-drug-resistance-journal>

Dovepress
Taylor & Francis Group