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Nosocomial infections and resistance pattern of common bacterial isolates in an intensive care unit of a tertiary hospital in Nigeria: A 4-year review

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ABSTRACT

Introduction: Infection is a major determinant of clinical outcome among patients in the intensive care unit. However, these data are lacking in most developing countries; hence, we set out to describe the profile of nosocomial infection in one of the major tertiary hospitals in northern Nigeria.
Method: Case records of patients who were admitted into the intensive care unit over a 4-year period were retrospectively reviewed. A preformed questionnaire was administered, and data on clinical and microbiological profile of patients with documented infection were obtained.
Results: Eighty-our episodes of nosocomial infections were identified in 76 patients. Road traffic accident (29/76, 38.2%) was the leading cause of admission. The most common infections were skin and soft tissue infections (30/84, 35.7%) followed by urinary tract infection (23/84, 27.4%). The most frequent isolates were *Staphylococcus aureus* (35/84, 41.7%), *Klebsiella pneumoniae* (18/84, 21.4%), and *Escherichia coli* (13/84, 15.5%). High rate of resistance to cloxacillin (19/35, 54.3%) and cotrimoxazole (17/26, 65.4%) was noted among the *S aureus* isolates. All the Enterobacteriaceae isolates were susceptible to meropenem, whereas resistance rate to ceftriaxone was high (*E coli*, 55.6%; *K pneumoniae*, 71.4%; *Proteus* spp, 50%).
Conclusion: Infection control practice and measures to curtail the emergence of antimicrobial resistance need to be improved.

1. Introduction

Nosocomial infections (NIs) are infections that are acquired in a hospital setting. The Centers for Disease Control and Prevention define *intensive care unit (ICU)–associated infections* as those infections that occur after 48 hours of ICU admission or within 48 hours after transfer from an ICU [1].

Nosocomial infections have increased the morbidity and mortality of hospitalized patients and especially those admitted in an intensive care setup. In addition, these infections lead to extra hospital stay and expenditure, thus overburdening the already strained health economy in resource-poor countries. In studies conducted by various authors in developed countries, NIs were reported to affect as many as 50% or more of patients admitted into ICUs compared with 5% to 15% of hospitalized patients admitted into regular wards [2]. Earlier studies reported much lower incidence of 2.8% to 21.6% [3,4], highlighting the impact of new interventional procedures in the ICUs. In developing countries, the magnitude of the problem remains underestimated largely because of poor surveillance system which requires expertise and resources [5,6] coupled with health care system deficiencies that are aggravated by economic problems. In addition, overcrowding and understaffing in hospitals result in inadequate infection control practices; lack of infection control policies, guidelines, and trained professionals also adds to the extent of the problem.

Antimicrobial resistance constitutes a major challenge in the management of ICU infections, and these often emerged from selective pressure due to increased and sometimes inappropriate antibiotic use and transmission via health workers. The adequacy of initial empirical antimicrobial treatment is crucial in terms of outcome [7].

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Table 1
Baseline characteristics of the patients

Variables	n = 76
Age (y), median (IQR)	32 (23-46)
Sex	
Male, n (%)	50 (65.8)
Female, n (%)	26 (34.2)
ICU LOS (d), median (IQR)	6 (3-10)
ICU mortality, n (%)	24 (31.6)
Disease condition	n = 76
Renal failure, n (%)	7 (9.2)
RTA, n (%)	29 (38.2)
PE, n (%)	12 (15.8)
Craniotomy, n (%)	3 (3.9)
Tetanus, n (%)	4 (5.3)
Burns, n (%)	7 (9.2)
Asthma, n (%)	5 (6.6)
Laminectomy, n (%)	4 (5.3)
SCA, n (%)	2 (2.6)
Laparotomy, n (%)	3 (3.9)

LOS indicates length of stay; SCA, sickle cell anemia.

We conducted this study to describe the profile of nosocomial infections including common sites of infections, common bacterial isolates, and antibiotic sensitivity patterns.

2. Methods

The study was a retrospective study carried out at a major tertiary hospital in northwestern Nigeria by reviewing records of NIs in the ICU over a 4-year period. The hospital's ICU is a 4-bed ICU (1 cubicle with 3 general beds and an isolation unit with 1 bed) which represents 0.7% of the total hospital's bed capacity of 550. It is a multidisplinary ICU run by anesthesiologists who also have training in intensive care. The average nurse staffing ratio is 1:1 during the morning shifts and 1:2 in afternoon and evening shifts. There is a single trained infection control nurse who also oversees other parts of the hospital. The unit is decontaminated every 6 months or more frequently as determined by the infection control nurse. There are an alcohol-based hand rub attached to each bed and a single sink in the cubicle housing the 3 general beds, whereas the isolation unit containing a single bed also has alcohol-based hand rub stationed at the entrance of the unit as well as a sink within the room. All visitors and staff are required to wear protective gowns and mask provided at the entrance of the unit. The ICU lacks a dedicated respiratory therapist, but this service is provided by the general physiotherapy unit of the hospital. There are ventilation machines attached to each bed; although the ventilators have noninvasive ventilation mode, invasive ventilation is the dominant mode of ventilation used because of the erratic supply of continuous positive airway pressure masks.

All case records of patients admitted into the ICU during the period of January 2011 to December 2014 were reviewed, and those who were identified to have developed infection from 48 hours after admission up to 2 days after discharge were recruited. A preformed questionnaire was administered, and data on age, sex, reason for ICU admission, site of infection, isolated organisms, and their corresponding antibiotic susceptibility pattern were obtained and analyzed. Seven case records with inadequate data were excluded.

The hospital's laboratory is open 24 hours a day, and clinical specimens are usually processed as soon as they are received in the laboratory. Microbiologic specimens are processed, analyzed, and interpreted according to the Clinical Laboratory Standards Institute guideline [8].

Definitions: *ICU nosocomial infection* was defined as any infection that occurred in the ICU after 48 hours of admission that was not manifest or incubating at the time of admission into the ICU. A case of *urinary tract infection (UTI)* was defined based on documented clinical evidence suggestive of UTI and a positive urine culture (10^5 CFU/mL). *Pneumonia* was defined based on the documented clinical evidence (fever >38.8°C, production of sputum, cough, dyspnea, ronchi/rales, or pleural rub) and radiologic evidence of pneumonia, and positive gram stain and/or isolated organism from sputum culture. *Ventilator-associated pneumonia* was defined based on the documented clinical evidence of pneumonia, new or worsening chest radiograph infiltrates which started 48 hours after mechanical ventilation, together with positive gram stain and culture of tracheobronchial aspirate. Clinical Pulmonary Infection Score was applied, and scores >6 were considered diagnostic. A case of *primary bacteremia* was defined based on documentation of isolated bacteria from blood without any identified focus of infection. *Catheter-related bloodstream infection* was defined as bacteremia in the setting of intravascular catheter infection with no other apparent source.

Ethical clearance was obtained from the ethics committee of Aminu Kano Teaching Hospital with reference number NHREC/21/08/AKTH/EC/930.

3. Results

Over the study period, there were 893 admissions into the ICU with 84 episodes of infections in 76 patients, giving an NI rate of 76 (11.8%) of 893. Fifty (71.6%) of the patients were male, and the overall median age of all the patients was 32.0 (interquartile range [IQR], 23-46). The median length of ICU stay was 6 days (IQR, 3-10). Twenty-eight of the 76 patients studied were mechanically ventilated, giving a mechanical ventilation rate of 36.8%.

Road traffic accident (29/76, 38.2%) was the leading cause of admission followed by pulmonary embolism (PE) (12/76, 15.8%) (Table 1). Of the 12 patients with PE, 7 were confirmed with a spiral chest computed tomographic scan, whereas in the remaining 5, the diagnosis was based on the clinical presentation (Wells criteria) and elevated serum D-dimer. The most commonly identified infections were skin and soft tissue infections (SSIs) (30/84, 35.7%) followed by UTI (23/84, 27.4%) and primary bacteremia (18/84, 21.4%), with the least being VAP (3/84, 3.6%) (Table 2). The rate of VAP among the mechanically ventilated patients was 3 (10.7%) of 28. Of the 30 patients with SSIs, 11 of 30 and 6 of 30 were classified as superficial and deep infection, respectively,

Table 2
Frequency of the infections by disease condition

	Infection site					
	UTI n = 23	SSI n = 30	Pneumonia n = 5	Primary bacteremia n = 18	Line infection n = 5	VAP n = 3
RTA	10 (43.5)	15 (50)	2 (40)	5 (27.8)	0 (0.0)	1 (33.3)
Laparotomy	1 (4.3)	1 (3.3)	1 (20)	0 (0.0)	0 (0.0)	0 (0.0)
Burns	2 (8.7)	4 ((13.3)	0 (0.0)	4 (22.2)	0 (0.0)	0 (0.0)
Craniotomy	0 (0.0)	2 (6.7)	0 (0.0)	0 (0.0)	1 (20)	0 (0.0)
Laminectomy	0 (0.0)	2 (6.7)	0 (0.0)	2 (11.1)	0 (0.0)	0 (0.0)
Renal failure	4 (17.4)	1 (3.3)	0 (0.0)	3 (16.7)	2 (40)	0 (0.0)
PE	3 (13.0)	5 (16.7)	0 (0.0)	1 (5.6)	2 (40)	1 (33.3)
Tetanus	2 (8.7)	0 (0.0)	0 (0.0)	1 (5.6)	0 (0.0)	1 (33.3)
Asthma	0 (0.0)	0 (0.0)	2 (40)	1 (5.6)	0 (0.0)	0 (0.0)
SCA	1 (4.3)	0 (0.0)	0 (0.0)	1 (5.6)	0 (0.0)	0 (0.0)