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GRADUATE SURVEY ARTICLE

Factors Influencing the Distribution of Nosocomial Infections in Some Selected Hospitals of Kaduna State

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ABSTRACT

It is becoming alarming on the rate by which nosocomial infections tend to rapidly spread affecting lives especially patient placed in the intensive care unit or wards thereby extending patient stay beyond specified period of time. Therefore, the cross sectional study is designed to determine the factors influencing the distribution of nosocomial infection in Kaduna state. The exploration into the research problem was carried out using qualitative method which involve generating an interpretive qualitative data using structured questionnaire and face to face interviews. The method comprises of the study setting, participants, method of data collection, procedure, data management and analysis. A total of 5 different species (*E.coli, S.aureus, k.Pneumoniae , Bacillus cereus, Pseudomonas aeruginosa)* were identified from 6 parameters (fomites, sterilization techniques, disinfection techniques, water source, bed spacing, cleaning methods) evaluated from 100 respondents across the hospital screened and all the organism shows significant p-value less than 0.05 (p-value ≤0.05) across all the parameters evaluated. The findings suggest that infection control program should be set up in all public and private hospital to ensure effective management and control strategy and to curtail the widespread of these pathogenic nosocomial infections.

Keywords: Nosocomial organisms, parameters evaluated, significant P-value.

1 Introduction

Nosocomial infections are also referred to as hospital acquired infection. This is infections that are acquired within 48 hours of stay in hospital environment or after 30 days after discharged especially hospital wards and intensive care units and it is becoming alarming on the rate by which nosocomial infections tend to rapidly spread affecting life especially patient placed in the intensive care unit or wards with a mortality rate 30,000 people per year in developing countries [1]. Globally approximately 15% of hospitalized patients have been reported affected with nosocomial infections [2].The mortality rate of neonate is approximately 4% to 56% of which the incidence rate of 75% in south-east Asia and sub-Africa [1]. This has drastically affected the income of countries with an estimate of 5.7% and 19.1% in middle and low income countries [1].The initiation of surveillance programmes has shown that 5-10% of hospital admission of which about 90000 in the US are caused by nosocomial infections [2]. The prevalence of nosocomial infections in France

has been estimated to 6.9-7.5% of which 5-19% are hospitalized patient and 30% are patients admitted in the intensive care unit [2]. 6.7% of hospitalized patient infected with nosocomial has been recorded in Italy of which approximately 4500 and 7000 patients died as a result of nosocomial infections [3]. Nosocomial infections were reported in Nigeria having a percentage of 4.2% in the northern part and 3.8% in the southern part respectively [3]. It was also report that 2.7% of nosocomial infection was identified in Ife, 29% from Lagos and 4.2% from Ilorin [3]. Studies have proven that among other types of nosocomial infections, urinary tract infections and blood stream infections are the most common and frequent in the medical service and nurseries [4]. However, pneumonia or lower respiratory infections have reported to be the most dangerous among all other nosocomial infections having a fatality rate of 30% and shows in the intensive care unit or post-surgical recovery room [4]. Due to this infection inpatient tend to stay longer beyond a specified period of time resulting in the increasing rate of antimicrobial resistance to treatment, socio-economic and mortality rate

2 Materials and Methods

This study used an exploratory qualitative method. The qualitative method involved exploration into the research problem by generating interpretive qualitative data using semi-structured and face to face interviews, This section outlines the methods used such as the study setting, participants, method of data collection, procedure, data management and analysis. The four hospitals within Kaduna state were selected for the research which comprises of two major public hospitals and two private hospitals. There were three participants in the parent study; this involves the ward station nurses, ward cleaners and patient or patient guidance across all the hospital used as case study Face-to-face and semi-structured interviews were conducted using oral and structured questionnaire. Semi-structured Interviews are a common data collection method especially when aiming to collate information to inform the development of a quantitative survey also Face-to-face interviews are arguably more successful in increasing the response rate and recall of past events providing better data quality and to a rich Breadth of data.

Ethical clearance from ministry of health Kaduna state for easy access to the hospitals was collected. Questionnaire regarding the research problem and also for the achievement of the aim and objective of the research, cutting across all socio-demographic factors. was distributed to the specified participant. All responses from the participant were collated and subjected to statistical tool (T-test) using SPSS version 7.

3 Results and Discussion

Following the distribution of bacterial isolates from fomite across hospitals wards (male ward, female wards and paediatric wards) was determined using both oral interview and structured questionnaire and all data collated from 100 respondents were subjected to statistical tool using t-test to compare the variation of occurrence of the isolated bacterial and it's significant across public and private hospitals. In public hospital twenty isolates of *Staphylococcus aureus* were identified from bed spread, eleven isolates from patient side table's seventeen isolates from patient files and five from nurse station table but wasn't identified on wash hand basin.In private hospital five isolates of *Staphylococcus aureus* were identified from bed spread seventeen isolates from patient side table, five isolates from patient files and thirteen isolates from nurse station table. All having a significant P-value of 0.026. In public hospitals thirteen isolates of *E.coli* were identified on bed spread, seventeen isolates from wash hand basin, twelve isolates from patient side table, twenty six isolates from patient files and nineteen isolates from nurse station table. In private hospital twenty three isolates of *E.coli was* identified from bed spread, seven isolates from wash hand basin, twelve isolates from patient side table, fourteen isolates from patient files and eighteen isolates from nurse station table having a significant P-value of 0.014 In public hospital fifteen isolates of *Pseudomonas aeruginosa* were identified from wash hand basin, and seven isolates from nurse station table but was not found on bed spread, patient side table and patient files. In private hospital twelve isolates of *Pseudomonas aeruginosa* were identified on wash hand basin, and five isolates from nurse station table, but were not present on bed spread, patient side table and patient files having an insignificant P-value of 0.62.In public hospitals, two isolates of *Klebsiella pneumonia* were

found on bed spread, two isolates from wash hand basin, three isolates from patient side table, three isolates from nurse station table but were not present on patient files. In private hospital four isolates of *Klebsiella pneumoniae* were identified from bed spread, five isolates from patient side table, two isolates from nurse station table but absent on wash hand basin, patient files having a significant P-value of 0.041. In public hospital five isolates of Bacillus *cereus* were identified on bed spread, four isolates from wash hand basin, eight isolates from patient side table, two isolates from nurse station table but not identified from patient files while in private hospital seven isolates of *Bacilus cereus* were identified from bed spread, four isolates from patient side table and three isolates from patient files but not identified on wash hand basin and nurse station table having a significant P-value of 0.029. *Staphylococcus aureus, E.coli, Klebsiella pneumoniae* and *Bacilus cereus* were significant across the hospital with a p-value less than 0.05 ($p<0.05$), while *Pseudomonas aeruginosa* was insignificant across the hospitals with a p-value greater than 0.05 ($p>0.05$). This investigation is in agreement with other findings of [5, 6, 7].

Table 1: *Distribution of Bacterial Isolates from Fomite across Hospitals*

	Fomites Screened										
	BS		WHB		PST		PF		NST		
Organism Isolated	Pub	pri	Pub	pri	Pub	pri	Pub	pri	Pub	pri	P.value
Staphylococcus aureus	20	5	0	0	11	17	17	5	9	13	0.026
E.coli	13	23	17	7	12	12	26	14	19	18	0.014
Pseudomonas aeruginosa	0	0	15	12	0	0	0	0	7	5	0.062
Klebsiella pneumoniae	2	4	2	0	3	5	0	0	3	2	0.041
Bacilus cereus	5	7	4	0	8	4	0	3	2	0	0.029

Key: P.value ≥0.05=insignificant, P.value ≤0.05= Significant, BS= Bed spread, WHB= Wash hand basin, PST= patient side table, PF= patient Files, NST= Nurse Station Table, Pub= Public, Pri= Private

The result represented in table 2. showing the distribution of bacterial isolates on hospital fomires treated with different sterilization techniques such as autoclaving, chemical sterilization and U.V light sterilization across public and private hospitals wards (male ward, female wards and pediatric wards) was determined using structured questionnaire and all data collated from 100 respondents were subjected to statistical tool using t-test to compare the variation of occurrence of the isolated bacterial and it's significant across public and private hospitals. In public hospital ten isolates of *Staphylococcus aureus* were identified from autoclaving, two isolates from Chemical sterilization, and none identified from U.V light sterilization whilein private hospital five isolates of *Staphylococcus aureus* were identified from autoclaving, one isolate from Chemical sterilization, and none identified from U.V light sterilization having a significant P-value of 0.015. In public five isolates of *E.coli* were identified from autoclaving, eight isolates from Chemical sterilization, and no isolate was identified from U.V light sterilization. In private hospital six isolates of *E.coli was* identified from autoclaving, eight isolates from Chemical sterilization and none identified from U.V light sterilization having a significant P-value of 0.039. In both public and private hospitals there was no identification of *Pseudomonas aeruginosa* across all sterilization techniques evaluated. In public hospitals, one isolate of *Klebsiella pneumoniae* was identified from autoclaving, one isolate from Chemical sterilization and five isolates from U.V light sterilization while in private hospitals three isolates of *Klebsiella pneumoniae* were identified from autoclaving and none were identified from both Chemical sterilization and U.V light sterilization having an insignificant P-value of 0.052. In public hospital three isolates of Bacillus *cereus* were identified from autoclaving, two isolates from Chemical sterilization and one isolate identified from U.V light sterilization, whilein private hospital four isolates of *Bacilus cereus* were identified from autoclaving, two isolates from

Chemical sterilization and none identified from U.V light sterilization having a significant P-value of 0.043. *Staphylococcus aureus, E.coli,* and *Bacilus cereus* were significant across the hospitals with a p-value less than 0.05 ($p<0.05$), while *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* was insignificant across the hospitals with a p-value greater than 0.05 ($p>0.05$). this agrees with the findings of [8, 9] in relation to sterilization of fomites adopted within hospitals.

Table 2: *Distribution of Bacterial Isolates on Hospital Fomites Treated with different Sterilization Techniques*

	Sterilization Techniques						
	Autoclaving		Chemical		U.V light		
Organism Isolated	Pub	pri	Pub	pri	Pub	pri	P.value
Staphylococcus aureus	10	5	2	1	0	0	0.015
E.coli	5	6	8	7	0	0	0.039
Pseudomonas aeruginosa	0	0	0	0	0	0	0.000
Klebsiella pneumoniae	1	3	1	0	5	0	0.052
Bacilus cereus	3	4	2	2	1	0	0.043

Key: P.value > 0.05=insignificant, P.value <0.05= Significant, Pub= Public, Pri= Private

Following the distribution of bacterial isolates on hospital fomites treated with different disinfection methods across public and private hospitals wards (male ward, female wards and paediatric wards) which include concentrated disinfectant, moderate disinfectant and weak disinfectant was determined using structured questionnaire and all data collated from 100 respondents that participated in the exercise were subjected to statistical tool using t-test to compare the variation of occurrence of the isolated bacterial and it's significant across public and private hospitals. In public hospital two isolates of *Staphylococcus aureus* were identified from concentrated disinfectant, eight isolates from moderate disinfectant, and ten isolates identified from weak disinfectant while in private hospital nine isolates of *Staphylococcus aureus* were identified from moderate disinfectant, twelve isolates from weak disinfectant, and none identified from concentrated disinfectant having a significant P-value of 0.020. in public six isolates of *E.coli* were identified from concentrated disinfectant, three isolates from moderate disinfectant, and ten isolates were identified from weak disinfectant while In private hospital three isolates of *E.coli was* identified from concentrated disinfectant, four isolates from moderate disinfectant, and fourteen isolates identified from weak disinfectant having a significant P-value of 0.025. In public hospitals three isolates of *Pseudomonas aeruginosa* were identified from concentrated disinfectant, four isolates from weak disinfectant but was not identified from moderate disinfectant while in private three isolates of *Pseudomonas aeruginosa* were only identified from weak disinfectant having an insignificant P-value of 0.433 across hospitals analyzed. In public hospitals and private hospital, one isolate each of *Klebsiella pneumonia* was identified from weak disinfectant however, none were identified from both concentrated disinfectant and moderate disinfectant having an insignificant P-value of 0.811. In public hospital two isolates of Bacillus *cereus* were identified from Concentrated disinfectant, two isolates from moderate disinfectant and seven isolates identified from weak disinfectant while in private hospital four isolates of *Bacilus cereus* were identified from Concentrated disinfectant, two isolates from moderate disinfectant and three isolates were identified from weak disinfectant having a significant P-value of 0.036. *Staphylococcus aureus, E.coli,*and *Bacilus cereus* were significant across the hospital with a p-value less than 0.05 ($p<0.05$), while *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* was insignificant

across the hospitals with a p-value greater than 0.05 (p>0.05). The results of investigation shows that disinfection method has been found to be the important factor towards the distribution of nosocomial bacteria which also agrees with other findings [8, 9].

Table 3: *Distribution of Bacterial Isolates on Hospital Fomites Treated with different Disinfection Methods*

	Disinfectant Used						
	Concentrated		Moderate		Weak		
Organism Isolated	Pub	pri	Pub	pri	Pub	pri	P.value
Staphylococcus aureus	2	0	8	9	10	12	0.020
E.coli	6	3	3	4	10	14	0.025
Pseudomonas aeruginosa	3	0	0	0	4	3	0.433
Klebsiella pneumoniae	0	0	0	0	1	1	0.811
Bacilus cereus	2	4	2	2	7	3	0.036

Key: P.value > 0.05=insignificant, P.value <0.05= Significant, Pub= Public, Pri= Private

Following the distribution of bacterial isolates on hospital fomites treated with different cleaning method across public and private hospitals wards (male ward, female wards and paediatric wards) which include critical, semi critical and none critical was determined using both oral interview and structured questionnaire and all data collated from 100 respondents that participated in the exercise were subjected to statistical tool using t-test to compare the variation of occurrence of the isolated bacterial and it's significant across public and private hospitals. In public hospital four isolates of *Staphylococcus aureus* were identified from critical cleaning, twelve isolates from semi-critical cleaning and seven isolates identified from non-critical cleaning while in private hospital two isolates of *Staphylococcus aureus* were identified from critical cleaning, one isolate from semi-critical cleaning, and eight isolates identified from non-critical cleaning having a significant P-value of 0.025. in public seven isolates of *E.coli* were identified from critical cleaning, six isolates from semi-critical cleaning, and five isolates were identified from non-critical cleaning while In private hospital three isolates of *E.coli was* found from critical cleaning, four isolates from semi-critical cleaning, and four isolates identified from non-critical cleaning having a significant P-value of 0.042. In both public hospitals two isolates of *Pseudomonas aeruginosa* were identified from critical cleaning, two isolates from semi-critical cleaning and four isolates were identified from non-critical cleaning while in private one isolate of *Pseudomonas aeruginosa* was identified from critical cleaning, two isolates were identified from semi-critical cleaning and eleven isolates were identified from non-critical cleaning having a significant P-value of 0.030 across hospitals analysed. One isolate each of *Klebsiella pneumoniae* was only identified from non-critical cleaning in public hospital and two isolates of *Klebsiella pneumoniae* were identified from private hospital however none were identified from both critical cleaning and semi-critical cleaning in both public and private hospitals having an insignificant P-value of 0.611. In public hospital no isolate of Bacillus *cereus* were identified while in private hospital two isolates of *Bacilus cereus* were identified from semi-critical cleaning and four isolates from non-critical cleaning however none were identified from critical cleaning having a significant P-value of 0.193. *Staphylococcus aureus, E.coli,*and *Pseudomonas aeruginosa* were significant across the hospital with a p-value less than 0.05 (p<0.05), while *Bacilus cereus* and *Klebsiella pneumoniae* was insignificant across the hospitals with a p-value greater than 0.05 (p>0.05). Our findings are in agreement with several studies regarding cleaning of hospital wards and intensive care units [9].

Table 4: *Distribution of Bacterial Isolates on Hospital Fomites Treated With different Cleaning Methods*

	Cleaning Methods						
	Critical		Semi-Critical		Non-Critical		
Organism Isolated	Pub	pri	Pub	pri	Pub	pri	P.value
Staphylococcus aureus	4	2	12		7	8	0.025
E.coli	7	3	6	4	5	4	0.042
Pseudomonas aeruginosa	2	1	2	2	4	11	0.030
Klebsiella pneumoniae	0	0	0	0	1	2	0.611
Bacilus cereus	0	0	0	2	0	4	0.193

Key: P.value > 0.05=insignificant, P.value <0.05= Significant, Pub= Public, Pri= Private

The result represented in table 5. shows the distribution of bacterial on hospital fomites treated with source of water used across public and private hospitals wards (male ward, female wards and paediatric wards) was determined using both oral interview and structured questionnaire and all data collated from 100 respondents that participated in the exercise were subjected to statistical tool using t-test to compare the variation of occurrence of the isolated bacterial and it's significant across public and private hospitals. However all responses from the respondent shows that borehole is the only source of water used generally in both public and private hospitals. In public hospital no isolate of *Staphylococcus aureus* was identified while in private eight isolates of *Staphylococcus aureus* were identified having an insignificant P-value. Six isolates of *E.coli* were identified from public hospital and twelve isolates from private hospitals having a significant P-value of 0.037. Eighteen isolates of *Pseudomonas aeruginosa* were identified from public hospitals and twelve from private having a significant P-value of 0.030 across hospitals analyzed. Two isolates each of *Klebsiella pneumoniae* was only identified from public hospitals and none from private hospitals having an insignificant P-value of 0.611. Four isolates of Bacillus *cereus* were identified from both public and private hospital having an insignificant P-value of 0.193., *E.coli,* and *Pseudomonas aeruginosa* were significant across the hospital with a p-value less than 0.05 ($p<0.05$), while *Staphylococcus aureus, Bacilus cereus* and *Klebsiella pneumoniae* were insignificant across the hospitals with a p-value ≥ 0.05. This agrees with the findings of [10, 11].

Table 5: *The Distribution of Bacterial Isolate on Hospital Fomites Treated with Water Source used*

	Source of Water (Borehole)		
Organism Isolated	Public hospitals	Private hospitals	P.value
Staphylococcus aureus	0	8	0.000
E.coli	6	12	0.037
Pseudomonas aeruginosa	18	12	0.030
Klebsiella pneumoniae	2	0	0.611
Bacilus cereus	4	4	0.193

Key: P.value > 0.05=insignificant, P.value <0.05= Significant

Following the distribution of bacterial isolates on different hospital bed spacing across public and private hospitals wards (male ward, female wards and paediatric wards) which include congested wards, semi-congested wards and non-congested wards was determined using both oral interview and structured questionnaire and all data collated from 100 respondents that participated in the exercise were subjected to statistical tool using t-test to compare the variation of occurrence of the isolated bacterial and it's significant

across public and private hospitals. In public hospital one isolate of *Staphylococcus aureus* was identified from congested, two isolates from semi-congested and none identified from non-congested wards while in private hospital only one isolate of *Staphylococcus aureus* was identified from congested ward, none was identified from semi-congested wards and non-congested wards having an insignificant P-value of 0.612. In public six isolates of *E.col i*were identified from congested wards, ten isolates from semi-congested wards, and four isolate were identified from non-congested wards while In private hospital three isolates of E.coli *was* identified from congested wards, four isolates from semi-congested wards, and none identified from non-congested wards having a significant P-value of 0.031. In public hospitals eight isolates of *Pseudomonas aeruginosa* were identified from congested wards, one isolate from semi-congested wards and none identified from non-congested ward while in private two isolates of *Pseudomonas aeruginosa* was identified from congested wards, two isolates was also identified from semi-congested wards and none was identified from non-congested wards having a significant P-value of 0.142 across hospitals analyzed. in public hospital and one isolate each of *Klebsiella pneumoniae* was identified from congested wards, one isolate of *Klebsiella pneumoniae* was identified from semi-congested wards and none identified from non-congested wards while in private hospital two isolates were identified from congested wards, three isolates from semi-congested wards and three isolates from non-congested wards having an insignificant P-value of 0.331. In public hospital no isolate of Bacillus *cereus* was identified from congested ward and non-congested ward however three isolates were identified from semi-congested wards while in private hospitals four isolates of *Bacilus cereus* were identified from congested wards, one isolate from semi-congested wards but none was identified from non-congested having an insignificant P-value of 0.193. *Staphylococcus aureus, Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Bacilus cereus* were insignificant across the hospital with p-value greater than 0.05 ($p>0.05$) exception of *E.coli* showing significance with a p-value less than 0.05 ($p<0.05$) across the hospitals. This result agrees with the findings of other researchers [10, 11].

Table 6: *Distribution of Bacterial Isolates on different Hospital Bed Spacing*

	Bed Spacing						
	Congested		Semi-Congested		Non-Congested		
Organism Isolated	Pub	pri	Pub	pri	Pub	pri	P.value
Staphylococcus aureus	1	1	2	0	0	0	0.612
E.coli	6	3	10	4	4	0	0.031
Pseudomonas aeruginosa	8	2	1	2	0	1	0.142
Klebsiella pneumoniae	1	2	1	3	0	3	0.331
Bacilus cereus	0	4	3	1	0	0	0.193

Key: P.value ≥0.05=insignificant, P.value ≤0.05= Significant, Pub= Public, Pri= Private

4 Conclusion

This study revealed the presence of *Staphylococcus, Escherichia coli, Pseudomonas aeruginosa Klebsiella pneumoniae* and *Bacillus cereus* as nosocomial bacteria on hospital fomites. A correlation has established sterilization Techniques, disinfection Methods, water source and ward bed spacing are factors influencing the distribution of bacteria showing significant value of ≤0.05 across hospitals. Setting up or implementation of an infection control program that will regularly cross examine the prevalence of nosocomial organisms in other to prevent and control nosocomial infection in both private and public hospitals. Further studies also should be carried out using the same or more advanced methods on different fomites so as to enhance and improve healthcare service delivery.

5 Declarations

5.1 Competing Interests

I Eriba Hilary Ogbu do declare that the manuscript has no conflict of interests.

5.2 Publisher's Note

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