

Profile of Nosocomial Infections in an Intensive Care Unit in Sub-Saharan Africa (Abidjan, Côte d'Ivoire)

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ABSTRACT

Background: Nosocomial infections increase morbidity, mortality, and healthcare costs in intensive care units (ICUs). The study aimed to describe the epidemiological profile and outcomes of nosocomial infections in an ICU in sub-Saharan Africa.

Methods: It was a retrospective and analytical study from January 1st, 2013, to December 31st, 2021, in the intensive care unit of Cocody University Hospital, Abidjan, Côte d'Ivoire. All patients hospitalized for at least 48 hours in the ICU or in the referring department were included.

Results: Among 5330 admissions, 325 patients developed a nosocomial infection (6.1%). Of these, 52% acquired the infection before ICU admission and 48% during their ICU stay. The mean age of the patients was 44.1 years with a standard deviation of 21 years, and the male-to-female ratio was 1.25. Neurological disorders were the most frequent underlying conditions. Nosocomial pneumonia was the most common infection (49.7%), followed by urinary tract infection (44.2%), bacteremia (37.0%), and other infections (11.1%). Gram-negative bacilli were predominant (79.9%), followed by Gram-positive infections (15.4%) and yeasts (4.7%). The most frequently isolated germs were *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *E. coli*. The overall mortality rate was 77.2%. Poor prognostic factors included mechanical ventilation, deep coma, and ventilator-associated pneumonia (VAP).

Conclusion: Nosocomial infections most frequently complicated neurological conditions and were predominantly pulmonary. *Pseudomonas aeruginosa* was the leading causative pathogen. These infections were responsible of high mortality.

Introduction

Nosocomial infections, defined as infections acquired during or after hospitalization and not present at admission [1], pose a major threat to both patients and healthcare workers. They represent a persistent challenge for healthcare systems worldwide [2]. These hospital-acquired infections are responsible for the emergence of multidrug-resistant microorganisms [3]. Nosocomial infections are responsible for high

morbidity and mortality associated with high financial costs [4-5]. Intensive care unit pays a heavy price due to the frequent use of invasive devices [6]. The management of nosocomial infections remains a global problem, affecting approximately 10% of patients in developed countries [7] and up to 60% in some regions of Africa [7]. In Côte d'Ivoire, the prevalence of nosocomial infections was estimated at nearly 40% in 2011 [8]. This study aimed to describe the epidemiological and clinical profile of nosocomial infections in an intensive care unit in Sub-Saharan Africa.

The authors declare no conflicts of interest.

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Methods

We conducted a retrospective descriptive and analytical study over eight years, from January 1st 2013, to December 31st 2021, in the ICU of Cocody University Hospital, Abidjan, Côte d'Ivoire. The ICU is a 12-bed multipurpose unit with open compartments and limited isolation facilities.

It lacks automatic sliding doors and has a single handwashing station for the entire unit. The ICU does not have an internal pharmacy; medications are supplied by the hospital's central pharmacy located approximately 50 meters away. Because there is no universal health insurance system, families are responsible for purchasing prescribed medications and resuscitation supplies.

All medical records of patients admitted during the study period were reviewed. Patients who died or were discharged within 48 hours of admission were excluded. The variables analyzed included demographic, clinical, paraclinical, and therapeutic parameters. Data were collected using a pre-established standardized form in accordance with the principles of the Declaration of Helsinki. Quantitative variables were expressed as means $\pm$ standard deviation (SD), and qualitative variables as percentages. The chi-square test or Fisher's exact test was applied as appropriate, with a significance threshold set at $p < 0.05$.

Operational definitions

Sign of infection

A patient was considered to have a sign of infection if they presented:

Clinically: a temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ or chills associated with at least one of the following: cloudy urine, purulent discharge from the urinary meatus, purulent pulmonary secretions, induration along a peripheral catheter, pus at the insertion site of a peripheral or central venous catheter, localized skin swelling with purulent discharge, or infected pressure ulcers.

Biologically: leukocytosis > 10000 cells/ mm^3 or leucopenia < 4000 cells/ mm^3 , and/or elevated C-reactive protein (CRP).

Probable nosocomial infection

Patients were classified as having a probable nosocomial infection if, after at least 4 hours of hospitalization in the ICU or in the referring department, they developed:

Isolated fever without other clinical signs after appropriate antimalarial therapy or Fever and/or purulent bronchial secretions, inflammatory or purulent entry sites, suppurative or necrotic pressure ulcers, or cloudy urine.

Confirmed nosocomial infection

A confirmed nosocomial infection was defined as the presence of bacteriological confirmation corresponding to any clinical or biological signs of infection.

Controlled infection

An infection was considered controlled when its signs resolved under antibiotic therapy guided by a properly conducted antibiogram.

Invasive procedures

Invasive procedures included urinary catheterization, central venous catheterization, and tracheal intubation.

Results

Socio-demographic data

A total of 5330 admissions were recorded during the study period. Among them, 325 patients (6.1%) developed a nosocomial infection (NI). The mean age was 44.1 ± 21 years (range: 0–89 years). Males predominated, with a male-to-female ratio of 1.25. Most infections occurred in patients aged 18–45 years (76.1%).

Clinical data

Neurological disorders were the leading cause of admission, with 84.4% of patients presenting a Glasgow coma scale (GCS) score below 9. Diabetes mellitus was the most frequent comorbidity among patients with NIS (28.6%).

Invasive procedures were common: urinary catheterization was performed in 89.2%, and orotracheal intubation in 80% of infected patients. The main signs of infection were fever (79.1%) and purulent bronchial secretions (77.2%) (Table 1).

Table 1- Distribution of patients presenting signs of infection during hospitalization

Signs of infection	Number	Percentage
Purulent bronchial secretions	251	77.23
Bedsore	46	14.15
Fever	257	79.09
Purulent lochia	1	0.31
Purulent swelling	7	2.15

Biological and bacteriological data

A complete blood count was performed in all infected patients. Hyperleukocytosis was found in 63.2%, and anemia in 41.2% of cases. C-reactive protein (CRP) and procalcitonin (PCT) levels were elevated in 27.6% and 91.2%, respectively. Bacteriological cultures identified at least one pathogen in 68.9% of the samples analyzed.

The most frequently isolated organisms were *Pseudomonas aeruginosa* (42.5%) and *Klebsiella pneumoniae* (32.6%) (Figure 1).

Therapeutic and outcome data

Most patients (86.5%) received empirical antibiotic therapy. Following microbiological confirmation, less than half (42.5%) were treated with targeted antibiotic therapy based on susceptibility testing. The mean duration of hospitalization among infected patients was 18 ± 19.2 days. Despite antibiotic therapy guided by antibiogram results, infection persisted in 60% of cases.

The overall mortality rate was 35.2%, of which 77.2% occurred in patients with nosocomial infections. Mortality varied according to infection site and study year (Figure 2). Across all admissions, nosocomial infection was significantly associated with mortality (Table 2). Poor prognostic factors among patients with NI included severe coma (GCS < 8), mechanical ventilation, presence of a central venous catheter, ventilator-associated pneumonia (VAP), and comorbidities. Although bacteremia was not statistically associated with mortality, it was identified as a contributing factor (Table 2).

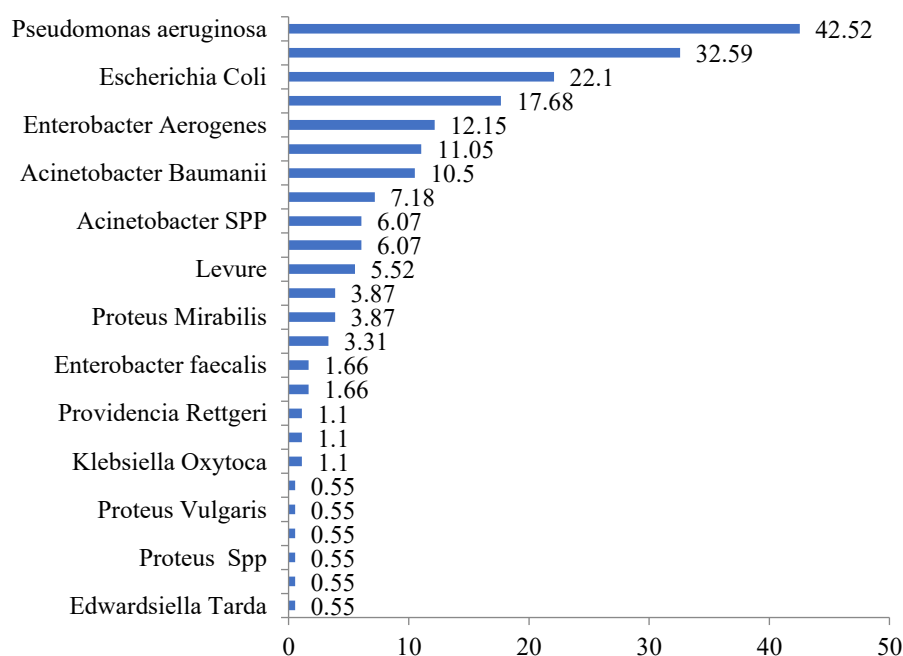


Figure 1- Overall proportion of isolated germs.

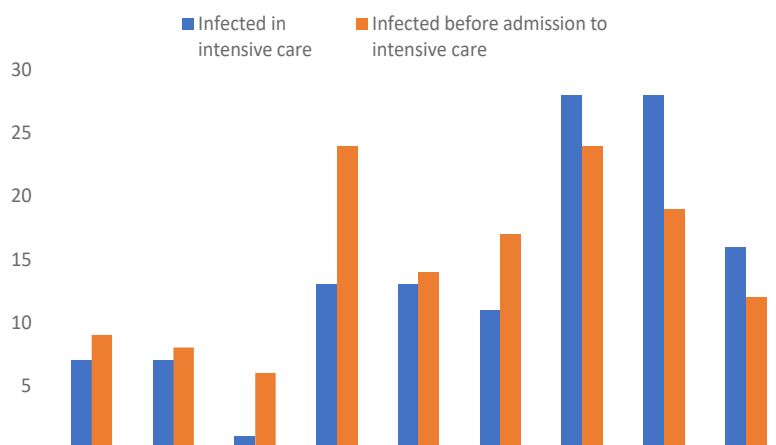


Figure 2- Distribution of deaths according to place of infection and year.

Table 2- Factors related to mortality.

Factors	Deceased	Total	p	OR [IC]
Nosocomial infection, n = 5330				
- Presence of NI	251	325	0.0000	7
- No infection	1626	5005		[5.4 – 9.1]
Site of infection, n = 325				
- In intensive care	129	156	0.02	1.8
- Out of intensive care	122	169		[1–3]
Comorbidity, n = 325				
- Present	80	93	0.0008	3.3
- Absent	171	240		[1.6 – 7.1]
Depth of coma, n = 325				
- GS ≤ 8	162	193	0.0004	2.5
- GS > 8	89	132		[1.4 – 4.2]
Mechanical ventilation, n = 325				
- Ventilated patients	231	260	0.0000	17
- Non-ventilated patients	20	65		[9.3 – 34.4]
Central venous access (CVA), n = 325				4.2
- Present	131	146	0.0000	[2.3 – 7.9]
- Absent	120	179		
Bacterium (B), n = 325				
- Present	109	139	0.65	1.1
- Absent	142	186		[0.6 – 1.9]
VMP, n = 260				
- Present	85	129	0.0000	3
- Absent	51	131		[1.8 – 5]

Discussion

This study found a male predominance among patients with nosocomial infections, with a male-to-female ratio of 1.25, consistent with findings from other authors [9–11]. The majority of patients were young, representing 73.31% of the sample [12]. This relative youth reflects the general population of our Africa country [12].

The prevalence of nosocomial infections in this study (6.1%) was higher than that reported in several other studies, including those conducted by ENP in France (2017), Sidoub in Morocco, Medskorosh in Iran, and Kasongo in the Democratic Republic of Congo [13–16]. This high prevalence was mainly due to lapses in aseptic technique. Stroke and head trauma were the main pathologies associated with high mortality in infected patients. This was also found in the studies by Irié Bi at the Bouaké University Hospital (48%) and Kouamé at the Yopougon University Hospital (19%) [17, 18]. The use of invasive devices and the severity of neurological conditions in these brain-injured patients would explain the frequent occurrence of nosocomial infections [17, 18, 19].

The majority of infected patients received empirical antibiotic therapy, as is the case in several African countries [20–21]. The main organisms identified were *Pseudomonas aeruginosa* and other Gram-negative bacilli, consistent with patterns reported in comparable

African and Mediterranean settings. The most frequent infection sites were pulmonary and urinary, followed by bloodstream infections.

The mortality rate among infected patients was 77.23%, remaining one of the highest identified in the various studies. Several factors could explain this mortality, including the lack of health insurance coverage, which justifies the purchase of medications at the expense of certain costly tests, and poor practices among healthcare providers.

Conclusion

Nosocomial infections remain a concern in our hospitals, particularly in intensive care units. The prevalence of nosocomial infections was high and responsible for high mortality. The main pathogens identified were *Pseudomonas* and Gram-negative bacilli. Ventilator-associated pneumonia (VAP) was the most common infection encountered. These findings raise questions about the measures to be taken.

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