National Journal of Advanced Research
ISSN: 2455-216X
Impact Factor: RJIF 5.12
www.allnationaljournal.com
Volume 4; Issue 2; May 2018; Page No. 07-12

Prevalence and antibiogram of nosocomial bacteria isolated from hospital environment

Unegbu Nnachetam Valetine[1*], Nkwoemeka Ndidi Ethel[2], Ezebialu Chinenye Uzoamaka[3], Ezennia Obioma Jennifer[4], Egwuatu Pius[5]

[1, 5] Department of Applied Microbiology, Renaissance University, Ugbawka, Enugu State, Nigeria
[2] Department of Biological Sciences, University of Nigeria Nsukka, Nsukka, Nigeria
[3] Department of Microbiology, Godfrey Okoye University, Enugu State, Nigeria
[4] College of Environmental Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

Abstract
Nosocomial bacteria are bacteria causing diseases that are obtained from the hospital environment; they are acquired from the hospital environment within few days of admission into the hospital or other health care facilities and are responsible for nosocomial infections. This study was therefore carried out to assess the prevalence and antibiogram of nosocomial bacteria isolated from hospital wards in a tertiary hospital. A total number of 300 specimens were collected from 6 different wards which include male medical wards, female medical wards, male surgical wards, female surgical wards, pediatrics wards, maternity wards and hospital surfaces were collected screened. Subsequent identification was done based on morphology, and biochemical tests. Kirby-Bauer-Clinical and Laboratory Standards Institute (CLSI) modified single disc diffusion technique was used to determine the antibiogram profile of the bacteria isolates. The total percentage prevalence of *Staphylococcus aureus* was 19.3%, *Pseudomonas aeruginosa* 32.1%, *Staphylococcus epidermidis* 11.8%, *Klebsiella pneumoniae* 6.6%, *Streptococcus pyogenes* 4.7% and *Escherichia coli* 25.5%. Male medical ward had the highest prevalence of 35.4% while the least prevalence was pediatrics ward 2.8%. Bacterial isolates were most prevalent in toilet seat with 48(22.6%) cases while the least was found in operating tables with 2(0.9%) cases. The difference in the prevalence of the bacteria in the hospital wards was not statistically significant. Ciprofloxacin, amoxicillin clavulanic acid and amikacin were 93%, 93% and 93.4% effective against all isolated bacteria. All the bacteria were 54.7% resistant to chloramphenicol, 52.8% resistant to ceftriaxone and 51.4% to tetracycline. The multiple antibiotic resistance indexes of the 17 isolates were in the range of 0.2 – 0.6. Hospital wards, inanimate surfaces in hospital environment and hands of health care workers are reservoirs of bacteria including the multidrug-resistant bacteria. The widespread use of antimicrobials, especially overused or underused or inappropriate use of antibiotics, has contributed to an increased resistance among bacteria. These findings therefore justify the need to carry out detailed studies on the prevalence of nosocomial bacteria in this town, with a view of finding the causes, attendant effect and remedial solutions.

Keywords: prevalence, antibiogram, nosocomial bacteria, multi-resistant bacteria

1. Introduction
Nosocomial bacteria are bacteria causing diseases that are obtained from the hospital environment; they are acquired from the hospital environment within few days of admission into the hospital or other health care facilities and are responsible for nosocomial infections [1]. Nosocomial infection, also known as hospital-acquired infection (HAI), is an infection that is acquired in a hospital or other health care facility [1]. To emphasize both hospital and nonhospital settings, it is sometimes instead called a health care–associated infection (HAI or HCAI). Such an infection can be acquired in hospital, nursing home, rehabilitation facility, outpatient clinic, or other clinical settings [1]. Infection is spread to the susceptible patient in the clinical setting by various means. Health care staff can spread infection, in addition to contaminated equipment, bed linens, or air droplets. The infection can originate from the outside environment, another infected patient, staff that may be infected, or in some cases, the source of the infection cannot be determined [1]. In some cases the microorganism originates from the patient's own skin microbiota, becoming opportunistic after surgery or other procedures that compromise the protective skin barrier. Though the patient may have contracted the infection from their own skin, the infection is still considered nosocomial since it develops in the health care setting.

Most nosocomial infections are caused by bacteria and are frequently associated with infection of blood, skin, surgical, the respiratory and urinary tracts and various other sites [2]. The symptoms for these infections may include: discharge from a wound, fever, cough, shortness of breathing, burning with urination or difficulty urinating, headache, nausea, vomiting, and diarrhea [2]. The patient is exposed to a variety of microorganisms during hospitalization and the likelihood of exposure leading to infection depends partly on the characteristics of the microorganisms, including resistance to antimicrobial agents, intrinsic virulence, and amount (Inocula) of infective material [2]. Infections may be caused by a microorganism acquired from another person in the hospital (cross-infection) or may be caused by the patient's own flora

(endogenous infection). Some organisms may be acquired from inanimate objects or substances recently contaminated from another human source (environmental infection) [2].

The emergence of antibiotic resistant bacteria (e.g., *Staphylococcus aureus* and *P. aeruginosa*) is increasing extremely rapidly around the globe, creating a serious threat to the spread and treatment of infectious diseases [3]. Antibiotic resistance is a worldwide problem. World health leaders have described antibiotic-resistant microorganisms as "nightmare bacteria" that "pose a catastrophic threat" to people in every country in the world [4]. Many of the bacteria that cause nosocomial infection have a high level of resistance to antibiotic treatment [5]. The major nosocomial bacteria increasingly resistant to antimicrobial drugs include *Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa*. Infections from methicillin-resistant staphylococci, vancomycin-resistant enterococci (VRE), and aminoglycoside-resistant *Pseudomonas* spp are becoming common [3].

The mechanisms by which bacteria become resistant are either by modification of the antibiotic or the target site or its removal from the cell [6].

In view of the fact that Nosocomial bacteria is becoming an increasing public health issue, this study was carried out to assess the prevalence and antibiogram of nosocomial bacteria isolated from hospital wards at Braithwhite Memorial hospital Port Harcourt, Rivers State.

2. Materials and Methods

Study Area and Sample Collection

The study area of this work was Braithwaite memorial specialist hospital, a government owned hospital, named after Eldred Curwen Braithwaite, a British doctor and pioneer of surgery. It is located inside Portharcourt City Local Government Area. A total number of 300 specimens were collected from (6) major wards which includes the male medical ward, female medical ward, female surgical ward, male surgical ward, maternity ward and pediatric ward. This was collected from different surfaces in the wards such as hands of some of Laboratory scientist/technicians, hands of hospital nurses/doctors, toilets seats, toilet door knob, operation tables, door knobs, Nurses' table tops, bedrails, stretchers, cupboards, sinks, using sterile swab sticks using wetted sterile cotton swabs. Ethical permission was obtained from the hospital authorities.

Cultivation and Isolation of Microorganisms

The obtained swabs were examined in the laboratory within 20 minutes to 1hr of collection using two methods, direct wet mount and culture technique. The swabs were cultured on the appropriate media (Nutrient agar, Macconkey agar and blood agar) and incubated at 37^{o}C for 24 hours for bacterial growth. Discrete colonies were further sub-cultured onto fresh prepared plates of nutrient agar plates to obtain pure cultures. The purified cultures were gram stained and stored on nutrient agar slants for biochemical tests and identification.

Observation of colonial morphology and characteristics

Presumptive morphological identification of the colonies was done by observing their individual appearances on their respective media that were used for the isolation.

Gram Stain

The method according to Cheesbrough, [7] was used.

Motility and Biochemical test

The tests distinguished between bacteria of different genera and species using their growth pattern on media and biochemical characteristics. The methods according to Singleton [8] were used.

Haemolytic Properties of the Isolates

All the bacterial isolates were cultured on Blood Agar to determine their hemolytic properties. This was done by inoculating them into blood agar plates. Plates were incubated at 37^{o}C for 24hours. A clearing zone surround the bacterial colony was observed and recorded [7]. The presence of hemolysis Alpha or incomplete haemolysis and Beta or complete haemolysis indicated ability to lyse Red blood cell (RBC) which could be used to indicate pathogenicity [8].

Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was performed for all bacterial isolates using disk diffusion method on Mueller-Hinton agar (Oxoid Basingstoke, Uk) according to the direction of the Clinical and Laboratory Standards Institute [9]. The antimicrobials agents on the disks and their concentrations are as follows: gentamicin (GEN, 10 µg), ciprofloxacin (CIP, 5 µg), chloramphenicol (CHL,10 µg), tetracycline (TET, 10 µg) and ceftriaxone (CTR, 30 µg). The rest are amoxicillin-clavulanic acid (AMC, 30 µg), co-trimazole (COL, 25 µg), imipenem (IMP, 10µg) and amikacin (AMK, 30µg). The zones of inhibition were measured to the nearest millimeter using a transparent foot ruler. The results obtained were interpreted as sensitive or resistant according to the direction of the Clinical and Laboratory Standards Institute.

Identification of multi-Drug Resistance (MDR) isolates

The multi-Drug Resistance (MDR) characters of the isolates in this study were identified by observing the resistance pattern of the isolates to at least 3 of the antibiotics used in this study.

Determination of Multiple Antibiotics Resistances (MAR) Index

The Multiple Antibiotic Resistance (MAR) index was determined for each of the selected bacterial isolate by dividing the number of antibiotics to which the isolate was resistant by the total number of antibiotics tested [10, 11].

Statistical analysis

Statistical analysis was carried out using the SPSS 21.0 window based program. The proportion of isolated bacteria with patient demographic information, and susceptibility to commonly used antibiotics was compared using the chi-square test. A value of $P < 0.05$ was considered to be statistically significant.

3. Results

A total number of 300 specimens were collected from the (6) major wards, out of which bacterial growth was present in 212(70.7%) cases while the rest were negative (Table 1). Males were more infected (71%) than female (69.5%). The age group 41 - 55 had the highest infected rate of 77.5% followed by the age group 26 - 40 with 76.7%. The least was the age group 56 – 70years with rate of 54% (table 1).

Table 1: Gender and age Distribution of hospital staff

Characteristics	Total no tested (No %)	No Positive (No %)
Sex		
Male	159	114(71.7)
Female	141	98(69.5)
Age		
10-25	41	30(73.2)
26-40	103	79(76.7
41-55	80	62(77.5)
56-70	70	41(54.0)
Total	300	212(70.7

Pseudomonas aeruginosa had the highest rate of isolation of 32.1% followed by E coli (25.5%) and *S. aureus* (19.3%). The least was *S. pyogenes* (4.7%). Furthermore, according to site or location of infection, bacterial isolates were most prevalent in male medical ward as there were 75(35.4%) cases, followed by male surgical ward with 42(19.8%) cases, female medical ward with 40 (18.9%) cases. The least was found in paediatrics ward with 6(2.8%) cases (table 2).

Table 2: Distribution of Isolates among Hospital wards

Isolated	No	MMW No (%)	FMW No (%)	MSW No (%)	FSW No (%)	PW No (%)	MW No (%)
S. aureus	41(19.3)	15(36.6)	10(24.4)	7(17.1)	4(9.8)	1(2.4)	4(9.8)
S. epidermidis	25(11.8)	11(44.0)	6(24.0)	2(8.0)	1(4.0)	0	5(20.0)
E. coli	54(25.5)	18(33.3)	10(18.5)	13(24.1)	4(7.4)	2(3.7)	7(13.0)
P. aeruginosa	68(32.1)	21(30.9)	8(11.8)	17(25.0)	5(7.4)	3(4.4)	14(20.6)
Klebsiella pneumoniae	14(6.6)	7(50.0)	4(28.6)	1(7.1)	0	0	2(14.3)
S. pyogenes	10(4.7)	3(30.0)	2(20.0)	2(20.0)	2(20.0)	0	1(10.0)
Total	212	75(35.4)	40(18.9)	42(19.8)	16(7.5)	6(2.8)	33(15.6)

Key: MMW = Male medical ward, FMW = Female medical ward, MSW – Male surgical ward, FSW = Female surgical ward, PW = Pediatric ward, MW = Maternity ward.

According to surfaces, bacterial isolates were most prevalent in toilet seat with 48(22.6%) cases, followed by sinks with 43(20.3%) cases, door knob with 35(16.5%) cases and cupboards with 30(14.2%) cases. The least was found in operating tables with 2(0.9%) cases (table 3).

Table 3: Distribution of bacteria isolates from hospital staff and surfaces

Isolated	No	HSS N (%)	TS N (%)	OT N (%)	DK N (%)	NTT (%)	BR N (%)	ST N (%)	CUP N (%)	SN N (%)
S. aureus	41	0	10(24.4)	0	8(19.5)	1(2.4)	1(2.4)	4(9.8)	8(19.5)	9(22.0)
S. epidermidis	25	2(8.0)	5(20.0)	0	4(16.0)	2(8.0)	1(4.0)	1(4.0)	3(12.0)	5(20.0
E. coli	54	2(3.7)	12(22.2)	1(1.9)	10(18.5)	0	3(5.6)	9(16.7)	6(11.1)	11(20.4)
P.aeruginosa	68	7(10.3)	15(22.1)	1(1.5)	10(14.7)	3(4.4)	5(7.4)	5(7.4)	9(13.2)	13(19.1)
K. pneumoniae	14	1(7.1)	4(28.6)	0	1(7.1)	0	1((7.1)	1((7.1)	3(21.4)	3(21.4)
S. pyogenes	10	0	2(20.0)	0	2(20.0)	1(10.0)	1(10.0)	1(10.0)	1(10.0)	2(20.0)
Total	212	14(6.6)	48(22.6)	2(0.9)	35(16.5)	7(3.3)	12(5.7)	21(9.9)	30(14.2)	43(20.3)

Key: HSS – Hands of hospital staff, TS = Toilet seats, OT = Operatory table, DK = Door knob, NTT Nurses table top, BR = Bed rails, ST = Stetchers, CUP = Cupboards, SN = Sinks.

Haemolytic Properties of the Bacterial Isolates

S. aureus, *S. pyogenes* and *Pseudomonas aeruginosa* showed complete haemolysis on blood agar (Beta haemolysis). There was no haemolysis in *E coli* and *K. pneumoniae* (Gamma haemolysis).

Antimicrobial Susceptibility Test

The susceptibility of bacteria to different antibiotics is shown in table 4. Among gram positive bacteria, *S. aureus* was 97.6% sensitive to ciprofloxacin, 95.1% sensitive to amoxicillin clavulanic acid and 95.1% sensitive to amikacin. Among the gram negative bacteria, *E coli* was 94.4% sensitive to ciprofloxacin, 33.3% sensitive to chloramphenicol, 30% sensitive to tetracycline, 92.6% sensitive to amoxicillin clavulanic acid and 98.2% sensitive to amikacin. Generally all the bacteria were 54.7% resistant to chloramphenicol, 52.8% resistant to ceftriaxone and 51.4% to tetracycline. Lastly, all the organisms were 93.0% sensitive to both ciprofloxacin and amoxicillin clavulanic acid, and 93.4% sensitive to amikacin.

Table 4: Antibiotic Sensitivity/Resistance pattern of bacteria isolates

Number of isolates sensitive to antibiotics (%)										
Bacteria Isolated	**No**	**GEN**	**CIP**	**CHL**	**TET**	**CTR**	**AMC**	**COL**	**IMP**	**AMK**
Gram + ve										
S. aureus	41	38(92.7)	40(97.6)	19(46.3)	25(61.0)	31(75.6)	39(95.1)	33(80.5	28(68.3)	39(95.1)
S. epidermidis	25	20(80.0)	22(88.0)	19(76.0)	21(84.0)	22(88.0)	23(92.0)	16(64.0)	18(72.0)	24(96.0)
Total	66	58(87.9)	62(94.0)	38(57.6)	46(70.0)	53(80.3)	62(94.0)	49(74.2)	46(70.0)	63(95.5)
Gram - ve										
E.coli	54	38(70.4)	51(94.4)	18(33.3)	16(30.0)	18(33.3)	50(92.6)	21(38.9)	24(44.4)	53(98.2)
P.aeruginosa	68	21(30.9)	64(94.1)	24(35.3)	26(38.2)	17(25.0)	65(95.0)	14(20.6)	31(45.6)	62(91.2)
K. pneumoniae	14	6(42.9)	12(85.7)	7(50.0)	(8(57.1)	6(42.9)	13(92.9)	8(57.1)	9(64.3)	12(85.7)
S. pyogenes	10	8(80.0)	8(80.0)	9(90.0)	7(70.0)	6(60.0)	7(70.0)	9(90.0)	7(70.0)	8(80.0)
Total	146	73(50.0)	135(92.5)	58(40.0)	57(39.0)	47(32.2)	135(92.5)	52(35.6)	71(48.6)	135(92.5)
Grand Total	212	131(61.8)	197(93.0)	96(45.3)	103(48.6)	100(47.2)	197(93.0)	101(47.6)	117(55.2)	198(93.4)

Key: GEN = Gentamicin, CIP = Ciprofloxacin, CHL = Chloramphenicol, TET = Tetracycline, CTR = Ceptriaxone, AMC = Amoxicillin-clavulanic acid, COL = Co-trimazole, IMP = Imipenem, AMK = Amikacin.

Multiple Antibiotics Resistance Bacteria

The multiple antibiotic resistance (MAR) of the bacteria isolates is found on table 5. The percentage MAR of *S. aureus*, *E coli*, *P. aeruginosa* and *K. pneumoniae* to 2 to 5 drugs is 29.4%, 23.5%, 41.2% and 5.9% respectively (table 5).

Table 5: Multiple Antibiotic Resistance (MAR) Bacteria

Name of bacteria	No. of MAR Isolate	Percentage of bacteria with MAR	No. of Antibiotics Resistant to Isolates
S. aureus	5	29.4	2-4
E coli	4	23.5	2-3
P. aeruginosa	7	41.2	3-5
K. pneumoniae	1	5.9	3
Total	17(8.0%)	100	

Multiple Antibiotics Resistance Indices of Bacterial Isolates

The Multiple Antibiotics Resistant Profile (MAR) and Indices (MARI) of Bacterial Isolates are found in table 6. The MARI range was between 0.2 to 0.6.

Table 6: Multiple Antibiotics Resistant Profile and Indices of Bacterial Isolates

Isolates	Multi-Antibiotic Resistant Profile Antibiotic Resistant Indices	Multi-Multi-Antibiotic Resistant Indices
S. aureus[1]	GEN-CHL-TET-COL	0.4
S. aureus[2]	TET-CTR- IMP	0.3
S. aureus[3]	GEN- CHL – TET	0.3
S. aureus[4]	CHL- IMP	0.2
S. aureus[5]	GEN – COL – IMP	0.3
E coli[1]	CHL – TET – CTR	0.3
E coli[2]	GEN – IMP- TET	0.3
E coli[3]	GEN – CIP – CTR	0.3
E coli[4]	GEN – IMP	0.2
P. aeruginosa[1]	GEN- CHL – CTR – IMP – AMK	0.6
P. aeruginosa[2]	CHL – COL – TET – IMP	0.4
P. aeruginosa[3]	GEN – TET – CHL	0.3
P. aeruginosa[4]	TET – COL – CTR – AMC	0.4
P. aeruginosa[5]	CTR – AMC – COL	0.3
P. aeruginosa[6]	GEN – CTR – COL	0.3
P. aeruginosa[7]	CHL – CTR – COL	0.3
K. pneumoniae[1]	TET- AMC – IMP	0.3

Key: TET=Tetracycline, AMC=Amoxicillin clavulanic acid, COL=Cotrimoxazole, CHL=Chloramphenicol, CIP=Ciprofloxacin, GEN= Gentamicin, IMP=Imipenem, CTR=Ceftriaxone, AMK=Amikacin

4. Discussion

The male staffs were more infected (71.7%) than their female staffs (69.5) but the difference among sex was not statistically significant ($P < 0.05$). The reason the males were more infected than females could be as a result poor hygienic practices observed among males compared to females. The prevalence of *Staphylococcus aureus* (19.3%), *Pseudomonas aeruginosa* (32.1%) and *Escherichia coli* (25.5%) from the hospital surfaces and wards in this work could be as a result of inadequate decontamination of the surfaces in these hospitals. The prevalence of these pathogens is higher than the earlier prevalence rate of *S. aureus* (30.2%), *P. aeruginosa* (12.0%)

and *E. coli* (11.6%) as reported [12] from some hospital surfaces in Sokoto. A lower prevalence of S. aureus (18.1%), P. aeruginosa (15.8%) and E. coli (12.6) was reported [13]. The prevalence of *Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Klebsiella pneumoniae, Streptococcus pyogenes* and *Pseudomonas aeruginosa* occurred more in the male medical ward and male surgical ward and and there was a significant difference in the distribution of the bacteria in the hospitals wards ($P > 0.05$).

All the wards in the hospitals had *Pseudomonas aeruginosa* (32.1%), E. coli (25.5%), *Staphylococcus aureus* (19.3%), *Staphylococcus epidermidis* (11.8%), *Klebsiella pneumoniae* (6.6%) and *Streptococcus pyogenes* (4.7%) in decreasing order as nosocomial bacteria. These predominant bacteria species are normal body microbial flora most likely originating from the hospital personnel, patients and visitors. The reason for the higher infection rate in the male medical ward, male surgical ward, female surgical ward and maternity ward as reported in this work might not be unconnected to the unsatisfactory hygienic condition in the operating room in this hospital and lack of proper demarcation of surgical wards from other wards. Particularly in this hospital where surgical patients were often admitted in the same wards with medical patients. *S. aureus, S. epidermidis, P. aeruginosa,* and *E. coli* have been reported notorious causative agents of nosocomial infections [14, 15].

High prevalence of *Pseudomonas aeruginosa*, *E. coli*, *S. aureus* and *S. epidermidis* on toilet seats, sinks, door knob and cupboard confirmed the report [16, 17, 18] that these bacteria are the major contaminants of hospital surfaces. The high level of contamination of these pathogens could also be as a result of inadequate decontamination of the bacterial load from the surfaces [19], even though statistically, there was no significant association between organisms isolated from the surfaces and the hospital wards. This finding corroborates earlier report [20, 21] that surfaces can act as reservoirs of microbes which could in turn lead to the spread of infection upon being touched by either healthcare workers, patients or visitors. The low rate of infection found on the operating table (0.9%) could be attributed to the high level of disinfection carried out before, during and after operation on the operating table. Similar findings were posited [22].

The role of hospital environment in the distribution of nosocomial bacteria cannot be overemphasized. The high rate of infection found in the hands of hospital staff (6.6%) might be as a result of inadequate hand hygiene and this could be one of the attributing factors of the distribution of the bacteria in the hospital environmental surfaces. This finding also confirms the reports [23] that the hands of healthcare workers play an important role in the propagation of microorganism within the healthcare environment and ultimately to the patients if not properly washed and disinfected; and that despite the hand washing and disinfection, many studies continue to show poor compliance with hand hygiene in most hospitals. Therefore, hand hygiene is a constant concern and the promoting of it is necessary as part of each hospital's infection control and safety programs.

The study showed that Gram negative bacteria were more resistant to the tested antibiotics than the Gram positive organisms. The result concurs with the study [24], who reported the prevalence of antibiotic resistance among Gram negative bacteria than Gram positive bacteria. Gram-negative bacteria are of particular concern because these organisms are inherently resistant to many hydrophobic antibiotics [25]. However, Gram negative bacteria are the most common causes of nosocomial infections [26]. Several factors that influence the action and effectiveness of antimicrobial agents on bacterial cells are known, however, it is the remarkable difference in structure and composition of the cell wall's murein layer between the gram negative and the gram positive bacteria that is responsible for this trend [27]. The extent of resistance to an antibiotic may be associated with the extent of antibiotic usage. E. coli which was isolated more from the toilet seats and sinks was highly resistant to chloramphenicol, tetracycline, ceftriaxone, clotrimazole and amipenem, which could be the result of repeated prescription of these antibiotics by the medical practitioners, can lead to resistant organisms, which is common practice in Nigeria. Expired antibiotics, self-medication, counterfeit drugs, inadequate hospital control measures can as well promote the development of resistance in clinical isolates [28]. In a developing country like Nigeria, self-medication is common and could be major cause of antibiotic resistance in clinical isolates since patients only think of going to the hospitals when they are unable to treat themselves [16].

Prevalence of multi-drug resistance to 2-5 commonly prescribed antimicrobial agents was observed in 17 (8.0%) of the isolates. The implication of this is that most of the patients or staff may not respond positively if they are infected with any of the isolated bacteria and treated with any of the antibiotics tested in this study.

All the 17(8.0%) isolates had MAR indices greater than 0.2. This was similar to the work [22] which confirms the report that when the multiple antibiotic resistant index is greater than 0.2, it shows that the organisms were isolated in an environment where antibiotics are abused widely [29], which was the case in this study.

5. Conclusion

Analysis of the result obtained in this study showed that the most frequent nosocomial bacteria were isolated in the male medical ward, male surgical ward, female medical ward and maternity ward. More so, the most frequent nosocomial bacteria at site (surfaces) were isolated in toilet seats, sinks, door knob and cupboards. This suggests that contaminated environmental surfaces are reservoirs of these bacteria. The hands of healthcare workers can readily acquire bacteria after having contact with contaminated hospital surfaces or patients and can transfer these bacteria to other patients and inanimate surfaces; this can lower the quality of healthcare services being provided in the hospital.

Antimicrobial susceptibility tests showed that these nosocomial bacteria were not only resistant to the commonly used antibiotics, they were multi-drugs resistant. These findings therefore justify the need to carry out detailed studies on the prevalence of nosocomial bacteria in this town, with a view of finding the causes, attendant effect and remedial solutions.

References

1. Medubi SA, Akande TM, Osagbemi GK. Awareness and pattern of needle stick injuries among health workers at University of Ilorin Teaching Hospital, Ilorin, Nigeria. African. Journal of Clinical and Experimental Microbiology. 2006; 7(3):183-187.
2. World Health Organisation. Nosocomial infections. Prevention of hospital Acquired infection Practicalguide. 2nd Ed. WHO/CDC/CSR/EPH/2002.12.www.who.int/emc 2002.
3. Oli AN, Nweke JN, Ugwu MC, Anagu LO, Oli AH, Esimone CO. Knowledge and use of disinfection policy in some government hospitals in South-East, Nigeria. British Journal of Medicine & Medical Research. 2013; 3(4):1097-1108.
4. Bockstael K, Aerschot AV. Antimicrobial resistance in bacteria. Central European Journal of Medicine. 2009; 4(2):141-155.
5. Jones RN, Pfaller MA. Bacterial resistance: a worldwide problem. Journal of Microbiology and Infectious Disease. 1998; 31:379-388.
6. DubMandal M. Experiments on exploration of environmental bacteria degrading a pesticide used in agriculture. Thesis, University of Jadavpur, 2005.
7. Cheesbrough M. Medical Laboratory Manual for Tropical Countries Microbiology. Tropical Health Technology, 14 Bevills Close, Doddington, Cambridgeshire, England. 2000; 2:111-143.
8. Singleton P. Bacteria in Biology. Biotechnology and medicine (5th Edition). Wiley 1999; pp. 362-412.
9. Clinical and Laboratory Standard Institute (CLSI). Performance standards for antimicrobial susceptability testing; twenty-forth informational supplement CLSI document M100-S24. CLSI. 2014; pp. 23-64.
10. Krumperman PH. Multiple antibiotic indexing Escherichia coli to identifying risk sources of fecal contamination of foods. Applied and Environmental Microbiology. 1983; 46:165-170.
11. Paul S, Bezbarauh RL, Roy MK, Ghosh AC. Multiple antibiotic resistance (MAR) Index and its reversion in Pseudomonas aeruginosa. Journal of Applied Microbiology. 1997; 24:169-171.
12. Muhammad UK, Isa MA, Aliyu ZM. Distribution of potential nosocomial pathogens isolated from environments of four selected hospitals in Sokoto, North Western Nigeria. Journal of Microbiology and Biotechnology Research. 2013; 3(1):139-43.
13. Aliyu HS, Daniel EO, Attah MU, Aikhuele UE. Multiple antibiotics resistant among bacteria isolated from hospital environment. Bioscience Journal. 2013; 1(1):80-85.
14. Abdalla OA, Alex VB, Ahmed HF, Abu AE, El Sir AM, Marjolein FQ, *et al*. Nasal carriage if Staphylococcus aureus and Epidermology of surgical site infections in a Sudanese University Hospital. Journal of Clinical Microbiology. 1998; 36(12):3614-3618.
15. Lizoli A, Privitera G, Alliata E, Antonietta EM, Bosco ML. Prevalence of nosocomial infections in Italy, result from the Lombardy Survey in 2000. Journal of Hospital Infection. 2003; 54(2):141-148.
16. Chikere CB, Chikere BO, Omoni VT. Antibiogram of clinical isolates from a hospital in Nigeria. African Journal of Biotechnology. 2008; 7(24):4359-4363.
17. Ijioma BC, Kalu IG, Nwachukwu CU. Bacteria prevalence on the Environmental labour as the cause of nosocomial infections in General hospital Umuguma and Umezuruike hospital Owerri, in Imo State, Nigeria. Report and Opinion. 2010; 2(9):45-52.
18. Jarvis WR. The inanimate environment. In: Bennet JV, Bracman PS (eds), Hospital infections, 5th ed. Philadelphia, PA, Lippincott-Raven. 2007; pp. 275-302.
19. Addy PA, Antepim GK, Frimpong EH. Prevalence of Pathogenic Escherichia coli and parasites in infants with diarrhoea in Kumasi, Ghana. East African Medical Journal. 2004; 81(7):353-357.
20. Hassan AN, Birt DM, Frank JF. Behaviour of Listeria monocytogenes on Pseudomonas putida biofilm on a condensate forming surface. Journal of Food Protection. 2004; 67(2):322-327.
21. Page K, Wilson M, Parkin I. Antimicrobial surfaces and their potential in reducing the role of the inanimate environment in the incidence of hospital-acquired infections, Journal of Material Chemistry. 2009; pp. 1-23.
22. Chrinius H, Edward D, Jatau MZ. Prevalence and Antibiogram Pattern of Some Nosocomial Pathogens Isolated from Hospital Environment in Zaria, Nigeria. Aceh International Journal of Science and Technology. 2014; 3(3):131-139.
23. WHO. Guidelines for hand hygiene in health care (Advanced draft). Geneva: World Health Organization. 2006.
24. Levy SB. The challenge of antibiotic resistance. Scientific American. 1998; 278:46-53.
25. Nikaido H. Molecular basis of bacterial outer membrane permeability revisited. Microbiology Molecular Biology Review 2003; 67(4):593-656.
26. Ayse B, Halil YM, Hamidullah U, Ahmet A. Evaluation of quinolone resistance in Gram negative bacilli isolated from community and hospital acquired infections. The Eurasian Journal of Medicine. 2008; 40:58-61.
27. Hancock RE. Peptide antibiotics. Lancet. 1997; 349:418-422.
28. Prescott LM, Harley JP, Klein DA. Microbiology. 6th ed. McGraw-Hill, New York. 2005; pp. 833-842.
29. Egger S, Ruckhofer J, Alzner E, Hell M, Hitzl W, Huber V. In vitro susceptibility to topical antibiotics of bacteria isolated from the surface of clinically symptomatic eyes. Ophthalmology. 2010; 107:1497-502.